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FEDERAL ENERGY
REGULATORY COMMISSION

PGE
Portland General Electric Company
121 SW Salmon Street • Portland, Oregon 97204

January 30, 2004

Honorable Magalie Roman Salas
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Project No. 2233 – Willamette Falls Hydroelectric Project
<u>Relicensing Settlement Agreement</u>

Dear Secretary Salas:

Portland General Electric Company ("PGE") is the applicant for a new license for Project No. 2233, the Willamette Falls Hydroelectric Project. On January 29, 2004, PGE, and 12 other parties, including 5 state and federal agencies, 3 tribal entities, and 4 non-governmental organizations, completed execution of a settlement agreement that provides for the relicensing of Project No. 2233. One other tribal entity, the Columbia River Inter Tribal Fish Commission, is completing its review process now.

Accordingly, enclosed for filing with the Commission, pursuant to 18 C.F.R. § 385.602, on behalf of PGE and the parties to the Settlement Agreement, are an original and eight copies of the following documents:

1. Settlement Agreement Concerning the Relicensing of the Willamette Falls Hydroelectric Project; including

    a) Exhibit A: Proposed License Articles;
    b) Exhibit B: Relicensing Implementation Plan;
    c) Exhibit C: Interim Measures; and
    d) Appendix A: Biological Evaluation.

2. Offer of Settlement and Joint Explanatory Statement in Support of Settlement Agreement.

Also enclosed is one additional copy of the complete filing. Please time-stamp and return it to me in the enclosed stamped, self-addressed enveloped envelope. If you have any questions, please contact me at 503-464-8864.

Very truly yours,

Julie A. Keil
Director, Hydro Licensing
Portland General Electric Company

Cc: Service List

OFFER OF SETTLEMENT

AND

JOINT EXPLANATORY STATEMENT

IN SUPPORT OF SETTLEMENT AGREEMENT

FEDERAL ENERGY REGULATORY COMMISSION

PROJECT NO. 2233

AND

SETTLEMENT AGREEMENT

CONCERNING THE RELICENSING OF THE

WILLAMETTE FALLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 2233

CLACKAMAS COUNTY

OREGON

January 2004

For additional copies of this document, contact:

Marty May
Portland General Electric Company
Hydro Licensing Dept. (3WTC-BRHL)
121 SW Salmon Street
Portland, Oregon 97204

OFFER OF SETTLEMENT
AND
JOINT EXPLANATORY STATEMENT
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FEDERAL ENERGY REGULATORY COMMISSION
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OREGON

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FEDERAL ENERGY
REGULATORY COMMISSION

UNITED STATES OF AMERICA

Before the

FEDERAL ENERGY REGULATORY COMMISSION

Portland General Electric Company	))))	**Project No. 2233**

Offer of Settlement and Joint Explanatory Statement In Support of Settlement Agreement

Portland General Electric Company (PGE) is applying for a new license for the 16 MW Willamette Falls Hydroelectric Project (FERC Project No. 2233), located on the Willamette River in Oregon. PGE and 12 other Parties have entered into a Settlement Agreement providing for the relicensing of the Project. The Settlement Agreement is the product of an intense eleven-month negotiation among the major stakeholders with interests in the resources affected by the Project. The Settlement Agreement represents a delicate balancing of the often-competing interests of the stakeholders. As discussed below, it represents the agreement of five governmental, three tribal, and four non-governmental Parties. All Parties have agreed that the Settlement Agreement is fair and reasonable and in the public interest. On behalf of the Parties, pursuant to 18 C.F.R. § 385.602, PGE hereby requests that the Commission approve the Settlement Agreement and adopt it as part of the new license without material modification.

This Joint Explanatory Statement presents the history of the settlement and explains the rationale behind the elements of the settlement. It also explains how the key components were developed and why the Parties to the Settlement Agreement believe that these components represent the best attainable balance of cost and environmental protection. It demonstrates that these elements form a unified package that serves the public interest.

Parties to the Settlement

There are, in addition to PGE, five governmental, three tribal, and four nongovernmental Parties to the Settlement Agreement. The Governmental Parties are US Fish and Wildlife Service ("FWS"); National Marine Fisheries Service ("NMFS"); Oregon Department of Environmental Quality ("ODEQ"); Oregon Department of Fish and Wildlife ("ODFW"); and Oregon Water Resources Department ("OWRD"). FWS, NMFS, and ODFW are referred to as the "Fish Agencies." The Tribal Parties are Confederated Tribes of the Warm Springs Reservation of Oregon ("CTWS"); Confederated Tribes of Siletz Indians of Oregon ("CTSI"); and Confederated Tribes of the Grand Ronde Community of Oregon ("CTGR").[1] The non-governmental Parties, other than PGE, are American Rivers, Oregon Trout, The Native Fish Society, and Trout Unlimited. Together, these Parties represent the major stakeholders with interests affected by the relicensing of the Willamette Falls Project.

Project Description

The Willamette Falls Hydroelectric Project is located at river mile 26.5 on the Willamette River between Oregon City and West Linn in Clackamas County in north-central Oregon. The Project is located in a highly populated, industrialized urban setting about 10 miles from downtown Portland. The obstruction of the river by volcanic

[1] One additional tribal party, the Columbia River Inter Tribal Fish Commission ("CRITFC"), participated in the settlement negotiations and is now seeking approval to sign the agreement.

bedrock causes the river to cascade over a Falls producing a hydraulic head of at least thirty feet. The Project is owned and operated by PGE.

The site has been home to hydroelectric generation for more than 100 years, beginning with PGE's Station A in 1889 and continuing to this day with PGE's T.W. Sullivan Powerhouse, built in 1895, and the Blue Heron development, built in 1916. Paper mill operations have also been present at the Falls for more than a century. Historically the area was also home to flour, saw and pulp mill operations that no longer operate. The navigation canal and locks on the west bank of the river have been operated since 1873, providing 30 ft of lift for commercial barge transport and recreational boat traffic.

The Project works consist of a 600-foot spillway section, a 2,300-foot dam topped with flashboards, the T.W. Sullivan ("TWS") Powerhouse, containing 13 units with a total generating capacity of 16 MW, and the Blue Heron Powerhouse, containing 2 units with a total generating capacity of 1.5 MW. A fish ladder, owned and operated by ODFW, is located on the west side of the Falls, and includes three entrances within the Falls and one at the TWS Powerhouse. A navigation lock at the Project is owned and operated by the U.S. Army Corps of Engineers.

On December 30, 1992, PGE, along with its co-registrants Simpson Paper Company and Smurfit Newsprint Corporation, who were then operating paper mills at the Falls, filed a Surface Water Registration Statement, Pre-1909 Vested Water Right Claim, with OWRD. This statement claims the right to divert 11,754 cfs for hydroelectric purposes from the Willamette River.

Background of the Settlement

The original hydroelectric generating station at Willamette Falls was constructed in 1889. The original dam was constructed in 1892. The initial license for the Project was issued by the Federal Power Commission on June 21, 1960, with an expiration date of December 31, 2004. On December 21, 1999, PGE and its co-licensee, Smurfit Newsprint Corporation, filed a notice of intent to seek a new license for the Project. On May 22, 2001, FERC approved the partial transfer of the Project licensee from Smurfit to Blue Heron Paper Company ("BHPC"). PGE and BHPC employed the FERC's Alternative Licensing Procedure, pursuant to which they filed their final application for a new license for the Project on December 27, 2002. On March 28, 2003, FERC accepted the application for filing; and on March 31, 2003, FERC issued a "Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, and Soliciting Comments, and Final Recommendations, Terms and Conditions, and Prescriptions," which established May 31, 2003, as the deadline for filing interventions, comments, and preliminary terms and conditions. Pursuant to that Notice, all Parties other than PGE and BHPC intervened and filed comments and, as applicable, preliminary terms and conditions and recommendations.

On January 24, 2003, PGE and BHPC initiated settlement discussions with a group of stakeholders including the Parties. In March 2003 a facilitated Settlement Working Group ("SWG") was formed and began meeting to negotiate a settlement agreement that would enable the Parties to resolve all outstanding issues affecting natural resources associated with the relicensing of the Project. The SWG met for a period of nine months, until November 2003.

On August 29, 2003, PGE filed, on behalf of all Parties to the settlement discussions, a Description of Preferred Alternative, which described the Parties' substantial agreement on the resource protection measures that would be implemented pursuant to the terms of a new license for the Project. It was intended to be utilized by Commission Staff as the preferred alternative and included the resource protection measures that the Parties believe the Commission should incorporate into its NEPA analysis of the Project. The Settlement Agreement accompanying this Joint Explanatory Statement implements those resource protection measures, as well as measures agreed upon by the Parties since the Description of Preferred Alternative was filed. The Description of Preferred Alternative was accompanied by a draft biological evaluation, which was intended to form the basis for initial ESA Section 7 consultation with USFWS and NMFS, as well as revisions to the PDEA that was filed with PGE's application for a new license.

Meanwhile, on July 29, 2003, PGE and BHPC entered into an Asset Purchase Agreement, pursuant to which PGE agreed to purchase and decommission the BHPC powerhouse and to assume all responsibilities of BHPC pursuant to the License from the date of the Asset Purchase Agreement. On October 6, 2003, PGE and BHPC applied to FERC for approval of the transfer of the license from BHPC to PGE. On October 15, 2003, FERC issued a notice of the application for approval of transfer of license. On November 17, FERC issued an order approving the transfer.

The SWG negotiations were designed to address the concerns of all interested parties. The negotiations were successful and the result is the Settlement Agreement that PGE has filed with the Commission today.

Components of the Settlement Agreement

1. Settlement Agreement

The Settlement Agreement describes the legal and regulatory obligations of each of the Parties to it. It specifically establishes PGE's obligation to file the Settlement Agreement with FERC and provides the procedural framework governing the relationship of the Parties throughout the term of the new license. In particular, it creates the framework for future consultation among the Parties and lays out PGE's substantive obligations to be implemented pursuant to the terms of the new license. Those substantive obligations are spelled out in detail in the exhibits attached to the Settlement Agreement.[2] Finally, the Settlement Agreement specifies a recommended new license term of 30 years. The Settlement Agreement provides that any Party may withdraw from the Settlement Agreement if the Commission rejects or materially modifies the Settlement Agreement, and that the withdrawal of any Party may void the Settlement Agreement.[3]

2. Exhibit A: Proposed License Articles

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[2] Based on a revised application for § 401 water quality certification submitted by PGE on November 21, 2003, ODEQ anticipates that relicensing the Project consistent with the Settlement Agreement will comply with Oregon water quality standards. ODEQ intends to issue a § 401 certification with conditions within one year of the November 21, 2003 application.

[3] PGE and the other Parties to the Settlement Agreement request that the Commission identify any part of the Settlement Agreement that is not enforceable by the Commission. The Parties recognize that license articles are generally enforceable only against the licensee, and that the Commission cannot enforce settlement agreements or license articles proposed in settlement agreements as to non-licensees. These are typically procedural provisions involving consultation and dispute resolution.

Exhibit A to the Settlement Agreement consists of proposed license articles. These are intended to be included in the license and to become obligations enforceable by the Commission. These proposed license articles were developed with reference to recent Commission licensing orders implementing other settlement agreements. The Settlement Agreement provides that any Party may withdraw from the Settlement Agreement if the Commission rejects or materially modifies the Proposed License Articles, and that the withdrawal of any Party may void the Settlement Agreement.

3. Exhibit B: Relicensing Implementation Plan

Exhibit B to the Settlement Agreement consists of a Relicensing Implementation Plan, which describes the precise measures that PGE will undertake to carry out its obligations under the Settlement Agreement and the New License. The Relicensing Implementation Plan also prescribes the detailed schedule by which these measures will be implemented and provides specific implementation information associated with each measure, study plan outlines, and specific requirements related to consultation with the Parties

4. Exhibit C: Interim Measures

The Relicensing Implementation Plan describes certain measures ("Interim Measures") that PGE will implement *prior to* issuance of the New License. In anticipation of the issuance of a New License consistent with the Settlement Agreement, PGE has agreed to undertake the Interim Measures promptly upon the Effective Date of the Settlement Agreement and to continue to implement them regardless of any delay in issuance of the New License. PGE will document the completion of these Interim Measures to the Commission within six months after the New License becomes effective.

5. Appendix A: Biological Evaluation

The Biological Evaluation will serve as a draft biological assessment for the Commission to use in consultation with NMFS, as required by Section 7 of the federal Endangered Species Act ("ESA"), with respect to threatened and endangered species affected by the Project. At this time, no FWS-listed species are affected by the Project. The Biological Evaluation attached to the Settlement Agreement was developed in informal consultation with NMFS and USFWS.

6. Joint Explanatory Statement

This Joint Explanatory Statement presents the history of the settlement and explains the rationale behind the elements of the settlement. It demonstrates that the settlement serves the public interest, and explains how the key components were developed. The Joint Explanatory Statement also explains why the Parties to the Settlement Agreement believe that these components represent the best attainable balance of cost and environmental protection, and, therefore, why the Settlement Agreement and all accompanying filings should be approved by the Commission. The Joint Explanatory Statement provides a summary of, but is not intended to modify or interpret, the Settlement Agreement.

Action Sought from the Commission

Implementation of the Settlement Agreement depends upon Commission approval and acceptance of the Settlement Agreement as part of the new license. The actions requested of the Commission and outlined in the Settlement Agreement are necessarily intertwined; implementation of *all* of them is essential if the shared goals of the Parties are to be realized. For this reason, the Parties respectfully request that, to the maximum extent possible, the Commission adopt language identical to or consistent with the language of the Settlement Agreement and Proposed License Articles. If the final Commission Order in this proceeding is inconsistent with these documents, the Settlement Agreement may be voided.

Description of the Settlement Agreement

The vast majority of issues in the settlement negotiations involved measures associated with fish related issues, primarily protection of salmonids and lamprey. Fish passage is the major issue associated with the Project, as passage at the Project affects all anadromous stocks in the Willamette Basin, excluding those in the Clackamas River. An important goal of the Willamette Falls settlement negotiations was to reach decisions that will provide for full and adequate protection, mitigation and enhancement of anadromous fish and other resources affected by the Project, in accordance with all Parties' statutory obligations under the Federal Power Act, the Endangered Species Act, the Clean Water Act, state law, and all other relevant jurisdictional authorities. Accordingly, the Settlement Agreement focuses on fishery resources issues and appropriate enhancement measures. With respect to the fishery resource, the Parties believe that the proposed fishery related measures, and the sequence and time line in which they are to be implemented, will significantly improve fish protection at the Willamette Falls Project.

As discussed in greater detail below, the Settlement Agreement focuses on five aspects of the Project's impact on fish resources: upstream passage through the fish ladder, downstream passage through TWS Powerhouse, up and downstream passage over the Falls, decommissioning of the BHPC Powerhouse, and research on Pacific lamprey. The Settlement Agreement establishes a sequence of modifications to be implemented in each area, and establishes a comprehensive program of monitoring and evaluation studies to determine the impact of the modifications, as well as the need to implement additional measures to achieve the goals and standards established by the Settlement Agreement. In addition, the Settlement Agreement provides for PGE to fund a comprehensive research program regarding the impact of the Project on the Pacific lamprey.

The Settlement Agreement also establishes a proposed framework that includes the following components:

- Performance standards and goals for addressing up- and downstream fish passage;
- A package of sequenced measures designed to increase the probability of achieving the agreed upon performance standards;
- A rigorous and comprehensive monitoring and evaluation program to ensure that performance standards are met; and
- A process for reaching agreement on "next steps", if the initial package of measures fails to achieve the performance standards.

As part of this adaptive management approach, all Parties will remain involved in the post-implementation performance testing and subsequent actions based upon the testing results.

Settlement Goals and Objectives for Affected Fish Resources.

A diverse fish fauna occurs in the vicinity of the Project. The anadromous fish resources from the Willamette Basin represent some of the largest runs in the lower Columbia River. Special status species in the basin include Spring run chinook, coho salmon, winter steelhead, bull trout, coastal cutthroat trout, and Pacific lamprey. Two of these species are listed by NMFS as threatened under the Endangered Species Act: spring chinook and winter steelhead, each of which is considered to be in decline. The primary goal of the Parties to the Settlement Agreement is to establish and maintain self-sustaining anadromous fish runs in the upper Willamette River Basin to fully utilize the available habitat and production capability. Therefore, elements of the Settlement Agreement are designed to enable the Project and all its associated features to maximize upstream and downstream fish passage effectiveness over the full range of river flows for which the Project maintains operational control. The Settlement Agreement also includes protection, mitigation, and enhancement measures for anadromous fish affected by the Project.

Willamette Falls Fisheries Technical Committee.

Much of the completion and development of plans and environmental measures prescribed for implementation in the new license will necessitate the continued involvement of the state and federal resource agencies, tribes and other affected parties. The Settlement Agreement provides that representatives from these Parties meet as necessary to provide technical input for fish and wildlife issues related to license implementation. The group, referred to as the Willamette Falls Fisheries Technical Committee ("FTC"), will provide input and review of several plans and designs which will not be completed until after the license is issued. In addition, some actions and decisions are proposed several years after issuance of the new license and will need to be reviewed in light of the results of monitoring and evaluations that have occurred since license issuance. The Proposed License Articles require the Licensee to consult with the FTC at numerous points during implementation of the Settlement Agreement.

1. **Upstream Passage at the Willamette Falls Project**

Prior to dam construction, chinook and steelhead passed during relatively high flow periods. With the advent of the dam, all anadromous salmonids were forced to use a ladder to pass the Falls. Upstream passage for salmonids is provided via the existing fishway. Pacific lamprey may pass the Project using the upstream fishway or by ascending the Falls and dam. The presence of the dam has eliminated natural channels, blocking salmonid runs that previously could negotiate the Falls. The powerhouses have decreased the magnitude of water flowing over the Falls and potentially created areas of false attraction and delay for upstream migrants. Also, flashboard installation may temporarily reduce flow over the Falls, stranding fish below the Falls.

If the Project is relicensed as proposed, these ongoing impacts will continue through the term of the new license. There is, therefore, justification for implementing measures that will allow the safe, timely, and effective upstream movement of fish past the Project. However, the Parties believe that it is not prudent or appropriate to require PGE to install a fishway when there is already one in place and operating.

The present fish ladder at Willamette Falls was constructed by the Oregon Department of Fish and Wildlife ("ODFW") between 1968 to 1971, and major renovations were made in 1996/1997. The existing fishway is not a project feature, and the Parties are not proposing to make the ladder a part of the Project. However, because the existing fishway addresses several impacts on upstream fish migration associated with the structural features and operation of the project as well as the natural features at the Falls, the Parties concluded that it would be appropriate for PGE to provide assurances that the fish ladder will continue to be operated effectively over the term of the new license. While ODFW will continue to hold ownership of the ladder and remain responsible for operation and maintenance of the fish counting station, the Settlement Agreement provides that PGE shall assume most of the fishway operations and maintenance ("O&M") duties under the Relicensing Implementation Plan, as well as certain other measures described below.

Specifically, PGE will complete specified backlog and annual O&M tasks described in the Relicensing Implementation Plan to ensure continued and proper operation of the Willamette Falls fish ladder. In addition, if outside funding for certain tasks can be obtained, PGE will, in lieu of performing certain improvements, contribute $100,000 to Pacific lamprey research in the Willamette basin. Within 6 months after the new license becomes effective, PGE will assume, for the life of the new license, responsibility, including all labor and necessary repair or replacement of equipment, to perform annual O&M tasks directly associated with fish ladder operation (as opposed to observation and fish counting, which remains the responsibility of ODFW). PGE will also assume debris removal responsibility at the fish ladder sluiceway adjacent to the Willamette Falls fish ladder and will develop an operational plan for the O&M measures. PGE will develop a more reliable auxiliary water source for Entrance 1 of the upstream fish ladder, which is located in the TWS Powerhouse tailrace, or shut down all turbine units in the event that Unit 1 is inoperable for more than 24 hours during upstream migration of anadromous fish. PGE will also determine the extent of ladder entrance #1 non-compliance with NOAA fisheries hydraulic criteria for ladder entrances, entrance pools, and auxiliary water systems. If feasible, PGE will extend the log boom in the TWS Powerhouse pre-forebay to reduce the amount of debris that accumulates at the fish ladder sluiceway. Any such extension would be completed within 1 year of the new license becoming final. In addition to the measures identified above, PGE will fund or undertake measures to enable the Willamette Falls fish ladder to pass adult Pacific lamprey upstream more effectively. Potential measures are identified in the Relicensing Implementation Plan.

2. Decommissioning of BHPC Powerhouse

The BHPC powerhouse was unscreened and provided no protection to outmigrants while the powerhouse was in operation. The mortality rate of fish entrained through the BHPC powerhouse was estimated at 18.7 percent. Instead of screening the units, BHPC shut down the powerhouse operations for 16 weeks or more during peak outmigrations in the spring to provide some protection for outmigrants. However, this mode of operation centered on the peak outmigration of hatchery releases that occurred in the spring, and no protection measures were provided for outmigrants outside of that 16 week shut down period. In addition, operation of the BHPC powerhouse may have injured salmonids attempting to swim upstream into the tailrace, and may have delayed upstream migration as well. Migration delays caused by tailrace effects may have a greater impact on fish populations than injury and mortality.

For these reasons, on July 29, 2003, PGE and BHPC entered into an Asset Purchase Agreement, pursuant to which PGE agreed to purchase and decommission the BHPC powerhouse and to assume all responsibilities of BHPC pursuant to the License from the date of the Asset Purchase Agreement. In 2003, PGE shut down the BHPC generating units. The Settlement Agreement provides that PGE will develop a plan by December 31, 2004, for the permanent, in-place decommissioning of the units. The Plan will be developed after consultation with the Parties and will provide for appropriate consultation under Section 106 of the National Historic Preservation Act. PGE will apply to FERC for approval of the decommissioning plan, and upon FERC approval, will implement the decommissioning plan.

3. Downstream Passage through TWS Powerhouse

Fish migrating down the Willamette River must pass the project by one of two primary routes: over the dam, or through the TWS Powerhouse, which is partially screened. Studies conducted by PGE indicate about 75 percent of the salmonid smolts entering the Sullivan Plant forebay are guided to the screened intake. The remaining 25 percent are subject to injury and mortality through the unscreened turbine units, resulting in an estimated overall plant mortality of 5.1-5.7 percent, depending on species. This estimate does not account for the injury and mortality associated with passage through the narrow trash racks just upstream of the turbine intakes. The Parties believe that properly designed, constructed and operated juvenile fish passage facilities at the Project will reduce injury or mortality to juvenile fish during their downstream migration through the Project area.

Existing technologies would allow full criteria screening of the powerhouses to agency fish criteria, which would result in a very high survival. However, this technology is quite expensive, and the Settlement Agreement provides for the implementation of alternative technologies as long as the alternative technologies can be shown to provide the same level of protection as criteria screens. The Settlement Agreement includes specific downstream passage performance standards for the TWS powerhouse that must be met to ensure the safe and timely downstream passage of fish.

These standards for salmonids are based on survival rates attainable with existing technologies designed to current agency fish criteria defined in NMFS's Juvenile Fish Screen Criteria.

PGE will implement a series of less costly downstream fish passage improvements, organized into tiers, which would be implemented sequentially as needed with the goal of achieving a level of downstream fish passage performance standards. The measures that PGE will undertake are designed to achieve survival rates attainable with existing technologies designed to current agency fish criteria defined in NMFS's Juvenile Fish Screen Criteria.

The tiers are described in detail in the Relicensing Implementation Plan. In short, however, PGE will complete all Tier 1 tasks before the effective date of the new license. These tasks include several environmental measures, forebay modeling, monitoring and evaluations of baseline conditions, and design work for Tier 2 environmental measures. PGE will complete all Tier 2 tasks within 4 years of the effective date of the new license. These tasks include several environmental measures, and post-modification monitoring and evaluations. PGE will complete Tier 3 tasks, if necessary, within 7 years of the effective date of the new license. These tasks include environmental measures as determined by the FTS based on previous monitoring and evaluation efforts, and any necessary post-implementation monitoring and evaluations. Finally, if monitoring and evaluations conducted in Tier 3 indicate the passage performance of the TWS Powerhouse requires major operational or structural changes, PGE will determine which of the Tier 4 options to pursue, within 8 years of the effective date of the new license. Any option selected shall be completed within 10 years of the effective date of the new license, but may be implemented sooner. Once an option is selected, PGE will develop an implementation plan in consultation with the FTC and with the approval of the Fish Agencies and the Commission. Specifically, the Settlement Agreement provides:

- By the end of 2004, PGE will improve forebay hydraulics to increase guidance of salmonid smolts, fry and juvenile lamprey to the Unit 13 bypass system, and siphon bypass (when installed pursuant to the schedule established in the Settlement Agreement).

- PGE will install and operate a forebay trashrack cleaning system to ensure the forebay trashracks remain free of debris build-up in order to maintain good hydraulic conditions conducive to guidance of fish to the Unit 13 and siphon bypass systems, and reduce potential for mortality and injury due to dirty/clogged racks.

- Within a year after the effective date of the new license, PGE will modify the existing siphon spillway adjacent to TWS Powerhouse Unit 13 to provide an additional bypass route for fish entering the TWS Powerhouse forebay. The siphon bypass will be designed to pass a flow of 500 cfs directly from the forebay to the tailrace during powerhouse operation and will work in conjunction with previous forebay modifications to improve forebay hydraulics and guidance of salmonid smolts, fry and juvenile lamprey, as well as adult salmonids (kelts and fallback) away from TWS Powerhouse's turbines. Discharge of the siphon bypass in the tailrace will also eliminate potential aquatic predator habitat along the north tailrace shoreline. Actual capacity of the siphon spillway will be determined through physical modeling in 2004.

- In order to improve the ability to monitor bypass system performance and outmigration fish passage, PGE will install new passive integrated transponder (PIT) tag interrogator system at the Unit 13 bypass. This detection system will be in addition to the PIT detector system currently installed in the bypass system evaluation flow route, allowing detection of PIT-tagged fish in either bypass system mode. If feasible, this PIT tag interrogator system will also be installed in the siphon bypass.

- In order to reduce or eliminate potential predator aquatic habitats located in the TWS Powerhouse tailrace between the discharges of Units 12 and 13, PGE will construct a physical structure between the Unit 12 and 13 discharges, which eliminates this area of slack water.

- In order to reduce potential for avian predation of downstream migrants passing through the TWS Powerhouse forebay and tailrace, PGE will upgrade avian predation deterrents in the powerhouse tailrace and install avian predation deterrents in the forebay as well as in the horseshoe below the Falls.

- Because the outfall from the TWS Powerhouse Unit 13 bypass system outfall does not meet NOAA Fisheries standards, PGE will, by the end of 2006, modify Unit 13 bypass outfall to meet NOAA Fisheries hydraulic impact velocity criteria.

- As part of PGE's maintenance program, older turbine runners will be replaced at a rate of two per year starting in 2004 with new runners designed to reduce gaps and improve hydraulic efficiency. Operation of the new runners will be governed by an operating plan developed in consultation with the FTC and with the approval of the Fish Agencies. PGE will index/efficiency test replaced runners.

- PGE will remove several outer headgate trashrack bars on the west (West Linn) end to facilitate downstream passage of adult salmonids.

- PGE will develop an operational plan covering all aspects of the TWS Powerhouse that will minimize adverse impacts on downstream migrant fish.

Modifying the TWS Powerhouse trashracks and forebay will address multiple goals, including improving fish guidance efficiency ("FGE") by creating more uniform hydraulic conditions in front of the trash racks and reducing the amount of debris caught on the trashrack through improved hydraulics and possibly increased rack spacing. Currently, the powerhouse and the existing trash rack create poor hydraulic conditions just in front of the rack including reverse flow, eddies, and non-uniform sweeping and approach velocities. As a result, the trashrack collects large amounts of debris that must be manually removed. These conditions can impede passage and cause injury to migrants.

Radio tagging of juvenile fish indicates that the majority of fish entering the forebay of TWS Powerhouse pass through the bypass at Unit 13. The second highest route of passage appeared to be in the vicinity of Units 11 and 12. The goal of the Settlement Agreement is to increase FGE through the forebay of the TWS Powerhouse by modifying the syphon spillway just downstream from unit 13 and creating another bypass route for fish to exit the system. The modified syphon spillway will be designed to minimize juvenile rejection of the system while providing safe passage.

Steelhead adults that return to the ocean after spawning (kelts) are known to pass through the TWS Powerhouse. The existing bypass was designed to pass juvenile fish and may not effectively address bypass of adult salmonids. Little information has been collected on the guidance effectiveness at TWS Powerhouse to safely pass kelts and other downstream migrating adults. Therefore, the Settlement Agreement includes evaluations to determine the effectiveness of fishway improvements for kelts.

To ensure the performance standards are met, comprehensive monitoring and evaluation plans will be developed in consultation with the FTC so the biological performance of these technologies can be determined. Such plans, used to demonstrate route specific survival against the performance standard, will provide the FTC assurance that adequate fish protection measures are being implemented during the new license.

4. Downstream Passage at the Falls

The dam constructed along the top of the Falls is 2,950 feet long and 6 to 20 feet high without flashboards. Prior to dam construction and during low flow periods, water was largely concentrated in natural channels, which are the areas where the dam is the tallest. These natural channels typically ended in pools or channels that likely provided safe landing areas for outmigrants. Continued presence of the dam and powerhouses affects water distribution over the Falls and downstream fish passage routes. Currently, the TWS Powerhouse diverts water away from the Falls, and the dam redistributes the remaining water evenly over the Falls. Hence, downstream migrating fish, including salmonid smolts, juvenile lamprey outmigrants, and adult steelhead kelts, are not guided along deeper main channels over the Falls to a safe landing. Instead these fish may pass the dam at any location along the dam, many of which do not provide safe egress or landing areas. Studies conducted at the Falls indicated that downstream migrating smolts were attracted to a concentrated flow with greater depth in a slot at the apex of the dam, which provided a safe egress and landing. However, many fish runs outmigrate during the higher spring runoff flows, when flashboards are not present, and cannot be installed due to safety concerns. Accordingly, the Settlement Agreement provides that PGE will construct additional structures at the dam that are needed to provide safe and effective downstream passage over the dam and Falls for all downstream migrations. Construction of a controlled flow device at the dam will allow greater control of the amount of water flowing over the Falls and of reservoir elevations.

As with TWS Powerhouse, PGE will institute a suite of measures at the Falls to improve downstream passage for salmonid smolts and fry, juvenile Pacific lamprey and upstream passage for lamprey adults. In addition, PGE will undertake measures to reduce other sources of mortality and injury at the Falls. Specifically, the Settlement Agreement provides that PGE shall undertake the following measures:

- To improve downstream migrant passage at the Falls, PGE will remove 150-ft of flashboards at the apex of the Falls to focus low fall flows to an area more conducive to safe downstream fish passage. This will be done by October 1 each year and will continue until the start of construction on the controlled-flow structure.

- PGE will construct and operate a controlled flow structure at the apex of the Falls to focus flow, and downstream migrants, that would otherwise be distributed around the crest of the Falls, to a location more conducive to safe downstream passage. The structure will be designed to pass up to 15,000 cfs. Field testing and modeling indicates this location and concept can pass a high percentage of downstream migrants over a high range of river flows.

- PGE will install wire or other effective avian predation deterrent devices in the lower horseshoe area of the Falls where avian predation activity has been observed. This will increase opportunity for downstream migrants to leave the horseshoe area of the Falls and enter deeper river flows.

- In 2004, subject to obtaining necessary permits and the available in-water work period, PGE will modify an existing hole, known as the "wet hole," located at the northeastern base of the Falls to provide egress and eliminate the stranding potential associated with this location.

- PGE will implement a comprehensive stranding management plan to reduce fish mortality associated with stranding below the Falls caused by sudden changes in flow related to Project operations, including flashboard installation. This will include notching the flashboards, salvaging stranded fish, and eliminating stranding locations by modifying stranding pools.

As with the measures to be implemented at TWS Powerhouse, the measures to improve fish passage at the Falls will be implemented in tiers, the timing of which is the same as for TWS Powerhouse. PGE will implement Tiers 1 and 2 and then evaluate passage performance at the dam. If evaluations indicate the downstream survival does not meet the applicable standards, PGE will implement Tier 3. If subsequent evaluations indicate the dam still does not meet passage standards, PGE will implement one or more options in Tier 4.

5. Pacific Lamprey Research

Pacific lamprey are an important anadromous species in the Willamette River Basin. Concerns regarding declines in Pacific lamprey populations have been raised throughout the Columbia River Basin and Oregon. Currently, Pacific lamprey are known to ascend Willamette Falls and pass over the dam, as well as use the existing fishway. Prior to dam construction and during low flow periods, water was largely concentrated into high-gradient, natural channels. Pacific lamprey were able to ascend the Falls through these areas, which are now where the dam is the highest. While lamprey have been documented passing the dam, the radio-tagging study conducted by the applicants indicated very poor passage through the Project area.

The issue of upstream passage for Pacific lamprey at the project is more complex than for salmonids for several reasons: 1) lamprey passage effectiveness through fishways originally designed for salmonids has been highly variable; 2) lamprey seek out passage over the Falls as well as through the ladder, increasing their potential passage routes; 3) complete understanding of lamprey migratory behavior is lacking; and 4) fisheries managers are only beginning to examine passage solutions for lamprey.

Because of the importance of Pacific lamprey in the Willamette River Basin, the effects of the project on upstream lamprey passage, and the uncertainties surrounding upstream passage issues for Pacific lamprey, a comprehensive study and plan to address lamprey passage at the Project is warranted. The Settlement Agreement provides that PGE will implement a detailed Lamprey Upstream Passage Plan, which includes detailed studies to identify specific passage problems and, determine passage effectiveness. The plan also includes provisions for the implementation and evaluation of passage improvements to determine their effectiveness and any necessary refinements.

The Settlement Agreement provides that PGE will implement measures to reduce impacts to Pacific lamprey and to develop a site-specific knowledge base regarding adult Pacific lamprey behavior, including passage, and to assist in effective upstream passage of adult Pacific lamprey through the Project. Specifically, the Settlement Agreement provides that PGE will implement the following measures related to adult lamprey:

- PGE will install a minimum of two lamprey passage ramps, and notch the flashboards, when flashboards are installed, to provide flows for lamprey below the dam and Falls, focusing on those areas where lamprey are known to congregate, such as the old fishway.

- PGE will undertake an effort to salvage stranded Pacific lamprey in accordance with the objectives listed in the Stranding Management Plan.

- Within six months of the effective date of the new license, PGE will fund a research effort on Pacific lamprey passage and behavior consistent with Adult Pacific Lamprey Passage Plan contained in the Relicensing Implementation Plan. PGE will initiate development of this research effort in 2004. Research objectives and general approaches will be developed by a committee of lamprey experts drawn from agencies, tribes, universities and the private sector.

- After the completion of this research, and construction of the controlled flow structure at the apex of the Falls, PGE will implement Pacific lamprey passage improvements to the dam/flashboards and the Willamette Falls fish ladder as required to meet any passage effectiveness goal identified by the research program. Improvements will be implemented by PGE within 3 years of completion of the research study.

In addition, PGE will develop, fund and implement a joint evaluation study program covering juvenile Pacific lamprey. The study program will determine Pacific lamprey guidance efficiency through the TS Powerhouse after implementation of the Tier 2 siphon bypass measure; estimate the potential injury and mortality to juvenile Pacific lamprey caused by the TWS Powerhouse; and determine additional improvements to passage conditions using the information gained through the above evaluations.

Approval of the Settlement Agreement is in the Public Interest

The Parties to the Settlement Agreement have worked intensively since January 2003 to craft an approach to relicensing the Willamette Falls Project that balances the cost of resource protection measures with the need to ensure adequate protection of the aquatic resources affected by the Project. The Parties believe that the tiered approach adopted by the Settlement Agreement satisfies these goals and ensures that the continued operation of the Project will have acceptable impacts throughout the term of a new license.

Conclusion

On behalf of all Parties to the Settlement Agreement, PGE respectfully requests that the Commission approve and adopt as part of the new license, without material modification, the Willamette Falls Settlement Agreement.

Respectfully submitted,

Julie A. Keil
Director, Hydro Licensing
Portland General Electric Company
Tel: 503-464-8864

SETTLEMENT AGREEMENT

CONCERNING THE RELICENSING OF THE
WILLAMETTE FALLS HYDROELECTRIC PROJECT
FERC PROJECT NO. 2233
CLACKAMAS COUNTY
OREGON

AMONG

PORTLAND GENERAL ELECTRIC COMPANY

NATIONAL MARINE FISHERIES SERVICE
US FISH & WILDLIFE SERVICE

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
OREGON DEPARTMENT OF FISH AND WILDLIFE
OREGON WATER RESOURCES DEPARTMENT

CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION OF OREGON
CONFEDERATED TRIBES OF SILETZ INDIANS OF OREGON
CONFEDERATED TRIBES OF THE GRAND RONDE COMMUNITY OF OREGON
COLUMBIA RIVER INTERTRIBAL FISH COMMISSION

AMERICAN RIVERS
THE NATIVE FISH SOCIETY
OREGON TROUT
and
TROUT UNLIMITED

January 29, 2004

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Exhibits and Appendices

WILLAMETTE FALLS SETTLEMENT AGREEMENT

This Settlement Agreement (with attached Exhibits, referred to collectively as this "Agreement") is made as of January 29, 2004, (the "Effective Date") by and among Portland General Electric Company, an Oregon corporation ("PGE"); United States Fish and Wildlife Service ("USFWS"); National Marine Fisheries Service ("NMFS"); Oregon Department of Environmental Quality ("ODEQ"); Oregon Department of Fish and Wildlife ("ODFW"); Oregon Water Resources Department ("OWRD"); Confederated Tribes of the Warm Springs Reservation of Oregon ("CTWS"); Confederated Tribes of Siletz Indians of Oregon ("CTSI"); Confederated Tribes of the Grand Ronde Community of Oregon ("CTGR"); Columbia River Inter Tribal Fish Commission ("CRITFC"); American Rivers, Oregon Trout, The Native Fish Society, and Trout Unlimited, each referred to individually as a "Party" and collectively as the "Parties." USFWS, NMFS, ODEQ, ODFW, and OWRD may be referred to collectively as the "Governmental Parties." CTWS, CTSI, CTGR, and CRITFC may be referred to collectively as the "Tribal Parties." American Rivers, Oregon Trout, Native Fish Society, and Trout Unlimited may be referred to collectively as the "NGO Parties."

RECITALS

A. The Willamette Falls Hydroelectric Project, also known as FERC Project No. 2233 and referred to in this Agreement as the "Project," is located at Willamette Falls at river mile 26.5 on the Willamette River between Oregon City and West Linn in Clackamas County in north-central Oregon. The Project is owned and operated by PGE. The Project works consist of a 600-foot spillway section, a 2,300-foot dam topped with flashboards, the T.W. Sullivan ("TWS") Powerhouse, containing 13 units with a total generating capacity of 16 MW, and the Blue Heron powerhouse, containing 2 units with a total generating capacity of 1.5 MW. A fish ladder, owned and operated by ODFW, is located on the west side of the Falls, and includes three entrances within the Falls and one at the TWS Powerhouse. A navigation lock at the Project is owned and operated by the U.S. Army Corps of Engineers.

B. The Willamette River in the vicinity of the Project is used by coho, chinook, steelhead, cutthroat trout, bull trout, lamprey, and other fish species. The winter steelhead, bull trout, spring chinook, and coho that use the Willamette River and its tributaries have been listed as threatened species pursuant to the Endangered Species Act ("ESA"). Continued operation of the Project under a new license could adversely affect these fish species. Areas upstream of the Willamette Falls project are designated Essential Fish Habitat ("EFH) for Pacific salmon pursuant to the Magnuson-Stevens Fishery Conservation and Management Act ("Magnuson-Stevens Act").

C. The Project is located primarily on private lands owned by PGE. Some portions of the Project may be located on beds and banks of the Willamette River owned by the State of Oregon and subject to lease or easement from the Oregon Division of State Lands.

D. Pursuant to Oregon Revised Statutes ("ORS") 539.240, on December 30, 1992, PGE, along with its co-registrants Simpson Paper Company and Smurfit Newsprint Corporation, filed a Surface Water Registration Statement, Pre-1909 Vested Water Right Claim, with OWRD ("1992 Surface Water Registration Statement"). This statement claims the right to divert 11,754 cfs for hydroelectric purposes from the Willamette River. The claim states that water development under this claim began on June 3, 1889. In addition, PGE has filed with OWRD and paid fees pursuant to ORS 543.720 for maintenance of Power Claim # 25 regarding the same diversion of 11,754 cfs for hydroelectric purposes.

E. The original hydroelectric generating station at Willamette Falls was constructed in 1888. The original dam was constructed in 1892. The initial license for the Project was issued by the Federal Power Commission, predecessor of the Federal Energy Regulatory Commission ("FERC"), on June 21, 1960, with an expiration date of December 31, 2004. On December 21, 1999, PGE and its co-licensee, Smurfit Newsprint Corporation, filed a notice of intent to seek a new license for the Project. On May 22, 2001, FERC approved the partial transfer of the Project licensee from Smurfit to Blue Heron Paper Company ("BHPC"). PGE and BHPC employed the FERC's Alternative Licensing Procedure, pursuant to which they filed their final application for a new license for the Project on December 27, 2002. On March 28, 2003, FERC accepted the application for filing. On March 31, 2003, FERC issued a "Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, and Soliciting Comments, and Final Recommendations, Terms and Conditions, and Prescriptions," which established May 31, 2003, as the deadline for filing interventions, comments, and preliminary terms and conditions. Pursuant to that Notice, all Parties other than PGE and BHPC intervened and filed comments and, as applicable, preliminary terms and conditions and recommendations.

F. Concurrent with filing of the application for a new license in December 2002, PGE filed with ODEQ an application for certification of compliance with state water quality standards ("Section 401 Certification") pursuant to Section 401 of the federal Clean Water Act, 33 U.S.C. §1342 ("CWA"). Due to incomplete information, on September 3, 2003, ODEQ denied this application without prejudice to the refiling of a revised application. PGE filed a revised application for Section 401 Certification on November 21, 2003.

G. On January 24, 2003, PGE and BHPC initiated settlement discussions with a group of stakeholders including the Parties. In March 2003 a facilitated Settlement Working Group ("SWG") was formed and began meeting to negotiate a settlement agreement that would enable the Parties to resolve all outstanding issues affecting natural resources associated with the relicensing of the Project. The SWG met for a period of eleven months, until November 2003.

H. On July 29, 2003 PGE and BHPC entered into an Asset Purchase Agreement, pursuant to which PGE agreed to purchase and decommission the BHPC powerhouse and to assume all responsibilities of BHPC pursuant to the License from the date of the Asset Purchase Agreement. On October 6, 2003, PGE and BHPC applied to FERC for approval of the transfer of the license from BHPC to PGE. On October 15, 2003, FERC issued a notice of the application for approval of transfer of license.

NOW, THEREFORE, in consideration of their mutual covenants in this Agreement, the Parties agree as follows:

SECTION 1. PURPOSE AND EFFECT OF THIS AGREEMENT

1.1 Purpose of Agreement.

The Parties have entered into this Agreement for the purpose of resolving all natural resource issues between the non-PGE Parties and PGE in connection with issuance of a FERC order issuing a new license for the Project. This Agreement establishes PGE's obligations for the protection of natural resources affected by the Project under a new license issued by FERC. It also specifies procedures to be used among the Parties to ensure the implementation of those obligations consistent with this Agreement, and with other legal and regulatory mandates. For these purposes, the Parties agree that this Agreement is fair and reasonable and in the public interest. Except as provided below, each of the Governmental Parties agrees that PGE's performance of its obligations under this Agreement will be consistent with and is intended to fulfill PGE's existing statutory and regulatory obligations as to each Governmental Party relating to the relicensing of the Project.

1.2 Limitations.

This Agreement does not address or resolve any issues arising under Section 106 of the National Historic Protection Act, 16 U.S.C. § 470F , or regulations thereunder. This Agreement establishes no principle or precedent with regard to any issue addressed in this Agreement or with regard to any Party's participation in any other pending or future licensing proceeding. Further, no Party to this Agreement shall be deemed to have approved, accepted, agreed to, or otherwise consented to any operation, management, valuation, or other principle underlying any of the matters covered by this Agreement, except as expressly provided in this Agreement. By entering into this Agreement, no Party shall be deemed to have made any admission or waived any contention of fact or law that it did make or could have made in any FERC proceeding relating to the issuance of a new license for the Project. This Agreement shall not be offered in evidence or cited as precedent by any Party to this Agreement in any other adjudicative proceeding, except in a proceeding to establish the existence of or to enforce or implement this Agreement. This Section 1.2 shall survive any termination of this Agreement.

1.3 Representations Regarding Consistency and Compliance with Statutory Obligations.

Except as specifically provided below, by entering into this Agreement, the Governmental and Tribal Parties represent that they believe their statutory and other legal obligations are, or can be, met through implementation of this Agreement and development of recommendations, terms and conditions consistent with this Agreement that are submitted to FERC for inclusion in the New License. Nothing in this Agreement is intended or shall be construed to affect or limit any Governmental or Tribal Party from complying with its obligations under applicable laws and regulation or from considering and responding to comments received in any environmental review or regulatory process related to the Project in accordance with this Agreement. This Agreement shall not be interpreted to predetermine the outcome of any environmental or administrative review or appeal process.

1.4 Federally-Reserved Water Rights.

Nothing in this Agreement is intended in any way to affect, diminish, impair, or predetermine any federally-reserved or state-law-based water right that the United States may have in the Willamette River or its tributaries.

1.5 Reserved Tribal Rights.

Nothing in this Agreement is intended to nor shall it create, abrogate, diminish, or otherwise alter any right of an Indian Tribe reserved or established by or in any treaty, executive order, or statute. Further, nothing in this Agreement is intended to nor shall it create, expand, abrogate, diminish, or otherwise alter the responsibilities and obligations of the United States toward Indian Tribes under any federal treaty, executive order or statute.

1.6 Extent of Agency Authority.

Nothing in this Agreement is intended in any way to expand or diminish any existing authority or to confer or consent to any approval authority or regulatory jurisdiction that does not already exist under applicable federal or state law.

SECTION 2. ACTIONS UPON EXECUTION OF THIS AGREEMENT

2.1 FERC Filings by PGE.

Within 30 days after the Effective Date, PGE shall file with FERC an offer of settlement pursuant to Rule 602 (18 C.F.R. § 385.602) consisting of a fully executed copy of this Agreement, including all Exhibits to the Agreement, a Joint Explanatory Statement, and the Biological Evaluation (attached hereto as Appendix A) (together, the "FERC Filing"). PGE shall request that FERC incorporate the Proposed License Articles contained in Exhibit A (hereafter the "Proposed License Articles") to this Agreement as conditions of the new license for the Project. PGE shall use its best reasonable efforts to obtain a FERC order approving this Agreement and issuing a new license for the Project consistent with this Agreement (the "New License") in a timely manner.

2.2 FERC Filings by Governmental Parties.

The Governmental Parties agree to join in the Joint Explanatory Statement in support of this Agreement to FERC. Subject to Section 1.3 of this Agreement, and except as to the receipt of new information not known to them on the Effective Date, the Governmental Parties agree: a) that the individual agency's complete and final recommendations, conditions, and/or prescriptions pursuant to Sections 4(e), 10(a), 10(j), and 18 of the FPA, to the extent those sections are applicable to the agency, shall be consistent with this Agreement; b) that any comments or responses to comments filed by them with FERC in the context of the relicensing process will be consistent with this Agreement; and c) to actively support, in all regulatory proceedings in which they participate that are related to the relicensing of the Project, regulatory actions consistent with this Agreement.

2.3 FERC Filings by Tribal Parties.

The Tribal Parties agree to join in the Joint Explanatory Statement in support of this Agreement to FERC. Subject to Section 1.3 of this Agreement, and except as to the receipt of new information not known to them on the Effective Date, the Tribal Parties agree: a) that the individual Tribal Party's complete and final recommendations, conditions, and/or prescriptions pursuant to Sections 10(a) of the FPA, to the extent those sections are applicable to the Tribal Party, shall be consistent with the Agreement; b) that any comments or responses to comments filed by them with FERC in the context of the relicensing process will be consistent with this Agreement; and c) to actively support, in all regulatory proceedings in which they participate that are related to the relicensing of the Project, regulatory actions consistent with this Agreement.

2.4 FERC Filings by NGO Parties.

The NGO Parties agree to join in the Joint Explanatory Statement in support of this Agreement to FERC. Except as to the receipt of new information not known to them on the Effective Date, the NGO Parties agree: a) that any comments or responses to comments filed by them with FERC in the context of the relicensing process will be consistent with this Agreement; and b) to actively support, in all regulatory proceedings in which they participate that are related to the relicensing of the Project, regulatory actions consistent with this Agreement.

2.5 Permits.

Subject to Section 7.3.1 of this Agreement, upon issuance of the New License, PGE shall apply for and use its best reasonable efforts to obtain in a timely manner and in final form all applicable federal, state, regional, and local permits, licenses, leases, easements, authorizations, certifications, determinations, and other governmental approvals for purposes of implementing this Agreement and the New License ("Permits"). The applications for such Permits shall be consistent with the terms of this Agreement. Subject to Section 1.3 and Section 2 of this Agreement, each Party, upon PGE's request, shall use its best reasonable efforts to support PGE's applications for Permits by submitting appropriate general letters of support of PGE's application within the Party's areas of expertise, and shall not file comments or recommend Permit conditions that are inconsistent with this Agreement, provided that this sentence shall not apply to a Party that is the agency issuing the requested Permit. PGE shall pay all fees required by law related to such Permits, except as provided otherwise in this Agreement. The Parties shall cooperate during the permitting, environmental review, and implementation of this Agreement. Except as expressly provided in this Agreement, PGE shall not be required by this Agreement to implement an action required under this Agreement or the New License until all applicable Permits required for that action are obtained. If a proceeding challenging any Permit required for the action ("Proceeding") has been commenced, PGE shall be under no obligation to implement the action or any related action under this Agreement until any such Proceeding is terminated. In the event any Proceeding is commenced, the Parties shall confer to evaluate the effect of such Proceeding on implementation of this Agreement. Nothing contained in this Section shall be construed to limit PGE's authority to apply for a Permit before issuance of the New License.

2.6 Communications with FERC and Other Government Agencies.

PGE shall submit a Joint Explanatory Statement to FERC in support of this Agreement. Thereafter, subject to Sections 2.1 to 2.5, as applicable, and to Section 7.2.2, the Parties may make such comments and responses to comments as the Parties deem necessary to be filed with FERC, ODEQ, OWRD, or any other agency in the context of the relicensing or Permit processes.

SECTION 3. IMPLEMENTATION OF RESOURCE PROTECTION MEASURES

3.1 Duration of Agreement.

This Agreement shall take effect on the Effective Date and shall remain in effect for the term of the New License and for any annual licenses issued subsequent thereto, unless this Agreement is sooner terminated or a Party withdraws as provided in Section 7. If this Agreement is in effect during the term of an annual license issued subsequent to the term of the New License, the Parties will not be subject to Section 2 of this Agreement regarding filings and communications pertaining to any relicensing proceeding for the Project pending during the term of the annual license.

3.2 Proposed License Articles and Relicensing Implementation Plan.

PGE shall, at its own expense, carry out the measures described in the Proposed License Articles, which are attached to and made a part of this Agreement as Exhibit A, and the Relicensing Implementation Plan, which is attached to and made a part of this Agreement as Exhibit B. Resource protection measures will be carried out pursuant to the schedule contained in the Relicensing Implementation Plan. If issuance of the New License or a Permit necessary to carry out the requirements of the New License is delayed, it is the expectation of the Parties that activities described in the Relicensing Implementation Plan, other than those described in Section 3.3 of this Agreement, could be delayed accordingly.

3.3 Interim Measures.

The Relicensing Implementation Plan describes certain measures that PGE shall implement prior to issuance of the New License ("Interim Measures"), which are listed in Exhibit C to this Agreement. In anticipation of and consistent with the issuance of a New License consistent with Exhibit A, PGE agrees to undertake the Interim Measures promptly upon the Effective Date of this Agreement and to continue to implement them regardless of any delay in issuance of the New License.

3.4 License Term.

The Parties shall recommend to FERC that the term of the New License be 30 years, and support such license term in any applicable filing or communication with FERC or other governmental agency.

3.5 Decommissioning of BHPC Powerhouse.

On July 29, 2003, BHPC and PGE entered into an Asset Purchase Agreement pursuant to which BHPC conveyed ownership of its powerhouse to PGE. PGE has terminated generation at the Blue Heron powerhouse and, upon receipt of a new license for the Project, will decommission the Blue Heron powerhouse as provided in the Proposed License Articles and the Relicensing Implementation Plan. Pursuant to the Asset Purchase Agreement, (i) BHPC will convey to PGE all rights owned by BHPC relating to the use of water from the Willamette River to generate power using the BHPC Powerhouse, and have no obligations pursuant this Agreement, and (ii) PGE shall be responsible to fulfill all obligations that BHPC might otherwise have by virtue of its current status as a licensee.

SECTION 4. COORDINATION AND DECISION MAKING

4.1 Purpose and Function.

The Parties agree to cooperate in implementing the letter and spirit of this Agreement. PGE shall provide periodic updates to the Parties regarding the status of its implementation of the Interim Measures, New License and the Relicensing Implementation Plan in accordance with Section 4.2.5 of this Agreement, the requirements of the Relicensing Implementation Plan, and any reporting obligations imposed by the FERC.

4.2 Fish Technical Committee.

Implementation of this Agreement shall be coordinated by PGE through a Fish Technical Committee. Within 60 days of the Effective Date, PGE shall convene the Fish Technical Committee, and each Party may designate a representative to the Fish Technical Committee. PGE shall consult with the Fish Technical Committee, and as specified in the New License, the Proposed License Articles, the Relicensing Implementation Plan, or this Agreement, request approvals from NMFS, USFWS, or ODFW, as appropriate, regarding the implementation of the Proposed License Articles, the Relicensing Implementation Plan, and this Agreement.

4.2.1 Decision-Making Process.

The Fish Technical Committee shall conduct its business by consensus, which for purposes of this Agreement shall mean that any decision must be acceptable to all representatives of the Parties participating in the Fish Technical Committee. At the request of the Fish Technical Committee, PGE shall fund and make available a mutually agreed upon third party expert to assist the Fish Technical Committee in reaching its decision. Decisions of the Fish Technical Committee shall not usurp the approval authority of the individual Parties or of agencies specifically identified in this Agreement or the New License. If the Fish Technical Committee cannot reach consensus on an issue, the dispute shall be resolved as provided in Section 7.6 of this Agreement.

4.2.2 Notice.

Unless otherwise specified in this Agreement, PGE shall provide members of the Fish Technical Committee a minimum of 30 days' notice prior to any meeting, provided that meetings may be called on shorter notice if the circumstances require.

4.2.3 Licensing Compliance Coordinator.

PGE shall designate its representative on the Fish Technical Committee as the Licensing Compliance Coordinator to oversee the coordination and implementation of the New License and the Relicensing Implementation Plan. The Licensing Compliance Coordinator will provide reasonable administrative and clerical support for the Fish Technical Committee.

4.2.4 Meetings.

The Licensing Compliance Coordinator shall arrange meetings of the Fish Technical Committee as required by the New License and the Relicensing Implementation Plan, as well as any additional meetings deemed necessary by the Parties to coordinate activities and inform the Parties concerning the status or implementation of this Agreement, the New License, and the Relicensing Implementation Plan.

4.2.5 Reports.

In addition to any reports that FERC may require, PGE shall prepare and file with FERC and the Parties a detailed annual report on the activities of the Fish Technical Committee and on the implementation of the Interim Measures, New License and the Relicensing Implementation Plan during the previous year. PGE's obligation to file such reports shall commence upon the first anniversary of the Effective Date and continue each year thereafter during the term of this Agreement. The Licensing Compliance Coordinator will prepare annual reports in consultation with the members of the Fish Technical Committee and will provide such members with at least 30 days to comment on a draft report prior to filing a final version with FERC. Unless otherwise provided in the New License, PGE shall file the annual report by March 31 of the year following the calendar year which is the subject of the report. PGE shall prepare and distribute such other reports as provided in the New License and the Relicensing Implementation Plan.

4.3 <u>Inspection, Consultation, and Notice</u>.

PGE shall permit the Parties to inspect Project facilities and Project records pertaining to the operation of the Project and implementation of the New License and Relicensing Implementation Plan upon reasonable notice at any reasonable time. As provided in the Relicensing Implementation Plan, PGE shall notify the Fish Technical Committee before the start of any construction or ground-, sediment-, or habitat-disturbing activities and upon completion of construction.

SECTION 5. COVENANTS

5.1 Public Benefit from Relicensing of the Project.

As described in the Joint Explanatory Statement, the Parties agree that relicensing of the Project in accordance with this Agreement serves the public interest and achieves a reasonable resolution of issues posed by relicensing the Project. The Parties also agree that the schedule set forth in the Proposed License Articles contained in Exhibit A, as implemented by the Relicensing Implementation Plan, is a reasonable time necessary to serve the public interest in a safe, appropriate, and effective manner. The Parties further agree that relicensing the Project in accordance with this Agreement is an effective and expedient means of protection, mitigation, and enhancement of fish, wildlife and other natural resources affected by the Project.

5.2 Coordination of Information.

The Parties agree to use their best efforts to coordinate information provided to public agencies and to the public regarding this Agreement, the Relicensing Implementation Plan, the FERC Filing, the New License, and the Permits.

5.3 Oregon Public Utility Commission Proceedings.

PGE may seek cost recovery associated with relicensing the Project consistent with this Agreement from the Oregon Public Utilities Commission. Upon request of PGE, each Party agrees to support any reasonable PGE application for cost recovery consistent with this Agreement by using its reasonable best efforts to submit appropriate general letters of support of PGE's application within the Party's areas of expertise.

SECTION 6. COMMITMENTS OF GOVERNMENTAL PARTIES

6.1 General Provisions.

6.1.1 Authority under the Federal Power Act.

The provisions of this Agreement are intended to create a process to satisfy the Governmental Parties' exercise of authority under the Federal Power Act. The Governmental Parties intend that any future terms, conditions, prescriptions, and recommendations, to the extent applicable to this proceeding, will be consistent with this Agreement and that any material inconsistency shall be resolved in accordance with Section 7.2 of this Agreement. In addition, each Governmental Party reserves the right to exercise any authority it may otherwise have under the Federal Power Act in the event this Agreement is not filed with FERC, the Governmental Party withdraws from this Agreement, PGE fails to implement any provision of this Agreement, or this Agreement is terminated for any reason whatsoever, provided in each instance that PGE's rights shall be governed by the applicable provision of Section 7 of this Agreement.

6.1.2 Other Statutory Authorities.

If PGE is required to obtain, from a Governmental Party, a Permit that is not specifically described in this Section 6, such Governmental Party shall, subject to Section 1.3 of this Agreement, use its reasonable best efforts to exercise its authority in a manner consistent with the intent and purpose of this Agreement.

6.1.3 Reservations of Authority.

If any Governmental Party includes a reservation of authority in the modified terms and conditions that it submits to FERC, and the reservation of authority is included as a condition of the New License, such reservation shall not be considered to be materially inconsistent with this Agreement, the Proposed License Articles, or the Relicensing Implementation Plan.

6.2 Endangered Species Act.

6.2.1 Applicable Procedures.

Under Section 7 of the federal Endangered Species Act ("ESA"), FERC may not issue the New License until it has completed consultation with NMFS and FWS with respect to threatened and endangered species affected by the Project. If FERC adopts the provisions of this Agreement, as described in the Biological Evaluation attached to this Agreement as Appendix A, as the proposed action, such proposed federal action shall be the basis for a Section 7 consultation between FERC and NMFS, and any biological opinion relating to relicensing the Project shall address and evaluate such provisions. The Biological Evaluation concludes that relicensing the Project does not affect species listed as threatened or endangered by FWS and no formal ESA consultation with FERC is anticipated for FWS listed species. PGE has been designated as FERC's nonfederal representative for the purpose of preparing a Biological Evaluation, which will serve FERC as a draft biological assessment, and which is attached to this Agreement as Appendix A. As of the date of this Agreement, ESA Section 7 consultation has not been completed.

6.2.2 Consultation.

The Biological Evaluation attached hereto as Appendix A has been developed in informal consultation with NMFS. PGE and NMFS have worked collaboratively to develop measures described in the Biological Evaluation, to be implemented as required in the Proposed License Articles and in the Relicensing Implementation Plan to address specifically the needs of ESA listed species. By signing this Agreement, NMFS does not formally bind itself to make any specific recommendations or take any particular action with respect to ESA compliance. NMFS acknowledges that the information contained in the Biological Evaluation is sufficient for FERC to begin formal consultation under Section 7 of the ESA. If FERC issues a Biological Assessment that is not materially different than the Biological Evaluation attached hereto as Appendix A, and if no new information that is materially different than the Biological Evaluation becomes available during the consultation process, NMFS anticipates that the measures contained in this Agreement will be adequate to avoid a jeopardy finding and minimize any incidental take occurring as a result of implementation of this Agreement for species presently listed as threatened or endangered. NMFS and FWS expressly reserve the right, consistent with federal law, to take such future actions as they may deem necessary to meet their obligations under the ESA. If during consultation with FERC pursuant to Section 7 of the Endangered Species Act, NMFS or FWS request any conservation measures that are materially inconsistent with the terms of this Agreement and the Relicensing Implementation Plan, the provisions of Section 7.2.2 of this Agreement will apply. Nothing in this Agreement shall limit or waive the authority of NMFS or FWS to take whatever action they may deem necessary if the New License fails to satisfy fully the requirements of ESA Section 7, including failing to adopt as license conditions the terms and conditions contained in a biological opinion issued by NMFS, provided that if such NMFS action is materially inconsistent with this Agreement, the Parties shall address any such inconsistency in accordance with Section 7.2.2 or 7.6 of this Agreement, as applicable.

6.3 <u>Clean Water Act</u>.

6.3.1 Section 401 Certification Upon Application to FERC.

Under Section 401 of the CWA, FERC may not issue a new license for the Project unless and until a Section 401 Certification has been made by the state agency responsible for certification, or the certification requirement is deemed waived. ODEQ is the entity in the State of Oregon statutorily authorized to issue Section 401 Certifications pursuant to the CWA and state water quality laws. Based upon PGE's revised application for Section 401 Certification, ODEQ anticipates that relicensing of the Project consistent with this Agreement, the Proposed License Articles, and the Relicensing Implementation Plan will comply with water quality standards, provide for compliance with future TMDL allocations, if any, protect beneficial uses, and be consistent with other appropriate requirements of state law within the meaning of 33 USC §1341(d). However, ODEQ does not intend to predetermine the outcome of its evaluation of the application for Section 401 Certification, and reserves its right to take all actions necessary to comply with the CWA and state law. ODEQ will provide public notice and opportunity to comment on a proposed Section 401 Certification decision consistent with this Agreement. If, as a result of consideration of public comment and any new information, ODEQ issues a Section 401 Certification materially inconsistent with this Agreement, the Parties shall address any such inconsistency in accordance with Section 7.2.2 of this Agreement.

6.3.2 Section 401 Certification for Other Federal Permits.

Upon applying for a federal permit or permits, other than the relicensing by FERC, for activities required by this Agreement or the New License that might result in a discharge to navigable waters, including a dredge and fill permit from the U.S. Army Corps of Engineers ("Corps") pursuant to CWA Section 404 ("Section 404 Permit"), PGE shall provide ODEQ written notice of such application and of any proposed changes in activities since the date of issuance of ODEQ's Section 401 Certification as described in Section 6.3.1 above. Within 60 days of ODEQ's receipt of notice from the Corps or other federal permitting agency that it is processing PGE's application, ODEQ, consistent with 33 U.S.C. § 1341(a)(3), shall notify the federal agency and PGE either (i) that the Section 401 Certification issued by ODEQ as described in Section 6.3.1 above is sufficient for purposes of the federal permit and permit conditions, or (ii) that, in light of new information related to the water quality impacts of activities since issuance of the Section 401 Certification as described in Section 6.3.1, there is no longer reasonable assurance of compliance with state water quality standards. In the latter event, ODEQ shall consider the new information, solicit and consider public and agency comment as required by law, and issue a Section 401 Certification determination for purposes of the federal permit activities. If, as a result of consideration of public comment and any new information, ODEQ issues a Section 401 Certification that requires measures that are materially inconsistent with this Agreement, the Parties shall address any such inconsistency in accordance with Section 7.2.2 or 7.6 of this Agreement, as applicable.

6.3.3 Application for Delegated State Section 404 Permit for Project Activities.

In the event ODSL assumes authority to administer a dredge and fill permit program under CWA Section 404 by the time a Section 404 Permit is required for Project activities, PGE shall apply for such Section 404 Permit from ODSL. ODEQ, ODFW, and OWRD shall provide comments to ODSL in accordance with ORS 196.825 or successor statutes in effect at that time. If ODEQ, ODFW, or OWRD provide comments or proposed conditions that would require PGE to undertake measures that are materially inconsistent with this Agreement, the Parties shall address any such inconsistency in accordance with Section 7.2.2 or 7.6 of this Agreement, as applicable.

6.4 Magnuson-Stevens Fishery Conservation and Management Act.

6.4.1 Applicable Procedures.

As required by section 305 of the Magnuson-Stevens Fishery Conservation and Management Act, FERC must consult with NMFS if its action may affect EFH. The measures in this Agreement, including the Exhibits and Appendices thereto, will form the proposed action. FERC must provide an EFH Assessment to NMFS to begin EFH consultation. PGE has been designated as FERC's non-Federal representative for purposes of preparing an EFH Assessment. NMFS will provide FERC with recommended EFH conservation measures to conserve and enhance EFH. FERC must then respond within 30 days, including a description of the measures the agency will take to avoid or mitigate the effects of the action on EFH. If FERC does not adopt the recommendations, it must provide a detailed explanation for this decision. NMFS will conduct the EFH consultation along with the ESA consultation in the interest of streamlining the consultation.

6.4.2 Consultation.

The Biological Evaluation attached hereto as Appendix A has been developed in informal consultation with NMFS. PGE and NMFS have worked collaboratively to develop measures described in the Biological Evaluation, to be implemented as required in the Proposed License Articles and in the Relicensing Implementation Plan to identify measures to conserve EFH. By signing this Agreement, NMFS does not formally bind itself to make any specific recommendations or take any particular action with respect to Magnuson-Stevens Act EFH consultation. NMFS acknowledges that the information contained in the Biological Evaluation is sufficient for an EFH assessment for FERC to use to begin consultation under Section 305 of the Magnuson-Stevens Act. NMFS anticipates that the measures contained in this Agreement will be adequate to conserve EFH as a result of implementation of this Agreement. NMFS expressly reserves the right, consistent with federal law, to take such future actions as it may deem necessary to meet its obligations under the Magnuson-Stevens Act. If during consultation with FERC pursuant to Section 305 of the Magnuson-Stevens Act, NMFS recommends any EFH conservation measures that are materially inconsistent with the terms of this Agreement and the Relicensing Implementation Plan, the provisions of Section 7.2.2 of this Agreement will apply. Nothing in this Agreement shall limit or waive the authority of NMFS to take whatever action it may deem necessary if the New License fails to to adopt as license conditions the EFH recommendations attached to the biological opinion issued by NMFS, provided that if such NMFS action is materially inconsistent with this Agreement, the Parties shall address any such inconsistency in accordance with Section 7.2.2 or 7.6 of this Agreement, as applicable.

6.5 State Fish Passage Law.

The resource protection measures required by this Agreement include fish passage within the meaning of ORS 509.585 and approved by ODFW pursuant to Oregon Administrative Rules Chapter 635 Division 412.

6.6 ODSL Lease.

Within 120 days after the Effective Date, PGE shall apply to ODSL for a lease to PGE authorizing occupancy of submerged and submersible lands by those portions of the Project that occupy State lands. No Party shall be deemed to have admitted, adjudicated, or otherwise agreed to the State of Oregon's claim to ownership of the beds and banks of the Willamette River by virtue of this Agreement.

6.7 Transfer of BHPC Water Rights.

Within 120 days after the Effective Date, PGE will file with OWRD a request to amend the 1992 Surface Water Registration Statement, pursuant to ORS § 539.240(9) and (11) and Oregon Administrative Rule 690-28-055, to allow for amendment to the registration statement to reflect the change in ownership of the water claimed for hydroelectric purposes and to be included in the records of the OWRD. No Party shall be deemed by virtue of this Agreement to have admitted, adjudicated, or otherwise agreed to the PGE's original or amended 1992 Surface Water Registration Statement. If any Party to the Settlement contests PGE's request to amend the 1992 Surface Water Registration Statement, such action shall be deemed to be an action materially inconsistent with this Agreement pursuant to Section 7.4.5.

SECTION 7. IMPLEMENTATION OF AGREEMENT

7.1 Parties Bound.

Any Party intending to withdraw from this Agreement, as allowed by this Section 7, must first provide 60 days advance written notice of its intent to withdraw and undertake dispute resolution under Section 7.6 of this Agreement toward eliminating the reason for such withdrawal. Except as provided in Section 7.2.1 of this Agreement, the withdrawal of a Party does not terminate this Agreement for remaining Parties. If a Party withdraws as allowed by this Agreement, that Party shall not be bound by this Agreement following such withdrawal except as might be established through an action for specific performance.

7.2 Resolution of Disputes Before Issuance of New License.

The following events may occur before FERC issues the New License, and the Parties shall seek to resolve any disputes regarding such events as provided in this Section.

7.2.1 Actions Before Filing of FERC Filing.

If any Party takes an action materially inconsistent with this Agreement before PGE files the FERC Filing, any other Party may withdraw from this Agreement, and PGE may, in its sole discretion, determine not to file the FERC Filing, in which case this Agreement terminates.

7.2.2 Actions After Filing of FERC Filing.

a. If any of the following occur after the FERC Filing is filed, but prior to FERC issuing the New License:

> **1.** The final biological opinion developed by NMFS pursuant to the ESA requires in its incidental take statement reasonable and prudent measures, or terms and conditions implementing the reasonable and prudent measures, that are materially inconsistent with this Agreement;
>
> **2.** Any Party takes action materially inconsistent with this Agreement, including submitting proposed conditions to the New License or Permits materially inconsistent with this Agreement or failing to timely implement any provision of this Agreement; or
>
> **3.** Any Party withdraws from this Agreement after complying with the requirements of Section 7.1,

the Parties, and in the case of Section 7.2.2(a)(3), the remaining Parties first shall undertake dispute resolution under Section 7.6 of this Agreement toward conforming this Agreement to the action or otherwise keeping this Agreement in effect.

b. If dispute resolution does not resolve a materially inconsistent action or Party withdrawal to the satisfaction of the Parties or the remaining Parties, as the case may be:

1. Any Party may petition FERC to adopt and enforce the provisions of this Agreement; or

2. Any Party may withdraw from this Agreement and, upon withdrawal, exercise any right or seek any remedy or authority available under applicable law; and

3. PGE may withdraw the FERC Filing, or oppose any new or amended term, condition, or recommendation submitted to FERC by a withdrawing Party.

7.2.3 PGE Fails To Perform Interim Measures.

If, after the FERC Filing is filed but prior to FERC issuing the New License, PGE fails to perform an Interim Measure and such failure is not a delay excused under Section 2.5 of this Agreement or force majeure excused under Section 8.6 of this Agreement, any Party may provide notice to the Parties of such failure. If PGE's failure to perform an Interim Measure is not capable of cure, or is capable of cure but not cured within three days of such notice, or is not curable within three days of such notice and PGE has not commenced a cure within that period and diligently proceeded with such cure, any non-PGE Party may:

1. Petition FERC to adopt and enforce this Agreement;
2. Seek specific performance or other remedies available under applicable law, without resorting to dispute resolution under Section 7.6 of this Agreement; or
3. Withdraw in accordance with Section 7.1, and, upon withdrawal, to the extent allowed by law, submit new or amended terms, conditions, prescriptions, or recommendations to FERC in connection with issuance of the New License.

7.3 Resolution of Disputes About New License.

7.3.1 Adoption by FERC without Modification.

The Parties have entered into this Agreement with the express expectation and condition that FERC approves this Agreement and issues a 30-year New License for the Project that incorporates, without material modification, the provisions of this Agreement and the Proposed License Articles. The Parties agree that if FERC approves this Agreement and incorporates the provisions of this Agreement and the Proposed License Articles into the New License without material modification, they will not seek rehearing of the FERC order granting a new license, or support in any way any request for rehearing by any non-Party to this Agreement; provided, however, that this obligation applies only if FERC (i) incorporates into the New License all conditions contained in ODEQ's Section 401 Certification, and (ii) issues the New License after issuance of the Biological Opinion and completion of EFH consultation.

7.3.2 Conditions of New License Inconsistent with This Agreement.

If the New License is inconsistent with this Agreement, this Agreement shall be deemed modified to conform to the inconsistency, unless a Party provides notice to the other Parties that it objects to the inconsistency and initiates dispute resolution within 30 days after the date of the FERC Order. If the disputing Party or Parties seek administrative rehearing or judicial review of the FERC order, such Party's request for rehearing or review shall constitute notice to the other Parties of the dispute. Any Party may, without resort to the dispute resolution procedures of Section 7.6 of this Agreement, seek administrative rehearing or judicial review of the New License or any other FERC order related to Project relicensing, as provided by the Federal Power Act. If any Party seeks rehearing or review, PGE may seek a stay of the New License or other order, and the Party or Parties seeking rehearing or review will not oppose such stay request as to the term or condition subject to rehearing or review and related terms and conditions affected by the rehearing or review. The Parties shall follow dispute resolution procedures to the extent reasonably practicable while any such rehearing or appeal is pursued. If a Party has filed for administrative rehearing or judicial review and the Parties subsequently agree to modify this Agreement to conform to the inconsistent action, the filing Party or Parties shall withdraw the appeal, or recommend such withdrawal, as appropriate. If, after rehearing or judicial review, as the case may be, the New License or other order is still inconsistent with this Agreement, any Party may, within 60 days after completing the dispute resolution procedures in Section 7.6 of this Agreement, withdraw from this Agreement and exercise any remedy available under applicable law. If any Governmental Party withdraws from this Agreement as provided in this Section, PGE shall, within 30 days of such withdrawal, have the option to withdraw from the Agreement, or take any other action to oppose any action by the withdrawing Party.

7.3.3 Provisions Omitted from New License

If the New License does not contain all of the provisions of this Agreement because FERC expressly determines that it does not have jurisdiction to adopt or enforce the omitted provisions, a Party may withdraw from this Agreement as provided in Section 7.3.2 if its interests are directly affected by the FERC determination. If the New License does not contain all of the provisions of this Agreement because FERC expressly determines that it does not have jurisdiction to adopt or enforce the omitted provisions, and if a Governmental Party has not withdrawn as provided in this Section, the Parties agree that they shall be bound by the entire Agreement, including those provisions omitted by FERC, and that any Party may, if necessary, exercise the remedies set forth in Section 7.4.2 of this Agreement. If a Governmental Party withdraws from this Agreement as provided in this Section, the remaining Parties may withdraw or take such other actions as provided in Section 7.4.2.

7.4 Resolution of Disputes after Issuance of New License.

7.4.1 PGE Fails To Comply with New License.

If PGE fails to perform any of the provisions of this Agreement included in the New License and is not excused by force majeure, any Party may, without resort to the dispute resolution procedures under Section 7.6 of this Agreement, petition FERC to enforce the New License. If FERC fails to enforce the New License, any Party other than PGE may withdraw from this Agreement or seek specific performance and exercise any remedy or authority available under applicable law.

7.4.2 PGE Fails To Perform Covenants of This Agreement Not Included in the New License.

If PGE fails to perform any of its obligations under this Agreement that are not included as terms in the New License, any Party may give PGE notice of the failure and, without resort to the dispute resolution procedures under Section 7.6 of this Agreement, withdraw from this Agreement or seek specific performance and exercise any remedy or authority available under applicable law.

7.4.3 Action by Third Party.

If, during the term of the New License, a third party not a Party to this Agreement successfully petitions FERC or obtains a court order modifying the operation of the Project in a manner that is materially inconsistent with this Agreement, then any Party who objects to such order may give notice to the other Parties and commence dispute resolution procedures pursuant to Section 7.6 of this Agreement to determine whether this Agreement should be amended or otherwise reconciled with such inconsistency. In addition, the aggrieved Party or Parties may seek administrative rehearing or judicial review of such order. If, after completion of the dispute resolution procedures or other proceedings, the order complained of remains in effect, or as modified is still inconsistent with this Agreement, any Party may withdraw from this Agreement and exercise any remedy or authority available under applicable law.

7.4.4 Review of Other Agency Actions.

To the extent provided by applicable law, any Party may seek administrative rehearing and judicial review of any action by a Governmental Party inconsistent with this Agreement. The dispute resolution procedures of Section 7.6 of this Agreement do not preclude any Party from timely filing and pursuing an appeal under the respective Governmental Party's applicable rules, or judicial review, of any such action that is materially inconsistent with this Agreement, or any other final condition that relates to subjects not resolved by this Agreement. However, the Parties shall follow dispute resolution procedures to the extent reasonably practicable while any such appeal of an inconsistency is pursued. If a Party has filed for administrative rehearing or judicial review of any inconsistent action and the Parties subsequently agree to modify this Agreement to conform to the inconsistent action, the filing Party or Parties shall withdraw the appeal, or recommend such withdrawal, as appropriate.

7.4.5 Actions After Issuance of New License.

If, after FERC issues the New License, any Party takes action materially inconsistent with this Agreement, or any Party withdraws from this Agreement after complying with the requirements of Section 7.1, the remaining Parties first shall undertake dispute resolution under Section 7.6 of this Agreement toward conforming this Agreement to the action or otherwise keeping this Agreement in effect. If dispute resolution does not resolve a materially inconsistent action or Party withdrawal to the satisfaction of remaining Parties, any Party may petition FERC to enforce the provisions of this Agreement; or any Party may withdraw from this Agreement and, upon withdrawal, exercise any right or seek any remedy or authority available under applicable law.

7.4.6 Effect of Withdrawal of a Party Other than PGE.

If a Party other than PGE withdraws from this Agreement pursuant to this Section 7.4, any Party may oppose any term, condition or recommendation that is materially inconsistent with this Agreement submitted to FERC by a withdrawing Party, or oppose the assertion of such other remedy or authority as that, or any other, Party seeks to assert under any applicable law. In addition, if a Party withdraws from this Agreement pursuant to any provision of this Section 7.4 other than Sections 7.4.1 or 7.4.2, and PGE withdraws from the Agreement in accordance with Section 7.1 of this Agreement, PGE may notify FERC that PGE has withdrawn from this Agreement and seek such further FERC action as PGE deems appropriate.

7.5 Cooperation Among Parties.

PGE shall be solely liable to pay for the cost of actions required of PGE by this Agreement. PGE shall have no obligation to reimburse or otherwise pay any other Party for its assistance, participation, or cooperation in any activities pursuant to this Agreement, the New License, the Relicensing Implementation Plan, or the Permits, except as specified in this Agreement, in cost reimbursement agreements among PGE and other Parties, or as required by law.

7.6 Dispute Resolution.

7.6.1 General.

Except to the extent that FERC or another agency with jurisdiction of a particular issue has a procedure that precludes implementation of this Section 7.6, and except where dispute resolution is expressly not required by another provision of this Agreement, all disputes among the Parties regarding the obligations of the Parties under this Agreement shall, at the request of any Party, be subject to dispute resolution pursuant to this Section 7.6. The Parties agree to devote such time, resources, and attention to dispute resolution as are needed and as can be reasonably provided to attempt to resolve the dispute at the earliest time possible; and each Party shall cooperate in good faith to promptly schedule, attend, and participate in the dispute resolution. Each Party shall implement promptly all final agreements reached, consistent with its applicable statutory and regulatory responsibilities. Nothing in Section 7.6 is intended or shall be construed to affect or limit the authority of FERC, the Governmental Parties, or other agency with jurisdiction over the Project to resolve a dispute brought before it in accord with its own procedure and applicable law.

7.6.2 General Procedures.

Except as otherwise provided in Section 7.6.3, a Party claiming a dispute shall give notice of the dispute within 30 days of the Party's actual knowledge of the act, event, or omission that gives rise to the dispute. At a minimum and in any dispute subject to these procedures, the Parties shall hold at least one informal meeting within 30 days after notice to attempt to resolve the disputed issue(s). If the informal meeting fails to resolve the dispute, the Parties may by unanimous agreement attempt to resolve the dispute using a neutral mediator unanimously selected by the disputing Parties within 15 days after notice by a Party that the informal meetings did not resolve the dispute. The mediator shall mediate the dispute during the next 60 days after its selection. Any of these time periods may be reasonably extended or shortened by agreement of the Parties, or as necessary to conform to the procedure of an agency or court with jurisdiction over the dispute. Unless otherwise agreed among the Parties, each Party shall bear its costs for its own participation in the dispute resolution. If the Parties are unable to resolve a dispute as provided in this Section, the matter in dispute may be referred to FERC as provided in Section 7.6.3.

7.6.3 Disputes Arising in Fish Technical Committee.

If the Fish Technical Committee cannot reach consensus on an issue, the Fish Technical Committee shall refer the issue to a dispute resolution committee ("Dispute Resolution Committee") consisting of one representative designated by each Party. At the request of the Dispute Resolution Committee, PGE shall make available a mutually agreed upon third party expert to assist the Dispute Resolution Committee in reaching its decision. Such referral shall satisfy the requirement in Section 7.6.2 that the Parties hold at least one informal dispute resolution meeting.

a. **Study Plans.** If after following the procedures specified in the Relicensing Implementation Plan, any Party believes that a final study plan is inconsistent with the New License or the Relicensing Implementation Plan, that Party may initiate dispute resolution by referring the matter to the Dispute Resolution Committee within 30 days of that Party's receipt of the final study plan. If the Dispute Resolution Committee has not resolved the matter within 30 days, any Party may, without further notice to the other Parties, either request FERC to order PGE to modify the disputed study plan or file comments responding to PGE's filing of the study plan.

b. **Facility Designs.** If after following the procedures specified in the Relicensing Implementation Plan, any Party believes that a facility design proposed by PGE is inconsistent with the New License or the Relicensing Implementation Plan, that Party may initiate dispute resolution by referring the matter to the Dispute Resolution Committee within 30 days of that Party's receipt of the final facility design. PGE shall not submit the facility design to FERC for approval until the Dispute Resolution Committee has had at least 30 days, which time period may be extended by agreement of the Parties, to resolve the dispute. If the Dispute Resolution Committee has not resolved the matter within 30 days, PGE may file the final design with FERC, including in its filing a description of the dispute and its proposed resolution thereof, and any other Party may, without further notice to the other Parties, request FERC to order PGE to modify the facility design, or file comments responding to PGE's filing of the facility design.

c. **Reports.** If after following the procedures specified in the Relicensing Implementation Plan, any Party believes that a report prepared by PGE, including a report of the results of a monitoring and evaluation study is inconsistent with the New License or the Relicensing Implementation Plan, that Party may initiate dispute resolution by referring the matter to the Dispute Resolution Committee within 30 days of that Party's receipt of the final study report. PGE shall not submit the report to FERC for approval until the Dispute Resolution Committee has had at least 30 days, which time period may be extended by agreement of the Parties, to resolve the dispute. If the Dispute Resolution Committee has not resolved the matter within 30 days, PGE may file the report with FERC, including in its filing a description of the dispute and its proposed resolution thereof, and any other Party may, without further notice to the other Parties, file comments responding to PGE's filing of the report.

