UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

ORIGINAL

May 3, 2004

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

RE: Biological Opinion for ESA Section 7 Consultation on Interim Operations for the Priest Rapids Hydroelectric Project (FERC No. 2114). NOAA Fisheries Consultation No.1999/01878.

Dear Secretary Salas:

Enclosed is the biological opinion prepared by the National Marine Fisheries Service (NOAA Fisheries) on the Federal Energy Regulatory Commission's (FERC) proposed amendment to the Priest Rapids Hydroelectric Project's existing license for implementation of an Interim Protection Plan for listed anadromous salmonids. This document represents NOAA Fisheries' biological opinion of the effects of the proposed action on listed species in accordance with Section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 *et seq.*). This represents NOAA Fisheries' response to your January 20, 1999, letter (and enclosed draft Environmental Assessment) requesting consultation.

In this biological opinion, NOAA Fisheries has determined that the action, as proposed, is likely to jeopardize the continued existence of Upper Columbia River spring-run chinook salmon and Upper Columbia River steelhead.

Enclosed as Section 9 of this biological opinion is NOAA Fisheries' Reasonable and Prudent Alternative (RPA) to the proposed action. The RPA was developed in consultation with Public Utility District No. 2 of Grant County (Project owner), State and Federal fishery resource agencies, and affected Indian Tribes.[1] NOAA Fisheries finds that implementation of the RPA would not jeopardize the continued existence of Upper Columbia River spring-run chinook salmon and Upper Columbia River steelhead.

Also enclosed as Section 13 of the biological opinion is a consultation regarding essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NOAA Fisheries

[1] The Yakama Nation, the Confederated Tribes of the Colville Reservation, the Confederated Tribes of the Umatilla Indian Reservation, and the the Confederated Tribes of the Warm Springs Reservation of Oregon.

finds that the proposed action will adversely affect EFH for chinook salmon and coho salmon and recommends that the measures listed in Section 9 (the RPA) and Section 12 (Incidental Take Statement) be adopted as EFH conservation measures. Pursuant to MSA (§305(b)(4)(B)) and 50 CFR 6000.920(j), Federal agencies are required to provide a written response to NOAA Fisheries'EFH conservation recommendations within 30 days of receipt of these recommendations.

Comments or questions regarding this biological opinion and MSA consultation can be directed to Scott Carlon, Fishery Biologist, NOAA Fisheries Hydropower Division, at 503-231-2379 or email Scott.Carlon@noaa.gov.

Sincerely,

D. Robert Lohn

D. Robert Lohn
Regional Adminstrator

Enclosure

cc. Original & Eight Copies to the Secretary
Service List

Endangered Species Act
Section 7(a)(2) Consultation

Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Consultation

Interim Protection Plan for Operation of the
Priest Rapids Hydroelectric Project
FERC Project No. 2114
Columbia River, Grant and Kittitas Counties, Washington

Action Agency:	Federal Energy Regulatory Commission
Consultation Conducted by:	NOAA Fisheries Northwest Region Hydropower Division
NOAA Fisheries Log Number:	1999/01878
Date:	May 3, 2004

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ACRONYMS AND ABBREVIATIONS

BAMP	Biological Assessment and Management Plan
CFR	Code of Federal Regulations
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRITFC	Columbia Inter-Tribal Fish Commission
DEA	Draft Environmental Assessment
DPAAP	Downstream Passage Alternatives Action Plan
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPE	fish passage efficiency
FR	Federal Register
GBD	gas bubble disease
Grant PUD	Public Utility District No. 2 of Grant County
HCP	Habitat Conservation Plan
IPP	Interim Protection Plan
LSOP	Listed Salmon Operations Plan
MCCC	Mid-Columbia Coordinating Committee
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
NOAA Fisheries	National Marine Fisheries Service
Opinion	Priest Rapids Hydroelectric Project Biological Opinion
PIT-tag	Passive Integrated Transponder-tag
PRCC	Priest Rapids Coordinating Committee
RM	river mile
RPA	reasonable and prudent alternative
RPM	reasonable and prudent measure
TDG	total dissolved gas
TRT	Technical Recovery Team
UCR	Upper Columbia River
USFWS	U.S. Fish and Wildlife Service
VSP	viable salmonid population
WCSBRT	West Coast Salmon Biological Review Team
WDFW	Washington Department of Fish and Wildlife

1. OBJECTIVES

This document constitutes the National Marine Fisheries Service's (NOAA Fisheries) biological opinion and concludes formal consultation with the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) and its implementing regulations, 50 CFR Part 402. The Public Utility District No. 2 of Grant County (Grant PUD) is seeking authorization from FERC to implement an Interim Protection Plan (IPP) that addresses impacts on listed Upper Columbia River (UCR) steelhead (*Oncorhynchus mykiss*) and UCR spring-run chinook salmon (*O. tshawytscha*) from ongoing operations of the Priest Rapids Hydroelectric Project (FERC No. 2114). In its January 20, 1999, letter transmitting its Draft Environmental Assessment (DEA) and requesting ESA Section 7 consultation, FERC adopted Grant PUD's November 2, 1998, IPP as part of FERC's proposed action. This biological opinion (hereinafter, the Opinion) considers the potential effects resulting from implementation of the IPP.

The Priest Rapids Hydroelectric Project is owned and operated by Grant PUD and consists of two developments, Wanapum and Priest Rapids, on the Columbia River in south-central Washington State. The Wanapum Development is located at river mile (RM) 415.8 in Grant and Kittitas Counties, and the Priest Rapids Development is located at RM 397.1 in Grant and Yakima Counties.

The objective of this Opinion is to determine whether implementation of the IPP and ongoing operation of the Priest Rapids Hydroelectric Project (hereinafter, the Project) is likely to jeopardize the continued existence of UCR steelhead and UCR spring-run chinook salmon. UCR steelhead were listed as endangered on August 18, 1997 (62 FR 43937) and UCR spring-run chinook salmon were listed as endangered on March 24, 1999 (64 FR 14308). Critical habitat was designated for these species on February 16, 2000 (65 FR 7764). However, on April 30, 2002, the U.S. District Court for the District of Columbia approved a NOAA Fisheries consent decree withdrawing critical habitat designations for 19 salmon and steelhead populations on the West Coast, including those for UCR steelhead and UCR spring-run chinook salmon. Therefore, this Opinion does not address critical habitat for these two species.

The current FERC license for the Project expires on October 31, 2005. This Opinion applies to the current license and any annual licenses issued after its expiration, up to December 31, 2013, at the latest, at which time this Opinion will expire and a new ESA Section 7(a)(2) consultation will be required. However, NOAA Fisheries expects that a new license for the Project will be issued before 2013. Because issuance of a new license will constitute a new Federal action, it will require reinitiation of ESA Section 7 consultation, resulting in a new biological opinion for the Project that will supersede this Opinion.

Grant PUD has engaged the resource agencies and affected Tribes in settlement negotiations regarding measures for salmon and steelhead that would be implemented under the new license. Nothing in this Opinion is intended to limit future discussions with respect to species or to protection, mitigation, and enhancement measures beyond the scope of Section 7(a)(2) of the ESA.

NOAA Fisheries expects that any settlement agreement will include many of the measures identified in this Opinion and additional future corrective actions that result from adaptive management, or from the development of new technology to address existing adverse project effects for which there are no currently available alternative actions. NOAA Fisheries has included in its reasonable and prudent alternative (RPA) several of the basic components of a longer-term adaptive management program in the expectation that these components will be incorporated into a settlement agreement and into the articles of a new license, as may be appropriate under the Federal Power Act. These include longer-term biological performance standards (consistent with those at other mainstem projects), development and implementation of off-site habitat and hatchery programs to offset unavoidable impacts at the Project itself, and long-term monitoring and evaluation activities to evaluate ongoing performance and identify opportunities to improve performance over time. NOAA Fisheries recognizes that several of these longer-term program elements will not be fully implemented, or the resulting improvements in survival may not be measurable, within the time frame covered by this Opinion. Nevertheless, NOAA Fisheries incorporates them into the recommended RPA to stimulate early action on these efforts so that benefits will be realized sooner than would be the case if deferred entirely until the issuance of a new license or entry into a long-term settlement.

1.1 Application of ESA Section 7(a)(2) Standards - Analysis Framework

This section reviews the approach used in this Opinion to apply the standards for determining jeopardy and destruction or adverse modification of critical habitat as set forth in Section 7(a)(2) of the ESA and as defined by 50 CFR §402.02 (the consultation regulations). Additional guidance for this analysis is provided by the Endangered Species Consultation Handbook, March 1998, issued jointly by NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS). In conducting analyses of actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations:

1. Evaluate biological requirements and current status of the species at the evolutionarily significant unit (ESU) level and within the particular action area (Section 4).

2. Evaluate the relevance of the environmental baseline in the action area to action-area biological requirements and the species' current action-area status (Section 5).

3. Determine the effects of the proposed or continuing action on the species and on any designated critical habitat (Section 6).

4. Determine and evaluate any cumulative effects within the action area (Section 7).

5. Evaluate whether the effects of the proposed action, taken together with any cumulative effects and added to the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely affect their designated critical habitat (Section 8). (See CFR §402.14(g).)

In completing step 5, if NOAA Fisheries determines that the action under consultation is likely to jeopardize the ESA-listed species or adversely modify critical habitat, NOAA Fisheries must identify any RPAs for the action that avoid jeopardy or adverse modification of critical habitat and meet the other regulatory requirements. (See CFR §402.02.)

1.1.1 Step 1: Evaluate Rangewide Biological Requirements and Current Status

The first step NOAA Fisheries takes when applying ESA Section 7(a)(2) to the listed ESUs considered in this Opinion is to define the species' rangewide biological requirements and evaluate the rangewide status relative to those requirements. The purpose of this step is to describe the current risk faced by each ESU to inform NOAA Fisheries' determination as to whether or not additional risks would "appreciably reduce" the likelihood of survival and recovery. The greater the current risk to the species, the more likely that additional risk will appreciably reduce the likelihood of survival and recovery.

The rangewide biological requirements of ESUs for long-term survival and recovery are met when a sufficient number and distribution of populations comprising the ESU are "viable." Viable populations are those that are large enough to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. McElhany et al. (2000) describe "viable salmonid populations" (VSP) as having a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. The attributes associated with VSPs populations include adequate abundance, productivity, spatial structure, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle. These factors, in turn, are influenced by the habitat and environmental conditions encountered by individuals within each population.

NOAA Fisheries has established Technical Recovery Teams (TRT) to identify the component populations of each ESU, to define viability criteria for each population, and to describe the number and distribution of populations that must be viable before the ESU can be considered recovered (and thus delisted). In this first step of the analysis, NOAA Fisheries reviews the current status of the populations affected by the proposed action in the context of VSP criteria. The status of all populations is then considered in aggregate to reach a conclusion for each ESU. NOAA Fisheries begins this analysis with the determinations made in its decision to provide ESA protection to the ESUs considered in this Opinion and also considers any new data that is relevant to the determinations. This information is reviewed in Section 4.

1.1.2 Step 2: Evaluate Relevance of the Environmental Baseline in the Action Area to Biological Requirements and the Species' Current Status

In this step, NOAA Fisheries analyzes the effects of past and present human and natural factors leading to the current status of the species and its habitat (including designated critical habitat) within the action area. The purpose of this step is to establish the conditions currently affecting species status within the action area, to which the effects of the proposed action will be added and evaluated in the jeopardy analysis. This evaluation within the action area, coupled with the rangewide status evaluated in the first step, informs NOAA Fisheries' determination as to whether or not additional risks associated with the proposed action would "appreciably reduce" the likelihood of survival and recovery. The greater the current risk to the species within the action area, the more likely that additional adverse effects within the action area will appreciably reduce the likelihood of the ESU's survival and recovery.

A number of sub-steps are required to describe and evaluate the environmental baseline. These are summarized below and evaluated in Section 5.

Describe the Action Area. The action area includes all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area is not delineated by the migratory range of the species affected by the project. The action area for this consultation is defined in Section 5.1.

Describe Biological Requirements Within the Action Area. As discussed above, the rangewide biological requirement of an ESU is a sufficient number and distribution of populations that meet the VSP requirements of adequate abundance, productivity, spatial structure, and diversity. If the action area is sufficiently large, there may be no distinction between the rangewide biological requirements and those associated with a particular action area. However, biological requirements for action areas that encompass a limited portion of the population's range may be expressed in terms such as 1) adequate survival rates through particular life history stages and/or 2) habitat characteristics that are expected to result in adequate survival and distribution of individuals within a population. This consultation includes elements of both approaches.

Describe the Environmental Baseline. The environmental baseline includes "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress" (50 CFR §402.02).

Describe the Environmental Baseline Relative to Biological Requirements and Species Status. In step 2 of the analysis, which is described in Section 5, NOAA Fisheries compares existing habitat conditions and their continuing effects, as well as the effects of qualifying future Federal projects, and contemporaneous State and private actions, to the action-area biological requirements described above for the listed salmonid ESUs. The extent to which the conditions under the environmental baseline fall short of the species' biological requirements indicates the current status of the species in the action area. The species' status in the action area is important for the ESA Section 7(a)(2) determinations in step 5 because it is more likely that any additional adverse effects caused by the proposed action will be significant if the species status is poor and the baseline is already degraded from a state where the biological requirements are met.

1.1.3 Step 3: Describe the Effects of the Proposed Action

Effects of the action, which are evaluated in Section 6, are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR §402.02). Direct effects occur at a project site and may extend upstream or downstream based on the potential for reducing survival or impairing important habitat elements. Indirect effects are defined in 50 CFR §402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

Effects of the proposed action, with respect to their impact on action area biological requirements, are compared in Section 6 to the proposed goal of 95% dam passage survival covering 95% of the run, and to NOAA Fisheries' performance standards of 93% juvenile project survival and a juvenile and adult combined survival of 91%, which account for the listed species' biological requirements such that there would remain an adequate likelihood of survival and recovery.

1.1.4 Step 4: Describe Cumulative Effects

Cumulative effects, which are described in Section 7, take into consideration the effect of future actions on the listed species' ability to survive and recover, as with the effects of the environmental baseline, provide additional information on the conditions experienced by the species in the action area relative to biological requirements. Cumulative effects include future State or private activities, not involving a Federal action, that are reasonably certain to occur within the action area under consideration (past and present effects of non-Federal actions are part of the environmental baseline). Indicators of actions "reasonably certain to occur" may include, but are not limited to: approval of the action by State, tribal, or local agencies or governments (e.g., permits, grants); indications by State, tribal, or local agencies or governments that granting authority for the action is imminent; a project sponsor's assurance that the action will proceed; obligation of venture capital; or initiation of contracts. The more State, tribal, or local administrative discretion remaining to be exercised before a proposed non-Federal action can proceed, the less reasonable certainty the project will be authorized. Speculative non-Federal actions that may never be implemented are not factored into the cumulative effects analysis. At the same time, "reasonably certain to occur" does not require a guarantee the action will occur. There may be economic, administrative, and legal hurdles remaining before the action proceeds.

The key outcome of this step will be an assessment of whether or not the net impact of the cumulative effects would be to improve or degrade the baseline and to estimate, to the extent practical, the magnitude of that change. The purpose of this step is to further assess the species' status and risk in the action area, to inform NOAA Fisheries' determination of what constitutes an "appreciable reduction" in survival and recovery. For example, if the status of the environmental baseline is very poor, but a suite of beneficial cumulative effects are likely, NOAA Fisheries may tolerate a greater adverse effect of a proposed action before considering it an "appreciable reduction," compared to the level of tolerance absent the beneficial cumulative effects. By the same token, expected harmful cumulative effects could reduce the tolerance level. As in the evaluation of the net effects of the proposed action, professional judgement will be required to make this determination.

1.1.5 Step 5: Conclusion

In Section 8, NOAA Fisheries considers whether the aggregate effects of the action, when added to the effects of the environmental baseline and cumulative effects in the action area, and viewed against the rangewide status of the species, reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of the survival and recovery of the listed species or to destroy or adversely modify designated critical habitat. This evaluation focuses on the juvenile and adult survival rates expected under the proposed action.

If NOAA Fisheries determines that the proposed action is likely to jeopardize listed species or adversely modify critical habitat, it must identify a reasonable and prudent alternative for the action that avoids these effects and satisfies the species' biological requirements.

2. BACKGROUND

2.1 Consultation History

Due to the listing of UCR steelhead on August 18, 1997, Grant PUD filed with FERC its IPP for this ESU on October 16, 1997. On December 22, 1997, FERC designated Grant PUD as its non-Federal representative for the purpose of conducting ESA Section 7 informal consultation with NOAA Fisheries for actions under the IPP. Grant PUD prepared a biological assessment addressing UCR steelhead and submitted it to FERC on April 27, 1998. During preparation of the biological assessment, NOAA Fisheries proposed to list UCR spring-run chinook salmon as endangered (63 FR 11482, March 9, 1998). Accordingly, Grant PUD developed an addendum to its biological assessment addressing UCR spring-run chinook salmon and submitted it to FERC on November 23, 1998.

In a January 20, 1999, letter, FERC requested consultation for UCR steelhead, and conferencing for UCR spring-run chinook salmon, with NOAA Fisheries on the proposed IPP for the Priest Rapids Hydroelectric Project. A final biological assessment, in the form of a DEA, was included. In a February 12, 1999, letter, NOAA Fisheries stated that it did not concur with FERC's conclusion that the IPP is not likely to adversely affect UCR steelhead or jeopardize UCR spring-run chinook salmon. NOAA Fisheries stated that it was proceeding with formal consultation on the proposed action.

Subsequent discussions between NOAA Fisheries, Grant PUD, and FERC resulted in modifications to, and further information regarding, the proposed action and the analyses of those actions proposed in the biological assessment. On August 26, 1999, NOAA Fisheries produced a pre-decisional review draft Biological Opinion. The review draft Biological Opinion consolidated the information and proposed actions from all five FERC-licensed hydroelectric projects on the mid-Columbia River (Wells, Rocky Reach, Rock Island, Wanapum and Priest Rapids Dams). NOAA Fisheries had elected to coordinate consultations on each of the separate FERC actions in an attempt to streamline the consultation process while enabling a quantitative assessment of the cumulative effects associated with all five dams. Consultation meetings were then held with all of the PUDs (Douglas County, Chelan County, and Grant County) and FERC non-decisional staff on September 9, 1999, and October 5, 1999, and with FERC and the Douglas and Chelan County PUDs on September 17, 1999. Additional technical consultations were held with Grant PUD on October 15, 1999.

Some of the initial concerns expressed by the PUDs were addressed during these consultation meetings and during informal discussions over the following two months. Several issues pertaining to the Habitat Conservation Plan (HCP) agreements proposed by the Douglas and Chelan County PUDs, however, continued to complicate the coordinated consultation process. Therefore, on January 20, 2000, NOAA Fisheries elected to separate the FERC actions back into independent consultations.

On May 31, 2002, NOAA Fisheries staff met with Columbia River Inter-Tribal Fish Commission (CRITFC) staff, Yakama Nation staff, American Rivers, the Washington Department of Fish and Wildlife (WDFW), and the USFWS to discuss the biological opinion and potential measures to mitigate for the Project's effects. NOAA Fisheries also met with Grant PUD on May 31, 2002, to discuss information analyzed in this Opinion.

On August 23, 2002, NOAA Fisheries again met with CRITFC staff, Yakama Nation staff, American Rivers, and the National Wildlife Federation to discuss alternative measures that would mitigate the effects of the ongoing operation of the Project on listed species. On September 13 and 20, 2002, NOAA Fisheries met with Grant PUD to discuss measures that could be implemented under a reasonable and prudent alternative.

On December 30, 2002, NOAA Fisheries released a pre-decisional draft of this Opinion for review and comment from FERC and Grant PUD. On January 9, 2003, NOAA Fisheries met with FERC and Grant PUD to discuss the technical merits of the draft Biological Opinion and to identify and correct inaccuracies. On January 21, 2003, NOAA Fisheries released the draft Biological Opinion for review by Grant PUD, Federal and State resource agencies, and affected Tribes. Other meetings with Grant PUD to discuss Section 9 of this Opinion were held on April 18, May 21, July 15, August 7, October 2 and 14, and December 18, 2003. Additional meetings were held with Federal and State resource agencies and affected Tribes on October 27, November 13, and December 2, 2003.

3. PROPOSED ACTION

FERC's DEA examined actions proposed in the IPP by Grant PUD. As stated earlier, FERC adopted the IPP as its proposed action. This Opinion, therefore, considers the proposed action as described in FERC's January 20, 1999, letter transmitting the DEA, and the November 2, 1998, IPP. FERC proposed to require that Grant PUD enact adult fish passage improvements, a spill program for juvenile migrants, turbine operation changes, gas abatement efforts, a predator control program, a gatewell dipping program, and monitoring and evaluation. NOAA Fisheries requested that Grant PUD provide additional detail describing the methods and criteria by which it would implement the IPP. In response, Grant PUD (1999) submitted to NOAA Fisheries a Listed Salmon Operations Plan (LSOP), which details methods and criteria for IPP implementation. The LSOP was developed after FERC had initiated consultation and therefore was not included in FERC's documentation of the proposed action. However, because the plan describes the way in which Grant PUD intended to implement FERC's proposed action, NOAA Fisheries herein refers to details presented in the LSOP.