If any Party takes action pursuant to this Section, any other Party may file such comments with FERC as it deems appropriate under the circumstances, and may seek a modification of any schedule affected by the matter in dispute. Any Party aggrieved by FERC's action may seek rehearing as provided in Section 7.3.2, withdraw from this Agreement, or seek specific performance and exercise any remedy or authority available under applicable law.

SECTION 8. GENERAL PROVISIONS

8.1 Entire Agreement.

This Agreement, together with the Exhibits and Appendices referred to in this Agreement, sets forth the entire agreement of the Parties or describes the Parties' intended procedures with regard to relicensing the Project. This Agreement is made on the understanding that each term is in consideration and support of every other term, and each term is a necessary part of the entire Agreement.

8.2 Modifications.

This Agreement may be amended by unanimous written consent of the Parties. Any Party may request all other Parties to commence negotiations for a period of up to 90 days to amend the terms and conditions of this Agreement in whole or in part. Any such amendment that renders the Agreement materially inconsistent with terms and conditions of the New License or other regulatory approvals then in effect shall be subject to approval by FERC or other permitting agency, except that the Parties may agree to implement on an interim basis, pending approval, any amendment not requiring prior regulatory approval. As appropriate, the Parties will submit a statement to FERC in support of any amendment.

8.3 Signatory Authority.

Each signatory to this Agreement certifies that he or she is authorized to execute this Agreement and to legally bind the Party he or she represents, and that such Party shall be fully bound by the terms hereof upon such signature without any further act, approval, or authorization by such Party.

8.4 No Third-Party Beneficiaries.

Without limiting the applicability of rights granted to the public pursuant to applicable law, this Agreement shall not create any right or interest in the public, or any member of the public, as a third-party beneficiary of this Agreement and shall not authorize any non-Party to maintain a suit at law or equity pursuant to this Agreement. The duties, obligations, and responsibilities of the Parties with respect to third parties shall remain as imposed under applicable law.

8.5 Successors, Transferees, and Assigns.

This Agreement shall apply to and be binding on the Parties and their successors and assigns. Upon completion of a succession, transfer, or assignment, the initial Party shall no longer be a Party to this Agreement, but shall remain secondarily liable for the performance of the assignee. No change in ownership of the Project or transfer of the New License by PGE shall in any way modify or otherwise affect any other Party's interests, rights, responsibilities, or obligations under this Agreement. A transferring or assigning Party shall provide notice to the other Parties at least 60 days prior to completing such transfer or assignment.

8.6 <u>Failure To Perform Due to Force Majeure.</u>

8.6.1 Declaration of Force Majeure.

No Party shall be liable to any other Party for breach of this Agreement as a result of a failure to perform or for delay in performance of any provision of this Agreement if such performance is delayed or prevented by force majeure. The term "force majeure" means any cause reasonably beyond the affected Party's control and that could not be avoided with the exercise of due care, whether unforeseen, foreseen, foreseeable, or unforeseeable, and without the fault or negligence of the affected Party. Force majeure may include, but is not limited to, natural events, labor or civil disruption, breakdown or failure of Project works, orders of any court or agency having jurisdiction over the Party's actions, or delay in issuance of any required permit. Increased cost for the performance of the Relicensing Implementation Plan shall not be deemed to constitute force majeure. The Party whose performance is affected by force majeure shall notify the other Parties in writing within 24 hours, or otherwise as soon as reasonably practicable, after becoming aware of any event that such affected Party contends constitutes force majeure. Such notice will identify the event causing the delay or anticipated delay, estimate the anticipated length of delay, state the measures taken or to be taken to minimize the delay, and estimate the timetable for implementation of the measures. The affected Party shall make all reasonable efforts to promptly resume performance of this Agreement and, when able, to resume performance of its obligations and give the other Parties written notice to that effect.

8.6.2 Consultation with NMFS and USFWS.

If PGE is unable to perform any obligation pursuant to any provision of this Agreement as a result of force majeure, it shall, within three days after notifying the other Parties of the existence of an event constituting force majeure, initiate consultation with NMFS and USFWS, as applicable, to minimize any take of species listed as endangered or threatened.

8.6.3 Duration of Force Majeure.

If PGE's inability to perform any obligation pursuant to any provision of this Agreement continues or is reasonably anticipated to continue for more than 180 days due to force majeure, any Party other than PGE may withdraw from this Agreement, and any Party that withdraws from this Agreement may pursue any other remedy available under applicable law. If any Party withdraws from this Agreement pursuant to this Section 8.6.3, PGE may oppose the assertion of such other remedy or authority that Party seeks to assert under any applicable law or notify FERC that PGE has withdrawn from this Agreement and seek such further FERC action as PGE deems appropriate.

8.7 <u>Indemnification and Hold Harmless.</u>

PGE shall indemnify and hold harmless each of the Parties to this Agreement and their respective boards, commissions, councils, officers, employees, and agents for any claims or liabilities for property damage or personal injury arising from resource protection Measures undertaken by PGE or its employees, agents, contractors, or successors.

8.8 Governing Law.

By executing this Agreement, no federal agency or officer is consenting to the jurisdiction of a state court. By executing this Agreement, no state agency or officer is consenting to the jurisdiction of a federal court. By executing this Agreement, no Tribal Party or Tribal official is consenting to the jurisdiction of a federal or state court. All activities undertaken pursuant to this Agreement shall be in compliance with all applicable law.

8.9 Elected Officials Not To Benefit.

No member of or delegate to Congress shall be entitled to any share or part of this Agreement or to any benefit that may arise from it.

8.10 No Partnership.

Except as otherwise expressly set forth herein, this Agreement does not, and shall not be deemed to, make any Party the agent for or partner of any other Party.

8.11 Reference to Regulations.

Any reference in this Agreement to any federal or state regulation shall be deemed to be a reference to such regulation or successor regulation in existence as of the date of the action.

8.12 Notice.

Except as otherwise provided in this Section, any notice required by this Agreement shall be written and shall be sent by first-class mail or comparable method of distribution to all Parties still in existence and shall be filed with FERC. For the purpose of this Agreement, a notice shall be effective seven days after the date on which it is mailed or otherwise distributed. When this Agreement requires notice in less than seven days, notice shall be provided by telephone, facsimile, or electronic mail and shall be effective when provided. Notices shall be addressed as follows:

American Rivers:

Ms. Brett Swift
Associate Director, NW Hydro Program
American Rivers
320 SW Stark, Suite 418
Portland, OR 97210
Tel: 503-827-8648
Fax: 503-827-8654

Confederated Tribes of the Warm Springs Reservation of Oregon:

Mr. Clay Penhollow
Hydropower Review Coordinator
Confederated Tribes of Warm Springs
Natural Resources Branch
P.O. Box C
Warm Springs, OR 97761-3001
Phone: 541.553.2014
Fax: 541.553.1994
Email: cpenhollow@wstribes.org

Confederated Tribes of Siletz Indians of Oregon:

Thomas Downey
Environmental Protection Specialist
PO Box 549
Siletz, OR 97380
Tel: 541-444-8226
Fax: 541-444-9688
Email: tomd@ctsi.nsn.us

With a copy to:

Mike Kennedy
Natural Resource Manager
PO Box 549
Siletz, OR 97380
Tel: 541-444-2532
Fax: 541-444-9688
Email: mikek@ctsi.nsn.us

Billy Barquine
LeRoy Wilder, PC
0225 S.W. Montgomery
Suite #6
Portland, OR 97201
Tel: 503-242-0705
Fax: 503-242-0716
Email: wbarquin@lwilder.com

Confederated Tribes of the Grand Ronde Community of Oregon:

Mr. Rod Thompson
Environmental Resource Specialist
47010 SW Hebo Road
Grand Ronde, OR 97347
Tel: (503) 879-2385
Fax: (503) 879-5622
Email: rod.thompson@grandronde.org

With a copy to:

Ms. Lisa Estensen
Tribal Attorney's Office
9615 Grand Ronde Road
Grand Ronde, OR 97347
Tel: (503) 879-2335
Tel: (503) 879-2333
Email: lisa.estensen@grandronde.org

Columbia River Intertribal Fish Commission:

Bob Heinith
Hydro Program Coordinator
729 NE Oregon
Suite 200
Portland, OR 97232
Tel: 503-731-1289
Fax: 503-235-4228
Email: heib@critfc.org

National Marine Fisheries Service:

Mr. D. Robert Lohn
Regional Administrator
National Marine Fisheries Service
525 NE Oregon Street, Suite 500
Portland, OR 7232-2737
Tel: 503-231-2319
Fax: 206-526-6426

With a copy to:

Mr. Keith Kirkendall
National Marine Fisheries Service
525 NE Oregon Street, Suite 500
Portland, OR 7232-2737
Tel: 503-230-5431
Fax:

Ms. Jane Hannuksela
NOAA Office of General Counsel
(GCNW)
7600 Sand Point Way NE
Seattle, WA 98115
Tel: 206-526-6515
Fax: 206-526-6542
Email: Jane.Hannuksela@noaa.gov

Native Fish Society:

Mr. Bill Bakke
Director
Native Fish Society
PO Box 19570
Portland, OR 97280
Tel: 503-977-0287
Fax: 503-977-0026

Oregon Department Of Environmental Quality:

Michael T. Llewelyn
Oregon Department of Environmental Quality
811 SW 6th Avenue
Portland, OR 97204
Tel: 503-229-5324
Fax: 503-229-5408

Oregon Department Of Fish And Wildlife:

Mr. John Zauner
Hydropower Coordinator
Oregon Dept. of Fish and Wildlife
17330 SE Evelyn Street
Clackamas, OR 97015
Tel: 503-872-5255
Fax: 503-872-5269
john.r.zauner@state.or.us

With a copy to:

Hydropower Program Project Leader
Oregon Department of Fish and Wildlife
3406 Cherry Avenue NE
Salem, OR 97303

Oregon Water Resources Department:

Mr. Craig Kohanek
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301-1271
Tel: 503-986-0821
Fax: 503- 986-

Oregon Trout:

Mr. Jason Miner
Conservation Director
Oregon Trout
117 SW Naito Parkway
Portland, OR 97204
Tel: 503-222-9091
Fax: 503-222-9187

Portland General Electric Company:

Ms. Julie A. Keil
Director, Hydro Licensing
Portland General Electric Company
121 SW Salmon Street
3-WTC BRHL
Portland, OR 97204
Tel: 503-464-8864
Fax: 503-464-2944

With a copy to:

The Office of the General Counsel
Portland General Electric Company
121 SW Salmon Street
1-WTC-1701
Portland, OR 97204
Tel: 503-464-7822
Email: 503-464-2200

Trout Unlimited:

Mr. Jeffery Curtis
Western Conservation Director
Trout Unlimited
213 SW Ash, Suite 205
Portland, OR 97204
Tel: 503-827-5700
Fax: 503-827-5672

US Fish & Wildlife Service:

Mr. Dave Allen
Regional Director
United States Fish and Wildlife Service
911 NE 11th Avenue
Portland, OR 97232-4181
Tel: 503-231-6199
Fax: 503-872-2716

With a copy to:

Mr. Kemper McMaster
Oregon State Supervisor
US Fish and Wildlife Service
2600 SE 98th Avenue Suite 100
Portland, OR 97266
Tel: 503-231-6179
Fax: 503-231-6195

The Parties shall provide notice of any change in the authorized representatives designated above, and PGE's License Compliance Coordinator shall maintain the current distribution list of such representatives.

8.13 Paragraph Titles for Convenience Only.

The titles for the paragraphs of this Agreement are used only for convenience of reference and organization, and shall not be used to modify, explain, or interpret any of the provisions of this Agreement or the intentions of the Parties.

8.14 Signing in Counterparts.

This Agreement may be executed in any number of counterparts, and each executed counterpart shall have the same force and effect as an original instrument as if all the signatory Parties to all of the counterparts had signed the same instrument. Any signature page of this Agreement may be detached from any counterpart of this Agreement without impairing the legal effect of any signatures, and may be attached to another counterpart of this Agreement identical in form having attached to it one or more signature pages.

8.15 Waiver.

Waiver by any Party of the strict performance of any term or covenant of this Agreement, or of any right under this Agreement, shall not be a continuing waiver, and must be in writing.

8.16 Availability of Funds.

Implementation of this Agreement for a Party that is a federal agency is subject to the requirements of the Anti-Deficiency Act, 31 USC §§ 1341-1519, and the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury. The Parties acknowledge that the Governmental Parties that are federal agencies shall not be required under this Agreement to expend any federal agency's appropriated funds unless and until an authorized official of each such agency affirmatively acts to commit such expenditures, as evidenced in writing. Implementation of this Agreement by Governmental Parties that are state agencies is subject to the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the Treasury of the State of Oregon. The Parties acknowledge that the Governmental Parties that are state agencies shall not be required under this Agreement to expend any appropriated funds unless and until an authorized official of each such agency affirmatively acts to commit such expenditures, as evidenced in writing. Implementation of this Agreement by Tribal Parties is subject to the availability of funding. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation or expenditure of any money from Tribal funds. The Parties acknowledge that the Tribal Parties shall not be required under this Agreement to expend any funds unless and until an authorized Tribal official affirmatively acts to commit such expenditures, as evidenced in writing.

IN WITNESS WHEREOF the Parties have entered into this Agreement as of the date first above written.

AMERICAN RIVERS

By: Rebecca R. Wodder
Rebecca R. Wodder
President

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION

By: ______________________________

CONFEDERATED TRIBES OF THE GRAND RONDE COMMUNITY OF OREGON

By: ______________________________
Cheryle A. Kennedy
Tribal Council Chairwoman

CONFEDERATED TRIBES OF SILETZ INDIANS OF OREGON

By: ______________________________
Delores Pigsley
Chairman

CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION OF OREGON

By: ______________________________
Garland Brunoe
Tribal Council Chairman

NATIONAL MARINE FISHERIES SERVICE

By: ______________________________
Bob Lohn
Regional Administrator

THE NATIVE FISH SOCIETY

By: ______________________________
Bill M. Bakke
Director

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

By: ______________________________
Michael T. Llewelyn
Administrator, Water Quality Division

OREGON DEPARTMENT OF FISH AND WILDLIFE

By: ______________________________
Lindsay A. Ball
Director

OREGON TROUT

By: ______________________________
Joe Whitworth
Executive Director

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Cheryle A. Kennedy
Tribal Council Chairwoman

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Garland Brunoe
Tribal Council Chairman

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By: D. Robert Lohn
Bob Lohn
Regional Administrator

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By: Bill M Bakke

Bill M. Bakke
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OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

By: ____________________

Michael T. Llewelyn
Administrator, Water Quality Division

OREGON DEPARTMENT OF FISH AND WILDLIFE

By: Lindsay A. Ball 12-19-03

Lindsay A. Ball
Director

OREGON TROUT

By: ____________________

Joe Whitworth
Executive Director

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President

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION

By: ______________________________

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Tribal Council Chairwoman

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Tribal Council Chairman

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OREGON TROUT

By: ______________________________
Joe Whitworth
Executive Director

OREGON WATER RESOURCES DEPARTMENT

By: ______________________________
Richard D. Bailey
Water Rights and Adjudications Administrator

PORTLAND GENERAL ELECTRIC COMPANY

By: ______________________________
Peggy Fowler
Chief Executive Officer

TROUT UNLIMITED

By: ______________________________
Jeff Curtis
Western Conservation Director

US FISH & WILDLIFE SERVICE

By: ______________________________
David Allen
Regional Director

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Water Rights and Adjudications Administrator

PORTLAND GENERAL ELECTRIC COMPANY

By: Peggy Fowler
Peggy Fowler
Chief Executive Officer

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TROUT UNLIMITED

By: ______________________________

Jeff Curtis
Western Conservation Director

US FISH & WILDLIFE SERVICE

By: David B. Allen 12/22/03

David Allen
Regional Director

EXHIBIT A

PROPOSED LICENSE ARTICLES

Exhibit A

Proposed License Articles

Ordering Paragraph

(D) The Settlement Agreement Concerning the Relicensing of the Willamette Falls Hydroelectric Project, filed with the Commission on or about January 29, 2004 (the "January 2004 Settlement Agreement"), including the Relicensing Implementation Plan attached thereto, is hereby approved and adopted and this license is subject to the Settlement Agreement conditions set forth in Appendix A to this order.

Appendix A: Settlement License Conditions

Article 1: Requirements of Settlement Agreement

(a) The Licensee shall establish a Fish Technical Committee (FTC) as provided in the January 2004 Settlement Agreement in order to ensure that the requirements of the Relicensing Implementation Plan are fully incorporated into the Licensee's implementation of the terms and conditions of this License. Licensee's development and implementation of study plans, reports, facility designs, and operating and implementation plans submitted to the FTC pursuant to the terms of this License shall comply with the requirements of the Relicensing Implementation Plan.

(b) Unless a different time period is specifically established pursuant to another provision of this License or the Relicensing Implementation Plan, the Licensee shall, where consultation with the FTC is required, allow a minimum of 30 days for the FTC members to comment and to make recommendations before filing any study plan, report, or facility design with the Commission. If the Licensee does not adopt a recommendation, the filing with the Commission shall include the Licensee's reasons, based on project-specific information for not adopting such recommendation.

(c) The National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Oregon Department of Fish and Wildlife are members of the FTC and are collectively referred to as the Fish Agencies. Where consultation with the FTC and approval by the appropriate Fish Agencies is required, the Licensee shall also submit the final study plan, report, facility design, or operating or implementation plan to the appropriate Fish Agencies for approval prior to filing with the Commission. In each case, the determination of which Fish Agencies are the appropriate agencies for approval shall be made by the Fish Agencies. The Licensee's implementation of measures pursuant to this license shall be reported to the FTC as provided in the Relicensing Implementation Plan.

(d) The Parties to the January 2004 Settlement Agreement shall comply with the requirements of Section 7 (Implementation of Agreement) of the January 2004 Settlement Agreement.

Article 2: Downstream Fish Passage

(a) The Licensee shall achieve the downstream passage performance standards specified in Table 1 of this Article for downstream passage of juvenile salmonids at the T. W. Sullivan Powerhouse, within the time limits specified in Articles 3 and 4.

Table 1. Performance standards for juvenile salmonid downstream passage at the T.W. Sullivan Powerhouse.*

Smolts > 60 mm in Length		Fry < 60 mm in Length		Action required pursuant to paragraph (b) of Article 1
Mortality	**Injury**	**Mortality**	**Injury**	
Design performance objective ≤0.5 % mortality	Design performance objective ≤2 % injury	Design performance objective ≤2 % mortality	Design performance objective ≤4 % injury	Objective met. No further measures required
Actual mortality > 0.5 % but ≤2 % would require additional work to lessen mortality	Actual injury > 2 % but ≤4 % would require additional work to lessen injuries	Actual mortality > 2 % but ≤4 % would require additional work to lessen mortality	Actual injury > 4 % but ≤6 % would require additional work to lessen injuries	• Tier 1 and Tier 2 actions implemented per schedule.
Actual mortality > 2 % would require major operational or structural changes	Actual injury > 4 % would require major operational or structural changes	Actual mortality > 4 % would require major operational or structural changes	Actual injury > 6 % would require major operational or structural changes	• Tier 3 actions implemented as needed and meaningful to improve performance. • Tier 4 actions implemented if performance after Tier 3 items is not satisfactory.

* The top row of Table 1 provides downstream passage performance standards that, if met, mean that no further measures are required by the Licensee. The second row provides mortality/injury ranges that mean that additional work provided in Tier 2 is needed to reduce mortality/injury pursuant to paragraph (b) of Article 1. The third row provides mortality/injury ranges that, if exceeded, mean actions listed in Tiers 3 and 4 are needed, as appropriate pursuant to paragraph (b) of Article 1.

(b) The "Actions" listed in Table 1 are categorized into four tiers according to planned timing of implementation and which level of performance standard is being addressed. The components of each Tier are specified in Appendix 5 of the Relicensing Implementation Plan attached to the January 2004 Settlement Agreement.

(i) As reported pursuant to Article 3, the Licensee shall have completed Tier 1 measures prior to issuance of the License.

(ii) As provided in Article 4, the Licensee shall undertake Tier 2 measures after issuance of the License and shall initiate evaluation of downstream passage performance at the T.W. Sullivan Powerhouse using the standards listed in Table 1 after completion of the siphon bypass. If necessary to achieve the performance standards in Table 1 based on the results of performance evaluations, the Licensee will implement remaining Tier 2 measures according to the timeline in the Relicensing Implementation Plan, provided that, if measured performance meets the second level of performance standards specified in Table 1 after Tier 2 items are implemented, the Licensee is not required to implement Tier 3 or Tier 4 measures. If necessary based on the results of performance evaluations and consultation with the FTC and with the approval of the appropriate Fish Agencies pursuant to Article 1, the Licensee will undertake additional modifications not specified in the Relicensing Implementation Plan to achieve further measurable mortality reduction

(iii) Not later than December 31, 2009, unless such deadline is extended with the agreement of the FTC pursuant to Article 1, the Licensee shall complete performance testing to determine if measured performance meets the second level of performance standards specified in the Table 1. If measured performance does not meet the second level of performance standards specified in the Table 1, the Licensee shall file with the Commission a plan to implement Tier 3 measures and performance testing. The plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval of the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the plan.

(iv) Not later than December 31, 2015, unless such deadline shall be extended with the agreement of the FTC pursuant to Article 1, the Licensee shall complete performance testing to determine if measured performance meets the second level of performance standards specified in the Table 1. If measured performance does not meet the second level of performance standards specified in the Table 1 after Tier 3 implementation, the Licensee shall file with the Commission a plan to implement Tier 4 measures and performance testing. The plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval of the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the plan.

(c) The licensee shall achieve the downstream passage performance standard of at least 97% survival for downstream passage of juvenile salmonid smolts at the controlled flow structure to be constructed at Willamette Falls as provided in Article 9.

(d) If a technology-based standard for Pacific lamprey survival and injury avoidance is developed and regionally adopted by the U.S. Fish and Wildlife Service during the term of the new license, the Licensee shall adopt such standard, which shall supersede the performance goal set forth in Table 2. If the studies conducted pursuant to Articles 15 and 16 indicate that the T.W. Sullivan Powerhouse does not comply with the newly-adopted technology-based standard, the Licensee shall consult with the FTC pursuant to Article 1 regarding measures, subject to Fish Agency approval, needed to comply with the standard at the T.W. Sullivan Powerhouse. Within twelve months of the adoptions of such standard, the Licensee shall file with the Commission a plan describing the measures that will be instituted to achieve the lamprey survival and injury standard at the T.W. Sullivan Powerhouse. The plan shall be prepared after consultation with the FTC pursuant to Article 1. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the plan. Upon Commission approval, the plan shall become a requirement of the License.

(e) The Licensee shall achieve the performance goals in Table 2 for upstream and downstream passage of Pacific Lamprey and adult salmonid migrants at the Willamette Falls Project:

Table 2. Performance Goals for the passage of Pacific lamprey and adult salmonids at the Willamette Falls Project.

Fish species/lifestage	Type of passage	Performance Goal
Juvenile lamprey	Downstream through the powerhouses	"safe, timely, and effective" qualitative goal without serious injury or mortality
Juvenile lamprey	Downstream over the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality: Assumed adequate when the standard for juvenile salmonids is met at the spillway ($\geq$97% survival), until appropriate technology is developed to assess juvenile lamprey survival over the controlled flow structure.
Adult lamprey	Upstream through the Project area	"safe, timely, and effective" qualitative goal without serious injury or mortality: Goal to be further developed through PGE funded study described in Section V.C and Appendix 4 of the Relicensing Implementation Plan
Adult lamprey	Downstream at the T.W. Sullivan Powerhouse and at the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality
Adult salmonids	Upstream through the Project area	"safe, timely, and effective" qualitative goal without serious injury or mortality
Steelhead kelts (i.e., post-spawning adults) and fallback (adult salmonids)	Downstream at the T.W. Sullivan Powerhouse and at the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality

Article 3: Implementation of Tier 1 Measures

Within six months of the effective date of the License, the Licensee shall file with the Commission a report, including as-built drawings, documenting the completion of the Tier 1 Measures described in Appendices 5 and 6 of the Relicensing Implementation Plan. The report shall be prepared after consultation with the FTC pursuant to Article 1.

Article 4: T.W. Sullivan Modifications

(a) Within twelve months of the effective date of the License, the Licensee shall modify the siphon spillway adjacent to the T.W. Sullivan Powerhouse to bypass a design flow of 500 cfs directly from the forebay to the tailrace during powerhouse operation. Within two months of the effective date of the License, the Licensee shall file with the Commission a plan to modify the siphon spillway. The plan shall include, but not be limited to: (1) functional design drawings; (2) an installation and implementation schedule providing for completion of construction by December 31, 2005; and (3) if feasible, new passive integrated transponder (PIT) tag interrogator detector systems or an equivalent system to ensure that fish passage efficiency and survival can be effectively measured. The design of the siphon bypass shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and the Commission, the Licensee shall implement the siphon bypass design.

(b) The Licensee shall develop and implement a multi-year study to evaluate fish guidance efficiency and mortality and injury to spring Chinook and steelhead smolts, and to the extent technically feasible, spring Chinook and steelhead fry and juvenile Pacific lamprey, passing through the T.W. Sullivan Powerhouse and siphon bypass. The Licensee shall file a study plan with the Commission within six months of the effective date of the License. The study plan, which shall be initiated upon completion of the siphon bypass pursuant to paragraph (a) of this Article, shall include, but not be limited to evaluating (i) fish guidance efficiency; (ii) mortality and injury to spring Chinook and steelhead smolts passing through the T.W. Sullivan Powerhouse and siphon bypass; (iii) the effects of turbine passage and turbine shutdown sequencing on fish guidance; (iv) if the field research technology becomes available and is applicable to conditions existing at the Project, mortality and injury to spring Chinook and steelhead fry passing through the T.W. Sullivan Powerhouse and siphon bypass; (v) if the field research technology becomes available and is applicable to conditions existing at the Project, impacts on juvenile Pacific lamprey as specified in Article 16; and (vi) injury and mortality to fish caused by the 2-inch spaced trashracks. The effectiveness of behavioral deterrent devices, if appropriate, should be included for evaluation in Tier 2. An extensive monitoring and evaluation program will assess the effectiveness of all modifications to the T.W. Sullivan Powerhouse and siphon bypass by 2009. The study plan shall provide for the filing of a final report with the Commission upon completion of at least three years of study, as well as the filing of interim reports summarizing the results of each year's study. The study plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the study plan.

(c) The Licensee shall file reports with the Commission of the results of the study, approved pursuant to paragraph (b) of this Article, on fish guidance efficiency and mortality and injury, relative to the standards contained in Table 1, to spring Chinook and steelhead smolts and fry passing through the T.W. Sullivan Powerhouse and siphon bypass. Results of juvenile lamprey testing will be reported relative to goals in Table 2. The Licensee shall file a final report not later than December 31, 2008, and interim reports by December 31 of each year during the study. If the downstream smolt and fry passage survival rates have not achieved the standards specified in Table 1 of Article 2, each interim report shall include plans to further improve the effectiveness of the facilities by implementing additional Tier 2 measures. If downstream fish passage survival rates have not achieved the standards specified in Table 1 of Article 2, the final report shall include plans to further improve the effectiveness of the facilities by implementing additional Tier 2 and Tier 3 measures as specified in Table 1. The report shall be developed in consultation with the FTC pursuant to

Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the recommendations in the report

(d) Not later than December 31, 2005, the Licensee shall file with the Commission a PIT tag interrogator plan to install new passive integrated transponder ("PIT") tag interrogator system at the Unit 13 bypass. Within two months of the effective date of the license, the Licensee shall file with the Commission a plan for installation of the PIT tag interrogator system. The PIT tag interrogator plan, which shall include, but not be limited to: (1) functional design drawings; and (2) an installation and implementation schedule providing for completion of construction by December 31, 2005, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the pit detector plan. If it is determined through consultation with the FTC that installation in 2005 would not be consistent with modification of the Unit 13 bypass outfall scheduled in 2006, then installation of the PIT tag interrogator system shall be implemented in conjunction with the Unit 13 bypass outfall modification.

(e) The Licensee shall periodically review the feasibility of installing a PIT tag interrogator system (or equivalent system) at the siphon bypass if the installation of such technology is not feasible when the design for that bypass is filed pursuant to paragraph (a) of this Article. Within six months of determining that it has become feasible to install such technology at the siphon bypass, the Licensee shall file with the Commission a plan to install a PIT tag interrogator system (or equivalent system) at the siphon bypass. The PIT tag interrogator plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the plan.

(f) The Licensee shall install and operate a trashrack cleaning system in the forebay of the T.W. Sullivan Powerhouse to ensure that the forebay trashracks remain free of debris that could adversely affect fish guidance efficiency and downstream migrant survival. Within two months of the effective date of the License, the Licensee shall file with the Commission a plan to install and operate the trashrack cleaning system The plan, which shall include, but not be limited to: (1) functional design drawings; and (2) an installation and implementation schedule providing for completion of construction by December 31, 2005, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the trashrack cleaning system plan.

(g) The Licensee shall modify the discharges of Units 12 and 13 at the T.W. Sullivan Powerhouse tailrace to eliminate potential aquatic predator habitat in existing slack water areas between the Unit 12 and 13 discharges. Not later than March 1, 2006, the Licensee shall file with the Commission a plan to modify the discharges of Units 12 and 13. The discharge modification plan, which shall include, but not be limited to: (1) functional design drawings; and (2) an installation and implementation schedule providing for completion of construction by October 31, 2006, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the discharge modification plan.

(h) The Licensee shall take measures to reduce the potential for avian predation on downstream migrants that pass the Project through the T.W. Sullivan Powerhouse. Not later than March 1, 2007, the Licensee shall file with the Commission a plan for reducing the potential for avian predation. The plan, which shall include, but not be limited to: (1) functional design drawings; (2) an installation and implementation schedule providing for completion of construction by December 31, 2007, and (3) addition or increase of wire or other equally effective avian deterrent technology in the forebay and tailrace in areas where avian predation activity has been observed, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the plan.

(i) The Licensee shall modify the outfall of the Unit 13 bypass to meet NOAA Fisheries hydraulic impact velocity criteria. Not later than March 1, 2006, the Licensee shall file with the Commission a plan to modify the outfall of the Unit 13 bypass. The plan, which shall include, but not be limited to: (1) functional design drawings; (2) an installation and implementation schedule providing for completion of construction by October 31, 2006; and (3) installation of a PIT tag interrogator system on the outfall if not previously installed in 2005, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the outfall modification plan.

(j) If the Licensee elects to develop a new auxiliary water supply system for fish ladder entrance #1, it shall file with the Commission a plan for implementing the new water supply system. The plan, which shall include, but not be limited to: (1) functional design drawings; (2) an installation and implementation schedule, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and the Commission, the Licensee shall implement the auxiliary water supply modification plan.

Article 5: T.W. Sullivan Powerhouse Runner Replacements

The Licensee shall replace runners in Units 1-7 and 10-12 at the T.W. Sullivan Powerhouse at a rate of two per year, unless otherwise agreed to after consultation with the FTC and with the approval of the appropriate Fish Agencies pursuant to Article 1. The Licensee shall index/efficiency test replaced runners. If the Licensee installs a runner design of significantly different design than that installed in Unit 8, Licensee shall, after consultation with the FTC pursuant to Article 1, conduct mortality testing, within 1 year of replacement and prior to additional unit replacements using such runner design.

Article 6: T. W. Sullivan Powerhouse Operational Plan

Within six months of the effective date of the License, the Licensee shall implement an operational plan for the T.W. Sullivan Powerhouse. Within three months of the effective date of the License, the Licensee shall file a T.W. Sullivan Powerhouse operational plan with the Commission. The plan shall provide for (1) accomplishing necessary unit shutdowns to minimize adverse effects on forebay hydraulics; (2) procedures governing maintenance shutdowns of Unit 13 and of the T.W. Sullivan Powerhouse when fish protection devices are not functioning or if Unit 1 is offline for more than 24 hours during salmonid upstream migration periods; (3) operation of the auxiliary water supply for entrance #1 of the fish ladder; (4) operating units with replacement runners within 1% of peak efficiency based on index/efficiency testing provided, however, that when forebay fish guidance efficiency is at least 95% for salmonid smolts, the Licensee may request a change or end to this operating condition, subject to consultation with the FTC and with the approval of the appropriate Fish Agencies; (5) operating existing runners within 1% of peak efficiency based on manufacturers' curves for the existing units, provided, however, that when forebay fish guidance efficiency is at least 95% for salmonid smolts, the Licensee may request a change or end to this operating condition, subject to consultation with the FTC and with the approval of the appropriate Fish Agencies. Consultation pursuant to items (4) and (5) of this Article will consider available information on smolts, fry, and juvenile Pacific lamprey, including necessary levels of protection, in addition to runner operation and performance information. The plan will be amended to include (1) operating the siphon bypass to provide a flow of up to 500 cfs; and (2) coordination of T.W. Sullivan Powerhouse and siphon bypass operation with operation of the controlled flow structure at the apex of the falls in accordance with the concepts described in Appendix C of the Relicensing Implementation Plan, when these facilities have been completed. The operational plan, and any amendments, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and the Commission, the Licensee shall implement the operational plan.

Article 7: Blue Heron Powerhouse Decommissioning

The Licensee shall decommission the Blue Heron Powerhouse by December 31, 2005. Within two months of the effective date of the License, the Licensee shall file with the Commission a Decommissioning Plan providing for the permanent, in-place decommissioning of the generating units in the Blue Heron Powerhouse. The Decommissioning Plan will provide for consultation under Section 106 of the National Historic Preservation Act. The Decommissioning Plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the Commission, the Licensee shall implement the Decommissioning Plan.

Article 8: Willamette Falls Dam Flashboard Removal

No later than October 1 of each year prior to the start of construction of the controlled flow structure pursuant to Article 9, the Licensee shall remove approximately 150 feet of flashboards at the apex of Willamette Falls to focus flow there and provide a better downstream passage route for fish passing over the falls.

Article 9: Willamette Falls Dam Controlled Flow Structure

(a) The Licensee shall construct and operate a controlled flow structure at the apex of Willamette Falls to pass a flow of up to 15,000 cfs. Not later than March 1, 2006, the Licensee shall file with the Commission a plan for a controlled flow structure designed to pass a flow of up to 15,000 cfs, unless final design evaluations require a modification of this flow. The design of the controlled flow structure, which shall include, but not be limited to: (1) functional design drawings; (2) an installation and implementation schedule providing for completion by October 31, 2007, shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and the Commission, the Licensee shall construct the controlled flow structure design.

(b) The Licensee shall develop and implement a multi-year study to evaluate impact of the controlled flow structure on fish passage. The study, which shall be initiated upon completion of the controlled flow structure pursuant to paragraph (a) of this Article, shall evaluate (i) mortality and injury to spring Chinook and steelhead smolts and, to the extent technically feasible, juvenile Pacific lamprey, passing through the controlled flow structure; (ii) the condition of downstream migrant steelhead kelts, adult salmonids classified as fallback, and adult Pacific lamprey at the controlled flow structure; (iii) whether the controlled flow structure is adversely affecting adult salmonid attraction to the fish ladder entrances; and (iv) the impacts on water quality from the operation of the controlled flow structure. The study plan shall provide for the filing of a final report with the Commission upon completion of at least three years of study, as well as the filing of interim reports summarizing the results of each year's study. Not less than six months prior to the scheduled completion date of the controlled flow structure, the Licensee shall file the study plan for this study with the Commission. The study plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the study plan.

(c) The Licensee shall file reports with the Commission of the results of the study, approved pursuant to paragraph (b) of this Article, on the impact of the controlled flow structure on fish passage. The Licensee shall file a final report not later than December 31, 2010, and interim reports by December 31 of each year during the conduct of the study. The reports shall be developed in consultation with the FTC pursuant to Article 1. If downstream smolt passage survival has not achieved the standard of at least 97% provided in Article 2(c), the interim report shall include plans to further improve the downstream landing area of the controlled flow structure. If the downstream fish passage survival rate has not achieved the standards specified in Article 2(c) and Table 2 of Article 2, the final report shall include plans to further improve the effectiveness of the controlled flow structure by implementing additional measures as agreed upon in consultation with the FTC pursuant to Article 1.

Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the recommendations in the report

Article 10: Willamette Falls Dam Controlled Flow Structure Operational Plan

The Licensee shall operate the controlled flow structure to focus flow not passing through the T.W. Sullivan Powerhouse consistently with Appendix 3 of the Relicensing Implementation Plan to provide safe, timely and effective downstream passage for fish passing over the falls. Within six months of completion of the controlled flow structure, the Licensee shall file with the Commission an amendment to the T.W. Sullivan Powerhouse Operational Plan. The amended operational plan shall provide for operating the controlled flow structure to focus flow that does not pass through the T.W. Sullivan Powerhouse through the controlled flow structure consistently with Appendix 3 of the Relicensing Implementation Plan to provide safe, timely and effective downstream passage for fish passing over the falls. The plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the controlled flow structure operating plan.

Article 11: Avian Predation Deterrents

The Licensee shall implement measures to reduce the potential for avian predation on downstream migrants that pass the Project over the Falls. Not later than March 1, 2006, the Licensee shall file with the Commission a plan for reducing the potential for avian predation on downstream migrants that pass the Project over the Falls. The plan shall include (1) provisions for wire or other effective avian deterrent technology at the downstream end of the horseshoe of the Falls in areas where avian predation activity has been observed, (2) functional design drawings; and (3) an installation and implementation schedule providing for completion by December 31, 2006. The plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the avian deterrent plan.

Article 12: Fish Ladder Operation and Maintenance

(a) Within six months of the effective date of the License, taking into account appropriate in-water work periods, the Licensee shall complete the following O&M backlog items on the fish ladder owned by the Oregon Department of Fish and Wildlife (ODFW) at Willamette Falls: (i) repair or replace the forebay level transducer; (ii) replace the weir support on the Obermeyer weir that has broken off; (iii) replace side seals on the Obermeyer weir and reattach restraining straps; and (iv) install a new heater on the Obermeyer weir to prevent freezing on the end plates. Within six months of completion of these items, the Licensee shall file a report with the Commission documenting such completion. The report shall be prepared after consultation with the FTC pursuant to Article 1.

(b) Within twelve months of the effective date of the License, taking into account appropriate in-water work periods, Licensee shall initiate a program to complete, within three years of the effective date of the License, diffuser grate cleaning and removal of debris from diffuser chambers in all the fish ladder legs and pool 48 of the fish ladder and repair fishway joints on all three fish ladder legs, unless ODFW has obtained outside funding for these items, in which case Licensee shall have no obligation to perform these items, but shall instead contribute $100,000 as a matching grant to conduct Pacific lamprey research in the Willamette River Basin. This amount shall be subject to escalation from the Effective date of the January 2004 Settlement Agreement as provided in Section II.B.4 of the Relicensing Implementation Plan. In the case of partial agency funding for these two items, PGE will be responsible to perform or fund the remaining tasks, and contribute $0.50 in matching funds, not to exceed $100,000, for the Pacific lamprey research for every dollar that the agencies put toward these backlog items.

(c) Within six months of the effective date of the License, the Licensee shall assume responsibility for labor and necessary repair or replacement of equipment, to perform (i) all annual O&M tasks directly associated with fish ladder operation, other than those tasks specifically identified in Appendix 2 of the Relicensing Implementation Plan as the responsibility of ODFW, (ii) debris removal at the fish ladder sluiceway adjacent to the Willamette Falls fish ladder, (iii) lubricating the gate stem for auxiliary water discharge at ladder entrance #1 and gate stems for the two exit gates on the 67-foot deck; (iv) cleaning out the level sensor stilling wells at entrances #2 and #3; (v) cleaning out debris at the auxiliary water channels at all three entrances; and (vi) exercising all equipment each month as listed on the exercise log.

(d) If feasible, the Licensee shall extend the log boom upstream of the T.W. Sullivan Powerhouse to reduce the amount of debris near the fish ladder exit. Within two months of the effective date of the License, the Licensee shall (i) determine if it is feasible to extend the log boom in the T.W. Sullivan Powerhouse pre-forebay to reduce the amount of debris that accumulates at the fish ladder sluiceway, and (ii) if such extension of the log boom is feasible, file a plan to extend the log boom with the Commission. The plan, which shall include (1) functional design drawings; and (2) an installation and implementation schedule providing for completion by December 31, 2005, shall be prepared after consultation with the FTC pursuant to Article 1.

(e) Within six months of completion of the report filed pursuant to paragraph (d) of Article 15, the Licensee shall file with the Commission a plan to modify the Willamette Falls fishway as recommended in results provided by the lamprey research expert pursuant to paragraphs (c) and (d) of Article 15. If a plan is required, it shall include (1) functional design drawings; and (2) an installation and implementation schedule and shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the fish ladder modification plan.

(f) Within six months of the effective date of the License, the Licensee shall file with the Commission a plan to modify entrance # 1 of the Willamette Falls fish ladder, based on the ability of the entrance to meet NOAA Fisheries criteria for ladder entrances, including but not limited to: (i) fishway entrance head; (ii) entrance width; (iii) installation of staff gages; (iv) use of non-corrosive, vertically-oriented flat-bar grate diffusers with maximum 1-inch clear opening; and (v) a maximum auxiliary water supply velocity less than 1 fps for vertical diffusers and 0.5 fps for horizontal diffusers. The plan shall include (1) functional design drawings; and (2) an installation and implementation schedule and shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the fishway entrance modification plan.

Article 13: Fish Ladder Operation and Maintenance Plan

Within six months of the effective date of the License, the Licensee shall file a fish ladder operating plan with the Commission. The plan (i) shall provide for the Licensee to operate the fish ladder at Willamette Falls as provided in Article 12, and (ii) shall contain appropriate tracking and reporting mechanisms to determine if specific changes are needed in the annual operating plan to ensure proper fish ladder operation. The plan shall also provide that debris removal at the sluiceway adjacent to the Willamette Falls Fish Ladder shall be consistent with an operational plan that takes into account debris loading in the river, PGE debris removal activities at T.W. Sullivan Powerhouse, and downstream migrant behavior, abundance and timing. The plan shall be developed in consultation with the FTC pursuant to Article 1. Upon approval by the appropriate Fish Agencies and filing with the Commission, the Licensee shall implement the plan.

Article 14: Stranding Management Plan

The Licensee shall implement the Stranding Management Plan contained in the Relicensing Implementation Plan. If changes in the Stranding Management Plan are necessary, they shall be developed after consultation with the FTC and with the approval of the appropriate Fish Agencies pursuant to Article 1. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the amended plan. Upon Commission approval, the amended plan shall become a requirement of the License.

Article 15: Adult Pacific Lamprey Program

(a) When flashboards are installed at the Falls, the Licensee shall initially install a minimum of two lamprey passage ramps, and notch the flashboards, to provide flows for upstream lamprey passage in those areas where lamprey are known to congregate. The Licensee shall assess the effectiveness of the lamprey ramps during the Pacific lamprey research project conducted pursuant to paragraph (c) of this Article, and shall, in consultation with the FTC and with the approval of the appropriate Fish Agencies pursuant to Article 1, modify the number, placement and design of the lamprey ramps, if the results of the research project indicate that such actions are appropriate.

(b) The Licensee shall salvage stranded Pacific lamprey in accordance with the Standing Management Plan, and shall release salvaged adult Pacific lamprey above or below the Falls as directed by ODFW and FWS, after consultation with the FTC pursuant to Article 1.

(c) Within six months of the effective date of the License, the Licensee shall fund a research study of at least two years duration on Pacific lamprey passage and behavior consistent with the scope and objectives identified in Appendix 4 to the Relicensing Implementation Plan. General research objectives and approaches will be developed in consultation with the FTC, and the research program will be conducted by a lamprey expert mutually acceptable to the Licensee and the FTC. The specific scope of work for the lamprey research study will be developed by the Licensee and lamprey expert, in consultation with the FTC pursuant to Article 1, and shall be filed with the Commission before the research study is initiated. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the study plan. Upon Commission approval, the plan shall become a requirement of the License.

(d) Within six months of completion of the lamprey research study conducted pursuant to paragraph (c) of this Article, the Licensee shall file with the Commission a report which discusses whether there is a need for modifications to the dam, flashboards, siphon bypass, fish ladder, and controlled flow structure. The report, which shall include (1) functional design drawings; and (2) an installation and implementation schedule, if there is a need for such modifications, shall be prepared in consultation with the FTC pursuant to Article 1. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the report. Upon Commission approval, the report shall become a requirement of the License.

Article 16: Juvenile Pacific Lamprey Program

(a) If the necessary field research technology becomes available and is applicable to conditions existing at the Project, the Licensee shall develop and implement a juvenile Pacific lamprey study program (i) to estimate Pacific lamprey guidance efficiency through the T.W. Sullivan Powerhouse after implementation of the Tier 2 siphon bypass measure; (ii) to estimate the potential impact of the T.W. Sullivan Powerhouse to juvenile Pacific lamprey based on guidance efficiency and turbine mortality estimates after implementation of Tier 2 measures; and (iii) to determine additional improvements to passage conditions using the information gained through the above estimates and other relevant information. The study plan, which may be part of the study of fish guidance efficiency, mortality and injury conducted pursuant to paragraph (b) of Article 4, shall be developed in consultation with the FTC and with the approval of the appropriate Fish Agencies. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the plan. Upon Commission approval, the plan shall become a requirement of the License.

(b) Within six months of the completion of the study conducted pursuant to paragraph (a) of this Article, the Licensee shall file with the Commission a report of the study results. If the study indicates that modifications to the Project are required to achieve safe passage of juvenile Pacific lamprey through the Project, the report shall include plans to modify the Project accordingly. The report shall be developed in consultation with the FTC pursuant to Article 1. Upon approvals by the appropriate Fish Agencies, the Licensee shall implement the plan. Upon Commission approval, the plan shall become a requirement of the License.

Article 17: 2004 Assessment Program

Within six months of the effective date of the License, the Licensee shall file with the Commission a report of assessments conducted during 2004 in order to (i) determine the presence and condition of salmonid fry and juvenile Pacific lamprey in the T.W. Sullivan bypass; (ii) determine juvenile Pacific lamprey impingement on the Unit 13 Eicher screen; (iii) evaluate the impact of existing improvements to the T.W. Sullivan bypass evaluator system on smolt injury, mortality and passage time; and (iv) to conduct a preliminary assessment of use of lamprey ramps at the Falls. The report shall be developed in consultation with the FTC pursuant to Article 1.

Article 18: Annual Report

The Licensee shall file with the Commission a detailed annual report on the activities of the Fish Technical Committee and on the implementation of the New License and the Relicensing Implementation Plan during the previous year. The Licensee shall prepare the report in consultation with the FTC pursuant to Article 1. The Licensee shall file the annual report by March 31 of the year following the calendar year which is the subject of the report. The initial report shall be filed by March 31, 2006.

Article 19: Escalation

(a) The Licensee shall escalate the sums identified in this Article as of January 1 of each year after the date of the January 2004 Settlement Agreement according to the following formula:

$$AD = D \times \frac{(NGDP)}{IGDP}$$

WHERE:

AD	=	Adjusted dollar amount as of January 1 of the year in which the adjustment is made.
D	=	Dollar amount prior to adjustment.
IGDP	=	GDP-IPD for the third quarter of the year before the previous adjustment date (or, in the case of the first adjustment, the third quarter of the year before the Effective Date).
NGDP	=	GDP-IPD for the third quarter of the year before the adjustment date.

"GDP-IPD" is the value published for the Gross Domestic Product Implicit Price Deflator by the U.S. Department of Commerce, Bureau of Economic Analysis in the publication Survey of Current Business, Table 7.1 (being on the basis of 1987 = 100), in the third month following the end of the applicable quarter. If that index ceases to be published, any reasonably equivalent index published by the Bureau of Economic Analysis may be substituted by the agreement of the Parties and the Licensee. If the base year for GDP-IPD is changed or if publication of the index is discontinued, the Licensees shall promptly make adjustments or, if necessary, select an appropriate alternative index acceptable to the Parties to achieve the same economic effect.

(b) Specific costs and payments subject to escalation as provided in this Article are:

1. The $5,000 per year accrued for egress channel physical modifications at Willamette Falls, pursuant to the Stranding Management Plan;

2. The $80,000 for the correction of the Wet Hole stranding/egress problem at Willamette Falls, pursuant to the Stranding Management Plan.

3. The $100,000 in matching funds to conduct lamprey research pursuant to paragraph (b) Article 12.

EXHIBIT B

RELICENSING IMPLEMENTATION PLAN

EXHIBIT B

Relicensing Implementation Plan

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Appendices:

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2. O&M Task List at Willamette Falls Fish Ladder
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4. Adult Pacific Lamprey Passage Plan
5. Comprehensive List of Fishery Resource Measures by Structure
6. Implementation Timeline

I. Introduction and Purpose

Portland General Electric Company ("PGE" or "Licensee"), the licensee for the Willamette Falls Hydroelectric Project, FERC Project No. 2233 (the "Project"), is applying to the Federal Energy Regulatory Commission ("FERC") for a new license for the Project. The current license for the Project will expire on December 31, 2004.

PGE and licensing participants have been engaged in settlement discussions related to the package of measures to be implemented at PGE's Willamette Falls Hydroelectric Project (FERC No. 2233) for fishery resources. PGE made a supplemental filing to FERC on August 28, 2003, submitting a description of the preferred alternative resulting from the settlement discussions. In that filing, PGE noted that the development of an implementation plan was an important next step to complete, and that the implementation plan would be part of the eventual offer of settlement to be submitted to FERC by the end of 2003.

These efforts were successful, and this Relicensing Implementation Plan (Implementation Plan) has been developed pursuant to the accompanying Settlement Agreement and attachments, which has been signed by 13 parties ("Parties"). The Settlement Agreement describes the legal context and regulatory authorities and related obligations of each of the Parties. The Settlement Agreement establishes PGE's obligation to file the Settlement Agreement and other associated documents with FERC, and requires that PGE shall implement the Settlement Agreement according to the specific methodology contained in this Implementation Plan and New License. This Exhibit is the implementation plan for the Settlement Agreement regarding relicensing of the Willamette Falls Hydroelectric Project.

This Implementation Plan has been approved by each of the parties to the Settlement Agreement. Unless otherwise noted herein, all of the actions identified in this Implementation Plan will be undertaken by PGE at its sole expense and responsibility. Unless otherwise noted, PGE shall fund and implement all aspects of Project operation and implementation, including but not limited to, all engineering, environmental assessment, permitting, construction, and mitigation activities in accordance with this Implementation Plan, the Settlement Agreement, and the New License.

The implementation sheets for each of the fishery measures provide specific implementation information associated with each measure, including a brief purpose and summary discussion, a schedule for implementation, associated study plan outlines, and specific requirements related to additional interaction with the Parties

Implementation sheets are grouped by project structure (T.W. Sullivan Powerhouse, BHPC Powerhouse, and Dam at Willamette Falls). The implementation sheets describe how each measure will be implemented. Implementation sheets are provided for measures involving a specific, one time action (i.e., installation of a new structure) as well as for measures involving an ongoing or multi-year program (i.e., an evaluation/research effort, operating plans, etc).]

II. Definitions and General Provisions

A. Definitions

Throughout this Exhibit, the following terms and their meaning apply:

TERM	MEANING
Licensee or PGE	Portland General Electric Company (PGE)
Parties	Signatories to the Settlement Agreement
Fish Agencies	ODFW, NOAA Fisheries (NMFS), and USFWS
FTC	Fish Technical Committee

B. General Provisions

The following provisions apply to all aspects of the Implementation Plan.

1. <u>Consultation</u>

The Settlement Agreement and the New License will be implemented on an ongoing basis in consultation with the Fish Technical Committee. Through this consultation, PGE and the FTC will make a good faith effort to reach consensus on decisions that need to be made associated with the measures contained in this Implementation Plan. Some decisions may require more formal approval by specific members of the committee (e.g., review and approval of facility design drawings by the USFWS and NOAA Fisheries). Specific notice, reporting, consultation, and approval requirements are identified throughout this Implementation Plan. As described in more detail below, this Implementation Plan incorporates four types of consultation: reporting, consultation with the FTC, consultation with the FTC and approval by the Fish Agencies, and Time-Critical Consultation. Approval by the Fish Agencies may include all or some of the Fish Agencies listed above depending upon state and federal laws and regulations. Additionally, nothing in this Implementation Plan is intended or shall be construed to (i) affect or limit any agency or tribe from complying with its obligations under applicable laws and regulations or from considering comments received in any environmental review or regulatory process related to the process; or (ii) expand the authority of any agency or tribe to confer any authority or jurisdiction where such authority or jurisdiction does not already exist under applicable law and regulations.

Report to FTC. Where "Report to FTC" is specified, PGE shall describe its agreed-upon implementation of the requirements of the new license or the Implementation Plan. In most cases, this will involve reports of construction progress or interim reports on study progress. PGE shall prepare a quarterly report to be provided to the FTC 30 days in advance of its next regularly scheduled quarterly meeting. The FTC will review the report and discuss it at that quarterly meeting. If a FTC member believes that the report indicates that PGE is not complying with the requirements of the new license or Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement.

Consultation with the FTC. Where "Consultation with the FTC" is specified, PGE shall prepare written draft materials for formal review and comment by the FTC. FTC members will have at least 30 days to provide written comments, and PGE shall incorporate those comments into the written materials, modifying them to respond to the comments, or indicating why the comments were not accepted. A final version of the materials will be provided to the FTC and, where required by the terms of the new license, to FERC for its approval. If a FTC member believes that the report, as filed, does not satisfy the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement.

Consultation with the FTC and Approval by the Fish Agencies. Where "Consultation with the FTC and Approval by the Fish Agencies" is specified, PGE shall prepare written draft materials for formal review and comment by the FTC. FTC members – other than the Fish Agencies – will have at least 30 days to provide written comments, and PGE shall incorporate those comments into the written materials, modifying them to respond to the comments, or indicating why the comments were not accepted. In addition, the Fish Agencies will have an opportunity to provide a formal approval (or disapproval) of the materials submitted. A final version of the materials will be provided to the FTC and, where required by the terms of the new license, to FERC for its approval. If PGE, or another FTC member, believes that an agency approval or lack thereof, is inconsistent with the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement.

Time-Critical Consultation. Where "Time-Critical Consultation" is specified, PGE shall provide email, or phone, notice to the FTC that a particular matter requires an immediate decision by the Fish Agencies. The notice will indicate when and where the consultation will take place and the nature of the approval PGE shall seek from the Fish Agencies. PGE shall implement the action approved by the Fish Agencies. In the event that no Fish Agency is able to participate in the consultation, PGE shall take such action, as it deems appropriate. Due to the time-critical nature of the action being implemented, there will be no opportunity to seek dispute resolution prior to implementation of the specific action that is the subject of the time-critical consultation. However, if an FTC member believes that the action being implemented does not satisfy the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement, the result of which may be applied if another time-critical consultation on this matter is required.

2. <u>FERC Reporting Requirements</u>

FERC Part 12 safety regulations impose reporting and approval requirements on licensees undertaking construction projects at licensed projects. These would be in addition to the consultation required pursuant to the new license and Implementation Plan.

3. <u>Study Plans</u>

The Evaluation summaries contained in Appendix 1 of this exhibit, and referenced in the individual implementation sheets, are intended to provide guidance to PGE and the FTC in the development of study plans. Study outlines and plans will include reporting requirements, consistent with section B.4. below, unless FTC consultation determines otherwise.

- PGE shall issue a study plan outline to the FTC no later than 180 days prior to the scheduled start of the study. The FTC will have 45 days to provide comments on the outline.

- PGE shall issue a draft study plan to the FTC for review within 30 days of the close of comments on the study plan outline.

- The FTC will have 45 days to provide comments on the draft study plan.

- PGE shall issue a final study plan not less than 30 days before the expected start of the study.

- Any FTC member that believes a final study plan is inconsistent with the new license or the Implementation Plan may initiate dispute resolution in accordance with the Settlement Agreement within 30 days of receipt of the final study plan.

4. <u>Reports</u>

- PGE shall distribute draft reports to the FTC for review and comment within 90 days of data collection completion. For studies involving multiple years of data collection, an interim report will be issued within 90 days of completion of data collection each year. Upon conclusion of the final year of data collection, a draft report will be prepared synthesizing the interim reports and any final data collection.

- The FTC will have 45 days to provide comments on the draft report.

- PGE shall issue a final report within 30 days after the comment period. If further discussion or field activity is necessary based upon the comments, the FTC may extend this 30 day period. The final report will respond to any comments provided by the FTC.

5. <u>Meetings and Notices</u>

- The FTC will meet at least every quarter, with monthly meetings being appropriate during early stages of the implementation plan (i.e., through completion of Tier 2 measures).

- Meetings will be scheduled at least 30-days in advance with notice and an agenda provided to FTC members by PGE, provided however, that monthly meetings may be scheduled with at least 2 weeks notice.

- A meeting of the FTC can be scheduled with less than 30-days notice if necessary to deal with an emergency or a rapidly developing situation that requires more immediate discussion.

6. Cost Adjustments

The costs or payment amounts specified in dollars, listed below, shall be deemed to be stated as of the Effective Date of the Settlement Agreement, and the Licensee shall escalate such sums as of January 1 of each year following the Effective Date of the Settlement Agreement according to the following formula:

$$AD = D \times \left(\frac{NGDP}{IGDP}\right)$$

WHERE:

AD	=	Adjusted dollar amount as of January 1 of the year in which the adjustment is made.
D	=	Dollar amount prior to adjustment.
IGDP	=	GDP-IPD for the third quarter of the year before the previous adjustment date (or, in the case of the first adjustment, the third quarter of the year before the Effective Date).
NGDP	=	GDP-IPD for the third quarter of the year before the adjustment date.

"GDP-IPD" is the value published for the Gross Domestic Product Implicit Price Deflator by the U.S. Department of Commerce, Bureau of Economic Analysis in the publication Survey of Current Business, Table 7.1 (being on the basis of 1987 = 100), in the third month following the end of the applicable quarter. If that index ceases to be published, any reasonably equivalent index published by the Bureau of Economic Analysis may be substituted by the agreement of the Parties and the Licensee. If the base year for GDP-IPD is changed or if publication of the index is discontinued, the Licensees shall promptly make adjustments or, if necessary, select an appropriate alternative index acceptable to the Parties to achieve the same economic effect.

Specific costs and payments subject to the above are:

1. The "$5,000 per year" accrued for egress channel physical modifications at Willamette Falls, per section V.B. Action 2.1 below;

2. The "up to $80,000" for the correction of the Wet Hole stranding/egress problem at Willamette Falls, per section IV.C.4 below; and

3. The $100,000 in matching funds to conduct lamprey research per section V.A.1.(3) below.

III. Performance Standards and Goals

A. Performance Standards

1. Downstream Passage of Salmonids

a. Juvenile Salmonid Passage through the T.W. Sullivan Powerhouse

Table 1 sets out the performance standard levels for downstream passage of juvenile salmonids at the T.W. Sullivan powerhouse within the Willamette Falls Project. Also listed in Table 1 is the corresponding tier of management actions to be taken as determined by the level of performance standard achieved. A comprehensive list of measures referred to in Table 1 is provided in Appendix 5 of this Exhibit.

Table 1. Performance standards for juvenile salmonid downstream passage at the T.W. Sullivan powerhouse.[1]

Smolts > 60 mm in Length		**Fry < 60 mm in Length**		**Actions, to include both PM&E Measures and Monitoring and Evaluation listed in Section IV.**
Mortality	**Injury**	**Mortality**	**Injury**	
Design performance objective ≤ 0.5 % mortality	Design performance objective ≤ 2 % injury	Design performance objective ≤ 2 % mortality	Design performance objective ≤ 4 % injury	Objective met. No further measures required
Actual mortality > 0.5 % but ≤ 2 % would require additional work to lessen mortality	Actual injury > 2 % but ≤ 4 % would require additional work to lessen injuries	Actual mortality > 2 % but ≤ 4 % would require additional work to lessen mortality	Actual injury > 4 % but ≤ 6 % would require additional work to lessen injuries	• Tier 1 and Tier 2 actions implemented per schedule.
Actual mortality > 2 % would require major operational or structural changes	Actual injury > 4 % would require major operational or structural changes	Actual mortality > 4 % would require major operational or structural changes	Actual injury > 6 % would require major operational or structural changes	• Tier 3 actions implemented as needed and meaningful to improve performance. • Tier 4 actions implemented if performance after Tier 3 items is not satisfactory.

The measures listed in Appendix 5 are categorized into four tiers according to planned timing of implementation and which level of performance standard is being addressed. Tier 1 measures are to be completed prior to new license issuance. No performance testing is planned after Tier 1 measures.

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[1] The top row of Table 1 provides downstream passage performance standards that, if met, mean that no further measures are required by the licensee. The second row provides mortality/injury ranges that mean additional work provided in tier 2 is needed to reduce injury/mortality. The third row provides mortality/injury ranges that, if exceeded, mean actions listed in Tiers 3 and 4 are needed, as appropriate.

Tier 2 measures are to be completed after new license issuance. At the T.W. Sullivan powerhouse, measurement of downstream passage performance for evaluation using the standards listed in Table 1 will be initiated after installation of the bypass siphon, the earliest Tier 2 measure (see Appendix 5). Remaining Tier 2 items will be implemented with associated performance measurement according to the timeline in Appendix 6. If measured performance meets the second level of performance standards specified in Table 1 after Tier 2 items are implemented, no Tier 3 measures are required. Additional minor improvements, designed to achieve further measurable mortality reduction, will still be pursued while the second level of performance standards continues to be met.

If measured performance does not meet the second level of performance standards specified in the Table 1 after Tier 2 measures performance testing is completed (no later than 2009 unless agreed to by the FTC), Tier 3 measures will be initiated with appropriate and agreed-to performance testing. Performance of Tier 2 measures will guide the Tier 3 implementation (for example, if no fish are passing Unit 12 after Tier 2 measures, installing an Eicher screen in Unit 12 would not improve downstream survival).

If measured performance still does not meet the second-level performance standards specified in Table 1 after Tier 3 implementation, Tier 4 would be initiated (no later than 2015 unless agreed to by the FTC) depending on measures identified and implemented under Tier 3.

b. Juvenile Salmonid Smolt Passage through the Controlled Flow Structure

PGE shall design and operate the controlled flow structure to achieve at least a 97% survival standard for juvenile salmonid smolts passing the Project via the controlled flow structure. This standard is based on results of juvenile fish survival studies conducted at spillways at mainstem Columbia River dams.

2. Downstream Passage Standards for Juvenile Pacific Lamprey

If a technology-based standard for Pacific lamprey survival and injury avoidance is developed and regionally adopted by the U.S. Fish and Wildlife Service (USFWS) during the term of the new license, PGE shall adopt the standard at the T.W. Sullivan powerhouse and consult with the FTC regarding measures, subject to Fish Agency approval, needed to comply with the standard. When adopted, this standard will supercede the goal set forth in Table 2.

B. Performance Goals

Table 2 sets out the performance goals for upstream and downstream passage of Pacific lamprey and adult salmonid migrants at the Willamette Falls Project.

Table 2. Performance Goals for the passage of Pacific lamprey and adult salmonids at the Willamette Falls Project.

Fish species/lifestage	Type of passage	Performance Goal
Juvenile lamprey	Downstream through the powerhouses	"safe, timely, and effective" qualitative goal without serious injury or mortality
Juvenile lamprey	Downstream over the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality: Assumed adequate when the standard for juvenile salmonid smolts is met at the spillway (≥97% survival), until appropriate technology is developed to assess juvenile lamprey survival over the controlled flow structure.
Adult lamprey	Upstream through the Project area	"safe, timely, and effective" qualitative goal without serious injury or mortality Goal to be further developed through PGE funded study described in Section V.C and Appendix 4
Adult lamprey	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality
Adult salmonids	Upstream through the Project area	"safe, timely, and effective" qualitative goal without serious injury or mortality
Steelhead kelts (i.e., post-spawning adults) and fallback (adult salmonids)	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality

IV. Implementation Sheets

The following measures, in addition to those described in Sections V. and VI., are Tier 1 and Tier 2 measures directly associated with section III. Performance Standards and Goals. Measurement of performance after these measures are implemented will inform the FTC concerning Tier 3 implementation.

A. TW Sullivan Powerhouse

1. Forebay rack and guidewall hydraulic modifications

Purpose:
Forebay hydraulics will be improved to increase guidance of salmonid smolts, fry and juvenile lamprey to the Unit 13 bypass system, and siphon bypass (when installed)

Summary of Measure:
PGE shall make necessary modifications to Unit 1, 2, 3 forebay trashracks and forebay guidewall, as identified through physical forebay modeling already completed, to improve forebay hydraulic characteristics

PGE shall modify racks and the guidewall in the T.W. Sullivan forebay in accordance with physical forebay modeling done by ENSR in 2002 and 2003. Modifications involve eliminating areas of swirl or velocity changes along the forebay through physical rack changes, additions, and guidewall relocation and extension.

Consultation:
Design: Consultation with FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2003	12/31	-Finalize ENSR physical forebay modeling report.
	12/31	-Preliminary designs
	12/31	-Initiate necessary permitting
2004	6/1	-Design, fabrication and permitting completed.
	6/1-12/31	-Construction (In-water work completed by 10/31)
2005	7/1	-File with FERC report of accomplishment/drawings

Post construction study:
None specific to these modifications (Study will be done after siphon bypass installation that will include testing of multiple T.W. Sullivan measures)

2. T.W. Sullivan Siphon Bypass

Purpose:
An additional bypass route will be provided for fish entering the T.W. Sullivan forebay. The siphon bypass will work in conjunction with previous forebay modifications to improve forebay hydraulics and guidance of salmonid smolts, fry and juvenile lamprey, as well as adult salmonids (kelts and fallback) and adult lamprey, away from T.W. Sullivan's turbines. Discharge of the siphon bypass in the tailrace will also eliminate potential aquatic predator habitat along the north tailrace shoreline

Summary of Measure:
PGE shall install and operate an additional downstream migrant bypass route through the siphon spillway, located adjacent to Unit 13, to pass a designed flow of 500 cfs directly from the forebay to the tailrace during powerhouse operation. Actual capacity will be determined through physical modeling in 2004 and associated hydraulic analysis.

Consultation:
Modeling: Consultation with the FTC.
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.
Operational Plan (see item 10.f.)

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004	-Small scale model	
	-Preliminary design	
	-Initiate necessary permitting	
2005	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-6/1	-Fabrication and permitting completed
	6/1-12/31	-Construction- (In water work completed by 10/31.)

Post-construction study:
See evaluation summary:

1- Downstream Passage Effectiveness of Salmonid Smolts through T.W. Sullivan
2- Downstream Passage Effectiveness of Fry ($\leq$60 mm) through T.W. Sullivan
3- Downstream Passage Effectiveness of Juvenile Pacific lamprey through T.W. Sullivan
4- Downstream Passage Effectiveness for Outmigrant Kelts and Fallback Salmon, Steelhead, and Adult Pacific Lamprey through T.W. Sullivan

3. PIT Tag Interrogator System

Purpose:
Newer technology, and higher flow volume PIT tag interrogator systems on both the Unit 13 bypass outfall chute and the siphon bypass will improve the ability to monitor bypass system performance and outmigration fish passage.

Summary of Measure:
PGE shall install new PIT tag interrogator systems at the Unit 13 bypass and siphon bypass to ensure fish passage efficiency can be effectively measured and to guide decisions consistent with the tiered management approach.

For the Unit 13 bypass system, PGE shall add a large area/flow volume PIT tag interrogator to the bypass flow outfall chute. This detection system will be in addition to the PIT detector system currently installed in the bypass system evaluation flow route, allowing detection of PIT-tagged fish in either bypass system mode.

For the siphon bypass, PGE shall install a large area/flow volume PIT tag interrogator (or equivalent technology) in the siphon bypass flow route to allow detection of PIT-tagged fish passing the project via this route.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

Unit 13 Bypass system:

2004	-Preliminary design	
2005	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-6/1	-Fabrication and permitting completed
	6/1-12/31	-Construction/Installation

NOTE: Installation in 2005 based upon a design and technology that will not conflict with the Unit 13 Bypass Outfall Modification (see Implementation Sheet IV.A.7), otherwise it will be installed with the Unit 13 Bypass Outfall Modification in 2006.

Siphon bypass:

2005 -Install with siphon bypass installation if technologically feasible, otherwise when technology allows (need to consult with FTC). (Implementation Sheet IV.A.2).

Post-construction study:
No specific study. Functional and acceptance testing.

4. Forebay Trash Rack Cleaning System

Purpose:
Routinely removing river debris from trashracks within the T.W. Sullivan forebay will help maintain good hydraulic conditions conducive to guidance of fish to the Unit 13 and siphon bypass systems, and reduce potential for adverse effects (i.e. mortality and injury) due to dirty/clogged racks.

Summary of Measure:
PGE shall install and operate a forebay trashrack cleaning system to ensure the forebay trashracks remain free of debris build-up that could adversely affect fish guidance efficiency (FGE) and downstream migrant survival.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004	-Preliminary design	
2005	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-6/1	-Fabrication completed
	6/1-12/31	-Construction

Post-construction study:

None. Performance will be measured in conjunction with post siphon bypass evaluation (Implementation Sheet IV.A.2.)

5. Unit 12 and 13 Discharge Flow Hydraulics

Purpose:
To reduce or eliminate potential predator aquatic habitats located in the T.W. Sullivan tailrace between the discharges of Units 12 and 13.

Summary of Measure:
PGE shall modify Unit 12 and 13 discharges to eliminate potential aquatic predator habitat.

PGE shall construct a physical structure between the Unit 12 and 13 discharges, which eliminates this area of slack water. The structure's shape will be such that discharge flow for each unit will join together, and with the overall tailrace flow, to avoid, or minimize, eddies that are favorable aquatic predator habitat.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2005	-Preliminary design	
2006	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-7/1	-Fabrication and permitting completed
	7/1-10/31	-Construction (in water work period)

Post-construction study:
See evaluation summary:
5- Aquatic Predation Potential in the T.W. Sullivan Tailrace

6. Tailrace and forebay avian predation deterrents

Purpose:
To reduce potential for avian predation of downstream migrants passing through the T.W. Sullivan powerhouse forebay and tailrace.

Summary of Measure:
PGE shall upgrade avian predation deterrents in the powerhouse tailrace and install avian predation deterrents in the forebay.

PGE shall add avian wire (or equivalent deterrent system) towards the downstream end of the forebay where downstream migrants are concentrated. PGE shall increase avian wire in the tailrace to expand the area of avian deterrence.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2006	-Preliminary design and permitting need assessment	
2007	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-6/1	-Fabrication and permitting completed
	6/1-12/31	-Construction

Post-construction study:
See evaluation summary:

11. Avian Predation Potential Immediately Downstream of the T.W. Sullivan Plant and Willamette Falls

7. Unit 13 Bypass Outfall Modification

Purpose:
The impact velocity of the T.W. Sullivan Unit 13 bypass system outfall flow will be reduced to within NOAA Fisheries standards to reduce the potential for bypassed fish injury, stress, and/or increased susceptibility to predation.

Summary of Measure:
PGE shall modify Unit 13 bypass outfall to meet National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) hydraulic impact velocity criteria.

PGE shall modify the existing outfall chute to slow the water velocity (i.e., use of corrugated materials) and discharge it closer to the tailrace water surface (i.e., lengthen chute or adjust with tailrace elevation).

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2005	-Preliminary design and permitting	
2006	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-7/1	-Fabrication and permitting completed
	7/1-10/31	-Construction

Post-construction study:
See evaluation summary:

7. Downstream Migrant Survival and Injury at the Unit 13 Bypass Outfall

8. Runner Replacements

Purpose:
As part of PGE's maintenance program, older turbine runners will be replaced with new runners. The new runners will be designed to reduce gaps and improve hydraulic efficiency. Operation of the new runners will be governed by an operational plan (see Implementation Sheet A.10).

Summary of Measure:
PGE shall replace runners in Units 1–7 and 10–12 at a rate of two per year beginning in 2004 unless otherwise agreed to through consultation with the FTC. PGE shall index/efficiency test replaced runners. Mortality testing, within 1 year of replacement and prior to additional unit replacements, will be conducted for any runner of a significantly different design than that installed in Unit 8.

Consultation:
Modified runner replacement schedule: Consultation with the FTC and approval by the Fish Agencies.
Runner replacement progress: Report to FTC.
Mortality testing requirement and methods: Consultation with the FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004 -First year of replacements
2005 -Index/efficiency test, and mortality test if necessary, within 1 year and prior to subsequent replacements. (NOTE: See Implementation Sheet A.10 for operational requirements).

Post-construction study:
See evaluation summary:
6- Downstream Migrant Survival through the T.W. Sullivan Turbines

9. Outer headgate selected bar removal for adults

Purpose:
Adult fish accumulate immediately above the main intake (head racks) for the plant near the west (West Linn) end. Installing a passage slot at this location will provide a clear route for adult fish to pass downstream through the racks into the plant forebay and out through the fish bypass.

Summary of Measure:
PGE shall remove several outer headgate trashrack vertical bars on the west end, providing a wider opening for adult salmonids, to facilitate downstream passage of adult salmonids that are observed in this area. The opening is proposed to be 18 inches wide and 8 feet deep as opposed to the current 6-inch openings on the rack. PGE shall coordinate removal with construction of the new trashrack cleaning system to ensure any increased debris entering forebay can be removed from the forebay trashrack system.

Consultation:
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004 -Bar removal done in conjunction with the forebay rack and guidewall modifications (see Implementation Sheet IV.A.1.)

2005 7/1 -File with FERC report of accomplishment

Post-construction study:
See evaluation summary:

4- Downstream Passage Effectiveness for Outmigrant Kelts and Fallback Salmon, Steelhead, and Adult Pacific Lamprey through T.W. Sullivan

10. T.W. Sullivan Operational Measures

Purpose:
Operate the T.W. Sullivan powerhouse, to include the Unit 13 and siphon bypass systems, in a manner that allows efficient and effective generation of electricity while minimizing impact to fish resources as a result of off-normal operating situations.

Summary of Measure:

a. Selected Unit shutdown (w/ validation after forebay modifications)

When selected unit shutdowns are necessary, PGE shall first shut down units that have the least negative effect on forebay hydraulics, as determined through physical forebay modeling. FGE testing, performed after siphon bypass installation (see Implementation Sheet IV.A. 2), will include testing to confirm, or modify, the selected unit(s) shutdown order, taking into account the runner replacement schedule in determining the long-term shutdown order.

Consultation: see Implementation Sheet IV.A.2.

b. Unit 13 maintenance shutdowns

PGE shall limit maintenance shutdown of Unit 13, which provides downstream migrant bypass capability, to no longer than 2 weeks during the period July 1 to July 31. Powerhouse operation during a maximum 2-week Unit 13 shutdown during this period will not require fish agency permission. Continued powerhouse operation during Unit 13 shutdowns longer than 2 weeks during this period, or Unit 13 shutdowns outside of this period, will require fish agency permission

Consultation: Time-critical consultation. Affirmative Fish Agency approval required to operate outside of allowed conditions.

c. Unit #1 ladder entrance 1 AWS operations

PGE shall continue to coordinate scheduled outages of Unit 1 with ODFW, and will shut down all T.W. Sullivan turbine units should Unit 1 be inoperable for more than 24 hours during upstream anadromous migration until operation of Unit 1 can be restored. Continued powerhouse operation during Unit 1 shutdowns longer than 24 hours during upstream anadromous migration will require Fish Agency permission. PGE may choose at a future date to develop a new auxiliary water supply system for fish ladder entrance #1 in lieu of this shutdown requirement.

Consultation: Time-critical consultation. Affirmative Fish Agency approval required to operate outside of allowed conditions.
New AWS system design: Consultation with the FTC and approval by the Fish Agencies.

d. Replaced Turbine runner operation within 1% of peak efficiency

PGE shall operate replaced runners in accordance with an operational plan developed by PGE in consultation with the FTC, within 1% of peak efficiency, as determined by index/efficiency testing, for the existing hydraulic conditions. When forebay FGE is at least 95% for salmonid smolts, PGE may request a change or end to this operating condition, subject to consultation with the FTC and approval by the Fish Agencies. Such consultation will consider available information on smolts, fry and juvenile lamprey, including necessary levels of protection, in addition to runner operation and performance information.

Consultation: Operational plan: Consultation with the FTC and approval by the Fish Agencies

e. Existing Turbine runner operation within 1% peak efficiency

PGE shall operate existing turbine runners, in accordance with an operational plan developed by PGE in consultation with the FTC, within 1% of peak efficiency based on manufacturers' curves for the existing hydraulic conditions. When forebay FGE is at least 95% for salmonid smolts, PGE may request a change or end to this operating condition, subject to consultation with the FTC and approval by the Fish Agencies. Such consultation will consider available information on smolts, fry and juvenile lamprey, including necessary levels of protection, in addition to runner operation and performance information.

Consultation: Operational plan: Consultation with the FTC and approval by the Fish Agencies

f. Powerhouse operation (including Unit 13 and Siphon bypass systems) in conjunction with Controlled Flow Structure at Falls apex.

PGE shall develop an operational plan for the T.W. Sullivan powerhouse, to include the Unit 13 and siphon bypass systems, operation that is coordinated with the controlled flow structure at the Falls Apex, and specific operational measures to support the stranding management plan (see Implementation Sheet V.B.). Intent is to identify how best to operate the powerhouse and the controlled flow structure to ensure intended protection of downstream migrants over the Falls is provided by the structure and that powerhouse operation is not adversely affected (i.e., river flow is not diverted over the Falls in lieu of entering the T.W. Sullivan forebay, or river elevation is maintained too low to support full powerhouse operation.

Consultation: Operational plan: Consultation with the FTC and approval by the Fish Agencies

<u>**Schedule**</u>:
PGE shall undertake such actions in accordance with the following schedule:

2004 -Begin consultation with FTC to develop Operational Plan for the above items:
-Initiate selected unit shutdowns based on 2002/3 ENSR physical modeling

2005	3/30	-Complete Operational Plan development
	3/30	File Operational Plan with FERC
	6/30	Implement Operational Plan
	10/31-12/31	-Begin consultation with FTC to incorporate Siphon Bypass into Operational Plan
2006	1/1-6/30	-Complete consultation and update Operational Plan
	6/30	-File updated Operational Plan with FERC
	10/31-12/31	-Begin consultation with FTC to incorporate Controlled Flow Structure into Operational Plan
2007	1/1-6/30	-Complete consultation and update Operational Plan
	6/30	-File updated Operational Plan with FERC

Post-construction study:
No specific evaluation required. Operational plan will include any needed assessments as part of facility operation.

B. Blue Heron Paper Company Powerhouse

1. Shutdown and In-Place Decommissioning of BHPC Powerhouse

Purpose:
Eliminate the impact of BHPC's operation on Willamette River fish resources

Summary of Measure:
In 2003, PGE shut down the Blue Heron Power Company (BHPC) units. After consultation with the Parties, PGE shall develop a plan by December 31, 2004, for the permanent, in-place decommissioning of the units. The Plan will provide for appropriate consultation under Section 106 of the National Historic Preservation Act. PGE shall apply to FERC for approval of the decommissioning plan. Upon approval, PGE shall implement the decommissioning plan.

Consultation:
Decommission plan: Consultation with the FTC, subject to approval by FERC and other permitting agencies, as applicable.
Decommissioning activities: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2003	- Shutdown BHPC powerhouse - FERC application for BHPC powerhouse ownership transfer	
2004	-Consult with FTC and develop in-place decommissioning plan	
2005	3/1	-File decommissioning plan with FERC
	6/1-12/31	-In-place decommissioning of BHPC powerhouse (in water work completed by 10/31))

Post-construction study:
None

C. Willamette Falls Dam

1. <u>150 feet of flashboard removal</u>

<u>Purpose</u>:
To improve downstream migrant passage at the Falls, 150-ft of flashboards will be removed at the apex of the Falls to focus low fall flows to an area more conducive to safe, timely, and effective downstream fish passage.

<u>Summary of Measure:</u>
PGE shall remove 150 feet of flashboards at the Falls apex no later than October 1 prior to the start of construction of the controlled flow structure (see Implementation Sheet IV.C.2.).

<u>Consultation</u>:
Flashboard removal: Report to FTC.

<u>Schedule</u>:
PGE shall undertake such actions in accordance with the following schedule:

2004 -Demonstration study needs will determine flashboard removal timing.
2005 (and beyond) -Annually remove 150-ft of flashboards at apex no later than October 1 until the Controlled Flow Structure is installed.

<u>Post- construction study:</u>
No study necessary. Report accomplishment of task.

2. Controlled Flow structure at Apex of Falls

Purpose:
A controlled flow structure (a "slot") will be constructed and operated at the apex of the Falls to focus flow, and downstream migrants, that would otherwise be distributed around the crest of the Falls, to a location more conducive to safe, timely, and effective downstream passage.

Summary of Measure:
PGE shall construct and operate a controlled flow structure at the Falls apex as described in Appendix 3. PGE shall design the controlled flow structure to pass up to 15,000cfs (NOTE: actual design capacity will be determined through design analysis and planning). It will be located at the apex of the Falls. Field testing and modeling indicates this location and concept can pass a high percentage of downstream migrants over a high range of river flows. Conceptual design indicates multiple sections of obermeyer type gates located at a natural channel at the apex of the Falls that would be operated in accordance with an overall Operational plan. Minimizing impacts to upstream adult salmonid passage, and enhancing upstream adult lamprey passage, will be included as design elements of the controlled flow structure.

Consultation:

Design of the controlled flow structure:	Consultation with the FTC and approval by the Fish Agencies.
Construction: Report to FTC.	
Downstream passage study and follow-up measures (if any):	Consultation with the FTC and approval by the Fish Agencies.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2003	-Preliminary hydraulic capacity assessment	
	-Pilot study of mark/recapture techniques in fall 2003	
2004	-CFD modeling of upstream flow field affects	
	-Small scale model planning	
2005	-Small scale modeling and preliminary design development and permitting needs.	
2006	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC (NOTE: will know if 1 or 2 construction years needed at this filing)
	3/1-6/1	-Fabrication and permitting completed
	6/1-12/31	-Construction
2007	1/1-10/31	-Complete construction as necessary.