3.1 Wanapum Development

The Wanapum Development was completed in 1964 and is located on the Columbia River at RM 415.8 within the state of Washington. The structure consists of both earth embankment and concrete sections that span approximately 8,637 ft across the river. The dam impounds 38 river miles, creating a gross reservoir storage capacity of 566,400 acre-ft and a surface area of 14,590 acres at a normal pool elevation of 570 ft mean sea level (msl). The forebay has a normal operating range of 11.5 ft (560-571.5 ft msl). The powerhouse contains 10 vertical shaft, 5-blade adjustable Kaplan turbines with a total generation capacity of 1,038 MW. Total powerhouse hydraulic capacity is roughly 187,000 cubic ft per second (cfs). The spillway has a total hydraulic capacity of 1,400,000 cfs and consists of 12 gated (tainter gates) ogee weir spill bays and one top-spill sluiceway.

Adult fish passage is provided via two ladders: one on the right bank (west side) and one on the left bank (east side). The left bank ladder consists of a powerhouse collection channel connected to the left bank main entrance and fish ladder. Auxiliary water is supplied by gravity from the forebay via a 120-inch diameter conduit and from the tailwater via two turbine pumps. The right bank ladder is located adjacent to the west end of the spillway. Auxiliary water is supplied by the forebay gravity feed conduit.

Juveniles migrating through Wanapum must pass either through the turbines, spillway (including sluiceway), or by gatewell dipnetting. There are currently no passage facilities operating at Wanapum. Spill is provided as a means to improve fish passage efficiency (i.e., passage via a non-turbine route).

3.1.1 Juvenile Passage

FERC (1999) proposed that through implementing the IPP, Grant PUD will achieve a 95% dam passage survival rate or 80% fish passage efficiency (FPE) rate over 95% of the run for downstream migrants passing Wanapum Dam. The following measures are proposed by FERC and Grant PUD for the purpose of satisfying the 95% survival goal.

3.1.1.1 Powerhouse Operations

Based on turbine model studies, fish distribution data, and a turbine survival study (Normandeau 1996), Grant PUD developed a model to predict juvenile salmonid survival rates through the Wanapum turbines over a range of forebay elevations, flows, and turbine efficiencies. Based on the model results, Grant PUD proposes to operate 6 of the 10 turbines 70% of the time within the 95% fish survival curve during the spring fish passage season. The 4 turbines potentially operating outside the 95% survival zone during fish passage would be those having the lowest operating priority based on fish passage rates, i.e., units demonstrating higher fish passage rates will have the highest priority for operation within the 95% fish survival curve. The resulting turbine operating priority would be as follows: 1-4, 10, 9, 8, 7, 6 and 5.

Discharge through all turbines would be limited so as not to exceed 15,700 cfs to minimize cavitation. This limit would be exceeded when required to avoid spill to stay within total dissolved gas (TDG) criteria. Any deviations from this operation would be applied to low priority turbines first. Grant PUD proposes that in-season changes to this operation would be coordinated through NOAA Fisheries and the Mid-Columbia Coordinating Committee (MCCC).[1]

3.1.1.2 Spillway Operation

FERC (1999) proposes to require that Grant PUD spill roughly 43% of total flow during the spring fish passage season. Spill would occur after April 1 when listed downstream migrants were present at the dam. Fish presence would be determined by smolt monitoring data collected at Rock Island Dam (the next development upstream from Wanapum), the timing and location of hatchery releases, and the dipnetting gatewells at Wanapum. Spill will be initiated when it is determined, in consultation with MCCC spill representatives, that roughly the first 5% of the spring migrants have passed Wanapum Dam.

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[1]The Mid-Columbia Coordinating Committee was established by FERC's Administrative Law Judge to develop plans for fish protection. It is made up of representatives from Federal and State resource agencies, affected Tribes, and mid-Columbia PUDs.

The decision to end spill would be based on (FERC 1999; Grant PUD 1999):

1. Stop the night following if gatewell samples indicate migration of listed species has ceased,
2. Stop two days following if Rock Island Dam bypass data suggests that migration of listed species has ended, or
3. Stop no later than June 15.

Grant PUD proposed to conduct radiotelemetry and PIT-tag studies to measure the survival rates of juvenile salmonids under the proposed spring spill operation. The studies would indicate whether adjustments in spill percentages were necessary to achieve 95% dam passage survival. Proposed criteria for adjusting spill levels, specified in the LSOP (Grant PUD 1999), are as follows:

1. If spill levels are creating TDG saturation greater than allowed under current water quality standards, and
2. If other measures improve total survival above 95%, then spill would be decreased provided that the 95% survival standard is still satisfied.

Maintenance would be scheduled so that all spill gates and the skim spill sluice gate would be available for the spring migration season. Maintenance on the spillway would be scheduled to occur between September 1 through March 31, each year (FERC 1999; Grant PUD 1999).

In-season spill management would be coordinated through NOAA Fisheries and the spill representatives of the MCCC. Decisions on spill would be based on the spill representatives' review of fish passage timing, flows, TDG, fish survival data, and other relevant data.

3.1.1.3 Dissolved Gas Management

Grant PUD tested two prototype spill deflectors at the Wanapum spillway in 1996 and 1998. Based on the performance of the prototypes, Grant PUD developed a third design, in a continuing effort to develop a deflector that would satisfy both biological and water quality criteria. In addition to installing deflectors, to determine compliance with State water quality criteria for TDG, Grant PUD would conduct 1) fixed site TDG monitoring of forebay and downstream areas, 2) across-river transect monitoring of TDG levels as provided in Grant PUD's Water Quality Monitoring Plan, and 3) examination of smolts collected from gatewells at Priest Rapids Dam for gas bubble disease (GBD).

<u>Fixed Site Monitoring</u>
Grant PUD's fixed monitoring stations would record hourly TDG pressure, dissolved oxygen pressure, water temperature, and barometric pressure. One station would be located in the forebay near mid-dam at turbine unit 8, and the other would be located near mid-river on the

Beverly Railroad Bridge roughly three miles downstream of Wanapum. Both stations would operate continuously through the fish passage and spill seasons.

During the fish spill season, data would be recorded hourly and uploaded daily to the U.S. Army Corps of Engineers' (Corps) CROHMS database. Data (hourly percentage TDG, spill volume, total discharge, results of any cross-sectional monitoring, and records of any observations of GBD) would also be posted on Grant PUD's website[2] (FERC 1999; Grant PUD 1999).

Across-River Monitoring

The purpose of the across-river monitoring is to determine the spatial distribution of TDG and also to determine how well the fixed sites represent river TDG levels. Surveys would be conducted to periodically measure this spatial distribution in the forebay and at the Beverly Railroad Bridge at points approximately one-third, one-half, and two-thirds across the river. Data collected would include TDG, barometric pressure, and water temperature (FERC 1999; Grant PUD 1999).

Biological Monitoring

At least 100 smolts would be collected twice weekly from various gatewells at Priest Rapids Dam and examined for GBD. Gatewells would be dipnetted to remove smolts that have accumulated for more than a day. The following morning, the same gatewells would be dipnetted again to sample fish that have entered since the previous day. Because the majority of smolts pass the dams at night, this procedure is expected to provide a sample that is representative of run-of-river fish. The examination procedures employed would be consistent with those used in the Smolt Monitoring Program (FERC 1999; Grant PUD 1999).

3.1.1.4 Dipnetting Gatewells

Listed UCR steelhead and UCR spring-run chinook salmon smolts can become entrained and spend from a few hours to a few days in the Wanapum gatewells. Grant PUD would employ a crane-operated dipnet to remove fish from the gatewells for release downstream of the dam. The dipnet consists of a nylon mesh with a fiberglass tank attached at the bottom. All fasteners are coated with silicon to minimize abrasion. The dipnet is lowered approximately to the top of the turbine intake and then lifted up the gatewell. Fish are crowded to near the surface and then funneled into the tank and lifted out of the gatewell. Captured fish are either placed in a recovery tank or are transferred to a sampling facility and then released below the dam. Transfer is accomplished via water-to-water, i.e., fish remain in water during the whole process.

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[2]The URL for Grant PUD's website is *www.gcpud.org*.

3.1.1.5 Predator Control

Predatory Fish

Control efforts would involve a volunteer angling program that targets northern pikeminnow (*Ptychocheilus oregonensis*) that are capable of eating smolts (i.e., pikeminnows ≥10 inches). Incidental catch of non-target species and northern pikeminnow under 10 inches would be returned to the river. Data collected and recorded would include date, time of day, location, number of northern pikeminnow caught and number kept, number of hours fished, and number of incidental species captured. Biological data collected on northern pikeminnow would include number sampled, length, weight, gender, location, method of capture, and observations of marks or tags. The stated goal is the removal of roughly 10,000 northern pikeminnow per year for the whole Priest Rapids Hydroelectric Project area (i.e., the two developments, combined).

Avian Predators

Gulls, cormorants, and terns are the primary piscivorus birds feeding on smolts in the Priest Rapids Hydroelectric Project area. FERC would require that Grant PUD install and maintain an array of wires across the Wanapum powerhouse tailrace to disrupt feeding activity. Also, hazing would be conducted at various locations around Wanapum using 15 mm pyrotechnics, fuse rope salutes, mylar tape, cracker shells, propane operated cannons, air rifles, and shotguns. It is anticipated that hazing would dissuade feeding behavior.

3.1.2 Adult Passage

Grant PUD would continue to operate and maintain the right (east) bank and left (west) bank fish ladders and their associated auxiliary water supply systems according to the criteria specified in the LSOP (Grant PUD 1999). FERC (1999) and Grant PUD (1999) have also proposed to:

1. Enhance entrance attraction at the fishways through planned operation of spill gates and turbines according to criteria.
2. Investigate ladder modifications to improve the ability to operate ladders within specified criteria.
3. Conduct modeling or other appropriate evaluations to determine the best actions for correcting delay problems in the junction pool area.
4. Develop solutions and implement corrective actions, in cooperation with NOAA Fisheries, if adult passage problems are identified.
5. Operate spillways and sluiceways during steelhead and spring-run chinook salmon adult and steelhead kelt passage periods to provide a downstream passage route for these life stages.
6. Evaluate steelhead passage using radiotelemetry.
7. Develop and test a prototype video fish counting system at Wanapum, which if successful, would be implemented for future adult counting.

3.2 Priest Rapids Development

The Priest Rapids Development was completed in 1961 and is located on the Columbia River at RM 397.1 within the state of Washington. The structure consists of both earth embankment and concrete sections that span approximately 10,103 ft across the river. The dam impounds over 18 miles of river with a gross reservoir storage capacity of 191,000 acre-ft (31,000 acre-ft of active storage) and a surface area of 7,580 acres at a normal pool elevation of 486.5 ft msl. The forebay has a normal operating range of 7.5 ft (481.5-488 ft msl). The powerhouse contains 10 vertical shaft, 6-blade adjustable Kaplan turbines with a total generation capacity of 955.6 MW. Total powerhouse hydraulic capacity is roughly 178,000 cfs. The spillway has a total hydraulic capacity of 1,400,000 cfs and consists of 22 gated (tainter gates) ogee weir spill bays and one top-spill sluiceway.

Like Wanapum, adult fish passage is provided via two ladders: one on the right bank (west side) and one on the left bank (east side). The left bank fishway consists of a powerhouse collection channel connected to the left main entrance and ladder. Auxiliary water is supplied via a gravity intake gate and a pumped water supply pool. This fishway has an adult fish count board near the downstream end of the ladder and an adult trapping facility at the ladder exit. The right bank ladder is located adjacent to the west end of the spillway. Auxiliary water is supplied by water drawn from the left bank supply system through the attraction water supply conduit. An adult fish count board is located in the middle portion of the ladder.

Juveniles must pass Priest Rapids either through the turbines, spillway (including sluiceway), or via gatewell dipnetting. There are currently no juvenile passage facilities operating at Priest Rapids. Spill is provided as a means to improve FPE (i.e., passage via a non-turbine route).

3.2.1 Juvenile Passage

FERC proposes that through the implementation of the IPP, Grant PUD will achieve a 95% survival rate or 80% FPE rate for downstream migrants passing Priest Rapids. The following measures are proposed by FERC and Grant PUD for the purpose of satisfying the 95% survival goal.

3.2.1.1 Powerhouse Operation

Because there is no specific survival data for juveniles encountering the Priest Rapids turbines, Grant PUD proposes to operate all turbines in a non-cavitation mode.[3] Turbine unit 10 would be operated in a last on/first off mode from April 1 to November 30 during daylight hours when the

[3] Injuries to juvenile fish such as swim-bladder rupture, hemorrhaging, and contusion due to cavitation can result in direct and indirect mortality (U.S. Army Corps of Engineers 1995).

powerhouse is operating at less than capacity. This will reduce hydraulics that confound attraction flows at the left bank fish ladder entrance.

3.2.1.2 Spillway Operation

FERC (1999) proposes to require that Grant PUD spill roughly 61% of total flow during the spring fish passage season for the purpose of achieving 95% survival of downstream migrants. Spill would occur after April 1 when listed downstream migrants are determined to be present at the dam. Fish presence will be determined by smolt monitoring data collected at Rock Island Dam and Wanapum Dam, and by gatewell dipping at Wanapum and Priest Rapids. Spill would begin at Priest Rapids one day after initiation of spill at Wanapum, or sooner if gatewell samples indicate presence of listed species.

The decision to end spill would be based on similar criteria:

1. Stop the night following if gatewell samples indicate migration of listed species has ceased,
2. Stop two days following if Rock Island Dam bypass data suggest that migration of listed species has ended, or
3. Stop no later than June 15.

Based on these criteria, spill would end one day following cessation of spill at Wanapum.

Grant PUD would conduct survival studies during the spring passage season to determine if adjustments in spill percentages are necessary to achieve 95% survival. Criteria for adjusting spill levels are specified in the LSOP (Grant PUD 1999):

1. If steelhead survival data for the Wanapum tailrace releases show a 20% greater mortality than that of the Priest Rapids tailrace releases, it may be necessary to reduce spill at Priest Rapids.
2. If TDG levels exceed the water quality standard.
3. If spill is increased at Wanapum, due to successful performance and installation of flow deflectors or to improve survival, spill may be decreased at Priest Rapids, provided that the 95% survival objective can still be achieved.
4. If other measures improve total survival above 95%, then spill may be decreased.

Maintenance would be scheduled so that all spill gates and the skim spill sluice gate would be available for the spring migration season. Maintenance on the spillway would be scheduled to occur between September 1 through March 31, each year.

In-season spill management would be coordinated through NOAA Fisheries and the spill representatives of the MCCC. Decisions on spill would be based on the spill representatives' review of fish passage timing, flows, TDG, fish survival data, and other relevant data.

3.2.1.3 Dissolved Gas Management

To determine compliance with State water quality criteria for TDG, Grant PUD would conduct 1) fixed site TDG monitoring of forebay and downstream areas, 2) across-river transect monitoring of TDG levels as provided in Grant PUD's Water Quality Monitoring Plan, and 3) examination of smolts collected from gatewells at Priest Rapids Dam for GBD.

Fixed Site Monitoring
Grant PUD's fixed monitoring stations would record hourly TDG pressure, dissolved oxygen pressure, water temperature, and barometric pressure. One station would be located near mid-dam in the forebay between turbine unit 1 and the sluiceway, and the other would be located near mid-river on the Vernita Bar Bridge roughly nine miles downstream of Priest Rapids. Both stations would operate continuously through the fish passage and spill seasons.

During the fish spill season, data would be recorded hourly and uploaded daily to the Corps' CROHMS database. Data (hourly percentage TDG, spill volume, total discharge, results of any cross-sectional monitoring, and records of any observations of GBD) would also be posted on Grant PUD's website (FERC 1999; Grant PUD 1999).

Across-River Monitoring
The purpose of the across-river monitoring is to determine the spatial distribution of TDG and also to determine how well the fixed sites represent river TDG levels. Surveys would be conducted once per week in the forebay and at the Vernita Bar Bridge at points approximately one-third, one-half, and two-thirds across the river. Data collected would include TDG, barometric pressure, and water temperature (FERC 1999; Grant PUD 1999).

Biological Monitoring
At least 100 smolts would be collected twice weekly from various gatewells at Priest Rapids Dam and examined for GBD. Gatewells would be dipnetted to remove smolts that have accumulated for more than a day. The following morning, the same gatewells would be dipnetted again to sample fish that have entered since the previous day. Because the majority of smolts pass the dams at night, this procedure is expected to provide a sample that is representative of run-of-river fish. The examination procedures employed will be consistent with those used in the Smolt Monitoring Program (FERC 1999; Grant PUD 1999).

3.2.1.4 Dipnetting Gatewells

Listed UCR steelhead and UCR spring-run chinook salmon smolts can become entrained and spend from a few hours to a few days in the Priest Rapids gatewells. Grant PUD would employ a crane-operated dipnet to remove fish from the gatewells for release downstream of the dam. The dipnet consists of a nylon mesh with a fiberglass tank attached at the bottom. All fasteners are coated with silicon to minimize abrasion. The dipnet is lowered approximately to the top of the turbine intake and then lifted up the gatewell. Fish are crowded to near the surface and then funneled into the tank and lifted out of the gatewell. Captured fish are either placed in a recovery tank or are transferred to a sampling facility and then released below the dam. Transfer is accomplished via water-to-water, i.e., fish remain in water during the whole process.

3.2.1.5 Predator Control

Predatory Fish

Control efforts would involve a volunteer angling program that targets northern pikeminnow (*Ptychocheilus oregonensis*) that are capable of eating smolts. Incidental catch of non-target species and northern pikeminnow under 10 inches would be returned to the river. Data collected and recorded would include date, time of day, location, number of northern pikeminnow caught and number kept, number of hours fished, and number of incidental species captured. Biological data collected on northern pikeminnow would include number sampled, length, weight, gender, location, method of capture, and observations of marks or tags. As stated in Section 3.1.1.5, the goal is the removal of roughly 10,000 northern pikeminnow per year for the whole Priest Rapids Hydroelectric Project area (i.e., the two developments, combined).

Avian Predators

Gulls, cormorants, and terns are the primary piscivorus birds feeding on smolts in the Priest Rapids Hydroelectric Project area. Grant PUD would install and maintain an array of wires across the Wanapum powerhouse tailrace to disrupt feeding activity. Also, hazing would be conducted at various locations around Wanapum using 15 millimeter pyrotechnics, fuse rope salutes, mylar tape, cracker shells, propane operated cannons, air rifles, and shotguns. It is anticipated that hazing would dissuade feeding behavior.

3.2.2 Adult Passage

Grant PUD would continue to operate and maintain the right (east) bank and left (west) bank fish ladders and their associated auxiliary water supply systems according to the criteria specified in the LSOP (Grant PUD 1999). FERC (1999) and Grant PUD (1999) have also proposed to:

1. Enhance entrance attraction at fishways through planned operation of spill gates and turbines according to criteria.
2. Investigate ladder modifications to improve the ability to operate ladders within specified criteria.
3. Conduct modeling or other appropriate evaluations to determine the best actions for correcting delay problems in the junction pool area.
4. Develop solutions and implement corrective actions, in cooperation with NOAA Fisheries, if adult passage problems are identified.
5. Operate spillways and sluiceways during steelhead and spring-run chinook salmon adult and steelhead kelt passage periods to provide a downstream passage route for these life stages.
6. Evaluate steelhead passage using radiotelemetry technique.
7. Rebuild the Priest Rapids fishway trap.

4. BIOLOGICAL INFORMATION

The biological requirements, life histories, migration timing, historical abundance, factors for decline, and current rangewide status of UCR spring-run chinook salmon and UCR steelhead have been well documented (WCSBRT 2003; Busby et al. 1996; Myers et al. 1998; NOAA Fisheries 1995, 1996, 1997, 1998a, 1998b, 2000a, and 2000b). The following sections briefly describe relevant biological information for UCR spring-run chinook salmon and UCR steelhead.

4.1 UCR Spring-Run Chinook Salmon

4.1.1 Geographic Boundaries and Spatial Distribution

This ESU includes spring-run chinook salmon populations found in Columbia River tributaries between Rock Island and Chief Joseph Dams. NOAA Fisheries has initially identified three independent populations within this ESU: the Wenatchee, Entiat, and Methow River populations (Interior Technical Recovery Team 2003).[4] The Wenatchee and Entiat Rivers are in the Northern Cascades Physiographic Province and the Methow River is in the Okanogan Highlands Physiographic Province. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Myers et al. 1998). Although fish in this ESU are genetically similar to spring-run chinook salmon in the adjacent Middle Columbia and Snake River ESUs, they are distinguished by ecological differences in spawning and rearing habitat preferences; e.g., UCR spring-run chinook salmon typically spawn in tributary streams at lower elevations (1,600 to 3,300 ft) than in the Snake and John Day River Basins. In addition, the following spring-run chinook salmon hatchery stocks, and their progeny, are considered part of the listed ESU: Chiwawa River, Methow River, Twisp River, Chewuch River, White River, and Nason Creek stocks (64 FR 14324).