Post-construction study:
See evaluation summary:

8. Downstream Migrant Survival through the Controlled Flow Structure
9. Effects of the Willamette Falls Controlled Flow Structure on Upstream Passage of Adult Salmonids.

3. Willamette Falls Avian Predation deterrents

Purpose:
Eliminate/reduce potential for avian predation on downstream migrants that pass the Project over the Falls. This will decrease predation potential and increase opportunity for downstream migrants to leave the horseshoe area of the Falls and enter deeper river flows.

Summary of Measure:
PGE shall install avian predation deterrent devices in the lower horseshoe area of the Falls.

PGE shall employ wire, or other effective technology, at the downstream end of the horseshoe of the Falls where avian predation activity has been observed.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2005	-Preliminary design and permitting needs	
2006	1/1-3/1	-Design completed
	3/1	-Final design filed with FERC
	3/1-6/1	-Fabrication and permitting completed
	6/1-12/31	-Construction/Installation

Post-construction study:
See evaluation summary:

11. Avian Predation Potential Immediately Downstream of the T.W. Sullivan Plant and Willamette Falls

4. Wet Hole Egress

Purpose:
Eliminate the stranding potential associated with the current "wet hole" condition.

Summary of Measure:
In 2004, subject to obtaining necessary permits and the available in-water work period, PGE shall modify the "wet hole" located at the northeastern base of the Falls to provide egress, at a cost of up to $80,000. This amount is in addition to PGE's permitting and design costs.

Consultation:
Design: Consultation with the FTC and approval by the Fish Agencies
Construction progress: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2003	-Preliminary design and permit planning	
2004	1/1-7/1	-Continue design and permitting
	7/1	-Design and permitting completed.
	7/1-10/31	-Construction (during in water work period)
2005	7/1	-File with FERC report of accomplishment

Post-construction study:
None. Location will become part of Stranding Management Plan annual egress reconnaissance.

V. Programs

A program is a measure that is performed on an ongoing basis
The following Programs are described in this section:

A. Willamette Falls Fish Ladder
B. Stranding Management Plan
C. Adult Pacific Lamprey
D. Juvenile Pacific Lamprey
E. Water Quality

A. Willamette Falls Fish Ladder

Willamette Falls Fish Ladder Responsibilities

The present fish ladder at Willamette Falls was constructed by Oregon Department of Fish and Wildlife (ODFW) between 1968 to 1971, and major renovations were made in 1996/1997. While ODFW will continue to hold ownership of the ladder and remain responsible for operation and maintenance of the fish counting station, PGE shall assume most of the fishway operations and maintenance (O&M) duties under this Implementation Plan, as well as other measures described in this section.

1. Fish Ladder Operation and Maintenance (O&M)

PGE shall complete the backlog and annual O&M tasks described below to ensure continued and proper operation of the Willamette Falls fish ladder.

a. Backlog O&M Items

PGE shall complete the following Willamette Falls fish ladder backlog O&M items:

(1) PGE shall, to the extent feasible, and if not already corrected, perform the following projects within 6 months after the new license becomes final or by July 2005, whichever occurs first, taking into account appropriate in-water work periods.
- Repair or replace the forebay level transducer.
- Replace the weir support on the Obermeyer weir that has broken off.
- Replace side seals on the Obermeyer weir and reattach restraining straps.
- Install a new heater on the Obermeyer weir to prevent freezing on the end plates.

(2) PGE shall perform the following backlog projects as part of its annual O&M commitment (in addition to the items listed under subsection b, below):
- Grease the gate stem for auxiliary water discharge at ladder entrance #1 and gate stems for the two exit gates on the 67-foot deck.
- Clean out the level sensor stilling wells at entrances #2 and #3.
- Clean out debris at the auxiliary water channels at all three entrances.
- Exercise all equipment each month as listed on the exercise log.

(3) PGE shall also be responsible to perform the following tasks; however, PGE and the Parties understand that an outside source of funding is being pursued to complete these backlog items. Should this outside funding be procured, PGE shall contribute $100,000 (Note: this amount is subject to escalation in accordance with Section II.B.4.) in matching funds to conduct Pacific lamprey research in the Willamette Basin. This amount is in addition to funding committed to elsewhere in the Settlement Agreement. In the case of partial agency funding for these two items, PGE will be responsible to perform or fund the remaining tasks, and contribute $0.50 in matching funds for the Pacific lamprey research for every dollar that the agencies put toward these backlog items, not to exceed $100,000. If outside funding is not obtained, PGE, in consultation with the FTC, will develop a plan and complete the below items within 3 years after the new license becomes final.

- diffuser grate cleaning and removal of debris from diffuser chambers (all three legs and pool 48)
- fishway joint repairs (all three legs)

b. Annual O&M Items

Unless otherwise indicated, within 6 months after the new license becomes final, or July 2005, whichever occurs sooner, PGE shall implement the following regarding the Willamette Falls fish ladder annual O&M responsibilities:

(1) PGE shall assume, for the life of the new license, responsibility, including all labor and necessary repair or replacement of equipment, to perform annual O&M tasks directly associated with fish ladder operation. Appendix 2 lists all annual O&M tasks and specifies whether PGE, or ODFW, has responsibility.

(2) PGE shall assume debris removal responsibility at the fish ladder sluiceway adjacent to the Willamette Falls fish ladder. Debris removal will be consistent with an operational plan that takes into account debris loading in the river, PGE debris removal activities at T.W. Sullivan, and downstream migrant behavior, abundance and timing. The sluiceway will be opened to pass debris only between the hours of 10:00 a.m. and 2:00 p.m.

(3) PGE shall develop an operational plan for the above ladder measures. The plan will include appropriate tracking and reporting mechanisms to determine if specific changes are needed in the annual O&M plan to ensure proper fish ladder operation.

Consultation:
Fish Ladder Operational plan: Consultation with the FTC and approval by the Fish Agencies.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:
2004 Begin consultation with FTC for Ladder Maintenance Operational Plan
2005 3/1 -File Ladder Maintenance Operational Plan with FERC
7/1 -Ladder Maintenance Operational Plan implemented

2. Log Boom Extension

If feasible, PGE shall extend the log boom in the T.W. Sullivan pre-forebay to reduce the amount of debris that accumulates at the fish ladder sluiceway. Any such extension would be completed within 1 year of the new license becoming final.

Consultation:
Log boom extension: Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004 Determine feasibility and begin design if feasible

If determined feasible:

2005	1/1-3/1	-Complete design
	3/1	-File design with FERC
	3/1-6/1	-Complete fabrication and permitting
	6/1-10/31	-Construction

3. Pacific Lamprey Passage Ladder Improvements

In addition to the measures identified above, PGE shall fund or undertake measures to enable the Willamette Falls fish ladder to pass adult Pacific lamprey upstream more effectively. Potential measures, subject to recommendation by the lamprey research expert (see section IV.C., item 4, below) include, but are not necessarily limited to:

- Partially covering the floor gratings with a solid contiguous plate.
- Rounding off 90-degree corners at critical junctures in the ladder.
- Installing an infrared light at the counting window instead of a bright light.
- Modifying ladder entrances.
- Other modifications identified through regional and/or national Pacific lamprey research.

Consultation:
Ladder modifications: Consultation with the FTC and approval by the Fish Agencies.

Schedule:
NOTE: specific modifications and scheduling will be developed upon conclusion of lamprey research effort and FTC consultation (see item V.C). Ladder modifications will be completed within 3 years of lamprey research effort conclusion.

4. Hydraulic Conditions at Ladder Entrance #1

PGE shall determine the extent of ladder entrance #1 non-compliance with NOAA fisheries hydraulic criteria for ladder entrances, entrance pools, and auxiliary water systems (AWS), taking into account the changing hydraulic conditions at Willamette Falls and upstream migration run-timing. Evaluation results will inform the consultation with the FTC and development of an action plan for needed modifications that PGE shall implement.

These criteria include, but are not limited to:

- The fishway entrance head (hydraulic drop shall be maintained between 1 to 1.5 feet).
- The minimum entrance width shall be 4 feet and depth at least 6 feet.
- Staff gages shall be installed to verify the entrance head.
- Diffusers shall consist of non-corrosive, vertically-oriented flat-bar grates with a maximum 1-inch clear opening.
- The maximum AWS diffuser velocity shall be less that 1 fps for vertical diffusers and 0.5 fps for horizontal diffusers.

PGE shall develop and implement an action plan for agreed upon modifications.

Consultation:
Assessment of ladder entrance: Consultation with the FTC and approval by the Fish Agencies
Action Plan: Consultation with the FTC and approval by the Fish Agencies
Construction (if required): Report to FTC.

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2003	-Complete assessment relative to hydraulic criteria compliance and run timing	
2004	-Consult with FTC, develop conceptual action plan	
2005	-1/1-6/1	-Finalize action plan
	-6/1	-File action plan with FERC
	-6/1	-Implement action plan (Note: additional modification scheduling may be needed as a result of the action plan)

B. Stranding Management

General Management Approach

Fish that are temporarily held in pools without stress and that are able to find egress are not considered "stranded" and should not be salvaged. Salvage efforts are needed when fish have been stranded at least 48 hours (or less when they show signs of stress), and other means to ameliorate the stranding proven ineffective.

Any Party can notify PGE, ODFW, or USFWS that it believes that fish are "stranded." When ODFW or USFWS determines that fish are "stranded," PGE shall take such action as soon as practicable consistent with the objectives set forth below. The first approach for PGE to implement will be to encourage fish to move downstream voluntarily by providing flow into the stranding pool or modifying Project operations as described by actions in Objective 1 below. If a pool or channel has become a chronic stranding problem to fish, PGE shall implement actions to provide egress channels, as identified in Objective 2 below. PGE shall implement salvage operations, described in Objective 3 below, as needed, but only if the actions in Objective 1 have been implemented and found to be insufficient. Objective 4 (see below) includes actions that the Parties agree will reduce or eliminate stranding during closures of the Willamette Falls fish ladder. Project operations to support this stranding management program will, to the extent possible, be incorporated into the Operational Plan developed in consultation with the FTC under Implementation Sheet IV.A.10.

Objective 1:

Reduce or eliminate adult salmonid and Pacific lamprey stranding potential at Willamette Falls resulting from annual flashboard installation or other Project operations.

Action 1.1: PGE shall operate the controlled flow structure, when constructed, at the apex of Willamette Falls to minimize fish stranding below the Falls.

Action 1.2: PGE shall notify the FTC when flashboard installation is planned. The first notification will be approximately 2 weeks prior to the expected installation date, and the second notification 3–5 days prior to actual installation.

Action 1.3: Immediately after flashboard installation, PGE shall reduce load at the T.W. Sullivan powerhouse to minimize the duration of time that there is a disruption of flow over the crest of the Falls, and use the controlled flow structure to minimize stranding. Normal plant operation will resume when flow through notches, installed under Action 1.6, has been established.

Action 1.4: During the flashboard installation and over the following 2 days, PGE shall coordinate (with those FTC members expressing interest in response to notification under Action 1.2) and conduct reconnaissance survey of adult salmonid stranding locations and severity at the Willamette Falls. PGE shall record adult Pacific lamprey congregations and movement. Appropriate actions will be determined under Objective 3.

Action 1.5: For Project operations that may result in stranding, such as startup after a powerhouse shutdown, PGE shall also notify the FTC 3 days prior to a planned event or within 24 hours of an unplanned event. Appropriate actions will be determined under Objective 3.

Action 1.6: PGE shall provide flow to pools, or other areas, that either have fish in them, or could later have fish present. Appropriate flow at each location will be determined considering the nature of the pool, egress potential for fish, and the need to maintain head at the Project. Flow can be provided either through notches in flashboards and/or by not adding felt cloth to selected flashboard sections.
Consultation: Time-critical consultation.

Objective 2:
Provide egress channels at stranding pools by implementing structural changes to eliminate stranding pool blockages, including a specific problem identified at the "wet hole".

Action 2.1: PGE shall provide $5,000 annually to fund the creation of egress channels. This amount can be funded in advance if a specific modification project will cost more than the amount accrued. In the event an identified modification will exceed available funding, PGE shall consult with the FTC on how to address the funding shortfall.
Consultation: Need for additional funding: Consultation with the FTC.

Action 2.2: The FTC will assess the Falls each spring with the intent of identifying stranding conditions that could be improved by physically modifying the topography below the Falls to provide egress from stranding pools.
Consultation: Assessment of stranding conditions: Consultation with FTC

Action 2.3: During the first year after a stranding situation is identified, the Parties will identify possible corrective actions and PGE shall do the preparatory work (including permitting, cost estimating, channel modification assessments) for their modification the following year. The cost of this preparatory work is in addition to the annual commitment described in Action 2.1.
Consultation: Design: Consultation with the FTC and with approval by the Fish_Agencies.
Construction: Report to FTC.

Action 2.4: The year following the identification of locations having egress blockage, PGE shall re-survey these locations. To the extent funding is available under Action 2.1, and the egress blockage persists, PGE shall take corrective actions in the next available in-water work period.
Consultation: Report to FTC

Objective 3:
Provide actions to reduce or eliminate the stranding, including salvage operations if needed, of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls as the result of the annual installation of the flashboards or other Project operations that may cause stranding.

Action 3.1: PGE shall operate the controlled flow structure, when constructed, at the apex of Willamette Falls so as to minimize the occurrence of fish stranding below the Falls.

Action 3.2: PGE shall apply for all federal and State permits required to conduct the salvage of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls. Permit applications will include a salvage plan, developed in consultation with the FTC. PGE shall be prepared to implement the plan in accordance with Action 3.6.
Consultation: Salvage Plan: Consultation with FTC.

Action 3.3: PGE and the Fish Agencies will determine salvage feasibility and needs when flashboards are installed each year.
Consultation: Time-critical consultation.

Action 3.4: PGE and the Fish Agencies will also determine appropriate actions, including any reconnaissance and salvage needs, following flow fluctuations that might cause stranding, such as fluctuations due to powerhouse startup after a shutdown or significant river flow changes (i.e., flow changes greater than 10% in a 24-hr period). PGE shall contact the FTC as described in Action 1.5 to coordinate this determination.
Consultation: Time-critical consultation.

Action 3.5: For safety concerns, PGE shall conduct salvage for adult salmonids, if necessary, only in the old fish ladder pools located on the west side of the Falls. PGE shall release the fish in the tailwater of the Falls.

Action 3.6: When deemed necessary by the Fish Agencies, PGE shall conduct adult Pacific lamprey salvage over a 2-day period determined by Actions 3.3 and 3.4. PGE shall release lamprey either above or below the Falls as determined by ODFW and USFWS.
Consultation: Time-critical consultation.

Action 3.7: PGE shall document the number and species of fish salvaged. PGE shall also note carcasses prior to salvage effort and document for the FTC any fish mortality associated with salvage efforts.
Consultation: Report to FTC

Objective 4:
Reduce or eliminate stranding of adult salmonids and Pacific lamprey inside the Willamette Falls ladder during fish ladder closures.

Action 4.1: PGE shall develop, an Operational plan for the installation and removal of exclusion gratings at the Willamette Falls fish ladder.
Consultation: Consultation with the FTC and approval of the Fish Agencies.

Action 4.2: PGE shall be responsible for the cost of constructing, maintaining, installing, and removing the exclusion grating for all four fish ladder entrances at the Willamette Falls fish ladder.

C. Adult Pacific Lamprey

PGE shall implement the following measures at Willamette Falls to develop a site-specific knowledge base regarding adult Pacific lamprey behavior, including passage, and to assist in effective upstream passage of adult Pacific lamprey through the Project:

1. PGE shall initially install a minimum of two lamprey passage ramps each year, and notch the flashboards, when flashboards are installed, to provide flows for lamprey below the dam and Falls, focusing on those areas where lamprey are known to congregate, such as the old fishway. PGE shall implement these measures within 6 months of the new license becoming final. PGE shall assess the effectiveness of the ramps during the Pacific lamprey research project (item 3, below), and continued implementation will be guided by the results of that research. PGE, in consultation with the FTC, will conduct a preliminary assessment of lamprey ramp use in 2004 (see item VI.D.). PGE shall make modifications to the placement and design of ramps if results of the monitoring program suggest that such actions are appropriate. If effective, PGE shall install additional ramps as needed to provide passage in areas where Pacific lamprey can be attracted.

   Consultation: Placement of Lamprey Passage Ramps: Time-critical consultation
   All Other Elements Above: Consultation with the FTC and approval by the Fish agencies

   Schedule:
   PGE shall undertake such actions in accordance with the following schedule:

   2003 Annually at flashboard installation, install Lamprey passage ramps and notch flashboards.

2. PGE shall undertake an effort to salvage stranded Pacific lamprey in accordance with the objectives listed in the Stranding Management Program. PGE shall release salvaged adult Pacific lamprey back into the river in accordance with Action 3.6 of the Stranding Management Program.

3. PGE shall fund, within 6 months of the new license becoming final, a research effort on Pacific lamprey passage and behavior consistent with Appendix 4 (Adult Pacific Lamprey Passage Plan). PGE shall initiate development of this research effort in 2004, to include the following:

- Research objectives and general approaches will be developed by an ad hoc committee of lamprey experts drawn from agencies, tribes, universities and private industry. This committee's recommendation and the proposed scope of research will be reviewed by the FTC. PGE shall then contract with one or more research groups to conduct this work. Research will be conducted by a lamprey expert mutually acceptable to PGE and the FTC.
  Consultation: Selection of Ad hoc committee: Consultation with the FTC
  Selection of Lamprey expert: Consultation with the FTC
  Scope of lamprey research: Consultation with the FTC and approval by the Fish Agencies.

- The research will evaluate Pacific lamprey passage at the Project area and identify potential modifications to the dam/flashboards and the Willamette Falls fish ladder to improve passage.
  Consultation: Report to FTC

- If Pacific lamprey passage problems are identified, the research effort will assess the applicability and effectiveness of a lamprey capture-and-haul program at the Falls as a potential interim management tool to be used until permanent solutions to the passage problem are implemented.
  Consultation: Consultation with FTC and approval by Fish Agencies

- The research will evaluate the effectiveness of the lamprey passage ramps at the Falls.
  Consultation: Report to FTC

- The research will consider appropriate testing of Pacific lamprey passage performance of the controlled-flow structure at the apex of the Falls, and specifically evaluate upstream passage effectiveness of adult lamprey passage features constructed along with or near the controlled flow structure.
  Consultation: Report to FTC

- The research will develop a reasonable Project structure related performance goal for upstream passage of Pacific lamprey at Willamette Falls.
  Consultation: Consultation with the FTC and approval by the Fish Agencies

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004	-PGE initiate research effort development in consultation with FTC	
2005	3/1	-File Research plan with FERC
	5/1	-PGE fund and initiate research plan

4. After the completion of the research study outlined above, and construction of the controlled flow structure at the apex of the Falls, PGE shall implement Pacific lamprey passage improvements to the dam/flashboards and the Willamette Falls fish ladder (see V.A.3) as required to meet any passage effectiveness goal identified by the research program. Improvements shall be implemented by PGE within 3 years of completion of the research study.
   Consultation: Consultation with the FTC and approval by the Fish Agencies

5. PGE shall also test downstream passage of adult Pacific lamprey through the siphon bypass and controlled flow structure. PGE shall make modifications to the structures as needed to assure safe, timely, and effective passage of Pacific lamprey.
   Consultation: Testing: Consultation with the FTC
   Modifications: Consultation with the FTC and approval by the Fish Agencies

   Note: This evaluation is part of the siphon bypass and controlled flow structure Post-construction evaluation plans.

D. Juvenile Pacific Lamprey

PGE, in consultation with the FTC, shall develop, fund and implement a joint evaluation study program covering juvenile Pacific lamprey. The study program will address the following:

1. Determine Pacific lamprey guidance efficiency through the T.W. Sullivan powerhouse after implementation of the Tier 2 siphon bypass measure.

2. To the extent technically feasible, estimate the potential impact (i.e. injury and mortality) of the T.W. Sullivan powerhouse to juvenile Pacific lamprey.

3. Determine additional improvements to passage conditions using the information gained through the above evaluations and other relevant information to determine additional improvements to passage conditions at the Project site for PGE to implement.

To achieve the goal of "safe, timely, and effective" passage for juvenile Pacific lamprey, PGE, in consultation with the FTC, shall implement additional measures identified by these studies as appropriate to reduce injury and mortality of Pacific lamprey that pass through the T.W. Sullivan powerhouse, and, if technology allows assessment, through the controlled flow structure at the Willamette Falls apex. PGE shall implement the additional measures within 3 years of assessment completion.

The above assessments for juvenile lamprey will be part of the siphon bypass and controlled flow structure evaluation programs (see Implementation Sheets IV.A.2. and IV.C.2.).

Consultation: Study Plan: Consultation with the FTC and approval by the Fish Agencies
Design: Consultation with the FTC and approval by the Fish Agencies.

Schedule:
Assessments done as part of the siphon bypass (IV.A.2.) and controlled flow structure (IV.C.2.)

E. Water Quality

The Oregon Department of Environmental Quality (ODEQ) is the lead agency regarding compliance with water quality standards through its 401 Water Quality Certification process. PGE has applied for certification pursuant to Section 401 of the federal Clean Water Act. PGE shall comply with the requirements established by ODEQ in its 401 water quality certification for the Project.

Critical to this process, is the need for assurance that the controlled flow structure to be located at the apex of Willamette Falls will be designed and operated in a manner to not contribute to high total dissolved gas conditions that have occurred at the Falls. To this end, PGE shall coordinate the design of the controlled flow structure (including the use of a small-scale physical model) with ODEQ in accordance with the 401 water quality certification, in addition to the FTC.

Also critical is the development of a Water Quality Monitoring and Management Plan (WQMMP). At ODEQ's request, PGE has agreed to develop appropriate WQMMP(s) for the Project.

VI. 2004 Assessments

This section provides those assessments to be done in 2004 to gain a more complete understanding of existing conditions.

Purpose:
The below assessments are intended to develop information in 2004 concerning the performance of the existing T. W. Sullivan bypass system as it relates to the presence and condition of salmonid fry and juvenile pacific lamprey. This includes a field assessment of juvenile Pacific lamprey impingement of the Eicher fish screen at Unit 13.

Summary of Assessments:

A. Salmonid Fry and Juvenile Pacific Lamprey presence and condition in the T.W. Sullivan bypass

PGE shall collect presence and condition data for salmonid fry and juvenile Pacific lamprey that are observed in the T.W. Sullivan bypass system as part of its annual fish count program.
Consultation: Report to FTC

B. Juvenile Pacific Lamprey Impingement on the Unit 13 Eicher Screen

In 2004, PGE shall determine the rate of impingement of juvenile Pacific lamprey on the existing Eicher screen utilizing juvenile Pacific lamprey from mainstem Columbia River bypass systems. PGE, in consultation with the FTC, will develop an appropriate assessment method and study plan. Potential methods include, but are not limited to:

- Perform a mark-recapture study of externally marked juvenile lamprey in the evaluator plunge pool to determine rate of recapture.
- Perform a mark-recapture study of externally marked juvenile lamprey released in front of Unit 13. Recapture/examination in the evaluator will emphasize checking their condition that might have resulted from interactions with the Unit 13 Eicher screen.
- Install an underwater video camera and monitor the Eicher screen during operation for the presence of juvenile lamprey impinged on the screen.

Consultation: Study & Assessment elements: Consultation with the FTC

C. Current bypass system improvements testing

PGE shall assess improvements to the Unit 13 bypass and evaluator system to determine if issues associated with delay in the bypass/evaluator system are eliminated or reduced. This assessment will be done in 2004 using PIT tags on smolts to provide an indication of how the system is operating prior to its use for performance testing of subsequent PM&E measures.
Consultation: Consultation with the FTC

D. Lamprey Passage Ramp use preliminary assessment.

As part of the Adult Pacific Lamprey Program described in section V.C. item 1, PGE, in consultation with the FTC, will conduct a preliminary assessment of lamprey ramp use in 2004. The purpose of this preliminary assessment is to inform subsequent decisions regarding the placement and design of lamprey passage ramps.
Consultation: Consultation with the FTC

Schedule:
PGE shall undertake such actions in accordance with the following schedule:

2004 -Consult with FTC to develop assessment plans for 2004
-Perform presence and condition assessments for fry and juvenile lamprey
-Perform Eicher Screen impingement assessment for juvenile lamprey
-Perform current bypass system improvements testing
-Perform lamprey ramp use assessment

2005 7/1 -File with FERC report of accomplishment

APPENDIX 1

Evaluation Summaries

Background

Portland General Electric Company (PGE) has committed to a series of measures at the Willamette Falls Project with the intent of meeting public expectations for environmental resource protection and agreements made with multiple stakeholders in PGE's collaborative effort to re-license the Project with the FERC. Of particular concern, and addressed most strongly by these measures, are native and ESA-listed anadromous fish that migrate up- and downstream through the Project during their life cycles. Measures committed to by PGE are intended to reduce delays, injuries, and/or mortality of these fish as they attempt to migrate through the Project. The Evaluation Summaries in this Appendix outline many of the basic steps that will be taken to assure that the realized performance of the measures implemented by PGE under its new FERC-issued operating license will provide sufficient protection to migratory fish.

Implementing and Evaluating Measures

Completion of the measures to which PGE has committed will follow an adaptive approach, much of which has been outlined in this Implementation Plan. A tiered series of measures to address each of multiple fish passage issues or other concerns will be implemented at the Project over a period extending a decade and possibly farther into the future (see schedules in Appendix 6). Initial (Tier 1 and 2) measures identified in this Implementation Plan will be completed and their efficacy at meeting pre-defined performance standards or goals tested. Measures or suites of measures meeting the standards or goals specific to the issue(s) they address will be considered both successful and sufficient. Additional measures (Tiers 3 and/or 4, as appropriate) will be taken if and where initial measures at the Project do not meet the relevant standard(s) or goal(s).

With regard to the performance standards and goals (see Section III. of Exhibit B), success in meeting some (generally the standards) will be measurable using readily available technologies and evaluative study designs not dramatically different than those that have been already applied either at the Project or at hydroprojects elsewhere in the region. Others (typically the goals) will be measurable to varying levels of precision or certainty, using technologies that may or may not be familiar or available to the parties at present. In at least one instance (the survival of out-migrant lamprey), future evaluations of the efficacy of specific measures or suites of measures to meet the agreed standard or goal for protecting one or more lifestages of a particular migratory fish might not occur until well into the new license period. This is because existing study technologies and methods would be insufficient to conduct reliable tests of whether or not the relevant performance standard or goals are being met.

The Implementation/Evaluation Cycle

Evaluating performance of measures implemented at the Project will follow a consistent pattern, shown in Figure 1. At approximately the same time that the design and construction of an initial measure or logical group (referred to earlier as a "suite") of initial measures is completed, the Fisheries Technical Committee (FTC) will work to clarify measurable elements of any relevant performance standards or goals that at the time are still lacking clear definition. This process of clarification may often result in little more than a slightly improved understanding of the conditions under which the effectiveness of the measure(s) will be judged a success, but will be essential to designing meaningful evaluative studies and making efficient use of both PGE funding and the time of the FTC members. The FTC will coordinate with PGE or its consultants in the design of studies appropriate for evaluating whether or not the measures in question meet the relevant performance standard(s) or goal(s). If situations arise where it becomes difficult or impossible to reach agreement on the design of a particular study, the FTC may seek decision-making support or dispute resolution, pursuant to provisions of the Settlement Agreement, which includes the possible use of a mutually agreed upon third party expert to assist the FTC in reaching its decision.

When a measure or logical suite of measures has been implemented, the approved evaluative studies (see Section II.B.3. of Exhibit B) will occur. Study execution and associated analyses of evaluation data will take place in close consultation with the FTC. PGE will consult with the FTC regarding its choice of consultants or other experts to develop and execute the studies and associated analysis. Results of the study (or studies) will be summarized in a report that PGE and the FTC will use in determining whether the standard(s) or goal(s) of interest have been met. The approved report will provide a clear, documented, and technical basis for determining that PGE has either met its obligation or needs to implement additional remedial measures in its efforts to meet the agreed performance levels. If situations arise where there is difficulty reaching agreement on interpretations of study results, or on how these results ought best be characterized in a final evaluation report, the FTC may seek decision-making support or dispute resolution, pursuant to provisions of the Settlement Agreement, which includes the possible use of a mutually agreed upon third party expert to assist the FTC in reaching its decision.

A study report and associated decision indicating that applicable standard(s) and/or goal(s) had been met would complete efforts to improve the specific Project feature(s) evaluated. A report and decision indicating otherwise would lead PGE to take additional remedial steps to improve fish passage conditions at the evaluated Project feature(s) and initiate another cycle of designing and implementing additional measures, concurrent study design efforts involving the FTC, evaluative study, and an assessment of the need for still further Project enhancements. Whether one or more than one cycle of improvement is needed at a given Project feature or logical group of features, it is anticipated that the same basic pattern as depicted in Figure 1 will be followed.

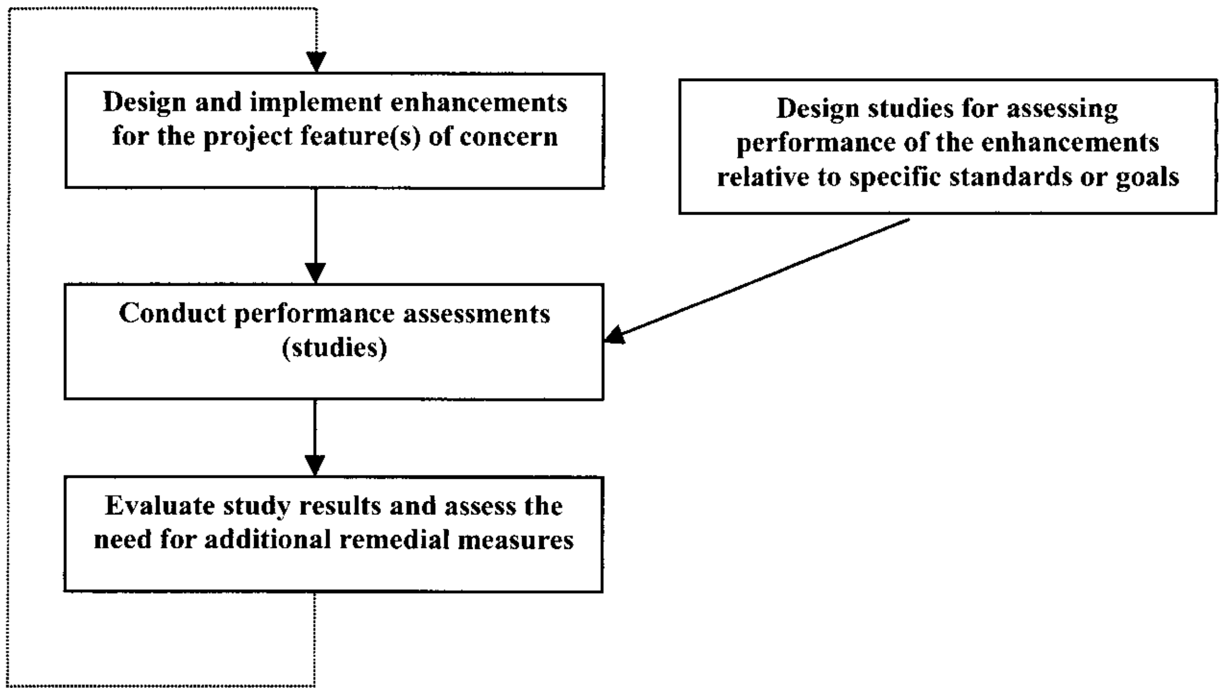

Figure 1. Characteristic evaluation cycle to be followed during implementation of measures at the Willamette Falls Hydroelectric Project.

Summaries of Future Evaluation Efforts at the Willamette Falls Project

Per the evaluation cycle characterized in Figure 1, studies necessary to evaluate the efficacy of measures at the Project will be designed in concert with the design and implementation of these measures. Detailed study plans for the evaluations are not available at present because the design and implementation process is just getting underway. However, the Parties see value in describing what is already known about the evaluative studies that need to be conducted. Summaries of most of these evaluations are provided on the pages that follow.

1. Downstream Passage Effectiveness for Salmonid Smolts Through T.W. Sullivan

Measures: Inner forebay rack replacement (units 1-3), guidewall realignment, siphon bypass installation, evaluator improvements (e.g., PIT tag detectors), Unit 13 bypass chute modification, and a new trash rack cleaning system.

Performance standard: A survival standard has been established for smolts entering the Sullivan forebay. Actual performance will be compared against the standard, based on an integration of information on fish guidance efficiency (FGE), turbine survival rates, bypass survival rates, effects of the new cleaning system for the forebay racks, and estimated direct mortality of surviving fish that exit the plant for both the bypass and turbines.

Performance assessment: Performance of the improved fish bypass system at T.W. Sullivan will be evaluated using live fish testing with passive integrated transponder (PIT) tag technology, radio telemetry and other research methods as needed or available.

- FGE will be evaluated with PIT tag technology using methods described by Skalski (2000), to ensure statistically sound results. FGE testing will be done on spring chinook salmon in the fall (October 1 to December 15) and in the spring (March 1 to June 1) and on steelhead in the spring (April 1 to June 15). Each species for each season could have six paired releases (forebay and calibration), four from the middle of the forebay and two with composite releases at left, middle and right side of forebay. As an example, each forebay release group could be 150 test fish, each control or calibration release would be done concurrent with forebay releases and could be 75 test fish. This approach would yield PIT tag test fish releases of 1,350 in the fall and 4,050 in the spring for a total sample size of 5,400 test fish per year.
- Direct survival will be determined using 48 hour holding periods of fish collected from the fish bypass evaluator. Survival can also be estimated when using radio tags or other "sending" tags that indicate test fish are alive and moving downstream past two established monitoring stations.
- Direct survival assessments may incorporate existing data on turbine survival from on-site studies conducted in the 1960s and in 1997, or from tests of new turbine runners. These estimates could be adjusted for effects of the inner forebay rack cleaning system.
- Predation on fish that have successfully passed through the plant, either via the bypass or turbines, will be estimated for each route.
- Fish behavior through the forebay and bypass system will be assessed using radio telemetry to determine individual unit passage and bypass holding location(s).
- Effects of PIT tagging will be assessed as part of the evaluation by holding tagged and untagged fish separate from field testing.
- Effects of an inner forebay rack cleaning system to be installed in 2005 will be assessed by conducting FGE testing with the system operating and idle, or through use of an underwater video camera, or both.

Assessment timing: Focused study of the improved fish bypass facility will occur for a minimum of three years and begin within a year after the new facilities are installed and operating. The evaluation will occur with the siphon bypass operating and redesigned inner forebay completed. Study plan preparation, permitting, equipment and tag procurement will occur a year prior to field study each year. PGE shall conduct routine testing of the PIT tag interrogation system as well as other monitoring stations will occur.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the Fisheries Technical Committee (FTC) and PGE. Such evaluation may involve routine monitoring, focused study, or both.

2. Downstream Passage Effectiveness of Salmonid Fry ($\leq$60 mm) Through T.W. Sullivan

Measures: Inner forebay rack replacement (units 1-3), guidewall realignment and siphon bypass installation, evaluator improvements (e.g., PIT detectors), Unit 13 bypass chute modification and a new trash-rack cleaning system.

Performance standard: A survival standard has been established for salmonid fry entering the Sullivan forebay. Actual performance will be compared against the standard, based on an integration of information on FGE, turbine survival estimates, bypass survival estimates, effects of the new cleaning system for the forebay racks, and estimated direct mortality of surviving fish that exit the plant for both the bypass and turbines.

Performance assessment: Evaluations of the improved fish bypass system for passing downstream migrant fry will be conducted using live fish testing. Fry are not readily available from the T.W. Sullivan evaluator so there will be a need for an outside source of test fish, most likely from a fish hatchery. Hatchery fry size will be representative of naturally migrating fry.

- FGE testing could be conducted on fry using mark-recapture techniques with total body dye used to identify test fish. The dyes used to mark fry last approximately 48 hours creating logistical problems with a mark-recapture study. It may take more than 48 hours for test fish to be recaptured after release. A schedule and sampling design will be developed for fry FGE testing through the fisheries technical committee (FTC). FGE testing could also be attempted on fry using PIT tag technology. Effects of PIT tagging on fry will be factored into the FGE assessments.
- Effects of an inner forebay rack cleaning system to be installed in 2005 will be assessed by conducting FGE testing with the system operating and idle, or through use of an underwater video camera, or both.
- Direct survival of fry using the bypass could be determined using 48 hour holding periods of salmonid fry collected from the fish bypass evaluator. The study will include, as appropriate, a control group of fry.
- Turbine survival of fry will be estimated using known models and equations as there are no tags or methods available to adequately test fry passing this route. These estimates could be adjusted for effects of the inner forebay rack cleaning system.
- Salmonid fry presence will be documented in the Sullivan fish bypass evaluator whenever fish counts are performed.

Assessment timing: Focused study of the improved fish bypass facility's effectiveness at passing fry safely downstream will be conducted over a three year period and shall begin within a year after the new facilities are operating or as soon thereafter as the FTC believes that suitable testing technologies are available to PGE. The evaluation will occur with the siphon bypass and redesigned inner forebay completed. Study plan development and associated permitting will occur through the FTC prior to field study each year.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

3. Downstream Passage Effectiveness of Juvenile Lamprey Through T.W. Sullivan

Measures: Inner forebay rack replacement (units 1-3), guidewall realignment and siphon bypass installation, evaluator improvements (e.g., PIT detectors), and a new trash-rack cleaning system.

Performance goal: A goal of "safe, timely and effective" downstream passage has been established for juvenile lamprey entering the T.W. Sullivan forebay. Success in meeting the goal will be evaluated by testing FGE, estimating turbine survival rates, and assessing bypass survival rates, including rates of impingement of juvenile lamprey guided to the existing Eicher screen. The necessary studies will not be conducted until the FTC concludes that available study technologies are sufficient to yield meaningful results. A clearer definition of what constitutes "safe, timely and effective" passage will be developed by the FTC and PGE, which will help guide the study design and evaluation process.

Performance assessment: Performance of the improved fish bypass system with regard to downstream passage of lamprey will be tested using live juvenile fish (> 100 mm total length). Methods for conducting this testing are not as well developed as those commonly used to evaluate passage effectiveness for salmonid smolts (i.e., passive integrated transponder (PIT) tag technology, radio telemetry and other research methods). Limited exploratory studies will be conducted in the near-term to get a clearer sense of how and how well juvenile lamprey are passing through T.W. Sullivan. Such studies might suggest ways to improve passage effectiveness for these fish. The methods ultimately settled upon by the FTC for more detailed evaluative efforts will need to have a reasonable likelihood of answering the questions of interest in an authoritative manner before post-implementation field studies are conducted.

- FGE will be evaluated at T.W. Sullivan with a mark/recapture study using externally marked juvenile lamprey and or PIT tag technology on an experimental basis, or using other improvements in technology proven effective for marking/tagging juvenile lamprey. Either a fin clip or body dye could be used along with extended manual checks of the bypass catch tank to recapture test lamprey. At present, there is no known method to recapture juvenile lamprey at the proposed siphon bypass.
- Effects of an inner forebay rack cleaning system to be installed in 2005 will be assessed by conducting FGE testing with the system operating and idle, or through use of an underwater video camera, or both.
- Overall survival of juvenile lamprey using the bypass will be determined using 48 hour holding periods of juvenile lamprey collected from the fish bypass evaluator.
- Turbine survival assessments of juvenile lamprey will be conducted if feasible. If no tagging techniques have been developed for this species for this type of testing, turbine survival rates could be estimated using existing information. These estimates could be adjusted for effects of the inner forebay rack cleaning system.
- Assessing the Eicher screen for juvenile lamprey impingement and condition will be conducted in 2004 with test specimens provided from other locations. PIT tagging, mark-recapture methods or underwater video monitoring could be used for this experiment. A study plan will be developed through the FTC.
- Juvenile lamprey presence will be documented in the Sullivan fish bypass whenever fish counts are performed.

Assessment timing: Focused studies of the improved fish bypass facility's effectiveness at meeting the performance goal for juvenile lamprey will be conducted for a minimum of three years and shall begin within a year after the new facilities are operating or as soon thereafter as the FTC believes that suitable testing technologies are available to PGE. The evaluation will occur with the siphon bypass and redesigned inner forebay completed, with the exception of an impingement assessment of the Unit 13 Eicher screen that will occur in 2004. Study plan preparation, permitting, equipment and any tag procurement will occur through the FTC prior to field study each year.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

4. Downstream Passage Effectiveness for Outmigrant Kelts and Fallback Salmon, Steelhead, and Adult Pacific Lamprey through T.W. Sullivan

Measures: Gap in outer forebay racks, inner forebay rack replacement (units 1-3), guidewall realignment and siphon bypass installation, evaluator improvements (e.g., PIT tag detectors), and a new trash-rack cleaning system.

Performance goal: A goal of "safe, timely and effective" downstream passage of steelhead kelts, and fallback salmon, steelhead, and adult Pacific lamprey has been established for fish entering the Sullivan forebay. Adding clarity to this goal will help guide study design and the evaluation process.

Performance assessment: Performance of the improved fish bypass system will be monitored and evaluated using live adult fish testing. Steelhead kelts, fallback adult salmon, and adult Pacific lamprey will either be collected for assessments from the bypass catch tank or acquired from a hatchery or other sources. It is expected that radio telemetry and other "sending" tags, or other appropriate methodologies will be used to evaluate condition of these fish after using and exiting the fish bypass system.

- Kelt and fallback salmon and lamprey condition will be evaluated in areas immediately upstream, at, and immediately downstream of the Project for indications that fish are (or are not) having difficulty passing downstream. A focused study will evaluate the downstream passage success of several test groups of steelhead kelts (~50 fish each) obtained from an appropriate fish hatchery and released into specific routes of passage at the Project. The FTC and PGE will agree upon the details of this study prior to field study.
- Overall condition of steelhead kelts and adult fallback salmon and lamprey will be estimated using radio tags or other "sending" tags that indicate fish are alive and moving past two established monitoring stations downstream, or through some other method identified by the FTC. When using radio telemetry for this assessment, it is assumed that adult salmonids and lamprey will continue downstream to be detected at stationary radio receiver sites.
- Fish behavior through the forebay and bypass system can be assessed using radio telemetry to determine potential bypass holding locations.
- A passage slot will be installed at the main intake for the plant near the west corner of the main head racks. Adult fish accumulate immediately above this location. The passage slot is intended to provide a better route for adult fish that pass downstream through the racks into the plant forebay and out through the fish bypass. The slot is proposed to be 18 inches wide and 8 feet deep as opposed to the current 6-inch openings on the rack. This passage slot will become part of the improved fish bypass system at the Sullivan plant.

Assessment timing: Routine study of the improved fish bypass facility will occur for a minimum of three years. Testing will coincide with documented steelhead kelt presence in the fish bypass evaluator and during upstream migration periods of spring chinook salmon, steelhead, and lamprey from approximately February through June. Study plan preparation, permitting, equipment and tag procurement will occur through the FTC prior to field study each year. Routine testing of the radio tag system as well as other monitoring stations will occur.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both. Any follow-up evaluations will be conducted after remedial measures that address the problem(s) have been implemented.

5. Aquatic Predation Potential in the T.W. Sullivan Tailrace

Measures: Inner forebay rack replacement (units 1-3), guidewall realignment, siphon bypass installation , unit 13 bypass outfall modifications and flow deflectors at units 12 and 13 discharge.

Performance: The goal is to reduce or eliminate aquatic predator habitat in the Sullivan plant forebay and tailrace. Success in achieving this goal can be evaluated either by assessing aquatic habitat before and after the facilities are built, or by assessing behavior of aquatic predatory fish, or both. A clearer definition of what constitutes adequate reduction in predator habitat will be developed by the FTC and PGE. Developing clarity in this definition will inform study design and the evaluation process.

Performance assessment: An assessment of the physical aquatic habitat in the tailrace will be conducted using habitat mapping and information on water velocity profiles collected prior to completion of the siphon bypass and prior to installation of structural flow deflectors near the unit 12 and 13 discharge areas. A similar analysis will be done after the siphon bypass is operating and the flow deflectors are in place. Detailed bathymetry evaluations of the Sullivan tailrace have already been completed. Any need for additional bathymetry data will be assessed when conducting this before-and-after analysis.

The before-and-after field data will be used to show changes in aquatic habitat from the siphon bypass discharge into the Sullivan tailrace that may eliminate low velocity areas suited for predators. If velocity profiles and physical habitat mapping do not suffice in characterizing the effects of the siphon bypass outfall and the flow deflector structures on reducing aquatic predator habitat, or a significant predation problem is identified by the FTC, a study using live fish and radio tagging will be conducted.

Assessment timing: Focused assessment of physical habitat characteristics near the siphon bypass outfall will be completed within one year after installation. Field data collection will occur during normal operating conditions in the spring and fall and when conditions within the area can be safely accessed.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

6. T.W. Sullivan Plant Evaluation Summary

Issue: Downstream Migrant Survival through the T.W. Sullivan Turbines

Measures: Installation of new turbine runners at T.W. Sullivan and operation of the turbines in accordance with the operating plan.

Performance: Mortality test a replacement runner, designed differently than in Unit 8, prior to subsequent runner replacements. Index/efficiency testing of replaced runners will be part of the runner replacement engineering effort.

Performance assessment: An assessment of fish mortality through a new turbine runner if the new runner is a different design than in Unit 8.

Existing knowledge relevant to the design and conduct of this evaluation, should it occur, includes:

- Turbine mortality testing can be conducted through Sullivan's turbines using the Hi-Z Turb'N Tag technique and has successfully been completed before at Sullivan (unit # 8 in 1997).
- Assessing turbine mortality through any newly designed turbine runner(s) to be installed at T.W. Sullivan may be beneficial in determining improvements to this passage route, or it may show that mortality reductions associated with new runner designs help meet the downstream passage standard.

Assessment timing: Turbine mortality testing, if necessary, will be done within 1 year of installation and prior to any subsequent year installations of that runner design.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

7. Downstream Migrant Survival and Injury at the Unit 13 Bypass Outfall

Measures: Redesigned bypass outfall at unit 13

Performance: The goal will be to redesign the Unit 13 bypass outfall chute to meet established passage criteria (NOAA Fisheries) for impact velocity at the tailwater. Mortality and injury of smolts and salmonid fry using the bypass as determined by live fish testing will be used in determining if the overall T.W. Sullivan performance standards are met (See Summaries 1 & 2).

Performance assessment: The existing chute has been assessed hydraulically under a range of conditions to determine impact velocities. After the chute is modified or replaced, its performance will be evaluated hydraulically to determine if impact velocity criteria established by NOAA Fisheries is being met. Design modifications will be developed for the Sullivan bypass outfall chute through the FTC.

- Alterations to the outfall chute will be analyzed relative to tailwater conditions when migrating fish are present and exiting the bypass via the chute. A hydraulic assessment will be completed that will show if the chute is meeting criteria, or not.
- Additional adjustments and modifications to the outfall chute will be developed by the FTC and implemented by PGE if the passage criteria have not been achieved.
- Additional testing for mortality and injury using live fish will be conducted in conjunction with FGE bypass testing, as determined by the FTC, to determine if overall performance standards for passage through the TW Sullivan plant are being met (see Summaries 1 and 2).

Assessment timing: Focused hydraulic assessments of the improved fish bypass outfall will occur following modifications. Additional assessments of fish condition for fish that pass through the improved bypass outfall could occur in conjunction with other bypass testing.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

8. Downstream Migrant Survival Through the Controlled Flow Structure

Measures: Controlled flow structure installed at apex of Willamette Falls

Performance standard and goals: A survival standard has been established for juvenile salmonid smolts passing through the proposed Willamette Falls controlled flow structure. A goal of "safe, timely and effective" downstream passage has been established for adult lamprey, juvenile lamprey, adult salmonids and steelhead kelts. A clearer definition of what constitutes "safe, timely and effective" passage will be developed by the FTC and PGE. Developing clarity in the definition of this goal will help guide study design and the evaluation process.

Performance assessment: Assessing the performance of the controlled flow structure placed at the apex of Willamette Falls will use results of a demonstration study completed in the fall of 2003 with spring chinook salmon smolts. This demonstration study used radio tags and Hi-Z Turb'N tags to better understand the feasibility of assessing survival and fish condition through the controlled flow structure using these methodologies in future testing. Results of this demonstration study will inform PGE and the FTC in study plan development to assess the controlled flow structure. Assessing the performance of the controlled flow structure will also depend on safe access to the site for releasing test fish through the slot.

- Kelt and fallback salmon condition will be evaluated in areas immediately upstream, at, and immediately downstream of the controlled flow structure for indications that fish are (or are not) having difficulty passing downstream. A focused study will evaluate the downstream passage success of several test groups of steelhead kelts (~50 fish each) obtained from an appropriate fish hatchery or the unit 13 bypass evaluator and released through the structure. The FTC and PGE will agree upon the details of this study.
- Salmonid smolt condition will be assessed through the slot using Hi-Z Turb'N tags, radio tags or other "sending" tags that indicate fish are alive and moving downstream past two established monitoring stations. The radio telemetry receiver established site at Sportcraft Marina will be used with 2 separate receivers and antennas spaced approximately ¼ mile apart.
- Fish behavior in the horseshoe area of the Falls and downstream will be assessed after passage through the slot using radio telemetry to determine potential holding locations or problem outfall areas.
- At this time, technology and research methods are not well established for juvenile lamprey and salmonid fry to assess these animals at this structure. Salmonid smolt condition will act as a surrogate for fry and juvenile lamprey until such time appropriate technologies are available for mark-recapture studies.
- Adult Pacific lamprey condition and survival through the controlled flow structure will be tested as part of the post-construction monitoring and evaluation for injury and mortality.

Assessment timing: Focused study of the controlled flow structure will coincide with downstream passage peaks of adult steelhead kelts, fall back salmon and salmonid smolts and occur for a minimum of three years. Access to the controlled flow structure for testing in the spring (March through June) when these peaks occur, will be a logistical and safety challenge.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both. Any follow-up evaluations will be conducted after remedial measures that address the problem(s) have been implemented.

9. Effects of the Willamette Falls Controlled Flow Structure on Upstream Passage of Adult Salmonids.

Measures: Controlled flow structure installed at apex of Willamette Falls

Performance goal: A goal of "safe, timely, and effective" upstream passage of adult salmonids has been established for the Willamette Falls Project. A clearer definition of what constitutes "safe, timely and effective" passage will be developed by the FTC and PGE. A clearer definition of the goal will be helpful in guiding study design and the evaluation process.

Performance assessment: The operation of the proposed controlled flow structure and its potential impacts to upstream migrations will be assessed. Effects of the controlled flow structure on upstream salmonid passage through the Willamette Falls fish ladder will be assessed. Effects of the controlled flow structure placed at the apex of Willamette Falls on upstream salmonid passage will incorporate the use of radio telemetry technology or other "sending" type tags. The assessment is not intended to measure the performance of the Willamette Falls fish ladder in meeting a standard of passage efficiency or passage time. The assessment will attempt to identify problem areas associated with operation of the controlled flow structure that negatively affect upstream salmonid passage. A detailed study plan will be developed with FTC review.

- Adult salmonid upstream passage will be evaluated in the horseshoe area of Willamette Falls near the controlled flow structure discharge. The study will focus immediately downstream of the controlled flow structure for indications that fish are (or are not) having difficulty passing upstream. Assessment of the discharge of the controlled flow structure on attraction to entrances 2, 3 and 4 of the fish ladder will be conducted, possibly through intermittent operation of the spillway during field testing.
- These studies will evaluate the effects of the controlled flow structure on upstream passage of adult winter steelhead (*Oncorhynchus mykiss*) and spring chinook salmon (*Oncorhynchus tshawytsca*) with approximately 50 test fish for each stock. No assessment is intended for adult summer steelhead, fall chinook salmon or coho salmon, unless there are indications that passage for these species is being adversely impacted.
- Test fish can be obtained from the Willamette River below the Falls by angling, from the Willamette Falls fish ladder trap on leg #1, or from an appropriate fish hatchery. The FTC and PGE will agree upon the details of this study.
- These studies will use an array of radio receivers or other tag detection devices at the horseshoe section of the Falls, below the Falls at Sportcraft Marina and above the Falls. Each detection array above and below the Falls will cover the entire river channel.

Assessment timing: Assessment of the controlled flow structure on upstream salmonid passage will occur throughout passage periods (February through June). These assessments will occur for a minimum of three years.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both. Any follow-up evaluations will be conducted after remedial measures that address the problem(s) have been implemented.

10. Aquatic Predation Potential Immediately Downstream of Willamette Falls

Measure: ***Controlled flow structure installed at apex of Willamette Falls***

Performance: **The goal is to reduce or eliminate aquatic predator habitat in the outfall area of the controlled flow structure in the horseshoe section below Willamette Falls. Success in achieving this goal can be evaluated either by assessing aquatic habitat before and after the facilities are built, or by assessing the behavior of aquatic predatory fish, or both. A clearer definition of what constitutes adequate reduction of predator habitat or unfavorable predator behavior will be developed by the FTC and PGE. Clarity in the definition of this goal will be needed to guide study design and the subsequent assessment of Project effectiveness.**

Performance assessment: An assessment of the physical aquatic habitat in the horseshoe section of the Falls will be done using habitat mapping and water velocity profiles prior to installing and operating the controlled flow structure at the Falls. A similar analysis will be done with the facility installed and operating. The before-and-after field data is intended to show changes in aquatic habitat from the operation of the controlled flow structure into the horseshoe section of the Falls. Willamette River flow and water surface elevation below the Falls will be a variable in these analyses. Access to the field data collection areas may limit sampling. If velocity profiles and physical habitat mapping do not suffice in determining the effects of the controlled flow structure outfall on reducing aquatic predator habitat, a study using live fish and radio tagging could be investigated. Detailed bathymetry of the horseshoe section of the Falls are already completed. Any additional detail toward gathering more bathymetry data will be assessed when conducting this analysis.

Assessment timing: Focused assessment of physical habitat characteristics near the controlled flow structure outfall and the siphon bypass outfall will be completed within one year after both are installed and operating. Field data collection could most likely safely occur in moderate to low flows in the spring and fall.

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

11. Avian Predation Potential Immediately Downstream of the T.W. Sullivan Plant and Willamette Falls

Measures: Controlled flow structure installed at apex of Willamette Falls. Sullivan Plant inner forebay rack replacement (units 1-3), guidewall realignment, siphon bypass installation, redesigned bypass outfall at unit 13 and flow deflectors in tailrace.

Performance: The goal is to reduce or eliminate avian predation opportunities on fish in the Sullivan plant tailrace and the outfall area of the controlled flow structure in the horseshoe section below Willamette Falls. This goal could be accomplished using physical barrier deterrents. Efficacy of deterrents in the tailrace can be monitored and evaluated by quantifying avian predation activity before and after installed.

Assessment monitoring: An assessment of the efficacy of avian predation deterrents should be done during downstream juvenile salmon and steelhead migrations with the unit 13 bypass, siphon bypass and apex controlled flow structure operating. If it is determined that deterrents are not effective, hazing of birds to reduce predation will be investigated.

Assessment timing: Focused assessment of physical avian deterrents in the Sullivan tailrace and Willamette Falls will be completed after the siphon bypass and controlled flow structure are installed and operating. Field observations should occur during downstream fish migrations in the spring (March 1 to June 1) and in the fall (October 1 to December 15).

Evaluation of additional measures: The performance of any additional structural or operational measures implemented to address identified problems will be evaluated following protocols agreed upon by the FTC and PGE. Such evaluation may involve routine monitoring, focused study, or both.

Appendix 2

O&M Task List at Willamette Falls Ladder:

The following list is from the table *Anticipated Costs of Willamette Falls Fish Ladder (5/5/03)* developed by ODFW. Tasks associated with ODFW personnel (ie, labor, potable water, and sanitary facilities) and fish management (ie, counting and trapping stations, and aesthetics) will remain the responsibility of ODFW. PGE shall assume its tasks within six months of the new license becoming final.

PGE O&M ITEMS

ANNUAL OPERATIONS

Power

ANNUAL MAINTENANCE

Cranes-routine exercising and minor maintenance
Entrance One Crane
Chain Hoist over gates 1b, 1c
Chain Hoist @ gate 1d
Jib Crane - Fishway One
Jib Crane - #1 on 67' Deck
East Jib Crane on 67' Deck
South Jib Crane on 67' Deck
Sealion barrier frame hoist @ Entrance 2
Inspection & maintenance
Misc. Repairs
Contract annual service

ELECTRIC PUMPS
Entrance one dewatering pump
Entrance two dewatering pump
Entrance three dewatering pump
Valve pit dewatering pump
Lower count room sump pump
Inspection & maintenance

HYDRAULIC GATE OPERATORS
Entrance one gates 1b, 1c
Entrance two
Entrance three
Entrance four
Water intake gates 1-12
Inspection & maintenance

ELECTRIC GATE OPERATORS
Entrance One gate 1d
Fishway entrance gate North
Fishway entrance gate South
Entrance Two Aux. Water valve
Entrance Three Aux. Water valve
Pool 48 makeup water valve.
Velocity Gate
Inspection & maintenance

PLC & COMPUTER EQUIP.
Inspection & maintenance

Lighting
Inspection & maintenance

BASCULE BRIDGE
Inspection & maintenance

OBERMEYER WEIR
Inspection & maintenance

TRASH RAKE
Inspection & maintenance

PAINTING
Inspection & maintenance

STAFF GAUGE (CLEANING AND MAINT.)
Inspection & maintenance

LEVEL TRANSDUCERS
Wet well & debris cleaning

WATERTIGHT BULKHEADS
Inspection & maintenance

DEBRIS REMOVAL
Debris removal (head racks)
Debris removal contract (head racks)
Fishways & Aux. Channels

ODFW O&M ITEMS

ANNUAL OPERATIONS

Labor, Phone, Contract annual service

ANNUAL MAINTENANCE

ELECTRIC PUMPS
Misc. Repairs year 2002

WINDOW WASH UNIT
Inspection & maintenance

VERTICAL CROWDER
Inspection & maintenance

HORIZONTAL CROWDER
Inspection & maintenance
light box

VIDEO EQUIPMENT
Inspection & maintenance

PAINTING
Aesthetic

HVAC

ELEVATOR
O&M (contract), inspect., license

SMOKE & FIRE ALARM
O&M (contract), fire extinguishers

Potable Water system
Inspection & maintenance

Sanitary Facilities
Inspection & maintenance

Lower count room and trap

KOWASKI MULE

STORAGE CONTAINER

APPENDIX 3

Willamette Falls Controlled Flow Structure Design Process and Proposed Operation

A. Objectives

1. The purpose of a controlled flow structure at the apex of the Falls is to focus river flow that would otherwise be distributed around the crest of Willamette Falls to the apex (most upstream location) which is more conducive to safe, timely, and effective downstream passage of fish.

2. The controlled flow structure design and its operation will change the location where the flow actually goes over the Falls (within flows that it can control). It is not intended to significantly change the amount of water that goes over the Falls.

3. Assuming an obermeyer type structure is used, opening the structure to pass more flow involves lowering the obermeyer and closing the structure to pass less flow involves raising the obermeyer. A multi-segment structure is anticipated with a deeper obermeyer in the center and a shallower obermeyer on either side (dependent on bathymetry).

4. Operation of the structure is based upon upstream river elevation, which changes as river flow changes.

5. The design maximum capacity of the controlled flow structure is based on a top elevation of 54.5", which is a 6" veil flow over the top of the flashboards.

6. The controlled flow structure will influence approximately 25,000 cfs of river flow based on a 6" veil spill over the dam and flashboards, distributed as follows:
   Sullivan, , fish ladder, and 6" veil flow ~ 10,000cfs;
   Controlled flow structure ~ 15,000 cfs*.

   Downstream migrants are assumed to avoid a veil flow less than or equal to 6".

7. Improved upstream passage of adult lamprey will be a design element of the controlled flow structure (either integrated into the structure or located adjacent to it). The design and operation of the controlled flow structure will enhance upstream passage conditions for adult lamprey to the extent practicable.

*Actual flow amount will be determined through the design process described in the following section.

B. Design process of a Controlled Flow Structure at the Falls apex.

PGE shall implement the following steps, in consultation with the FTC and subject to the approval of the Fish Agencies, relative to the sizing and design of the controlled flow structure at the apex of the Falls:

1. Design capacity objective of the structure is 15,000 cfs based on an elevation of 54.5'.
2. Engineering analysis of any hydraulic or physical constraints for a 15,000 cfs structure at the Falls apex. (2003),
3. If constrained, determine the maximum design capacity for a structure at Falls apex.
4. CFD model the resultant structure flow capacity to assess upstream flow fields (2004)
5. Small-scale physical model to aid in design and minimize impacts (ie, downstream migrants, fish ladder entrances, and total dissolved gas). 2005/2006
6. Structure construction in 2006/2007

C. Proposed Controlled Flow Structure Operational Concept:

PGE, in consultation with the FTC, will develop an operating plan for the controlled flow structure and T.W. Sullivan powerhouse that takes into account the objectives in Section A and the need to maintain river flow to those measures implemented around the Falls (i.e., notches in flashboards, lamprey ramps, and future lamprey passage devices). The following description is conceptual only. Specific operating details will be developed in consultation with the FTC and subject to approval by the Fish Agencies in the operating plan developed under Implementation Sheet IV.A.10.

For the purposes of discussion, description of the proposed operation of the controlled flow structure starts with river flows decreasing through the spring and all T.W. Sullivan units and fish bypass systems operating. Flashboards are not in place (typically having been washed out during winter high flows), and the controlled flow structure is fully open (lowered) but there is sufficient flow in the river such that upstream elevation is >52.5' at the dam.

The structure will remain fully open (lowered) at river elevations > 52.5' or elevation required for full T.W. Sullivan powerhouse operation (turbine units and fish bypass systems), whichever is higher. This is referred to as the "pre-flashboard level". This is consistent with Objectives 1 and 2.

As river flow continues to decrease and upstream elevation decreases to the pre-flashboard level, the structure will be incrementally closed (raised) as needed to maintain upstream elevation. As flow varies, the exact position of the structure will be adjusted as needed.

PGE shall install flashboards at the Falls when considered safe to do so, taking into account that the structure may allow installation of flashboards earlier that historically possible due to the structure reducing flow over the concrete dam.

With flashboards installed (this includes the required areas of flashboard notches to provide stranding pool flow), the structure will be operated to maintain upstream elevation between 53' and 54.5'. The 53' minimum elevation ensures adequate T.W. Sullivan forebay levels for fish bypass system operation, and the 54.5' maximum ensures a veil of no more than 6" of water flowing over the flashboards. While river flows are less than 25,000 cfs, if other water routes are in operation (ie, TWS, ladder), the structure is passing all flow over the Falls (minus what is going through board seams, lamprey passage structures, and stranding flow notches).

As flows begin to increase in the fall/winter, the structure will be opened (lowered) to maintain upstream elevation between 53'-54.5'. At river flows approach 25,000 cfs, the structure will be at or near full open (lowered) and will remain in the full open position until the following spring when flows start to decrease.

APPENDIX 4

The Willamette Falls Project:
Adult Pacific Lamprey Passage Plan

**Study outline for Adult Lamprey Issues
At Willamette Falls**

Evaluate effectiveness of adult lamprey passage through project area:

PGE shall fund a research effort on Pacific lamprey passage and behavior consistent with the proposal below. PGE shall initiate development of this research effort in 2004 with the intent for research to begin in 2005.

PROPOSED MAIN OBJECTIVES:
Determine specific passage routes of adult Pacific lamprey moving upstream through the project; and identify potential passage problems including but not necessarily limited to:

- The Falls
- The dam with and without flashboards
- The Willamette Falls fish ladder.

Determine passage effectiveness at lamprey passage structures, including ramps, the controlled flow structure, the Willamette Falls fish ladder, flashboard notches, or any other passageway constructed

Determine the feasibility and applicability of a capture and haul program as a means to improve/ensure adequate passage.

POTENTIAL PROPOSED METHODOLOGIES AND OTHER OBJECTIVES

a. Implant lamprey captured throughout the project area with radio tags (for example: 100 to 150 per year to ensure adequate sample size for subsequent evaluations); release fish in immediate vicinity of capture;

b. Track radio-tagged lamprey to develop estimates of the proportion and timing of lamprey passing by route (fish ladder or Falls), and distribution of lamprey across the Falls. Set up antennas and receivers so that passage routes can be determined at a relatively fine scale, and so that lamprey negotiating the Falls but not the dam/cap can be identified;

c. Estimate overall success of passage as the proportion of adult lamprey reaching a pre-determined starting point (e.g., ladder entrance, and a specific area below the Falls assumed to be a point beyond which the individual is attempting to move past the Falls) that successfully pass upstream;

d. Evaluate the sequential effectiveness of lamprey attempting to pass first over the bedrock Falls and subsequently over the dam/flashboards atop the Falls, to estimate "unimpaired" passage effectiveness for the project area (see Figure 1). Results of this evaluation of "unimpaired" effectiveness may be used to refine the preliminary goal for lamprey passage.

e. Use information collected to determine where passage impediments exist and therefore where passage could be improved;

f. Develop plan for specific improvements for PGE to implement and subsequently evaluate.

Commitments from the Applicant

It is estimated that this study will take two years. Annual budgets for the proposed work will depend on the level of effort expended to capture and mark lamprey, the number of lamprey radio tagged, and the precision used in determining locations of radio-tagged lamprey. For reference, the estimated cost for the first year is likely to range from a minimum of $140,000 to a maximum of $190,000.

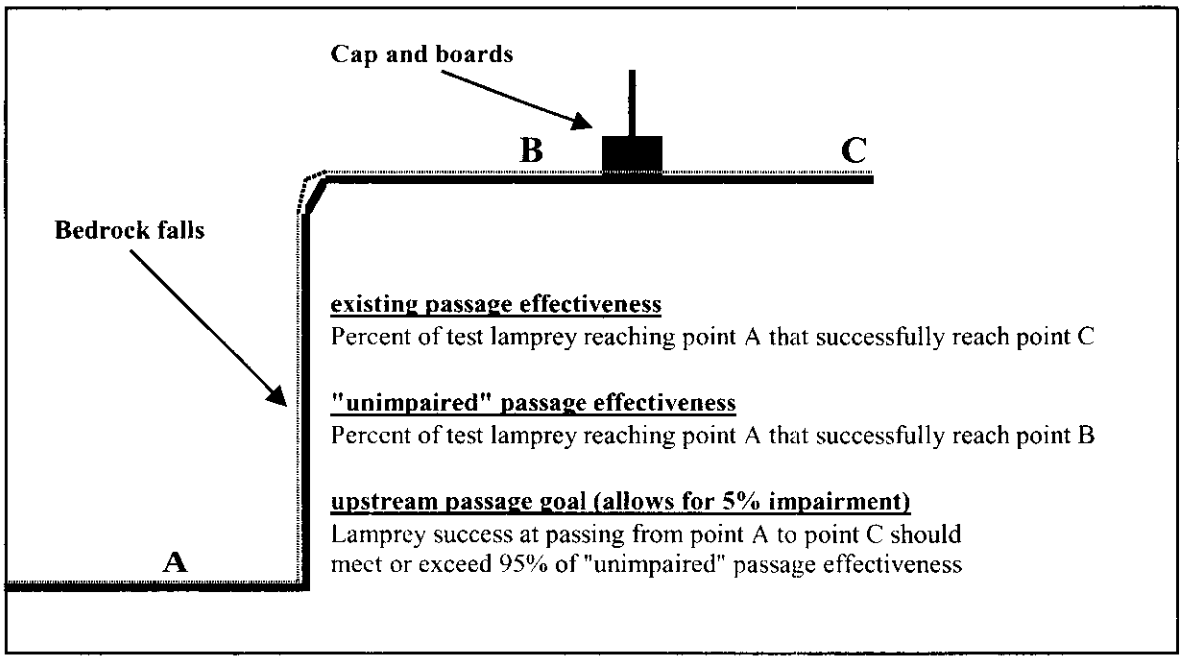

Figure 1. Conceptual approach to developing an upstream passage goal for Pacific Lamprey at Willamette Falls.

APPENDIX 5

Comprehensive List of Fishery Resource Measures by Structure

A. T.W. Sullivan Powerhouse

Tier 1 (Pre-license: present to January 2005)

Environmental Measures

- Implement shutdown priorities for TWS turbine units to maintain FGE during periods of low flow based on forebay modeling.
- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon bypass construction in 2005.
- Remove selected bars at headgate trashracks for adult downstream passage.

Design Work / Modeling/Analysis

- Model TWS forebay, including changes for the guide wall and siphon bypass; model runs to include a range of forebay flows, selected unit(s) offline, and trash rack spacing.
- Small scale model and preliminary design of siphon bypass to support construction in 2005
- Design trash rack cleaning system to support construction in 2005.
- Clarify how rights for the additional water needed for siphon bypass operations will be addressed.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards

Monitoring and Evaluations

- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Assess presence and condition of juvenile lamprey guided through the TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing)
- Perform turbine index/efficiency testing for replaced runners (2 per year), and operate replaced and existing runners within peak efficiency band based on consultation with fish agencies. Mortality test new runner design as applicable.

Tier 2 (Planned post-license measures; final testing to be completed by 2008)

Environmental Measures

- Siphon bypass constructed (2005)
- Implement PIT technology in the siphon bypass.
- Trash rack cleaning system installed (2005).
- Modify Unit 12 and 13 discharge to reduce predator-holding areas after implementation of siphon bypass. (2006)
- Modify or replace existing bypass outfall in tailrace to meet NMFS criteria (2006.)
- Implement TWS shutdown program when fish protection facilities are not functioning per agreed upon schedule. (greater than two weeks during July 1 to July 31 period).
- If Unit 1 off-line for >24hrs during upstream salmonid migration period, then remaining turbine units will be shutdown. (2005 and on)

- Rehabilitate the Unit 13 fish bypass system by adding a new large volume PIT tag detection system in the bypass discharge to allow PIT tag interrogation in both bypass and sampling mode.

Monitoring and Evaluations

- Evaluate FGE and mortality and injury for smolts (spring chinook, steelhead), salmonid fry, and juvenile lamprey after implementation of siphon bypass, to include effects of turbine passage and turbine shutdown sequencing on fish guidance. Three years of fall and spring testing starting in the fall of 2005 or 2006.
- Verify the effects of turbine selected unit shutdown on FGE during low flow periods to verify physical model results.
- Assess the detection efficiency of new PIT tag detector installed in Unit 13 bypass (non-sampling route) and siphon bypass.
- Assess upstream passage effectiveness for adult salmonids (project-level evaluation) after siphon bypass is installed and operating.
- Hydraulic evaluation of tailrace after modification of Units 12 & 13 discharge.
- Assess the injury and mortality of downstream migrant steelhead kelts and adult lamprey after passage through the siphon bypass.
- Upgrade the avian predation deterrents in place at the T.W. Sullivan tailrace and install avian deterrents in the forebay after the siphon bypass has been installed.

Tier 3 (Post-license measures to be implemented if Tier 2 measures are insufficient. Order of implementation, assessing the protective value to the resource, and a review of additional options would occur before construction. Implementation would begin no later than 2009 unless agreed to by the FTC.)

Environmental Measures

- Assess injury/mortality of fish caused at TWS's 2-inch spaced trashracks, and implement new rack system if indicated as reducing mortality (wider/narrower bars, solid/perforated plate, angled/straight bars)
- Behavioral deterrent devices (strobe/acoustic)
- Eicher screen installed in Unit 12 and linked to Unit 13 bypass/evaluator, if the existing Eicher screen is favorable for juvenile lamprey passage.
- Other bypass structure/equipment upgrades as identified.

Monitoring and Evaluations

- Performance monitoring as needed for modifications made.

Tier 4 (This is an open-ended list of options in the event that Tier 3 measures are not sufficient to meet standards. This would begin not more than 10 years after the new license is finalized unless agreed to by the FTC.)

- Criteria Screening.
- Seasonal shutdowns during salmonid migration periods.
- Project decommissioning.
- Other options as determined.

B. Willamette Falls

Tier 1 (Pre-license: present to January 2005)

Environmental Measures

- Remove 150 feet of flashboards at the Falls apex no later than October 1 prior to start of construction of the controlled flow structure at Falls apex.
- Place lamprey passage devices at the cap (minimum of 2) when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Provide "Wet Hole" egress

Design Work / Modeling / Analysis

- Assess ladder entrance #1 for compliance with NMFS criteria. Consult with NMFS, USFWS and ODFW on action plan for ladder entrance #1.
- Assess constraints and begin design of a controlled flow structure at the Falls apex including use of an upstream CFD model. Capacity goal is 15,000 cfs.
- Convene lamprey expert group and design upstream lamprey research study for implementation in 2005.

Monitoring and Evaluations

- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.
- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing.004).

Tier 2 (Planned post-license measures; final testing to be completed in 2009)

Environmental Measures

- Construct controlled flow structure at Falls apex and make minor downstream landing area improvements associated with the controlled flow structure. (2006/2007)
- Install avian predation deterrents below the horseshoe section of the Falls. (2006)
- Begin implementing Willamette Falls fish ladder entrance #1 modifications, O&M task list and stranding plan. (2005)
- Consult with FTC to implement new or improved (such as existing ladders) passage for adult lamprey passage as indicated by research efforts.

Monitoring and Evaluations

- Provide funding for Lamprey research effort at the Falls (2 year effort beginning in 2005)
- Small-scale physical model to aid design of controlled flow structure at apex of Falls and to assess/avoid potential adverse impacts that the controlled-flow structure might have on the ability of fish to locate the Willamette Falls fish ladder entrances. (Note: model construction in 2005). Include potential impacts on water quality (i.e. TDG, etc.) from the installation of the controlled-flow structure.
- Perform injury and mortality testing (for juvenile downstream migrants) through the controlled-flow structure.
- Assess the efficiency of the avian predation-deterrents installed below the Falls.
- Assess the fate of downstream migrant steelhead kelts and adult salmonids classified as fallback at the controlled-flow structure.
- Evaluate the controlled-flow structure to ensure it is not compromising the adult salmonid guidance to the adult fish ladder entrances.
- Assess overall upstream passage effectiveness for lamprey including benefits of trap-and-haul and/or capture-and-haul program.

Tier 3 (Post-license measures to be implemented if Tier 2 measures are insufficient. Order of implementation, assessing the protective value to the resource, and a search for additional options would occur before construction. Implementation would begin no later than 2010 unless agreed to by the FTC.)

Environmental Measures

- Major modifications to the downstream/landing area of the flow-control structure(s) to improve downstream migrant survival.

Monitoring and Evaluations

- Evaluate any operational changes made in Tier 3.
- Evaluate physical changes made at the Falls or controlled-flow structure(s).

Tier 4 (This is an open-ended list of options in the event that Tier 3 measures are not sufficient to meet standards. (not more than 10 years after the new license is finalized unless agreed to by the FTC.)

- Decommissioning and removal of the dam on Willamette Falls.
- Additional structure at Falls if improved juvenile passage is still needed at the Falls.
- Other options as determined.

APPENDIX 6

Implementation Timeline

The Parties agree to the following implementation timeline associated with the T.W. Sullivan and Willamette Falls PM&E measures. The intent of the following timeline is to complement Section IV (Implementation Sheets for T.W. Sullivan and Willamette Falls measures).

PRE LICENSE ISSUANCE

2003
T.W. Sullivan

- Model TWS forebay, including changes for the guide wall and siphon bypass; model runs to include a range of forebay flows, selected unit(s) offline, and wider trashrack spacing.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards
- Clarify how rights for the additional water needed for siphon bypass operations will be addressed.
- Implement shutdown priorities for TWS turbine units to maintain good FGE during periods of low flow based on forebay modeling.

Willamette Falls

- Assess constraints for a control flow structure designed for 15,000 cfs as desired capacity
- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.
- Place lamprey passage devices at the cap (minimum of 2) when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Assess fish ladder entrance #1 for NMFS entrance criteria

2004
T.W. Sullivan

- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon bypass construction in 2005.
- Remove selected bars at headgate trashracks for adult downstream passage.
- Small scale model and preliminary design of siphon bypass to support construction in 2005
- Design trash rack cleaning system to support construction in 2005.
- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Assess presence and condition of juvenile lamprey guided through TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing)
- Perform turbine index/efficiency testing for replaced runners (2 per year), and operate replaced and existing runners within 1% of peak efficiency based on consultation with FTC. Mortality test new runner design as applicable.

Willamette Falls

- Remove 150 feet of flashboards at the Falls apex NLT October 1 prior to the start of construction of the controlled flow structure at Falls apex.
- CFD modeling of Controlled Flow Structure upstream flow field extent.
- Provide "Wet Hole" egress
- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing

POST FINAL LICENSE

2005
T.W. Sullivan

- Complete design and construct siphon bypass, to include any additional forebay modifications, not completed in 2004, identified by physical forebay model.
- Upgrade Unit 13 fish bypass system by adding and assessing a new large volume PIT tag detection system in the bypass discharge to allow PIT tag interrogation in both bypass and sampling mode. This will improve monitoring and evaluation capabilities.
- If technically possible, implement and assess PIT technology in the siphon bypass to improve monitoring and evaluation capabilities. (ongoing based on technical capabilities)
- Trash rack cleaning system installed. (2005/2006)
-
- Implement TWS shutdown program when fish protection facilities are not functioning per agreed upon schedule. (greater than two weeks during July 1 to July 31 period).
- Evaluate FGE and mortality and injury for smolts (spring chinook, steelhead), salmonid fry and juvenile lamprey after implementation of siphon bypass, to include effects of turbine passage and turbine shutdown sequencing on fish guidance. Three years of fall and spring testing starting in the fall of 2005 or 2006.
- If Unit 1 off-line for >24hrs during upstream salmonid migration period, then remaining turbine units will be shutdown. (2005 and on)

Willamette Falls

- Begin design of Controlled Flow Structure, to include small-scale physical model (2005). Physical modeling will assess methods for preventing contribution to high TDG.
- Assess overall upstream passage effectiveness for lamprey including benefits of trap-and-haul and/or capture-and-haul program.
- Begin implementing Willamette Falls fish ladder O&M task list and stranding plan.

2006
T.W. Sullivan

- Modify Unit 12 and 13 discharge to reduce predator-holding areas after implementation of siphon bypass.
- Modify or replace existing bypass outfall in tailrace.
- Upgrade avian predation deterrents in T.W. Sullivan tailrace and
- Observational data collection on juvenile lamprey, and as new technology becomes available and proven, participate in implementing juvenile lamprey bypass efficiency studies.
- Assess downstream migrant steelhead kelts after passage through the siphon bypass.

Willamette Falls

- Install controlled flow structure at Falls Apex. (2006/2007)
- Install avian predation deterrents in horseshoe area of Falls (2006-2007)
- Initiate injury and mortality testing through the controlled-flow structure at the Falls.
- Assess downstream migrant steelhead kelts and adult salmonids classified as fallback at the controlled-flow structure.
- Evaluate the controlled-flow structure to ensure it is not compromising the adult guidance to the adult fish ladder entrances.

- Evaluate the impacts on water quality (i.e. TDG, etc.) from the operation of the controlled-flow structure.

2007
T.W. Sullivan
- Hydraulic evaluation of tailrace after modification of Units 12 & 13 discharge and siphon bypass installation.
- Verify the effects of turbine selected unit shutdown on fish guidance FGE during low flow periods to verify physical model results.

Willamette Falls
- Assess the effectiveness of the avian predation-deterrents installed below the Falls and in the T.W. Sullivan tailrace. (2007/8)

2008
Willamette Falls
- Based on performance testing of controlled flow structure, make minor modifications to downstream landing area to meet standards as needed. Test after modification(s)

2009
Willamette Falls
Evaluate modifications made associated with control flow structure

2010
(Note: Exact implementation timeline of the following items will be determined as need is identified. Post modification testing performed by this time will provide information to help identify which measures would be meaningful. Anticipated timeframe is 3-5 years.)

T.W. Sullivan
- Assess injury/mortality of fish caused at TWS's 2-inch spaced trashracks, implement new rack system if indicated as reducing mortality (wider/narrower bars, solid/perforated plate, angled/straight bars)
- Behavioral deterrent devices (strobe/acoustic)
- Eicher screen installed in Unit 12 and linked to Unit 13 bypass/evaluator.
- "Fish Friendly" runner replacements on all/selected Units.
- Other bypass structure/equipment upgrades as identified.
- Performance monitoring as needed for modifications made.

Willamette Falls
- Assess options associated with control flow structure (ie, major modification to landing area, additional structure locations)

2015
Re-engage Parties to determine next steps

EXHIBIT C

INTERIM MEASURES

Exhibit C

Interim Measures

This Exhibit lists those measures ("Interim Measures"), described in detail in the Relicensing Implementation Plan attached to the Settlement Agreement as Exhibit B, that PGE shall implement promptly upon the Effective Date of this Agreement and that PGE shall continue to implement regardless of any delay in issuance of the New License.

2003
T.W. Sullivan

- Model TWS forebay, including changes for the guide wall and siphon spillway; model runs to include a range of forebay flows, selected unit(s) offline, and wider trashrack spacing.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards
- Clarify how rights for the additional water needed for siphon spillway operations will be addressed.
- Implement shutdown priorities for TWS turbine units to maintain good FGE during periods of low flow based on forebay modeling.

Willamette Falls

- Assess constraints for a control flow structure designed for 15,000 cfs as desired capacity
- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.
- Place lamprey passage devices at the cap (minimum of 2) when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Assess fish ladder entrance #1 for NMFS entrance criteria

2004
T.W. Sullivan

- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon spillway construction in 2005.
- Remove selected bars for headgate trashracks for adult downstream passage.
- Small scale model and preliminary design of siphon bypass to support construction in 2005
- Design trash rack cleaning system to support construction in 2005.
- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Assess presence and condition of juvenile lamprey guided through TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing)
- Perform turbine index/efficiency testing for replaced runners (2 per year), and operate replaced and existing runners within peak efficiency band based on consultation with fish agencies. Mortality test new runner design as applicable.

Willamette Falls

- Remove 150 feet of flashboards at the Falls apex no later than October 1 prior to the start of construction of the controlled flow structure at Falls apex.
- CFD modeling of Controlled Flow Structure upstream flow field extent.
- Provide "Wet Hole" egress
- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing.

Tier 1 (Pre-license: present to January 2005)

A. T. W. Sullivan Powerhouse

Environmental Measures

- Implement shutdown priorities for TWS turbine units to maintain good FGE during periods of low flow based on forebay modeling.
- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon spillway construction in 2005.
- Remove selected bars at headgate trashracks for adult downstream passage.