4.1.2 Historical Information

The construction of Grand Coulee Dam (completed in 1942) blocked anadromous fish habitat upstream of RM 596.6 after 1938. The concurrent Grand Coulee Fish Maintenance Project (1939 through 1943) homogenized stocks across the ESU, influencing the present-day loss of genetic diversity. Production of non-listed Carson-origin spring-run chinook salmon has also taken place within the UCR spring-run chinook salmon ESU. Non-listed spring-run chinook salmon hatchery populations contained within this ESU include Leavenworth, Entiat, and Winthrop National Fish Hatcheries.

[4] All chinook salmon in the Okanogan River are apparently ocean-type and are considered part of the UCR summer- and fall-run ESU.

Many populations in this ESU have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation. Although the West Coast Salmon Biological Review Team (2003) considered this an encouraging sign, the last year or two of higher returns was preceded by a decade or more of steep declines to all-time record low escapements. In addition, this ESU continues to have a very large influence from both production/mitigation and supplementation hatchery programs.

4.1.3 Life History

Upper Columbia River spring-run chinook salmon have a stream-type life history; the juveniles typically spend 1 year in freshwater before migrating to the Pacific Ocean. Adults return to the Wenatchee River from late March to mid-May, and to the Entiat and Methow Rivers from late March to June. Most adults return after spending 2 years in the ocean, while 20% to 40% return after 3 years at sea. Peak spawning for all three populations occurs from August to September. Few coded-wire tags are recovered in ocean fisheries, suggesting that these fish move quickly out of the north-central Pacific and do not migrate along the coast. Details can be found in Myers et al. (1998) and Chapman et al. (1995).

4.1.4 Population Trends and Risks

NOAA Fisheries determined that UCR spring-run chinook salmon are at risk of becoming extinct in the foreseeable future, listing them as endangered under the ESA on March 24, 1999 (64 FR 14307). On April 4, 2002, NOAA Fisheries defined interim abundance recovery targets for each spawning aggregation in this ESU (Lohn 2002). These numbers are intended to represent the number and productivity of naturally produced spawners that may be needed for recovery, in the context of whatever take or mortality is occurring. They should not be considered in isolation, as they represent the numbers that, taken together, may be needed for the population to be self-sustaining in its natural ecosystem. For UCR spring-run chinook salmon, the interim recovery levels are 3,750 spawners in the Wenatchee River, 500 spawners in the Entiat River, and 2,000 spawners in the Methow River.

All three of the existing UCR spring-run chinook salmon populations have exhibited similar trends and patterns in abundance over the past 40 years. The 1998 status review (Myers et al. 1998) reported that long-term trends in abundance were generally negative, ranging from -5% to +1%. Analyses of the data series, updated to include 1996-2001 returns, indicate that those trends have continued. Based on redd count data series, spawning escapements for the Wenatchee, Entiat, and Methow Rivers have declined an average of 5.6%, 4.8%, and 6.3% per year, respectively, since 1958. In the most recent 5-year geometric mean (1997-2001), spawning escapements were 273 for the Wenatchee population, 65 for the Entiat population, and 282 for the Methow population, only 8% to 15% of the interim abundance recovery targets, although escapement increased substantially in 2000 and 2001 in all three river systems. Based on 1980-2000 returns, the average annual growth rate for this ESU is estimated as 0.85. Assuming that population growth rates were to continue at 1980-2000 levels, UCR spring-run chinook salmon populations are projected to have very high probabilities of 90% decline within 50 years (87% to 100%).

4.2 UCR Steelhead

4.2.1 Geographic Boundaries and Spatial Distribution

This ESU occupies the Columbia River Basin upstream of the Yakima River (excluded) to Chief Joseph Dam. Rivers in the area primarily drain the east slope of the northern Cascade Mountains and include the Wenatchee, Entiat, Methow, and Okanogan River Basins. NOAA Fisheries has initially identified three independent populations within this ESU: the Wenatchee, Entiat, and Methow populations (Interior Technical Recovery Team 2003). The Wells Hatchery steelhead stock was also included in the listing of this ESU (64 FR 43946).

4.2.2 Historical Information

Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams. Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a pre-fishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman et al. 1994b). Runs, however, may have already been depressed by lower Columbia River fisheries and other habitat degradation problems in the natal trubutaries. Grand Coulee Dam blocked anadromous fish from habitat upstream of RM 596.6 after 1938. The concurrent Grand Coulee Fish Maintenance Project also influenced the present distribution of the ESU. In 1961, the Chief Joseph Dam also blocked anadromous fish from remaining habitat upstream of RM 545.1.

4.2.3 Life History

As in other inland steelhead ESUs (Snake and Middle Columbia River), steelhead in the UCR ESU remain in freshwater up to a year before spawning. Smolt age is dominated by 2- and 3-year-olds; however, some of the oldest smolt ages for steelhead, up to 7 years, are reported for this ESU (Pevan 1990). Based on limited data, steelhead from the Wenatchee and Entiat Basins return to freshwater after 1 year in saltwater, whereas Methow River steelhead typically spend 2 years in saltwater before returning (Howell et al. 1985). Similar to other inland Columbia River Basin steelhead ESUs, adults typically return to the Columbia River between May and October and are considered summer-run steelhead. Adults may spend up to 1 year in freshwater before spawning. The relationship between anadromous and non-anadromous forms in the geographic area is unclear. Unlike chinook salmon or sockeye salmon, a fraction of steelhead adults attempt to migrate back to the ocean. These fish are known as kelts, and those that survive will migrate from the ocean to their natal stream to spawn again. Details can be found in Busby et al. (1996) and Chapman et al. (1994b).

4.2.4 Population Trends and Risks

NOAA Fisheries determined that UCR steelhead are at risk of becoming extinct in the foreseeable future, listing them as endangered under the ESA on August 18, 1997 (62 FR 43937). On April 4, 2002, NOAA Fisheries defined interim abundance recovery targets for each spawning population in this ESU (Lohn 2002). These targets are intended to represent the number and productivity of naturally produced spawners that may be needed for recovery, in the context of whatever take or mortality is occurring. They should not be considered in isolation, as they represent the numbers that, taken together, may be needed for the population to be self-sustaining in its natural ecosystem. For UCR steelhead, the interim recovery levels are 2,500 spawners in the Wenatchee River, 500 spawners in the Entiat River, and 2,500 spawners in the Methow River (Lohn 2002).

Returns of both hatchery and naturally produced steelhead to the Upper Columbia River have increased in recent years. The average 1997-2001 return counted through the Priest Rapids fish ladder was approximately 12,900 fish. The average for the previous 5 years (1992-1996) was 7,800 fish. Abundance estimates of returning naturally produced UCR steelhead have been based on extrapolations from mainstem dam counts and associated sampling information (e.g., hatchery/wild fraction, age composition). The natural component of the annual steelhead run over Priest Rapids Dam increased from an average of 1,040 (1992-1996), representing about 10% of the total adult count, to 2,200 (1997-2001), representing about 17% of the adult count during this period of time (WCSBRT 2003).

In terms of natural production, recent population abundances for both the Wenatchee/Entiat aggregate population and the Methow population remain well below the interim recovery levels developed for these populations (WCSBRT 2003). A 5-year geometric mean (1997-2001) of approximately 900 naturally produced steelhead returned to the Wenatchee and Entiat Rivers (combined), compared to a combined abundance target of 3,000 fish. Although this is well below the interim recovery target, it represents an improvement over the past (an increasing trend of 3.4% per year). However, the average percentage of natural fish for the recent 5-year period dropped from 35% to 29%, compared to the previous status review. For the Methow population, the 5-year geometric mean of natural returns over Wells Dam was 358. Although this is well below the interim recovery target, it represents an improvement over the past (an increasing trend of 5.9% per year). In addition, the estimated 2001 return (1,380 naturally produced spawners) was the highest single annual return in the 25-year data series. However, the average percentage of wild origin spawners dropped from 19% for the period prior to the 1998 status review to 9% for the 1997-2001 returns.

4.3 Significant Factors Influencing Rangewide Status of Each ESU

4.3.1 Harvest

Harvest rates for most ESUs have been substantially reduced as either a direct or indirect result of many species being listed under the ESA during the 1990s. Table 1 provides NOAA Fisheries' best estimates of current total harvest rates for ESA-listed species which are substantially lower than harvest rates occurring prior to ESA listings in the Columbia River Basin (NOAA Fisheries 2001).

Table 1. NOAA Fisheries' estimates of current total harvest rates (Treaty Indian Fisheries and Non-Indian Fisheries) for ESA-listed species /ESUs.

Species / ESUs	Run / Origin	Total Estimated Impact	
		Maximum	Expected
UCR Steelhead	Wild	9.6 %	4.4 %
	Hatchery	11.6 %	7.2 %
UCR Spring-Run Chinook Salmon	Spring Migrants	≤ 15.0 %	≤ 15.0 %

4.3.2 Hatcheries

4.3.2.1 UCR Spring-Run Chinook Salmon

Spring-run chinook salmon from the Carson National Fish Hatchery—a large composite, non-native stock—were introduced into, and have been released from, local hatcheries (Leavenworth, Entiat, and Winthrop National Fish Hatcheries). There is little evidence to suggest that these hatchery fish stray into wild areas or hybridize with naturally spawning populations. In addition to these national production hatcheries, two supplementation hatcheries are operated by WDFW in this ESU. The Methow Fish Hatchery Complex (operations began in 1992) and the Rock Island Fish Hatchery Complex (operations began in 1989) were both designed to implement supplementation programs for naturally spawning populations on the Methow and Wenatchee Rivers, respectively (Chapman et al. 1995).

Risks associated with artificial production programs within the ESU are a concern because of the use of non-native Carson stock for fishery enhancement and hydropower mitigation. However, programs have been initiated to develop locally adapted broodstocks to supplement the natural populations in the ESU. The Carson stock is being phased out at those facilities where straying and natural stock interactions are problematic. Captive broodstock programs are under way in Nason Creek and White River, tributaries to the Wenatchee River, and in the Twisp River, a tributary to the Methow River, to prevent those populations from going extinct. In some recent years, all spring-run chinook salmon have been trapped at the Wells Hydroelectric Project to begin a composite-stock broodstock supplementation program for the Methow Basin.

4.3.2.2 UCR Steelhead

The naturally spawning population of UCR steelhead has been augmented for a number of years by straying hatchery fish. Replacement ratios for naturally spawning fish—both natural and hatchery origin—are quite low, on the order of 0.3. This very low return rate suggests that either hatchery strays are largely supporting the population, or that hatchery strays are not contributing substantially to subsequent adult returns and natural origin fish are returning at or just below the replacement rate, or some intermediate combination of these factors. Given these uncertainties, efforts are underway to diversify broodstocks used for supplementation, minimizing the differences between hatchery and natural origin fish, as well as other concerns associated with supplementation. Assuming that the hatchery broodstock represents the listed ESU, NOAA Fisheries expects that the early life history survival advantage of hatchery smolts will help stocks to rebuild. However, there are also substantive concerns about the long-term effect on the fitness of natural origin populations resulting from an ongoing, long-term infusion of hatchery influenced spawners (Busby et al. 1996).

The hatchery component is relatively abundant and routinely exceeds the needs of the supplementation program by a substantial margin. NOAA Fisheries is currently developing new hatchery policies to guide how hatchery fish will be considered in future status reviews and listing decisions. NOAA Fisheries expects that the hatchery policy will be finalized and a new status review of the UCR steelhead ESU will be completed in 2004.

4.3.3 Hydropower

The construction of Grand Coulee Dam blocked upstream migration in the Columbia River after 1938. This project not only eliminated populations of anadromous fish upstream of the dam, but the resultant hatchery mitigation plan likely influenced the UCR spring-run chinook salmon and UCR steelhead; fish from multiple populations were mixed into relatively homogenous groups and redistributed into streams and lakes throughout the region or raised and released from hatcheries. Grand Coulee Dam, as well as the large upstream storage projects in Canada, Idaho, and Montana, have affected the quantity and timing of runoff in the Columbia River. Compared with historical flows, the spring freshet has been greatly reduced, summer flows have been somewhat reduced, and fall and winter flows have been increased (NOAA Fisheries 2000a).

The five FERC-licensed Mid-Columbia River hydroelectric dams (Wells, Rocky Reach, Rock Island, Wanapum and Priest Rapids) and reservoirs have affected the mainstem migration corridor and reduced the survival of juvenile migrants. Each of these projects has license requirements and/or settlement agreements that specify operations or processes that govern operations for the purpose of reducing the effects of these projects on anadromous salmonids throughout the remainder of their FERC-issued licenses.

Four Federally-owned hydroelectric projects in the lower Columbia River (McNary, John Day, The Dalles, and Bonneville) have also affected the mainstem migration corridor and reduced the survival of juvenile and adult migrants. For these projects, the best estimates of recent juvenile and adult project survivals contributing to the rangewide status of UCR spring-run chinook salmon and UCR steelhead is contained in NOAA Fisheries' 2002 Findings Report (NOAA Fisheries 2002a) and the Federal action agencies' 2002 Progress Report (U.S. Army Corps of Engineers et al. 2003).

4.3.4 Habitat

Spawning and rearing habitat in the Columbia River and its tributaries upstream of the Yakima River includes dry areas where conditions are less conducive to salmon and steelhead survival than in many other parts of the Columbia River Basin (Mullan et al. 1992). Salmon in this ESU must pass up to nine Federal and non-Federal dams, and Chief Joseph Dam prevents access to historical spawning grounds farther upstream. Degradation of remaining spawning and rearing habitat continues to be a major concern associated with urbanization, irrigation projects, and livestock grazing along riparian corridors.

More detailed descriptions of tributary habitat conditions in the Methow and Okanogan River Basins are available in supporting document B (Aquatic Species and Habitat Assessment: Wenatchee, Entiat, Methow, and Okanogan Watersheds) of the HCP and in the Upper Columbia Regional Technical Team's (2003) report to the Upper Columbia Salmon Recovery Board titled "A biological strategy to protect and restore salmonid habitat in the Upper Columbia Region."

The estuary and near-shore ocean environment have also been changed by human activities. Historically, the downstream half of the estuary was a dynamic environment with multiple channels, extensive wetlands, sandbars, and shallow areas. Winter and spring floods, low flows in late summer, large woody debris floating downstream, and a shallow bar at the mouth of the Columbia River kept the environment dynamic. Today, navigation channels have been dredged, deepened, and maintained; jetties and pile-dike fields have been constructed to stabilize and concentrate flow in navigation channels; marsh and riparian habitats have been filled and diked; and causeways have been constructed across waterways. These actions have decreased the width of the mouth of the Columbia River from 4 miles to 2 miles and increased the depth of the Columbia River channel at the bar from less than 20 ft to more than 55 ft. Sand deposition at river mouths has extended the Oregon coastline approximately 4 miles seaward and the Washington coastline approximately 2 miles seaward.

More than 50% of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreational, agricultural, or urban uses. More than 3,000 acres of this habitat have been converted to other uses since 1948 (Lower Columbia River Estuary Program

1999). Many wetlands along the shore in the upper reaches of the estuary have been converted to industrial and agricultural lands after levees and dikes were constructed. Furthermore, water storage and release patterns from reservoirs upstream of the estuary have changed the seasonal pattern and volume of discharge. The peaks of spring/summer floods have been reduced, and the amount of water discharged during winter has increased.

4.4 Species-Level Biological Requirements

Species-level biological requirements are best defined as the attributes associated with VSPs (McElhany et al. 2000). Viable salmonid populations have a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. The attributes associated with VSPs include: adequate abundance, productivity (population growth rate), population spatial scale, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, and are therefore distinguished from the more specific biological requirements associated with the action area (described in Section 5) and the particular action under consultation (Section 6). Species-level biological requirements are influenced by all actions affecting the species throughout its life cycle. It is important that the action area biological requirements be considered in the context of these species-level biological requirements to evaluate the potential for the species to survive and recover given the comprehensive set of human activities and environmental conditions that it experiences.

By definition, most populations comprising listed species are not viable. Listed species will be considered recovered[5] when, among other things, factors for decline have been ameliorated and when a sufficient number of populations within the ESU have become viable. For ESUs with multiple populations, the spatial scale and diversity criteria for viable populations are addressed primarily by specifying the number of populations that must meet species-level biological requirements, as defined above. This is considered on an ESU-by-ESU basis, depending upon the degree to which populations, and their relation to one other within an ESU, have been delineated and the degree to which a mixture of populations within an ESU is required to maintain long-term evolutionary potential, including survival in the face of catastrophic events and other long-term demographic processes (McElhany et al. 2000). This information is

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[5] The regulatory terms *survival* and *recovery* are defined for use in the jeopardy/critical habitat analysis as follows.

Survival: The species' persistence, as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.

Recovery: improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the ESA. (50 CFR 402.02.)

(USFWS and NOAA Fisheries 1998).

incompletely developed for most ESUs at present. Therefore, when information to the contrary is absent, NOAA Fisheries will assume that all populations within an ESU must meet the species-level biological requirements described above to conclude that the entire ESU is meeting those biological requirements.

4.5 Species Status With Respect to Species-Level Biological Requirements

The current status of each species, as described in Sections 4.1 through 4.3, indicates that the species-level biological requirements described in Section 4.4 are most likely not being met. The abundance of UCR steelhead and UCR spring-run chinook salmon, while increasing in recent years, remains far below historic levels. This information clearly indicates that substantial improvements in survival rates (assessed over the entire life cycle and throughout the range of the ESUs) are necessary to increase abundance to meet species-level biological requirements of the ESA-listed ESUs in the future. Because the effects of this Project and the other projects have been identified as significant factors for decline, it is reasonable to expect that a portion of the needed survival improvement should be reflected in future operations at this Project, as well as the other projects.

5. ENVIRONMENTAL BASELINE

5.1 Action Area

The action area includes all areas affected directly or indirectly by the Federal action (50 CFR § 402.02). Direct effects of the Project on UCR spring-run chinook salmon and UCR steelhead are confined to the reservoir, forebay, dam, and tailrace. For the purposes of this Opinion, the action area relative to implementation of the IPP and ongoing operation of the Priest Rapids Hydroelectric Project is defined as the mainstem Columbia River from approximately 1,000 ft downstream of Rock Island Dam, to roughly 1,000 ft downstream of Priest Rapids Dam, a distance of approximately 56 river miles.[6]

5.2 Biological Requirements Within the Action Area

The biological requirements within the action area are those conditions that support the continued existence of the ESU by addressing the population-level biological requirements. Within the action area, the biological requirements of the listed species stem from the essential features of juvenile rearing areas and juvenile and adult migration corridors. Therefore, the biological requirements for the listed species include adequate substrate, adequate water quality (including quantity, temperature, and velocity), adequate cover and shelter, adequate riparian vegetation, adequate space, and adequate conditions for safe passage. In addition, an adequate food supply is required in juvenile rearing areas. NOAA Fisheries assumes that access to these biological requirements can be estimated via adult and juvenile reach survivals, which include both direct and indirect (delayed) effects of project passage and include natural mortality. As a reference for determining whether biological requirements are met, NOAA Fisheries calculates survival as a percentage of that expected in a free-flowing reach of equal length.

5.3 Environmental Baseline Effects

"The past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all the proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" are all included within the environmental baseline (50 CFR §402.02). The environmental baseline encompasses the effects of both human and natural factors leading to the current status of the species in the action area, including the past and present operation of an existing project that is under

[6] Project effects on water quality parameters (temperature and TDG) are cumulative in nature and accordingly must be considered in a broader context. Currently, the Environmental Protection Agency, the Washington Department of Ecology, and the Oregon Department of Environmental Quality, in consultation with NOAA Fisheries, are evaluating these standards in the mainstem Snake and Columbia Rivers and will allocate loads to meet those standards in the near future.

consultation. However, future impacts resulting from the operation of the Project, and other activities authorized pursuant to the proposed action, are not part of the environmental baseline.

Although the action area described in Section 5.1 only encompasses a small part of the species' range, up to 100% of the juvenile and adult populations have been affected by the existing conditions in the migration corridor. While the historical existence and operation of the Project have affected current status under the environmental baseline, the continued existence and operation of the Project are the subject of the proposed action and therefore are not in the baseline. Because the proposed action is essentially a continuation of recent operations, mortality and sublethal effects (e.g., changes in migration timing or speed) associated with river impoundments, dam passage, and other aspects of project operations within the action area in recent years are summarized in Cooney (2002) and Section 6 of this Opinion.

Similarly, the past operation and continuing effect of the existence of three other FERC-licensed dams (Wells, Rocky Reach, and Rock Island) and Federal projects (Grand Coulee and Chief Joseph Dams) have substantially affected, both directly and indirectly, the environmental baseline in the action area. The past effects of the Wells, Rocky Reach and Rock Island Developments are summarized in Cooney (2002) and the December 2002 Final Environmental Impact Statement for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects' Anadromous Fish Agreements and Habitat Conservation Plans. The effects of past and continued operation of the Grand Coulee and Chief Joseph Dams, and Canadian storage and hydroelectric projects, have also affected the environmental baseline within the action area by affecting seasonal and daily flows, the thermal regime, and TDG levels in the Mid-Columbia River.