Design Work / Modeling/Analysis

- Model TWS forebay, including changes for the guide wall and siphon spillway; model runs to include a range of forebay flows, selected unit(s) offline, and trash rack spacing.
- Small scale model and preliminary design of siphon bypass to support construction in 2005
- Design trash rack cleaning system to support construction in 2005.
- Clarify how rights for the additional water needed for siphon spillway operations will be addressed.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards

Monitoring and Evaluations

- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Assess presence and condition of juvenile lamprey guided through the TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing)
- Perform turbine index/efficiency testing for replaced runners (2 per year), and operate replaced and existing runners within peak efficiency band based on consultation with fish agencies. Mortality test new runner design as applicable.

B. Willamette Falls

Environmental Measures

- Remove 150 feet of flashboards at the Falls apex no later than October 1 prior to the start of construction of the controlled flow structure at Falls apex.
- Place lamprey passage devices at the cap (minimum of 2) when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Provide "Wet Hole" egress

Design Work / Modeling / Analysis

- Assess ladder entrance #1 for compliance with NMFS criteria. Consult with NMFS, USFWS and ODFW on action plan for ladder entrance #1.
- Assess constraints and begin design of a controlled flow structure at the Falls apex including use of an upstream CFD model. Capacity goal is 15,000 cfs.
- Convene lamprey expert group and design upstream lamprey research study for implementation in 2005.

Monitoring and Evaluations

- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.
- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing.

APPENDIX A

BIOLOGICAL EVALUATION

WILLAMETTE FALLS HYDROELECTRIC PROJECT

BIOLOGICAL EVALUATION

Prepared By
PORTLAND GENERAL ELECTRIC
121 SW Salmon Street
Portland OR 97219

With Technical Assistance from
STILLWATER SCIENCES
850 G Street
Arcata CA 95521
(707) 822-9607

November 2003

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1 INTRODUCTION

The Willamette Falls Hydroelectric Project is operated under a Federal Power Act license issued by the Federal Energy Regulatory Commission (FERC), the term of which will expire on December 31, 2004. The Project consists of two hydropower developments: the T.W. Sullivan Hydroelectric Development operated by Portland General Electric (PGE), and the Blue Heron Development operated by Blue Heron Paper Company (BHPC). The Project license is held jointly by PGE and BHPC, although PGE and BHPC have applied for FERC permission to transfer Blue Heron's interest to PGE. The licensees have initiated a relicensing process, as described more fully below. Accordingly, PGE is the "applicant" for Endangered Species Act (ESA) Section 7 consultation and conference for the proposed new license. PGE is FERC's designated non-federal representative for this consultation and conference.

Section 7 of the ESA requires federal agencies to consult with the U.S. Fish & Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) when a proposed agency action "may affect" a species listed as threatened or endangered under the Act, or may affect designated critical habitat for such species. A Section 7 conference is required if the proposed action may jeopardize species proposed for listing, or may adversely modify or destroy proposed critical habitat. The purpose of a Biological Assessment (BA) is to evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and to determine whether any such species or their critical habitat is likely to be adversely affected by the action. The ESA requires the BA to be based on the best scientific and commercial data available. As the FERC's designated nonfederal representative, PGE has developed this "Biological Evaluation" (BE) to examine the potential effects of the Project.

1.1 Status of FERC Relicensing

The current license for the Willamette Falls Project was issued on July 24, 1964, with an effective date of January 1, 1955, for a period of 50 years. The license expires on December 31, 2004. At issuance, license holders included PGE for its T.W. Sullivan Development, Blue Heron Paper Company (formerly Smurfit Newsprint Corporation) for its Blue Heron Development, and Simpson Paper Company. Simpson, however, removed its hydroelectric generating facilities from service in 1996 and has been removed from the current license. This request was approved by a FERC order dated January 3, 2001 (Docket Number P-2233-034).

Under the authority of the Federal Power Act, a new license for up to 50 years may be issued. Under FERC's regulations, a licensing decision requires preparation of an environmental analysis in accordance with the National Environmental Policy Act (NEPA) of 1969, and the Council on Environmental Quality's guidelines (40 CFR Part

1500). In accordance with FERC regulations for licensing hydroelectric projects using the Applicant Prepared Environmental Assessment (APEA) alternative process, the Applicants filed a license application that included a preliminary draft Environmental Assessment (pDEA) that analyzed the issues raised during the scoping process and the pre-filing consultation. FERC will evaluate the pDEA and, if it meets approved criteria and standards, issue its own draft EA (DEA) for comment, followed by a final EA (FEA) when its licensing decision is made.

If a new license is not issued by the time the current license expires, the Project would operate under an annual license, typically in accordance with the terms and conditions of the original license order. Alternatively, the participants could agree to begin implementing certain mitigation and enhancement measures while operating under an annual license, anticipating that the measures would be similar (if not identical) to requirements contained in a new license.

In 1997, the Applicants began discussions with resource agencies and potential relicensing participants (participants) to develop a relicensing process for the Willamette Falls Project. Meetings were held both individually and collectively with relicensing participants. Meetings initially focused on providing the information necessary to understand both traditional and alternative relicensing processes available and their advantages and disadvantages. Over time, support for an alternative process developed to the point that the Applicants engaged participants in preparing process documents that accompanied PGE and Blue Heron's September 1, 1998, request to FERC to conduct an alternative relicensing process; specifically, an APEA process was selected for Willamette Falls.

The APEA process integrates pre-filing consultation with FERC's environmental review process. This allows an applicant for a new license to prepare an environmental assessment in consultation with agencies and interested parties at the same time as the license application is being prepared. FERC reviewed and approved the proposed APEA process for Willamette Falls on December 10, 1998. In December 1998 the Initial Information Package was distributed. The NEPA scoping of the issues began in February 1999 and continued throughout 1999. During this period, the relicensing participants, consisting of state and federal resource agencies, local government officials, Indian tribes, non-governmental organizations (NGOs), members of the public, and the Applicants, held numerous meetings to identify resource issues to be addressed during the relicensing process. These issues were presented in Scoping Document 1 (SD1). SD1 was distributed to relicensing participants on December 14, 1999, with formal public scoping meetings held on February 6, 2000. In June 2001 Scoping Document 2 (SD2) was distributed. SD2 incorporated comments provided by the public and the relicensing participants in their oral or written comments on SD1. A draft application was submitted in December 2001 with a final application, reflecting draft application comments and continued study results and participant input, in December 2003. The Applicants and participants engaged in settlement discussions in 2002 to resolve outstanding fishery resource issues and determine necessary Protection, Mitigation and Enhancement (PM&E) measures, which are described and analyzed in this BE.

1.2 The Willamette Falls Fish, Aquatics, and Terrestrial Workgroup

The Willamette Falls APEA process was approved by FERC in December 1998. The Fish, Aquatics, and Terrestrial Workgroup was convened for the Willamette Falls Hydroelectric Project relicensing process in 1999. The workgroup includes representatives from various federal, state, and resource management agencies, universities, non-government organizations, Native American groups, conservation groups, members of the public, and the Applicants. The workgroup's role is to identify issues and concerns pertinent to the Project that will be considered during the relicensing process. The workgroup identified, scoped, and conducted assessments and/or studies completed as part of relicensing. NOAA Fisheries and USFWS were active participants in the relicensing workgroups and, as such, contributed to identifying and designing studies that assessed the effects of the Project on listed and proposed species, and have contributed to identifying appropriate measures included in the new license application and subsequent Settlement Agreement to address Project impacts.

1.3 Section 7 Consultation and Conferencing

Section 7 of the ESA requires federal agencies to consult with NOAA Fisheries and/or USFWS when a proposed agency action "may affect" a species listed as threatened or endangered under the Act, or may affect designated critical habitat for such species. A Section 7 conference is required for activities which are likely to jeopardize the continued existence of species that have been proposed for listing, or are likely to adversely modify or destroy proposed critical habitat. The purpose of a Biological Assessment (BA) is to evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and to determine whether any such species or their critical habitat is likely to be adversely affected by the action. The ESA requires the BA to be based on the best scientific and commercial data available.

The action for which Section 7 consultation will be initiated is FERC's relicensing proposal. Incidental take coverage is therefore requested for potential take of listed species resulting from the operation of the Project for the term of the new license, and under the terms and conditions of the new Project license. The take for which coverage is sought through this consultation includes take resulting from the performance of conservation and other measures (referred to as "Protection, Mitigation and Enhancement Measures (PM&E's)" that would be required under the license.

2 DESCRIPTION OF THE PROPOSED ACTION AND AREA OF ANALYSIS

2.1 Proposed Action

PGE is seeking a new federal license for the continued operation of Willamette Falls Hydroelectric Project. The purpose of this action is to comply with the Federal Power Act (FPA), which requires a license for the construction, operation, and maintenance of non-federal hydroelectric projects. The need for this action is to provide a continuing and reliable source of electrical energy for PGE to use in serving the needs of its customers.

The proposed federal action under consideration is the Commission's decision on issuing a new Project license for the Willamette Falls Hydroelectric Project and what the conditions of that license would be. The purpose for this action is to determine whether to grant a new license for the continued operation and maintenance of hydroelectric and related facilities in compliance with FPA requirements and other laws. The FPA authorizes FERC to regulate the licensing of non-federal hydroelectric projects. In deciding whether to issue a license for a hydroelectric project the Commission must determine that the Project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued, the Commission must give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of fish and wildlife including related spawning grounds and habitat. Providing equal consideration to these resources balances the interests of the public, regulatory agencies, and the applicant. To minimize the effects of the new FERC license on listed species and their designated critical habitat, PGE proposes to implement Protection, Mitigation and Enhancement Measures (PM&E's) as conditions of the license application. A description of the measures being considered is provided in Section 3.

2.2 Area of Analysis

The Project analysis area includes the entire Willamette River, and all tributaries upstream of Willamette Falls. The cumulative effect analysis area includes the entire Willamette River watershed (Figures 1 and 2).

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3 PROPOSED CONDITIONS OF THE NEW LICENSE

Background
Since the operation of the Project under the new license will have the potential to affect listed, proposed, and candidate species, a set of measures has been identified to provide for the conservation of these species during the period of the new FERC license. The Applicants have worked with the Willamette Falls Fish, Aquatics, and Terrestrial Workgroup to identify, design, and implement studies to quantify the effects of operation of the Willamette Falls Hydroelectric Project on protected salmonids. Based on these and previous studies, PM&E's were developed and proposed in the final license application in December 2002, and an August 2003 supplemental filing, to reduce take of protected salmonids.

During an extensive collaborative process, environmental PM&E's were identified for the relicensing of the Project that will provide the applicant flexibility to improve fish passage at its facilities, while at the same time providing the participants certainty regarding the level of resource protection that will be achieved. To that end, clearly stated enforceable performance standards were adopted for this Project, where applicable. Where standards were not adopted, performance goals or targets were identified. A strong Monitoring and Evaluation program will ensure that the PM&E's will function effectively to meet the performance standards and goals. If the performance standards or goals are not effectively met, the PM&E's will guide decision to implement alternative measures described within this alternative.

3.1 Performance Standards and Goals

3.1.1 Performance standards

3.1.1.1 Downstream passage of salmonids

Juvenile salmonid passage through the T.W. Sullivan Powerhouse
Table 3-1 sets out the performance standard levels for downstream passage of juvenile salmonids at the T.W. Sullivan powerhouse within the Willamette Falls Project. Also listed in Table 3-1 are the corresponding tiers of management actions to be taken as determined by the level of performance standard achieved. A comprehensive list of the PM&E measures and Monitoring and Evaluation program components referred to in Table 3-1 are provided in Appendix A.

Table 3-1. Performance standards for juvenile salmonid downstream passage at the T.W. Sullivan powerhouse.

Smolts >60 mm in Length		Fry <60 mm in Length		Actions, to include both Environmental Measures and Monitoring and Evaluation listed in Section 3.3
Mortality	**Injury**	**Mortality**	**Injury**	
Design performance objective ≤0.5% mortality	Design performance objective ≤2% injury	Design performance objective ≤2% mortality	Design performance objective ≤4% injury	Objective met. No further measures required
Actual mortality >0.5% but ≤2% would require additional work to lessen mortality	Actual injury >2% but ≤4% would require additional work to lessen injuries	Actual mortality >2% but ≤4% would require additional work to lessen mortality	Actual injury >4% but ≤6% would require additional work to lessen injuries	• Tier 1 (pre-new license actions) and Tier 2 actions implemented per schedule.
Actual mortality >2% would require major operational or structural changes	Actual injury >4% would require major operational or structural changes	Actual mortality >4% would require major operational or structural changes	Actual injury >6% would require major operational or structural changes	• Tier 3 actions implemented as needed and meaningful to improve performance. • Tier 4 actions implemented if performance after Tier 3 items is not satisfactory.

The PM&E measures listed in Appendix A are categorized into four tiers according to planned timing of implementation and which level of performance standard is being addressed. Tier 1 measures are to be completed prior to new license issuance. No performance testing is planned after Tier 1 measures.

Tier 2 measures are to be completed after new license issuance. At the T.W. Sullivan powerhouse, measurement of downstream passage performance for evaluation using the standards listed in Table 3-1 will be initiated after installation of the bypass siphon, the earliest Tier 2 measure (see Appendix A). Remaining Tier 2 items will be implemented with associated performance measurement according to the timeline in Appendix B. If measured performance meets the second level of performance standards specified in Table 3-1 after Tier 2 items are implemented, no Tier 3 measures are required. Additional minor improvements designed to achieve further measurable mortality reduction, will still be pursued while the second level of performance standards continues to be met.

If measured performance does not meet the second level of performance standards specified in the Table 3-1 after Tier 2 measures performance testing is completed (no later than 2009 unless agreed to by the Fish Technical Committee [FTC; see Section 3.2, below]), Tier 3 measures will be initiated with appropriate and agreed-to performance testing. Performance of Tier 2 measures will guide the Tier 3 implementation (for example, if no fish are passing Unit 12 after Tier 2 measures, installing an Eicher screen in Unit 12 would not improve downstream survival).

If measured performance still does not meet the second-level performance standards specified in Table 3-1 after Tier 3 implementation, Tier 4 would be initiated (no later than 2015 unless agreed to by the FTC) depending on measures identified and implemented under Tier 3.

Juvenile salmonid passage through the Controlled Flow Structure
PGE shall design and operate the controlled flow structure to achieve at least a 97% survival standard for juvenile salmonids passing the Project via the controlled flow structure. This standard is based on results of juvenile fish survival studies conducted at spillways at mainstem Columbia River dams.

3.1.1.2 Downstream passage standards for juvenile Pacific lamprey

If a technology-based standard for Pacific lamprey survival and injury avoidance is developed and regionally adopted by the U.S. Fish and Wildlife Service (USFWS) during the term of the new license, PGE shall adopt the standard at the T.W. Sullivan powerhouse and shall consult with the FTC regarding measures needed to comply with the standard.

3.1.2 Performance goals

Table 3-2 sets out the performance goals for upstream and downstream passage of Pacific lamprey and adult salmonid migrants at the Willamette Falls Project.

Table 3-2. Passage Goals for the passage of Pacific lamprey and adult salmonids at the Willamette Falls Project.

Fish species/lifestage	Type of passage	Performance Goal
Juvenile lamprey	Downstream through the powerhouses	"safe, timely, and effective" qualitative goal without serious injury or mortality
Juvenile lamprey	Downstream over the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality: Assumed adequate when the standard for juvenile salmonid smolts is met at the spillway (at least 97% survival), until appropriate technology is developed to assess lamprey survival over the controlled flow structure.

Adult lamprey	Upstream through the project area	"safe, timely, and effective" qualitative goal without serious injury or mortality. Goal to be further developed through PGE funded study described in Appendix C.
Adult lamprey	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality
Adult salmonids	Upstream through the project area	"safe, timely, and effective" qualitative goal without serious injury or mortality
Steelhead kelts (i.e., post-spawning adults) and Fall Back (adult salmonids)	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/Falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality

3.2 Consultation and Decision Making — Fish Technical Subcommittee

In order to provide a framework for consultation and decision making during the term of the new license, PGE shall establish a Fish Technical Committee (FTC), which will consist of technical representatives from each party to the Willamette Falls Settlement Agreement (Settlement Agreement). Through this consultation and decision making, PGE and the FTC will make a good faith effort to reach consensus on decisions that need to be made associated with the measures contained in this Implementation Plan The operation of the FTC, including the resolution of disputes, will be governed by the Settlement Agreement. The following terms regarding consultation are defined below:

Consultation with the FTC. Where "Consultation with the FTC" is specified, PGE shall prepare written draft materials for formal review and comment by the FTC. FTC members will have at least 30 days to provide written comments, and PGE shall incorporate those comments into the written materials, modifying them to respond to the comments, or indicating why the comments were not accepted. A final version of the materials will be provided to the FTC and, where required by the terms of the new license, to FERC for its approval. If a FTC member believes that the report, as filed, does not satisfy the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement.

Consultation with the FTC and Approval by the Fish Agencies. Where "Consultation with the FTC and Approval by the Fish Agencies" ("Consultation and Approval") is specified, PGE shall prepare written draft materials for formal review and comment by the FTC. FTC members – other than the Fish Agencies – will have at least 30 days to provide written comments, and PGE shall incorporate those comments into the written materials, modifying them to respond to the comments, or indicating why the comments were not accepted. In addition, the Fish Agencies will provide a formal approval (or disapproval) of the materials submitted. A final version of the materials will be provided to the FTC and, where required by the terms of the new license, to FERC for its approval. If PGE, or another FTC member, believes that an agency approval or lack thereof, is inconsistent with the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement.

Time-Critical Consultation. Where "Time-Critical Consultation" is specified, PGE shall provide email, or phone, notice to the FTC that a particular matter requires an immediate decision by the Fish Agencies. The notice will indicate when and where the consultation will take place and the nature of the approval PGE shall seek from the Fish Agencies. PGE shall implement the action approved by the Fish Agencies. In the event that no Fish Agency is able to participate in the consultation, PGE shall take such action, as it deems appropriate. Due to the time-critical nature of the action being implemented, there will be no opportunity to seek dispute resolution prior to implementation of the specific action that is the subject of the time-critical consultation. However, if an FTC member believes that the action being implemented does not satisfy the requirements of the new license or the Implementation Plan, it can refer the matter to dispute resolution in accordance with the Settlement Agreement, the result of which may be applied if another time-critical consultation on this matter were required.

3.3 Protection, Mitigation, and Enhancement (PM&E) Measures

As noted above in Section 3.1, PM&E measures to be implemented by PGE at the Project for fish protection are structured in a tiered format. The tiers identify which measures are implemented during the current license period (Tier 1) or immediately after the new license is finalized (Tier 2). If measured performance does not meet the standards identified in Section 3.1 (Table 3-1), Tier 3, and potentially Tier 4, measures would be implemented in consultation with the FTC.

PGE, in consultation with the FTC, will develop Monitoring and Evaluation plans to determine the effectiveness of each of the PM&E measures. The Settlement Agreement will describe review and approval authority over plans and resolution of any disputes arising from the development of the Monitoring and Evaluation plans. Each Monitoring and Evaluation plan will address the following areas:

- Identification of the PM&E measure
- Statement of the specific issue being addressed
- The applicable performance standard or goal
- Performance monitoring and evaluation methodology and procedures
- Schedule, reflecting the importance and need for timely study plan development, reviews, and reporting of results

- Identification and evaluation of subsequent measures and/or actions

3.3.1 Downstream passage

3.3.1.1 T.W. Sullivan Powerhouse

Juvenile salmonids
Appendix A provides a detailed list of the PM&E measures that will be implemented at the Project to meet the downstream salmonid standards specified in Section 3.1. Agreed-upon measures to address juvenile salmonid passage at the T.W. Sullivan powerhouse are:

1) Forebay rack and guidewall hydraulic modifications (2004).

PGE shall make necessary modifications to Unit 1, 2, 3 forebay trashracks and forebay guidewall, as identified through physical forebay modeling already completed, to improve forebay hydraulic characteristics. PGE shall modify racks and the guidewall in the T.W. Sullivan forebay in accordance with physical forebay modeling done by ENSR in 2002 and 2003. Modifications involve eliminating areas of swirl or velocity changes along the forebay through physical rack changes, additions, and guidewall relocation and extension.

2) T.W. Sullivan Siphon Bypass (2005)

An additional bypass route will be provided for fish entering the T.W. Sullivan forebay. The siphon bypass will work in conjunction with previous forebay modifications to improve forebay hydraulics and guidance of salmonid smolts, fry and juvenile lamprey, as well as adult salmonids (kelts and fallback) away from T.W. Sullivan's turbines. Discharge of the siphon bypass in the tailrace will also eliminate potential aquatic predator habitat along the north tailrace shoreline. PGE shall install and operate an additional downstream migrant bypass route through the siphon spillway, located adjacent to Unit 13, conceptually designed to pass a continuous flow of at least 500 cfs of flow directly from the forebay to the tailrace during powerhouse operation, in consultation with the FTC and approval by the Fish Agencies. (Actual capacity will be determined through physical modeling in 2004 and associated hydraulic analysis. Design goal is at least 500 cfs.) PGE shall modify the siphon spillway in accordance with physical forebay modeling done in 2004 in consultation with the FTC. Modification involves the installation of a flow control weir, conceptually designed for a continuous flow of at least 500 cfs, in the siphon spillway to provide a bypass flow from the forebay to the tailrace during powerhouse operation.

3) Forebay Trash Rack Cleaning System (2005/6)

Routinely removing river debris from trashracks within the T.W. Sullivan forebay will help maintain good hydraulic conditions conducive to guidance of fish to the Unit 13 and siphon bypass systems, and reduce potential for adverse affects due to dirty/clogged racks. PGE shall install and operate a forebay trashrack cleaning system to ensure the forebay trashracks remain free of debris build-up that could adversely affect fish guidance efficiency (FGE) and downstream migrant survival, in consultation with the FTC and approval by the Fish Agencies.

4) Selected Unit shutdown (w/ validation after forebay modifications) (2004)

When selected unit shutdowns are necessary, PGE shall first shut down units that have the least negative effect on forebay hydraulics, as determined through physical forebay modeling in consultation with FTC. Subsequent FGE or outmigrant survival testing may identify different units to selectively shutdown.

5) Unit 13 maintenance shutdowns (2005)

PGE shall limit maintenance shutdown of Unit 13, which provides downstream migrant bypass capability, to no longer than 2 weeks during the period July 1 to August 1. Powerhouse operation during a maximum 2-week Unit 13 shutdown during this period will not require fish agency permission. Continued powerhouse operation during Unit 13 shutdowns longer than 2 weeks during this period, or Unit 13 shutdowns outside of this period, will require Affirmative Fish Agency approval during time-critical consultation.

6) Unit 12 and 13 Discharge Flow Hydraulics (2006)

To reduce or eliminate potential predator aquatic habitats located in the T.W. Sullivan tailrace between the discharges of Units 12 and 13. PGE shall modify Unit 12 and 13 discharges to eliminate potential aquatic predator habitat, in consultation with FTC and approval by the Fish Agencies. PGE shall construct a physical structure between the Unit 12 and 13 discharges, which eliminates this area of slack water. The structure's shape will be such that discharge flow for each unit will join together, and with the overall tailrace flow, to avoid, or minimize, eddies that are favorable aquatic predator habitat.

7) Tailrace and forebay avian predation deterrents (2007)

To reduce the potential for avian predation of downstream migrants passing through the T.W. Sullivan powerhouse. PGE shall upgrade avian predation deterrents in the powerhouse tailrace and install avian predation deterrents in the forebay, in consultation with FTC and approval by the Fish Agencies. PGE shall add avian wire (or equivalent deterrent system) towards the downstream end of the forebay where downstream migrants are concentrated. PGE shall increase avian wire in the tailrace to expand the area of avian deterrence.

8) PIT Tag Interrogator System (2005).

Newer technology, and higher flow volume PIT tag interrogator systems on both the Unit 13 bypass outfall chute and the siphon bypass will improve the ability to monitor bypass system performance and outmigration fish passage. PGE shall install new passive integrated transponder (PIT) tag interrogator technology at the Unit 13 bypass and siphon bypass, in consultation with FTC and approval by the Fish Agencies, to ensure fish passage efficiency can be effectively measured and to guide decisions consistent with the tiered management approach. For the Unit 13 bypass system, PGE shall add a large area/flow volume PIT tag interrogator to the bypass flow outfall chute. This detection system will be in addition to the PIT detector system currently installed in the bypass system evaluation flow route, allowing detection of PIT-tagged fish in either bypass system mode. For the siphon bypass, PGE shall install a large area/flow volume PIT tag interrogator (or equivalent technology) in the siphon bypass flow route to allow detection of PIT-tagged fish passing the project via this route. Note: Installation in 2005 based upon a design and technology that will not conflict with the Unit 13 Bypass Outfall Modification (see item 9 below), otherwise it will be installed with the Unit 13 Bypass Outfall Modification.

9) Unit 13 Bypass Outfall Modification (2006)

The impact velocity of the T.W. Sullivan Unit 13 bypass system outfall flow will be reduced to within NOAA Fisheries standards to reduce the potential for bypassed fish injury, stress, and/or increased susceptibility to predation. PGE shall modify Unit 13 bypass outfall to meet National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) hydraulic impact velocity criteria, in consultation with FTC and approval by the Fish Agencies. PGE shall modify the existing outfall chute to slow the water velocity (i.e., use of corrugated materials) and discharge it closer to the tailrace water surface (i.e., lengthen chute or adjust with tailrace elevation).

10) Runner Replacements (2004)

Older turbine runners will be replaced with new runners. New runners would reduce gaps and improve efficiency. Peak efficiency point will be matched for operating conditions and units will be operated within 1% of peak efficiency for hydraulic conditions present to reduce potential for entrainment injury/mortality until FGE meets or exceeds 95%. PGE shall replace runners in Units 1–7 and 10–12 at a rate of two per year beginning in 2004 unless otherwise agreed to through consultation with the FTC and approval by the Fish Agencies. PGE shall index/efficiency test replaced runners. PGE shall operate replaced runners in accordance with an operational plan developed by PGE in consultation with the FTC, within 1% of peak efficiency, as determined by index/efficiency testing, for the existing hydraulic conditions (i.e., based on a 48-hr average of hydraulic conditions). When forebay FGE is at least 95% for salmonid smolts, PGE may request a change or end to this operating condition, subject to consultation with the FTC and approval by the Fish Agencies. Such consultation will consider available information on smolts, fry and juvenile lamprey, including necessary levels of protection, in addition to runner operation and performance information. Mortality testing, within 1 year of replacement and prior to additional unit replacements, will be conducted for any runner of a significantly different design than that installed in Unit 8.

11) Existing Turbine runner operation within 1% peak efficiency
PGE shall operate existing turbine runners, in accordance with an operational plan developed by PGE in consultation with the FTC, within 1% of peak efficiency based on manufacturers' curves for the existing hydraulic conditions (based on 48-hr average). When forebay FGE is at least 95% for salmonid smolts, PGE may request a change or end to this operating condition, subject to consultation with the FTC and approval by the Fish Agencies. Such consultation will consider available information on smolts, fry and juvenile lamprey, including necessary levels of protection, in addition to runner operation and performance information.

12) Powerhouse operation (including Unit 13 and Siphon bypass systems) in conjunction with Controlled Flow Structure at Falls apex (2005)

PGE shall develop an operation plan for T.W. Sullivan powerhouse, in consultation with FTC, to include the Unit 13 and siphon bypass systems, operation that is coordinated with the controlled flow structure at the Falls Apex (see 3.3.1.2), and specific operational measures to support the stranding management program (see section 3.3.4). Intent is to identify how best to operate the powerhouse and the controlled flow structure to ensure intended protection of downstream migrants over the Falls is provided by the structure and that powerhouse operation is not adversely affected (i.e., river flow is not diverted over the Falls in lieu of entering the T.W. Sullivan forebay, or river elevation is maintained too low to support full powerhouse operation).

Downstream passage assessment
The below assessments are intended to develop information in 2004 concerning the performance of the existing T. W. Sullivan bypass system as it relates to the presence and condition of salmonid fry and juvenile pacific lamprey, to include a field assessment of juvenile pacific lamprey impingement of the Eicher fish screen at Unit 13:

1. Salmonid Fry and Juvenile Pacific Lamprey presence and condition in the T.W. Sullivan bypass

PGE shall collect presence and condition data for salmonid fry and juvenile Pacific lamprey that are observed in the T.W. Sullivan bypass system as part of its annual fish count program.

2. Juvenile Pacific Lamprey Impingement on the Unit 13 Eicher Screen

In 2004, PGE shall determine the rate of impingement of juvenile Pacific lamprey on the existing Eicher screen utilizing juvenile Pacific lamprey from mainstem Columbia River bypass systems. PGE, in consultation with the FTC, will develop an appropriate assessment method and study plan. Potential methods include, but are not limited to:

- Perform a mark-recapture study of externally marked juvenile lamprey in the evaluator plunge pool to determine rate of recapture.
- Perform a mark-recapture study of externally marked juvenile lamprey released in front of Unit 13. Recapture/examination in the evaluator will emphasize checking their condition that might have resulted from interactions with the Unit 13 Eicher screen.
- Install an underwater video camera and monitor the Eicher screen during operation for the presence of juvenile lamprey impinged on the screen.

3. Current bypass system improvements testing

PGE shall assess improvements to the Unit 13 bypass and evaluator system to determine if issues associated with delay in the bypass/evaluator system are eliminated or reduced. This assessment will be done in 2004 using PIT tags on smolts, in consultation with the FTC to provide an indication of how the system is operating prior to its use for performance testing of subsequent PM&E measures.

4. Lamprey Passage Ramp use preliminary assessment.

As part of the Adult Pacific Lamprey Program described in section 3.3.3, PGE, in consultation with the FTC, will conduct a preliminary assessment of lamprey ramp use in 2004. The purpose of this preliminary assessment is to inform subsequent decisions regarding the placement and design of lamprey passage ramps.

Downstream juvenile Pacific lamprey

PGE, in consultation with the FTC, shall develop, fund and implement a joint evaluation study program covering juvenile Pacific lamprey. The study program will address the following:

1) Determine Pacific lamprey guidance efficiency through the T.W. Sullivan powerhouse after implementation of the Tier 2 siphon bypass measure.

2) Estimate the potential impact (i.e. injury and mortality) of the T.W. Sullivan powerhouse to juvenile Pacific lamprey.

3) Determine additional improvements to passage conditions using the information gained through the above evaluations and other relevant information to determine additional improvements to passage conditions at the Project site for PGE to implement.

To achieve the goal of "safe, timely, and effective" passage for juvenile Pacific lamprey, PGE, in consultation with the FTC and with approval of the Fish Agencies, shall implement additional measures identified by these studies as appropriate to reduce injury and mortality of Pacific lamprey that pass through the T.W. Sullivan powerhouse, and, if technology allows assessment, through the controlled flow structure at the Willamette Falls apex. PGE shall implement the additional measures within 3 years of assessment completion.

The above assessments for juvenile lamprey will be part of the siphon bypass and controlled flow structure evaluation programs (see item 2 of *Juvenile salmonids*, section 3.3.1.1 and item 2 of section 3.3.1.2).

Adult salmonids (kelts and fallback)
PM&E measures applicable to the protection of adult salmonids are:

1) Outer headgate selected bar removal for adults (2004)

Adult fish accumulate immediately above the main intake (head racks) for the plant near the west corner of the main head racks. Installing a passage slot at this location will provide a clear route for adult fish to pass downstream through the racks into the plant forebay and out through the fish bypass. PGE shall remove several outer headgate trashrack bars on the west (West Linn) end to facilitate downstream passage of adult salmonids that are observed in this area. PGE shall remove one or two vertical bars from the headracks, providing a wider opening for adult salmonids to pass. The opening is proposed to be 18 inches wide and 8 feet deep as opposed to the current 6-inch openings on the rack. It will be located at the West Linn end of the head racks, where adults have been observed holding. PGE shall coordinate removal with construction of the new trashrack cleaning system to ensure any increased debris entering forebay can be removed from the forebay trashrack system.

2) Assess the condition of adult salmonids that pass downstream through the T.W. Sullivan powerhouse and take measures identified as appropriate to ensure safe, timely, and effective passage of these fish.

3.3.1.2 Willamette Falls

Agreed-upon measures to address downstream salmonid passage at Willamette Falls (Falls) are:

1) 150 feet of flashboard removal (2005/6)

Prior to installation of the controlled flow structure at the apex of the Falls in 2006, the desire to focus fall low flows for downstream migrant passage at the Falls apex exists. Removing 150-ft of flashboards at the apex provides this focused flow. PGE shall remove 150 feet of flashboards at the Falls apex no later than October 1 until the controlled flow structure is installed.

2) Controlled Flow structure at Apex of Falls (2006/7)

River flow not used elsewhere at the Project is presently distributed around the crest of the Falls, allowing some downstream migrants to pass over the Falls at locations not conducive to safe passage. A controlled flow structure (a "slot") will be constructed and operated at the apex of the Falls to focus that flow, and downstream migrants, that would otherwise be distributed around the crest of the Falls, to a location more conducive to safe downstream passage. Overall result will be improved survival of downstream migrants. PGE shall construct and operate a controlled flow structure at the Falls apex as described in Appendix D, in consultation with FTC and approval by the Fish Agencies. PGE shall design the controlled flow structure to pass up to 15,000cfs (NOTE: actual design capacity will be determined through design analysis and planning). It will be located at the apex of the Falls. Field testing and modeling indicates this location and concept can pass a high percentage of downstream migrants over a high range of river flows. Conceptual design indicates multiple sections of obermeyer type gates located at a natural channel at the apex of the Falls that would be operated in accordance with an overall operation plan. A downstream passage study and follow-up measures (if any) will require consultation with FTC and approval by the Fish Agencies.

3) Assess the condition of adult salmonids that pass downstream through the controlled flow structure at the apex of the Falls and take measures identified as appropriate to ensure safe, timely, and effective passage of these fish.

4) Willamette Falls Avian Predation deterrents (2006)

Eliminate/reduce potential for avian predation on downstream migrants that pass the Project over the Falls. This will decrease predation potential and increase opportunity for downstream migrants to leave the horseshoe area of the Falls and enter deeper river flows. PGE shall install avian predation deterrent devices in the lower horseshoe area of the Falls, in consultation with FTC and approval by the Fish Agencies. PGE shall employ wire, or other effective technology, at the downstream end of the horseshoe of the Falls where avian predation activity has been observed.

3.3.2 Upstream passage

3.3.2.1 Willamette Falls fish ladder responsibilities

The present fish ladder at Willamette Falls was constructed by Oregon Department of Fish and Wildlife (ODFW) between 1968 to 1971, and major renovations were made in 1996/1997. While ODFW will continue to hold ownership of the ladder and remain responsible for operation and maintenance of the fish counting station, PGE shall assume most of the fish ladder operations and maintenance (O&M) duties under the Settlement Agreement as well as other measures described in this section.

3.3.2.2 PGE duties and measures at Willamette Falls fish ladder

Attraction flow at ladder entrance #1
PGE shall continue to coordinate scheduled outages of Unit 1 with ODFW, and will shut down all T.W. Sullivan turbine units should Unit 1 be inoperable for more than 24 hours during upstream anadromous migration until operation of Unit 1 can be restored. Continued powerhouse operation during Unit 1 shutdowns longer than 24 hours during upstream anadromous migration, will require Fish Agency permission during time-critical consultation. PGE may chose at a future date to develop a new auxiliary water supply system for fish ladder entrance #1, in consultation with FTC and approval by Fish Agencies, in lieu of this shutdown requirement.

Hydraulic conditions at ladder entrance #1
PGE shall determine the extent of ladder entrance #1 non-compliance with NOAA fisheries hydraulic criteria for ladder entrances, entrance pools, and auxiliary water systems (AWS), taking into account the changing hydraulic conditions at Willamette Falls and upstream migration run-timing, in consultation with FTC and approval by the Fish Agencies (2003). Evaluation results will inform the consultation with the FTC and development of an action plan for needed modifications that PGE shall implement. These NOAA fisheries hydraulic criteria include, but are not limited to:

1) The fish ladder entrance head (hydraulic drop shall be maintained between 1 to 1.5 feet).

2) The minimum entrance width shall be 4 feet and depth at least 6 feet.

3) Staff gages shall be installed to verify the entrance head.

4) Diffusers shall consist of non-corrosive, vertically-oriented flat-bar grates with a maximum 1 inch clear opening.

5) The maximum AWS diffuser velocity shall be less that 1 fps for vertical diffusers and 0.5 fps for horizontal diffusers.

PGE shall develop and implement an action plan for agreed upon modifications, in consultation with FTC and approval by the Fish Agencies (2004/5).

Fish ladder Operation and Maintenance (O&M)
PGE agrees to complete the backlog and annual O&M tasks described below to ensure continued and proper operation of the Willamette Falls fish ladder.

(1) Backlog O&M Items

PGE agrees to complete the following Willamette Falls fish ladder backlog O&M items:

1) PGE shall, to the extent feasible, and if not already corrected, perform the following projects within 6 months after the new license becomes final or by July 2005, whichever occurs first, taking into account appropriate in-water work periods.

   - Repair or replace the forebay level transducer.
   - Replace the weir support on the Obermeyer weir that has broken off.
   - Replace side seals on the Obermeyer weir and reattach restraining straps.
   - Install a new heater on the Obermeyer weir to prevent freezing on the end plates.

2) PGE shall perform the following backlog projects as part of its annual O&M commitment (in addition to the items listed under subsection (2), below):
   - Grease the gate stem for auxiliary water discharge at ladder entrance #1 and gate stems for the two exit gates on the 67-foot deck.
   - Clean out the level sensor stilling wells at entrances #2 and #3.
   - Clean out debris at the auxiliary water channels at all three entrances.
   - Exercise all equipment each month as listed on the exercise log.

3) PGE shall also be responsible to perform the following tasks; however, PGE and the Parties understand that an outside source of funding is being pursued to complete these backlog items. Should this outside funding be procured, PGE shall contribute $100,000 in matching funds to conduct Pacific lamprey research in the Willamette Basin. This amount is in addition to funding committed to elsewhere in the Settlement Agreement. If ourside funding is not obtained, PGE, in consultation with the FTC, will develop a plan and complete the below items within 3 years after the new license becomes final.

   - diffuser grate cleaning and removal of debris from diffuser chambers (all three legs and pool 48)
   - fish ladder joint repairs (all three legs)

(2) Annual O&M Items

Unless otherwise indicated, within 6 months after the new license becomes final, or July 2005, whichever occurs sooner, PGE agrees to implement the following regarding the Willamette Falls fish ladder annual O&M responsibilities:

1) PGE shall assume, for the life of the new license, responsibility, including all labor and necessary equipment, to perform annual O&M tasks directly associated with fish ladder operation. Appendix F lists all annual O&M tasks and specifies whether PGE, or ODFW, has responsibility.

2) PGE shall assume debris removal responsibility at the fish ladder sluiceway adjacent to the Willamette Falls fish ladder. Debris removal will be consistent with an operational plan that takes into account debris loading in the river, PGE debris removal activities at T.W. Sullivan, and downstream migrant behavior, abundance and timing. The sluiceway will be opened to pass debris only between the hours of 10:00 a.m. and 2:00 p.m.

3) PGE shall develop an operational plan for the above ladder measures in consultation with the FTC and approval by the Fish Agencies. The plan will include appropriate tracking and reporting mechanisms to determine if specific changes are needed in the annual O&M plan to ensure proper fish ladder operation (2005).

4) If feasible, PGE shall extend the log boom in the T.W. Sullivan pre-forebay to reduce the amount of debris that accumulates at the fish ladder sluiceway. Any such extension would be completed within 1 year of the new license becoming final.

5) In addition to the measures identified above, PGE shall fund or undertake measures to enable the Willamette Falls fish ladder to pass Pacific lamprey more effectively. Potential measures, subject to recommendation by the lamprey research expert (see Section 3.3.3, below) and approved by appropriate fish agencies as applicable to the Willamette Falls Project, include, but are not necessarily limited to:

   - Partially covering the floor gratings with a solid contiguous plate.
   - Rounding off 90-degree corners at critical junctures in the ladder.
   - Installing an infrared light at the counting window instead of a bright light.
   - Modifying ladder entrances.
   - Other modifications identified through regional and/or national Pacific lamprey research.

   Note: specific modifications and scheduling will be developed upon conclusion of lamprey research effort and FTC consultation (see section 3.3.3). Ladder modifications will be completed within 3 years of lamprey research effort conclusion, and under consultation with FTC and approval by the Fish Agencies.

3.3.3 Adult Pacific lamprey

PGE shall implement the following measures at Willamette Falls to develop a site-specific knowledge base regarding adult Pacific lamprey behavior, including passage, and to assist in effective upstream passage of adult Pacific lamprey through the Project:

1) PGE shall install a minimum of two lamprey passage ramps, and notch the flashboards, when flashboards are installed, to provide flows for lamprey below the dam and Falls, focusing on those areas where lamprey are known to congregate, such as the old fishway (2003). PGE shall implement these measures within 6 months of the new license becoming final. PGE shall assess the effectiveness of the ramps during the Pacific lamprey research project (item 3, below), and continued implementation will be guided by the results of that research. PGE, in consultation with the FTC, will conduct a preliminary assessment of lamprey ramp use in 2004. PGE shall make modifications to the placement and design of ramps if results of the monitoring program suggest that

such actions are appropriate. If effective, PGE shall install additional raps as needed to provide passage in areas where Pacific lamprey can be attracted. Placement of lamprey passage ramps will require time critical consultation, and all other elements above will require consultation with the FTC and approval by the Fish Agencies.

2) PGE shall undertake an effort to salvage stranded Pacific lamprey in accordance with the objectives listed in the Stranding Management Program (see Section 3.3.4, below). PGE shall release salvaged adult Pacific lamprey back into the river in accordance with Action 3.6 of the Stranding Management Program.

3) PGE shall fund, to begin within 6 months of the new license becoming final, a research effort on Pacific lamprey passage and behavior consistent with Appendix C, which contains the study-related portions outlined by the Non-Licensee Parties in their April 28, 2003, Adult Pacific Lamprey Passage Conceptual Proposal document (2005). PGE shall initiate development of this research effort in 2004, to include the following:

   - The research objectives and general approaches will be developed by an ad hoc committee of lamprey experts drawn from agencies, tribes, universities and private industry under consultation with FTC. This committee's recommendation and the proposed scope of research will be reviewed by the FTC. PGE shall then contract with one or more research groups to conduct this work. Research will be conducted by a lamprey expert mutually acceptable to PGE and the FTC.
   - The research will evaluate Pacific lamprey passage at the Project area and identify potential modifications to the dam/flashboards and the Willamette Falls fish ladder to improve passage.
   - If Pacific lamprey passage problems are identified, the research effort will assess the applicability and effectiveness of a lamprey capture-and-haul program at the Falls as a potential interim management tool to be used until permanent solutions to the passage problem are implemented, under consultation with FTC and approval by Fish Agencies.
   - The research will evaluate the effectiveness of the lamprey passage ramps at the Falls.
   - The research will consider appropriate testing of Pacific lamprey passage performance of the controlled-flow structure at the apex of the Falls, and specifically evaluate passage effectiveness of lamprey passage features constructed within the controlled flow structure.
   - The research will develop a reasonable Project structure related performance goal for upstream passage of Pacific lamprey at Willamette Falls, under

consultation with the FTC and approval by the Fish Agencies.

4) After the completion of the research study outlined above, and construction of the controlled flow structure at the apex of the Falls, PGE shall, after consultation with the FTC and approval by the Fish Agencies, implement Pacific lamprey passage improvements to the dam/flashboards and the Willamette Falls fish ladder (see section 3.3.2.2, subsection "Fish ladder Operation and Maintenance (O&M)", item 3)) as required to meet any passage effectiveness goal identified by the research program. Improvements shall be implemented by PGE within 3 years of completion of the research study.

5) PGE shall also test downstream passage of adult Pacific lamprey through the siphon bypass and controlled flow structure, under consultation with FTC. PGE shall make modifications to the structures as needed to assure safe passage of Pacific lamprey, under consultation with the FTC and approval by the Fish Agencies.

Note: This evaluation is part of the siphon bypass and controlled flow structure Post-construction evaluation plans.

3.3.4 Stranding

PGE shall implement an Adult Salmonid and Adult Pacific Lamprey Stranding Plan at Willamette Falls. For the purposes of this plan, "stranding" is defined as a condition faced by an adult salmonid or Pacific lamprey when it cannot escape a dewatered or physically isolated area, and lacks sufficient flow to stay alive until egress can occur. A fish of these species in a dewatered or physically isolated area and showing signs of stress or mortality is considered "stranded". However, fish that are temporarily held in pools without stress and that are able to find egress are not considered "stranded" and should not be salvaged.

Some adult salmonids and adult Pacific lamprey get stranded in pools below Willamette Falls. These fish are attracted to naturally formed pools in the tailwater of the Falls or within the no longer active man-made fish ladder pools cut into the rock in the 1880's. When the flashboards are installed atop the dam, spill over the Falls is temporarily interrupted, causing stranding. Occasionally, changes in Project operations or changes in Willamette River flows will result in a change in the amount of spill over the Falls, which may cause stranding in these pools.

Efforts have been made to salvage and release adult salmonids stranded below Willamette Falls. These efforts have been successful in the old fish ladder channel cut into the rock at the Falls; however, stranding holes on the east side of the Falls are generally too deep or too obstructed to allow effective fish salvage operations. Recent permit requests to conduct adult salmonid salvage at the Falls have been denied by NOAA Fisheries due to concern that the fish would be stressed or killed in a salvage operation. However, adult Pacific lamprey could be captured by hand or by dip net and live transported for release with less risk of mortality.

3.3.4.1 General management approach

As indicated previously, fish that are temporarily held in pools without stress and that are able to find egress are not considered "stranded" and should not be salvaged. Salvage efforts are needed when fish have been stranded at least 48 hours (or less when they show signs of stress), and other means to ameliorate the stranding proven ineffective.

Any Party can notify PGE, ODFW, or USFWS that it believes that fish are "stranded." When ODFW or USFWS determines that fish are "stranded," the first approach will be to encourage fish to move downstream voluntarily by providing flow into the stranding pool or modifying Project operations as described by actions in Objective 1 (see below). If a pool or channel has become a chronic stranding problem to fish, PGE shall implement actions to provide egress channels, as identified in Objective 2 (see below). PGE shall implement salvage operations, described in Objective 3 (see below), as needed, but only if the actions in Objective 1 have been implemented and found to be insufficient. Objective 4 (see below) includes actions that the Parties agree will reduce or eliminate stranding during closures of the Willamette Falls fish ladder. Project operations to support this stranding management program will, to the extent possible, be incorporated into the Operational Plan developed in consultation with the FTC under item 12 of section 3.3.1.1, *Juvenile salmonids*.

Objective 1:

Reduce or eliminate adult salmonid and Pacific lamprey stranding potential at Willamette Falls resulting from annual flashboard installation or other Project operations.

<u>Action 1.1</u>: PGE shall operate the controlled flow structure, when constructed, at the apex of Willamette Falls to minimize fish stranding below the Falls.

<u>Action 1.2</u>: PGE shall notify Parties when flashboard installation is planned. The first notification will be approximately 2 weeks prior to the expected installation date, and the second notification 3–5 days prior to actual installation.

<u>Action 1.3</u>: Immediately after flashboard installation, PGE shall reduce load at the plant to minimize the duration of time that there is a disruption of

flow over the crest of the Falls, and use the controlled-flow structure to minimize stranding. Normal plant operation will resume when flow through notches, installed under Action 1.4, has been established.

Action 1.4: During the flashboard installation and over the following 2 days, PGE shall coordinate (with those FTC members expressing interest in response to notification under Action 1.2) and conduct reconnaissance survey of adult salmonid stranding locations and severity at the Willamette Falls. PGE shall record adult Pacific lamprey congregations and movement.

Action 1.5: For Project operations that may result in stranding, such as startup after a powerhouse shutdown, PGE shall also notify the FTC 3 days prior to a planned event or within 24 hours of an unplanned event.

Action 1.6: PGE shall provide flow to pools, or other areas, that either have fish in them, or could later have fish present. Appropriate flow at each location will be determined, based on time-critical consultation, considering the nature of the pool, egress potential for fish, and the need to maintain head at the Project. Flow can be provided either through notches in flashboards and/or not adding felt cloth to selected flashboard sections.

Objective 2:

Provide egress channels at stranding pools by implementing structural changes to eliminate stranding pool blockages, including a specific problem identified at the "wet hole".

Action 2.1: PGE shall provide $5,000 annually to fund the creation of egress channels. This amount can be funded in advance if a specific modification project will cost more than the amount accrued. In the event an identified modification will exceed available funding, PGE shall consult with the FTC on how to address the funding shortfall.

Action 2.2: The FTC will assess the Falls each spring with the intent of identifying stranding conditions that could be improved by physically modifying the topography below the Falls to provide egress from stranding pools.

Action 2.3: During the first year after a stranding situation is identified, the Parties will identify possible corrective actions and PGE shall do the preparatory work (including permitting, cost estimating, channel modification assessments) for their modification the following year, in consultation with FTC and approval by the Fish Agencies. The cost of this preparatory work is in addition to the annual commitment described in Action 2.1.

Action 2.4: The year following the identification of locations having egress blockage, PGE shall resurvey these locations. To the extent funding is available under Action 2.1, and the egress blockage persists, PGE shall take corrective actions in the next available in-water work period.

Action 2.5: Eliminate the stranding potential associated with the current "wet hole" condition. In 2004, subject to obtaining necessary permits and the available in-water work period, PGE shall modify the "wet hole" located at the northeastern base of the Falls to provide egress, at a cost of up to $80,000, in consultation with FTC and approval by the Fish Agencies. This amount is in addition to PGE's permitting and design costs.

Objective 3:

Provide actions to reduce or eliminate the stranding, including salvage operations if needed, of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls as the result of the annual installation of the flashboards or other Project operations that may cause stranding.

Action 3.1: PGE shall operate the controlled flow structure, when constructed, at the apex of Willamette Falls so as to minimize the occurrence of fish stranding below the Falls.

Action 3.2: PGE shall apply for all federal and State permits required to conduct the salvage of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls. . Permit applications will include a salvage plan, developed in consultation with the FTC.

Action 3.3: PGE and the Fish Agencies will determine salvage feasibility and needs when flashboards are installed each year, based on time-critical consultation.

Action 3.4: PGE and the Fish Agencies will also determine appropriate actions, including salvage needs, following flow fluctuations that might cause stranding, such as fluctuations due to powerhouse startup after a shutdown or significant river flow changes (i.e., flow changes greater than 10% in a 24-hr period), based on time-critical consultation. PGE shall contact the FTC as described in Action 1.5 to coordinate this determination.

Action 3.5: For safety concerns, salvage for adult salmonids, if necessary, only in the old fish ladder pools located on the west side of the Falls. PGE shall release the fish in the tailwater of the Falls.

Action 3.6: When deemed necessary by the Fish Agencies, PGE shall conduct adult Pacific lamprey salvage over a 2-day period determined by Actions 3.3 and 3.4, based on time-critical consultation. PGE shall release lamprey either above or below the Falls as determined ODFW.

Action 3.7: PGE shall document the number and species of fish salvaged. PGE shall also note carcasses prior to salvage effort and document for the FTC any fish mortality associated with salvage efforts.

Objective 4:

Reduce or eliminate stranding of adult salmonids and Pacific lamprey inside the Willamette Falls ladder during fish ladder closures.

Action 4.1: PGE shall develop, in consultation with the FTC and approval of Fish Agencies, an operation plan for the installation and removal of exclusion gratings at the Willamette Falls fish ladder.

Action 4.2: PGE shall be responsible for the cost of constructing, maintaining, installing, and removing the exclusion grating for all four fish ladder entrances at the Willamette Falls fish ladder.

3.4 Blue Heron Powerhouse shutdown

In 2003, PGE shut down the Blue Heron Power Company (BHPC) units. After consultation with the Parties, PGE shall develop a plan by December 31, 2004, for the permanent, in-place decommissioning of the units. The Plan will provide for appropriate consultation under Section 106 of the National Historic Preservation Act. PGE shall apply to FERC for approval of the decommissioning plan. Upon approval, PGE shall implement the decommissioning plan. The decommissioning plan will require consultation with FTC, subject to approval by FERC and other permitting agencies, as applicable. PGE shall provide notice to the Oregon Water Resources Department that the water previously earmarked for generation at the BHPC powerhouse has been assigned to PGE.

3.5 Water Quality

The Oregon Department of Environmental Quality (ODEQ) is the lead agency regarding meeting of water quality standards through its 401 Water Quality Certification process. PGE has applied for certification pursuant to Section 401 of the federal Clean Water Act. PGE shall comply with the requirements established by ODEQ in its 401 water quality certification for the Project.

Critical to this process, is the need for assurance that the controlled flow structure to be located at the apex of Willamette Falls will be designed and operated in a manner to not contribute to high total dissolved gas conditions that have occurred at the Falls. To this end, PGE shall coordinate the design of the controlled flow structure (including the use of a small-scale physical model) with ODEQ in accordance with the 401 water quality certification, in addition to the FTC.

Also critical is the development of a Water Quality Monitoring and Management Plan (WQMMP). At ODEQ's request, PGE has agreed to develop appropriate WQMMP(s) for the Project.

3.6 General Escalator Language

The costs or payment amounts specified in dollars, listed below, shall be deemed to be stated as of the date of signing of the Settlement Agreement, and the Licensee shall escalate such sums as of January 1 of each following year after Settlement Agreement signing according to the following formula:

$$AD = D \times \frac{(NGDP)}{IGDP}$$

WHERE:

AD	=	Adjusted dollar amount as of January 1 of the year in which the adjustment is made.
D	=	Dollar amount prior to adjustment.
IGDP	=	GDP-IPD for the third quarter of the year before the previous adjustment date (or, in the case of the first adjustment, the third quarter of the year before the Effective Date).
NGDP	=	GDP-IPD for the third quarter of the year before the adjustment date.

"GDP-IPD" is the value published for the Gross Domestic Product Implicit Price Deflator by the U.S. Department of Commerce, Bureau of Economic Analysis in the publication Survey of Current Business, Table 7.1 (being on the basis of 1987 = 100), in the third month following the end of the applicable quarter. If that index ceases to be published, any reasonably equivalent index published by the Bureau of Economic Analysis may be substituted by the agreement of the Parties and the Licensee. If the base year for GDP-IPD is changed or if publication of the index is discontinued, the Licensees shall promptly make adjustments or, if necessary, select an appropriate alternative index acceptable to (the agencies) to achieve the same economic effect.

Specific costs and payments subject to the above are:

1) The "$5,000 per year" accrued for egress channel physical modifications,

2) The "up to $80,000" for the correction of the Wet Hole stranding/egress problem, and

3) The $100,000 in matching funds to conduct lamprey research as discussed under "Upstream Passage," above.

4 DESCRIPTION OF THE WILLAMETTE FALLS HYDROELECTRIC PROJECT

The Willamette Falls Project is composed of two separate hydroelectric generating facilities located on the east (Oregon City) and west (West Linn) sides of Willamette Falls (Figure 2). Hydroelectric power generation has been ongoing at this location for more than 100 years, beginning at PGE's Station A in 1889 and continuing to this day at PGE's T.W. Sullivan (Station B) facility since 1895 and at the Blue Heron facility location from 1916, until its shut down in 2003. Historically, there were numerous industrial facilities on the site. The navigation canal and locks on the west bank of the river have operated since 1873, providing 30 ft (9 m) of lift for commercial barge transport and recreational boat traffic. Table 4-1 summarizes the Project features.

Table 4-1 Summary of Willamette Falls Project Features

	T. W. Sullivan Powerhouse	Blue Heron Powerhouse	Impoundment
Turbine Type	Propeller-type (units 1-8 and 10-13) Francis-type (Unit 9)	Francis-Type	N/A
Number of Turbines	13	2	N/A
Normal Maximum Water Surface Area	N/A	N/A	2,304 acres
Normal Maximum Water Surface Elevation	N/A	N/A	54.0 feet mean sea level (msl)
Gross Storage Capacity	N/A	N/A	17,000 acre-feet
Usable Storage Capacity	None	None	None
State Water Right	6,850 cfs	898 cfs	N/A
Hydraulic Capacity	6,850 cfs		N/A
Generation Capacity	16 MW	1.5 MW	N/A
Required Min. Flow (FERC)	None	None	N/A
Ramping Rate Restrictions	None	None	None
Fish Passage			
Upstream	Willamette Falls fish ladder	Willamette Falls fish ladder	Willamette Falls fish ladder
Downstream	Fish bypass and evaluator station	16-week shutdown of turbines	None
Screens or Racks	Trash racks at powerhouse	Trash racks at powerhouse	None
Impoundment Capacity	N/A	N/A	17,000 acre-feet

N/A indicates "not applicable"

4.1 T.W. Sullivan Hydroelectric Facility

PGE operates the T.W. Sullivan Hydroelectric facility at Willamette Falls, located on the west side of the Willamette River at river mile (RM) 26 near the end of the river's tidal waters, and 10 miles (16.1 km) upstream of Portland. The Falls are a natural feature, with the river cascading over a 40-ft (12.2-m) high, horseshoe-shaped rock formation. The Falls mark the upstream end of tidal influence in the Willamette River. When PGE's predecessor, the Willamette Falls Electric Company, constructed Station A in 1889, it was the site of the first long-distance power transmission in the United States. Construction of Station B began in 1893 on the west side of the river, and the first generating units were in service by the end of 1895. Between 1897 and 1927, Station B was improved with a series of equipment additions and modifications. In 1952, Station B was shut down, and over the next year was renovated into what is now known as the T.W. Sullivan facility. The Project today is much the same as it was in 1953, with the notable exception of the addition of downstream fish passage facilities in 1991 (PGE and Smurfit 1998) (Figure 3).

Intakes for the T.W. Sullivan facility are located approximately 200 ft (61 m) upstream of the forebay. The ten 5- by 12-ft (1.5- by 3.7-m) intakes are equipped with trash racks, and direct water into the forebay. The forebay extends under the west end of the West Linn Paper facility and along the navigation canal (Figure 4). The forebay has an angled guidance system, which reduces turbulence and helps to guide downstream-migrating fish to the bypass facilities at Unit 13. Water is directed through the forebay into 13 turbines, each with a 10-ft (3.1-m) diameter penstock. A siphon spillway located at the end of the forebay limits water surface elevations in the forebay. The siphon spillway is capable of passing 7,000 cfs, (198 m^3/s) and of routing water directly to the tailrace should a sudden plant shutdown or flood occur.

There are four types of turbines at T.W. Sullivan:

- Unit 9 is a Francis turbine. It is a vertical unit rated at 1,200 hp at 240 rpm and a 35-ft (10.7-m) head. The turbine has a hydraulic gate controller.

- Units 1–7 and 10–12 are vertical, adjustable-pitch, six-blade Kaplan, propeller turbines. These turbines are rated at 1,600 hp at 242 rpm and a 40-ft (12.2-m) head. The blade pitch is changed to match the head conditions; this change is performed with the turbine stopped. These turbines are controlled with a gate position controller on each turbine to control wicket gate settings. The combination of gate position and blade angle is used to optimize water use and to minimize cavitations. The propeller machines are normally operated only at full load.

- Unit 13 uses a fixed, six-blade, propeller-type turbine made of stainless steel. This was installed in 1991. It is rated at 1,600 hp at 242 rpm. This unit is effectively screened from fish entrainment at all times.

- Unit 8 uses a fixed, six-blade, propeller-type turbine made of stainless steel. This turbine was installed in 1996. It is rated at 1,600 hp at 242 rpm.

Each turbine has an intake from the forebay, and discharges into the tailrace cul-de-sac area of the Falls, which then flows into the Willamette River immediately below the Falls. The facility is also equipped with a downstream fish bypass and evaluator facility (Figure 3). The discharge from Unit 1 provides attraction flows for the Willamette Falls fish ladder entrances in the T.W. Sullivan tailrace, and Unit 13 provides flows for operating the downstream migrant bypass facility. These are the first two units placed on line during operations, and the last to be shut down. Unit 9 has a Francis-type turbine, and is the last to be placed on line and the first to be shut down (PGE and Smurfit 1998).

The T. W. Sullivan development output is fed through a 16-MW, 57/4.16 kV transformer located on the powerhouse deck on top of the siphon spillway. A single-circuit transmission line carries the power to the switchyard and substation on the bluff above the plant, outside the Project boundary (PGE and Smurfit 1998).

4.2 Blue Heron Hydroelectric Development

In 2003, PGE purchased and immediately shut down the Blue Heron Power Company (BHPC) units at Willamette Falls. The following descrption of the facility is provided for context, as the project will be decommissioned during the new license.

The Blue Heron Development is a 1.5 MW facility located on the east-side of the Falls near Oregon City that has been operating since 1916. The development utilizes the Project dam and spillway at Willamette Falls and has no seperate structures other than the headworks owned by Blue Heron Paper Company on the Oregon City side of the Project. The forebay is located on the Oregon City side of the Falls at the downstream end of the low concrete gravity dam that runs along the top crest of the Falls. The intakes are located in a small bay in the upstream portion of the basin that was originally constructed in the 1850s for steamboat moorage. The intakes are provided with 16-ft (4.9-m) high trash racks and a headgate for each of the two turbines.

The Blue Heron powerhouse has two penstocks for its two horizontal, Francis-type, double runner turbines rated at 1,100 horsepower at 32 feet of head. Unit 1 turbine operates at 240 rpm and Unit 2 turbine operates at 300 rpm.. The penstock for Unit 1 is 7.25 ft in diameter and the Unit 2 penstock is 8.5 ft in diameter. Both penstocks are constructed of riveted steel plates. Just beyond the Blue Heron powerhouse forebay on the upstream side of the Falls is a small basin originally referred to as the "Mill Reserve." BHPC's process water intake is located at the downstream end of this basin.

The powerhouse is located at the upstream end of the Blue Heron Mill industrial site on the Oregon City side of the Project. The two horizontal Francis-type turbines each drive a single generator. Each turbine has its own intake from the forebay and discharges into the main river channel just below Willamette Falls on the Oregon City side. The two double-runner turbines are rated at 1,100 hp at 32 ft (9.7 m) of head. Unit 1 turbine operates at 240 rpm and Unit 2 turbine operates at 300 rpm. Combined, the turbines require approximately 900 cfs (25 m^3/s) of flow to operate. Under the actions described in Section 3.3.3, the BHPC powerhouse will cease operation in 2003.

There are no transmission facilities associated with the Blue Heron Development powerhouse. The output of the generators is fed directly into the 2,300-volt service bus in the Smurfit Newsprint mill complex (PGE and Smurfit 1998).

4.3 Dam Impoundment

The Willamette Falls Project includes a 6- to 20-ft (1.8- to 6.1 m) high concrete dam along the crest of the Falls that is seasonally fitted with 2-ft (0.6-m) high flashboards (Figure 5). The poured concrete dam was constructed in 1904 and 1908, and consists of several different sections that dam natural channels cut through portions of the Falls. The dam ranges from 10 to 15 ft (3.1 to 4.6 m) thick at the base, while the top of the dam is about 6 ft (1.8 m) wide.

Historically, the main channel through the Falls was located in a v-notch at a base elevation of 34.4 ft (10.5 m) (Normandeau Associates 2001g). The top of the dam was constructed to an elevation of 52 ft (15.9 m), about 18 ft (5.5 m) above the base of the former main channel. The dam is 2,950 ft (899.8 m) long in total length (entire dam is comprised of several structures), and allows overflow of water along most of its length. The flashboards added atop the dam are used to increase water surface elevation above the Falls during the summer when low flows limit power production potential at the T.W. Sullivan Powerhouse. The dam, and flashboards when installed, store about 17,000 ac-ft, and affect water levels for an estimated 20 miles (32.2 km) upstream. Flashboards are installed as early as practical along most of the length of the Falls, usually around the first week of July when flows drop to 7,000 cfs (198 m^3/s). These flashboards increase the height of the dam by 2 ft (0.61 m), thus diverting more water to the powerhouse forebays with the increased 2 (0.61 m) ft of head. Flashboards remain in place until high flows wash them out, usually in October. On the east side of the dam, a 600-ft (183-m) long spillway section of the dam, 20 ft (6.1 m) high, has a crest elevation of 55 ft (16.78 m) with 4 ft (1.22 ft) of stoplogs on top. Flood flows can be passed over this spillway as well as the free-flowing portion of the Falls, without damaging Project features.

4.4 Fish Passage Facilities

Although Willamette Falls is a formidable natural obstacle to migrating salmon and steelhead in the Willamette River, both winter steelhead and spring Chinook salmon did ascend the Falls and spawn in the upper basin under natural (pre-Project) conditions. Early historical accounts of fur traders from 1812, 1814, and 1816 documented that the Falls appeared to block upstream fish migration; however, other observations, particularly some dating from 1841 during high spring flows, documented the presence of salmon leaping at the Falls, with about one in ten successfully passing upstream under optimal passage conditions. Upstream migration of native winter steelhead peaked from February through May, while upstream migration of native spring Chinook salmon peaked in May and June. During these periods, Willamette River flows were often sufficiently high that, when combined with high flows in the Columbia River, the relative height of the Falls was reduced to about 10 ft (3 m), and enough to allow upstream passage. Winter steelhead and spring Chinook were the only two anadromous salmonids to spawn upstream of Willamette Falls under natural conditions. Other anadromous salmonids, such as summer steelhead, fall Chinook salmon, and coho salmon, did not pass above Willamette Falls because they migrate upstream during the summer and fall when Willamette River flows are lower and the Falls was impassable. Coastal cutthroat and bull trout had resident populations upstream and downstream of the Falls under historical conditions, but were not documented as migrating upstream over the Falls.

Both upstream and downstream fish passage facilities are currently in place at Willamette Falls. Upstream passage facilities are funded by NMFS, ODFW, and PGE. The Willamette Falls fish ladder is owned, maintained, and operated by the state while downstream passage facilities are funded by PGE.

Upstream passage is provided at the Willamette Falls fish ladder, owned and operated by Oregon Department of Fish and Wildlife (ODFW) (Figure 6). A crude fish ladder was first constructed in the bedrock of the Falls in 1885 using funds appropriated by the Oregon State Legislature. The current fish ladder, which began operation in 1971, was partially (16.3%) funded by PGE as mitigation for PGE's raising of the height of the Falls. The ladder has four entrances with attraction water discharged at each entrance; it requires approximately 1,000 cfs (28 m^3/s) to operate. Each entrance uses flows from 32 to 48 cfs (0.9 to 1.4 m^3/s) to provide for upstream movement of fish, with an additional 300 to 450 cfs (8 to 13 m^3/s) periodically added for attracting adult salmonids to the ladder (Normandeau Associates 2001e). One entrance is located in the cul-de-sac arm of the Falls in the T.W. Sullivan tailrace. Unit 1 discharge provides attraction water at this entrance. The other three entrances are located inside the Falls, with attraction water originating from intakes above the Falls. All fish entering the fishway are guided into one exit section where a viewing chamber is located.

Upstream fish passage counts are performed continuously at Willamette Falls, except during flood events or construction activities. A video camera and videotape recorders are used to complete 24-hour fish counts. An ODFW staff person operates the viewing window by reading tapes, making daily counts, and reporting results to the general public via a web site and phone recording. A trap is available on the leg of the fishway at entrance one in the cul-de-sac arm, and ODFW can conduct limited trapping, tagging, and recovery of adult fish at the Falls. PGE does not manage, operate or otherwise conduct fish passage activities associated with the Willamette Falls fish ladder, which activities are the exclusive responsibility of ODFW.

A downstream migrant bypass system was installed at the T.W. Sullivan Plant in 1971, with modifications incorporated in 1980 and 1991 and various improvements made subsequently. The current juvenile fish bypass evaluator station was installed in 1991. The fish bypass system is made up of two sections — the guidance (behavioral barrier) section and the bypass (physical barrier) section. The guidance section is part of the forebay and is the first section of the bypass facility that fish encounter (Figure 4). Fish are guided by vertical louver racks that cover the entire intake area of the turbine penstocks. The gap between bars on the racks varies from 1.5 inches (38.1 mm) on the upstream end and 2 inches (51 mm) farther down the forebay to 5-inch (127-mm) spacing where fish enter Unit 13. A solid angled training wall also guides fish into Unit 13. Once inside the Unit 13 turbine penstock, fish are physically separated from turbine flow with an angled tilting screen, known as an Eicher screen (Figure 3). The screen is a stainless steel, wedgewire design with 0.08 inch (2 mm) spacing and 0.08 inch (2 mm) wide bars. A fixed section of screen identical to the angled screen extends directly above the Unit 13 turbine. When clogged with debris, the tilting screen automatically rotates clockwise around its center point to back-flush the debris off. The cleaning cycle takes approximately 17 minutes to complete, during which time fish entering the system are not screened from the Unit 13 turbine.

Once guided into the bypass facility by the screens, the fish are transported through a 36-in (914-mm) conduit with a flow of 50 cfs (1 m^3/s) into a plunge pool and a fish holding station. The holding station, called a fish evaluator, was installed in 1991 on the back wall of the powerhouse over the tailrace area of Unit 13. The fish bypass evaluator is a permanent structure with modern sampling equipment and large holding areas to evaluate bypass effectiveness. The facility can be used to bypass fish directly to the tailrace (bypass mode), or can be switched to be able to examine the fish being bypassed for PIT tag detection (sample mode).

Until shut down by PGE in 2003, Blue Heron provided protection for downstream-migrating salmonids at its facility by shutting down turbines during peak downstream migration periods, as directed by ODFW. The shutdown periods, normally 16 weeks in length, occured during the months of February, March, April, May, and June. The hydroelectric facility at Blue Heron is not equipped with screens or bypass facilities.

4.5 Army Corps of Engineers Navigation Canal and Locks

An Army Corps of Engineers (ACOE) navigation canal and locks have been operated at Willamette Falls since 1873, providing 30 ft (9.2 m) of lift for boat traffic. Average flow through the locks is estimated to be less than 10 cfs (0.3 m^3/s). The locks operated by the ACOE allow movement of commercial and recreational boat traffic past the Falls. The series of four chambers (not counting the canal basin and guard lock) allows for movement of boats and barges up to 210 ft (64.1 m) in length and 40 ft (12.2 m) wide with a 6-ft (1.8-m) draft. About 2,000 vessels move through the locks from May through September. Prior to 1996, the traffic was divided equally between commercial and recreational craft. Since then, commercial use has declined and recreational craft make up about 80% of the usage (I. Mendez, 1998, personal communication, as cited in PGE and Smurfit 1998). Downstream and upstream fish passage at ACOE locks occurs, but is not monitored. It has been observed that while very few salmonids use the locks, all upstream shad movement occurs there.

4.6 Associated Facilities

PGE owns most lands within the Willamette Falls Project boundary, as well as much of the adjoining lands. BHPC, West Linn Paper Company (WLPC), the City of West Linn, the City of Oregon City, and private landowners own adjacent lands also. Additionally, PGE leases lands to WLPC. PGE also leases land to the City of West Linn for Bernert Landing and a portion of Willamette Park. The only lands within the Project boundary not owned by PGE are sections of land around the BHPC Mill Reserve owned by BHPC, and two small state-owned parcels around the Falls, specifically a parcel just to the west of the Falls most upstream point that has on it ODFW fish ladder structures and a section of the dam, and a parcel at the west side of the upstream end of the BHPC Mill Reserve basin that has on it a section of the dam and access road.

The T.W. Sullivan Development output is fed through a 16-MW, 57/4.16 kV transformer located on the powerhouse deck on top of the siphon spillway. A single-circuit transmission line carries the power to the switchyard and substation on the bluff above the plant, outside the Project boundary. There are no transmission facilities associated with the Blue Heron Development powerhouse. The output of the Blue Heron generators is fed directly into the 2,300-volt service bus in the Blue Heron Paper Company mill complex.

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5 FEDERALLY LISTED, PROPOSED, AND CANDIDATE SPECIES AND CRITICAL HABITAT OCCURRING IN THE ANALYSIS AREA

5.1 Animals

The Willamette Falls Project facilities and operations in the Willamette River basin potentially affect one listed bird species and several salmonid evolutionarily significant units (ESUs) and distinct population segments (DPSs) that are listed, proposed for listing, or candidates for listing under the Federal ESA. The bald eagle (*Haliaeetus leucocephalus*), is the only protected terrestrial species that has the potential to occur in the Project area. The bald eagle was proposed for de-listing in the lower 48 states in 1999 (USFWS 1999a). Protected salmonid ESUs and DPSs that occur in the basin include Upper Willamette River and Lower Columbia River fall and spring Chinook salmon, Lower Columbia River/Southwest Washington Coast coho salmon, Upper Willamette River and Lower Columbia River winter and summer steelhead, and Columbia River bull trout (Table 5-1). In addition, Pacific lamprey, western brook lamprey and river lamprey potentially occur in the Willamette River basin and have been petitioned for listing (Klamath-Siskyou Wildlands Center et al. 2003). Pacific lamprey occur in the Project area but there is little information on their abundance, and it is not known whether western brook lamprey and river lamprey occur in the Project area (Doug Cramer, pers. comm., Kostow 2002).The status of these ESUs and DPSs is discussed in Section 6.1 below. Life history and habitat requirements for these species are described in Appendix G and H.

Table 5-1 Special-status salmonids in the Willamette River basin

SPECIES	ESU[1]	FEDERAL STATUS	NOTES	CRITICAL HABITAT
Chinook Salmon	Lower Columbia River	Threatened	ESU includes all naturally spawned fall- and spring-run Chinook salmon from mouth of Columbia River to crest of Cascade Range (including tributaries), excluding areas above Willamette Falls (NMFS 1999a). Includes spring-run, tule, and late-fall "bright" populations. Progeny of naturally spawning hatchery fish are treated as listed for the purposes of the ESA. Listing includes fall- and spring-run Chinook in the Willamette River downstream of Willamette Falls.	NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)]

SPECIES	ESU[1]	FEDERAL STATUS	NOTES	CRITICAL HABITAT
	Upper Willamette River	Threatened	ESU includes all naturally spawning spring-run populations in the Willamette River basin above Willamette Falls (NMFS 1999a). ESU does not include fall-run populations upstream of Willamette Falls, which are introduced. ESU was extended downstream to include naturally spawned spring-run (but not fall-run) Chinook in the Clackamas River (resulting in an overlap with the Lower Columbia ESU). Listing includes spring-run Chinook in the Willamette River upstream of Willamette Falls, with the exception of Stayton Ponds hatchery stock.	NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)]
Coho Salmon	Lower Columbia River/Southwest Washington Coast	Candidate	ESU includes all naturally spawning populations from all tributaries of the Columbia River below approximately the Klickitat and Deschutes rivers, including the Willamette River as far upstream as Willamette Falls, as well as coastal drainages in southwest Washington. NMFS has yet to complete final listing assessments for candidate ESUs (NMFS 1995). In 2000, NMFS was petitioned to list lower Columbia River coho salmon on an emergency basis and to designate critical habitat under the ESA (NMFS 2000b).	No critical habitat designated at this time
Steelhead	Lower Columbia River	Threatened	ESU includes all naturally spawned winter- and summer-run steelhead in the Columbia River basin and tributaries between Cowlitz and Wind rivers in Washington and Willamette and Hood rivers in Oregon, excluding upper Willamette River basin above Willamette Falls (NMFS 1998a). Hatchery stocks were included in the ESU, but no hatchery populations were determined essential for recovery and they are therefore not covered under the listing. Listing includes winter- and summer-run steelhead spawning downstream of Willamette Falls. Hatchery stocks are not listed as threatened.	NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)]
	Upper Willamette River	Threatened	ESU includes all naturally spawning winter-run steelhead in the Willamette River and its tributaries above Willamette Falls (NMFS 1999b). Excludes areas upstream of the Calapooia River. Listing includes winter-run steelhead occurring in the Willamette River basin upstream of Willamette Falls to the Calapooia River. ESU excludes Skamania-origin summer-run steelhead introduced upstream of Willamette Falls.	NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)]
Bull Trout	Columbia	Threatened	Columbia River DPS includes all populations	Critical habitat proposed for

SPECIES	ESU[1]	FEDERAL STATUS	NOTES	CRITICAL HABITAT
	River DPS[2]		occurring throughout entire Columbia River basin within U.S. and all tributaries, excluding bull trout found in Jarbridge River, NV. Subpopulations in Willamette and Deschutes rivers are included in this listing (USFWS 1998). Populations in Middle Fork Willamette, Clackamas, and upper Deschutes rivers currently believed extirpated. No bull trout are expected to occur in the vicinity of Willamette Falls. Bull trout are believed to have historically occurred throughout the basin, but are presently found only in the McKenzie River basin.	the upper Willamette River, upstream of, and including, the McKenzie River (USFWS 2002b).

1 Evolutionarily Significant Unit
2 Distinct Population Segment

Prior to construction of fish ladders, anadromous salmonids passed Willamette Falls only during high flows, which occurred in late winter and spring (PGE 1997). Late-run winter steelhead and spring Chinook salmon were the only salmonid runs native to the Willamette River basin above the Falls prior to the construction of the first fish ladder at the Falls in 1885. Summer steelhead, fall Chinook salmon, and coho salmon runs did not occur upstream of Willamette Falls until the fish ladder was built (PGE 1997). Resident trout, including cutthroat, bull trout, and rainbow trout, all occurred upstream and downstream of the Falls.

5.2 Plants

Five federally listed plant species could potentially occur in the Project area (Table 5-2) (USFWS 2001, ONHP 2001). A search on the Oregon Natural Heritage Program Database (July 2001) indicated that only the Willamette Valley daisy has been observed within two miles of the Project area (last observed in 1896).

Table 5-2 Federally listed plant species potentially occurring in the Project area.

Species	Federal Status
Golden Indian paintbrush (*Castilleja levisecta*)	Threatened
Water howellia (*Howellia aquatillis*)	Threatened
Bradshaw's lomatium (*Lomatium bradshawii*)	Endangered
Nelson's checker-mallow (*Sidalcea nelsoniana*)	Threatened
Willamette Valley daisy (*Erigeron decumbens decumbens*)	Endangered

6 BASELINE ENVIRONMENTAL CONDITIONS IN THE PROJECT AREA

The environmental baseline represents the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat (including designated critical habitat), and the ecosystems affected by the Project. For ongoing water projects, the baseline includes the total effects of all past activities, including the effects of past operation of the Project, past and ongoing non-Federal activities, and Federal projects for which Section 7 consultations have been completed (USFWS and NMFS 1998). This section describes the environmental baseline, current status of the species and their habitat, and the effects of past Project operations on listed species and critical habitat.

The Project area contains no designated or proposed critical habitat. However, in light of the possibility that critical habitat for anadromous species may be designated in the future, the Applicant has evaluated potential Project habitat impacts using the analytical framework established by NOAA Fisheries for assessing impacts to anadromous fish critical habitats, which includes consideration of essential habitat types and essential features of critical habitat for anadromous salmonid species (NMFS 2000a). Essential habitat types identified by NOAA Fisheries include: (1) juvenile rearing areas, (2) juvenile migration corridors, (3) areas for growth and development to adulthood, (4) adult migration corridors, and (5) spawning areas. Essential features of critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions.

6.1 Status of the Listed, Proposed, and Candidate Fish Species

6.1.1 Chinook salmon (*Oncorhynchus tshawytscha*)

Both spring-run Chinook salmon ("spring Chinook") and fall-run Chinook salmon ("fall Chinook") are present in the Willamette River. Chinook salmon are distributed in the Pacific Ocean throughout the northern temperate latitudes in North America and northeast Asia. In North America, they spawn in rivers from Kotzebue Sound, Alaska to the San Joaquin River in California's Central Valley (Healey 1991). In Oregon, larger populations are found in the Columbia River and its major tributary systems and in larger coastal drainages. Smaller populations are also found throughout Oregon's coastal streams. Fall and spring Chinook spawning downstream of Willamette Falls are included in the Lower Columbia River ESU, and are listed as threatened under the ESA. This listing includes the progeny of naturally spawning hatchery fish. Spring Chinook salmon spawning upstream of Willamette Falls are included in the Upper Willamette River ESU, which are also listed as threatened under the ESA. Fall Chinook salmon were introduced upstream of Willamette Falls, and are not included in the Upper Willamette River ESU.

The NOAA Fisheries report "Factors contributing to the decline of Chinook salmon" (NMFS 1998b) discusses factors affecting the Lower Columbia River and Upper Willamette River Chinook salmon ESUs. NMFS (1998b) lists the following as factors affecting Lower Columbia River ESU Chinook salmon:

- hatchery introgression
- habitat blockages
- logging
- eruption of Mount St. Helens
- hydropower development
- predation
- harvest

NMFS (1998b) states that in the Lower Columbia River ESU, habitat quantity and quality for Chinook salmon has been significantly reduced by extensive urbanization, dredge and fill activities associated with development and navigation, and water quality degradation. Dams and water diversions have blocked access to substantial amounts of spawning and rearing habitat. Harvest rates in this ESU are moderately high, with harvest rates somewhat lower for spring stocks. Hatchery programs are widespread in the region; transfers of non-indigenous stocks have likely influenced the life history characteristics of spring and fall Chinook salmon populations in many rivers in this ESU. Kostow (1995) identified straying as one of the major problems affecting naturally spawning fall Chinook salmon in Oregon's lower Columbia River tributaries, along with habitat degradation, over-harvest, and competition from juvenile hatchery fish. Since 1960, most natural reproduction of fall Chinook salmon in these tributaries has been attributed to hatchery strays (Olsen et al. 1992, as cited in Myers et al. 1998).

NMFS (1998b) lists the following as factors affecting Upper Willamette River ESU Chinook salmon:

- habitat blockages
- hatchery introgression
- urbanization
- logging
- hydropower development
- harvest

Dams, water diversions, and stream channelization have altered the abundance, freshwater distribution, and migration timing of spring Chinook salmon in the Upper Willamette River ESU. Habitat quality and quantity has been reduced by irrigation withdrawals, timber harvesting and associated splash dam construction, and extensive urbanization. Harvest rates in this ESU are moderately high. Native spring Chinook populations in this ESU are maintained primarily through artificial propagation, with less than 10% of escapement to the ESU being the progeny of naturally spawning fish.

Because extensive transfers of fish between hatcheries within the ESU took place during the first half of the 1900s, there has been considerable homogenization of populations within the ESU; however, the genetic integrity of the ESU as a whole has not been greatly impacted. Although hybridization between transplanted fall Chinook and native spring Chinook has not been documented, the potential for this to occur exists.

6.1.1.1 Spring Chinook salmon

Spring Chinook spawning naturally downstream of Willamette Falls are included in the Lower Columbia River ESU, and are listed as threatened. NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for this ESU. Spring Chinook salmon spawning naturally upstream of Willamette Falls are included in the Upper Willamette River ESU, and are also listed as threatened. NOAA Fisheries has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for this ESU. The life history and habitat requirements of spring Chinook salmon are described in Appendix G. The life history timing of spring Chinook is shown in Appendix H.