NOAA Fisheries can consider the future downstream effects of the Wells, Rocky Reach, and Rock Island Developments in the environmental baseline for the present action because ESA Section 7(a)(2) consultation was completed for these projects on August 12, 2003. These effects are most likely described by elevated TDG levels due to (infrequent) high river discharges, which increase the incidence of mortality or sublethal effects related to gas bubble trauma in the action area for the Project (NOAA Fisheries 2003). However, effects on the environmental baseline in the action area from upstream Federal storage projects cannot be considered in this Opinion because the ESA Section 7(a)(2) consultation has been remanded.[7]

[7]The 2000 biological opinion for the operation of the Federal Columbia River Power System (FCRPS) was remanded but not set aside while NOAA Fisheries considers remedies to address concerns identified by the Court in NWF v. NMFS, CV 01-640-RE (D. Or. Order dated 6/2/03). For the purposes of this consultation, the effects of the RPA recommended by that biological opinion are not considered part of the environmental baseline. NOAA Fisheries is currently in consultation with the FCRPS action agencies and is collaborating with the regional fisheries co-managers to develop a new opinion. Although the collaboration effort is likely to extend the date of issuance for the new opinion past June 2, 2004, a new date has not been approved by the Court. This means that the existing effects of the FCRPS, which are part of the environmental baseline, will include the effects of the current operation under the 2000 biological opinion RPA until some unknown date after June 2, 2004. While this is the legal effect of the restrictions in the regulatory definition of "effects of the action" 50 CFR §402.02 (no consideration of future

5.3.1 Proposed Spill and Flow Deflectors at Wanapum Dam

The following discussion describes physical and operational changes to the Project that were instituted subsequent to initiation of this consultation in 1999. These changes are included here because they are part of the environmental baseline analyzed in this Opinion.

In 1996, Grant PUD installed and tested a prototype deflector in spill bay 2. The deflector was successful at reducing TDG levels, but the estimated fish survival rates were too low and there was evidence that the design might cause erosion of the spillway apron downstream. Based on modeling evaluations, Grant PUD installed a different design in spill bay 4 in 1998. This deflector did not appreciably reduce TDG and produced unsatisfactory fish survival rates at higher flow levels. Further modeling resulted in the design of a third prototype, which was installed and tested in spill bay 5 in 1999. This design satisfied both TDG and biological criteria (Normandeau 2000; Parametrix 2000).

Also in 1998, Grant PUD began implementing the proposed spill program for juvenile UCR spring-run chinook salmon and juvenile UCR steelhead. However, due to the ongoing analysis of the flow deflector in spill bay 5, and the TDG limit (120% saturation), spill was limited to roughly 20% of average river flow at Wanapum Dam. To compensate for the reduced spill level at Wanapum, Grant PUD spilled approximately 76% of average river flow at Priest Rapids Dam during the spring migration season.

The third prototype flow deflector was installed at all spill bays during the winter of 1999/2000. With flow deflectors in place, it was anticipated that spill could be increased at Wanapum to the proposed spill level of 43% of average river flow, and spill would be scaled back at Priest Rapids to the proposed 61%. Therefore, beginning with the spring outmigration season of 2000, Grant PUD has implemented the proposed spill program. While spring spill at Priest Rapids Dam has averaged about 61% since 2000, spill at Wanapum has ranged between 34% and 38% due to TDG criteria. The one exception is that, during the drought of 2001, Grant PUD was able to maintain spill at Wanapum at 43% due to low river flows.

5.4 Status of the Species Within the Action Area

As described in Section 6.4.3, the environmental baseline, including the historical effects of the Project, only equates to 79% to 85% of the juvenile survival rate in a free-flowing reach of equal

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Federal actions that have not yet completed Section 7 consultation), as a practical matter, this analysis only qualitatively assumes that the future level of take caused by the FCRPS (Section 4.3.3) will be reduced in the action area as a result of this consideration. Quantitative estimates of this reduced take are not possible.

length. Therefore, even though recent returns of these species has improved,[8] the environmental baseline within the action area does not meet the biological requirements. Maintenance or further degradation of the existing conditions within the action area would contribute to the long-term declining trend of the ESA-listed species and thus would continue to increase the high risk of extinction on which the listings were based. Measures must be taken at the Project to avoid or minimize ongoing impacts that have contributed to the trend towards extinction and to aid in establishing improved conditions whereby each species will continue to exist into the future while retaining the potential for recovery. The successful implementation of these measures at the Project is necessary for the proposed action to avoid jeopardizing the listed species.

[8]Because recent returns have been above average and because continuing operation of the Project and other Federal actions that have not undergone Section 7 consultation are not in the baseline, the species' status would be expected to improve in the future.

6. EFFECTS OF PROPOSED ACTION

6.1 Analytical Methods

In this section, NOAA Fisheries evaluates the effects of the proposed action using the five-part approach for applying the ESA jeopardy standard to Pacific salmon described in Section 1.1. During this step of the analysis, effects of the action are evaluated with respect to action area biological requirements. Specifically, NOAA Fisheries evaluates whether or not the proposed action results in a reduction of the reproduction, numbers, or distribution of the species which constitutes an appreciable reduction in the likelihood of both survival and recovery. This determination is informed by the rangewide status of the species and the effects of the environmental baseline and cumulative effects in the action area. To identify action-area biological requirements, NOAA Fisheries looks to the survival that would likely have occurred in a free-flowing river of equal length (i.e., survival that would likely have occurred if the project did not exist). NOAA then considers how much the survival through the reach under the proposed action is reduced from that of the unimpounded reach, recognizing that an unknown portion of any reduction is attributable to the environmental baseline. The status of the species and the magnitude of the effect of the environmental baseline and cumulative effects guide the judgment of whether the reduction also appreciably reduces the likelihood of both survival and recovery. NOAA Fisheries also qualitatively evaluates any remaining project-related effects and the effects of interrelated and interdependent actions within the entire action area (including those in the tributaries and downstream of the project) by comparing the expected effect of the proposed action on the specific species-level biological requirements of these species.

6.1.1 Methods for Evaluating Action-Area Biological Requirements

It is difficult to define a level of adequacy for many biological requirements of Pacific salmonids through specific, measurable standards. In many cases, the relationship between the critical habitat element and species survival is not clearly understood. However, as noted in Section 1.1.2, this is not the case with respect to the effects of the Project itself. Various mainstem migration corridor habitat elements relevant to achieving the biological requirements of the listed species within the Project area can be captured in summary reach survival statistics for both juveniles and adults. For this reason, although FERC has proposed that Grant County PUD achieve a dam passage survival standard of 95% for 95% of the juvenile spring migrants, NOAA Fisheries believes that a reach survival standard, which accounts for the effects of passage through the reservoirs as well as past the dams, is a better indicator metric. Thus the primary approach to evaluating the proposed action in the action area is to estimate juvenile and adult survival rates through the Project area (reservoir, forebay, dam, and tailrace). These estimates include both direct and indirect (or delayed) mortality related to Project impacts, and include natural mortality.

Project-level survival rates should capture the great majority, although not necessarily all, of the impacts of the Project's existence and operation on the listed species' action-area biological requirements in the mainstem Columbia River. The biological requirements also include:

- Adequate Substrate and Adequate Food Supply for Juveniles: The impoundment of water by the Wanapum and Priest Rapids Developments has probably changed the characteristics of substrate in each reservoir reach from gravel and cobble to finer material. Gravel and cobble substrate with a low percentage of fines is desired for salmon spawning and incubation. However, this change in substrate is unlikely to affect adults or early life stages of UCR spring-run chinook salmon or UCR steelhead because they are tributary spawners. It is possible that the change in substrate has influenced food production, possibly reducing feeding success and growth of smolts migrating through the impounded reach. However, evidence for this effect is speculative at present (ISG 1996). NOAA Fisheries assumes that if such an effect occurs, it is likely to be captured in either the direct survival or indirect mortality rates estimated later in this section.

- Adequate Water Quality: The primary characteristics of water quality affected by operations of the Priest Rapids Hydrolectric Project are TDG levels and temperature. This effect would presumably be observable in estimates of adult and juvenile survival rates.

- Adequate Cover and Shelter: Impoundment of water has modified the physiographic complexity of this reach compared to conditions in a free-flowing river, resulting in a modification of cover and shelter and a potential change in predation on juveniles of listed species. This effect would presumably be observable in estimates of adult and juvenile survival rates.

- Adequate Space and Conditions For Safe Passage: The configuration and operation of the Priest Rapids Hydroelectric Project primarily affects the safe passage of juveniles and adults through the action area. Safe passage is captured in adult and juvenile survival rates.

6.2 General Effects on UCR Spring-Run Chinook Salmon and UCR Steelhead

Upper Columbia River spring-run chinook salmon and UCR steelhead from the Methow and Okanogan Rivers must pass through nine hydropower developments: Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids Dams, and four lower Columbia River Federal dams, during their migrations to and from the Pacific Ocean. Entiat River spring-run chinook salmon and steelhead must pass through eight developments and Wenatchee River spring-run chinook salmon and steelhead must pass through seven developments. The direct effects of the Columbia River dams include blocking of habitat, altering of habitat, and presenting barriers to or otherwise modifying juvenile and adult migrations. Injury and mortality occur during downstream passage through turbines, juvenile fish bypass systems, and to a lesser degree, spill. Indirect effects of passage though all routes may include disorientation, stress, passage delay, exposure to high concentrations of dissolved gases, exposure to high water temperatures, and the cumulative effects of the above. Although direct mortality of adults is probably minimal during passage at individual dams, each dam presents the potential for delay at fishway facilities, energy expenditure in passage through multiple fishways, involuntary fallback, and, during periods of involuntary spill, increased exposure to high concentrations of dissolved gases. For adults that reach spawning areas, the cumulative indirect effects associated with passage through multiple dams can reduce fecundity and reproductive success. However, the relationship between passage components and reproductive success is not well understood (NOAA Fisheries 2000a).

The hydropower system may also positively affect some aspects of the upstream migration. For example, the travel time and energy expenditures of the upstream migrants may be reduced in reservoirs relative to free-flowing rivers. However, the true direction and magnitude of cumulative effects on adult passage are unknown.