Local Distribution
Spring Chinook salmon are native to the Willamette River and its tributaries above and below Willamette Falls. Upper Willamette River ESU spring Chinook salmon historically spawned upstream of Willamette Falls in the Middle Fork Willamette, McKenzie, South Santiam, North Santiam and Molalla rivers. In the 1950s, Federal dams were constructed, which blocked access on all major tributaries to the Willamette River above Willamette Falls and blocked more than 400 miles (644 km) of historically accessible spawning and rearing habitat (PGE 1997). The distribution of spring Chinook in the Willamette River basin has been greatly reduced, and historical populations in at least the Molalla, Pudding, Calapooia, Middle Fork, and Coast Fork subbasins are considered to be extinct (Kostow 1995). A majority of the remaining spring Chinook spawn in the Clackamas River (Lower Columbia River ESU) and upstream of Willamette Falls in the Santiam and McKenzie rivers (Upper Willamette River ESU) (Kostow 1995). Little spawning occurs in the mainstem Willamette River, which serves primarily as a migration corridor (Cramer et al. 1996).

Population Trends
Adult spring Chinook salmon belonging to the Upper Willamette River ESU have been counted at the Willamette Falls fish ladder since 1953. Escapement over Willamette Falls has averaged about 37,600 fish over the last 48 years, and about 33,500 over the last 10 years. Counts at the fishway have ranged from a low of 14,400 fish in 1960 to a high of 71,300 fish in 1990 (Figure 7). The number of spring Chinook passing over the Falls declined from 1994 through 1996, and increased in 1997 through 2000. The ODFW Willamette River Management Plan (ODFW 2001, as cited in Montgomery Watson Harza

2001) indicates an annual escapement goal of 30,000-spring Chinook past the Falls (hatchery and natural escapement). Population levels in general are stable or increasing, but are highly dependent on hatchery supplementation (Cramer et al. 1996). Only a portion of hatchery fish were marked prior to 1997; therefore, accurate data on population sizes and trends in abundance of wild spring Chinook are unknown (Kostow 1995). Since 1999, increased adipose fin-clipping of hatchery spring Chinook salmon by ODFW resulted in an estimated clip rate of 69% in 2001 and 90% in 2002 (ODFW 2000). Adults that are the progeny of hatchery fish that spawned naturally in the basin will still be indistinguishable from the progeny of wild fish in reproductively isolated areas (Lichatowich 1999). The number of returning adults is highly correlated with hatchery releases, however, suggesting that most adult fish returns are of hatchery origin (Cramer et al. 1996). Aerial redd surveys in the McKenzie River indicate that the number of fish spawning naturally fluctuates, but is largely stable. Population trends for Lower Columbia River ESU spring Chinook are not addressed here; the Project is not expected to have any impacts on spring Chinook that spawn downstream of Willamette Falls.

Hatchery Influence
Hatchery-reared fish have been released into the Willamette and its tributaries since the early 1900s. Early hatchery efforts were largely unsuccessful due to poor hatchery practices, and few adults returned until the mid 1950s (Wallis 1961, as cited in Howell et al. 1985). The Upper Willamette River ESU spring Chinook population currently consists of both hatchery and naturally spawning components (Willis et al. 1995).

ODFW's current objective is to maintain an average annual run of 100,000 Willamette River spring Chinook (adults and jacks) entering the Columbia River (includes both Lower Columbia River and Upper Willamette River ESU fish). Management goals set in the Willamette River Basin Fish Management Plan (ODFW 1998) also call for 30,000 to 45,000 Upper Willamette River ESU spring Chinook over Willamette Falls. This management goal is based on a sliding scale dependent on predicted run size. ODFW considers the escapement goal of 30,000 to 45,000 fish over the Falls adequate for providing a sport fishery, hatchery production needs of the upper basin, and some natural spawning. Since 1973, escapement goals for spring Chinook passing over Willamette Falls have been met, with the exception of seven years, including 1994, 1995, and 1996. During this period, the escapement goal was reduced by ODFW to 27,000 fish to assist the lower Willamette sport fishery. Due to the depressed 1996 run, the lower river sport fishery was managed on a 6,000 fish quota limit.

Hatchery-produced and wild salmon spawn naturally in a river or stream, die before spawning, or are taken in the commercial or sport harvest. Some hatchery-produced adults are collected at hatchery traps. Historically, spring Chinook were trapped and spawned from nearly all-major eastside tributaries of the Willamette River (Howell et al. 1985). Adults are currently captured for spawning at the following locations: (1) ODFW's Clackamas Hatchery on the Clackamas River, (2) Minto on the North Santiam

River, (3) South Santiam Hatchery on the South Santiam River, (4) McKenzie Hatchery on the McKenzie River, and (5) Dexter on the Middle Fork Willamette River. Hatchery releases are derived primarily from native Willamette stock. Hatchery-reared fish have been released in the Clackamas, Santiam, McKenzie, and Willamette rivers since the early 1900s. From 1909 until 1942, broodstock were collected on the McKenzie and Middle Fork Willamette rivers and the eggs shipped to Bonneville Hatchery for incubation and rearing. It is not known whether the juveniles released back in the Willamette system were from those same egg takes or from other stocks reared at the hatchery. However, few adults returned from hatchery releases until the mid-1950s due to poor hatchery practices, such as releasing large numbers of very small fry (Wallis 1961).

Willamette spring Chinook are produced in seven hatcheries and contribute significantly to natural production in three subbasins (McKenzie, North Santiam, Clackamas), with additional natural production occurring in others (Cramer et al. 1996). Five large hatcheries above Willamette Falls (Marion Forks, South Santiam, McKenzie, Willamette, Dexter Ponds) currently produce about 8.8 million spring Chinook salmon smolts each year. About 19% of releases occur in the fall, 26% in February, and 55% in March. About 75% of this production is funded by the ACOE as mitigation for lost production in spawning and rearing areas now inaccessible to fish because of dams or other manmade barriers. In 1992 and 1993, releases of spring Chinook included 1.3 million into the Clackamas River and mainstem below Willamette Falls (Kostow 1995). Most smolts are released above Willamette Falls, with some fish being trucked below the Falls for release and another small group held in net pens below the Falls prior to release. Approximately one-third of all releases occur in November as sub-yearling fish with the remaining two-thirds released in March as larger yearlings. A small portion of hatchery releases consists of placing smaller fingerling-stage Chinook into reservoirs. These fish are expected to rear and grow in the reservoir and to undergo a certain amount of mortality when passing downstream through the dam or powerhouse. This program puts approximately one million fingerlings annually into Fall Creek, Detroit, Hills Creek, and Lookout Point reservoirs. Hatchery fingerlings have also been released in various rivers throughout the Willamette River basin, such as the Calapooia and Molalla, to encourage re-colonization by spring Chinook.

Hatchery spring Chinook are known to stray and spawn naturally in the basin, as based on a limited amount of coded-wire tag data (Kostow 1995). Hatchery fish spawning in the wild are successfully reproducing in at least a portion of subbasins (Willis et al. 1995). Hatchery juveniles released below Willamette Falls have been found to have straying rates exceeding 75% (Willis et al. 1995). Stock structuring within the basin has been thoroughly homogenized through extensive exchange of fish between hatcheries, outplanting of hatchery fish, high straying rates, overharvest of naturally-produced adults, and loss of habitat (Cramer et al. 1996). Overall, hatchery influence has likely led to a reduction in genetic variation (Cramer et al. 1996).

One example of out-of-basin fish stocks introduced into the Willamette River basin includes the experimental groups of 1976–1980 brood Carson stock spring Chinook that were released from Marion Forks Hatchery (Smith and Zakel 1981). Carson stock fish originated from upriver-bound spring Chinook salmon that were trapped at Bonneville Dam on the Columbia River (Howell et al. 1985). Approximately 200,000 to 350,000 smolts of each brood year were released. Survival of this stock in the Willamette was much lower than that of the native Willamette stock, and releases of Carson stock were discontinued following the 1980 brood year releases (Howell et al. 1985). Hybridization with Willamette stock is thought to have been minimal due to differences in time of spawning and additional precautions taken by fish culture personnel (Howell et al. 1985).

Only a portion of hatchery spring Chinook released in large numbers into the Willamette River were marked prior to 1997; therefore, unmarked hatchery fish were indistinguishable from wild fish at the counting station at Willamette Falls (Kostow 1995). Since 1999, increased adipose fin-clipping of hatchery spring Chinook salmon by ODFW resulted in an estimated clip rate of 69% in 2001 and 90% in 2002 (ODFW 2000). Runs occurring since the 1960s are suspected of being dominated by hatchery fish (Bennett 1994, Kostow 1995). The percentage of wild spring Chinook salmon in the present run (of the Upper Willamette River ESU) is unknown, but is estimated at 5% to 15% of the total run (PGE 1997). According to Willis et al. 1995, "Doug Cramer (pers. comm., PGE) reported that 15.4% (1993) and 2.8% (1994) of the spring Chinook salmon smolts sampled at Willamette Falls appeared to be of natural origin, and these could be inflated estimates because of the presence of hatchery fish released as presmolts which become indistinguishable from naturally produced smolts." In addition, Kostow (1995) reports that "actual wild population abundance trends and current population sizes are therefore unknown. The wild populations are thought to be small and dominated by hatchery strays with the largest population suspected to be in the McKenzie River".

6.1.1.2 Fall Chinook salmon

Fall Chinook salmon spawning naturally downstream of Willamette Falls are included in the Lower Columbia River ESU, and are listed as threatened. NMFS has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for this ESU. Fall Chinook salmon were introduced upstream of Willamette Falls, and are not included in this ESU (or the Upper Willamette River Chinook salmon) for the purposes of the ESA. The life history and habitat requirements of fall Chinook salmon are described in Appendix G, and the life history timing of fall Chinook are shown in Appendix H.

Local Distribution

Lower Columbia River ESU fall Chinook spawn and rear in the mainstem Willamette

River and the lower reaches of its east-side tributaries (Foster 1994). Fall Chinook salmon were not known to occur above Willamette Falls prior to 1964, when improvements to fish passage facilities at Willamette Falls made upstream movement at low flows possible.

Population Trends
Fall Chinook salmon included in the Lower Columbia River ESU have not been counted at Willamette Falls. Adult fall Chinook occurring upstream of the Falls, however, have been counted at the Willamette Falls fish ladder since 1954. Escapement over the last 47 years has averaged about 8,900 fish, and about 4,600 fish over the last 10 years. No fish returned from 1961 through 1964, and maximum counts of about 34,000 were observed in 1974 (Figure 8).

Hatchery Influence
When improvements to fish passage facilities at Willamette Falls made upstream movement at low flows possible, the introduction of early-spawning fall-run tule Chinook stock began (Foster 1994, Rien et al. 1992). From 1964 to 1994, about 5 to 12 million-fall Chinook smolts were released into the Willamette River basin annually (PGE and Smurfit 1998). Most of these smolts were reared at Aumsville and Stayton ponds and released into the Willamette River upstream of Willamette Falls at Wheatland (RM 72), Peoria (RM 142), McCartney Park (RM 156), Harrisburg (RM 161), and Marshall Island (RM 168) (Rien et al. 1992). In 1971, ODFW began experimental releases of Cowlitz stock fall Chinook but discontinued these releases in 1977 (Howell et al. 1985). All hatchery fall Chinook releases into the Willamette River and its tributaries were discontinued in 1996 (PGE 1997; PGE and Smurfit 1998). Natural production above Willamette Falls sustains the current fall Chinook runs (PGE 1997).

6.1.2 Coho salmon (*Oncorhynchus kisutch*)

Coho salmon spawning in the Willamette River downstream of Willamette Falls belong to the Lower Columbia River/Southwest Washington Coast ESU of coho salmon, which is currently a candidate species for listing (NMFS 1995). No critical habitat is designated for this ESU. Coho salmon did not historically spawn upstream of Willamette Falls; therefore coho occurring upstream of the Falls are not included in the ESU.

NMFS (1995) has identified the following factors as contributing to declines of coho salmon in the Lower Columbia River/Southwest Washington Coast ESU:

- habitat degradation from logging, agricultural activities, urbanization, stream channelization, dams, and wetland loss;
- water withdrawals and unscreened diversions;
- overfishing;
- inadequate regulatory mechanisms;
- negative effects of artificial propagation programs;

- drought; and
- adverse ocean conditions over the last two decades.

Extensive use of artificial propagation is believed to have had a significant impact on production of coho salmon on the West Coast (NMFS 1995). Cramer and Cramer (1994) hypothesized that production of native coho may have decreased by more than 50% as a result of the shift to a later adult return and spawning time, causing more restricted spawning distribution, later fry emergence, a shortened growing season, and changes in juvenile migration (Cramer and Cramer 1994). These authors recommended substantial reductions of in-river harvest in the period after mid-October to reduce artificial harvest selection and restore original migration and spawning timing, thus increasing stock productivity.

Coho salmon populations in the Lower Columbia River/Southwest Washington Coast ESU have been extensively influenced by hatchery practices (NMFS 1995). Extensive stock transfers have occurred within the Columbia River basin, both within and between hatcheries from Washington and Oregon (NMFS 1995). Transfers from the Oregon coast were also common prior to about 1960 and some introductions of Puget Sound stocks have also occurred (NMFS 1995). The outplanting of large numbers of fry and parr into streams already occupied by naturally produced fish may place the native fish at a competitive disadvantage and reduce their survival (Chapman 1962, Solazzi et al. 1990, as cited in NMFS 1995). The life history and habitat requirements of coho salmon are described in Appendix G, and life history timing is shown in Appendix H.

Local Distribution

The historical range of this ESU probably extended beyond the lower Columbia River to include coho salmon populations from the southwest Washington coast and the Willamette River below Willamette Falls (including the Clackamas River) (NMFS 1995). The relationship of naturally reproducing coho salmon populations in these two areas to those historically occurring in the ESU is uncertain (NMFS 1995). Within the Willamette system, the Clackamas River is the only major tributary in which coho salmon were native (Howell et al. 1985).

The species' current distribution upstream of Willamette Falls has not been clearly determined, but they likely use streams on the west side of the Willamette Valley and some streams in the Molalla/Pudding rivers drainage (Foster 1994). Natural spawning of coho salmon in the Willamette River system above the Falls has been documented in the Mohawk, Mary's, Luckiamute, South and North Santiam, Mill, Calapooia, Long Tom, Coast Fork Willamette, Middle Fork Willamette, North Yamhill, Pudding, Molalla, and Tualatin river systems during spawning surveys conducted from 1970 to 1977 (Williams 1983, as cited in Howell et al. 1985).

Population Trends

Coho salmon included in the Lower Columbia River/Southwest Washington Coast ESU have not been counted at Willamette Falls. Adult coho occurring upstream of the Falls, however, have been counted at the Willamette Falls fish ladder since 1954. Escapement has averaged about 5,600 fish over the last 47 years, and about 1,472 over the last 10 years. Coho salmon counts at the fishway have fluctuated over the years ranging from a low of 0 fish in 1961 through 1964, to a high of 37,300 fish in 1970 (Figure 9). Recent declines are likely related to substantial cutbacks in hatchery releases after 1988.

Hatchery Influence

After construction of fish passage facilities at Willamette Falls, ODFW began releasing early-run coho salmon stock above Willamette Falls in an attempt to establish runs above the Falls. Several out-of-basin stocks of coho salmon have been released into the Willamette River basin. Coho salmon releases above the Falls peaked in the mid-1960s to early 1970s. During this period, a total of 1.4 million yearlings, 0.9 million fingerlings, and 9.8 million fry were released (Howell et al. 1985). Early-run hatchery stock released above Willamette Falls likely originated primarily from native Toutle River stock coho salmon (Howell et al. 1985). These releases, however, may have consisted of a mixture of early-run coho salmon stocks due to the extensive transfers of coho salmon eggs between most Columbia River hatchery facilities that occurred during this period (Howell et al. 1985). Coastal Oregon stocks were also introduced, and from 1974 to 1979, several groups of Cowlitz River late-run stock were released (Howell et al. 1985). Since 1985, only Columbia River early-run coho stocks have been released in the Willamette River system (Howell et al. 1985). Attempts to establish coho runs, however, never reached expectations and from 1974 to 1980 coho releases in the Willamette River basin were restricted to the Tualatin River system (Williams 1983, as cited in Howell et al. 1985). All coho salmon releases upstream of Willamette Falls were discontinued in 1988 (except for those in Tualatin River) due to concerns over competition with other native game fish species and the lack of contribution to Willamette River fisheries (Foster 1994, PGE 1997).

6.1.3 Steelhead (*Oncorhynchus mykiss*)

Steelhead is the term used to distinguish anadromous populations of rainbow trout from resident populations. Much life history variability exists among steelhead populations, but populations can be broadly categorized into two reproductive groups, most commonly referred to as winter-run and summer-run. Steelhead, unlike other pacific salmon, do not always die after spawning. Adult steelhead, usually females, may out-migrate to the ocean as "kelts" after spawning, rear for additional time in the ocean, and return to freshwater to spawn again. The percentage of adults spawning more than once is generally very low in the Columbia basin (Busby et al. 1996). Steelhead kelts are commonly detected in the T.W. Sullivan bypass facility in the spring, at the rate of about one per day (D.Domina, Pers.Comm., 2002).

The Willamette River supports both winter and summer runs of steelhead. Only winter steelhead are native to areas of the basin upstream of Willamette Falls. Summer steelhead were introduced upstream of the Falls in the late 1960s and small populations of naturally-reproducing summer steelhead originating from hatchery stocks now occur in the basin. Naturally spawning winter and summer steelhead downstream of Willamette Falls belong to the Lower Columbia River steelhead ESU. Naturally spawning winter steelhead upstream of Willamette Falls to the Calapooia River belong to the Upper Willamette River ESU. NOAA Fisheries has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for this ESU as well. Both of these ESUs are listed as threatened under the ESA.

NMFS (1996b, 1998a) has identified the following factors as contributing to declines of steelhead in the Lower Columbia River ESU:

- competition and interbreeding with hatchery fish, including summer steelhead;
- impaired access to habitat;
- logging;
- the eruption of Mt. St. Helens;
- hydropower development;
- predation; and
- harvest.

The widespread occurrence of hatchery fish in naturally spawning steelhead populations throughout the Lower Columbia River ESU is a major concern (NMFS 1998a). Competition, genetic introgression, and disease transmission resulting from hatchery introductions may reduce the production and survival of native, naturally reproducing steelhead (NMFS 1998a). In addition, naturally spawning winter-run steelhead populations are believed to have been negatively impacted by introductions of non-native summer-run steelhead due to interbreeding or competition (Chilcote 1997, as cited in

NMFS 1998a). Recently implemented changes in hatchery release practices by ODFW are generally believed by NOAA Fisheries to be positive, but NOAA Fisheries believes these changes have relatively minor compared to widespread artificial propagation and the history of stock transfers within the ESU (NMFS 1998a).

NOAA Fisheries identified interactions with hatchery fish as a major concern for the Lower Columbia River steelhead ESU (NMFS 1998a). Concerns include mixing of hatchery and natural fish in spawning areas, competition between progeny of hatchery and wild fish. Kostow (1995) notes that the introduction of non-indigenous summer steelhead into the Molalla, Santiam, McKenzie, and Middle Fork Willamette rivers may have contributed to declines of native winter steelhead.

NMFS (1996b) has identified the following factors as contributing to declines of steelhead in the Upper Willamette River ESU:

- urbanization
- logging
- habitat blockages
- predation
- agriculture
- harvest

Steelhead in the Upper Willamette ESU are distributed in a few, relatively small natural populations (NFMS 1999b). Federal dams on the Santiam River and upper mainstem Willamette River have resulted in substantial blockages to historically accessible spawning and rearing habitat and smaller dams or impassable culverts likely also act as migration barriers within this ESU. Spawning by Upper Willamette River steelhead was historically concentrated in the North and Middle Santiam River basins (Fulton 1970, as cited in NMFS 1999b); however, these areas are now largely blocked to fish passage by dams. Because of stocking efforts, spawning is currently distributed throughout more of the upper Willamette River basin than in the past (Fulton 1970, as cited in NMFS 1999b). Clearcut logging has been common throughout most watersheds in this ESU and extensive urbanization has occurred in the Willamette Valley (NMFS 1999b), both of which can act to reduce habitat quality and quantity for steelhead. Introduced hatchery stocks of summer and early-run winter steelhead also occur in the upper Willamette River, with estimates of the proportion of hatchery fish in natural spawning escapements ranging from 5–25% (NMFS 1999b). NMFS is concerned about the potential for these fish to interact with native steelhead where spawning areas are sympatric, but declines in the native steelhead population appear to be resulting from causes other than artificial propagation, such as poor ocean conditions or recent harvest pressure in the lower Columbia River (NMFS 1999b).

6.1.3.1 Winter steelhead

Winter steelhead in the lower Willamette River downstream of Willamette Falls belong to the Lower Columbia River ESU and are currently threatened under the Federal ESA. Naturally reproducing winter steelhead in the Willamette River and its tributaries upstream of the Falls belong to the Upper Willamette ESU and are also currently listed as threatened under the federal ESA. NOAA Fisheries has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for these ESUs.

Upper Willamette River ESU steelhead native to the upper Willamette basin are late-migrating winter steelhead, entering fresh water primarily in March and April (Howell et al. 1985, as cited in NMFS 1999b, in contrast to most other populations of west coast winter steelhead that enter fresh water beginning in November or December (NMFS 1999b). Stocks of Big Creek Hatchery winter steelhead, which are earlier-returning than the native stock, also occur in the mainstem Willamette River. The life history and habitat requirements of winter steelhead are described in Appendix G, and the life history timing is shown in Appendix H.

Local Distribution
Late-run winter steelhead are the only steelhead native to the upper Willamette River basin. Winter steelhead spawning and rearing in the mainstem Willamette River is currently believed to be minimal (Rien et al. 1992). As recently as 1969, winter steelhead spawned and reared in the mainstem upstream of RM 100 (Fulton 1970) and good spawning habitat is believed to be scattered throughout this reach (Rien et al. 1992). The Calapooia River is the upper limit of the indigenous winter steelhead distribution in the Willamette River basin (Kostow 1995). The listing of the Upper Willamette River steelhead ESU excludes naturally spawning steelhead in areas upstream of the Calapooia River. Steelhead in the Calapooia River basin are believed to have had the least amount of hatchery influence within the Willamette River basin (Kostow 1995). The Santiam River basin produces about 60% of the wild winter steelhead in the Willamette River basin above Willamette Falls (Kostow 1995). Since 1994, all wild steelhead caught in the Willamette River basin have been required to be released by anglers (Kostow 1995).

Population Trends
Adult winter steelhead have been counted at the Willamette Falls fish ladder since 1950. Escapement of native late-run fish has averaged about 4,800 fish over the last 30 years, and about 3,300 over the last 10 years. Native winter steelhead counts at the fishway have fluctuated over the years ranging from a low of 1,300 fish in 1990, to a high of 18,500 fish in 1971 (Figure 10). Escapement of early-run (Big Creek Hatchery stock) has averaged about 4,700 fish over the last 48 years. Population trends for Lower Columbia

River ESU steelhead are not addressed here; the Project is not expected to have adverse effects on steelhead that spawn downstream of Willamette Falls.

Hatchery Influence
Estimates of the proportion of hatchery fish in natural spawning escapements of Upper Willamette River ESU winter steelhead range from 5% to 25% (NMFS 1999b). In an effort to expand recreational angling opportunities, Big Creek Hatchery stock, which return primarily in December and January, were introduced in the 1960s and have since established naturally reproducing populations upstream of the Falls. Winter steelhead passing over Willamette Falls prior to mid-February belong primarily to the introduced Big Creek hatchery stock, while those passing after mid-February primarily belong to the indigenous Willamette stock.

Big Creek stock originated from wild winter steelhead returning to Big Creek on the lower Columbia River near Astoria and have been widely outplanted in the Willamette River basin (Kostow 1995). Kostow (1995) notes that the steelhead above Willamette Falls still exhibit genetic distinction from all other steelhead populations, despite the introduction of this stock (Schreck et al. 1986, as cited in Kostow 1995) suggesting that Willamette Falls forms a gene flow barrier between the populations above and below it (Kostow 1995). There are no more hatchery winter steelhead released into the Willamette Basin due to ESA concerns with hatchery fish affecting the gene pool of native fish; however, the state does still stock hatchery summer steelhead smolts for angling opportunities.

6.1.3.2 Summer steelhead

Summer steelhead that spawn naturally downstream of Willamette Falls belong to the Lower Columbia River ESU, and are listed as threatened under the ESA. NOAA Fisheries has withdrawn the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for this ESU. Hatchery stocks in the Lower Columbia River ESU have not been determined essential for recovery and are not listed. Hatchery summer steelhead introduced above Willamette Falls are excluded from the Upper Willamette River ESU, and are not listed under the ESA. The life history and habitat requirements of summer steelhead are described in Appendix G, and life history timing is shown in Appendix H.

Local Distribution
Summer steelhead did not occur upstream of Willamette Falls prior to the construction of fish passage facilities but were introduced above Willamette Falls in the late 1960s with releases of hatchery fish (Foster 1994).

Population Trends
Adult summer steelhead have been counted at the Willamette Falls fish ladder since 1970. Escapement has averaged about 21,400 fish over the last 31 years, and about 11,314 over the last 10 years. Counts at the fishway have fluctuated over the years ranging from a low of 149 fish in 1970, to a high of 40,700 fish in 1986 (Figure 11).

Hatchery Influence
After construction of fish passage facilities at Willamette Falls, hatchery fish were released starting in the late 1960s (Foster 1994). Since 1972, these releases consisted of Skamania hatchery stock summer steelhead that are native to Washington (Foster 1994, PGE and Smurfit 1998). Hatchery summer steelhead are currently released into the mainstem Willamette River (Rien et al. 1992). The mainstem Willamette River is believed to provide little potential for natural production of steelhead, and successful instream spawning by summer steelhead is probably rare (Rien et al. 1992).

Small populations of naturally reproducing summer steelhead have become established in some areas of the Willamette River (Kostow 1995). Natural production of summer steelhead is low and is discouraged through release strategies and liberal angling regulations for the purpose of avoiding competition between these steelhead and the native salmon stocks (PGE 1997).

6.1.4 Bull trout (*Salvelinus confluentus*)

The Columbia River distinct population segment (DPS) of bull trout is listed as threatened, and includes all populations occurring throughout the entire Columbia River basin, and all tributaries, excluding bull trout found in Jarbridge River, NV. Subpopulations in Willamette and Deschutes rivers are included in this listing (USFWS 1999b). USFWS proposed to designate critical habitat in for bull trout in 2002. The proposed designation includes the upper Willamette River, upstream of, and including, the McKenzie River (USFWS 2002b). Willamette Falls and the Project are located downstream from, and outside of, proposed critical habitat. Bull trout (*Salvelinus confluentus*), members of the family Salmonidae, are a char that historically occurred in major river drainages from about 41°N to 60°N latitude. Bull trout and Dolly Varden (*Salvelinus malma*) had been previously considered a single species but were formally recognized as separate species by the American Fisheries Society in 1980 (USFWS 1998).

The USFWS (1998) has identified the following factors as contributing to declines of bull trout in the Columbia River DPS:

- dams and diversions;
- forestry;
- agriculture;
- mining; and
- overharvest.

The Columbia River DPS of bull trout has been adversely affected by dams in almost every major river in the basin except for the Salmon River in Idaho (USFWS 1998). Impassable dams have caused declines primarily by preventing access to historically accessible spawning and rearing areas in headwaters and by precluding recolonization of areas where bull trout have been extirpated (Rieman and McIntyre 1993, as cited in USFWS 1998). Logging and associated roads and their legacy effects have altered habitat by increasing sedimentation, reducing habitat complexity, increasing water temperature, and promote channel instability (USFWS 1998). Bull trout in the Willamette River basin have been adversely affected by habitat alterations, especially by dams and culverts that are impassable by fish (Wevers et al. 1992, as cited in Buchanan et al. 1997). Habitat degradation, passage barriers, overharvest, chemical treatment projects to control non-game fish, and hybridization and competition with brook trout have been listed as possible factors suppressing bull trout in the Willamette Basin by Ratliff and Howell (1992, as cited in Buchanan et al. 1997). Timber harvest and road construction, loss of wild juvenile spring Chinook salmon as a major food source, and overharvest by recreational anglers may all have contributed to declines in bull trout in the Middle Fork Willamette River (Ambrosier et al. 1995, as cited in Buchanan et al. 1997). The life history and habitat requirements of bull trout are described in Appendix G.

Local Distribution

Bull trout were thought to have historically occurred throughout the Willamette River basin, but are presently found only in the upper McKenzie River subbasin. The three subpopulations in the McKenzie River basin are currently isolated by dams (Trailbridge and Carmen) (USFWS 1998). Populations in the Clackamas, North and South Fork Santiam, and Middle Fork Willamette rivers are believed to be extirpated (USFWS 1998). In discussions regarding the Clackamas River the USFWS stated that migratory bull trout may enter the Willamette River from the Columbia River to spawn and rear (Anne Gray, USFWS, pers. comm., 2001). However, no bull trout observations have been recorded to date at the Project despite PGE's extensive fisheries management activities. The best available scientific and commercial information demonstrates that bull trout only occur in the McKenzie River subbasin in the upper Willamette, and do not occur at or in the vicinity of the Project. Further, habitat in the Willamette River between the McKenzie River and the Project are unlikely to support bull trout, due to water quality and lack of habitat complexity.

6.1.5 Lamprey

Four species of lamprey potentially occur in the Willamette River; Pacific lamprey, river lamprey, western brook lamprey, and Pacific brook lamprey. Western brook lamprey (*Lampetra richardsoni*) have a distribution spanning from California northward to southeastern Alaska, and can be found as far inland as the Columbia drainage in Oregon (as far as the Yakima River), and the Sacramento-San Joaquin drainages in California (Kostow 2002, Moyle 2002). Second only to the Pacific lamprey, the non-parasitic western brook lamprey is the most abundant lamprey species in Oregon (Kostow 2002). Western brook lamprey are closely related to the river lamprey both biochemically and genetically, though unlike river lamprey, they are unable to enter salt water at any life stage (Kostow 2002, Moyle 2002, Docker et al. 1999 as cited in Klamath Siskiyou Wildlands Center et al. 2003). The combination of salt water intolerance and the inability to move long-distances within a river system have most likely led to a substantial population structure within coastal areas (Kostow 2002, Moyle 2002). Kostow (2002) has suggested that numerous populations within the Columbia basin may have existed in complete isolation long enough to lead to distinct population segments.

Lampreys currently are neither listed nor candidate species under the ESA. However, in light of their presence in the Project area, the need to address lamprey issues in relicensing, and the fact that a lamprey listing petition was submitted to USFWS in 2003, lamprey are addressed in this document. Because they are not listed or proposed for listing, relicensing consultation will not result in either a biological opinion or a conference opinion for lamprey. The consultation process will, however, assist FERC and PGE in the identification of appropriate measures for the conservation of lamprey based on the best available scientific information and the input of the USFWS.

River lamprey (*Lampetra ayresi*) are distributed from the Sacramento River, California, to 20 km (12 mi) north of Juneau, Alaska, and have been documented as far inland as the Columbia Gorge region of the Columbia River, Oregon (Moyle 2002). Related to the western brook lamprey, this smaller, parasitic, anadromous species tends to be concentrated in downstream reaches of large rivers such as the Columbia, Fraser, and Sacramento, though specimens in smaller Oregon coastal streams have also been observed (Kostow 2002). Kostow (2002) notes that a high degree of population structure is likely to exist for this species because they remain near their natal stream estuaries during their ocean phase, and are likely to spawn in these same rivers.

Pacific brook lamprey (*Lampetra pacifica*) have a limited distribution in northern California and Oregon (Vladykof 1973 and Lee et al. 1980 as cited in Kostow 2002). Though some contention exists on the distinction between this species and the western brook lamprey, samples collected from the Willamette River and other coastal Oregon streams exist in the Oregon State University fish collection (Kostow 2002).

No records of river lamprey or Pacific brook lamprey exist for the Project area, though data on lamprey in general is very limited. Western brook lamprey and Pacific lamprey, however, do occur within the Project area. Western brook lamprey have been observed occasionally, and very little is known about the effects of the Project on them. Therefore, more detailed information on the Pacific lamprey is presented in the section below, and in Appendix G and H. It is assumed that Project impacts to Pacific lamprey are indicative of potential impacts to the other lamprey species.

6.1.5.1 Pacific lamprey (*Lampetra tridentata*)

Pacific lamprey (*Lampetra tridentata*) are distributed from Baja California to the Bering Sea in Alaska and Asia. Pacific lamprey are present in the Willamette River, though very little information exists on their abundance at Willamette Falls Fish Ladder. On January 23, 2003 the USFWS was petitioned to list Pacific lamprey and three other species of lamprey as threatened or endangered under the ESA (Klamath-Siskyou Wildlands Center et al. 2003). In April 2003 the USFWS responded that the agency saw no reason to grant emergency protection for any of the species, and will not have the time or money to begin formal consideration until October 1, 2003 when Fiscal Year 2004 begins.

Existing factors affecting the species

Lampreys have declined in abundance throughout the Northern Hemisphere due to human–related impacts (Renaud 1997, as cited in Klamath-Siskyou Wildlands Center et al. 2003). Lampreys have declined along with salmonids which occupy the same freshwater habitat and have the same habitat requirements as salmonids. This suggests that the same human disturbances that have caused the decline of salmonids and resulted in their federal listing, may also affect lamprey (NMFS 1996b, 1998c, Close et al. 2002). The life history and habitat requirements of Pacific lamprey are described in Appendix G, and life history timing is shown in Appendix H.

As with salmonids, lamprey are adversely impacted by habitat losses due to reduced river flows, water diversions, streambed scouring, dredging, channelization, inadequate protection of streamside vegetation, chemical and organic waste poisoning, and impeded upstream passage due to dams and poorly designed road culverts (Moyle 2002). Dams such as Bonneville, Dalles, and John Day Dams on the lower Columbia River have caused mortality of lampreys and blocked passage. Introduction of exotic fish predators such as small mouth bass has also been a factor in the decline of lamprey (Klamath-Siskyou Wildlands Center et al. 2003).

Dams on the lower Columbia River (Bonneville, Dalles, and John Day Dams) affect Pacific lamprey by preventing complete access to historical spawning locations (Moser et al. 2002). Kostow (2002) reported that fewer than half of the radio tagged lampreys that approached the Dalles and John Day dams were able to move above them. Moser et al. (2002) conducted radio tagging from 1997 to 2000 at the first three dams that adult lamprey encounter in the lower Columbia River (Bonneville, The Dalles, and John Day). Results indicated that lamprey had only 38 to 47% passage efficiency at Bonneville Dam. The median time for adult lamprey to pass over the dam ranged from 4.4 to 5.7 days. At the Dalles Dam, passage efficiency ranged from 50 to 82%, and passage times ranged from 2 to 4 days (Moser et al. 2002). Only 3% of the adult lamprey tagged by Moser et al. (2002) were able to ascend to areas above John Day Dam. Hanson and Mathur (2002) found that 9 (19.1%) out of 47 radio tagged lamprey successfully passed upstream of the Willamette Falls Hydroelectric Project.

Pacific lamprey migrating downstream may suffer turbine mortality where fish bypass facilities are not effective for lamprey (Close et al. 1995). At Columbia River dams, possibly only 10% of lamprey outmigrants use the downstream bypass systems (B.Muir, NOAA Fisheries, pers. comm.., as cited in Close et al. 1995). Most downstream migrating lamprey may enter turbine intakes near the center and bottom (Long 1968) where salmonid bypass systems may prove ineffective. During the 1970s and 1980s, observations indicated that juvenile lampreys were being impinged on the perforated plates of mainstem Columbia River dams in large numbers (Kostow 2002). Hammond (1979) reported that lamprey became impinged on traveling screens used to bypass downstream-migrating salmonids at dams. There may be less impact to lamprey that pass through the turbines than those exposed to existing screens intended for salmonid protection.

Tide gates, hatchery weirs, and stream diversion structures are also barriers to upstream migration. Lamprey also appear to be unable to pass culverts with outfalls since they cannot jump like salmonids. Rapid water level fluctuations caused by hydropower generation temporarily dewaters stream margin habitats used by ammocoetes that may result in mortalities before they can move to deeper water (Stillwater Sciences 1998).

Lamprey ammocoetes are small enough to pass through some fish screens, at water diversions, that were designed to exclude juvenile salmonids. Ammocoetes that pass through fish screens and enter irrigation ditches are likely to become stranded there. If the ditch is dewatered they are likely to die because they are unable to return to the stream channel.

Population trends

There is scant information on population trends for lamprey species in the Willamette River. However similar to salmon, human impacts to freshwater habitats of Pacific lamprey have been severe and cumulative. Pacific lamprey have shown a dramatic declining trend throughout their range from California to the Columbia River portions of their range. Data indicates that Pacific lamprey are in a precipitous decline in the Columbia and Snake Rivers (Close et al 1995, Klamath-Siskyou Wildlands Center et al. 2003). This trend is consistent at all dams regardless of the differences in monitoring protocols, counting methods or data processing (Close et al. 1995). Pacific lamprey at Ice

Harbor Dam on the Snake River declined from 50,000 in the early 1960s to less than a thousand during the 1990s. Lamprey at Winchester Dam on the North Umpqua River declined from 46,785 in 1966 to less than 50 annually since 1995 (Klamath-Siskyou Wildlands Center et al. 2003). Counts from Gold Ray Dam on the Rogue River, Oregon ranged from 155 to 2,370 per year since 1993, but abundance is believed to be much below historic numbers (Klamath-Siskyou Wildlands Center et al. 2003).

Pacific lamprey have been harvested at Willamette Falls (Ward 2001). Decreases in annual commercial harvest from an average of 250,000 lbs in the 1940s (Figure 12) have been attributed to completion of the Willamette Valley Project and building of 13 U. S. Army Corps of Engineers dams in 1967 (Ward 2001). Commercial landings at Willamette Falls have stabilized at a much reduced level during the 1990's, with corresponding reduction in harvest levels set by ODFW (Ward 2001).

6.2 Introduced Fish Species

Many introduced fish species occur in the Willamette River basin, some purposely introduced by fisheries agencies, and others introduced without authorization. The following list identifies introduced, non-native fish species present in the Willamette River and in the Project area:

Common name	Scientific name
American shad	*Alosa sapidissima*
Largemouth bass	*Micropterus salmoides*
Smallmouth bass	*Micropterus dolomieui*
Green sunfish	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Warmouth	*Lepomis gulosus*
Redear sunfish	*Lepomis microlophus*
Yellow perch	*Perca flavescens*
Walleye	*Stizostedion vitreum*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Carp	*Cyprinus carpio*
Goldfish	*Carassius auratus*
Fathead minnow	*Pimephales promelas*
Black bullhead	*Ameiurus melas*
Brown bullhead	*Ameiurus nebulosus*
Yellow bullhead	*Ameiurus natalis*
Channel catfish	*Ictalurus punctatus*
Mosquito fish	*Gambusia affinis*
Tench	*Tinca tinca*
Brown trout	*Salmo trutta*
Brook trout	*Salvelinus fontinalis*

Some introduced fish, such as bluegill, crappie, black bass, and catfish, were stocked by the state to increase angling opportunities. There are large harvest limits on these introduced fish with limited effort by anglers on the Willamette River. Smallmouth bass fishing is increasing in popularity in the Willamette Falls area. ODFW has very little information on population levels and harvest and encourages increased harvest of these fish. A limited commercial harvest of carp occurs in the Willamette River. ODFW has a management objective to increase angling effort on warmwater game fish. ODFW also has a management objective to control undesirable fish species where they affect the growth or abundance of more desirable species.

American shad are a very prolific introduced anadromous fish to the Willamette River basin. Adult shad migrate up the Willamette River from May to July, peaking in June. Shad rarely use the Willamette Falls fishway and are presumed to migrate above the Falls via the COE navigation locks. Juvenile shad migrate downstream to the ocean from June through October shortly after hatching. During July and August, both upstream migrating adult shad and downstream migrating juvenile shad are present in the river. Observations made at PGE's T.W. Sullivan fish bypass evaluator station indicate that the numbers of shad seem to be increasing each year at Willamette Falls.

6.3 Summary of Existing Regulatory Mechanisms

The USFWS and NOAA Fisheries have determined that existing regulatory mechanisms are inadequate to conserve listed salmonids. Although efforts are underway to conserve salmonids, the implementation and enforcement of existing federal and state laws designed to conserve fishery resources, maintain water quality, and protect aquatic habitat have not prevented past and ongoing habitat degradation. This inadequacy has led to declines and isolation of salmonid populations and was a factor in the determination to list various salmonid population segments as threatened, proposed, or candidate under the federal ESA. Federal management efforts, including several listed below, address important habitat-related risk factors.

Current federal regulatory mechanisms that affect salmonids and their habitat include the ESA, the Northwest Forest Plan, the National Forest Management Act, the Federal Land Policy and Management Act, the Public Rangelands Improvement Act, the Clean Water Act, the National Environmental Policy Act, and the Federal Power Act. In addition, the Oregon Endangered Species Act and numerous state laws and regulations govern an array of land and water management activities that affect salmonids and their habitat. The NFP and Clean Water Act regulatory mechanisms are further described below.

- The Northwest Forest Plan (NFP) is a federal management policy with important benefits for salmonids. While the NFP covers a very large area, the overall effectiveness of the NFP in conserving salmonids is limited by the extent of federal lands and the fact that federal land ownership is not uniformly distributed in watersheds within the affected DPS/ESU (USFWS 1998) and ESUs (NMFS 1996a). The extent and distribution of federal lands limits the NFP's ability to achieve its aquatic habitat restoration objectives at watershed and river basin scales and highlights the importance of complementary aquatic habitat conservation measures on non-federal lands within the Columbia River DPS of bull trout and ESUs of other Pacific salmonids.

- Under Section 303(d) of the Clean Water Act, each state must prepare a list of waters that are not meeting their water quality standards for several parameters, including temperature. These lists are required to be submitted to the Environmental Protection Agency (EPA) for review and approval every April of even years (e.g., 1996, 1998). Total Maximum Daily Loads (TMDLs) are then established from the most recently approved list. The Willamette River mainstem currently violates water quality standards for temperature, bacteria, and several toxic pollutants including mercury. In addition, numerous other streams in the basin do not meet water quality standards for pollutants including temperature, bacteria, dissolved oxygen, pH, and a variety of toxic pollutants. The TMDL for the Willamette River mainstem is scheduled for completion in 2003.

6.4 Status of Listed, Proposed, and Candidate Non-Fish Species

6.4.1 Bald eagle

The bald eagle (*Haliaeetus leucocephalus)* is the only listed animal species likely to occur in the Project area. The bald eagle is a federal threatened species that is currently proposed for delisting (USFWS 1999a). The species usually nests in multi-storied forest stands with old growth components near water bodies that support adequate prey. Nest trees are usually large with open branching habit and dominant in the canopy. Bald eagles often-select dense forest stands with high basal areas in locations with minimal logging or other human disturbances (Anthony and Issacs 1989).

There are three known bald eagle nest sites in Clackamas County. None are within the Project area, but bald eagles are observed there. One nest is located upstream of the Project near the mouth of the Molalla River, the second is located downstream of the Project near Lake Oswego, and the third is near Barton (Isaacs and Anthony 2000 and G. Concannon, pers. comm., 2001, both as cited in Harza Engineering 2001). Due to the lack of suitable habitat or existing nests in the vicinity of the Project it is unlikely that they will be there in the future, and therefore the continued operation of the Project will not affect bald eagles.

6.4.2 Willamette Valley daisy

Willamette Valley daisy (*Erigeron decumbens decumbens*) populations occurring in the Willamette Valley are a federally listed endangered species (USFWS 2000b). Critical habitat designation was determined not to be prudent, due to concerns of vandalism. The Willamette daisy was historically widespread in the alluvial floodplain soils of the Willamette Valley. Once common, the Willamette daisy is currently reduced to 28 remnant populations on 286 acres (1.2 km^2), mostly along roadsides and marginal areas (USFWS 2000b). The last observation of a Willamette Valley daisy in the Project area was in 1896 (OHNP letter July 2001). Due to the confined channel and lack of established flood plain in the vicinity of the Project it is unlikely that they will be there in the future, and therefore the continued operation of the Project will not affect the Willamette Valley daisy.

6.5 Properly Functioning Conditions

In addition to critical habitat and the essential features of critical habitat, NOAA Fisheries has developed a Properly Functioning Conditions (PFC) matrix (NMFS 1996c), which identifies pathways and indicators that correspond to major ecosystem components and defines criteria that can be used to assess whether a stream or stream section is properly functioning in terms of salmonid habitat. The PFC matrix pathway and indicators corresponding to each heading or subheading in this report are identified in Table 6-1 for ease in relating this report to the PFC framework. The baseline habitat conditions in the Willamette River basin and/or at the Project site are also shown in Table 6-1 to help determine the full range of potential Project effects.

Table 6-1 Correspondence Between NOAA Fisheries Properly Functioning Conditions Matrix, Current Baseline Conditions, and BE Sections.

NOAA Fisheries Properly Functioning Conditions Matrix			Current Baseline Conditions in Willamette River Basin	Risk	Corresponding BE Sections
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**			
Water Quality	Temperature	50–57°F (10-14°C)	summer temperatures exceeding 68°F (20°C)	not properly functioning for salmon migration	6.7 Water Quality and 6.7.1 Water Temperature
	Sediment/Turbidity	<12% fines in gravel, turbidity low	no gravels present, turbidity low	properly functioning	6.7.2 Other Water Quality Issues
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches	2 reaches 303(d) listed for excess nutrients, many reaches listed for excess toxins not associated with Project	not properly functioning	6.3 Summary of Existing Regulatory Mechanisms and 6.7 Water Quality and 6.7.2 Other Water Quality Issues
Habitat Access	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream passage at all flows	Upstream fish passage provided at all Project facilities with ODFW fish ladder. Downstream passage provided at T.W. Sullivan, at the Falls, and not at Blue Heron.	Potentially at risk	6.8.1 Upstream Passage for Adult Salmonids 6.8.2 Downstream Passage for Juvenile Salmonids
Habitat Elements	Substrate	dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%	Downstream of Project, 30% boulder, 60% cobble, 10% mud/muck. 0-24% embedded.[1] upstream of Project area, claypan and bedrock with high embeddedness.[2]	Upstream pool potentially at risk for fine sediment and embeddedness	6.9 Habitat
	Large Woody Debris	>80 pieces/mile >24" diameter>50 ft length	large woody debris removed to aid navigation on mainstem	Potentially not properly functioning	6.6 Watershed Conditions
	Pool Frequency	100 ft channel; 18 pools/mile	N/A	N/A	N/A

NOAA Fisheries Properly Functioning Conditions Matrix			Current Baseline Conditions in Willamette River Basin	Risk	Corresponding BE Sections
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**			
	Pool Quality	pools> 1 meter deep (holding pools) with good cover and cool water, minor reduction of pool volume	Pools>1 meter deep with some cover and warm water, no reduction of pool volume in mainstem	At risk for temperature and cover	
	Off-channel Habitat	backwaters with cover, and low energy off-channel areas	Mainstem is channelized.[3] Some backwaters with cover and low energy off-channel areas available upstream of Project.[4]	not properly functioning	
	Refugia	habitat refugia exist and are adequately buffered	N/A	N/A	N/A
Channel Conditions and Dynamics	Width/Depth Ratio	<10	N/A	N/A	N/A
	Streambank Condition	>90% stable	11% of mainstem rip-rapped. Banks heavily modified for industry.[4]	not properly functioning	6.9 Habitat
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland function, riparian vegetation and succession.	Natural flooding has been dramatically reduced from channelization	not properly functioning	6.6 Watershed Conditions
Flow/ Hydrology	Change in Peak/Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography.	Peak flows have been decreased, and base flows increased, as a result of dams other than those at the Project	not properly functioning	6.6 Watershed Conditions 6.9 Habitat

NOAA Fisheries Properly Functioning Conditions Matrix			**Current Baseline Conditions in Willamette River Basin**	**Risk**	**Corresponding BE Sections**
PFC Pathway	**PFC Indicator**	**Properly Functioning Conditions**			
	Increase in Drainage Network	zero or minimum increase in drainage network density due to roads	no Project-related increase in roads, but significant urbanization in basin	not properly functioning	6.6 Watershed Conditions
Watershed Conditions	Road Density & Location	<2 mi/mi^2, no valley bottom roads	high road density, including valley bottom roads, not associated with Project	not properly functioning	6.6 Watershed Conditions
	Disturbance History	<15% ECA with no concentration of disturbance in unstable or potentially unstable areas, and/ or refugia, and/or riparian area	N/A	N/A	N/A
	Riparian Reserves	the riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds	Riparian is fragmented, poorly connected, and provides incomplete protection of habitat along mainstem and tributaries	not properly functioning	6.6 Watershed Conditions

[1] Tetra Tech (1994, as cited in Normandeau Associates 2001d)
[2] Hughes and Gammon (1987, as cited in Normandeau Associates 2001d)
[3] Altman et al. (1997)
[4] Normandeau Associates (2001d)

6.6 Watershed Conditions

The Willamette River flows north through the Willamette Valley and joins the Columbia River at the city of Portland, draining a 12,000 mi^2 (31,080 km^2) basin in western Oregon (Figure 1). The basin includes 13 major tributaries, 12 of which occur upstream of the Project site, with only the Clackamas River discharging below the Project. Most of the Willamette's major tributaries are dammed for flood control, and/or hydroelectric power generation (PGE and Smurfit 1998). Much of the basin (70%) is forested, with the lower portions being used primarily for agriculture (22%) (PGE and Smurfit 1998). Most of the urbanized portion of the basin (5%) consists of the Portland metropolitan area; 70% of the population of Oregon lives in the Willamette Valley. Water from the Willamette River is used for irrigation, municipal water supplies, and hydroelectric power, as well as for fishing, boating, and wildlife viewing.

The climate of the Willamette River basin is dominated by exposure to prevailing westerly winds that produce a modified maritime temperature regime characterized by cool, wet winters and warm, dry summers. Precipitation in the Project area is normal for most of the Willamette Valley, averaging about 43 in/yr (109 cm/yr), most of which occurs as rainfall between November and March. Precipitation in the Coast Range on the western side of the Willamette River basin can be as high as 150 in/yr (381 cm/yr). At higher elevations (>4,000 ft [>1,220 m]) in the Cascade Range on the east side of the basin, precipitation is about the same as in the Coast Range, but occurs mostly as snow. Snowmelt generally occurs from April through June, and major floods can occur from rain-on-snow events that accelerate run-off (PGE and Smurfit 1998).

The Willamette River basin is the most urbanized river basin in the state and has undergone significant changes from historical conditions that have affected habitat for anadromous salmonids. Historically, the mainstem Willamette River was a highly braided channel that meandered through a broad, low gradient riparian woodland and wetland habitat that extended from Eugene to the Columbia River (Sedell and Froggatt 1984, as cited in Kostow 1995). The mainstem is now primarily a single-thread channel. Approximately 75% of the original shoreline has been modified (Sedell and Froggatt 1984, as cited in Kostow 1995). Large woody debris has been removed from the channel to aid navigation, channels have been dredged, "cut-off" dams have been constructed, and dikes have been built (PGE and Smurfit 1998, II-19). As a result of channel modifications and dam construction, natural flooding has been dramatically reduced in the Basin. By the late 1940s, serious water quality problems had developed in the mainstem Willamette River stemming from discharge of urban and industrial effluents into the river (Kostow 1995). With the advent of waste-water treatment, which began in the 1960s, water quality in the Willamette River improved substantially; however, the lower Willamette River is on the Clean Water Act Section 303(d) list for excessive nutrients (phosphorus), toxics (mercury, PCBs, creosote), temperature, bacteria (fecal coliform), chlorophyll, dissolved oxygen, pH, and biological criteria (fish skeletal deformities). Numerous flood control and hydroelectric dams were constructed in the basin above Willamette Falls in the 1950s and 1960s (Kostow 1995), and upper basin tributaries are listed for flow modifications in addition to water quality criteria.

Hydrologic regimes in the Willamette River basin are characterized by low flows from July through September, and high flows generated by rainfall in the winter. Peak flows in the Willamette River have decreased and minimum flows have increased as a consequence of dam construction in the basin (PGE and Smurfit 1998). Hydrologic regimes and sediment dynamics have also likely been altered by extremely high road densities in urban areas in the basin, and road networks in forested areas.

A description of the geology of the Willamette River basin can be found in Gannett and Caldwell (in press, as cited in PGE and Smurfit 1998), and of the hydrology of the basin in Woodward et al. (in press, as cited in PGE and Smurfit 1998).

Water developments support a variety of consumptive uses. Water is diverted from the Willamette River and its tributaries throughout the Willamette Valley to irrigate farmland. Public municipalities throughout Oregon draw water from the Willamette River, its tributaries, and groundwater for domestic and industrial purposes. Water is also diverted for livestock.

Hydropower is the most significant non-consumptive use of the Willamette River basin. The Army Corp of Engineers (ACOE) operates eight hydroelectric facilities, the Eugene Water and Electric Board operates a hydroelectric facility on the McKenzie River, and PGE and BHPC operate the run-of-river hydroelectric facility at Willamette Falls. Locks allowing the movement of commercial and recreational boat traffic past Willamette Falls are operated by the ACOE. Recreational boating and fishing are common on the river.

6.7 Water Quality

NOAA Fisheries has identified water quality as an important component of the PFC pathway. Properly functioning indicators of water quality include temperature, sediment/turbidity, and chemical contaminants/nutrients. Suitable water quality and water temperatures are also essential elements of designated critical habitat (NMFS 2000a). Existing information on baseline water quality and water temperature and the effects of current Project operations on water quality and water temperature are summarized below.

6.7.1 Water temperature

The impoundment created by the Project dam has the potential to increase water temperatures. Increased water temperatures may affect fish passage, and can result in direct and indirect effects on salmonids. The Oregon Department of Environmental

Quality (ODEQ) standard for the Willamette River and its associated sloughs and channels from the mouth to RM 50 is for surface water temperatures to not exceed 68.0°F (20.0°C). Temperatures exceeding 68.0°F (20.0°C) are considered by the ODEQ to be harmful for migrating adult salmonids. The ODEQ has not set rearing temperature requirements for the mainstem Willamette River, because it is primarily used as a migration corridor. Water temperatures often exceed ODEQ standards from June through August (Figure 13), and the lower Willamette River is currently on the Clean Water Act Section 303(d) list as water-quality limited. Fall Chinook salmon, coho salmon, and summer steelhead migrate upstream during the late summer, and could be potentially be affected by elevated water temperatures. Computer modeling conducted in 2002 and 2003 addressed the affects of the dam and flashboards on water temperature, and is described in section 6.7.3.

6.7.2 Other water quality issues

Impoundment and powerhouse discharges can also potentially affect water quality characteristics such as turbidity and suspended sediment, dissolved oxygen and gas supersaturation, and pollutant levels. Changes to these water quality characteristics may result in direct or indirect effects on salmonids. The Project dam and flashboards at Willamette Falls increase the water surface elevation upstream of the Falls in a very low-sloped reach, increasing the water volume in this reach. Water velocity is decreased because of the increased volume, and the ability of the river to transport sediment is also decreased. The Fish and Aquatics workgroup has expressed concern that sediment could potentially accumulate upstream of the Falls and the Project, and could potentially modify the fluvial depositional environment of the Willamette River, thus potentially affecting sedimentation rate and the type of sediment stored. Computer modeling was conducted in 2002 and 2003 to determine the influence of increased water volume on water velocity in this reach, and potential effects of dam and flashboards on sediment (section 6.7.3).

Turbidity in the lower Willamette River is generally low during the summer (averaging 4 Nephelometric Turbidity Units [NTUs]), and higher during the winter. The U.S. Geological Survey (USGS) samples the Willamette River for Total Suspended Sediment (TSS) both above (at Canby Ferry) and below (at Hawthorne Bridge) the Falls. Comparison of these two stations indicates that TSS decreases in a downstream direction. Though this could be due in part to dilution (there is a higher concentration of suspended sediment from tributaries upstream of Canby Ferry), it appears that some fraction of the suspended load is deposited on the channel bed upstream of the Falls. Modeling of sediment transport rates conducted by Tetra Tech (1993a, as cited in Normandeau Associates 2001g) also indicated that deposition of fine sediment was leading to lower concentrations of suspended sediment at the Falls.

The ODEQ tested sediment samples from the area directly upstream of the Falls in 1988 and 1989. The results of the sediment analysis indicated that the concentration of inorganic and organic contaminants did not exceed levels recommended by the ODEQ. Comparison of samples collected by the ODEQ in 1994 with samples collected by the USGS in 1973 showed that levels of trace metals are declining, suggesting that the Willamette Falls Project is not causing metal-contaminated sediments to accumulate (Normandeau Associates 2001g). Results of bioassay tests, however, indicated that contaminant levels could be acutely toxic to aquatic organisms (Normandeau Associates 2001g). The test was a solid-phase bioassay test that did not discriminate between sources of toxins.

6.7.3 Modeling studies

The Applicants developed a water quality model for the mid-Willamette River system to assess the impact of the dam and flashboards on the water quality upstream. The water quality model CE-QUAL-W2 (Version 3.1) was used in these studies (Annear et al. 2002). In order to understand the impact of the flashboards and dam on water quality upstream, temperature and water quality parameters were predicted and evaluated, and included the effect of management scenarios on dissolved oxygen, suspended solids deposition, water levels, velocity, and other water quality characteristics set by ODEQ's water quality standards.

The effect of the flashboards and dam at Willamette Falls on water quality was generally small (Table 6-2). For the "no dam" scenario, dissolved oxygen concentration was at most 0.18 mg/l higher than other managed scenarios. Since the travel time of water was shorter for the "no dam" and "no flashboard" scenarios, there was less of an effect of sediment oxygen demand on water column dissolved oxygen concentrations. The shorter residence times of the "no dam" and "no flashboard" scenarios resulted in slightly lower algae concentrations. Between the scenarios there were only small differences in the amount of suspended solids that settled to the bottom.

The impact of the scenarios on water levels upstream of the Falls was about the same. All scenarios affected water levels to approximately RM 56, at which point the slope of the river becomes steeper. Average velocities in the Newberg pool reach were 0.13 m/s for the "base" case, 0.14 m/s for the "no flashboards" scenario, and 0.18 m/s for the "no dam" scenario.

Temperature gradients in the Newberg pool became significant only when flow rates were less than 5000 cfs (141.58 cms), which is normally the minimum USACE flow rate target at Salem. When flow rates were greater than or equal to 5000 cfs the maximum difference between the surface and the bottom temperature was 1.5°C, due to fluctuations caused by daily heating rather than any long-term temperature stratification. Therefore, after nighttime cooling, the water column had no vertical temperature gradient. Further discussion of potential effects of water quality on listed salmonid ESUs was deemed to be outside the scope of this BE because (1) it does not appear that the Project appreciabley affects water quality, and (2) the fish most likely to be affected (coho salmon) are not native to the Willamette River upstream of the Falls and are not in any listed ESUs.

Table 6-2 Summary of impact of flashboards and dam on hydrodynamics and water quality in the Willamette River, based on computer modeling (Berger et al. 2002).

Parameter	Impact of dam and flashboards
Travel time	Travel time through the reach RM 53.2 to 26.5 for the flows of 2001 was 4.1 days at the base case and 2.8 days for the "no dam" and "no flashboards" case
Velocity regime	As the water level is decreased with the "no flashboards" and "no dam" scenarios, the velocities are increased from an average of 0.13 m/s (base case) to 0.18 m/s ("no dam" and "no flashboards")
Water level	For the year 2001 flows, the water level was reduced about 0.5 m with "no flashboards" and over 2 m without the dam and effects levels from RM 26.5 to RM 56.
Temperature	Travel time of water and location of daily maximums is altered. "No dam" and "no flashboards" lower the water level and reduce the travel time; with a lower water level, water responds more to diurnal heating and cooling, hence slightly higher temperatures may be found during the day. As flow rates increase this impact lessens.
Dissolved oxygen	There is very little algal photosynthesis in this reach, but there is sediment oxygen demand (SOD). Hence, the lowering of water levels could potentially increase the impact of SOD (resulting in lower DO), but countering this is the reduction in travel time, which can decrease the impact of SOD (resulting in higher DO). According to the model results some sampling stations had slightly higher DO with "no flashboards" and "no dam", typically between 0.1 mg/l and 0.2 mg/l. Lower dissolved oxygen predictions were a result of reduced impact of SOD as the retention time of the system was reduced by removing the flashboards and the dam.
Algae	With reduced retention time, there was less time for algae growth. This decrease was from 0.2 to 0.9 µg/l chlorophyll a.
Nutrients	Dissolved PO_4 and ammonia were only slightly affected by the "no flashboard" and "no dam" scenarios. Ammonia concentrations decreased at most by 0.02 mg/l and PO_4 decreased at most by 0.002 mg/l. Both of these are changes are extremely low and not significant. The small decrease in nutrients with the "no dam" and "no flashboard" scenarios may stem from the reduced travel time and hence the less time for organics to decay into dissolved ammonia and PO_4.
Suspended Solids	Small particles are unaffected by the "no flashboard" and "no dam" scenarios. As the travel time is reduced, there is less time for a particle to settle out, whereas, if the depth is reduced there is greater chance for a particle to settle out. With these competing influences, the effect on the dam and flashboards on the particles was very small. There were differences from 0 to 5% in the deposition fractions based on particle size. Most differences were in very fine silt, whereas coarse silt and clays had no differences in particle capture.
pH	pH changes were at most 0.01 pH units between the scenarios and were negligible.

6.8 Habitat Access

NOAA Fisheries has identified habitat access as an important component of the PFC pathway. Properly functioning indicators for this pathway are physical barriers. Migration corridors are also identified as a critical habitat essential habitat type, and safe passage conditions are identified as an essential feature of critical habitat (NMFS 2000a). Existing information on baseline habitat access conditions and the effects of existing Project operations on habitat access are summarized below.

6.8.1 Upstream passage for adult salmonids

During lower flows in the summer and fall, Willamette Falls was historically approximately 30 ft (9.2 m) high, blocking upstream fish migration. During winter and spring high flows, the height of the Falls decreases to approximately 10 ft (3.1 m), which allowed adult salmonids to pass upstream under historical conditions. Peak runs of salmonids historically occurred in February–March and May–June when water levels were high and fish could pass over the Falls. Prior to the construction of fish passage facilities, late-run winter steelhead and spring Chinook salmon were the only anadromous salmonids that ascended the Falls and spawned in the upper basin. Summer steelhead, fall Chinook salmon, and coho salmon did not occur upstream of the Falls prior to creation of fish passage. Passage is possible in the ACOE navigation lock at the Falls, but use of this route is not monitored, and based on radio telemetry data the ladder is considered to be the dominant route for passage.

In 1884, the Oregon State Legislature appropriated money to build a fish ladder over Willamette Falls. The ladder was completed in 1885. Since then, the ladder has been modified and new facilities have been built. Holmes and Bell (1960, as cited in Normandeau Associates 2001e) evaluated fish passage in the late 1950s and made specific recommendations that were incorporated into later modifications. The current fish passage facilities, for which PGE paid 16.3% of the total cost, were constructed from 1966 to 1971, and are operated by ODFW. The ladder, its design, and operation are not considered part of Project. The Falls are not currently a barrier to upstream migration of salmonids. Rather, the ladder has increased access both for runs that did not historically occur upstream of the Falls as well as for those that did historically occur upstream of the Falls. Listed salmonid ESUs that could be affected by mortality, injury, or delay during upstream passage include Upper Willamette River ESU winter steelhead and spring Chinook salmon. Fish belonging to other runs passing upstream over the Falls (e.g., coho salmon, summer steelhead, fall Chinook salmon) are not currently protected under the ESA.

Delays in upstream migration

The construction of the fish ladder significantly reduced delays in upstream migration at the Falls and allowed for year-round fish passage. Delays in migration may potentially increase pre-spawning mortality, lead to spawning in sub-optimal habitat, or result in a loss of energy reserves. It is unknown whether fish that are delayed in upstream migration have reduced spawning success. Passage at the fish ladder is variable, and highly dependent on flows and water temperatures. ODFW fish counts show that numbers of fish passing over the ladder are higher at lower river flows and higher water temperatures. High flows tend to be associated with lower water temperatures, and appear to suppress upstream movement at the Falls (perhaps because of increased turbidity) (Normandeau Associates 2001e). Stream temperatures tend to be highest during the late summer, when adult fall Chinook and coho salmon are likely to be migrating (Figure 13). Studies of the effects of the Project on migration delays are complicated by the presence of numerous hatchery stocks. Many smolts are released below the Falls, and are thus less likely to home to areas upstream of the Falls when returning as adults. Fish of hatchery origin that are not marked are indistinguishable from wild fish, and determining which fish are being delayed at the ladder and which are returning to release sites below the Falls has not been possible. Normandeau Associates (2001p) radio tagged 50 adult spring Chinook salmon during spring 2001 to measure migration delays at the Project. Passage effectiveness (number of fish passed=12/effective sample size=27) was 44%. Delay in the Project vicinity was between 0.5–434 hours (mean=128 hours) for fish that passed upstream. Four of the fish were delayed for more than 276 hours, far exceeding the NMFS criteria for the Project area of a maximum of 24 hours (Normandeau Associates 2001p). However, there is no evidence that this delay was due to the presence or operation of the Project.

Water discharged from the cul-de-sac reduces attraction to the horseshoe section of the Falls. Entrance No. 1 (the "cul-de-sac leg" of the fishway) is the downstream-most entrance and is located in the tailrace of PGE's Sullivan Powerhouse where up to 13 hydroelectric turbines may be discharging. This entrance is used by large numbers of anadromous salmonids that migrate upstream in the fall and smaller numbers of fish migrating at other times of the year (Foster 1994, 1995). Discharge from T.W. Sullivan Plant Unit No. 1 provides attraction flow to the cul-de-sac entrance on the river's left bank. Most winter steelhead and spring Chinook currently use Entrance No. 2, located on the west side of the Fall's horseshoe area (Foster 1994, 1995). NMFS has identified turbulence associated with the powerhouse discharge and its potential to attract salmonids to the cul-de-sac entrance as a potential concern. Competing false attraction flows in the cul-de-sac were reduced when the Simpson Paper Company decommissioned its hydroelectric turbine units in 1996. In a spring 2001 spring Chinook salmon radio tagging study 22 of 50 tagged fish entered the T.W. Sullivan tailrace area for between 1 and 7,215 minutes (mean=534 minutes). Eight of these fish used the fishway entrance No.1, and two used entrances in the horseshoe area of the Falls. There is no existing information to quantify the potential effects of attraction flows. Listed salmonid ESUs that could be affected by false attraction flows include Upper Willamette River ESU winter steelhead and spring Chinook salmon.

There is evidence that some delay in migration occurs within the Willamette Falls fish ladder. Schreck et al. (1994, as cited in Normandeau Associates 2001e) radio-tagged 224 adult spring Chinook between 1989 and 1992 to study migratory behavior at Willamette Falls. They found that early-run spring Chinook had variable passage times, but that later running fish passed rapidly upstream. Fish generally passed rapidly through the ladder, although some individuals took up to 6 days to exit the facility. Domina (2000, as cited in Normandeau Associates 2001e) tagged 19 adult spring Chinook in 2000, and found that passage time through the ladder ranged from about 1 to 19 hours. Most of the tagged fish remained below the Falls. In a spring 2001 spring Chinook salmon radio tagging study

Normandeau Associates (2001p) found the time between entry to and exit from the fishway ranged from 4 to 262 hours (mean=97 hours). Passage behavior is often complicated by fish of hatchery origin homing to locations below the Falls. Tagging effects (e.g., stress from handling and tagging, delayed mortality) may also influence migratory behavior. Though some delays are likely occurring at the Falls, it is likely that passage times are reduced from historical conditions.

Upstream passage of Pacific lamprey

Pacific lamprey ascend the rock faces of Willamette Falls to migrate upstream in the Willamette River (Hansen and Mather 2002). They also use the ODFW fish ladder and may use the ACOE navigation locks coincident with boat traffic to move upstream (Normandeau Associates 2001f). The Project can potentially affect Pacific lamprey by restricting their ability to move upstream over the dam and flashboards, as well as enable harvest during low flow periods when the flashboards are installed on the dam (Normandeau Associates 2001f). The effectiveness of the fish ladder for upstream passage of lamprey is not known, counts have not been made at the fish ladder (Normandeau Associates 2001f). In a study on lamprey congregation, lamprey tended to congregate in the confluence of the lower T.W. Sullivan tailrace and the lower Falls and were generally sedentary regardless of levels of spill (Hansen and Mather 2002).

Injury in passage

Project facilities have minimal potential to injure adult salmon. Injury to upstream migrating adult salmon at hydroelectric facilities occurs most often when adults enter open draft tubes during shutdowns. Draft tubes at the Project are curved downwards toward the substrate, and have continuous relatively high discharges, thus minimizing the likelihood that upstream migrating adult salmon will come in contact with turbine runner blades. Further, the Project has no bypass reach, power canal, or peaking operations, all factors that have been shown to contribute to upstream passage injuries at other hydroelectric facilities. In a spring 2001 spring Chinook salmon radio tagging study (Normandeau Associates 2001p) four fish were detected within the vicinity of the draft tubes, and all four entered the fishway entrance No. 1. There was no evidence that the draft tubes, turbine runner, or powerhouse wall injured or killed any of the upstream migrating spring Chinook. Schreck et al. (1994, as cited in Normandeau Associates 2001e) did observe some mortality of adult spring Chinook within the ladder. Listed salmonid ESUs that could be affected by injury during upstream passage include Upper Willamette River ESU winter steelhead and spring Chinook.

Fallback

"Fallback" occurs when upstream migrating adults pass through a fishway, and then voluntarily or involuntarily return downstream. Fallback can be caused by either active downstream movement, or by passive entrainment into flow channels. Active movement may be caused by fish overshooting spawning areas due to confusing environmental cues or inadequate downstream spawning areas. Incomplete imprinting and high straying rates are common in systems with significant hatchery releases, and may increase overshooting of spawning areas. Involuntary fallback occurs when fish are entrained over a falls, through a spillway, or into a turbine. At the Willamette Falls fish ladder, the exit is in close proximity to the crest of the Falls and dam. Fallback likely occurs over the concrete roof of the fishway, and/or over the Falls. Any adult salmonid entering the T.W. Sullivan forebay must pass through the fish bypass because the inner forebay rack spacing excludes adult fish from the turbines. The degree of fallback is likely related to the amount of flow spilling over the Falls. During spring high flows, the substantial amount of water spilling over the west side of the Falls may increase the incidence of fallback. The effects of fallback are exacerbated at low flows, when the Falls are effectively higher and fish may suffer more injury passing over the Falls. The operations of the Project may reduce fallback by diverting some flow from the Falls to the T.W. Sullivan powerhouse. Schreck et al. (1994, as cited in Normandeau Associates 2001c) observed fallback rates at the Falls of 10%, 12%, and 4% in 1990, 1991, and 1992, respectively. These rates are similar to those observed at other facilities in the Columbia River basin (Normandeau Associates 2001c). A pilot study conducted in 2000 found that of three fish observed to use the fishway, all passed upstream with no fallback (Normandeau Associates 2001c). In a spring 2001 spring Chinook salmon radio tagging study (Normandeau Associates 2001p) one of the 12 tagged fish that used the fishway, fell back and then subsequently re-ascended. Fish that survive spilling back over the Falls may re-ascend the dam within hours or days after falling back (Normandeau Associates 2001c). In the spring 2001 study the one fish observed falling back subsequently used the fishway a second time. Information concerning the effects of fallback on mortality or injury of adults is lacking. Listed salmonid ESUs that could be affected by mortality, injury, or migration delay because of fallback include Upper Willamette River ESU winter steelhead and spring Chinook salmon.

Fish Stranding

Adult salmon and steelhead migrating upstream can become trapped in large scour pools at the base of Willamette Falls when flows decrease. Under natural conditions, adult stranding may have occurred as flows fluctuated. Under the current configuration and operating practices at the Falls, adult fish stranding still occurs and is exacerbated by the installation of flashboards at the time of installation. Flashboards are designed to direct water into the Project's forebays to maximize head. Typically, in early July installation of the boards abruptly eliminates spill, leaving some fish stranded without flow in the scour pools. In most cases, intermittent spill occurs over the boards throughout the summer. Stranded fish are subject to mortality without flow into the pools from warm summer water temperatures as well as predation. Summer steelhead are the species that appear most vulnerable to stranding; summer steelhead bound for the upper Willamette River are not listed under the ESA. Some threatened Upper Willamette River Chinook salmon ESU are also stranded. In the past, PGE has conducted salvage efforts to remove stranded fish. This practice is very hazardous and salvage of fish from some of the isolated scour holes is not possible. Fish salvage is also not likely to be very effective because of high water temperatures and the stress to fish caused by netting and handling. In 2001, NOAA Fisheries denied PGE a 4(d) research permit to salvage adult fish at Willamette Falls.

To reduce the potential for stranding, PGE in cooperation with ODFW, blasted passage channels to some of the holes in 1991. Additionally, ODFW filled one large hole with reinforced concrete, which has gradually re-scoured to its historic depth. PGE periodically removes rocks to provide egress from stranding pools and provides flow by removing selected sections of the flashboards above pools to help stranded fish. Physical alterations to scour holes, such as blasting channels or fill, can be altered very quickly by natural changes or processes at the Falls.

6.8.2 Downstream passage

Salmonid fry, juveniles, and smolts, juvenile lamprey, and steelhead kelts (outmigrating adult steelhead) outmigrating past Willamette Falls in the Willamette River pass either over the dam and Falls, through Project turbines, or through the T.W. Sullivan Development juvenile bypass facilities. Additional routes include sluiceways, a siphon spillway, Willamette Falls fish ladder, and ACOE navigation locks. Each of these routes has the potential to direct and/or result in indirect effects on salmonids. Fish can be subjected to various hydraulic forces such as turbulence, shear, pressure changes, magnitude of water cushion, and terminal velocity. Fish can also be subject to impact collisions, abrasive surfaces, obstructions, and other contact. Effects on fish may vary depending on the magnitude and influence of various factors occurring at each route (Normandeau Associates 2001a). Downstream passage at the T.W. Sullivan Development is provided by a fish bypass system. Blue Heron Paper Company, until its shutdown by PGE in 2003, provided downstream migrant protection at its facility by shutting down its turbines for 16 weeks during the spring outmigration period, as agreed upon with ODFW. Non-turbine passage routes are generally considered to be benign, with survival ranging from 92 to 100% (Franke et al. 1997). Listed salmonid ESUs that could be affected by mortality, injury, or delay during downstream passage include Upper Willamette River ESU winter steelhead and spring Chinook salmon.

History of juvenile passage studies at Willamette Falls

Prior to the construction of the juvenile bypass system at the T.W. Sullivan Development, fish migrating downstream past Willamette Falls either passed over the Falls or were entrained into powerhouse intakes and passed through turbines at the industrial facilities located at the Falls. In 1962, the Oregon State Game Commission investigated engineering considerations for improving passage for juvenile salmonids at the Falls (Cornell et al. 1962, as cited in Normandeau Associates 2001a). Criteria for protecting, diverting, and transporting fish were provided by the Game Commission and then used to develop methods for screening that could be used at T.W. Sullivan. This study concluded that louver deflection systems and/or mechanical screen facilities could be used to safely transport fish downstream past the turbines. Efficiency of louver systems would depend on approach flow velocities, however, while almost 100% efficiency could be attained by mechanical screens regardless of flow velocities. The engineers that conducted the study recommended installing louver systems because of their lower total and annual cost.

Until 2003 when PGE purchased and shut down the project, the Blue Heron Paper Company operated under an agreement with, and at the direction of the ODFW. This agreement required the Blue Heron Paper Company shuts down the operation of its two turbines from mid-February through mid-June to reduce mortality to outmigrating salmonids (Normandeau Associates 2001b). Although juvenile salmonids migrate downstream in all months of the year in the Willamette River, with the fewest numbers outmigrating in midsummer, turbine closures occur for only 16 weeks in the spring when peak numbers occur (Foster 1994, 1995). PGE was included in these agreements until 1991 when the evaluator was completed at the juvenile bypass facility in 1991.

In 1991, fisheries agencies and PGE adopted a formal study plan for evaluating the juvenile bypass system at the T.W. Sullivan Powerhouse. The study plan was updated each year following review of test results by a committee of biologists. The major objectives of the 5-year study were to determine: (1) Fish Guidance Efficiency (FGE) (the percent of downstream migrating fish entering the forebay that use the bypass system) under normal plant operations at different levels of head, (2) the extent and source of injury to fish using the bypass facility, (3) the mortality of fish within 48 hours after they have passed through the bypass facility, (4) the effect on FGE of shutting selected units off, (5) the relative abundance and timing of juvenile salmonids outmigrating at the T.W. Sullivan plant, and to (6) refine the Willamette Falls mortality model, and (7) estimate the impact of operating the T.W. Sullivan plant has on juvenile salmonids. Much of what is known concerning impacts to juvenile outmigrants has been based on this study.

6.8.2.1 Downstream passage at T.W. Sullivan development

Once outmigrating fish have entered the T.W. Sullivan forebay, impacts on them depend on two parameters; guidance of fish to the Unit 13 fish bypass, and passage through the Unit 13 fish bypass. Guidance to the bypass is achieved with laminar flow from a solid angled training wall and a trash rack louver system in the forebay. An Eicher tilting fish screen covers the entire Unit 13 penstock, and fish are diverted around the Unit 13 turbine via the Eicher screen and a fixed plate fish screen into a conduit that flows into the bypass. Once in the bypass at Unit 13, fish either pass directly to the tailrace, or into an evaluator holding facility.

Fish guidance efficiency (FGE)

From 1992 to 1997, the estimated proportion of all outmigrating smolts entering the T.W. Sullivan forebay was 22.3% (Normandeau Associates 2001a). In a fall 2000 radio telemetry study, Normandeau Associates (2001h) found that with flashboards installed, and daily average river flows between 10,404 and 11,118 cfs (295 and 315 m^3/s), 65% of outmigrating juvenile spring Chinook entered the forebay, and the remainder passed over the Falls or through the Blue Heron Development. During spring 2002 Karchesky et al. (2002) found that 24% of radio tagged steelhead smolts passed via the T.W. Sullivan Powerhouse, and 76% passed via the Falls. During the period of this study, flows above the Falls ranged from 9,856 to 21,411 cfs. Site-specific guidance efficiency data for salmonid fry (<2.4 in [60 mm]) and juvenile lamprey are lacking at the T.W. Sullivan facility.

The proportion of downstream-migrating fish entering the forebay that use the bypass system at Unit 13 varies between species. Determining FGE is the most critical aspect of evaluating the operation of the bypass system. FGE is determined through forebay and calibration tests. A forebay test usually consists of releasing 100 PIT-tagged fish into the river directly above the main intake racks. Assuming that all of the fish enter the forebay, this test measures the number of fish entering the forebay that pass through the bypass system. A calibration test usually consists of releasing 50 PIT-tagged fish directly in front of the detection system in the bypass evaluator station. This test measures the PIT tag detectors' efficiency in detecting tagged fish. FGE is determined by dividing the percent of forebay test fish detected by the percent of calibration test fish detected. For example, if 80 of 100 forebay test fish were detected, and 48 of 50 calibration test fish detected, FGE would be calculated as follows:

$$\text{FGE} = \frac{(80/100)}{(48/50)} = \frac{0.80}{0.96} = 0.83 \text{ or } 83\%$$

Cramer and Domina (1998) estimated FGE at the T.W. Sullivan facility to be 84% for spring Chinook salmon, 84% for coho salmon, 76% for steelhead, and 81% for fall Chinook salmon. Estimated FGEs vary among and between years due to many variables, including disease, high water temperatures, and PIT tag detector malfunctions. Cramer (1996) found that in 1992, FGEs averaged 92%, 82%, and 85% for spring Chinook salmon, fall Chinook salmon, and steelhead, respectively. These guidance efficiencies are slightly lower than the 95% found for fin- and dye-marked fish in tests conducted in 1982 just after installation of the Eicher screen. In 1996, FGEs were 78% and 86% for steelhead and spring Chinook, respectively (Domina 1997). After five years of evaluating the T.W. Sullivan fish bypass system, average FGEs were:

- 84% for spring Chinook salmon and coho salmon;
- 81% for fall Chinook salmon; and

- 76% for steelhead (PGE and Smurfit 1998).

Limited FGE testing has been accomplished with selected units shut down. Initial test results indicated that FGE did not substantially vary with selected units shut down, so this aspect of the study plan was not pursued further. Skalski (2000) conducted a review of the statistical procedures used to determine the T.W. Sullivan's FGE, and using only results of paired testing, found that FGEs were 76.7% for Chinook salmon and 74.5% for steelhead. Preliminary analysis of the fall 2000 Chinook smolt radio-tagging study found a FGE of 73.1%, corroborating Skalski's (2000) results. During spring 2002 Karchesky et al. (2002) found that of the 41 radio tagged steelhead smolts that entered the forebay, 39, or over 95% passed via the Unit 13 fish bypass facility, slightly higher than Skalski's estimates.

Tests have been conducted in attempts to determine how different levels of head affect the FGE of the bypass system. For spring Chinook salmon, it appears that FGE may increase with increasing head (Cramer 1996). Confounding factors, such as fish condition or increased debris loading and screen-cleaning cycles have made it difficult to draw additional conclusions. Observations indicate that the configuration of the training wall, which directs fish to the bypass facility, may affect FGE. The existing training wall does not have a smooth surface, and eddies created by the wall likely reduce FGE. Gaps and holes have also occurred in the training wall, which requires routine checks and maintenance.

Trash racks

Site-specific data on injury and mortality associated with fish passing through both clean and clogged fine trash racks directly in front of the intakes are lacking. No direct mortality to salmonids has been observed at the trash racks, though shad are often impinged (D. Domina pers. comm., 2001). Debris on trash racks may increase the chance of injury or mortality by impinging out migrating juvenile salmonids or steelhead kelts on sticks associated with debris, and from increased pressure from clogged screens.

Eicher screen

Laboratory studies of Eicher screens by Wert (1988, as reported in Normandeau Associates 2001a) reported findings and conclusions for two tested screen dimensions: (1) 0.08-in (2-mm) wide bars with 0.08 inch (2 mm) spacing along the screen length, and (2) 0.08-in (2-mm) wide bars with 0.04 inch (1 mm) spacing in the last 18 inches (46 cm) of the downstream end. Impingement occurred when bypass velocities were lower than test section velocities (<4 ft/s [122 cm/s]). Individual species and fish sizes tested (2.5 to 7.8 inches [64 mm to 198 mm]) passed through most effectively when bypass velocities exceeded 7 ft/s (213 cm/s) and no significant loss of scales was noted as a result of contact with screens (Normandeau Associates 2001a).

Bypass facility passage

Results of the Normandeau Associates (2001h) radio telemetry study showed that 44% of spring Chinook smolts migrating downstream past Willamette Falls went through the bypass facility at Unit 13. Roughly 80% of all outmigrants that enter the T.W. Sullivan facility forebay enter the bypass facility (Cramer and Domina 1998). Direct and indirect effects of the bypass facility on salmonid fry and smolts include injury and mortality. In 1996, 24 mortalities (1.33%) resulted from testing 1,810 salmonids for 48-hour delayed mortality after being captured in the T.W. Sullivan bypass evaluator. From 1991 to 1995, average percent mortalities for fish held for 48 hours were 1.32%, 2.05%, and 0.32% for spring Chinook, fall Chinook, and steelhead, respectively. Delayed mortality (48-hr) observed for Chinook in 1996 was 1.37%, which was lower than in 1995 (3.91%) and higher than in 1993 and 1994 (Domina 1997). Delayed mortality of steelhead in 1996 averaged 1.26%. In 1997, a total of 2,099 salmonids were tested for 48-hour delayed mortality. Delayed mortality for these fish was 2.05% (43 mortalities) (Domina 1998).

During the 1991–1995 period, over 500,000 fish were examined for injury and descaling (defined as the loss of >20% of scales) as part of the T.W. Sullivan bypass system study. The average occurrence of injury and descaling (including that which may have occurred prior to fish entering the bypass) for all species in all years was 0.44% and 1.81%, respectively. Descaling and injury tests were removed from study plan tasks in 1996 through agency agreement because the 1991–1995 data were considered sufficient to meet study objectives (Domina 1998). American shad may contribute to descaling and injury of juvenile salmonids in the bypass during late summer and early fall when 5,000 to 15,000 juvenile shad per day may pass through the system and when dead spawned-out adults may clog the screens (Domina 1997).

Domina (1997) reported an injury rate of 0 to 1.8%, with average 48-hr mortalities of 1.3% for spring Chinook, 2.0% for fall Chinook, and 0.3% for steelhead smolts, at the T. W. Sullivan louver-Eicher screen bypass system. Normandeau Associates (2001a) notes that no controls were used in Cramer's evaluation; therefore, the portion of losses associated with existing fish condition, capture, handling, marking, and recapture is unknown.

Fish exit the bypass system via a "ski jump" type spillway chute. Depending on river flow, the drop from the end of the chute to the tailrace water surface may vary from approximately 15 ft (4.6 m) to zero when the end is submerged. Concerns have been expressed regarding stress and injury to bypassed fish exiting through the spillway chute and their susceptibility to predation by other fish as well as birds. In March 1997, as part of turbine mortality testing, PGE tested fish condition and orientation to tailrace flow after exiting the bypass system. Twenty-hatchery spring Chinook salmon and 20 hatchery steelhead were fitted with balloon tags, released through the chute, recovered in the tailrace or river, and held for 48 hours. All 40 fish were recaptured. All 40 fish survived after 48 hours and were still alive when released after 96 hours. Results showed that 34 of the 40 fish (85%) were recaptured outside the tailrace in the main river channel where flow conditions are considered more favorable for avoiding predators than in the tailrace area.

Normandeau Associates (2001a) reported that results from balloon-tagged fish released from the bypass evaluator outfall chute indicated that no immediate or 120-hr (5-day) delayed mortality occurred (Cramer and Domina 1998), and that fish held in holding pools for five days showed little to no stress or injury related to passing through the chute. However, based on a literature review and site-specific data, a bypass system mortality of 1% direct and 1% indirect was assumed by Normandeau Associates (2001a). Normandeau Associates (2001a) reported that, except for certain site-specific cases, salmonid mortality rates at spillways were generally less than 3%, reaching 0% at many sites; sluice mortality ranged from 4% to 9%, and mortality at natural falls ranged from 0 to 41%.

Delay at bypass facility

In general, downstream migrating smolts do not appear to be delayed by the Project. Radio tagging studies have shown that residency time at the Project is typically less than 1 hour, and does not appear to be effected by season or species of salmonid Karchesky et al. (2002). However, delays in the bypass facility of up to ten days have been observed with test fish released into the forebay (Cramer 1996). FGE calibration tests indicated that some test fish took up to two months to move through the bypass system when it is in sampling mode (PGE and Smurfit 1998). As a result, specific tests were performed by PGE and Smurfit (1998) to determine if similar delays occurred with bypassed fish while in the bypass mode.

In the bypass mode, fish follow the bypass system flow directly into the tailrace via the ski-jump outfall chute. In the sampling mode, the water level is raised and velocities reduced and bypassed fish are diverted into the PIT tag detector section with screens and a flow of approximately 15 cfs (0.42 m^3/s), and then over an incline screen with fast, shallow flow. It is possible that operating the bypass facility in the sampling mode delays fish exiting the system.

To evaluate delays in the bypass facility, PIT-tagged fish were released directly at the outlet of the plunge pool with the facility set in the bypass mode. The system was operated in the bypass mode for 72 hours and then switched to the sampling mode for 120 hours. At the time of the switch, 50 additional PIT-tagged fish were released at the plunge pool outlet to serve as a calibration release. While in the sampling mode, the only exit for the test group fish remaining in the bypass plunge pool area, as well as the calibration group, was through the PIT tag detector. The objective was to determine how many of the test fish remained in the bypass system. Three (0.97%) of the 308 test fish tagged and released into the bypass plunge pool were recovered during the 120-hour sampling period. Of the 100 calibration fish tagged and released, 62% were recovered.

Using the same method that is used to calculate FGE (0.97%/62% = 1.6%) it was estimated that 1.6% of the fish released into the plunge pool remained after 72 hours in the bypass mode. Studies to address bypass facility impacts are ongoing.

Downstream passage of juvenile Pacific lamprey
Juvenile Pacific lamprey are considered to be weak swimmers relative to the swimming ability of juvenile salmonids (Dauble and Moursund 1999 as cited PGE and Blue Heron 2002). Information on sweeping velocities, screen spacing, and field evidence (no observations of injured or dead lamprey) indicate that impingement or injury of juvenile Pacific lamprey is unlikely (PGE and Blue Heron 2002). Modifications to FGE intended to benefit salmonid smolts are expected to benefit juvenile Pacific lamprey (PGE and Blue Heron 2002).

Passage through turbines
Entrainment in hydroelectric turbines or through other passage routes can result in both direct and indirect effects. There are a number of mechanisms by which passage of fish through turbines can result in either direct injury or mortality or indirect effects that may result in delayed mortality (Normandeau Associates and Skalski 1997). These mechanisms include: (1) direct mortality from mechanically induced injuries, pressure, cavitation, or shear stresses; (2) direct mortality, injury, or loss of equilibrium during passage through turbines; and/or (3) indirect effects that occur over a more extended period of time and distance after passage through turbines, including increased susceptibility to predation and disease, or physiological stress. Direct effects of passage through turbines, spillways, or sluices are those manifested immediately and are relatively easy to quantify (Normandeau Associates 2001a). Indirect effects may occur over an extended period of time and/or over a wider spatial area and are thus more difficult to quantify (Normandeau Associates 2001a).

Information concerning mortality of early life-history stages of fish (e.g., eggs, larvae, and fry) during passage through hydroelectric turbines and non-turbine passage routes is scant (Normandeau Associates 2001a). Much of the existing information resides in the literature, and is based on data gathered in the laboratory and field relative to intake guidance screens and diversion louvers at stream electric stations, irrigation canals, and pumping stations. Impacts to fish have generally been found to increase with fish size; therefore, smaller fish would be expected to have lower mortality. In the winter and spring of 2002, the presence of fry will be documented at the fish bypass evaluator station. Downstream-migrating adult steelhead kelts entering the T.W Sullivan facility are completely protected from turbine entrainment due to tight rack spacing in the inner forebay.

Direct effects include physical injuries from machinery, shear-turbulence, cavitation, and pressure, and are manifested immediately after passage as instantaneous mortality, injury, and loss of equilibrium. Mechanical injuries may result from direct contact with rotating runner blades; wicket gates; stay vanes; discharging rings; draft tubes; trash racks, intake fish guidance screens, and/or passage through gaps between the blades and hub, or through the distal end of the blades. The probability of mechanical contact is influenced by such variables as the distance between and the number of runner blades, runner blade speed, and fish length (Franke et al. 1997, as cited in Normandeau Associates 2001a).

Normandeau Associates (2001a) estimated mortality rates for 2- to 12-inch (51- to 305-mm) long fish using the mathematical equations in Franke et al. (1997) for both the Kaplan/propeller and Francis turbines. Critical factors affecting passage mortality of fish include turbine type, size of fish relative to turbine size, clearance between structural components (i.e., spacing between runner blades or buckets, wicket gates, and turbine housing), number of runner blades or buckets, runner blade speed, flow, and angle of water flow through turbines (Normandeau Associates 2001a). Mathematical integration of these variables led to the development of equations to predict mortality of various fish sizes as a probability of contact with mechanical parts. Normandeau Associates (2001a) reports that Franke et al. (1997) provide detailed discussion of the equations and other predictive models as a useful reference point when empirical data are unavailable for fish sizes that may not be readily field tested at a given site. In many cases, the equation was found to overestimate turbine passage mortality when compared with estimates using empirical data, and was quite sensitive to fish length (Normandeau Associates 2001a). Empirical data obtained at the T.W. Sullivan facility (for both Kaplan/propeller and Francis-type turbines) for certain fish size groups was also compared to values predicted by the equations to evaluate the level of confidence in predicting and assessing the effects of passage through turbines. These are discussed in greater detail below. Separate predictions were made for fish mortality in passage through Kaplan/propeller and Francis-type turbines.

Two site-specific data sources have been used to estimate mortality of smolts entering the forebay that do not enter the juvenile bypass facility at Unit 13 (Normandeau Associates 2001a). Fish that are not guided into the bypass facility pass downstream through turbines at the T. W. Sullivan facility or the Blue Heron facility or pass over Willamette Falls. The T.W. Sullivan facility has Kaplan turbines at units 1-8 and 10-13, and a Francis turbine at Unit 9. The Blue Heron facility has two Francis turbines.

Mortality at Francis-Type Turbines

Massey (1967) studied smolt passage mortality at turbine Unit 2 (a Francis turbine) of the Publishers Paper Company (Blue Heron), at turbines operated by PGE, and at the Crown Zellerbach Corporation, in 1960 and 1961. Recapture rates for treatment and control groups were substantially higher in the second year of studies. Results are shown in Table 6-3

Normandeau Associates (2001a) used mathematical equations developed by Franke et al. (1997) to predict survival ranging from 88% for larger fish to 98% for smaller fish for

Chinook salmon and steelhead 2-10 in (51-254 mm) in length passing through turbine Unit 9 at the T. W. Sullivan facility. Mortality appeared to increase with fish length. Mortality rates predicted for periods of off-peak efficiency (70 and 90% turbine efficiency) were generally less than 1% different from those predicted for periods of efficient operation (80% turbine efficiency).

Massey (1967) reported mortality rates at Unit 9 for 4.4-in (112-mm) Chinook and 5-in (127-mm) steelhead smolts at 14.3 and 25.9%, respectively. Normandeau Associates (2001a) predicted values for similarly sized fish varied from 6.5 to 14.3%. Normandeau Associates (2001a) attributes the higher mortality rate reported by Massey (1967) for steelhead to sampling difficulties encountered during the 1967 study. A nearby station at Publishers Paper, with similar turbine characteristics, reported steelhead mortality rates of 15.5 and 12.1% and Chinook mortality rates of 12.5% and 12.9% at two units (Normandeau Associates 2001a). In addition, Normandeau Associates (2001a) reported that Massey's (1967) high value for steelhead mortality fell outside the range of mortality rates observed elsewhere at similar turbines. Normandeau Associates (2001a) predicted steelhead mortality through the Francis turbine Unit 9, at 14.3%.

Table 6-3 Estimated Mortality of salmonid smolts passing through PGE powerhouse turbines.

Turbine Unit	Species	Fish Length mm	Estimated Mortality (%)	Source	Comments
Kaplan turbines					
Unit 7	steelhead	105	7.7	Massey (1967)	
Unit 7	Chinook	112	11.8	as above	
Unit 8	Chinook	164	17.9	Normandeau Associates and Skalski (1997)	
Unit 8	steelhead	227	14.9	as above	
Francis turbines					
Blue Heron	steelhead	128	12.5	Massey 1967	1960 and 1961 data combined
Blue Heron	Chinook	112	13.5	as above	1960 and 1961 data combined
Unit 9	steelhead	127	25.9	as above	
Unit 9	Chinook	112	14.3	as above	

Mortality at Kaplan Turbines

In 1997, evaluation of juvenile salmonid survival through a new turbine in Unit 8 was conducted to determine the potential benefits of replacing turbines at the T.W. Sullivan facility (Normandeau Associates and Skalski 1997). The study evaluated survival of salmonids passing through turbine Unit 8 where one of the existing adjustable Kaplan turbines was replaced with a new six-blade fixed-pitch turbine runner. The objectives of the study were to estimate one- and 48-hour survival probabilities for juvenile Chinook salmon and steelhead passing through the new turbine, and to provide baseline data for comparison with survival probabilities following any modifications to facility turbines.

Juvenile salmonids were balloon- and radio-tagged and released at three different depths within the penstock to account for the different depths at which fish may enter the turbine intake, whereas Massey (1967) released fish at a single unspecified location into the old Unit 8 turbine intake. Results showed estimated survivals through the turbine of 85.1% for steelhead and 82% for spring Chinook salmon. These survival rates were lower than those found in Massey's (1967) study (Table 6-3). Normandeau Associates and Skalski (1997) suggested that the lower survival may have been due to one or more of the following factors: (1) the use of larger test fish (which results in higher injury or mortality rates), (2) the release of fish from three different depths rather than a single location, (3) conducting the tests at higher water temperatures, and (4) assuming that stationary radio signals represented dead fish (Normandeau Associates and Skalski 1997). The results of Normandeau Associates and Skalski (1997), and of Massey (1967) are shown in Table 6-3. The predicted mortality values compare favorably with the empirically determined values (Normandeau Associates 2001a).

6.8.2.2 Downstream Passage at Blue Heron Facility

In 2003, PGE purchased and immediately shut down the Blue Heron Power Company (BHPC) units at Willamette Falls. The following descrption of the downstream passage at the Blue Heron facility is provided for context, as the project will be decommissioned during the new license.

The Blue Heron facility is outfitted with two horizontal double-runner Francis-type turbines, similar to turbine Unit 9 at the T.W. Sullivan facility. These turbines may cause direct and/or indirect mortality of outmigrating salmonids. A relatively minor proportion of flow passes through the Blue Heron facility; therefore, a relatively small number of outmigrants are susceptible to entrainment at this facility. In a study using radio-tagged Chinook smolts, Normandeau Associates (2001h) found that 4% of tagged fish entered the Blue Heron facility when flashboards were in place at the top of Willamette Falls, and 2% of all tagged downstream-migrating salmonids entered the facility when a 300-ft long (91.5-ft) gap was created by removing the 2 ft flashboards at the apex of the Falls.

Massey (1967, as cited in Normandeau Associates 2001a) found turbine-related mortality to average 12.5% for steelhead, and 13.5% for Chinook salmon at the Blue Heron turbines (Table 6-3). In this study, slightly higher mortalities were observed at T.W. Sullivan facility's Unit 9 (a Francis-type turbine) (Table 6-3). Some indirect mortality (e.g., predation, delayed mortality due to injury) may also occur, but no quantitative information on indirect effects is available for the Blue Heron facility. Based on studies conducted at similar facilities, and observations of predation occurring downstream of the facility (see Section 6.10) indirect mortality has been estimated at 2.5% for the Blue Heron facility (Normandeau Associates 2001a). During a spring 2000 radio-tagging study 12% of tagged steelhead passed over the Falls in the vicinity of the Blue Heron powerhouse, though Blue Heron was shutdown at the time. From 1995 until its permanent shutdown in 2003, the two turbines at the Blue Heron facility were shut down for 16 weeks from approximately mid-February through mid-June during the peak of the salmonid outmigration season to provide for downstream passage protection.

The listed Upper Willamette River steelhead ESU outmigrates during the seasonal shutdown described above. If no shutdown were to occur, an estimated 3.85% of all outmigrating salmonids would be entrained into the two turbines (Normandeau Associates 2001b). With the turbines shut down for 16 weeks, entrainment (not necessarily mortality) has been estimated to be 0.8% of all outmigrating salmonids; therefore, the shutdown decreases entrainment by approximately 3.05% (Normandeau Associates 2001b). Normandeau Associates (2001b) estimated that mortality of outmigrating salmonids would be 0.81% without turbine shutdown and 0.17% with turbine shutdown. The listed Upper Willamette River spring Chinook salmon ESU outmigrates in the fall, outside of the period protected by the mid-February to mid June shutdown used at BHPC from 1995-2003.

6.8.2.3 Downstream passage at Willamette Falls

The fate of outmigrating salmonid smolts during downstream passage at Willamette Falls depends on the distribution of fish as they approach the Project, and the survival of fish that pass over the Falls. Both of these components, and their relationship to continued Project operations, have been studied by PGE.

The distribution of fish as they approach the Falls is influenced by the Project. During a spring 2002 study Karchesky et al. (2002) found that 65% of steelhead smolts that passed via the Falls went over the Falls to the east of the apex (apex being the most upstream point of the dam), while the remaining 35% passed over the Falls to the west of the apex. The Project dam is set back from the crest of the Falls, but it does appear that passage conditions are effected by the dam and flashboards. Normandeau Associates (2001h) found that for those radio-tagged spring Chinook that passed over the Willamette Falls, 38% passed over a 300-ft long area just east of the apex of the Falls with flashboards installed and daily average flows ranging from 10,404 to 11,118 cfs (295 to 315 m^3/s). After removing a 300-ft (91.5-m) section of flashboards just east of the apex, 81% of spring Chinook smolts passing over the Falls used the slot created by the removed flashboards. Based on these initial results, it appears that creation of a slot, evidenced by this flashboard removal test, can affect Falls passage location of outmigrating salmonids.

Little data is available on mortality or injury of salmonid smolts or fry that pass over the Falls. Based on an investigation carried out in 1997, gulls in the vicinity of the Project were observed to be more successful at feeding on dead or injured juvenile salmonids than on healthy live fish (Normandeau Associates 2001i). Gull feeding observations conducted at Willamette Falls in 1984 and 1985 showed that 92% of successful prey captures occurred below the Falls, while only 8% occurred at the T. W. Sullivan tailrace.

Because gulls were substantially more successful at capturing prey below the Falls than in the tailrace, it is believed that greater injury or mortality of juvenile salmonids occurs at the Falls than through the bypass facility (Normandeau Associates 2001i). PGE recognizes that the dam and flashboards at the Project have modified flow distribution over the Falls and has worked with licensing participants to develop proposed Falls passage improvements.

6.9 Habitat Elements and Channel Condition and Dynamics

NMFS includes habitat elements and channel conditions and dynamics as properly functioning conditions pathways. Properly functioning indicators of habitat elements include substrate, large woody debris, pool frequency, pool quality, off-channel habitats, and "hot spots" and refugia. Properly functioning indicators of channel conditions and dynamics include width/depth ratio, streambank condition, and floodplain connectivity.

6.9.1 Geomorphic processes and channel morphology

Investigations have been conducted to determine if the dam impoundment has changed channel morphology of the Willamette River above the Falls. Depth-sounding data collected by the ACOE indicates that the longitudinal profile has changed over time, but not in a consistent upward or downward trend. If sediment was being deposited behind the Falls, the channel profile would be expected to gradually increase in elevation. Channel cross-sections for locations directly upstream of the Falls show lateral shifting of the centerline of the channel, but no overall increase or decrease in bed elevation. No aggradation of the bed was apparent from the ACOE data. Some localized degradation was observed, but is likely the result of gravel mining that occurred in the late 1980s or early 1990s (Normandeau Associates 2001g). The Willamette River upstream of the Falls has been periodically dredged to maintain access to several former log-handling facilities and for commercial mining of sand and gravel. In total, several million cubic yards of sediment have been removed from the channel in the vicinity of the Falls for navigation and commercial harvest, which may equal or exceed natural sedimentation rates in the channel (Klingeman 1973, as cited in Normandeau Associates 2001g). Localized areas prone to deposition still appear to be accumulating fine grain sediment.

Changes in the fluvial depositional environment upstream of the Falls are unlikely to impact spawning and rearing salmonids, including threatened Upper Willamette River Chinook salmon and steelhead ESUs, Columbia River bull trout DPS, and coho salmon (populations above the Falls are not listed). Bull trout, spring Chinook salmon and winter steelhead spawning have not been observed in the mainstem Willamette River above the Falls, and limited rearing habitat is available. Therefore, potential increases in sediment deposition are not likely to affect salmonids in the Project vicinity.

6.9.2 Floodplain connectivity and riparian habitats

Operation of the dam and installation of the flashboards cause backwater effects that increase water surface elevation upstream of the Falls. Soils in the riparian zone that would otherwise be dry during several weeks in the summer are inundated. The seasonal hydrograph, however, is not affected by Project operations, and riparian species continue to become established and scoured much as they would be under natural conditions (Harza Engineering 2001). Further, riparian vegetation is dominated by species that can tolerate brief periods of inundation in the summer (alder, cottonwood, willow, dogwood, salmonberry). No direct effects of continued Project operations on riparian habitats are expected.

6.10 Predation

Aquatic, avian, and terrestrial predators commonly prey on juvenile and adult salmonids under natural conditions. Modifications to riverine and riparian habitats resulting from the construction and operation of hydroelectric projects may artificially increase predation on salmonids. Listed salmonids that may be affected by increased predation in the Project area include Upper Willamette River Chinook salmon and steelhead ESUs. Fish belonging to other runs passing downstream over the Falls (e.g., coho salmon, summer steelhead, fall Chinook salmon) are not currently protected under the ESA.

Hydroelectric facilities at Willamette Falls may increase predation on adult salmon by delaying their upstream passage and prolonging their exposure to marine mammals. Sea lions have been observed at Willamette Falls, including the entrance to the Willamette Falls fish ladder. Marine mammals, however, are natural predators of adult salmon, and the construction of the fish ladder has increased numbers of fish passing over the Falls compared to historical conditions. ODFW has documented marine mammal predation at Willamette Falls and will continue to monitor such predation.

Hydroelectric facilities in general may increase predation on outmigrating juvenile salmonids. Predators of juvenile salmonids in the vicinity of the Project and in downstream reaches include gulls (California and ring-billed), Caspian terns, smallmouth bass, channel catfish, northern pikeminnow, and walleye. Possible factors influencing predation rates in this area include: prey fish disorientation and/or stress related to passage through Project facilities or over the Falls, reduced water velocities, reduced turbidity, and increased water temperature. Avian predation rates at the T.W. Sullivan facility are low (<1%), probably as a result of the placement of avian exclusion wires in the tailrace (Normandeau Associates 2001i). Predation on juvenile salmonids by birds has been observed downstream of the Falls inside the horseshoe formation (D. Domina, pers. obs., 2001). Belted kingfishers and great blue herons have also been observed feeding on salmonid smolts in the forebay when they are congregating at the entrance to the Unit 13 bypass. At Wanapum Dam on the Columbia River, Ruggerone (1986, as cited in Normandeau Associates 2001i) estimated that 2% of the salmonid run was consumed by gulls during peak outmigration. In 1997, PGE conducted an experiment on avian predation at the fish bypass outfall in the T.W. Sullivan tailrace (Domina 1998). Gulls appeared to be feeding primarily on fish that were stressed, injured, or disoriented, while healthy fish appeared better able to avoid capture by gulls (Domina 1998). Measures proposed to reduce the potential for avian predation were developed by PGE and participants.

Northern pikeminnow are a native cyprinid species that co-evolved with and naturally prey on juvenile anadromous salmonids (Hankin and Richards 2000). In the Columbia River, northern pikeminnow have been recognized as the most significant aquatic predator on emigrating juvenile salmonids (Brown and Moyle 1981). The significance of northern pikeminnow predation on juvenile salmonids varies with prey species, water temperature, and prey size (Normandeau Associates 2001i). Northern pikeminnow consumption rates have been found to be highest at water temperatures between 60.8–71.6°F (16-22°C) (Brown and Moyle 1981). Although northern pikeminnow are a natural predator of juvenile salmonids, the development of the Columbia River hydropower system has likely increased predation in this highly modified river system. Brown and Moyle (1981) found that predation by pikeminnow on anadromous salmonids was minimal except in areas affected by dams and other structures. Similarly, Buchanan et al. (1981) found that predation on salmonids by northern pikeminnow was minimal in free-flowing reaches of the Willamette River. Several additional studies have confirmed that pikeminnow densities (Beamesderfer and Rieman 1991, Ward et al. 1995) and consumption rates on juvenile salmonids (Vigg et al. 1991, Ward et al. 1995) are highest near dams. These studies suggest that northern pikeminnow predation on juvenile salmonids is likely greater in the Snake and Columbia rivers today than what it may have been prior to dam construction.

Dams and hydroelectric projects can affect fish predator-prey interactions in several ways. Dams may concentrate prey in forebay and tailrace areas thereby increasing exposure time of juvenile salmonids to predators, and can reduce water velocity and decrease turbidity, which may also increase predator efficiency. Northern pikeminnow appear to be opportunistic predators that can take advantage of situations where prey fish are spatially or temporally concentrated, or where there may be dead, injured, stressed, or disoriented fish, such as at fish bypass facility outfalls below dams, or where hatchery releases occur (Buchanan et al. 1981). In the Columbia and Snake rivers, Beamesderfer et al. (1996) estimated that approximately 16.4 million emigrating juvenile anadromous salmonids were consumed by northern pikeminnow annually prior to the Northern Pikeminnow Management Program (NPMP). Northern pikeminnow have been estimated to consume approximately 8% of the estimated 200 million juvenile anadromous salmonids produced in the Columbia and Snake rivers combined (Hankin and Richards 2000). Information on northern pikeminnow predation at natural falls or hydroelectric projects similar to the Willamette Falls Project is lacking. Beamesderfer (2000) suggests that dams in the Willamette River have not disrupted predator-prey interactions as they have in the mainstem Columbia River.

The Willamette Falls Project does not substantially change the amount of water impounded, so increased predation is less likely to be a concern than in larger reservoirs. In addition, the Willamette River channel immediately upstream of the Project is a wide shallow basalt shelf with a substrate of bedrock and relatively high water velocities that provide less than optimal conditions for predatory fish. Immediately downstream of the Project, Hanson and Mather (2002) found that northern pikeminnow densities were about 10 times lower in the vicinity of the Project than in the Columbia River.

Buchanan et al. (1981) investigated northern pikeminnow predation on juvenile salmonids in free-flowing sections of the Willamette River basin and found that of the approximately 59% of northern pikeminnow stomachs that contained food items, only 2% contained salmonids. Buchanan et al. (1981) has suggested that previous reports may overestimate predation because most studies were conducted in artificial situations, such as below dams or following a hatchery release. Ward et al. (1994) examined the stomach contents of northern pikeminnow in the lower Willamette River and found that 12.3% of the stomach contents collected contained juvenile salmonids. Electrofishing and stomach content analysis conducted during June 1993 in the T.W. Sullivan tailrace found 1 of 23 northern pikeminnow had remains of salmonids (Normandeau Associates 2001i). This finding is much lower than the 29% noted by Tabor et al. (1993) just below the free-flowing section in the Hanford Reach, and the 33.5% found by Poe et al. (1991) downstream of the McNary Dam. At the Project facilities, predation most likely occurs at the fish bypass spillway, where exiting fish can be stunned and disoriented (Buchanan et al. 1981, Hankin and Richards 2000), and predators can utilize low velocity habitat.

In areas with high water velocities, such as at the tailrace of the T.W. Sullivan facility, salmonids are not likely to be important items in the diets of smallmouth bass or northern pikeminnow. Northern pikeminnow have been found to prefer habitats with low water velocities (Bennett and Naughton 1998, as cited in Normandeau Associates 2001a) ≤1 fps—and to generally avoid areas where water velocities exceed 3 fps (91 cm/s) (Issak and Bjornn 1996, as cited in Normandeau Associates 2001i). Predation by piscivorous fish would most likely occur in the limited amount of low velocity habitat that is available in the tailrace downstream of the powerhouse, particularly in an eddy adjacent to the Unit 13 exit. An eddy also exists along the shoreline downstream of the Unit 13 exit. A radio telemetry study of 20 northern pikeminnow indicate that the primary congregation area was in the eddy downstream of Unit 13, but congregations were also observed in the River downstream of the cul de sac arm of the T.W. Sullivan tailrace, and in the horseshoe of the Falls (Normandeau 2001a).

Northern pikeminnow in the tailrace may prey primarily on dead or injured fish. Ward et al. (1994, as cited in Normandeau Associates 2001i) released 61 radio-tagged salmonids below Willamette Falls and found that none were consumed. In addition, none of the 40 balloon-tagged salmonids with impaired swimming ability released from the T. W. Sullivan bypass were preyed upon, suggesting that predation on live fish may be minimal.

Smaller-size (<5.9 inch [<150 mm]) spring and fall Chinook salmon migrating past the Project are more likely to be vulnerable to northern pikeminnow predation. In March through April and November through December, hatchery-reared spring Chinook salmon migrate past the Project site when water temperatures are lower and predator abundance is lower due to high river flows. Steelhead smolts, because of their size (≥7.1 inches [≥180 mm]), are generally less vulnerable to predation (Normandeau Associates 2001i). Downstream migrating fall Chinook pass though the Project when temperatures are high and the fish are small (<5.9 inches [<150mm]), and thus are the most susceptible to predation. Juvenile fall Chinook salmon originating from above the Falls are not listed. Depending on assumed predation rates and distributional patterns, modeled predation rates on fall Chinook salmon (≤5.9 inches [≤150 mm) range from 2.0 to 6.0% (Normandeau Associates 2001i).

Due to low densities of northern pikeminnow in the Willamette River, the minimal increase in volume impounded upstream of the Falls, and the relatively high water velocities immediately downstream of the Falls, the Project is not likely to increase northern pikeminnow predation on salmonids. Nonetheless, measures are proposed to further reduce the potential for aquatic predation by eliminating predation habitat.

6.11 Competition/Interaction with Introduced Species

Salmon and steelhead migrating and rearing in the Willamette River potentially compete for resources with introduced species, and American shad in particular. American shad are a very prolific introduced anadromous fish to the Willamette River basin. In the Columbia River there has been concern that a high abundance of adult upstream migrating shad in fish ladders may prevent adult salmon from using the facilities. However, shad rarely use the Willamette Falls fishway and primarily migrate above the Falls via the ACOE navigation locks. Juvenile shad migrate downstream to the ocean from June through October shortly after hatching. Competition between juvenile shad and juvenile salmonids for common prey items may reduce growth rates of juvenile salmonids, while larval shad may be a food source for juvenile salmonids. However, very little data is available to address these interactions.

6.12 Flow/Hydrology

NOAA Fisheries has identified flow/hydrology as an important component of the PFC pathway. Properly functioning indicators of flow and hydrology include changes in peak and base flows.

Hydrologic regimes in the Willamette River are not affected by the Project because it is operated as run-of-the-river. The dam and flashboards, when installed, are designed solely to direct water into the Project's forebays to maximize head. Water that does not flow through the powerhouse flows over the Falls and proceeds downstream, while water diverted through the powerhouse rejoins the main Willamette River immediately below the Falls. During low flow periods (e.g., July and August), up to 80% of the flow in the river passes through the powerhouses, while only a minor portion (e.g., <10%) passes through the powerhouses during the winter (PGE and Smurfit 1998). The balance of the flow passes through the fish ladder (approximately 1,000 cfs [28 m^3/s]), navigation locks, and other minor industrial uses and the remainder passes over the Falls (PGE and Smurfit 1998). The Project thus does not affect this PFC pathway.

6.13 Ground Faults on the T. W. Sullivan Transmission Line

On rare occasions, ground faults have occurred on the transmission line that connects the T. W. Sullivan powerhouse to PGE's transmission and distribution system. These faults have been caused by unforeseeable accidents, such as cars hitting power poles or birds or squirrels causing ground faults on the lines. These incidents can result in electrical current passing through the turbine draft tubes and into the water where adult salmon congregate, and may result in the mortality of listed salmonids (D. Domina, pers. comm., 2001).

In April 2001, a ground fault occurred due to a small bird landing on a feeder line on the steel tower northwest of the T. W. Sullivan powerhouse. Between the time of the fault and its clearing by the line breaker, at least some of the fault current traveled through the turbine draft tubes. Because of the nature of the incident, it was not possible to accurately determine the number of fish that may have been affected. The carcasses of approximately 31 adult Chinook salmon were collected by state and federal agents downstream of the Project following the incident, but it is unknown how many of these fish were wild or hatchery fish (PGE 2001). A similar incident occurred at the powerhouse in 1994.

PGE convened a task force to resolve issues associated with ground faulting and hired an outside grounding consultant - Safe Engineering Services & Technology of Montreal, Canada - to assist in identifying potential remedial measures to the plant's grounding system. In May 2001, the T. W. Sullivan plant was taken off line and several remedial measures identified by the PGE task force were implemented. PGE is currently waiting for the results of the Safe Engineering Services & Technology study and is continuing efforts to determine if there are additional long-term precautionary measures that can be implemented to reduce the risk of such incidents occurring in the future. Upon completion of this study, PGE anticipates working with ODFW and NOAA Fisheries to develop specific additional precautionary measures.

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7 EFFECTS OF CONTINUED OPERATIONS UNDER THE CONDITIONS OF A NEW LICENSE ON LISTED, PROPOSED, AND CANDIDATE SPECIES AND CRITICAL HABITAT

7.1 Terrestrial species

Bald eagles and the Willamette Valley daisy are the only listed non-salmonid species potentially occurring in the Project vicinity. There are three known bald eagle nest sites in Clackamas County. None are within the Project area, but bald eagles are observed there. One nest is located upstream of the Project near the mouth of the Molalla River, the second is located downstream of the Project near Lake Oswego, and the third is near Barton (Isaacs and Anthony 2000 and G.Concannon, pers. comm., 2001, both as cited in Harza Engineering 2001). Due to the lack of nesting habitat within the Project area, it is unlikely that the continued operation of the Project will have an effect on bald eagles. The Willamette Valley daisy has not been observed within the vicinity of the Project in over 100 years. Further, due to the confined channel and lack of established flood plain in the vicinity of the Project it is unlikely that the continued operations of the Project will have an effect the Willamette Valley daisy.

7.2 Aquatic Species

The direct and indirect effects of the proposed action and continued Project operations on petitioned, listed, proposed, and candidate fish species and potential future designated critical habitat are described below. Cumulative effects are described in Section 7.3. These anticipated effects, as well as existing, short-term, and potential long-term measures to reduce effects are summarized in Table 7-1.

7.2.1 Effects of continued operations under a new license

The direct, indirect, and cumulative effects of existing Project operations on petitioned, listed, proposed, and candidate species and potential future designated critical habitat are described under baseline conditions in Section 6. Continued operations of the Project would result in continuation of baseline conditions until the issuance of a new FERC license.

7.2.2 Effects and expected benefits of conditions under a new license to Listed, Proposed, and Candidate Salmonids

Since the operation of the Project under the new license will have the potential to affect petitioned, listed, proposed, and candidate species, PGE has developed a set of measures and modifications as conditions under the new license to provide for the conservation of these species during the period of the new FERC license. PGE has worked with the

Willamette Falls Fish and Aquatics and Terrestrial workgroups to identify, design, and implement studies to quantify the effects of operation of the Willamette Falls Hydroelectric Project on protected salmonids. Based on these and previous studies, conservation measures (described in Section 3) were developed to reduce take of protected salmonids as conditions of the new license. The effect of these measures and continued operation of the Project under these conditions on listed, proposed and candidate salmonids are analyzed. The direct, indirect, and cumulative effects of existing Project operations on listed, proposed, and candidate species and designated critical habitat are described under baseline conditions in Section 6.

7.2.2.1 Downstream passage at T.W. Sullivan Development

Measures proposed to improve downstream fish passage at T.W. Sullivan Development are described in Section 3.3, and listed in Appendix A. These measures will be implemented in a tiered approach, as described in Section 3.1, and have the objective of achieving the performance standards and goals described in Section 3.1. In general, these measures are designed to benefit salmonids and lamprey, and include major modifications to the T.W. Sullivan Powerhouse to increase fish guidance efficiency, increase survival through the powerhouse, and decrease predation risk.

Due to the location of the Project, fishes have the greatest potential to be impacted during their downstream migration. Evaluating the impacts to fish resources of proposed passage options at the powerhouses encompass the effects from multiple factors, including species run timing, river flows, proportion diverted into the forebay, proportion guided into a bypass system (FGE), unguided proportion transported through turbines, survival of fish passing through each of the turbine types, and post-passage effects, such as predation. The impacts of the Project on downstream migration are described in Section 6.8.2.

At T.W. Sullivan, passage survival though the powerhouse is directly related to the ability to guide downstream migrants (i.e., FGE) to the downstream bypass system. Tier 1 measures (Appendix A) are intended to improve FGE but will occur before the new license is implemented and may be considered part of the baseline condition. Tier 2 measures are intended to provide an additional bypass route - effectively increasing FGE, reducing tailrace predation potential, and improving guidance system reliability with a cleaning system (also improving FGE). Tier 3 measures, if required, would further improve FGE by reducing entrainment into Unit 12, or by directly reducing injury/mortality of downstream migrants. In addition to environmental measures, modeling, analysis, and monitoring will be conducted to evaluate the performance and effectives of implemented measures. The results from these efforts will guide the design and implementation of additional measures.

Modification to trash racks

Modifying the trash racks in front of Units 1, 2, and 3, which includes reorienting the guidewall, would not reduce entrainment into the forebay at the T.W. Sullivan powerhouse, but would increase FGE and the number of downstream migrants guided into the existing Unit 13 fish bypass system. Instead of straight trash racks in front of Units 1, 2, and 3, the modified 80-foot trash rack section would be curved to improve flow hydraulics and fish guidance to the downstream end of the forebay. The guidewall will be extended to further improve flow hydraulics. Increased FGE would increase numbers of bypassed fish and decrease mortality and injury associated with downstream passage through the T.W. Sullivan powerhouse. In addition, selected bar removal at headgate trash racks on the west (West Linn) end will help encourage downstream passage of adult salmonids into the plant forebay; and out through the fish bypass.

Little information is available to predict the effects of forebay rack modifications on FGE for salmonid fry or other non-salmonid species entrained through T.W. Sullivan. However, it is likely that some reduction in entrainment mortality through T.W. Sullivan would be realized for all fishes by improving forebay hydraulics and FGE.

No information about juvenile Pacific lamprey guidance is available to predict the effects of improved forebay hydraulics. However, any improvement in forebay hydraulics likely would result in improved guidance of most fishes, including juvenile Pacific lamprey, to a safer passage route via unit 13 or a siphon spillway (discussed below).

Installation of modified trash racks, reorienting the guidewall in the forebay, and removal of selected bars at headgate trash racks would reduce mortality (direct and indirect) associated with powerhouse passage. Implementation of these modifications, in concert with other modifications that improve bypass or tailrace hydraulics, would provide additional enhancement for fisheries resources at the Project. This measure is expected to benefit threatened Upper Willamette River spring Chinook salmon and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Discharge of Units 12 and 13

Modifying the discharge from Units 12 and 13 is would eliminate the back-eddy conditions along the powerhouse foundation between the discharges, and thereby removing an environment that increases predation risks for downstream migrants. Tailrace predation rates would be reduced by eliminating eddies and slow pockets, and reducing areas available for ambush predators (e.g., northern pikeminnow).

The effect of this option on entrained smolt predation was estimated. It was assumed that tailrace predation rates would decreased by one half for bypassed fish and by one-fourth for turbine passed fish (resultant predation rates of 0.5% for bypassed and 1.5% for turbine-passed). This yielded an estimated reduction in tailrace predation mortality from 1.15% down to 0.65% at an FGE of 85%. Modification of the Unit 12 and 13 turbine discharges to improve T.W. Sullivan tailrace hydraulics would enhance fisheries resources at Willamette Falls. Hydraulic conditions in the T.W. Sullivan tailrace would be improved with the implementation of this option and predation on smolts passing through the powerhouse likely would decrease. This measure is expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Siphon Spillway Modification

It has been estimated that FGE may increase an additional 10% at the T.W. Sullivan plant with a siphon spillway bypass system installed. At a starting FGE of 75% and an added 10% guidance from the Unit 1, 2 and 3 trash rack modification, FGE after the siphon spillway modification is anticipated to be approximately 95%.

Modifying the existing siphon spillway at the north end of the forebay to improve fish passage at the T.W. Sullivan powerhouse would increase the total amount of flow entering the forebay and being passed into the T.W. Sullivan tailrace. This increased flow may slightly increase the potential for downstream migrants to be entrained into the T.W. Sullivan forebay. The modified siphon spillway is expected to pass at least an additional 500 cfs. As a result, T.W. Sullivan forebay flow would increase from 5,850 cfs to 6,350 cfs under most river flow conditions, or from 6,850 cfs to 7,350 cfs under maximum flow conditions, or an increase of 8.6% or 7.3% respectively. An increase in flow and potential entrainment of smolts into the T.W. Sullivan forebay most likely would be realized during low flow periods when inflow is relatively close to the T.W. Sullivan hydraulic capacity. Thus, any increased smolt entrainment primarily would affect summer or early fall migrants, such as later portions of natural steelhead or fall Chinook salmon runs, or early natural spring Chinook salmon migrants. This factor, however, does not affect the percent mortality analysis because mortality is calculated as a percentage of the fish entrained.

Increasing flow through the current forebay configuration would increase velocities by approximately 1 fps at the headgates. Present forebay velocities range from 4-6 fps in mid forebay, with highest velocities nearest the headgates (PGE velocity profile data, October 1997). If siphon spillway modifications were implemented, the estimated velocity at the headgates would be 7 fps. Comparable increases in velocity at other forebay locations are likely. The increased sweeping velocity in the forebay is intended to result in more fish moving past Units 1-12 and entering either the existing Unit 13 bypass or the new siphon spillway, thus increasing the overall FGE of entrained fish at T.W. Sullivan. Improved FGE would decrease the potential for direct impacts due to turbine mortality or injury, and reduce predation on turbine-passed smolts, an indirect effect.

The siphon spillway modification option also includes changes to the T. W. Sullivan tailrace north shoreline. Such modifications would eliminate low-flow and eddy conditions conducive to ambush predators. Increasing discharge flow into the tailrace and improving hydraulics would reduce tailrace predation and eliminate ambush predator sites.

Enhanced forebay flows also should improve Pacific lamprey, steelhead kelt, and adult salmonid fallback passage through T.W. Sullivan. For all species, the higher forebay velocities should increase sweeping velocities across the louver array. Higher sweep velocity may assist transporting these fish to the Unit 13 bypass or modified siphon spillway by increasing warning stimuli (e.g. faster flows and perhaps sound from entrained air; Kynard and Horgan 2001) detectable by fishes near the louvers.

Improvements in the T.W. Sullivan tailrace that accompany a siphon spillway modification would be designed to eliminate existing eddy conditions along the tailrace north shoreline and improve outfall conditions for bypassed fish. As a result, some reduction in potential predation on bypassed fish may occur. Assuming a reduction of bypassed fish predation mortality from 1% down to 0.5% would reduce overall predation mortality to a approximately 0.7%

Installation of a new passage route through the siphon spillway would enhance fish passage at the T.W. Sullivan Development. Under this option, FGE likely would increase due to faster forebay flows, and hydraulic conditions in the tailrace would also improve. Both changes would reduce potential for injury and mortality to fish that pass through the T.W. Sullivan powerhouse, as well as potentially reduce indirect impacts of aquatic predators in the tailrace. This measure is expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Operations

A measure to address periods of low flow is the implementation of operational priorities for T.W. Sullivan turbine units to maintain good FGE when flows are low and cannot support operation of all turbine units.

A PIT tag detector will be installed in the siphon bypass, and an upgraded PIT tag detector will be added to the Unit 13 bypass system to allow monitoring and evaluation of out migrant facility performance. When selected unit shutdowns are necessary, units that have the least effect on forebay hydraulics, as determined through physical forebay modeling, will be shut down first. Subsequent FGE testing may identify different units to selectively shutdown.

Unit 13, which provides downstream migrant bypass capability, will be shutdown for maintenance for no longer than 2 weeks during the period July 1 to August 1. Powerhouse operation during a maximum 2-week Unit 13 shutdown during this period will not require agency permission. Continued powerhouse operation during unit 13 shutdowns longer than two weeks during this period, or Unit 13 shutdowns outside of this period, will require agency permission.

Other operational measures include replacing runners in units 1-7 and 10-12. New and existing turbine runners will be operated in accordance with an operational plan developed by PGE in consultation with fish agencies, within a 1% band around peak efficiency based on manufacturer's curves for the existing hydraulic conditions (based on 48-hr average) until forebay FGE $\geq$ 95% for salmonid smolts and fry and juvenile lamprey.

These measures are expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Unit 13 fish bypass system outfall

Modification of the T.W. Sullivan bypass outfall involves modifying the discharge to reduce impact velocity. Modifying the existing outfall chute could involve a hinged/articulated chute and float/guide assembly that moves with tailrace level. This would enable the release elevation to adjust automatically with changing tailrace levels while meeting NOAA Fisheries impact velocity criteria. Improving the bypass system discharge would reduce predation potential. Most benefits of reduced predation would accrue to spring and fall Chinook salmon smolts that are more prone to predation due to their size (many less than 150 mm).

Modification of the bypass outfall at T.W. Sullivan to improve downstream passage would enhance fisheries resources at Willamette Falls. Bypassed fish release conditions into the T.W. Sullivan tailrace would be improved and predation on smolts passing through the powerhouse likely would decrease. This measure is expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Trash rack cleaning system

Debris build up on trash racks can decrease FGE, and increase the risk of impingement. The installation and operation of a forebay trash rack cleaning system will ensure the forebay trash racks remain free of debris build-up, thus increasing FGE, and decreasing potential injury. This measure is expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

Post-Tier 2 measures

Measures identified to be implemented if needed after Tier 2 measures include retrofitting Unit 12 with an Eicher screen, new rack system, criteria screening, and Project shut-downs. Retrofitting Unit 12 with an Eicher screen similar to that in place at Unit 13, if implemented, would improve downstream fish passage at T.W. Sullivan by improving survival of those fish entrained into Unit 12. Unit 12 is a Kaplan turbine located immediately upstream of Unit 13. The retrofit could include provisions for screened fish from Unit 12 to be bypassed to the existing Unit 13 bypass and evaluator facility for exit to the tailrace.

The fall 2000 downstream study monitored groups of T.W. Sullivan units for downstream entrainment. Twenty of 39 tagged smolts, or approximately 50%, that did not use Unit 13 and passed through the turbines went through Units 8 through 12. Spring 2002 testing showed only 2 of 41 test fish did not use the Unit 13 bypass, with one of the two passing through unit 12.

It is difficult to calculate the FGE improvement that adding an Eicher screen to Unit 12 would provide because it this modification would be done after Units 1,2, and 3 trash racks were modified (a Tier 1, pre-new license action) and after a siphon spillway bypass had been installed (Tier 2), both of which would affect the distribution of smolts in the T.W. Sullivan forebay. An optimistic calculation would assume 50% of non-bypassed (Unit 13 or siphon spillway) fish pass through Unit 12. If FGE were 90% prior to adding an Eicher screen in Unit 12, then FGE could be increased an additional 5% (50% of the 10% non-bypassed fish) for an overall 95% FGE. If FGE prior to adding an Eicher screen in Unit 12 were 95%, then FGE would increase an additional 2.5% (50% of the 5% non-bypassed fish). Improvement to FGE with an Eicher screen in Unit 12 is directly related to the number of fish entrained into Unit 12 after previously made improvements, thus, performance testing after Units 1,2, and 3 trash rack modification and adding a siphon spillway downstream passage route would monitor Unit 12 passage to help determine this modification's passage improvement potential.

A concern was expressed that an additional Eicher screen in Unit 12 could add to a potentially existing juvenile lamprey impingement problem. The compressed tail of small lamprey has been shown to cause juvenile Pacific lamprey to impinge at protective screens with 3 mm openings, and to a lesser degree at those with 2 mm openings (Dauble and Moursund 1999). T.W. Sullivan's Eicher screen has 2mm openings. More recent field and laboratory testing was done by PNNL for the Columbia River basin (add reference Moursund, R.A., R.P. Mueller, T.M. Degerman, and D.D. Dauble. 2001. Effects of dam passage on juvenile Pacific lamprey Lampetra tridentata. Final Report. Prepared for U.S. Army Corps of Engineers, Portland District, Portland, Oregon. Pacific Northwest National Laboratory, Richland, WA). An analysis of this work indicates that the 2 mm clear spacing of the Unit 13 Eicher screen, its wedge-wire bar orientation in the penstock (parallel to flow), and high sweeping flows (5.6-6.9 fps) relative to through flow (2-3.1 fps) would largely preclude tail-first penetration behavior (PGE and Blue Heron 2002).

During a substantial amount of sampling in 2001 and 2002 at the T.W. Sullivan evaluator, there was no evidence that lamprey impingement occurred at T.W. Sullivan based on the physical condition of juvenile lamprey sampled from the Unit 13 Eicher screen bypass evaluator. All lamprey captured were alive, and had no marks or injuries (e.g., bent or mangled tail) that would suggest they had been impinged on the screen face (PGE and Blue Heron 2002). Unit 13 Eicher screen bypass evaluator sampling occurred 3 days per week for 8 h daily from March 1 through June 8, 2001, and either 8 h or 16 h per day, 3 days per week, from September 27, 2001 through June 8, 2002 with the following expanded total counts: 675 in spring 2001, 176 in fall 2001, 260 in winter 2001-2, and 34 in spring 2002 (Tables 1 to 4, PGE and Blue Heron 2002). These periods encompass the major outmigrations of juvenile Pacific lamprey (Beamish and Levings 1991). Any injured or dead lamprey passing through the Unit 13 penstock or coming off the Eicher screen would have been seen by sampling personnel.

Based on the site specific juvenile lamprey observations and juvenile lamprey passage studies summarized above, adding an Eicher screen at Unit 12 would not adversely affect juvenile lamprey. A more rigorous assessment of juvenile impingement on the Unit 13 Eicher screen will be conducted in 2004 to confirm this conclusion. Modifying the T.W. Sullivan powerhouse to include an Eicher screen at Unit 12, if implemented, would improve downstream passage through T.W. Sullivan and enhance fishery resources at Willamette Falls. This measure is expected to benefit threatened Upper Willamette River spring Chinook salmon and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

In addition to the Eicher screen, additional assessments of injury/mortality of fish at T.W. Sullivan's 2-inch spaced trash racks will be conducted. A new rack system will be implemented if mortality can be reduced. Behavioral deterrent devices will also be implemented to further reduce outmigrant injury and mortality. If Tier 1, 2, and 3 measures are not adequate to meet stated standards and goals for downstream migration at T.W. Sullivan, Tier 4 measures will be implemented, including criteria screening, seasonal shutdowns, or Project decommissioning, which clearly would protect aquatic species.

7.2.2.2 Downstream passage over Willamette Falls

The presence of the dam around the crest of the Falls modifies flow patterns around and over the Falls by spreading out the flow around the entire Falls. This is most noticeable at lower flows where much of the flow may have been guided over the Falls through natural upstream channels between Moore and Abernathy Islands. By spreading the flow around the entire crest of the Falls, it is believed that some downstream migrants are deterred from passing at the Falls due to only a shallow veil of water passing over the dam/flashboards, or they pass over the Falls at locations that may result in injury from rock outcroppings or by landing on rocks at the base of the Falls. As noted earlier, this concern is applicable to not only juvenile downstream migrants but also for kelts and for upstream migrant fallback. The effect of the dam on downstream passage during low flow conditions is difficult to measure, but has been identified as a concern by the fsih agencies. Measures have been identified to reduce injury and mortality to fish migrating downstream at Willamette Falls, as described below.

Operations plan and flashboard removal
A portion of outmigrating juvenile salmonids (and presumably lamprey) pass over the horseshoe section of Willamette Falls. PGE shall remove selected flashboards near the apex of Willamette Falls no later than October 1 until a controlled flow structure is installed at Falls apex (Tier 2, as described in Appendix D). A specific schedule of flashboard removal will be determined by consulting with the agencies. The flow control structure and the removal of the flashboards will create a slot through which juvenile salmonids can safely pass. The slot will be approximately 150 ft (45.8 m) long and is intended to provide access to a safer downstream passage route over the horseshoe section of the Falls. Three hundred feet of flashboards were removed in a pilot test in the fall of 2000, but when flashboards were removed near the apex in the fall of 2001 at the request of NMFS (2001), it was determined that a 150 ft (45.8 m) wide slot was a more appropriate width to effectively provide access for downstream migrating juveniles and steelhead kelts to the historic thalweg of the channel (Normandeau Associates 2001h), while avoiding directing flow over adjacent rock outcrops. The 150 ft (45.8 m) slot will provide passage through the "canyon" portion of the Falls, where improved plunge and outfall conditions exist. When the controlled flow structure is installed an operations plan will be modified for the T.W. Sullivan powerhouse.

Removal of flashboards and the later construction of a flow control structure to create a slot at the apex of the Falls is expected to provide an improved passage route for downstream migrating juvenile lamprey, salmonids and kelt steelhead. The volume of water passing through this location should attract migrants to this downstream passage location and increase their survival by providing a landing area with a rock-free hydraulic cushion. The apex of the Falls is considered the historic thalweg of the channel (ENSR 2002), and is the likely historic migration corridor. Results of a radio telemetry study conducted in October 2000 at Willamette Falls found that a gap at this location attracted downstream-migrating spring Chinook salmon as intended (Normandeau Associates 2001h). The study found that after removing the flashboards at the gap, 81% of the radio tagged spring Chinook smolts that passed over the Falls used the gap. NMFS has recognized the benefit of removing flashboards, and has stated that the gap at the apex of the Falls will provide improved downstream passage (NMFS 2001).

Increasing flow through a gap at the apex of the Falls will also likely reduce spill over the west side of the Falls near the exit of the fish ladder, and may therefore reduce fallback of adult salmonids over the Falls. However, it is possible that increasing flows at this location could also increase fallback of adult fish attracted to the flow at the gap. The survival of downstream-migrating steelhead kelts should also be increased by this conservation measure by providing a passage corridor with enough flow volume to provide a plunge area with a hydraulic cushion.

Outmigration of threatened Upper Willamette River Chinook salmon occurs both in the spring and the fall, with peak outmigration occurring in late October. This measure is designed particularly to benefit juvenile spring Chinook salmon by increasing survival of downstream migrants during their peak outmigration period. Survival is expected to increase by improving passage conditions (NMFS 2001). Survival of outmigrating threatened Upper Willamette River steelhead, and other juvenile and adult salmonids passing over the Falls during periods when the slot is open, will also potentially improve. Downstream kelt movement typically occurs in spring after steelhead spawn. Passage of kelts over the Falls may also be enhanced by attracting kelts to a preferred Falls passage route.

Avian predation deterrents
Continuing and expanding the bird predation reduction program is expected to decrease predation by birds on juvenile salmonids. Placing bird deterrence devices over the lower horseshoe section of the Falls is expected to reduce bird predation on juvenile outmigrants passing over the Falls. This measure is expected to benefit threatened Upper Willamette River spring Chinook and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey.

7.2.2.3 Downstream passage at Blue Heron Paper Company Powerhouse

In 2003, PGE purchased and immediately shut down the Blue Heron Power Company (BHPC) units at Willamette Falls. The following descrption of the downstream passage at the BHPC powerhouse is provided for context, as the project will be decommissioned during the new license.

The BHPC Development, on the east side of Willamette Falls, houses two horizontal Francis turbines (PGE and BHPC 1998a). The development also has two spillway sections (600 and 120 ft long) adjacent to the powerhouse. There are no fish bypass facilities, so 1-in bar racks in the forebay and shutdowns had provided protection of smolts during downstream passage during emigration periods in the spring. Between 1995 and 2003, the plant was seasonally shutdown between mid-February and mid-June. From 1992 to 1994, the BHPC Development also shut down for up to two weeks in the fall, typically in November.

At the BHPC Powerhouse, salmonid smolts were entrained during turbine operation. Impacts resulting from entrainment include turbine passage mortality and tailrace predation on turbine-passed smolts. The effectiveness of the shutdown period varies by species. Available data suggests 84.5% of the combined run (all species and stocks) are protected from entrainment by the spring shutdown regime with protection ranging from a low of 38.2 % for wild spring Chinook to a high of 97.9% for coho salmon (NAI 2001b). Mortality for those smolts that entered the BHPC powerhouse during operational periods was estimated at 18.7%.

The permanent shoutdown of the BHPC Powerhouse is expected to benefit fisheries resources by eliminating injury or mortality in the BHPC turbines. This measure is expected to benefit threatened Upper Willamette River spring Chinook salmon and winter steelhead ESUs. The measure should also benefit juvenile Pacific lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

7.2.2.4 Upstream fish passage

Measures proposed to improve upstream fish passage are described in Section 3.3.2, and listed in Appendix A. These measures will be implemented in a tiered-approach, as described in Section 3.1.

Upstream fish passage at Willamette Falls varies by species and is affected by natural conditions (e.g., discharge, water temperatures) and attraction flows present at the fish ladders relative to other flows around the entrance. False attraction to turbine discharges can delay upstream migrants by masking fishway attraction flows or lead to fish injury by contact with turbine runner blades. If upstream migrants are delayed in locating the ODFW ladder entrance No. 1 in the cul-de-sac, they also could be exposed to increased risk of sea lion predation. Unit 1 at T.W. Sullivan provides attraction flow for the ODFW fishway.

In addition to environmental measures described below, modeling, analysis, and monitoring will be conducted to evaluate the performance and effectives of implemented measures. The results from these efforts will guide the design and implementation of additional measures. Lamprey upstream passage in particular will be further improved (Tier 2).

Controlled flow structure

A controlled flow structure at the apex of the dam can affect upstream fish passage by producing competing attraction flows for migratory adults away from ODFW fish ladder entrances 2, 3, and 4. However, the apex location does provide flow near one of the fish ladder entrances, and flow at the upstream end of the Falls horseshoe, which is a more favorable location than one that would create potentially competing attraction flows away from a ladder entrance, such as on the Oregon City side of the Falls.

The potential attraction that may result from a controlled flow structure at the apex may be least noticeable for winter/spring migrants such as winter steelhead and spring Chinook salmon. Both are ESA-listed species whose migration is largely over by June when river flows typically begin to subside. Species such as fall Chinook salmon and coho salmon that migrate in late summer and fall when river flows are typically low, and later-run summer steelhead migrants may also be affected.

Design considerations for lamprey upstream passage could be incorporated into or nearby the controlled flow structure at the apex. Areas of velocity refuge and smooth surfaces that lamprey can cling to can be provided at or near the structure. The availability of a watered route through or adjacent to focussed flow through the dam may possibly enhance Pacific lamprey passage. The burst swimming speed of Pacific lamprey is estimated at 8 fps, but adults may be able to pass through areas with water velocities greater than 8 fps due to sucking attachment.

Providing a controlled flow structure in the dam at the apex of the Falls would focus flows to a location more conducive to the safe downstream passage of salmonids, and potentially other species. A design objective would be to minimize attraction away from ladder entrances, and possibly even enhance attraction to a ladder entrance.

Fish ladder operation and maintenance

While ODFW will continue to own the ladder and will continue to be responsible for operation and maintenance of the fish counting station. PGE shall assume responsibility for the fishway operations and maintenance (O&M) duties associated with the physical structure of the ladder and all associated pumps, trash racks, and dewatering screens as described in Section 3.2.2.1. PGE shall also develop and implement an action plan for ladder entrance #1 (a Tier 1, pre-new license action).

PGE's operations and timely maintenance of this ladder should benefit threatened Upper Willamette River Chinook salmon and steelhead ESUs. It is anticipated that maintaining the ladder will increase its reliability, and decrease the risk of a catastrophic failure. The measure should also benefit adult lamprey, Lower Columbia River Chinook salmon, Lower Columbia River steelhead, Lower Columbia River/Southwest Washington Coast coho salmon, and Upper Willamette River coastal cutthroat trout.

7.2.2.5 Fish stranding

Migrating adult salmonids and lamprey can become trapped in large scour pools at the base of Willamette Falls during flashboard installation when flows temporarily cease. Anadromous species such as lamprey, adult spring Chinook salmon, and summer steelhead have the greatest potential to be stranded below Willamette Falls as they migrate upstream through the Project, based on field surveys. Measures designed to address fish stranding are described below.

Controlled flow structure
While a controlled flow structure would focus flow through a location at the Falls instead of allowing that flow to be spread out around the Falls, it is not expected to contribute to the stranding of fish below the Falls when flashboards are installed. Focusing flow over the Falls at the apex will also put river flow into the upper end of the Falls horseshoe that would otherwise enter further downstream. This increased flow through the entire Falls horseshoe may improve conditions within the Falls horseshoe as they relate to stranding.

Selected flashboard removal
Selected removal of flashboard sections will continue when flashboards are installed in order to provide water into isolated scour pools along the crest and base of the Falls. This may prevent the stranding of adult spring Chinook salmon, summer steelhead, and Pacific lamprey, but even if stranding occurs, the conditions for those stranded fish will be improved. Removing flashboards to create nothces above scour pools will have a beneficial effect on listed salmonids. The measure will provide increased flow to scour pools at the base of the Falls, where currently adult salmonids and Pacific lamprey may be stranded prior to their upstream migration over the Falls. This measure will have the effect of reducing stress and mortality for stranded adults. The proposed measure should benefit threatened Upper Willamette River Chinook salmon, as well as summer steelhead and Pacific lamprey.

Modification of the "wet hole" located at the northeastern base of the Falls will help eliminate the stranding potential associated with the current "wet hole" condition.

PGE shall install a minimum of two lamprey passage ramps, and notch the flashboards when installed, to provide flows for lamprey below the dam and Falls. The effectiveness of the ramps will be assessed during the lamprey research project (described below) and continued implementation will be guided by the results of that research. Modifications to the placement and design of ramps will be made if results of the monitoring program suggest that such actions are appropriate. If effective, additional ramps will be installed as needed to provide passage in areas where lamprey can be attracted.

7.3 Cumulative Effects

The ESA requires the NOAA Fisheries and USFWS to evaluate the cumulative effects of the proposed action on listed species and designated critical habitat and to consider cumulative effects in formulating Biological Opinions (50 CFR §402.14). The agencies define cumulative effects as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area" of the proposed action subject to consultation (50 CFR §402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. Federal actions, including hatcheries, fisheries, and land management activities are, therefore, not addressed in this Biological Opinion.. The area of cumulative effects analysis is defined as the Willamette River watershed.

A number of other commercial and private activities, including timber harvest, recreation, urban and rural development, and water supply development, that could potentially affect listed species occur in the Willamette River basin, as discussed below. PGE is not aware of any additional state or private action in Willamette River Project area that is reasonably certain to occur or that would affect the listed species or their critical habitat. It is likely that ongoing non-federal activities that affect listed salmonids and their habitat will continue in the short-term at similar intensities as in recent years.

Non-Federal Timber Harvest
About 70% of the Willamette River basin is forested, with almost 40% of the basin in federal ownership. USFS and BLM ownership is primarily in the mid- and high-elevations, with over 50% of lowland coniferous forest in non-industrial private ownership (Pacific Northwest Ecosystem Research Consortium in press). A large percentage of forestland in the watershed is in federal ownership. Because the majority of harvestable forestland in the watershed is in federal ownership, it is unlikely that timber harvest on private lands in the foreseeable future will result in detectable impacts to salmonids or salmonid habitat.

Recreation
The Willamette River provides a wide variety of recreational opportunities including boating (e.g., power boats, fishing boats, canoes), wildlife viewing, and fishing. Pleasure craft pass near Willamette Falls. Fishing is the major recreational attraction of the

Willamette River. Fishing is particularly active below Willamette Falls as anglers attempt to catch Chinook, coho, and steelhead prior to their passage up the fish ladder at Willamette Falls.

The state of Oregon regulates salmon and steelhead harvest in the basin as outlined in the Final Rule Governing the Take of 14 Threatened Salmon and Steelhead Evolutionarily Significant Units (NMFS 2000c). The NMFS letter of concurrence signifies that the state prohibitions on take of threatened steelhead in recreational fisheries in the Willamette River basin are sufficient to not threaten the persistence of listed species occurring there.

Urban and Rural Development

Urban and rural development can contribute to riparian habitat fragmentation, water quality degradation (especially from non-point sources), and other impacts to salmonids and salmonid habitat. Much of the Willamette River watershed upstream of the Project is used for agriculture—currently about 20% is considered agricultural. The effects of agricultural and other rural development on salmonids and salmonid habitat in the Willamette River basin will likely continue at current levels. It is possible that rural development within the Willamette River basin will threaten the persistence of listed species occurring there.

About 7% of the Willamette River watershed is comprised of urban development. Portland and its urban outgrowths are downstream of the Project, and several cities (e.g., Eugene, Springfield, Corvallis, Salem) are along the Willamette River upstream of the Project. Currently, about 70% of Oregonians (2.3 million) live within 20 miles (32.2 km) of the mainstem Willamette River, with an expectation for increases in Oregon state population as high as 4 million in 2050, with corresponding increases in urban development.

Protecting and restoring fish and wildlife habitat and populations levels in the Willamette River basin, promoting proper floodplain management, and enhancing water quality is the focus of the Willamette Restoration Initiative (WRI 2001).

Water Supply

In most areas of the Willamette River basin, surface water supplies have been fully allocated, with no further water available for new water rights and in dry years more junior water rights are not satisfied (Pacific Northwest Ecosystem Research Consortium in press). Increases in the demand for surface water will occur with expected increasing population density. In 1995, the largest water withdrawals were for irrigation, representing 49% of the total withdrawals (surface and groundwater). Domestic water withdrawals represented 15% of the total water withdrawn.

Table 7-1 Direct, indirect, and cumulative effects of existing Willamette Falls Hydroelectric Project and ODFW fish ladder operations on protected salmonid ESUs and Pacific lamprey.

Project Feature	Effect Pathway/ Indicator	Potential Effects	Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey	Measures and Studies to Address Effects on Listed Salmonids
Dam and Flashboards	Habitat Elements	Direct Effect: Flow to scour holes at base of Willamette Falls is decreased by installing flashboards, increasing potential for stranding of adult salmonids in these locations.	• Upper Willamette River Chinook salmon ESU • Pacific lamprey	**Existing Measures**: ODFW filled in a wet hole and capped with concrete in 1966, which washed out and collapsed in winter flows of 2001/2 PGE, in cooperation with ODFW, blasted and excavated egress channels to some of the scour pools in 1991 to reduce entrapment. PGE periodically salvages stranded fish and removes rocks from pool egress routes to reduce entrapment and removes selected flashboards to provide flows to stranded fish. **PM&E's**: Flashboards will be notched to provide flow to stranding pools and "wet hole" egress will be provided (a Tier 1, pre-new license action).
		Indirect Effect: Alteration of flows downstream of Project.		The Project is a run-of-river facility, and there are no affects to downstream hydrology.
	Habitat Access	Direct Effect: Fish passing over the Falls are subject to injury and/or mortality.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: None **PM&E's**: Flashboards will be removed at apex of Falls (a Tier 1, pre-new license action). A controlled flow structure and improvements to landing area will be implemented (Tier 2). In addition, an operations plan for T.W. Sullivan powerhouse coordinating operations with the controlled flow structure will be developed.

Project Feature	**Effect Pathway/ Indicator**	**Potential Effects**	**Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey**	**Measures and Studies to Address Effects on Listed Salmonids**
	Water Quality	Indirect Effect: Project impoundment may increase water temperatures in the Willamette River downstream of the Project.	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	**Existing Measures**: Existing data indicate that the Project impoundment does not increase water temperatures. **Relevant Studies**: Water temperature monitoring in 2000/2001 and computer modeling in 2002 conducted to address specific areas of concern.
		Indirect Effect: Project impoundment may reduce water quality by reducing water velocities, and storage of contaminated sediment may be increased.	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	**Existing Measures:** Existing data indicate that ODEQ standards for DO are exceeded in isolated locations in the Project vicinity but are adequate to protect beneficial uses. Other ODEQ standards for water quality are not being exceeded in the Project vicinity. Sedimentation is not affected by the project. **Relevant Studies**: Water quality monitoring in 2000/2001 and computer modeling in 2002 conducted to address specific areas of concern.
T.W. Sullivan Powerhouse / Blue Heron Paper Company Powerhouse	Habitat Access	Direct Effect: Fish may enter draft tubes and be subject to injury and/or mortality.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: Under current conditions, the draft tubes are curved downwards and powerhouse discharges are constant, which likely discourages fish attraction to the draft tubes. No injury or mortality has been associated with draft tubes. **Relevant studies**: Adult radio tracking study in spring 2001 showed no draft tube concerns at TW Sullivan. Assessment of TW Sullivan and Blue Heron draft tube physical geometry and flows indicate unlikely access to adults. The Blue Heron facility will be decommissioned.

Project Feature	Effect Pathway/ Indicator	Potential Effects	Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey	Measures and Studies to Address Effects on Listed Salmonids
		Direct Effect: Outmigrating juvenile salmonids and steelhead kelts may become entrained in turbines and be subject to injury and/or mortality.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: Fish bypass facilities are currently provided at Unit 13. Blue Heron Development turbines are shut down from mid-February through mid-June under an existing agreement with ODFW. **PM&E's**: An improved fish bypass facility using the current siphon spillway will be constructed (Tier 2). Fish guidance into the bypass facility at unit 13 and the siphon spillway will be improved with trash rack modifications (a Tier 1, pre-new license action), changes to operations (a Tier 1, pre-new license action), and other measures. The Blue Heron facility will be decommissioned.
		Direct Effect: Debris on trash racks may cause impingement, resulting in injury or mortality to downstream migrating salmonids.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: Racks are cleaned as needed, about 5 times a year. **PM&E's**: Selected bars will be removed from headgate trashracks for adult downstream passage (a Tier 1, pre-new license action). A trash rack cleaning system will be implemented (Tier 2).
		Indirect Effect: Upstream migration of adult salmonids may be delayed due to attraction to powerhouse discharge.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU	**Relevant Studies**: Radio-tagging studies to assess upstream passage has shown delay does occur but no relationship to project operation or facilities. **PM&E's**: Decommissioning of Blue Heron facility will reduce potential attraction to that discharge.
T.W. Sullivan Fish Bypass Facility	Habitat Access	Direct Effect: Injury and/or mortality of outmigrating fish occurring within bypass facility.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: Studies indicate low mortality rate in bypass facility (~1% direct mortality). **PM&E's**: Direct effects to juvenile salmonids using the bypass will be monitored using an improved evaluator facility (Tier 2). Bypass system improvements made over prior years will be evaluated in conjunction with trash rack modification testing.

Project Feature	Effect Pathway/ Indicator	Potential Effects	Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey	Measures and Studies to Address Effects on Listed Salmonids
		Indirect Effect: Delays in outmigration due to passage through bypass facility.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**Existing Measures**: Recent modifications to system (cleaning system, larger pit detector, increased flow) have been done to eliminate sources of delay. **PM&E's**: Direct effects to juvenile salmonids using the bypass will be monitored using an improved evaluator facility (Tier 2). Bypass system improvements made over prior years will be evaluated in conjunction with trash rack modification testing.
		Indirect Effect: Exposure to avian predation at bypass facility entrance, tailrace, and horseshoe of Falls. Aquatic predation exacerbated by slack water between Unit 12 and 13 turbine exits and along north shoreline of tailrace.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU	**Existing Measures**: Bird deterrence cables are currently in place over the tailrace area. **PM&E's**: Unit 12 and 13 discharge will be modified to reduce predator-holding areas (Tier 2), and bypass outfall will be modified or replaced (Tier 2). **Relevant Studies**: Radio-tagging studies of predaceous fish (northern pikeminnow) indicates low abundance relative to Columbia River and significant movement throughout Project vicinity.
ODFW Willamette Falls Fish Ladder	Habitat Access	Direct Effect: Mortality and/or injury of fish occurring within fish ladder.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**PM&E's** PGE to develop and implement an action plan for ladder entrance #1 (a Tier 1, pre-new license action). In addition, PGE to perform operation and maintenance duties on fish ladder to ensure proper functioning and increase reliability.
		Indirect Effect: Upstream migration of adult salmonids may be delayed at fish ladder or may be more prone to fallback.	• Upper Willamette River Chinook salmon ESU • Upper Willamette River steelhead ESU • Pacific lamprey	**PM&E's**: PGE to develop and implement an action plan for ladder entrance #1 (a Tier 1, pre-new license action). In addition, PGE to perform operation and maintenance duties on fish ladder to ensure proper functioning and increase reliability.

Project Feature	Effect Pathway/ Indicator	Potential Effects	Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey	Measures and Studies to Address Effects on Listed Salmonids
Cumulative Effects on the Mainstem Willamette River	Habitat Access	Cumulative Effect: Timber harvest on non-federal non-Project lands may increase sediment supply to the channel and increase water temperature	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	Because the majority of harvestable forestland in the watershed is in federal ownership, it is unlikely that timber harvest on private lands in during the period of the BO will result in detectable impacts to salmonid habitat.
		Cumulative Effect: Non-Project roads and culverts on non-federal, non-Project lands may block migration.	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	
	Flow/ Hydrology	Cumulative Effect: Local water supply developments may alter flow conditions	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	

Project Feature	Effect Pathway/ Indicator	Potential Effects	Affected Listed, Proposed, and Candidate Salmonid ESUs, and Pacific lamprey	Measures and Studies to Address Effects on Listed Salmonids
	Watershed Conditions	Cumulative Effect: Urban and rural development may alter flow conditions, reduce water quality, and increase angling pressure.	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	
	Hatchery Practices	Cumulative Effects: Continued introduction of hatchery-origin salmon and steelhead.	• Upper Willamette River Chinook salmon ESU • Lower Columbia River Chinook salmon ESU • Upper Willamette River steelhead ESU • Lower Columbia River steelhead ESU • Lower Columbia River/Southwest Washington Coast coho salmon ESU • Pacific lamprey	

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8 DETERMINATION

The proposed action for which Section 7 consultation will be initiated is FERC relicensing . Incidental take coverage is therefore requested for potential take of listed species resulting from the operation of the Project for the term of the new license and under the terms and conditions of the new Project license. The Applicants have determined, based on information presented in this BE, that the proposed action is not likely to adversely affect any listed terrestrial or plant species. The proposed action is considered likely to adversely affect but not jeopardize Pacific lamprey, and the following listed, proposed, or candidate salmonid ESUs:

- Upper Willamette River Chinook salmon ESU (threatened), and
- Upper Willamette River steelhead ESU (threatened).

The proposed action is considered not likely to adversely affect the following listed, proposed, or candidate salmonid ESUs and DPSs because their distribution is limited to below the Project:

- Lower Columbia River Chinook salmon ESU (threatened),
- Lower Columbia River steelhead ESU (threatened),and
- Lower Columbia River/Southwest Washington Coast coho salmon ESU (candidate).

To minimize the effects of the operation of the Project on these ESUs and potential future designated critical habitat, the Applicants propose to implement Protection, Mitigation, and Enhancement Measures (PM&E's). PM&E's are described in Section 3, a comprehensive list is provided in Appendix A, and their effects are described in Section 7. As discussed in Section 7, these measures will provide immediate and permanent conservation benefits to the affected ESUs, DPSs, and potential future designated critical habitat. These actions are anticipated to provide long-term and substantial benefits for listed, proposed, and candidate species and potential future designated critical habitat.

Based on an evaluation of the effects of the proposed action, including the PM&E's, the proposed action is not likely to adversely modify or destroy potential future designated critical habitat. Determination of the effects of the proposed license on listed, proposed, and candidate salmonid ESUs are provided in Section 8.1. Determination of effects on potential future designated critical habitat is provided in Section 8.2.

8.1 Listed, Proposed, and Candidate Salmonid ESUs

Standards for determining jeopardy are set forth in Section 7(a) (2) of the ESA. Jeopardy is defined as to "engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." 50 CFR 402.02. Based on the best available scientific information, the Applicants believe that the proposed action will not jeopardize the continued existence or recovery of any listed, proposed, or candidate species in the Willamette Falls Hydroelectric Project area. In addition, the Applicants believe that the proposed action will not destroy or adversely modify habitat designated as critical to any listed salmonid species in the Project area. This conclusion is based on the PM&E's developed during the collaborative relicensing process that will provide long-term protection for these species. It is anticipated that the USFWS and NOAA Fisheries will include incidental take authorization in a BO and conference opinion for operation of the Project under the terms of the new FERC license. Conclusions and determinations for each ESU are summarized below.

Upper Willamette River Chinook salmon ESU

Spring Chinook salmon spawning upstream of Willamette Falls are currently included in the Upper Willamette River ESU and are listed as threatened (NMFS 1999a). The distribution of spring Chinook salmon in the Willamette River basin has been greatly reduced, and that historical populations in at least the Molalla, Pudding, Calapooia, Middle Fork, and Coast Fork subbasins are considered to be extinct (Kostow 1995). A majority of the remaining spring Chinook salmon spawn in the Clackamas River (Lower Columbia River ESU) and upstream of Willamette Falls in the Santiam and McKenzie rivers (Upper Willamette River ESU) (Kostow 1995). Little spawning occurs in the mainstem Willamette River, which serves primarily as a migration corridor (Cramer et al. 1996).

Continued operation of the Project under a new license is considered likely to adversely affect this ESU as described in Section 7 of the BE. The effects of Project operations are summarized in Table 7-1. Within the area of analysis, potential direct and indirect effects on this ESU include delayed upstream migration of adults, stranding of adults below the Falls and mortality of juvenile downstream migrants passing over the Falls and through the powerhouse. The most significant effects of the Project on this ESU are thought to be mortality of juvenile downstream migrants passing over the Falls (with or without flashboards) or entrainment through Project turbines.

PM&E's are included in the proposed license application (described in Section 3) to minimize adverse effects to this ESU and to reduce potential take. Implementation of the new license and all the PM&E's would benefit this ESU compared to baseline conditions.

Implementation of the proposed action would benefit this ESU compared to baseline conditions by improving conditions for downstream passage for juvenile outmigrants and improving conditions for upstream migration of adults through the fish ladder. Modifications to the trashracks, operational priorities, and a trashrack cleaning system would increase the FGE and the number of downstream migrants guided into the existing Unit 13 fish bypass system and a proposed new siphon bypass facility. Increased FGE would increase numbers of bypassed fish and decrease mortality and injury associated with downstream passage through the T.W. Sullivan powerhouse. The proposed siphon bypass facility, modification of the Unit 13 fish bypass outfall, a shutdown program, and modification to the Unit 12 and 13 discharges, will decrease the mortality and injury to Chinook salmon outmigrating through the T.W. Sullivan powerhouse, including reductions in potential predation.

Cessation of operations at the Blue Heron powerhouse, removal of selected flashboards during low flows, a controlled flow structure, and installation of avian predation deterrents would increase the survival and decrease injury of outmigrating Chinook salmon passing over the Falls. Notching flashboards upstream of stranding pools, elimination of stranding potential associated with the current "wet hole" condition located at the northeastern base of the Falls, and improvements and maintenance of the fish ladder (in addition to development of an action plan for ladder entrance #1) would improve conditions for upstream migrating adults at the Falls. Downstream passage of adults will be improved by outer headgate selected bar removal at West Linn end of head racks at T.W. Sullivan Powerhouse.

Through the relicensing process, the Applicants worked with the Willamette Falls Fish, Aquatics, and Terrestrial Workgroup (which includes the Services) to implement studies to determine survival standards and goals for the Project to protect Chinook salmon (as described in Section 3). Because all reasonable actions for meeting these survival standards for listed salmonids in the Project area are being proposed, and because the Applicants have committed to monitoring of Project effects, the Applicants believe that the proposed action will not jeopardize the continued existence of this ESU.

Upper Willamette River steelhead ESU

Winter steelhead were the only steelhead run that occurred upstream of Willamette Falls under historical conditions (PGE and Smurfit 1998). Summer steelhead were introduced upstream of the Falls in the late 1960s and small populations of naturally reproducing summer steelhead, originating from hatchery stocks, now occur in the basin (Foster 1994). All naturally reproducing winter steelhead in the Willamette River and its tributaries upstream of the Falls belong to the threatened Upper Willamette River ESU (NMFS 1999b). The Calapooia River is considered to be the upstream-most limit of the indigenous winter steelhead distribution in the Willamette River basin (Kostow 1995).

Continued operation of the Project under a new license is considered likely to adversely affect this ESU, as described in Section 7 of the BE. The effects of Project operations are summarized in Table 7-1. Within the area of analysis, potential direct and indirect effects on this ESU include delayed upstream migration of adults, stranding of adults below the Falls and mortality of juvenile downstream migrants passing over the Falls and through the turbines. The most significant effects of the Project on this ESU are thought to be mortality of juvenile downstream migrants passing over the Falls (with or without flashboards) or entrainment through Project turbines.

PM&E's are included in the proposed license application (described in Section 3) to minimize adverse effects to this ESU and to reduce potential take. Implementation of the new license and all the PM&E's would benefit this ESU compared to baseline conditions.

Implementation of the proposed action would benefit this ESU compared to baseline conditions by improving conditions for downstream passage of juvenile outmigrants and improving conditions for upstream migration of adults through the fish ladder. Modifications to the trashracks, operational priorities, and a trashrack cleaning system would increase the FGE and the number of downstream migrants guided into the existing Unit 13 fish bypass system and a proposed new siphon bypass facility. Increased FGE would increase numbers of bypassed fish and decrease mortality and injury associated with downstream passage through the T.W. Sullivan powerhouse. The proposed siphon bypass facility, modification of the Unit 13 fish bypass outfall, a shutdown program, and modification to the Unit 12 and 13 discharges will decrease the mortality and injury to steelhead outmigrating through the T.W. Sullivan powerhouse, including reductions in potential predation.

Cessation of operations at the Blue Heron powerhouse, removal of selected flashboards during low flows, a controlled flow structure, and installation of avian predation deterrents would increase the survival and decrease injury of outmigrating steelhead passing over the Falls. Notching flashboards upstream of stranding pools, elimination of stranding potential associated with the current "wet hole" condition located at the northeastern base of the Falls, and improvements and maintenance of the fish ladder would improve conditions for upstream migrating adults at the Falls. Downstream passage of adults will be improved by outer headgate selected bar removal at West Linn end of head racks at T.W. Sullivan Powerhouse.

Through the relicensing process, the Applicants worked with the Willamette Falls Fish, Aquatics, and Terrestrial Workgroup (which includes the Services) to implement studies to determine survival standards and goals for the Project to protect steelhead (as described in Section 3). Because all reasonable actions for meeting these survival standards for listed salmonids in the Project area are being proposed, and because the Applicants have committed to monitoring of Project effects, the Applicants believe that the proposed action will not jeopardize the continued existence of this ESU.

Lower Columbia River Chinook salmon ESU
Fall Chinook salmon spawning naturally downstream of Willamette Falls are included in the Lower Columbia River ESU, and are listed as threatened (NMFS 1999a). Fall Chinook salmon were not known to occur above Willamette Falls prior to 1964, when improvements to fish passage facilities at Willamette Falls made upstream movement at

low flows possible (PGE and Smurfit 1998). Fall Chinook salmon spawning upstream of the Falls are therefore not included in the ESU or protected under the ESA.

Continued operation of the Project under the new license is considered not likely to adversely affect this ESU, as described in Section 7 of the BE. The effects of Project operations are summarized in Table 7-1. Project effects have not been identified downstream of the facilities, and the distribution of this ESU is limited to the area downstream of the Falls.

Implementation of the proposed action and PM&E's are expected to have no adverse or beneficial effects on this ESU. In terms of the ESA listing for this ESU, the range of the ESU is restricted to downstream of Willamette Falls. No adverse or beneficial effects to habitat downstream of the Falls resulting from the proposed action or PM&E's have been identified.

Fall Chinook salmon spawning upstream of the Falls (outside of the range of the listed ESU), however, would be expected to benefit from the PM&E's. In particular, fall Chinook salmon spawning upstream of the Falls would benefit from monitoring outmigration and cessation of the BHPC operation.

Lower Columbia River steelhead ESU

Winter and summer steelhead in the Willamette River basin downstream of the Willamette Falls are included in the Lower Columbia River ESU and are listed as threatened (NMFS 2000a). Continued operation of the Project under a new license is considered not likely to adversely affect this ESU, as described in section 7 of the BE. The effects of Project operations are summarized in Table 7-1. Project effects have not been identified downstream of the facilities, and the distribution of the ESU is limited to the area below the Falls.

Implementation of the proposed action and PM&E's are expected to have no adverse or beneficial effects on this ESU. In terms of the ESA listing for this ESU, the range of the ESU is restricted to downstream of Willamette Falls. No adverse or beneficial effects to habitat downstream of the Falls resulting from the proposed action or conservation measures have been identified.

Lower Columbia River/Southwest Washington Coast coho salmon ESU
Coho salmon occurring in the Willamette River below the Willamette Falls belong to the Lower Columbia River/Southwest Washington Coast ESU and are a candidate species for listing (NMFS 2000b). Critical habitat has not been designated. Coho salmon were not known to occur above Willamette Falls prior to introductions and fish ladder improvements (PGE and Smurfit 1998).

Implementation of the proposed action and PM&E's are expected to have no adverse or beneficial effects on this ESU. In terms of the ESA listing for this ESU, the range of the ESU is restricted to downstream of Willamette Falls. No adverse or beneficial effects to habitat downstream of the Falls resulting from the proposed action or PM&E's have been identified.

Coho salmon spawning upstream of the Falls (outside of the range of the listed ESU), however, would be expected to benefit from the PM&E's. In particular, coho salmon spawning upstream of the Falls would benefit from monitoring outmigration and cessation of the BHPC operation.

Columbia River bull trout DPS
The Columbia River distinct population segment of bull trout is listed as threatened. Subpopulations in the upper Willamette and Deschutes rivers are included in this listing (USFWS 1999b). In 2002 the USFWS proposed that critical habitat include the upper Willamette River, upstream of, and including the McKenzie River (USFWS 2002b). Bull trout are thought to have occurred historically throughout the Willamette River basin, but presently are found only in the McKenzie River subbasin. No observations of bull trout have been recorded to date at the Project despite PGE's extensive fisheries management activities. The best available scientific and commercial information demonstrates that bull trout only occur in the McKenzie River subbasin in the upper Willamette, and do not occur at or in the vicinity of the Project. Therefore, the proposed action will have no effect on the Columbia River bull trout DPS.

Pacific Lamprey
Lampreys currently are neither listed nor candidate species under the ESA. However, in light of their presence in the Project area, the need to address lamprey issues in relicensing, and the fact that a lamprey listing petition was submitted to USFWS in 2003, lamprey are addressed in this document. Pacific lamprey are present in the Willamette

River but little is known about their distribution or abundance. The information necessary to assess Project effects on trends in abundance and habitat conditions specific to Pacific lamprey are lacking. The PM&E's include measures to provide more information, including determining the FGE and effects of the T.W. Sullivan facility on migrating juvenile lamprey, convening an expert lamprey research team, and assessment of lamprey passage devices at the Willamette Falls.

Continued operation of the Project under a new license is considered likely to adversely affect Pacific lamprey, as described in Section 7 of the BE. The effects of Project operations are summarized in Table 7-1. Within the area of analysis, potential direct and indirect effects on lamprey include delayed upstream migration of adults, stranding of adults below the Falls and mortality of juvenile downstream migrants passing over the Falls and through the turbines. The most significant effects of the Project on lamprey are thought to be mortality of juveniles from impingement and/or entrainment through Project turbines.

PM&E's are included in the proposed license application (described in Section 3) to minimize adverse effects to lamprey. Implementation of the new license and all the PM&E's would benefit lamprey compared to baseline conditions.

Implementation of the proposed action would benefit lamprey compared to baseline conditions by improving conditions for downstream passage for juvenile outmigrants and improving conditions for upstream migration of adults through the fish ladder. Modifications to the trashracks, operational priorities, and a trashrack cleaning system would increase the FGE and the number of downstream migrants guided into the existing Unit 13 fish bypass system and a proposed new siphon bypass facility. Increased FGE would increase numbers of bypassed juveniles and decrease mortality and injury associated with downstream passage through the T.W. Sullivan powerhouse. The proposed siphon bypass facility, modification of the Unit 13 fish bypass outfall, a shutdown program, and modification to the Unit 12 and 13 discharges will decrease the mortality and injury to lamprey outmigrating through the T.W. Sullivan powerhouse.

Cessation of operations at the Blue Heron powerhouse, removing apex flashboards by October 1 until the controlled flow structure is implemented, a controlled flow structure, would increase the survival and decrease injury of outmigrating lamprey passing over the Falls. Notching flashboards upstream of stranding pools, elimination of stranding potential associated with the current "wet hole" condition located at the northeastern base of the Falls, improvements and maintenance of the fish ladder, and implementation of new and improved methods for lamprey passage would improve conditions for upstream migrating adults at the Falls. Downstream passage of adults will be improved by outer headgate selected bar removal at West Linn end of head racks at T.W. Sullivan Powerhouse.

Through the relicensing process, the Applicants worked are working with the Willamette Falls Fish, Aquatics, and Terrestrial Workgroup (which includes the Services) to implement studies to determine survival standards and goals for the Project to protect lamprey (as described in Section 3). Because actions for determining survival standards Pacific lamprey in the Project area are being proposed, and because the Applicants have committed to implementing measures to protect lamprey, the Applicants believe that the proposed action will not jeopardize the continued existence of Pacific lamprey.

8.2 Critical Habitat

Section 7(a) (2) of the ESA and its implementing regulations establish the standards for determining whether a proposed action will adversely modify or destroy designated critical habitat. Adverse modification or destruction means a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species, including but not limited to alterations that adversely modify any of the physical or biological features that were the basis for determining the habitat to be critical. This standard is applied in this section to determine potential effects on proposed critical habitat.

Currently, the Project area contains no designated or proposed critical habitat. However, in light of the possibility that critical habitat may be designated in the future, potential Project habitat impacts were evaluated using the analytical framework established by NOAA Fisheries for assessing impacts to anadromous fish critical habitats, which includes consideration of essential habitat types and essential features of critical habitat for anadromous salmonid species [Section 7] (NMFS 2000a).

The Project area and the area of analysis include withdrawn designated critical habitat for the Upper Willamette River and Lower Columbia River Chinook salmon ESUs, and the Upper Willamette River and Lower Columbia River steelhead ESUs. In 2002, NOAA Fisheries withdrew the designation of critical habitat [(*National Association of Home Builders v. Evans*, Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)] for these ESUs. Prior to withdrawal, critical habitat for both Chinook salmon and steelhead was designated to include all reaches of the river accessible within the range of the ESUs, except for reaches in Native American lands. NMFS (2000a) identified essential habitat types and essential features of critical habitat. Essential habitat types identified by NMFS included: (1) juvenile rearing areas, (2) juvenile migration corridors, (3) areas for growth and development to adulthood, (4) adult migration corridors, and (5) spawning areas. Essential features of critical habitat included adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions. The proposed action will not adversely modify or destroy withdrawn designated critical habitat for the Upper Willamette River Chinook salmon ESU, Lower Columbia River Chinook salmon ESU, Upper Willamette River steelhead ESU, or Lower Columbia River steelhead ESU. The rationale for this finding is presented below.

Implementation of the proposed action and PM&E's will have no effect on withdrawn designated critical habitat for the Lower Columbia River Chinook salmon ESU or the Lower Columbia River steelhead ESU, located below the Project. Implementation of the proposed action and PM&E's will have no effect on proposed critical habitat for Columbia River bull trout DPS, as Willamette Falls and the Project are located downstream and outside of the proposed critical habitat.

Implementation of the proposed PM&E's including modifications to the trashracks, operational priorities, a trashrack cleaning system, the proposed siphon bypass facility, modification of the Unit 13 fish bypass outfall, a shutdown program, and modification to the Unit 12 and 13 discharges, cessation of operations at the Blue Heron powerhouse, removal of selected flashboards during low flows, a controlled flow structure, and installation of avian predation deterrents will benefit withdrawn designated critical habitat for Upper Willamette River Chinook salmon ESU and Upper Willamette River steelhead ESU compared to baseline conditions by improving downstream passage conditions for juvenile outmigrants at both the T.W. Sullivan facility and BHPC. Implementation of PM&E's including notching flashboards upstream of stranding pools, elimination of stranding potential associated with the current "wet hole" condition located at the northeastern base of the Falls, and improvements and maintenance of the fish ladder will benefit designated critical habitat for Upper Willamette River Chinook salmon ESA and Upper Willamette River steelhead ESU compared to baseline conditions by improving upstream adult passage conditions at the Willamette Falls fish ladder. Downstream passage of adults will be improved by outer headgate selected bar removal at West Linn end of head racks at T.W. Sullivan Powerhouse.

Based on an evaluation of the effects of the proposed action, including the continued operation of the Project under the new license and implementation of the proposed PM&E's, the proposed action is not likely to adversely modify or destroy designated critical habitat.

8.3 Essential Fish Habitat

Public law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to establish new requirements for Essential Fish Habitat (EFH) in Federal fishery management plans and actions and to require agencies to consult with NOAA Fisheries on activities that may affect EFH. The MSA defined essential fish habitat as those waters and substrate necessary for fish use in spawning, breeding, feeding or growth to maturity. The Pacific Fisheries Management Council (PFMC) has designated EFH for the Pacific Salmon fishery that includes those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery.

EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to coho and Chinook salmon in Oregon, Washington, Idaho and California, except above the impassable barriers identified by PFMC. EFH excludes areas above natural barriers, such as waterfalls. The relicensing of the Project on the Willamette River will include PM&E's designed to protect salmonids and lamprey. In the short, and long-term the Applicants expect the effects of the proposed action, including PM&E's to be beneficial for EFH. In summary, effects of the proposed actions will not result in substantial adverse effects to EFH.

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9 REFERENCES

Altman, B., C. M. Henson, and I. R. Waite. 1997. Summary of information on aquatic biota and their habitats in the Willamette Basin, Oregon, through 1995. Water Resources Investigations Report No. 97-4023. U. S. Geological Survey.

Ambrosier, A. M., S. D. Hammond, and G. C. Thelen. 1995. Bull trout (*Salvelinus confluentus*) population and habitat surveys in the Middle Fork Willamette and McKenzie River systems. Unpublished progress report. Oregon Department of Fish and Wildlife, Springfield.

Annear, R., Wells, S., and Berger, C. 2002. Mid-Willamette River: Boundary Conditions and Model Set-Up, prepared for PGE, Portland, OR.

Anthony, R. G., and F. B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53: 148-159.

Barnhart, R. A. 1991. Steelhead *Oncorhynchus mykiss*. Pages 324-336 *in* J. Stolz and J. Schnell, editors. Trout. Stackpole Books, Harrisburg, Pennsylvania.

Beamesderfer, R. C. P. 2000. Managing fish predators and competitors: deciding when intervention is effective and appropriate. Fisheries 25: 18-23.

Beamesderfer, R. C., and B. E. Rieman. 1991. Abundance and distribution of northern squawfish, walleyes, and smallmouth bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120: 439-447.

Beamesderfer, R. C., D. L. Ward, and A. A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish (*Ptychocheilus oregonensis*) in the Columbia and Snake rivers. Canadian Journal of Fisheries and Aquatic Sciences 53: 2898-2908.

Beamish, R. J. 1980. Adult biology of the river lamprey (*Lampetra ayresi*) and the Pacific lamprey (*Lampetra tridentata*) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 37: 1906-1923.

Beamish, R. J., and C. D. Levings. 1991. Abundance and freshwater migrations of the anadromous parasitic lamprey, *Lampetra tridentata*, in a tributary of the Fraser River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 48: 1250-1263.

Beamish, R. J., and S. Lowartz. 1996. Larval habitat of American brook lamprey. Canadian Journal of Fisheries and Aquatic Sciences 53: 693-700.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society, Bethesda, Maryland.

Bell, E. 2001. Survival, growth and movement of juvenile coho salmon (*Oncorhynchus kisutch*) over-wintering in alcoves, backwaters, and main channel pools in Prairie Creek, California. Master's thesis. Humboldt State University, Arcata, California.

Bell, E., W. G. Duffy, and T. D. Roelofs. 2001. Fidelity and survival of juvenile coho salmon in response to a flood. Transactions of the American Fisheries Society 130: 450-458.

Bell, M. C., editor. 1986. Fisheries handbook of engineering requirements and biological criteria. Report No. NTIS AD/A167-877. Fish Passage Development and Evaluation Program, U. S. Army Corps of Engineers, North Pacific Division, Portland, Oregon.

Bennett, D. E. 1994. 1993 Willamette River spring Chinook salmon run. *In* D. E. Bennett and C. A. Foster. 1993 Willamette River spring Chinook salmon run, fisheries, and passage at Willamette Falls. Oregon Department of Fish and Wildlife, Clackamas.

Bennett, D. H., and G. P. Naughton. 1998. Predator abundance and salmonid prey consumption in Lower Granite Reservoir and tailrace. Draft completion report. U. S. Army Corps of Engineers, Walla Walla, Washington.

Berger, C., Wells, S., and Annear, R. 2002. Mid-Willamette River: Model Calibration, prepared for PGE, Portland, OR.

Bisson, P., J. L. Nielsen, R. A. Palmason, and L. E. Grove. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low streamflows. Pages 62-73 *in* N. B. Armantrout, editor. Proceedings of the symposium on acquisition and utilization of aquatic habitat inventory information. American Fisheries Society, Western Division, Bethesda, Maryland.

Bisson, P. A., K. Sullivan, and J. L. Nielsen. 1988. Channel hydraulics, habitat use, and body form of juvenile coho salmon, steelhead trout, and cutthroat trout in streams. Transactions of the American Fisheries Society 117: 262-273.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. Special Publication No. 19. American Fisheries Society, Bethesda, Maryland.

Bottom, D. L., T. E. Nickelson, and S. L. Johnson. 1986. Research and development of Oregon's coastal salmon stocks: coho salmon model. Annual Progress Report AFC-127. Oregon Department of Fish and Wildlife, Portland, Oregon.

Briggs, J. C. 1953. The behavior and reproduction of salmonid fishes in a small coastal stream. Fish Bulletin No. 94. California Department of Fish and Game, Marine Fisheries Branch.

Brown, L. R., and P. B. Moyle. 1981. The impact of squawfish on salmonid populations: a review. North American Journal of Fisheries Management 1: 104-111.

Buchanan, D. V., M. E. Hanson, and R. M. Hooton. 1997. Status of Oregon's bull trout: distribution, life history, limiting factors, management considerations, and status. Oregon Department of Fish and Wildlife, Portland.

Buchanan, D. V., R. M. Hooton, and J. R. Moring. 1981. Northern squawfish (*Ptychocheilus oregonensis*) predation on juvenile salmonids in sections of the Willamette River Basin, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 38: 360-364.

Burner, C. J. 1951. Characteristics of spawning nests of Columbia River salmon. U. S. Fish and Wildlife Service Fishery Bulletin 52: 97-110.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Oceanographic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-27. National Marine Fisheries Service, Seattle, Washington.

Bustard, D. R., and D. W. Narver. 1975a. Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 32: 667-680.

Cederholm, C. J., W. J. Scarlett, and N. P. Peterson. 1988. Low-cost enhancement technique for winter habitat of juvenile coho salmon. North American Journal of Fisheries Management 8: 438-441.

Chapman, D. W. 1962. Aggressive behavior in juvenile coho salmon as a cause of emigration. Journal of the Fisheries Research Board of Canada 19: 1047-1080.
Chilcote, M. W. 1997. Conservation status of steelhead in Oregon. Draft report. Oregon Department of Fish and Wildlife, Portland.

Close, D. A., M. Fitzpatrick, H. Li, B. Parker, D. Hatch, and G. James. 1995. Status report of the Pacific lamprey (*Lampetra tridentata*) in the Columbia River basin. Report No. DOE/BP-39067-1. Bonneville Power Administration, Portland, Oregon.

Close, D. A., M. S. Fitzpatrick, and H. W. Li. 2002. The ecological and cultural importance of a species at risk of extinction, Pacific lamprey. Fisheries 27: 19-25.

Cornell, Howland, Hayes, and Merryfield Consulting Engineers. 1962. Engineering study of the downstream migrant fish screening facilities for the Willamette Falls area, Oregon City, Oregon.

Cramer, D. P. 1996. Evaluation of a louver guidance system and Eicher screen for fish protection at the T. W. Sullivan Plant in Oregon. Portland General Electric, Portland, Oregon.

Cramer, S. P., C. F. Willis, D. Cramer, M. Smith, T. Downey, and R. Montagne. 1996. Status of Willamette River spring Chinook salmon in regards to the Federal Endangered Species Act. Part 2: Determine the extent and causes of trends in abundance for each ESU and Assess the risks that threaten persistence of each ESU. Special Report. Submitted to National Marine Fisheries Service on behalf of Portland General Electric Company and Eugene Water and Electric Board. S. P. Cramer and Associates, Inc., Gresham, Oregon.

Cramer, D. P., and D. J. Domina. 1998. Sullivan compensation analysis: estimated unavoidable fish losses at the T. W. Sullivan Plant, November 9, 1971 through December 31, 1997. Portland General Electric, Portland, Oregon.

Cramer, D. P., and S. P. Cramer. 1994. Status and population dynamics of coho salmon in the Clackamas River. Technical Report. Portland General Electric Company, Portland, Oregon.

Dauble, D. D., and R. A. Moursund. 1999. Effects of extended length bypass screens on juvenile Pacific lamprey. Pacific Northwest National Laboratory, Richland, Washington.

Dauble Moursund, R. A., D. D. Dauble, and M. D. Bleich. 2000. Effects of John Day Dam bypass screens and project operations on the behavior and survival of juvenile Pacific lamprey (*Lampetra tridentata*). Final report. Prepared by Pacific Northwest National Laboratory, Richland, Washington for U. S. Army Corps of Engineers, Portland District, Portland, Oregon.

Docker, M. F., J. H. Youson, R. J. Beamish, and R. H. Devlin. 1999. Phylogeny of the lamprey genus *Lampetra* inferred from mitochondrial cytochrome b and ND3 gene sequences. Canadian Journal of Fisheries and Aquatic Sciences 56: 2340-2349.

Dolloff, C. A., and G. H. Reeves. 1990. Microhabitat partitioning among stream-dwelling juvenile coho salmon, *Oncorhynchus kisutch*, and Dolly Varden, *Salvelinus malma*. Canadian Journal of Fisheries and Aquatic Sciences 47: 2297-2306.

Domina, D. J. 1997. Evaluation of the downstream migrant bypass system T. W. Sullivan Plant, Willamette Falls, Oregon, FERC No. 2233. Progress Report for 1996. Portland General Electric, Portland, Oregon.

Domina, D. J. 1998. Evaluation of the downstream migrant bypass system T. W. Sullivan Plant, Willamette Falls, Oregon, FERC No. 2233. Progress Report for 1997. Portland General Electric, Portland, Oregon.

Domina 2000 [as cited on p. 36; as cited in Normandeau Associates 2001e—waiting for this reference]

ENSR International. 2002. RE: Willamette Falls conveyance capacity. Letter to A. Behbehani-Divers, Project Manager, Portland General Electric Company, Portland, Oregon from E. Wicklein, Project Engineer, and C. E. Sweeney, Hydraulic Engineering Program Manager, ENSR International, Redmond, Washington. 15 November.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29: 91-100.

Everest, F. H., G. H. Reeves, J. R. Sedell, J. Wolfe, D. Hohler, and D. A. Heller. 1986. Abundance, behavior, and habitat utilization by coho salmon and steelhead trout in Fish Creek, Oregon, as influenced by habitat enhancement. Annual Report 1985 Project No. 84-11. Prepared by U. S. Forest Service for Bonneville Power Administration, Portland, Oregon.

Everest, F. H., N. B. Armantrout, S. M. Keller, W. D. Parante, J. R. Sedell, T. E. Nickelson, J. M. Johnston, and G. N. Haugen. 1985. Salmonids. Pages 199-230 *in* E. R. Brown, editor. Management of wildlife and fish habitats in forests of western Oregon and Washington. Part 1—Chapter narratives. USDA Forest Service, Portland, Oregon.

Farlinger, S. P., and R. J. Beamish. 1984. Recent colonization of a major salmon-producing lake in British Columbia by the Pacific lamprey (*Lampetra tridentata*). Canadian Journal of Fisheries and Aquatic Sciences 41: 278-285.

Fontaine, B. L. 1988. An evaluation of the effectiveness of instream structures for steelhead trout rearing habitat in the Steamboat Creek basin. Master's thesis. Oregon State University, Corvallis.

Foster, C. A. 1994. 1993 Fish passage at Willamette Falls. *In* D. E. Bennett and C. A. Foster. 1993 Willamette River spring Chinook salmon run, fisheries, and passage at Willamette Falls. Oregon Department of Fish and Wildlife, Clackamas.

Foster, C. A. 1995. 1994 Fish passage at Willamette Falls. *In* D. E. Bennett and C. A. Foster. 1994 Willamette River spring Chinook salmon run, fisheries, and passage at Willamette Falls. Oregon Department of Fish and Wildlife, Clackamas.

Franke, G. F., et al. (10 co-authors). 1997. Development of environmentally advanced hydropower turbine system design concepts. Prepared for U. S. Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, DOE Idaho Operations Office, and Hydropower Research Foundation, Inc.

Fulton, L. A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River Basin—past and present. Special Scientific Report--Fisheries No. 618. National Marine Fisheries Service.

Goetz, F. 1989. Biology of the bull trout, *Salvelinus confluentus*, a literature review. USDA Forest Service, Willamette National Forest, Eugene, Oregon.

Hammond, R. J. 1979. Larval biology of the Pacific lamprey, *Entosphenus tridentatus* (Gairdner), of the Potlatch River, Idaho. Master's thesis. University of Idaho, Moscow.

Hankin, D. G., and J. Richards. 2000. The northern pikeminnow management program: an independent review of program justification, performance, and cost-effectiveness. Prepared for Northwest Planning Council by D. G. Hankin, Professor of Fisheries, Humboldt State University, Arcata, California and J. Richards, Assistant Professor of Economics, Portland State University, Portland, Oregon.

Hanson, B. N., T. D. Brush, D. D. Royer, R. Heun, H. Carson, and D. Mathur. 2001. Monitoring of adult Pacific lamprey congregation areas and movements in the vicinity of the Willamette Falls Project, Fall 2001. Progress report. Prepared by Normandeau Associates, Westmoreland, New Hampshire for Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup, Portland General Electric Company, Portland, Oregon.

Hanson, B. N., and D. Mathur. 2002. Congregation areas and movements of adult Pacific lamprey in the vicinity of the Willamette Falls Project, fall 2001 - spring 2002. Prepared by Normandeau Associations, Inc. for Portland General Electric (PGE), Portland, Oregon and Blue Heron Paper Company, Oregon City, Oregon and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Hartman, G. F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 22: 1035-1081.

Hartman, G. F., B. C. Andersen, and J. C. Scrivener. 1982. Seaward movement of coho salmon (*Oncorhynchus kisutch*) fry in Carnation Creek, an unstable coastal stream in British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 39: 588-597.

Harza Engineering Company. 2001. Terrestrial resource report. Prepared for Portland General Electric Company, Portland, Oregon, and Blue Heron Paper Company, Oregon City, Oregon.

Healey, M. C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, British Columbia.

Hillman, T. W., J. S. Griffith, and W. S. Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society 116: 185-195.

Holmes, H. B., and M. C. Bell. 1960. A study of the upstream passage of anadromous fish at Willamette Falls, with recommendations for improvements in fish passage facilities. Prepared for Oregon Fish Commission, Portland.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids. Volume I: Chinook, coho, chum and sockeye salmon stock summaries. Final Report, Contract DE-AI79-84BP12737, Project 83-335. Prepared by Oregon Department of Fish and Wildlife, Washington State Department of Fisheries, Washington Department of Game, and Idaho Department of Fish and Game for Bonneville Power Administration, Portland, Oregon.

Hughes, R. M., and J. R. Gammon. 1987. Longitudinal changes in fish assemblages and water quality in the Willamette River, Oregon. Transactions of the American Fisheries Society 116: 196-209.

Isaacs, F. B., and R. G. Anthony. 2000. Bald eagle nest locations and history of use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971-2000. Oregon Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife, Oregon State University, Corvallis.

Isaak, D. J., and T. C. Bjornn. 1996. Movement of northern squawfish in the tailrace of a lower Snake River dam relative to the migration of juvenile anadromous salmonids. Transactions of the American Fisheries Society 125: 780-793.

Kan, T. T. 1975. Systematics, variation, distribution, and biology of lampreys of the genus *Lampetra* in Oregon. Doctoral dissertation. Oregon State University, Corvallis.

Karchesky, C. M., T. D. Brush, D. Mathur, and E. J. White. 2002. Evaluation of juvenile steelhead downstream migration at the Willamette Falls Project, spring 2002. Draft report. Prepared by Normandeau Associations, Inc. for Portland General Electric (PGE), Portland, Oregon and Blue Heron Paper Company, Oregon City, Oregon and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Klamath-Siskiyou Wildlands Center, Siskiyou Regional Education Project, Umpqua Watersheds, Friends of the Eel, Northcoast Environmental Center, Environmental Protection Information Center, Native Fish Society, Center for Biological Diversity, Oregon Natural Resources Council, Washington Trout, and Umpqua Valley Audubon Societ. 2003. A petition for rules to list: Pacific lamprey (*Lampetra tridentata*); river lamprey (*Lampetra ayresi*); western brook lamprey (*Lampetra richardsoni*); and Kern brook lamprey (*Lampetra hubbsi*) as threatened or endangered under the Endangered Species Act. Submitted to U. S. Fish and Wildlife Service, Office of Endangered Species by Siskiyou Regional Education Project, Cave Junction, Oregon.

Klingeman, P. C. 1973. Indications of streambed degradation in the Willamette River. Report WRRI-21. Water Resources Research Institute, Oregon State University, Corvallis.

Klingeman, P. C. 1987. Geomorphic influences on sediment transport in the Willamette River. R. L. Beschta, T. Blinn, G. E. Grant, F. J. Swanson and G. G. Ice, editors. Erosion and sedimentation in the Pacific Rim. IAHS Publication No. 165. International Association of Hydrological Scientists, Corvallis, Oregon.

Klingeman, P.C., Sollit, C.K., and Setiawan, A. 1999. T.W. Sullivan Power Plant Forebay Flow Study Data Summary. Oregon State University, Wave Research Lab, Corvallis, Oregon.

Kostow, K., editor. 1995. Biennial report on the status of wild fish in Oregon. Oregon Department of Fish and Wildlife, Portland.

Kostow, K. 2002. Oregon lampreys: natural history, status, and analysis of management issues. Oregon Department of Fish and Wildlife, Portland.

Kynard, B., and M. Horgan. 2001. Guidance of yearling shortnose and pallid sturgeon using vertical bar rack and louver arrays. North American Journal of Fisheries Management 21: 561-570.

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, editor. 1980. Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh.

Leider, S. A., M. W. Chilcote, and J. J. Loch. 1986. Comparative life history characteristics of hatchery and wild steelhead trout (*Salmo gairdneri*) of summer and winter races in the Kalama River, Washington. Canadian Journal of Fisheries and Aquatic Sciences 43: 1398-1409.

Levings, C. D., and R. B. Lauzier. 1991. Extensive use of the Fraser River basin as winter habitat by juvenile Chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Zoology 69: 1759-1767.

Lichatowich, J. 1999. Recovering salmon and healthy watersheds in the Willamette Basin: review of the Willamette River Initiative. Draft report. Prepared for the Oregon Business Council, Portland.

Lindsay, R. B., K. R. Kenaston, R. K. Schroeder, J. T. Grimes, M. G. Wade, K. Homolka, and L. Borgerson. 1997. Spring Chinook salmon in the Willamette and Sandy rivers. Annual Progress Report, Project No. F-163-R-01. Oregon Department of Fish and Wildlife, Portland, Oregon.

Lindsay, R. B., W. J. Knox, M. W. Flesher, B. J. Smith, E. A. Olsen, and L. S. Lutz. 1986. Study of wild spring Chinook salmon in the John Day River system. 1985 Final Report, Contract DE-AI79-83BP39796, Project 79-4. Prepared by Oregon Department of Fish and Wildlife, Portland for Bonneville Power Administration, Portland, Oregon.

Lister, D. B., and H. S. Genoe. 1970. Stream habitat utilization of cohabiting underyearlings of Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon in the Big Qualicum River, British Columbia. Journal of the Fisheries Research Board of Canada 27: 1215-1224.

Long, C. W. 1968. Diel movement and vertical distribution of juvenile anadromous fish in turbine intakes. Fishery Bulletin 66: 599-609.

Mallatt, J. 1983. Laboratory growth of larval lampreys (*Lampetra [Entosphenus] tridentata* Richardson) at different food concentrations and animal densities. Journal of Morphology 162: 249-274.

Marcotte, B. D. 1984. Life history, status, and habitat requirements of spring-run Chinook salmon in California. Lassen National Park, Chester, California.

Marshall, A. 1993. Summary and analysis of the genetic data available for Oregon Chinook populations. Washington Department of Fisheries, Olympia.

Mason, J. C. 1976. Some features of coho salmon, *Oncorhynchus kisutch*, fry emerging from simulated redds and concurrent changes in photobehavior. Fishery Bulletin 74: 167-175.

Massey, J. B. 1967. Summary report on juvenile downstream migrant fish passage and protection studies at Willamette Falls, Oregon. Columbia River Fishery Development Program Final Report Project 912.4-SCR-1, Contract No. 14-17-0001-456. Oregon State Game Commission, Portland.

Mattson, C. R. 1949. The lamprey fishery at Willamette Falls, Oregon. Fish Commission of Oregon Research Briefs 2 (2): 23-27.

McCain, M. E. 1992. Comparison of habitat use and availability for juvenile fall Chinook salmon in a tributary of the Smith River, California. FHR Currents No. 7. USDA Forest Service, Region 5.

McEwan, D., and T. A. Jackson. 1996. Steelhead restoration and management plan for California. Management Report. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

MacLennan, D.N. and E.J. Simmonds. 1992. Fisheries Acoustics. Chapman and Hill, London, 325 p.

McMahon, T. E., and G. F. Hartman. 1989. Influence of cover complexity and current velocity on winter habitat use by juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 46: 1551-1557.

Meehan, W. R., and T. C. Bjornn. 1991. Salmonid distributions and life histories. Pages 47-82 *in* W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication No. 19. Bethesda, Maryland.

Montgomery Watson Harza. 2001. Willamette Falls Hydroelectric Project preliminary draft environmental assessment - affected environment sections. Participant review draft. Prepared for Portland General Electric and Blue Heron Paper, Portland, Oregon.

Moser, M. L., P. A. Ocker, L. C. Stuehrenberg, and T. C. Bjornn. 2002. Passage efficiency of adult Pacific lampreys at hydropower dams on the lower Columbia River, USA. Transactions of the American Fisheries Society 131: 956-965.

Moyle, P. B., J. E. Williams, and E. D. Wikramanayake. 1989. Fish species of special concern of California. Final Report. Prepared by Department of Wildlife and Fisheries Biology, University of California, Davis for California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova.

Moyle, P. B. 2002. Inland fishes of California. Revised edition. University of California Press, Berkeley.

Murphy, M. L., J. Heifetz, J. F. Thedinga, S. W. Johnson, and K. V. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Oncorhynchus*) in the glacial Taku River, southeast Alaska. Canadian Journal of Fisheries and Aquatic Sciences 46: 1677-1685.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-35. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

Nicholas, J. W. 1978. A review of literature and unpublished information on cutthroat trout (*Salmo clarki clarki*) of the Willamette watershed. Information Report Series, Fisheries No. 78-1. Oregon Department of Fish and Wildlife, Research Section, Charleston.

Nicholas, J. W., and D. G. Hankin. 1989. Chinook salmon populations in Oregon coastal river basins: descriptions of life histories and assessment of recent trends in run strengths. Report EM 8402. Oregon Department of Fish and Wildlife, Research and Development Section, Corvallis.

Nickelson, T. E., J. D. Rodgers, S. L. Johnson, and M. F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences 49: 783-789.

NMFS (National Marine Fisheries Service). 1995. Endangered and threatened species; proposed threatened status for three contiguous ESUs of coho salmon ranging from Oregon through central California. Federal Register 60: 38011-38030.

NMFS (National Marine Fisheries Service). 1996a. Endangered and threatened species; notice of six-month extension on the final determination on whether to list the Oregon coast and southern Oregon/northern California coast evolutionarily significant Units (ESUs) of coho salmon. Federal Register 61: 56211-56213.

NMFS (National Marine Fisheries Service). 1996b. Factors for decline: a supplement to the notice of determination for West Coast steelhead under the Endangered Species Act. NMFS, Protected Species Branch, Portland, Oregon and NMFS, Protected Species Management Division, Long Beach, California.

NMFS (National Marine Fisheries Service). 1996c. Making Endangered Species Act determinations of effect for individual or grouped actions at the watershed scale. Draft Report. NMFS, Environmental and Technical Services Division, Habitat Conservation Branch, Long Beach, California.

NMFS (National Marine Fisheries Service). 1996d. Endangered and threatened species; endangered status for Umpqua River cutthroat trout in Oregon. Federal Register 61: 41514-41522.

NMFS (National Marine Fisheries Service). 1998a. Endangered and threatened species; threatened status for two ESUs of steelhead in Washington, Oregon, and California. Federal Register 63: 13347-13371.

NMFS (National Marine Fisheries Service). 1998b. Status review update for West Coast Chinook salmon (*Oncorhynchus tshawytscha*) from Puget Sound, lower Columbia River, upper Willamette River, and upper Columbia River spring-run ESUs. Prepared by the West Coast Chinook Salmon Biological Review Team, NMFS, Northwest Fisheries Science Center, Seattle, Washington.

NMFS (National Marine Fisheries Service). 1998c. Factors contributing to the decline of Chinook salmon: an addendum to the 1996 West Coast steelhead factors for decline report. NMFS, Protected Resources Division, Portland, Oregon.

NMFS (National Marine Fisheries Service). 1999a. Endangered and threatened species; threatened status for three Chinook salmon evolutionarily significant Units (ESUs) in Washington and Oregon, and Endangered Status for one Chinook salmon ESU in Washington. Federal Register 64: 14308-14328.

NMFS (National Marine Fisheries Service). 1999b. Endangered and threatened species; threatened status for two ESUs of steelhead in Washington and Oregon. Federal Register 64: 14517-14528.

NMFS (National Marine Fisheries Service). 2000a. Designated critical habitat: critical habitat for 19 evolutionarily significant units of salmon and steelhead in Washington, Oregon, Idaho, and California. Federal Register 65: 7764-7787.

NMFS (National Marine Fisheries Service). 2000b. Listing endangered and threatened species and designating critical habitat: petition to list Lower Columbia River coho salmon. Federal Register 65: 66221-66222.

NMFS (National Marine Fisheries Service). 2000c. Endangered and threatened species; final rule governing take of 14 threatened salmon and steelhead evolutionarily significant Units (ESUs). Federal Register 65: 42421-42481.

NMFS (National Marine Fisheries Service). 2001. RE: Willamette Falls Project (FERC No. 2233) fish protection measures. Letter to Dave Heintzman, Portland General Electric, Portland, Oregon and Bruce Martin, Blue Heron Paper, Inc., Oregon City, Oregon from Bryan Nordlund, FERC and Water Diversion Branch, NMFS. 31 August.

Normandeau Associates, Inc. 2001a. Final Phase I report (DFP1) on safe passage effectiveness of fish through the T. W. Sullivan Development. Final Report, Issue No. DFP1. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001b. Assessment of the impacts of the Blue Heron Paper Company Development on downstream migrants. Final Report, Issue No. DFP2. Prepared for Blue Heron Paper Company, Oregon City, Oregon, Portland General Electric Company, Portland, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001c. Evaluation of the potential effects of the Willamette Falls Project on adult salmonid fallback after upstream passage. Final Report, Issue No. DFP3. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001d. Assessment of the Willamette Falls Project on habitat and non-salmonid aquatic species. Final Report, Issue No. GF1. Prepared for Blue Heron Paper Company, Oregon City, Oregon, Portland General Electric Company, Portland, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001e. Evaluation of the potential effects of the Willamette Falls Project on salmonid upstream passage delay and injury. Final Report, Issue No. UF1. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001f. Assessment of Willamette Falls Project operational effects on upstream passage of non-salmonid species, in particular, Pacific lamprey. Final Report, Issue No. UFP2. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates, Inc. 2001g. Final Phase I report: Assessment of dam and flashboards and Project operations on sedimentation. Final Report, Issue No. WQ1. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates. 2001h. Fall 2000 evaluation of juvenile spring Chinook salmon downstream migration at the Willamette Falls Project under two passage scenarios. Final Report. Prepared for Portland General Electric Company, Portland, Oregon, Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup.

Normandeau Associates. 2001i. Draft supplementary report on predation potential of juvenile salmonids at the Willamette Falls Project, Willamette River, Oregon. Prepared for Blue Heron Paper Company, Oregon City, Oregon, and Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup, Portland General Electric Company, Portland, Oregon.

Normandeau Associates. 2001p. Assessment of adult spring Chinook salmon upstream passage and residency near T. W. Sullivan draft tubes. Draft report for review. Prepared for Willamette Falls Project Fisheries, Aquatics, and Terrestrial Workgroup, Portland General Electric Company, Portland, Oregon.

Normandeau Associates, Inc. and J. R. Skalski. 1997. Survival estimation of juvenile salmonids in passage through a new turbine at T. W. Sullivan station, Willamette River, Oregon. Prepared for Portland General Electric Company, Portland, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 1998. Memorandum from J. W. Greer, ODFW to R. Waples, National Marine Fisheries Service (NMFS). October 7, 1998. [Available from NMFS, Protected Resources Division, 525 NE Oregon St., Suite 500, Portland, Oregon 97232].

ODFW (Oregon Department of Fish and Wildlife). 2000. Public meeting, 3 February 2000: Regulations for the 2000 Willamette spring Chinook fisheries. ODFW, Oregon City.

ODFW (Oregon Department of Fish and Wildlife). 2001. Fisheries Management and Evaluation Plan: Upper Willamette River spring Chinook in freshwater fisheries of the Willamette Basin and Lower Columbia River mainstem. ODFW, Portland.
Olsen, E., P. Pierce, M. McLean, and K. Hatch. 1992. Stock summary reports for Columbia River anadromous salmonids. Volume I: Oregon. Project No. 88-108. Bonneville Power Administration, Portland, Oregon.

ONHP (Oregon Natural Heritage Program). 2001. Rare, threatened and endangered plants and animals of Oregon. ONHP, Portland, Oregon.

Pacific Northwest Ecosystem Research Consortium. In press. Willamette River Basin Atlas. Trajectories of Environmental and Ecological Change. A Planning Atlas.

Pearcy, W. G., and J. P. Fisher. 1988. Migrations of coho salmon, *Oncorhynchus kisutch*, during their first summer in the ocean. NOAA Fisheries Bulletin 86: 173-195.

PGE (Portland General Electric). 1997. Fish runs and the PGE hydroelectric system. PGE, Portland, Oregon.

PGE (Portland General Electric). 2001. RE: Project No. 2233, Oregon Willamette Falls Project - Portland General Electric [letter in response to request for information relating to the April 11, 2001 fish mortality incident near the T. W. Sullivan Plant]. Letter to The Secretary, Federal Energy Regulatory Commission, Washington, D. C. from Julie A. Keil, Director, Hydro Licensing and Water Rights, Portland General Electric, Portland, Oregon. 30 May.

PGE and Blue Heron (Portland General Electric and Blue Heron Paper Company, Inc.). 2001. Scoping document 2 for a preliminary draft environmental assessment, Willamette Falls Hydroelectric Project, T. W. Sullivan Development, Blue Heron Paper Development, FERC Project No. 2233. Prepared by Harza Engineering Company for PGE, Portland, Oregon and Blue Heron Paper Company, Inc., Oregon City, Oregon.

PGE and Blue Heron (Portland General Electric and Blue Heron Paper Company, Inc.). 2002. Assessment of juvenile Pacific lamprey downstream passage at T. W. Sullivan Development relative to the Unit 13 Eicher screen. PGE, Portland, Oregon and Blue Heron Paper Company, Inc., Oregon City, Oregon.

PGE and Smurfit (Portland General Electric and Smurfit Newsprint Corporation). 1998. Initial information package for the Willamette Falls Hydroelectric Project FERC No. 2233: T. W. Sullivan Development and Smurfit Development. Portland, Oregon.

Platts, W. S., M. A. Shirazi, and D. H. Lewis. 1979. Sediment particle sizes used by salmon for spawning with methods for evaluation. Ecological Research Series EPA-600/3-79-043. U. S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Pletcher, T. F. 1963. The life history and distribution of lampreys in the Salmon and certain other rivers in British Columbia, Canada. Master's thesis. University of British Columbia, Vancouver.

Poe, T. P., H. C. Hansel, S. Vigg, D. E. Palmer, and L. A. Prendergast. 1991. Feeding of predaceous fishes on outmigrating juvenile salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120: 405-420.

Potter, I. C. 1980. Ecology of larval and metamorphosing lampreys. Canadian Journal of Fisheries and Aquatic Sciences 37: 1641-1657.

Puckett, L. E. 1975. The status of spring-run steelhead (*Salmo gairdneri*) of the Eel River system. Memorandum Report. California Department of Fish and Game.Raleigh, R. F., T. Hickman, R. C. Solomon, and P. C. Nelson. 1984. Habitat suitability information: rainbow trout. FWS/OBS-82/10.60. U. S. Fish and Wildlife Service, Washington, D. C.

Ratliff, D. E., and P. J. Howell. 1992. The status of bull trout populations in Oregon. Pages 10-17 *in* P. J. Howell and D. V. Buchanan, editors. Proceedings of the Gearhart Mountain bull trout workshop. American Fisheries Society, Oregon Chapter, Corvallis. Reedy, G. D. 1995. Summer abundance and distribution of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) in the Middle Fork Smith River, California. Master's thesis. Humboldt State University, Arcata, California.

Renaud, C. B. 1997. Conservation status of northern hemisphere lampreys (Petromyzontidae). Journal of Applied Ichthyology 13: 143-148.

Richards, J. E. 1980. Freshwater life history of the anadromous Pacific lamprey *Lampetra tridentata*. Master's thesis. University of Guelph, Ontario.

Richards, J. E., and F. W. H. Beamish. 1981. Initiation of feeding and salinity tolerance in the Pacific lamprey *Lampetra tridentata*. Marine Biology 63: 73-77.

Rickert, D. A., V. C. Kennedy, S. W. McKenzie, and W. G. Hines. 1977. A synoptic survey of trace metals in bottom sediments of the Willamette River, Oregon. USGS Circular 715-F. U. S. Geological Survey.

Rieman, B. E., and J. D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. USDA Forest Service, Intermountain Research Station, Ogden, Utah.

Rien, T., M. J. Wevers, J. Massey, J. Wetherbee, J. Haxton, and M. Wade. 1992. Main stem Willamette subbasin fish management plan. Oregon Department of Fish and Wildlife, Portland.

Roelofs, T. D. 1983. Current status of California summer steelhead (*Salmo gairdneri*) stocks and habitat, and recommendations for their management. Report to USDA Forest Service, Region 5.

Ruggerone, G. T. 1986. Consumption of migrating juvenile salmonids by gulls foraging below a Columbia River dam. Transactions of the American Fisheries Society 115: 736-742.

Ruggles, C. P. 1966. Depth and velocity as a factor in stream rearing and production of juvenile coho salmon. The Canadian Fish Culturist 38: 37-53.

Sandercock, F. K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pages 397-445 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, B. C.

Scarnecchia, D. L. 1981. Effects of streamflow and upwelling on yield of wild coho salmon (*Oncorhynchus kisutch*) in Oregon. Canadian Journal of Fisheries and Aquatic Sciences 38: 471-475.

Schreck, C. B., H. W. Li, R. C. Hjort, and C. S. Sharpe. 1986. Stock identification of Columbia River Chinook salmon and steelhead trout. Final Report, Contract DE-AI79-83BP13499, Project 83-451. Prepared by Oregon Cooperative Fisheries Research Unit, Oregon State University, Corvallis for Bonneville Power Administration, Portland, Oregon.

Schreck, C. B., J. C. Snelling, R. E. Ewing, C. S. Bradford, L. E. Davis, and C. H. Slater. 1994. Migratory behavior of adult spring Chinook salmon in the Willamette River and its tributaries. Completion Report DOE/BP-92818-5. Prepared by Oregon State University Cooperative Fishery Research Unit for Bonneville Power Administration, Portland, Oregon.

Scott, W. B., and E. J. Crossman. 1973. Pacific lamprey, *Entosphenus tridentatus* (Gairdner). Pages 42-55 *in* Freshwater fishes of North America. Holt, Rinehart and Winston, New York.

Sedell, J. R., and J. L. Froggatt. 1984. Importance of streamside forests to large rivers: the isolation of the Willamette River, Oregon, U.S.A., from its floodplain by snagging and streamside forest removal. [International Association of Theoretical and Applied Limnology] 22: 1828-1834.

Shapovalov, L., and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. Fish Bulletin 98. California Department of Fish and Game.

Shirvell, C. S. 1990. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying streamflows. Canadian Journal of Fisheries and Aquatic Sciences 47: 852-861.

Shirvell, C. S. 1994. Effect of changes in streamflow on the microhabitat use and movements of sympatric juvenile coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*) in a natural stream. Canadian Journal of Fisheries and Aquatic Sciences 51: 1644-1652.

Skalski, J. R. 2000. Retrospective analysis of FGE trials at T. W. Sullivan Plant, Oregon. Prepared for Portland General Electric Company, Portland, Oregon.

Smith, E. M., and J. C. Zakel. 1981. Willamette River spring Chinook evaluation. Annual progress report. Oregon Department of Fish and Wildlife, Portland.

Solazzi, M. F., T. E. Nickelson, and S. L. Johnson. 1990. An evaluation of the use of coho salmon presmolts to supplement wild production in Oregon coastal streams. Fisheries Research Report 10: 1-22. Oregon Department of Fish and Wildlife.

Steward, C. R., and T. C. Bjornn. 1987. The distribution of Chinook salmon juveniles in pools at three discharges. Proceedings of the Annual Conference Western Association of Fish and Wildlife Agencies 67: 364-374.

Stillwater Sciences. 1998. The North Umpqua cooperative watershed analysis synthesis report. Prepared by Stillwater Sciences, Berkeley, California for PacifiCorp, Portland, Oregon.

Stuart, T. A. 1953. Water currents through permeable gravels and their significance to spawning salmonids. Nature (London) 172: 407-408.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. Canadian Journal of Zoology 64: 1506-1514.

Tabor, R. A., R. S. Shively, and T. P. Poe. 1993. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. North American Journal of Fisheries Management 13: 831-838.

Tetra Tech, Inc. 1993[a]. Willamette River basin water quality study, Component II: Willamette River basin toxics component report. TC-8983-02. Prepared by Tetra Tech, Redmond, Washington for Oregon Department of Environmental Quality.

Tetra Tech, Inc. 1994. Willamette River basin water quality study, Phase II: biological sampling data report. TC-9719-02. Prepared by Tetra Tech, Redmond, Washington for Oregon Department of Environmental Quality.

Thompson, K. 1972. Determining stream flows for fish life. Pages 31-50 *in* Proceedings of the instream flow requirement workshop. Pacific Northwest River Basin Commission, Vancouver, Washington.

ULEP (Umpqua Land Exchange Project). 1998. Mapping rules for Pacific lamprey (*Lampetra tridentata*). Draft Report. ULEP, Roseburg, Oregon.

USFWS (U. S. Fish and Wildlife Service). 1986. Interagency cooperation - Endangered Species Act of 1973, as amended; final rule. Federal Register 51: 19926-19963.

USFWS (U. S. Fish and Wildlife Service). 1998. Endangered and threatened wildlife and plants; determination of threatened status for the Klamath River and Columbia River distinct population segments of bull trout. Federal Register 63: 31647-31674.

USFWS (U. S. Fish and Wildlife Service). 1999a. Endangered and threatened wildlife and plants; proposed rule to remove the bald eagle in the lower 48 states from the list of endangered and threatened wildlife; proposed rule. Federal Register 64: 36454-36464

USFWS (U. S. Fish and Wildlife Service). 1999b. Endangered and threatened wildlife and plants; determination of threatened status for bull trout in the coterminous United States; final rule. Federal Register 64: 58909-58933.

USFWS (U. S. Fish and Wildlife Service). 2000b. Endangered and threatened wildlife and plants; endangered status for *Erigeron decumbens* var. *decumbens* (Willamette daisy) and Fender's blue butterfly (*Icaricia icarioides fenderi*) and threatened status for *Lupinus sulphureus* ssp. *kincaidii* (Kincaid's lupine). Federal Register 65: 3875-3890.

USFWS (U. S. Fish and Wildlife Service). 2001. RE: Willamette Falls Hydroelectric Project (1-7-01-SP-928), request for information on listed and proposed endangered and threatened species in the area of the Willamette Falls Hydroelectric Project. Letter to S. Kramer, Stillwater Sciences, Arcata, California from K. M. McMaster, State Supervisor, USFWS, Oregon Fish and Wildlife Office, Portland. 25 July.

USFWS (U. S. Fish and Wildlife Service). 2002. Endangered and threatened wildlife and plants; proposed designation of critical habitat for the Klamath River and Columbia River distinct population segments of bull trout. Federal Register 67: 71236-71438.

USFWS and NMFS (U. S. Fish and Wildlife Service and National Marine Fisheries Service). 1998. Endangered species consultation handbook: procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. Final report. Washington, D. C.

Utter, F. M., G. Milner, G. Stahl, and D. Teel. 1989. Genetic population structure of Chinook salmon, *Oncorhynchus tshawytscha*, in the Pacific Northwest. Fishery Bulletin 87: 239-264.

Vladykov, V. D. 1973. *Lampetra pacifica*, a new nonparasitic species of lamprey (Petromyzontidae) from Oregon and California. Journal of the Fisheries Research Board of Canada 30: 205-213.

Vigg, S., T. P. Poe, L. A. Prendergast, and H. C. Hansel. 1991. Rates of consumption of juvenile salmonids and alternative prey fish by northern squawfish, walleyes, smallmouth bass, and channel catfish in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120: 421-438.

Vronskiy, B. B. 1972. Reproductive biology of the Kamchatka River Chinook salmon (*Oncorhynchus tshawytscha* [Walbaum]). Journal of Ichthyology 12: 259-273.

Wallis, J. 1961. An evaluation of the McKenzie River Salmon Hatchery. Evaluation report of the Fish Commission of Oregon.

Waples, R. S., D. J. Teel, and P. B. Aebersold. 1991. A genetic monitoring and evaluation program for supplemented populations of salmon and steelhead in the Snake River basin. DOE/BP-00911-1. Bonneville Power Administration, Portland, Oregon.

Ward, B. R., and P. A. Slaney. 1988. Life history and smolt-to-adult survival of Keogh River steelhead trout (*Salmo gairdneri*) and the relation to smolt size. Canadian Journal of Fisheries and Aquatic Sciences 45: 1110-1122.

Ward, D. L., A. A. Nigro, R. A. Farr, and C. J. Knutsen. 1994. Influence of waterway development on migrational characteristics of juvenile salmonids in the lower Willamette River, Oregon. North American Journal of Fisheries Management 14: 362-371.

Ward, D. L., J. H. Petersen, and J. J. Loch. 1995. Index of predation on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Transactions of the American Fisheries Society 124: 321-334.

Ward, D. L. 2001. Lamprey harvest at Willamette Falls. Columbia River Investigations. Oregon Department of Fish and Wildlife. Portland, Oregon.

Wert, M. 1988. Hydraulic model evaluation of the Eicher passive pressure screen fish bypass system. Pages 3-57 to 3-71 *in* W. C. Micheletii, editor. Proceedings: Fish protection at steam and hydroelectric plants. Electric Power Research Institute (EPRI), Palo Alto, California.

Wevers, M. J., J. Wetherbee, and W. Hunt. 1992. Santiam and Calapooia subbasin fish management plan. Oregon Department of Fish and Wildlife, Salem.

Williams, R. H. 1983. Coho salmon in the upper Willamette River, Oregon: a history of establishing a run of non-indigenous salmon and prospects for renewed efforts to increase the run. Draft report.

Willis, C. F., S. P. Cramer, M. Smith, D. Cramer, T. Downey, and R. Montagne. 1995. Status of Willamette River spring Chinook salmon in regards to the Federal Endangered Species Act. Part 1: Determine which spring Chinook population groupings within the Willamette River basin qualify as Evolutionarily Significant Units (ESUs). Special Report. Submitted to National Marine Fisheries Service on behalf of Portland General Electric Company and Eugene Water and Electric Board. S. P. Cramer and Associates, Inc., Gresham, Oregon.

Witty, K. L. 1999. Fish species of the Pelton Round Butte Hydroelectric Project area. Prepared by S. P. Cramer and Associates, Inc. for Portland General Electric Company, Portland, Oregon.

WRI (Willamette Restoration Initiative). 2001. The Willamette Restoration Strategy: Recommendations for the Willamette Basin Supplement to the Oregon Plan for Salmon and Watersheds.

Figures

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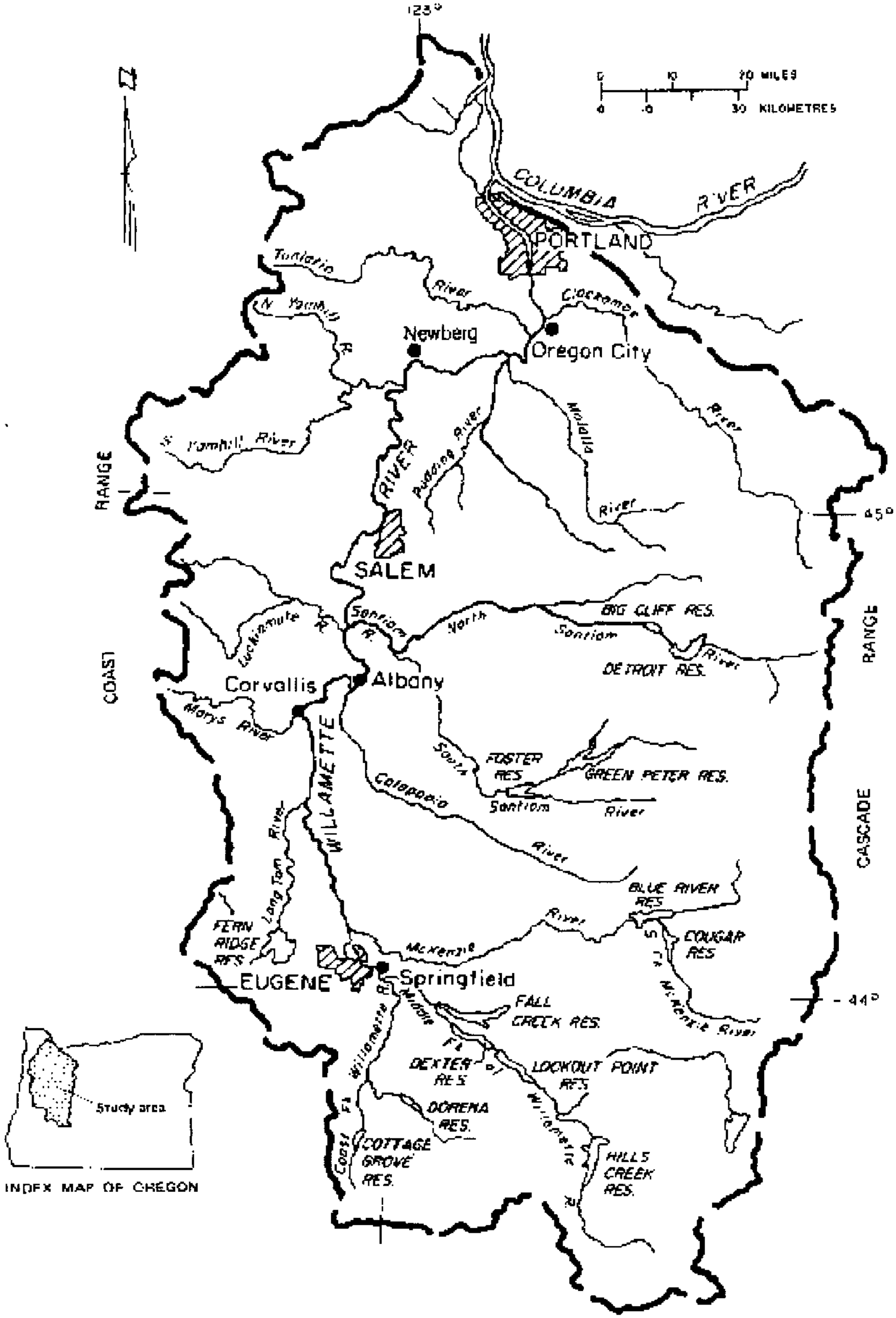

Figure1. Willamette River watershed.

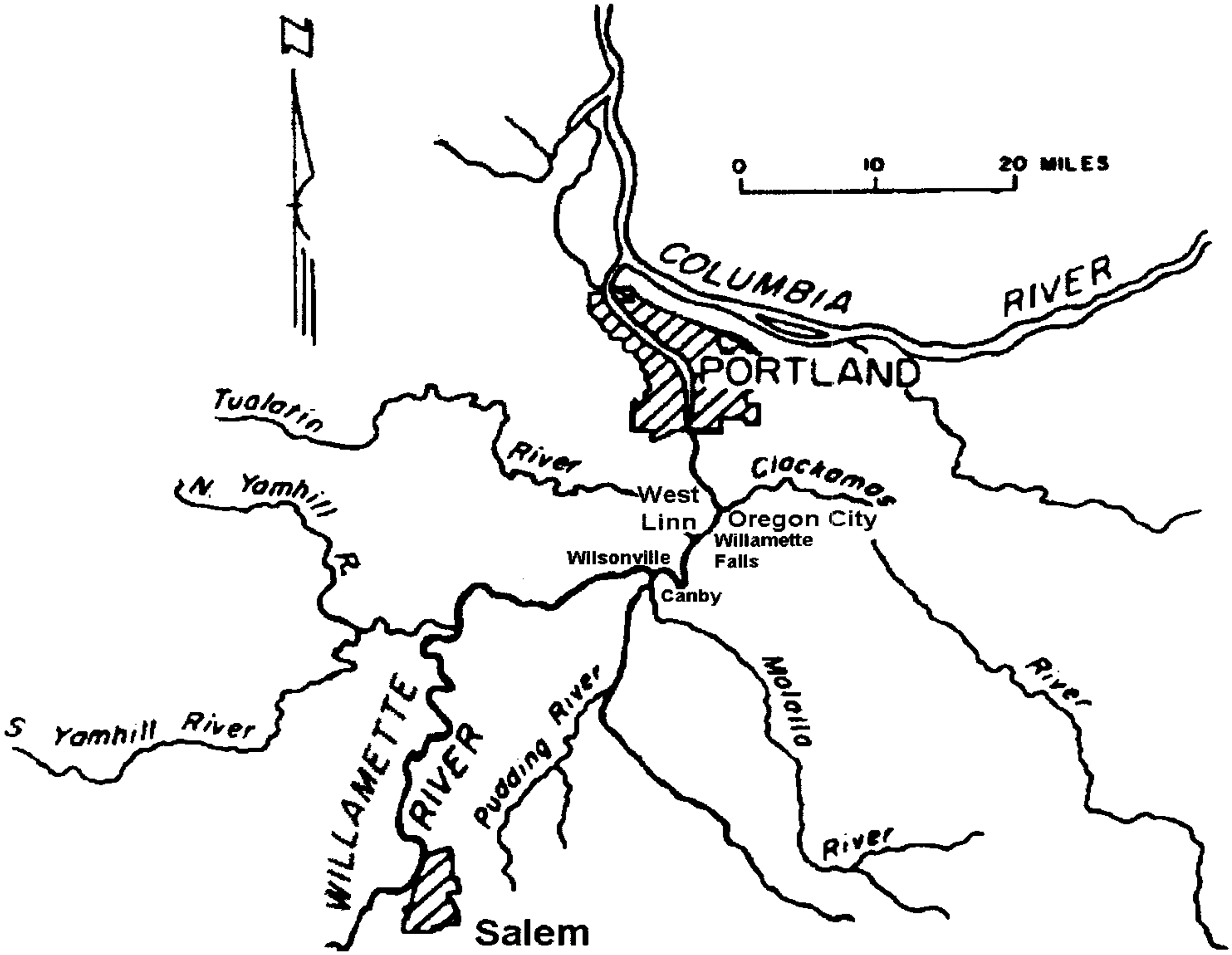

Figure 2. Willamette Falls Hydroelectric Project.

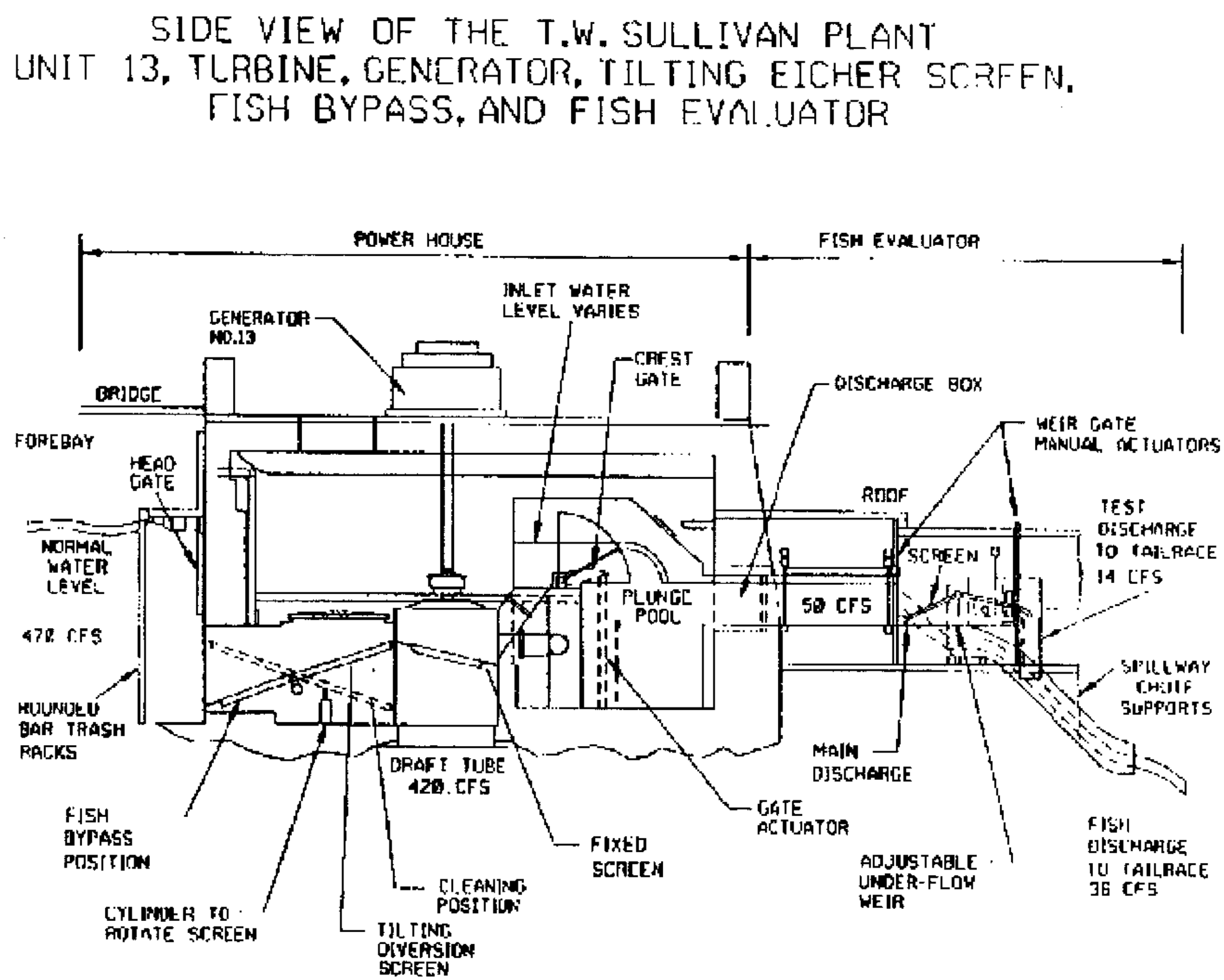

Figure 3. T.W. Sullivan fish bypass system.

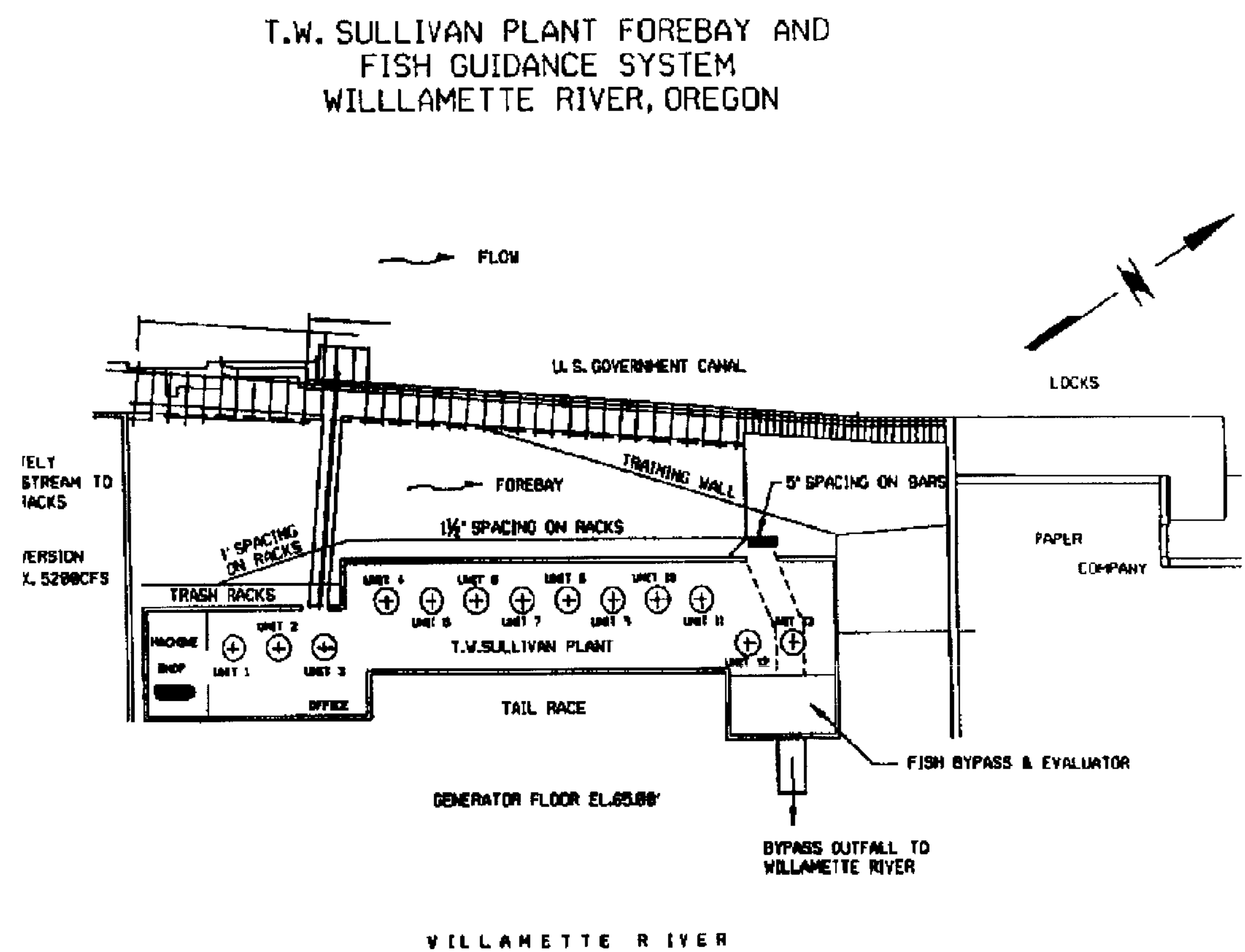

Figure 4. T.W. Sullivan forebay guidance system.

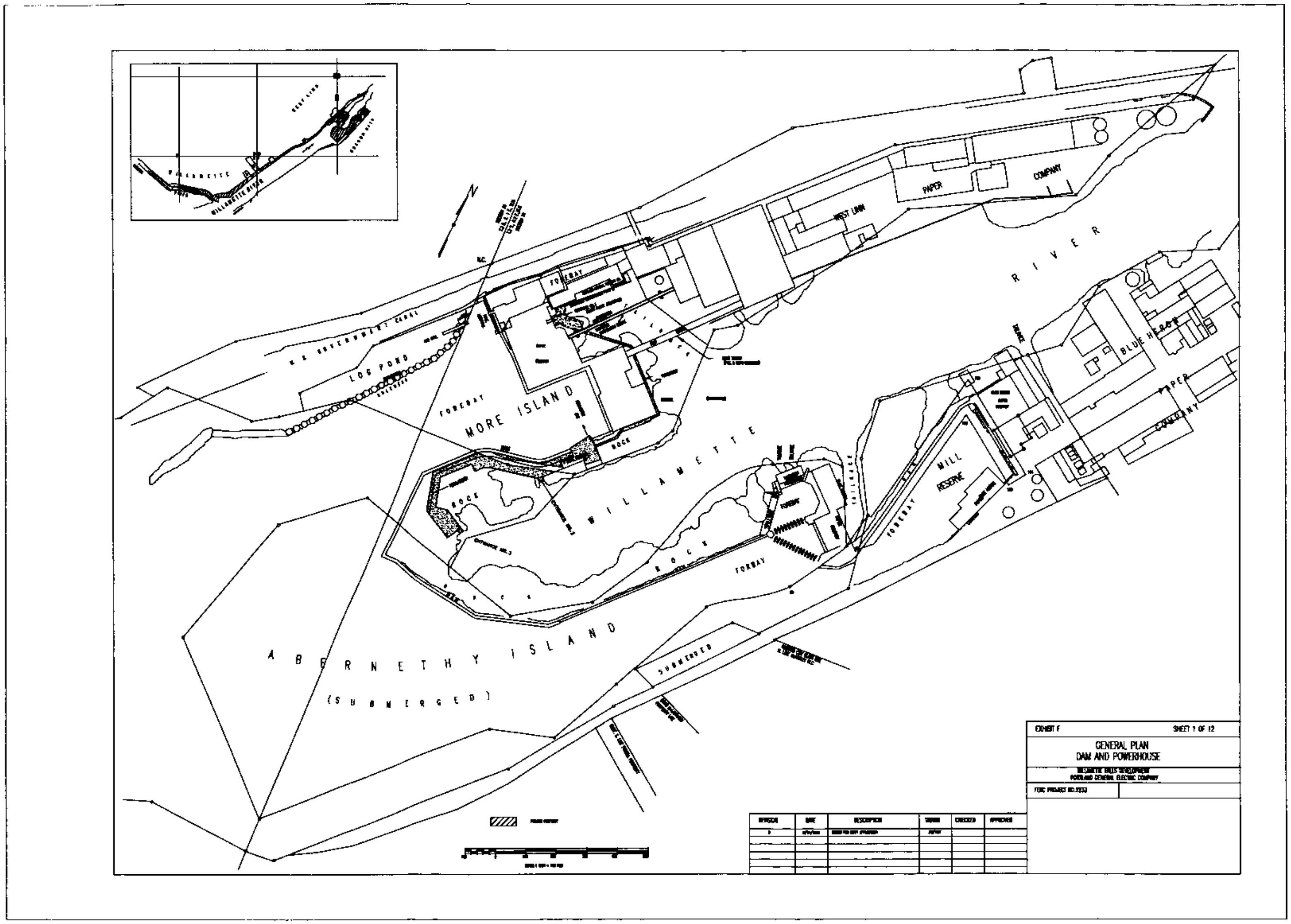

Figure 5. Willamette Falls Hydroelectric Project Area.

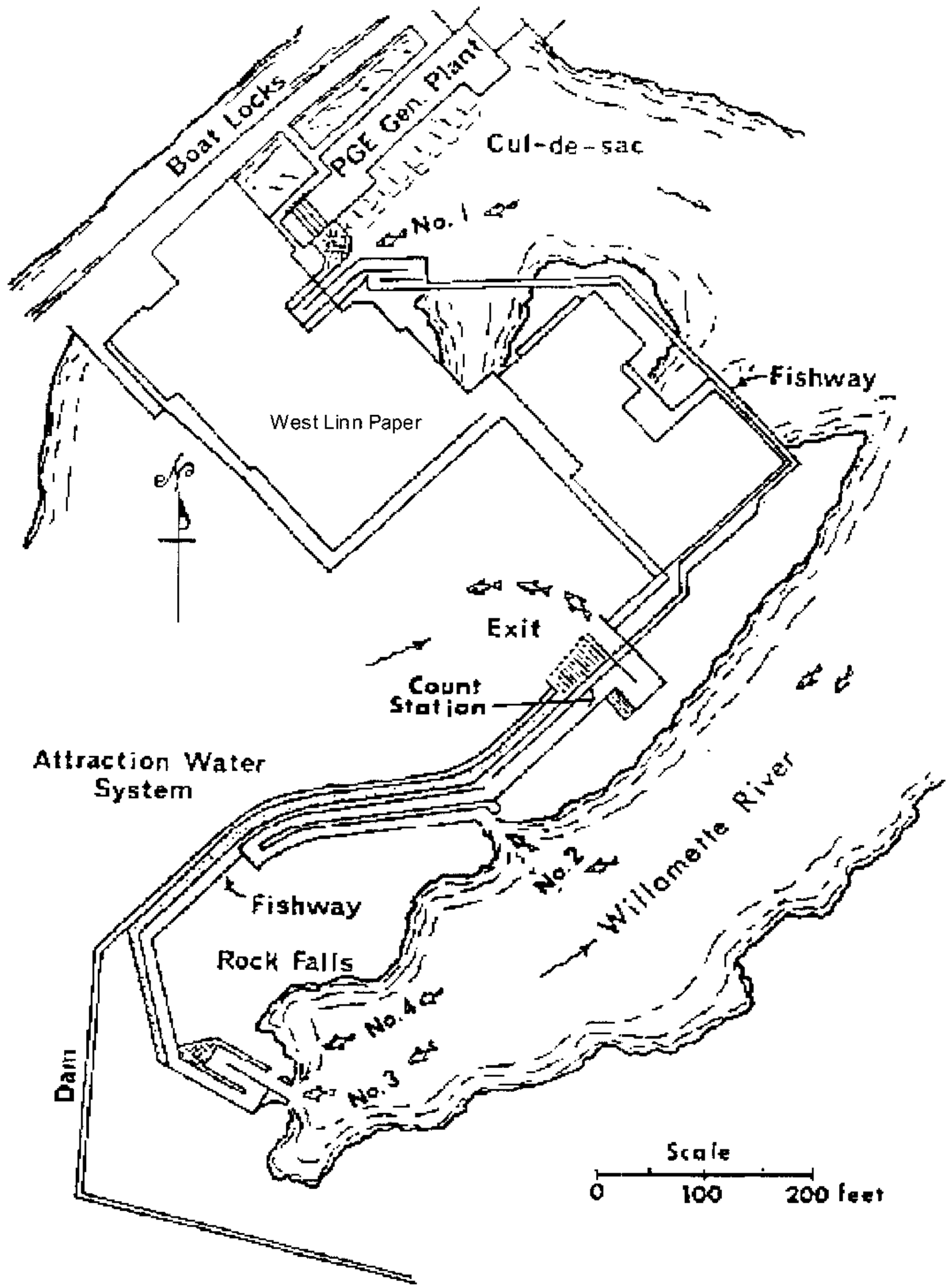

Figure 6. Willamette Falls fish ladder.

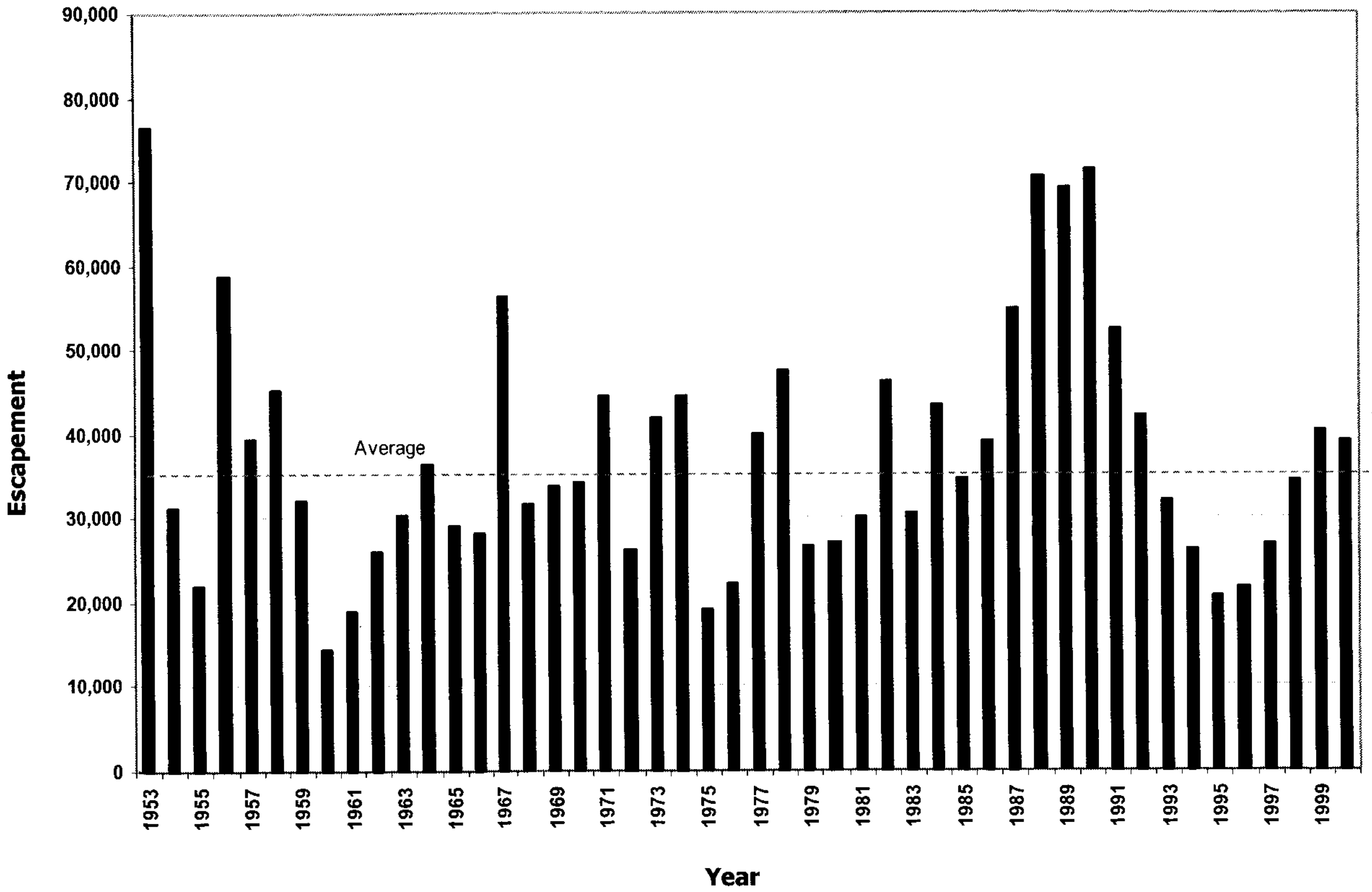

Figure 7. Adult spring Chinook salmon counts at Willamette Falls fish ladder.

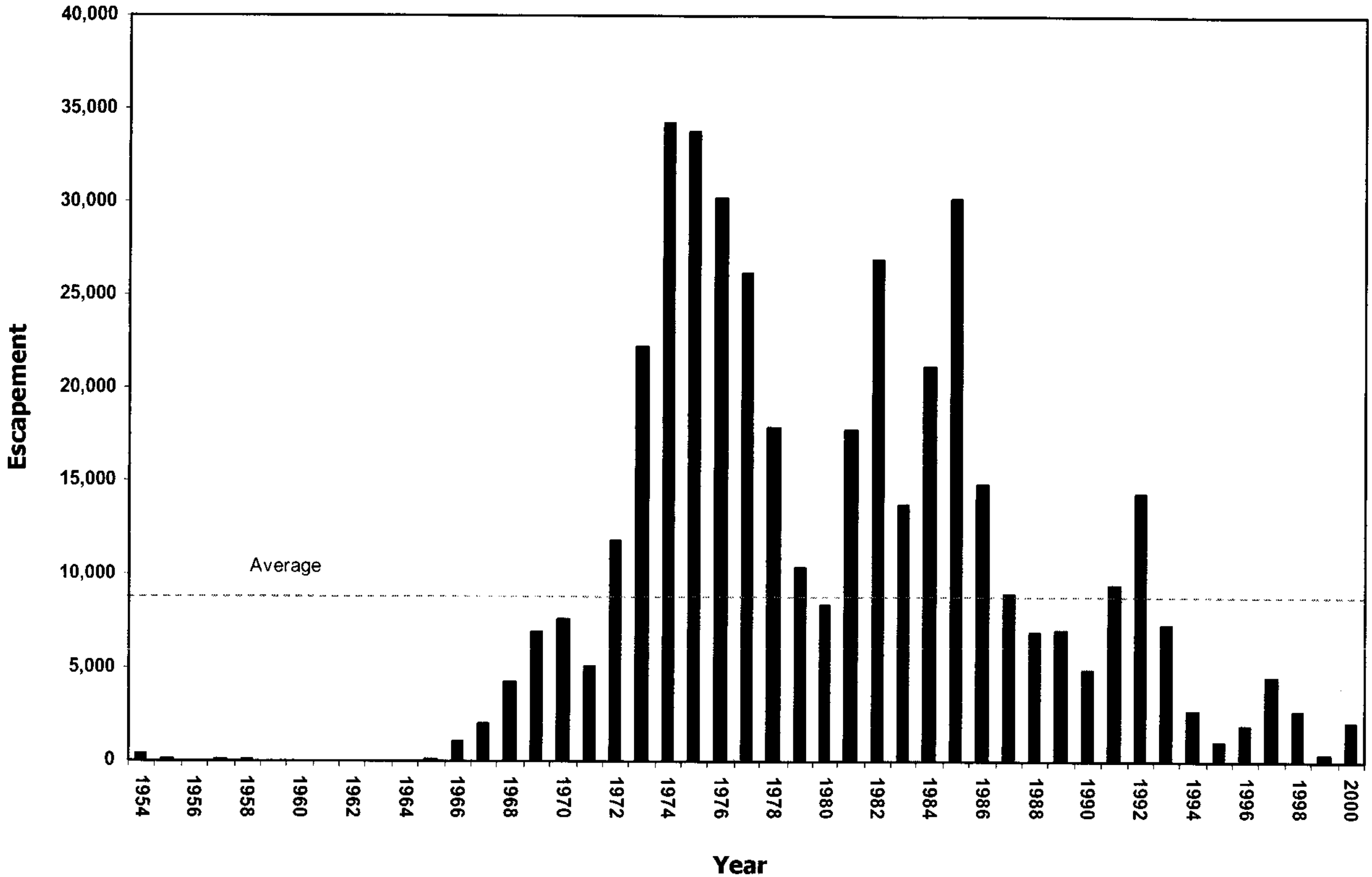

Figure 8. Adult fall Chinook salmon counts at Willamette Falls fish ladder.

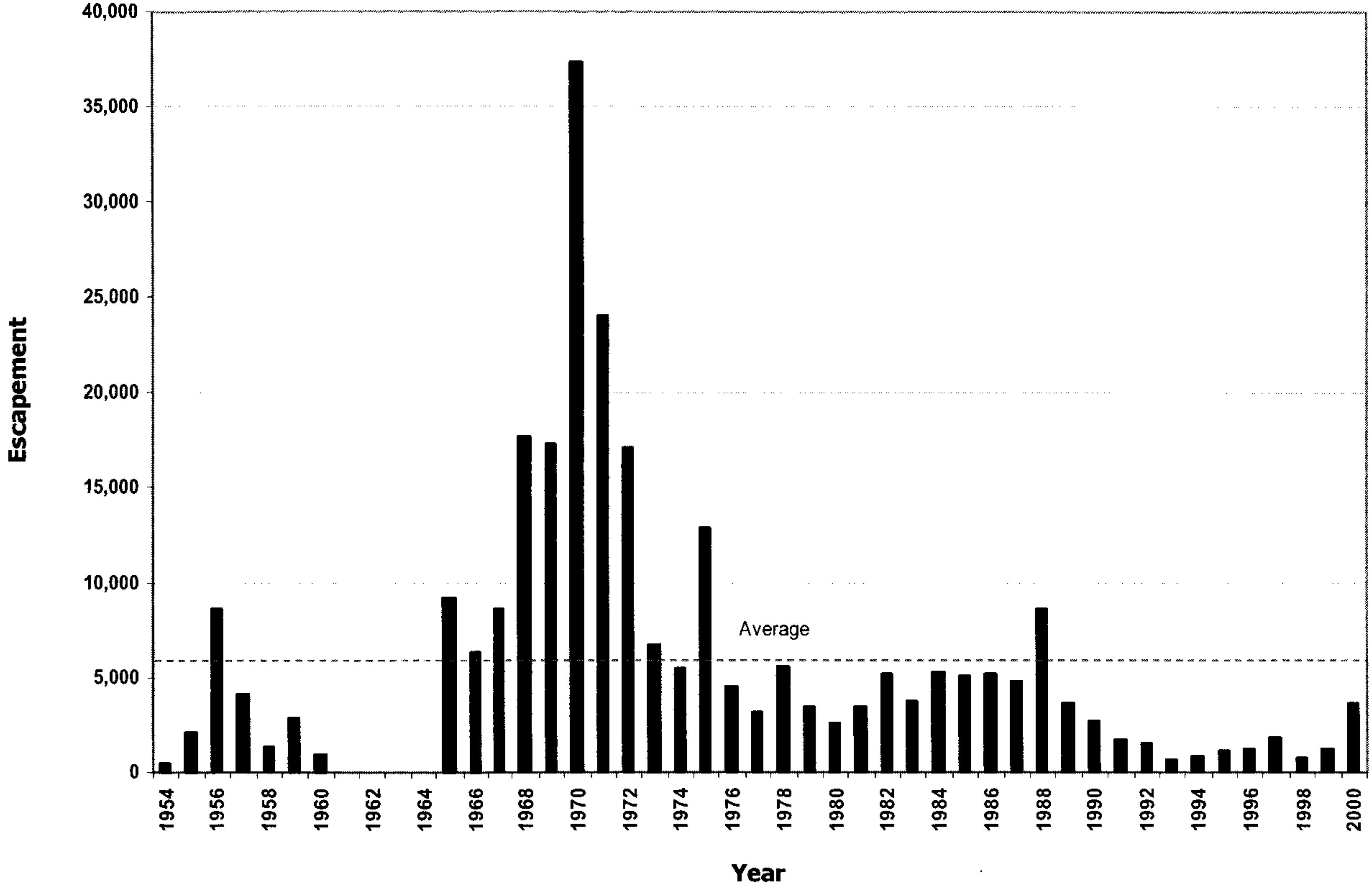

Figure 9. Adult coho salmon counts at Willamette Falls fish ladder

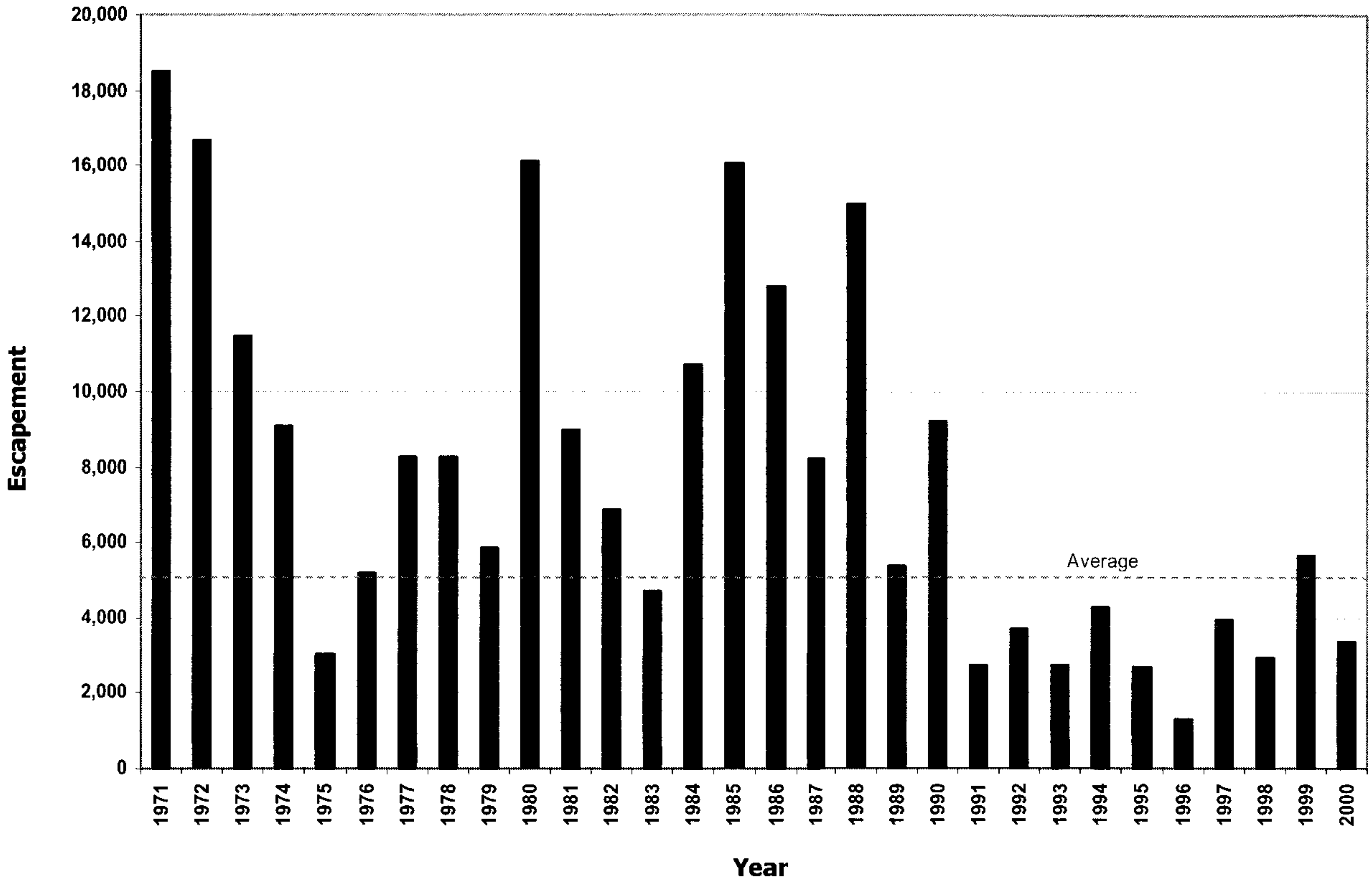

Figure 10. Adult winter steelhead counts at Willamette Falls fish ladder.

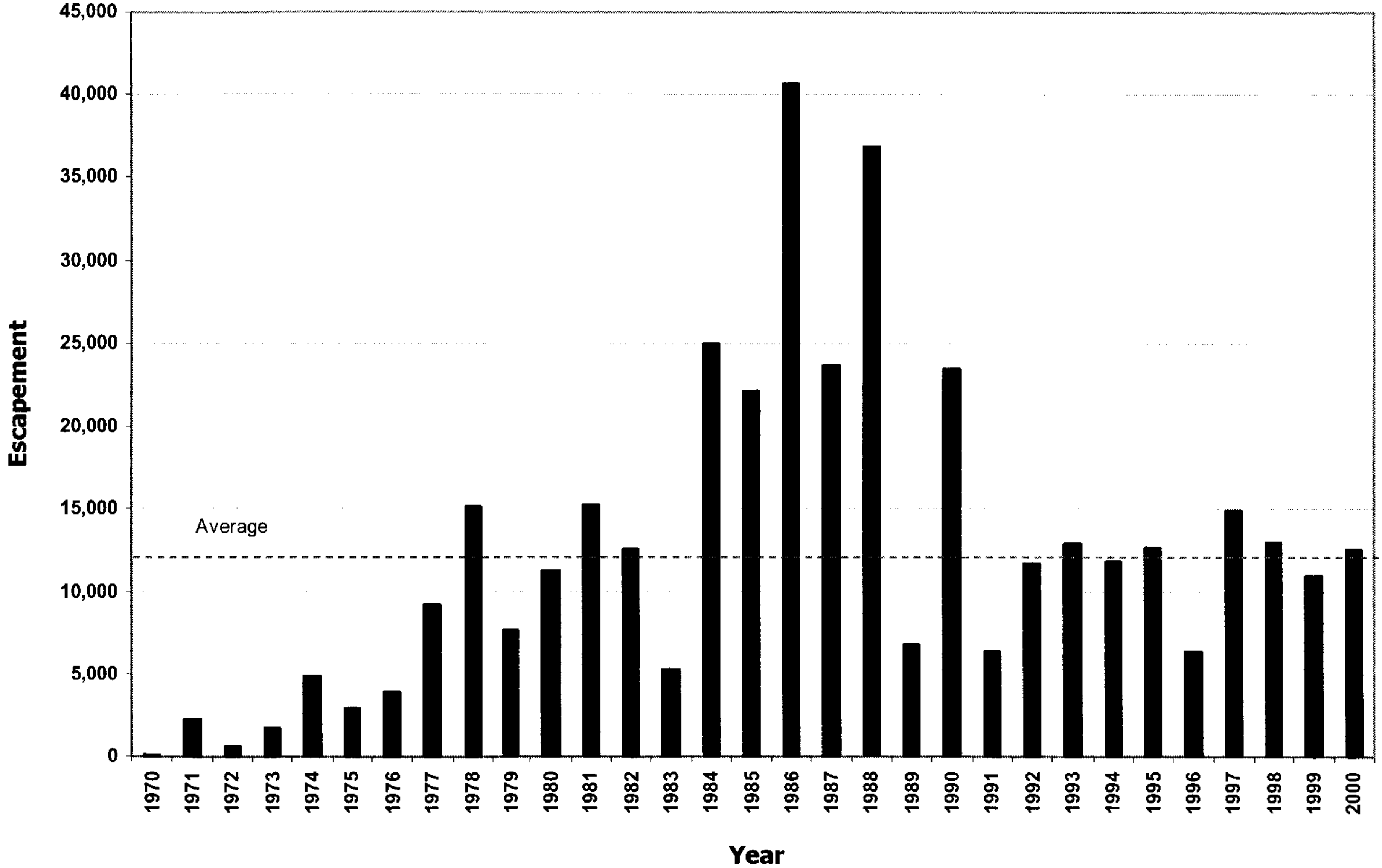

Figure 11. Adult summer steelhead counts at Willamette Falls fish ladder

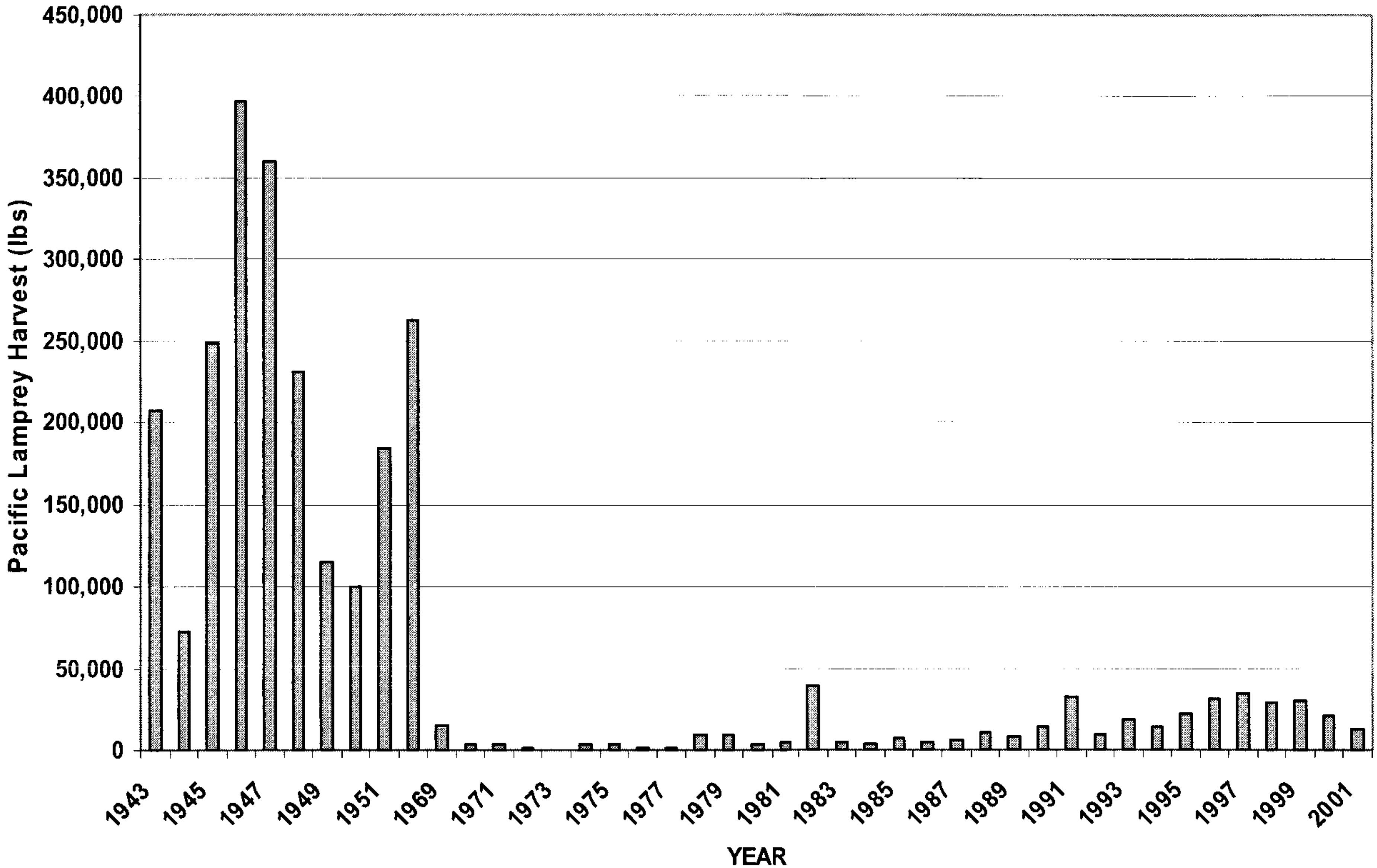

Figure 12. Adult Pacific lamprey harvest (lbs) at Willamette Falls.

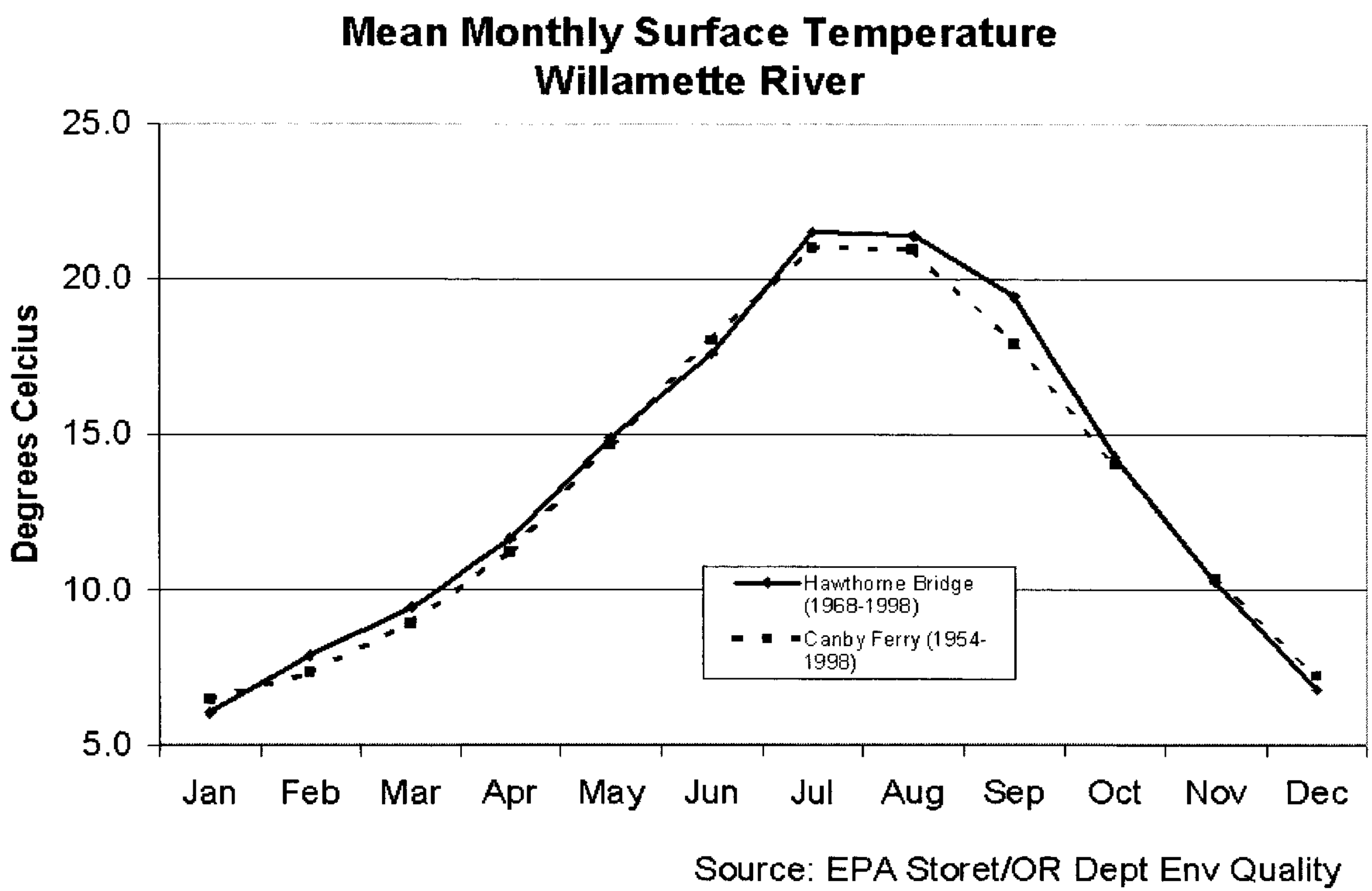

Figure 13. Mean monthly surface temperatures upstream and downstream of the Willamette Falls Project.

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APPENDIX A.
COMPREHENSIVE LIST OF PROTECTION, MITIGATION, AND ENHANCEMENT MEASURES BY STRUCTURE

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T.W. Sullivan Powerhouse

Tier 1 (Pre-license: present to January 2005)

Environmental Measures

- Implement shutdown priorities for TWS turbine units to maintain good FGE during periods of low flow based on forebay modeling.
- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon spillway construction in 2005.
- Remove selected bars at headgate trashracks for adult downstream passage

Design Work / Modeling/Analysis

- Model TWS forebay, including changes for the guide wall and siphon spillway; model runs to include a range of forebay flows, selected unit(s) offline, and trash rack spacing.
- Small scale model and preliminary design of siphon bypass to support construction in 2005.
- Design trash rack cleaning system to support construction in 2005.
- Clarify how rights for the additional water needed for siphon spillway operations will be addressed.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards.

Monitoring and Evaluations

- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Assess presence and condition of juvenile lamprey guided through the TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing)
- Perform turbine index/efficiency testing for replaced runners (2 per year), and operate replaced and existing runners within peak efficiency band based on consultation with fish agencies. Mortality test new runner design as applicable.

Tier 2 (Planned post-license measures; final testing to be completed by 2008)

Environmental Measures

- Siphon bypass constructed (2005)
- Implement PIT technology in the siphon bypass.
- Trash rack cleaning system installed (2005).

- Modify Unit 12 and 13 discharges to reduce predator-holding areas after implementation of siphon bypass. (2006)
- Modify or replace existing bypass outfall in tailrace to meet NMFS criteria (2006).
- Implement TWS shutdown program when fish protection facilities are not functioning per agreed upon schedule. (greater than two weeks during July 1 to August 1 period)
- If Unit 1 off-line for >24hrs during upstream salmonid migration period, then remaining turbine units will be shutdown. (2005 and on)
- Rehabilitate the Unit 13 fish bypass system by adding a new large volume PIT tag detection system in the bypass discharge to allow PIT tag interrogation in both bypass and sampling mode.

Monitoring and Evaluations

- Evaluate FGE and mortality and injury for smolts (spring Chinook, steelhead), salmonid fry, and juvenile lamprey after implementation of siphon bypass, to include effects of turbine passage and turbine shutdown sequencing on fish guidance. Three years of fall and spring testing starting in the fall of 2005 or 2006.
- Verify the effects of turbine selected unit shutdown on fish guidance FGE during low flow periods to verify physical model results.
- Assess the detection efficiency of new PIT tag detector installed in Unit 13 bypass (non-sampling route) and siphon spillway.
- Assess upstream passage effectiveness for adult salmonids (project-level evaluation) after siphon bypass is installed and operating.
- Hydraulic evaluation of tailrace after modification of Units 12 & 13 discharge.
- Assess the injury and mortality of downstream migrant steelhead kelts and adult lamprey after passage through the siphon bypass.
- Upgrade the avian predation deterrents in place at the T.W. Sullivan tailrace and install avian deterrents in the forebay after the siphon spillway has been installed.

Tier 3

(Post-license measures to be implemented if Tier 2 measures are insufficient. Order of implementation, assessing the protective value to the resource, and a review of additional options would occur before construction. Implementation would begin no later than 2009 unless agreed to by the FTC.)

Environmental Measures

- Assess injury/mortality of fish caused at TWS's 2-inch spaced trashracks, and implement new rack system if indicated as reducing mortality (wider/narrower bars, solid/perforated plate, angled/straight bars)

- Behavioral deterrent devices (strobe/acoustic)
- Eicher screen installed in Unit 12 and linked to Unit 13 bypass/evaluator, if the existing Eicher screen is favorable for juvenile lamprey passage.
- Other bypass structure/equipment upgrades as identified.

Monitoring and Evaluations

- Performance monitoring as needed for modifications made.

Tier 4 (This is an open-ended list of options in the event that Tier 3 measures are not sufficient to meet standards. This would begin not more than 10 years after the new license is finalized unless agreed to by the FTC.)

- Criteria Screening.
- Seasonal shutdowns during salmonid migration periods.
- Project decommissioning.
- Other options as determined.

Willamette Falls

Tier 1 (Pre-license: present to January 2005)

Environmental Measures

- Remove 150 feet of flashboards at the Falls apex no later than October 1 until controlled flow structure is installed at Falls apex.
- Place lamprey passage devices at the cap (minimum of 2) when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Provide "Wet Hole" egress.

Design Work / Modeling / Analysis

- Assess ladder entrance #1 for compliance with NMFS criteria. Consult with NMFS, USFWS and ODFW on action plan for ladder entrance #1.
- Assess constraints and begin design of a controlled flow structure at the Falls apex including use of an upstream CFD model. Capacity goal is 15,000 cfs.
- Convene lamprey expert group and design upstream lamprey research study for implementation in 2005.

Monitoring and Evaluations

- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.

- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing (2004).

Tier 2 (Planned post-license measures; final testing to be completed in 2009)

Environmental Measures

- Construct controlled flow structure at Falls apex and make minor downstream landing area improvements associated with the controlled flow structure (2006/7).
- Install avian predation deterrents below the horseshoe section of the Falls (2006).
- Begin implementing Willamette Falls fish ladder entrance #1 modifications, O&M task list and stranding plan (2006).
- Consult with FTC to implement new or improved (such as existing ladders) passage for adult lamprey passage as indicated by research efforts.

Monitoring and Evaluations

- Provide funding for Lamprey research effort at the Falls (2 year effort beginning in 2005)
- Small scale physical model to aid design of controlled flow structure at apex of Falls and to assess/avoid potential adverse impacts that the controlled-flow structure might have on the ability of fish to locate the Willamette Falls fish ladder entrances. (Note: model construction in 2005). Include potential impacts on water quality (i.e. TDG, etc.) from the installation of the controlled-flow structure.
- Perform injury and mortality testing (for juvenile downstream migrants) through the controlled-flow structure.
- Assess the efficiency of the avian predation-deterrents installed below the Falls.
- Assess the fate of downstream migrant steelhead kelts and adult salmonids classified as fallback at the controlled-flow structure.
- Evaluate the controlled-flow structure to ensure it is not compromising the adult guidance to the adult fish ladder entrances.
- Assess overall upstream passage effectiveness for lamprey including benefits of trap-and-haul and/or capture-and-haul program.

Tier 3 (Post-license measures to be implemented if Tier 2 measures are insufficient. Order of implementation, assessing the protective value to the resource, and a search for additional options would occur before construction. Implementation would begin no later than 2010 unless agreed to by the FTC.)

Environmental Measures

- Major modifications to the downstream/landing area of the flow-control structure(s) to improve juvenile survival.

Monitoring and Evaluations

- Evaluate any operational changes made in Tier 3.
- Evaluate physical changes made at the Falls or controlled-flow structure(s).

Tier 4 (This is an open-ended list of options in the event that Tier 3 measures are not sufficient to meet standards. (not more than 10 years after the new license is finalized unless agreed to by the FTC.)

- Decommissioning and removal of the dam on Willamette Falls.
- Additional structure at Falls if improved juvenile passage is still needed at the Falls.
- Other options as determined.

APPENDIX B.
IMPLEMENTATION TIMELINE

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The Parties agree to the following implementation timeline associated with the T.W. Sullivan and Willamette Falls PM&E's. The intent of the following timeline is to complement Section III (PM&E's for T.W. Sullivan and Willamette Falls).

Pre License Issuance

2003

T.W. Sullivan

- Model TWS forebay, including changes for the guide wall and siphon spillway; model runs to include a range of forebay flows, selected unit(s) offline, and wider trashrack spacing.
- Assess Unit 13 bypass outfall relative to NMFS velocity impact standards
- Clarify how rights for the additional water needed for siphon spillway operations will be addressed.
- Implement shutdown priorities for TWS turbine units to maintain good FGE during periods of low flow based on forebay modeling.

Willamette Falls

- Assess constraints for a control flow structure designed for 15,000 cfs as desired capacity
- Pilot study (fall 2003) to demonstrate the feasibility of evaluating juvenile salmonid survival through a controlled flow structure at the Falls apex.
- Place lamprey passage devices at the cap when flashboards are installed.
- Notch flashboards to provide flow into stranding pools below the dam and Falls.
- Assess fish ladder entrance #1 for NMFS entrance criteria

2004

T.W. Sullivan

- Modify trashracks in front of Units 1, 2 and 3 and modify forebay guidewall to support siphon spillway construction in 2005.
- Remove selected bars for headgate trashracks for adult downstream passage.
- Small scale model and preliminary design of siphon bypass to support construction in 2005.
- Design trash rack cleaning system to support construction in 2005.
- Determine impingement rate of lamprey at the Unit 13 Eicher screen.
- Assess presence and condition of salmonid fry guided through TWS fish bypass.
- Verify performance of Unit 13 bypass improvements (delay and mortality testing).
- Perform turbine index/efficiency testing for replaced runners (2 per year), and

operate replaced and existing runners within 1% of peak efficiency based on consultation with FTC. Mortality test new runner design as applicable.

Willamette Falls

- Remove 150 feet of flashboards at the Falls apex NLT October 1 until controlled flow structure is installed at Falls apex.
- CFD modeling of Controlled Flow Structure upstream flow field extent.
- Provide "Wet Hole" egress.
- Preliminary assessment of lamprey passage devices installed with the flashboards (2004). Results will inform subsequent design of lamprey passage devices in consultation with the FTC and lamprey research group for field testing.

Post Final License

2005

T.W. Sullivan

- Complete design and construct siphon bypass, to include any additional forebay modifications, not completed in 2004, identified by physical forebay model.
- If technically possible implement and assess PIT technology in the siphon bypass to improve monitoring and evaluation capabilities. (ongoing based on technical capabilities)
- Trash rack cleaning system installed. (2005/2006)
- Selected headgate trashrack bars removed for adult downstream passage.
- Implement TWS shutdown program when fish protection facilities are not functioning per agreed upon schedule. (greater than two weeks during July 1 to August 1 period)
- Evaluate FGE and mortality and injury for smolts (spring Chinook, steelhead), fry and juvenile lamprey after implementation of siphon bypass, to include effects of turbine passage and turbine shutdown sequencing on fish guidance. Three years of fall and spring testing starting in the fall of 2005 or 2006.
- If Unit 1 off-line for >24hrs during upstream salmonid migration period, then remaining turbine units will be shutdown. (2005 and on)

Willamette Falls

- Begin design of Controlled Flow Structure, to include small-scale physical model (2005). Physical modeling will assess methods for preventing contribution to high TDG.
- Assess overall upstream passage effectiveness for lamprey including benefits of trap-and-haul and/or capture-and-haul program.

- Begin implementing Willamette Falls fish ladder O&M task list and stranding plan.

2006

T.W. Sullivan

- Modify Unit 12 and 13 discharge to reduce predator-holding areas after implementation of siphon bypass.
- Modify or replace existing bypass outfall in tailrace.
- Upgrade avian predation deterrents in T.W. Sullivan tailrace and
- Observational data collection on juvenile lamprey, and as new technology becomes proven, participate in implementing juvenile lamprey bypass efficiency studies.
- Assess downstream migrant steelhead kelts after passage through the siphon bypass.

Willamette Falls

- Install controlled flow structure at Falls Apex. (2006/2007)
- Install avian predation deterrents in horseshoe area of Falls (2006-2007)
- Initiate injury and mortality testing through the controlled-flow structure at the Falls.
- Assess downstream migrant steelhead kelts and adult salmonids classified as fallback at the controlled-flow structure.
- Evaluate the controlled-flow structure to ensure it is not compromising the adult guidance to the adult fish ladder entrances.
- Evaluate the impacts on water quality (i.e. TDG, etc.) from the operation of the controlled-flow structure.

2007

T.W. Sullivan

- Upgrade Unit 13 fish bypass system by adding and assessing a new large volume PIT tag detection system in the bypass discharge to allow PIT tag interrogation in both bypass and sampling mode. This will improve monitoring and evaluation capabilities.
- Hydraulic evaluation of tailrace after modification of Units 12 & 13 discharge and siphon bypass installation.
- Verify the effects of turbine selected unit shutdown on fish guidance FGE during low flow periods to verify physical model results.

Willamette Falls

- Assess the effectiveness of the avian predation-deterrents installed below the Falls and in the T.W. Sullivan tailrace. (2007/8)

2008

Willamette Falls

- Based on performance testing of controlled flow structure, make minor modifications to downstream landing area to meet standards as needed. Test after modification(s)

2009

Willamette Falls

Evaluate modifications made associated with control flow structure2010 (Note: Exact implementation timeline of the following items will be determined as their need is identified. Post modification testing performed by this time will provide information to help identify which measures would be meaningful. Anticipated timeframe is 3-5 years.)

T.W. Sullivan

- Assess injury/mortality of fish caused at TWS's 2-inch spaced trashracks, implement new rack system if indicated as reducing mortality (wider/narrower bars, solid/perforated plate, angled/straight bars)
- Behavioral deterrent devices (strobe/acoustic)
- Eicher screen installed in Unit 12 and linked to Unit 13 bypass/evaluator.
- "Fish Friendly" runner replacements on all/selected Units.
- Other bypass structure/equipment upgrades as identified.
- Performance monitoring as needed for modifications made.

Willamette Falls

- Assess options associated with control flow structure (ie, major modification to landing area, additional structure locations)

2015

- Re-engage Parties to determine next step

APPENDIX C.
The Willamette Falls Project: Adult Pacific Lamprey Passage Plan

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Adult Lamprey Passage Plan

Study outline for Adult Lamprey Issues At Willamette Falls

Evaluate effectiveness of adult lamprey passage through project area:

PGE shall fund a research effort on Pacific lamprey passage and behavior consistent with the below. PGE shall initiate development of this research effort in 2004 with the intent for research to begin in 2005.

Proposed Main Objectives:

1. Determine specific passage routes of adult Pacific lamprey moving upstream through the project; and identify potential passage problems including but not necessarily limited to:
   - The Falls
   - The dam with and without flashboards
   - The Willamette Falls fishway.
2. Determine passage effectiveness at lamprey passage structures, including ramps, the controlled flow structure, the Willamette Falls fish ladder, flashboard notches, or any other passageway constructed
3. Determine the feasibility and applicability of a capture and haul program as a means to improve/ensure adequate passage.

Potential Proposed Methodologies And Other Objectives:

1. Implant lamprey captured throughout the project area with radio tags (100 to 150 per year to ensure adequate sample size for subsequent evaluations); release fish in immediate vicinity of capture;

2. Track radio-tagged lamprey to corroborate estimates of the proportion of lamprey passing by route (ladder, Falls, capture-and-haul), and distribution of lamprey across the Falls. Set up antennas and receivers so that passage routes can be determined at a relatively fine scale, and so that lamprey negotiating the Falls but not the dam/cap can be identified;

3. Estimate overall success of passage as the proportion of adult lamprey reaching a pre-determined starting point (e.g., ladder entrance, and a specific area below the Falls assumed to be a point beyond which the individual is attempting to move past the Falls) that successfully pass upstream;

4. Evaluate the sequential effectiveness of lamprey attempting to pass first over the bedrock falls and subsequently over the dam/flashboards atop the Falls, to estimate "unimpaired" passage effectiveness for the project area (see Figure C-1). Results of this evaluation of "unimpaired" effectiveness may be used to refine the preliminary goal for lamprey passage.
5. Use information collected to determine where passage impediments exist and therefore where passage could be improved;
6. Develop plan for specific improvements for PGE to implement and subsequently evaluate.

Commitments from the Applicant

It is estimated that this study will take two years. Annual budgets for the proposed work will depend on the level of effort expended to capture and mark lamprey, the number of lamprey radio tagged, and the precision used in determining locations of radio-tagged lamprey. For reference, the estimated cost for the first year is likely to range from a minimum of $140,000 to a maximum of $190,000.

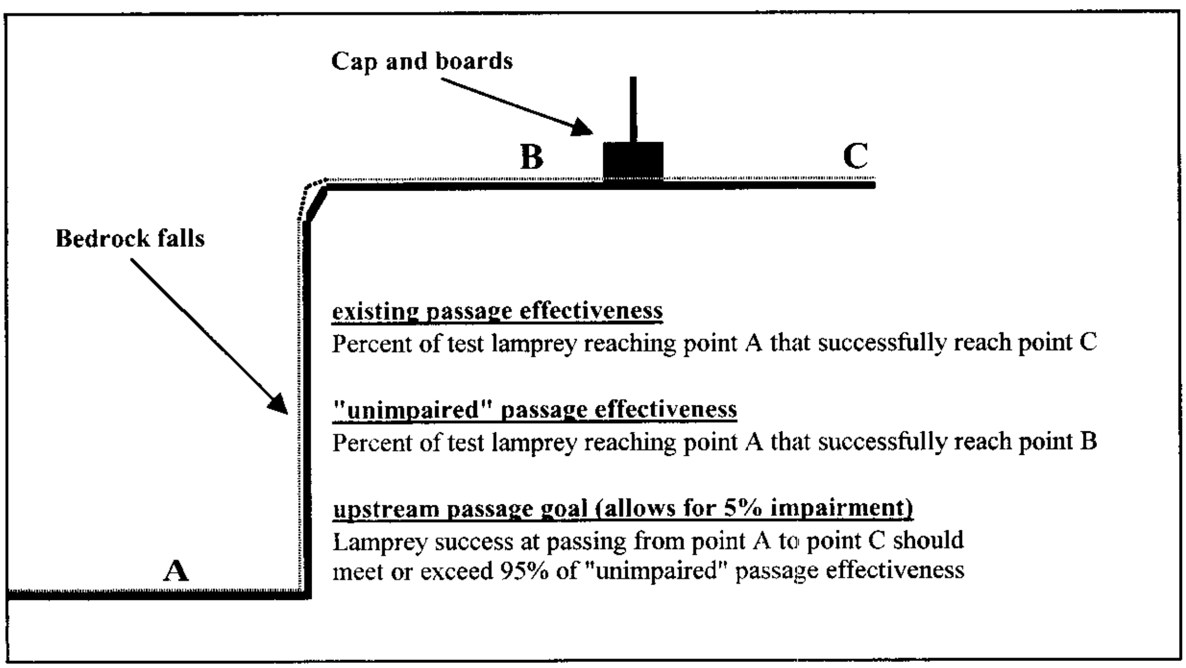

Figure C-1. Conceptual approach to developing an upstream passage goal for Pacific Lamprey at Willamette Falls.

APPENDIX D.
WILLAMETTE FALLS CONTROLLED FLOW STRUCTURE DESIGN AND PROPOSED OPERATIONS

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Objectives:

1. The purpose of a controlled flow structure at the apex of the Falls is to focus river flow that would otherwise be distributed around the crest of Willamette Falls to the apex (most upstream location) which is more conducive to safe downstream passage.

2. The controlled flow structure design and its operation will change the location where the flow actually goes over the Falls (within flows that it can control). It is not intended to significantly change the amount of water that goes over the Falls.

3. Assuming an obermeyer type structure is used, opening the structure to pass more flow involves lowering the obermeyer and closing the structure to pass less flow involves raising the obermeyer. A muliti-segment structure is anticipated with a deeper obermeyer in the center and shallower obermeyers on either side (dependent on bathymetry).

4. Operation of the structure is based upon upstream river elevation, which changes as river flow changes.

5. The design maximum capacity of the controlled flow structure is based on a top elevation of 54.5", which is a 6" veil flow over the top of the flashboards.

6. The controlled flow structure will influence approximately 25,000* cfs of river flow based on a 6" veil spill over the dam and flashboards, distributed as follows:
   - Sullivan, BHPC, fish ladder, and 6" veil flow ~ 10,000cfs;
   - Controlled flow structure ~ 15,000* cfs.

*Downstream migrants are assumed to avoid a veil flow less than or equal to 6".

7. Improved upstream passage of adult lamprey will be a design element of the controlled flow structure (either integrated into the structure or located adjacent to it). The design and operation of the controlled flow structure will enhance upstream passage conditions for adult lamprey to the extent practicable.

*Actual flow amount will be determined through the design process described in section B,

Design process of a Controlled Flow Structure at the Falls apex:

PGE shall implement the following steps, in consultation with participants, relative to the sizing and design of the controlled flow structure at the apex of the Falls:

1. Design capacity objective of the structure is 15,000 cfs based on an elevation of 54.5'.
2. Engineering analysis of any hydraulic or physical constraints for a 15,000 cfs structure at the Falls apex. (2003)
3. If constrained, determine the maximum design capacity for a structure at Falls apex.
4. CFD model the resultant structure flow capacity to assess upstream flow fields (2004)
5. Small scale physical model to aid in design and minimize impacts (ie, downstream migrants, fish ladder entrances, total dissolved gas). 2005/2006
6. Structure construction in 2006/2007

Proposed Controlled Flow Structure Operational Concept:

PGE, in consultation with the FTC, will develop an operational plan for the controlled flow structure and T.W. Sullivan powerhouse that takes into account the objectives in Section A and the need to maintain river flow to those measures implemented around the Falls (i.e., notches in flashboards, lamprey ramps, future lamprey passage devices). The following description is conceptual only. Specific operating details will be developed in consultation with the FTC in the operational plan developed under item 12 of *Juvenile salmonids*, section 3.3.1.1.

For the purposes of discussion, description of the proposed operation of the controlled flow structure starts with river flows decreasing through the spring and all T.W. Sullivan units and fish bypass systems operating. Flashboards are not in place (typically having been washed out during winter high flows), and the controlled flow structure is fully open (lowered) but there is sufficient flow in the river such that upstream elevation is >52.5' at the dam.

The structure will remain fully open (lowered) at river elevations > 52.5' or elevation required for full T.W. Sullivan powerhouse operation (turbine units and fish bypass systems), whichever is higher. This is referred to as the "pre-flashboard level". This is consistent with Objectives 1 and 2.

It is understood that prior to flashboard installation, elevations above 52.5' result in veil flows in excess of 6"; however, this is preferred over diverting water from the powerhouse to the Falls as a result of turbine unit shutdowns to maintain powerhouse fish bypass systems operational.

As river flow continues to decrease and upstream elevation decreases to the pre-flashboard level, the structure will be incrementally closed (raised) as needed to maintain upstream elevation. As flow varies, the exact position of the structure will be adjusted as needed.

PGE shall install flashboards at the Falls when considered safe to do so, taking into account that the structure may allow installation of flashboards earlier that historically possible due to the structure reducing flow over the concrete dam.

With flashboards installed (this includes the required areas of flashboard notches to provide stranding pool flow), the structure will be operated to maintain upstream elevation between 53' and 54.5'. The 53' minimum elevation ensures adequate T.W. Sullivan forebay levels for fish bypass system operation, and the 54.5' maximum ensures a veil of no more than 6" of water flowing over the flashboards. While river flows are less than 25,000* cfs, if other water routes are in operation (ie, TWS, ladder, BHPC), the structure is passing all flow over the Falls (minus what is going through board seams and stranding flow notches).

As flows begin to increase in the fall/winter, the structure will be opened (lowered) to maintain upstream elevation between 53'-54.5'. At river flows approach 25,000 cfs, the structure will be at or near full open (lowered) and will remain in the full open position until the following spring when flows start to decrease.

APPENDIX E.
NMFS Criteria for Fish Ladder Entrances

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ANADROMOUS SALMONID PASSAGE FACILITY GUIDELINES AND CRITERIA

Developed by
National Marine Fisheries Service
Northwest Region
Portland, Oregon

[Selected Sections]

Section 5. Upstream Passage System Criteria

5.1 Fishway entrance design criteria

5.1.1 Description, purpose and rationale: The fishway entrance is composed of an entrance gate or slot, through which fishway attraction flow is discharged and through which fish enter the upstream passage facility, and is possibly the most critical component in the design of an upstream passage system. Placing a fishway entrance in the correct location(s), with optimal fishway entrance hydraulic characteristics and geometry are key design parameters that will allow a passage facility to provide a good route of passage throughout the design range of passage flows. The most important aspects of a fishway entrance design are: 1) location of the entrance; 2) shape and amount of flow emanating from the entrance; 3) approach channel immediately downstream of the entrance; and 4) flexibility in operating the entrance flow to accommodate variations in tailrace elevation, stream flow conditions and project operations.

5.1.2 The fishway entrance gate configuration and operation will vary based on site specific project operations and streamflow characteristics. Entrance gates are usually operated in either a fully open or fully closed position, with the operating entrance dependent on tailrace flow characteristics. Sites with limited tailwater fluctuation may not require an entrance gate to regulate entrance head. Adjustable weir gates that rise and fall with tailwater elevation may also be used to regulate fishway entrance head. Other sites may accommodate maintaining proper entrance head by regulating auxiliary water flow through a fixed geometry entrance gate.

5.1.3 Fishway entrances shall be located at points where fish can easily locate the attraction flow and enter the fishway. When choosing an entrance location, high velocity and turbulent zones in a powerhouse or spillway tailrace should be avoided, in favor of relatively tranquil zones adjacent to theses areas. At locations where the tailrace is wide, shallow and turbulent, excavation to create a deeper, less turbulent holding zone adjacent to the fishway entrance(s) may be required.

5.1.4 Attraction flow from the fishway entrance should be between 5% and 10% of high design passage flows for streams with mean annual discharges exceeding 1000 cfs. For smaller streams, where feasible larger percentages (up to 100%) of streamflow should be used. Generally speaking, the higher percentage of total river flow used for attraction into the fishway, the more effective the facility will be in providing upstream passage.

5.1.5 The fishway entrance head (hydraulic drop) shall be maintained between 1 to 1.5 feet.

5.1.6 The minimum fishway entrance width shall be four feet, and the entrance depth at least six feet, although the shape of the entrance is dependant on attraction flow requirements. (See Section 11 requirements for mainstem Columbia and Snake River).

5.1.7 If the site has a multiple zones where fish accumulate, each tailrace accumulation location will require a minimum of one entrance. For long powerhouses, additional entrances are required. Since tailrace hydraulic conditions usually change with project operations and hydrologic events, it is often necessary to provide two or more fishway entrances.

5.1.8 Closure gates shall be provided to provide flow to the appropriate entrance gate, and shall not conflict with any potential path of fish migration. Fishway entrances shall be closed by downward-closing slide gates, unless otherwise approved by NOAA Fisheries.

5.1.9 Fishway entrances can be either adjustable submerged weirs, vertical slot, or orifices, provided that the hydraulic requirements specified in 5.1.3, 5.1.4 and 5.1.5 are achieved. It is noted that some non-salmonid species will avoid use of orifices.

5.1.10 The desired entrance weir and/or slot discharge jet hydraulic condition is streaming, not plunging, for submerged weir discharges. Plunging flow induces jumping and can cause injuries, and presents hydraulic conditions which some species may not pass.

5.1.11 In general, low flow entrances should be oriented more or less perpendicular to streamflow, and high flow entrances should be oriented more or less parallel to streamflow. Site specific assessments are required.

5.1.12 The fishway entrance design shall include staff gages to allow for a simple determination of whether entrance head criterion (see 5.1.4) is being met. Staff gages shall be located in the entrance pool and in the tailwater just outside of the fishway entrance in a area visible from an easy point of access. Care should be taken in the design when locating staff gages, avoiding turbulent areas and areas where velocity is increasing in front of the fishway entrance. Gages should be readily accessible to facilitate in-season cleaning.

APPENDIX E.
O&M Task List at Willamette Falls Ladder

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O&M Task List at Willamette Falls Ladder:

The following list is from the table *Anticipated Costs of Willamette Falls Fish Ladder (5/5/03)* developed by ODFW. Tasks associated with ODFW personnel (ie, labor, potable water, sanitary facilities) and fish management (ie, counting and trapping stations, and aesthetics) will remain the responsibility of ODFW. PGE shall assume its tasks within six months of the new license becoming final.

PGE O&M ITEMS

ANNUAL OPERATIONS

Power

ANNUAL MAINTENANCE

Cranes-routine exercising and minor maintenance
Entrance One Crane
Chain Hoist over gates 1b, 1c
Chain Hoist @ gate 1d
Jib Crane - Fishway One
Jib Crane - #1 on 67' Deck
East Jib Crane on 67' Deck
South Jib Crane on 67' Deck
Sealion barrier frame hoist @ Entrance
Inspection & maintenance
Misc. Repairs
Contract annual service

ELECTRIC PUMPS
Entrance one dewatering pump
Entrance two dewatering pump
Entrance three dewatering pump
Valve pit dewatering pump
Lower count room sump pump
Inspection & maintenance

HYDRAULIC GATE OPERATORS
Entrance one gates 1b, 1c
Entrance two
Entrance three
Entrance four
Water intake gates 1-12
Inspection & maintenance

ELECTRIC GATE OPERATORS
Entrance One gate 1d
Fishway entrance gate North
Fishway entrance gate South
Entrance Two Aux. Water valve
Entrance Three Aux. Water valve
Pool 48 makeup water valve.
Velocity Gate
Inspection & maintenance

PLC & COMPUTER EQUIP.
Inspection & maintenance

Lighting
Inspection & maintenance

BASCULE BRIDGE
Inspection & maintenance

OBERMEYER WEIR
Inspection & maintenance

TRASH RAKE
Inspection & maintenance

PAINTING
Inspection & maintenance

STAFF GAUGE (CLEANING AND MAINT.)
Inspection & maintenance

LEVEL TRANSDUCERS
Wet well & debris cleaning

WATERTIGHT BULKHEADS
Inspection & maintenance

DEBRIS REMOVAL
Debris removal (head racks)
Debris removal contract (head racks)
Fishways & Aux. Channels

ODFW O&M ITEMS

ANNUAL OPERATIONS

Labor, Phone, Contract annual service

ANNUAL MAINTENANCE

ELECTRIC PUMPS
Misc. Repairs year 2002

WINDOW WASH UNIT
Inspection & maintenance

VERTICAL CROWDER
Inspection & maintenance

HORIZONTAL CROWDER
Inspection & maintenance
light box

VIDEO EQUIPMENT
Inspection & maintenance

PAINTING
Aesthetic

HVAC

ELEVATOR
O&M (contract), inspect., license

SMOKE & FIRE ALARM
O&M (contract), fire extinguishers

Potable Water system
Inspection & maintenance

Sanitary Facilities
Inspection & maintenance

Lower countroom and trap

KOWASKI MULE

STORAGE CONTAINER

APPENDIX F.
LIFE HISTORY AND HABITAT REQUIREMENTS OF LISTED, PROPOSED, AND CANDIDATE FISH SPECIES

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Spring Chinook salmon

Life history

Chinook salmon exhibit life history variation in the length of their fresh- and saltwater residency and in the timing of their upstream and downstream migrations (Healey 1991). Chinook salmon have genetically distinct runs differentiated by the timing of spawning migration, stage of sexual maturity when entering fresh water, timing of juvenile or smolt outmigration, and other characteristics (Moyle et al. 1989). Spring (or "stream-type") Chinook typically spend up to one year rearing in fresh water before migrating to sea, perform extensive offshore migrations, and return to their natal river in the spring or summer, several months prior to spawning (Moyle et al. 1989, Healey 1991).

Life history characteristics and allozyme data clearly differentiate spring Chinook salmon spawning upstream of Willamette Falls from those spawning in the Columbia River basin and the rest of Oregon (Schreck et al. 1986, Utter et al. 1989, Waples et al. 1991, Marshall 1993, all as cited in Kostow 1995). Distinctive life history characteristics of Upper Willamette River spring Chinook include early entry of upstream-migrating adults into the lower Columbia River, and an ocean distribution that extends into the north Pacific, unlike other Columbia River basin spring Chinook. Upper Willamette River spring Chinook salmon primarily migrate downstream as yearlings, although a small percentage outmigrate as subyearlings, a life history trait common for Chinook salmon in coastal streams (Kostow 1995).

Adult spring Chinook begin entering the mouth of the Columbia River from the Pacific Ocean in early January, with numbers peaking in late March. Most fish are four to five years old when returning to spawn (PGE and Smurfit 1998). Sub-adult (2-year-old) male spring Chinook, called jacks,may also return to fresh water. Jacks usually are less than 22 inches in length. Adult fish begin entering the Willamette River in early February, with angler catch peaking in April. Most spring Chinook are counted passing Willamette Falls from mid-April to mid-June, with peak movement occurring at the fish ladder in May.

Migrating adults continue on to upper Willamette River basin tributaries such as the North and South Santiam and McKenzie rivers, remaining in the rivers over the summer months until September and October when spawning occurs. This life history strategy can make holding adults vulnerable to increases in water temperatures and reductions in flows that may increase their susceptibility to disease or predation. Deep, cold pools are thus an important habitat component for adults as they oversummer prior to spawning in the fall. Large concentrations of adult spring Chinook oversummer below Willamette Falls in the immediate vicinity as well as the whole lower river. Upstream movements of adult fish over the Willamette Falls fish ladder may be triggered by flow, temperature, or time of year. Under ideal passage conditions, as many as 2,000 spring Chinook adults may pass over Willamette Falls fish ladder in a single day. No counts exist for pre-ladder conditions, but it is widely believed that escapement over the Falls was far lower (PGE 1997).

Spring Chinook freshwater residency is highly variable. Wild spring Chinook smolts outmigrate from the Willamette River primarily from late September through May (PGE and Smurfit 1998). Outmigration is bimodal, with peaks occurring both in the fall and spring. The smallest numbers outmigrate from June through September. About one-third of the hatchery spring Chinook are released in fall (November) as subyearlings and about two-thirds in March as larger yearlings (PGE and Smurfit 1998). Peak outmigration for hatchery smolts thus occurs in March, with a smaller peak in the fall.

Adult Migration Habitat Requirements

Adult spring Chinook require large, deep pools with moderate flows for summer holding during their upstream migration. Marcotte (1984) reported that suitability of pools declines at depths less than 7.9 ft (2.4 m) and that optimal water velocities in holding habitat range from 0.5 to 1.2 ft/s (15 to 37 cm/s). In the John Day River, Oregon, Chinook adults usually hold in pools deeper than 4.9 ft (1.5 m) that have cover from undercut banks, overhanging vegetation, boulders, or woody debris (Lindsay et al. 1986). Adult Chinook salmon require water deeper than 0.79 ft (24 cm) and water velocities less than 8 ft/s (2.44 m/s) for successful upstream migration (Thompson 1972, as cited in Bjornn and Reiser 1991).

Spawning Habitat Requirements

Most Chinook salmon spawn in the mainstem and lower reaches of large rivers or tributaries, although spawning has been observed over a broad range of stream sizes, from small tributaries 2–3 m (6.6–9.8 ft) in width (Vronskiy 1972) to large mainstem rivers (Healey 1991). Chinook prefer low-gradient (<3%) reaches for spawning and rearing but will occasionally use higher-gradient areas (Kostow 1995). Spawning site (redd) locations are controlled primarily by hydraulic conditions dictated by streambed topography (Burner 1951). Redds are typically located near pool tailouts (i.e., heads of riffles), where high concentrations of intragravel dissolved oxygen are available. Redds are typically 111–189 ft^2 [10–17 m^2] in size, although they can range from 6–500 ft^2 [0.5 to 45 m^2] (Healey 1991).

Fry and Juvenile Habitat Requirements

Extensive use of mainstem reaches and estuaries as rearing habitat generally distinguishes juvenile Chinook salmon from coho salmon, steelhead, and sea-run coastal cutthroat trout. Early rearing typically occurs in mainstem areas and reaches of large tributaries that have relatively low gradients (Nicholas and Hankin 1989).

Following emergence, fry occupy low velocity, shallow areas near stream margins, including backwater eddies and areas associated with bank cover such as large woody debris (LWD) (Lister and Genoe 1970, Everest and Chapman 1972, McCain 1992). As fry grow, they move into higher velocity water. Because Chinook fry tend to be larger than coho fry upon emergence, they may tend to use areas with higher water velocities than coho (Murphy et al. 1989, Healy 1991). In general, as fry increase in size, they move to higher velocity, deeper areas further from stream banks (Hillman et al. 1987, Everest and Chapman 1972, Lister and Genoe 1970).

Juvenile Chinook salmon often disperse downstream in the fall from tributaries into mainstem reaches and take up residence in deep pools with LWD, interstitial habitat provided by boulder and rubble substrates, or along river margins (Swales et al. 1986, Healey 1991, Levings and Lauzier 1991). During higher flow events, juveniles have been observed to move to deeper pools, and they may also move laterally in search of velocity refuge (Shirvell 1994, Steward and Bjornn 1987).

Fall Chinook salmon

Life History

Fall Chinook salmon have a similar life history to spring Chinook salmon, although fall Chinook typically rear for a shorter period of time in fresh water (Nicholas and Hankin 1989). Fall (or "ocean-type") Chinook migrate to sea during their first year of life—typically within three months after their emergence from spawning gravels—spend most of their ocean life in coastal waters, and return to their natal river in the fall, a few days or weeks before spawning (Moyle et al. 1989, Healey 1991). Fall Chinook adult fish passage at Willamette Falls is from mid-August through late September, with peak passage from early to mid-September (Appendix H). Spawning occurs primarily from late September through early October (PGE and Smurfit 1998). Incubation occurs throughout the fall and winter with sac-fry emergence sometime from December to February. Fall Chinook smolts migrate quickly to the ocean as sub-yearlings, spending little time in freshwater. The peak of fall Chinook downstream migration is from May through July. Fall Chinook smolts migrate when water temperatures are warming up and the fish are small, in comparison to spring Chinook and steelhead downstream migrants. The combination of warm water and small body size make fall Chinook very susceptible to predation.

Adult Migration and Spawning Habitat Requirements

Fall Chinook salmon display similar habitat preferences to spring Chinook salmon, although they tend to be larger and, therefore, have slightly different habitat preferences. Like spring Chinook, fall Chinook tend to spawn in the mainstem and lower reaches of major tributaries, though often in deeper water, and in larger substrates than spring Chinook (Burner 1951, Healy 1991).

Fry and Juvenile Habitat Requirements

Following emergence in the spring, juvenile fall Chinook occupy backwater and stream margin habitat where there is slow shallow water and refuge from high flows. They have often been observed to school in groups of 20 to 40 individuals. Young fry have also been observed to use pool margins and pool tails associated with bedrock obstructions, rootwads, and overhanging banks. Juvenile Chinook appear to prefer deep, downstream portions of pool heads where velocity is lowest (Reedy 1995). Overwintering habitat typically is not used by fall Chinook, since they tend to outmigrate to the ocean in the spring or summer following emergence.

Coho salmon

Life History

Unlike Chinook salmon and steelhead, coho salmon do not appear to have genetically distinct, temporally segregated runs (Moyle et al. 1989). After attaining sexual maturity at about 2 years at sea, adult coho migrate to the vicinity of their natal stream during late summer and fall (Sandercock 1991). Adult coho salmon pass over Willamette Falls from August through December, with peak passage occurring in September.

In the Willamette River spawning occurs from September through December with peak spawning occurring in October and November (Appendix H). Females select a nest site after arriving on the spawning ground and defend the area against other females. Redd construction behavior is similar to that displayed by other salmonid species, with the female excavating a depression in the gravel by turning on her side and using her body and tail to displace the gravel downstream. Juveniles rear for approximately one year before outmigrating as smolts from March through June. Peak outmigration of smolts occurs in late May (PGE and Smurfit 1998).

Spawning Habitat Requirements

Redds are typically located in the transitional area at the downstream end (or "tail") of pools and the upstream end of riffles, where the water changes from a smooth to a turbulent flow (Briggs 1953, Stuart 1953). Flow tends to intrude into gravels in these sites, resulting in good intragravel flow and smaller amounts of fine sediment (Platts et al. 1979).

Fry and Juvenile Habitat Requirements

Within a few days after emergence, coho fry generally disperse upstream and downstream looking for suitable rearing habitat. Fry tend to aggregate in backwaters, side channels, stream margins, and other low velocity areas of the stream, especially where there is lower light intensity and overhead cover (Nickelson et al. 1992, Ruggles 1966). During early summer, fry are often found in shallow lateral habitat, that provide cover and low water velocities (Nickelson et al. 1992, Shirvell 1990). As fry increase in size, preferred water depth and velocities used also increase, and the preferred distance from cover decreases (Dollof and Reeves 1990).

In the winter, as water temperatures decline and flows increase, feeding and other activity is reduced and growth is negligible (Shapovalov and Taft 1954, Bell 2001). Studies have shown that deep pools with substantial cover in the form of LWD are the most important habitat elements used by juvenile coho in the winter (Cederholm et al. 1988, McMahon and Hartman 1989, Nickelson et al. 1992). Although juvenile coho use pools in all seasons, they show a preference for certain pool types in the winter that provide cover and the greatest refuge from high water velocities. Instream cover and areas of slow water are essential for protection against displacement by high flows, and for cover from predation (Bustard and Narver 1975a, Mason 1976, Hartman et al. 1982, Bell et al. 2001).

Pearcy and Fisher (1988) report that most variation in ocean mortality of coho salmon apparently occurs during the first few weeks of ocean residence. Near-shore conditions during late spring and early summer along the coasts of Washington, Oregon, and California may dramatically affect year-class strength (Scarnecchia 1981). Coho along the California and Oregon coasts may be more sensitive to ocean conditions as these areas lack the extensive bays, straits, and estuaries found in Washington and Alaska. These features may serve to buffer oceanographic effects (Bottom et al. 1986).

Winter steelhead

Life History

Steelhead return to spawn in their natal stream, usually in their fourth or fifth year of life, with males typically returning to freshwater earlier than females (Shapovalov and Taft 1954, Behnke 1992). Although the majority of steelhead populations are either primarily winter-run or summer-run, adults may enter spawning streams in almost any month of the year. Native winter steelhead pass over Willamette Falls from January to May, with peak passage occurring in March, and spawning occurs from March to early June (Appendix H).

Although most steelhead die after spawning, adults are capable of returning to the ocean and migrating back upstream to spawn in subsequent years, unlike most other Pacific salmon. Runs may include from 10–30% repeat spawners, the majority of which are females (Ward and Slaney 1988, Meehan and Bjornn 1991, Behnke 1992). Steelhead may migrate downstream to the ocean immediately following spawning or may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider et al. 1986).

Juveniles produced from naturally spawning fish in the Willamette River generally rear for two years in fresh water before outmigrating as smolts. Smolt outmigration occurs from early March to July, with peak outmigration occurring in April and May (PGE and Smurfit 1998).

Adult Migration Habitat Requirements

During their upstream migration, adult steelhead require deep pools for resting and holding (Puckett 1975, Roelofs 1983, as cited in Moyle et al. 1989). Steelhead need water with a minimum depth of 18 cm (7.1 in) and maximum velocity of 2.4 m/s (8 ft/s) for successful upstream migration (Thompson 1972, as cited in Everest et al. 1985). Relatively cool water temperatures (between 10 and 15°C [50 and 59°F]) are preferred by adults.

Spawning Habitat Requirements

Steelhead prefer areas of the stream with water depths of 18–137 cm (7–53 in) and velocities from 0.6 to 1.2 m/s (2.0–3.8 ft/s) for spawning (Moyle et al. 1989, Barnhart 1991). Pool tailouts or heads of riffles with well-oxygenated gravels are often selected as redd locations (Shapovalov and Taft 1954). Bell (1986) indicates that preferred temperatures for steelhead spawning range from 3.9 to 9.4°C (39.0 to 48.9°F). Steelhead may spawn in intermittent streams, but juveniles soon move to perennial streams after hatching (Moyle et al. 1989).

Incubation Habitat Requirements

Incubating eggs require dissolved oxygen, with optimal concentrations at or near saturation. Low dissolved oxygen increases the length of the incubation period and causes emergent fry to be smaller and weaker. Dissolved oxygen levels remaining below 2 ppm result in egg mortality (Barnhart 1991). Information available in the literature indicates that preferred incubation temperatures range from 9 to 11°C (48.20 to 51.80°F) (McEwan and Jackson 1996).

Fry and Juvenile Habitat Requirements

After emergence from spawning gravels in spring or early summer, steelhead fry move to shallow-water, low-velocity habitats such as stream margins and low-gradient riffles and may forage in open areas lacking instream cover (Hartman 1965, Everest et al. 1986, Fontaine 1988). As fry increase in size in late summer and fall, they increasingly use areas with cover and show a preference for higher-velocity, deeper mid-channel waters near the thalweg (Hartman 1965, Everest and Chapman 1972, Fontaine 1988). Older age classes of juvenile steelhead (age 1+ and older) occupy a wide range of hydraulic conditions. They prefer deeper water during the summer and have been observed to use deep pools near the thalweg with ample cover, as well as higher-velocity rapid and cascade habitats (Bisson et al. 1982, Bisson et al. 1988).

In winter, steelhead occur in pools, especially low-velocity deep pools with large rocky substrate or woody debris for cover, including backwater and dammed pools (Hartman 1965, Swales et al. 1986, Raleigh et al. 1984, Fontaine 1988). Age 1+ steelhead prefer water deeper than 45 cm (17.5 in), while age 0+ steelhead often occupy water less than 15 cm (5.9 in) deep and are rarely found at depths over about 60 cm (23.4 in). Juveniles often use the interstices between substrate particles as overwintering cover.

Little is known about steelhead use of ocean habitat, although changes in ocean conditions are important for explaining trends among Oregon coastal steelhead populations (Kostow 1995). Ward and Slaney (1988) suggested that increased ocean temperatures associated with El Niño events may decrease ocean survival. The magnitude of upwelling, which determines the amount of nutrients brought to the ocean surface and which is related to wind patterns, influences ocean productivity with significant effects on steelhead growth and survival (Barnhart 1991).

Summer steelhead

Life History

Passage of adult Skamania stock summer steelhead at Willamette Falls occurs primarily from April through June, with peak passage occurring from mid-May to late June (PGE and Smurfit 1998). Adult summer steelhead are collected at hatcheries upstream of Willamette Falls and are spawned from January through March (PGE and Smurfit 1998). Yearling smolts are released from mid-April through early May at hatcheries or acclimation ponds (PGE 1997).

Habitat Requirements

Summer steelhead have similar habitat requirements to winter steelhead (see Section 5.1.2), with the difference being run timing. Because summer steelhead migrate upstream and hold in rivers during the summer, holding temperatures are an important habitat requirement. Relatively cool water temperatures (between 10 and 15°C [50 and 59°F]) are preferred by adults. Cool water temperatures typically occur in deep pools, which summer steelhead use for resting and holding (Puckett 1975, Roelofs 1983, as cited in Moyle et al. 1989).

Bull trout

Life History and Habitat Requirements

Bull trout exhibit resident and migratory life history strategies. Resident bull trout complete their entire life cycle in the tributary streams in which they spawn and rear, whereas migratory bull trout spawn in tributary streams where juveniles rear for one to four years before migrating to either a lake (adfluvial), river (fluvial), or in certain coastal areas, to the sea (anadromous) where they mature (Rieman and McIntyre 1993). Resident and migratory forms may be found together and it is suspected that bull trout give rise to offspring that can exhibit either resident or migratory behavior (Rieman and McIntyre 1993). The diversity of life history strategies is considered important to the stability and persistence of bull trout populations.

Bull trout have more specific habitat requirements when compared to other salmonids (Rieman and McIntyre 1993). Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (USFWS 1998). Bull trout are found primarily in colder streams in association with complex forms of cover. Preferred spawning habitat consists of low gradient streams with loose, clean gravel and water temperatures of 5 to 9°C in late summer to early fall (Goetz 1989). Bull trout typically spawn from August to November during periods of decreasing water temperature. They normally reach sexual maturity in 4 to 7 years and live as long as 12 years. Growth varies by life history strategy: resident adults range from 150-300 millimeters (mm) in total length and migratory adults commonly reach 600 mm or more. Bull trout are opportunistic feeders with food habits determined by size and life history strategy. Though bull trout range widely in parts of Oregon, Washington, Idaho, and Montana, bull trout in the interior Columbia River basin presently occupy only 45% of the historical range (USFWS 1998).

Bull trout spawning in the McKenzie River usually occurs from early September to early October (Buchanan et al. 1997). Preferred spawning habitat consists of low gradient headwater streams or in mainstem areas with groundwater upwelling. In either case, bull trout need clean gravel and extremely cold water temperatures (5 to 9° C) to successfully spawn. Depending on water temperature, incubation is normally 100 to 145 days. After hatching in March and April, juveniles may remain in the substrate for several weeks or longer prior to emerging in spring (March-May). Time from egg deposition to emergence may surpass 200 days.

Bull trout can express three life-history patterns; resident, fluvial, and adfluvial. Resident bull trout remain within their cold natal headwater stream for their entire life. The McKenzie River is thought to have historically supported at least two fluvial populations (Buchanan et al. 1997). Fluvial bull trout migrate from their smaller natal stream to a larger river to rear, and then back to their natal stream to spawn. Adfluvial bull trout migrate from their smaller natal stream eventually entering a lake or reservoir to rear. After several years of growth, and with the onset of maturity, adfluvial bull trout retrace their earlier migration back to their natal stream to spawn. In some systems, distances migrated between natal spawning stream and downstream rearing areas can be very large, over 100 miles. Fluvial populations have been documented to become adfluvial when habitat conditions change (i.e. reservoir creation, Buchanan et al. 1997).

Bull trout in general are highly piscivorous, and growth varies depending on life history strategy and associated temperature and prey availability. Resident adults range from 150 to 300 mm total length and migratory adults, which typically rear where forage is more abundant and temperatures are warmer, commonly reach 600 mm or more (USFWS 1998). Bull trout normally reach sexual maturity in 4 to 7 years and may live as long as 12 years. Males often mature a year earlier than females. Egg numbers are high in females, ranging from 1,300 to 8,000 or more (Witty 1999, USFWS 1998). Because the different life history patterns can mix at spawning, and because of repeat spawning it is possible to have a spawning population composed of four or more different year classes.

Pacific lamprey

Life History

Little information is available regarding Pacific lamprey habitat requirements and timing of life history events specific to the Willamette River basin (Kostow 2002). This summary, therefore, draws upon a number of Pacific lamprey studies conducted in British Columbia, Oregon, and other areas. Although information on other lamprey species (river lamprey, western brook lamprey) that potentially could occur in the Willamette River is scant, it is assumed that life history and habitat requirements are similar to Pacific lamprey, as described here.

Pacific lamprey are an anadromous, parasitic fish species whose life history and spawning habits bear many resemblances to anadromous salmonids. Adult lamprey return from a 6-month to 2.5-year parasitic feeding period in the ocean to spawn in freshwater streams. The young lamprey hatch as eyeless, filter-feeding larvae called ammocoetes that burrow into fine sediments in low-velocity areas of the stream. After about 4–7 years of residing in these habitats, the ammocoetes undergo a 2-month metamorphosis into the eyed, toothed parasitic adult form. At this stage, they are referred to in the literature as "juveniles" or "young adults" as they are not yet sexually mature. After metamorphosis, the young adult lamprey migrate to the ocean where they feed parasitically on various host fish species before returning to freshwater where they become sexually mature adults and spawn.

Habitat Requirements

Adult upstream migration and spawning
During upstream migration, adult Pacific lamprey may spend several months in lakes or under stones and logs after returning to fresh water before they spawn (Beamish 1980, Scott and Crossman 1973, Moyle 2002). Where lamprey oversummer and overwinter prior to spawning, they are reported to use deep pools as habitat (R. J. Beamish, pers. comm., as cited in Close et al. 1995). Deep pools with coarse substrates or other cover, such as large woody debris (LWD), are believed important for both oversummering and overwintering adults (N. Armantrout and S. van de Wetering, pers. comm.; as cited in ULEP 1998). In two coastal Oregon streams, van de Wetering found that pool depths over 0.5 m (1.6 ft) appeared optimal (pers. comm., as cited in ULEP 1998). Adult lamprey have been observed to use interstitial spaces between coarse substrates as hiding cover (S. van de Wetering, pers. comm., as cited in ULEP 1998). They have also been reported to use LWD as cover (Moyle 2002), and have been found behind large (6–12-inch diameter) cobbles or debris accumulations in cascades or rapids (N. Armantrout, pers. comm., as cited in ULEP 1998). The presence of LWD may be important for creating the deep pools suitable for adult lamprey holding habitat.

Pacific lamprey may prefer medium to large streams over smaller streams for spawning. In Oregon, they are reported as appearing to prefer streams and habitat types similar to those used by coho salmon; i.e., low-gradient streams with high pool frequencies and high structural complexity (N. Armantrout, BLM, Eugene, pers. comm.; S. van de Wetering, pers. comm.; D. Close, pers. comm.; all as cited in ULEP 1998). Spawning is reported as usually occurring in low-gradient reaches of 3% gradient or less (Kan 1975; S. van de Wetering and N. Armantrout, pers. comm., as cited in ULEP 1998). Adult lamprey may migrate through higher gradient reaches and over obstacles such as cascades and waterfalls to reach areas with lower gradients more suitable for spawning.

Nests are most often constructed at the heads of riffles or the tail areas of pools (Scott and Crossman 1973; Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003, Kan 1975). In the Babine River system, British Columbia, spawning has been documented in gravel shoals (riffles) with consistent unidirectional flow (Farlinger and Beamish 1984). Although spawning may occur in gravel-sand substrates (Mattson 1949 as cited in Close et al. 1995,Scott and Crossman 1973, Kan 1975), a gravel component to sandy substrates appears to be preferred or required for nest construction (Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003).

Spawning occurs at depths ranging from approximately 0.4 to 1.0 m (1.3 to 3.3 ft) (Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003, Kan 1975). Most Pacific lamprey observed in the Babine River system spawned in riffles at depths of 0.3–1.0 m (1–3.3 ft), with spawning at depths up to 4 m (13.1 ft) near cut banks occurring only in small numbers (Farlinger and Beamish 1984). Nests are typically built in areas with flow velocities ranging from 0.5 to 1.0 m/s (1.6 to 3.3 ft/s) (Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003, Kan 1975).

W. Trush (pers. comm., 1997) reported Pacific lamprey spawning in association with spawning Chinook salmon, with the lampreys appearing to prefer slightly deeper (1.0 to 1.5 m [3.3 to 4.9 ft]) areas characterized by smaller substrates than used by the Chinook salmon.

Larval and post-metamorphosis

Larval lamprey burrow into mud and sand in areas with low water velocities. Optimal habitats for ammocoetes appear to be relatively stable substrates in shallow backwaters or eddies of pools (S. van de Wetering, pers. comm., as cited in ULEP 1998). Other features of optimal habitat for ammocoetes include areas with silt-clay substrates, available fine and coarse organic matter, low water velocity, shallow depth, and riparian cover (Beamish and Lowartz 1996, W. Trush, pers. comm., 1997). Emergent larvae appear to prefer mud substrate over sand or gravel (Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003). Because some current is necessary for bringing food to the ammocoetes, they are not found in stillwater habitats (S. van de Wetering, pers. comm., as cited in ULEP 1998). Water velocities measured over ammocoete beds in Oregon streams were found to range from 0.1 to 0.5 m/s (0.3 to 1.6 ft/s) (Kan 1975). Water velocities greater than about 0.3 m/s (1.0 ft/s) may prohibit emergent larvae from burrowing in any substrate (Pletcher 1963 as cited in Klamath-Siskyou Wildlands Center et al. 2003).

In the Babine River, British Columbia, ammocoetes were found in backwaters or near banks in silt- and detritus-covered mud (Farlinger and Beamish 1984). Ammocoete density in the Chemainus River of British Columbia was found to be highest in shallow areas along the stream banks (Richards 1980 as cited in Close et al. 1995). Only larger ammocoetes over 75 mm (3 in) in length were found to use the deeper middle portion of the river (Richards 1980 as cited in Close et al. 1995). S. van de Wetering (pers. comm., as cited in ULEP 1998) reports that ammocoetes appear to be abundant in areas where channel meanders or braiding occur, or where secondary channels exist. Such channel forms are most often found in unconfined reaches where lateral channel migration occurs (ULEP 1998). Large woody debris may be important for storing sediments and fine organic matter used by lamprey during the larval stage (ULEP 1998).

Pacific lamprey ammocoetes are usually found in cold water streams, but have been collected at temperatures ranging up to 25°C (77°F) in Idaho (Mallatt 1983 as cited in Close et al. 1995). Temperature preferences for the species are poorly documented (ULEP 1998). It has been suggested that temperatures of less than 20°C (68°F) are preferred (Mallatt 1983 as cited in Close et al. 1995). S. van de Wetering (pers. comm., as cited in ULEP 1998) held ammocoetes at temperatures as high as 27°C (80.6°F) for two weeks with minimal mortality, but considers temperatures near 18°C (64.4°F) to be optimal.

Metamorphosing Pacific lamprey move to areas with larger-sized substrates and moderate currents (Richards and Beamish 1981, Potter 1980). Pacific lamprey at an advanced stage of metamorphosis have been found to prefer gravel to boulder substrates with moderate to strong currents (Beamish 1980).

APPENDIX G.
TIMING OF ANADROMOUS FISH LIFE HISTORY EVENTS IN THE WILLAMETTE RIVER

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Legend

	Span of Light Activity
	Span of Moderate Activity
	Span of Peak Activity

WINTER STEELHEAD—NATIVE STOCK

Sources: Foster (1994); PGE 1997; PGE and Smurfit 1998; Normandeau Associates 2001a; Foster (Pers.Comm 2001)

LIFE STAGE	MONTH											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult Migration into Willamette River												
Adult Passage Over Willamette Falls[1]												
Spawning												
Adult Outmigration (post-spawning)												
Incubation												
Emergence												
Rearing[2]												
Juvenile Outmigration[3]												

1 "Winter steelhead passing [the Falls] from November 1 to February 15 are mainly introduced Big Creek stock, and fish passing the Falls after February 15 are mainly the indigenous Willamette stock" (PGE and Smurfit 1998).

2 "Naturally spawned juveniles generally spend two years in freshwater before smolting and migrating downstream" (PGE and Smurfit 1998).

3 Hatchery (Big Creek hatchery stock) introductions of winter steelhead into the Willamette Basin were discontinued in 1997.

SUMMER STEELHEAD—SKAMANIA STOCK

Sources: Foster (1994); PGE 1997; PGE and Smurfit 1998; Foster (pers. comm., 2001)

LIFE STAGE	MONTH											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult Migration into Willamette River												
Adult Passage Over Willamette Falls												
Spawning												
Incubation												
Emergence												
Rearing												
Release of yearling smolts												

SPRING CHINOOK SALMON – NATIVE STOCK

Sources: Cramer et al. 1996; PGE 1997; PGE and Smurfit 1998; Howell et. al. 1985; Myers et. al. 1998; Normandeau Associates 2001a; Foster (Pers.Comm 2001)

LIFE STAGE	MONTH											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult Migration into Willamette River[1]												
Adult Passage Over Willamette Falls												
Adult Holding												
Spawning												
Incubation												
Emergence												
Rearing												
Release of hatchery smolts[2]												
Outmigration of hatchery spring Chinook at Willamette Falls Project (Normandeau Associates 2001a)												
Juvenile outmigration[3]												

1 From Bennett (1994): "Spring Chinook bound for the Willamette River annually begin entering the Columbia River about the first of January, increasing to peak numbers in late March, with entries tapering off by mid-May...the run passes over Willamette Falls primarily in May and June, returning to upriver tributaries and hatcheries to await spawning in September."

2 "Approximately one-third of all releases occur in the fall (November) as subyearling fish with the remaining two-thirds released in March as larger yearlings" (PGE and Smurfit 1998).

3 "In general, wild spring Chinook downstream migration peaks at Willamette Falls in late October...The least active period of migration for wild spring Chinook is June through mid-September. The peak downstream migration for hatchery spring Chinook at Willamette Falls is in March. A spike of movement occurs in November with fall-released fish. With the exception of the period March through May and November, hatchery spring Chinook presence is minimal" (PGE and Smurfit 1998).

FALL CHINOOK SALMON--EARLY SPAWNING TULE STOCK

Sources: Foster (1994); Rien et. al. 1992; PGE and Smurfit 1998; Normandeau Associates 2001a; Foster (Pers.Comm 2001)

LIFE STAGE	MONTH											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult Migration into Willamette River												
Adult Passage Over Willamette Falls												
Spawning												
Incubation												
Emergence												
Rearing[1]												
Smolt Release into Willamette River[2]												
Juvenile outmigration												

1 "Fall Chinook smolts migrate quickly to the ocean as subyearlings, spending little time in freshwater" (PGE and Smurfit 1998).

2 From 1964 to 1994, ODFW released about 5-12 million smolts each year in the upper Willamette basin. Hatchery releases were discontinued in 1994 (PGE and Smurfit 1998).

COHO SALMON--EARLY RUN HATCHERY STOCK

Sources: Foster (1994); Howell et al. 1985; PGE and Smurfit 1998; Normandeau Associates 2001a; Foster (pers.comm 2001)

LIFE STAGE	MONTH											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult Migration into Willamette River												
Adult Passage Over Willamette Falls												
Spawning												
Incubation												
Emergence												
Rearing												
Juvenile Outmigration[1]												

1 All coho salmon hatchery releases upstream of Willamette Falls were discontinued in 1988 (except those in Tualatin River) (Foster 1994).

PACIFIC LAMPREY

Sources: Hanson et al. 2001; Close et al. 1995; Moyle 2002, Scott and Crossman 1973, Kostow 2002, Normandeau 2001f).

LIFE STAGE	MONTH											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Adult Migration into Willamette River[1]												
Spawning												
Incubation												
Emergence												
Rearing[2]												
Juvenile metamorphosis												
Young adult downstream migration[3]												

1 Pacific lamprey may migrate upstream several months to a year before spawning. There may be several distinct runs as with some species of salmon (Moyle 2002).
2 Pacific Lamprey larval stage or ammocoete stage may last from four to six years.
3 Young adults in some populations may stay in fresh water up to nine months after metamorphosis.