6.2.1 Juveniles, General Effects

Juvenile salmon and steelhead pass Columbia River dams through various routes including turbines, spillways, sluiceways, bypass systems, and dipnetting from gatewells. Some juvenile mortality is associated with all passage routes, but generally the highest levels of mortality occur during passage through turbines (Whitney et al. 1997). Therefore, to increase survival, an important objective of project operations is to route the highest possible proportion of juveniles past a project in a manner that avoids passage through turbines. The proportion of smolts that pass a project through non-turbine routes, e.g., bypasses or spillways (FPE) is an important indicator of the effectiveness of juvenile passage protection measures.

Passage Through Reservoirs

Juvenile mortality in tailraces and reservoirs may result from increased predation exposure, migrational delays, GBD, and altered water temperatures. Passage through reservoirs prolongs migrations and requires higher energy expenditures for juvenile salmonids to reach the ocean. Stress from multiple passage events can deplete energy reserves and cause disease. Prolonged migrations can also cause inappropriate timing for sea-water entry and higher rates of residualism.

The physical effects of water regulation and impoundment are well known (e.g., NOAA Fisheries 1995; ISG 1996) and can be related to the biological requirements of UCR spring-run chinook salmon and UCR steelhead in the migration corridor. Water regulation at Federal projects modifies the river's natural hydrograph and has an impact on the estuary and the ocean area influenced by the Columbia River plume. Water regulation reduces flows that would naturally occur in the spring and this, in turn, reduces water velocity. Water velocity is further reduced by impoundments on the mainstem river sections, increasing volume and cross-sectional area and creating reservoirs from formerly free-flowing river sections.

Water regulation and impoundments also change water quality factors such as temperature (increased due to mass heat storage) and turbidity (decreased), as well as salmonid prey production (which changes from riverine aquatic insects to lacustrine planktonic organisms). Load-following power operations may impact juvenile outmigrants by desiccating the littoral zone, thereby reducing the available food sources and by stranding and entrapping newly emergent fry, as noted in Section 6.1.1. Channel complexity is also reduced in reservoirs, which affects the complexity of fluid dynamics and substrate type (ISG 1996). Change in substrate probably does not affect adults or early life stages of UCR spring-run chinook salmon and UCR steelhead, as both of these species are tributary spawners. It is possible that the change in substrate has influenced food production, possibly reducing feeding success and growth of smolts migrating through the impounded reach. However, evidence for this effect is speculative at present (ISG 1996). If such an effect occurs, it is likely to be captured in either the direct survival or indirect mortality rates estimated later in this section. The presence of the Priest Rapids Hydroelectric Project may also decrease gravel recruitment to downstream reaches. This latter effect would be most likely to influence the spawning success of unlisted mid-Columbia River mainstem spawning species (e.g., Middle Columbia River chinook salmon), but would have little or no effect on UCR spring-run chinook salmon or UCR steelhead.

Passage Through Turbines

Juvenile salmonid turbine passage survival studies published through 1990 at the Snake and lower Columbia River dams have been reviewed by Iwamoto and Williams (1993). The Independent Scientific Group (ISG 1996) and Whitney et al. (1997) reviewed studies published through 1995, including several from the mid-Columbia River projects. Estimates of turbine mortality vary greatly among studies, ranging from 2.3% to 19%. Whitney et al. (1997) noted that in studies where marked fish were immediately recovered in the tailrace, mortality estimates were less than 7% (average 5.5%). In studies with longer times between turbine passage and recovery, mortality levels averaged 10.9% (Whitney et al. 1997). Whitney et al. (1997) also suggested that the lower survival estimates likely included some level of mortality only indirectly associated with turbine passage, such as predation on disoriented smolts. Both direct and indirect mortality of juvenile salmonids passing through turbines varies among projects and depend upon operating conditions, inherent efficiencies of the turbines, and other factors (ISG 2000).

In recent years, evaluations of the direct and indirect effects of juvenile fish passage through Kaplan-type turbines were conducted under operations presumed to provide the best conditions for fish, i.e., turbine operations within 1% of peak efficiency. NOAA Fisheries' turbine survival studies in the Snake River produced estimates of 92.7%, 92.0%, and 86.5% at Lower Granite, Little Goose, and Lower Monumental Dams in 1995, 1993, and 1994, respectively. Steelhead survival from turbine passage at Little Goose Dam in 1997 was 93.4% under similar conditions (Muir et al. 2001).

Passage Through Spillways
Whitney et al. (1997) reviewed 13 estimates of spill mortality (3 for steelhead and 10 for salmon) published through 1995 and concluded that 0% to 2% mortality is the most likely range for standard spill bays. It was also pointed out that local conditions, such as back eddies or other situations that favor predators, may lead to higher spillway passage mortality. Nevertheless, relative to other means of passage currently available, spillways are considered the most benign routes for juveniles to pass the mid-Columbia River projects, including the Priest Rapids Hydroelectric Project (Chapman et al. 1994a,1994b). Increasing spill can result in higher levels of TDG and thus a greater incidence of gas bubble trauma in UCR spring-run chinook salmon and UCR steelhead. This emphasizes the importance of the physical and biological TDG monitoring programs at the PUD and Federal dams.

6.2.2 Adults, General Effects

Three specific components of the adult migrations through the Priest Rapids Hydroelectric Project may affect listed species: delay at project fishways, passage success at project structures, and injuries and mortalities resulting from upstream and downstream passage through project facilities. Each of these components has the potential to increase pre-spawning mortality. For fish that do reach spawning areas, indirect effects associated with passage through multiple dams may reduce fecundity and reproductive success. Unfortunately, the relationship between each of these passage measures and reproductive success is not clearly understood.

Adult UCR spring-run chinook salmon and UCR steelhead pass upstream via fishways that were installed during the original construction of both developments. The fishways typically consist of an entrance gallery and ladder, a diffuser system that provides additional water at the ladder entrances (to attract fish from the tailrace), and a flow control section at the ladder exit that maintains ladder flow over varying forebay elevations. Observation areas have been established in the ladder to monitor upstream progress. Migrational delays are most likely to occur at fish ladder entrances, in the collection galleries, and during operation of traps. Injury related to fish passage facilities is usually minimal; however, system failures (especially at diffuser gratings in the entrance pools) can result in significant injury and mortality.

Adult passage information (e.g., time spent immediately downstream of the dam, success at passing into the collection channel and fishway entrances, time taken to traverse the ladder, etc.) is typically evaluated using radiotelemetry techniques. Project passage assessments determine how well radio-tagged fish pass from the tailrace of a specific dam into and through the fish ladders. The underlying assumption is that the behavior of radio-tagged fish is generally similar to untagged fish. Laboratory assessments of tagged and untagged fish and several years of field evaluations support this assumption, although little information is available regarding delayed effects of tagging on reproductive success. A direct relationship has not been established between project passage times and reproductive success, although reducing passage times to the greatest extent possible should reduce energy expenditures and improve the likelihood that adult fish will survive to spawn. Although specific criteria are not available, obvious delays in passage may indicate a need for operational or structural modifications.

Adult radio-tagged fish are monitored with aerial and underwater antennas as they move through the tailrace and into and through the fish ladders. Additional information can be collected by tracking radio-tagged fish from a boat or plane. By definition, project passage times are only developed for radio-tagged fish that successfully bypass the dam. Although fish that do not pass the dam are of equal or greater concern, it is extremely difficult to determine the cause of this behavior. Failure to bypass a dam may result from poorly designed passage facilities, inadequate attraction water, or complicated flow patterns exacerbated by project operations. These fish may also be destined for a downstream spawning location, or may have been injured prior to reaching the dam (as a result of natural or other effects). Tagging effects or regurgitated tags, neither of which are related to the operation of dams, can also affect the results. As a result, the detection rate of radio-tagged fish cannot be used to isolate specific cause-and-effect relationships between passage and reproductive success. The information can be used, however, to generally assess the success of adult salmonids migrating upstream through the Columbia River corridor and to develop an index that can be used to assess annual improvements in passage conditions.

Obtaining robust estimates of adult salmon and steelhead survival is also difficult, especially when attempting to use passage counts at mainstem hydroelectric dams. Radiotelemetry studies conducted prior to 1996 (e.g., Stuehrenber et al. 1995) in the mid-Columbia River are unreliable because of problems associated with the tags, receivers, and software used at the time. For example, Wainwright et al. (2001) found that Lotek receivers had data gaps ranging from tens to hundreds of hours over the course of the season, and a substantial number of false positives (tags that were already removed from the river, etc.) were included in the data set. Therefore, mortality rates (based on radiotelemetry) attributable to the effects of hydroelectric projects are undoubtedly lower than those presented, but to an unknown extent. For these reasons, it is most appropriate to consider survival estimates based on radiotelemetry studies as minimum estimates of total adult survival, which includes unknown tag loss as well as project-caused and natural mortality.

Radiotelemetry studies conducted as part of NOAA Fisheries (2000a) provided estimates of per project survival for adult UCR spring-run chinook salmon and UCR steelhead passing the four lower Columbia River dams (Bonneville, The Dalles, John Day, and McNary). The estimated mortality for UCR spring-run chinook salmon is 1.9% to 2.4%, and for UCR steelhead 2.7% to 3.2% (Table 9.7-2 in NOAA Fisheries 2000a). NOAA Fisheries believes these estimates are also generally applicable to all five of the FERC-licensed projects on the Columbia River, including the Wanapum and Priest Rapids Developments. As discussed above, it is not possible to differentiate natural effects from system-related effects at this time.

The importance of steelhead kelts (adults that have spawned and are migrating back downstream to the ocean) to inland populations of steelhead in the Columbia River Basin has received greater attention in recent years. The proportion of adults that spawn and migrate to the ocean as kelts is much higher than previously thought. English et al. (2001a) estimated that between 13% to 75% of the adult steelhead migrating upstream of Rocky Reach Dam in 1999 began migrating downstream as kelts in 2000.

In the Snake River, it is estimated that the proportion of wild adult steelhead attempting to outmigrate as kelts in 2001 was at least 25% of the ESA-listed adults migrating past Lower Granite Dam in 2000. The majority of these fish (>70%) were considered to be in good condition. However, it appears that few steelhead kelts survive the migration to the ocean and back to their natal streams. For example, only 3% (7/212) of the kelts radio tagged at Lower Granite Dam on the Snake River were detected at Bonneville Dam in 2001. The importance of multiple spawning by UCR steelhead to population dynamics is not well understood. Long and Griffin (1937) estimated that only 2% of the summer-run steelhead were repeat spawners, which comports with the findings of McGregor (1986) in the Thompson River Basin in Canada. However, should these fish successfully survive the mainstem Columbia River migration corridor and the ocean life-stage(s), even these small numbers could potentially enhance the reproductive capabilities of the endangered UCR steelhead ESU.

6.3 Project-Specific Effects on UCR Spring-Run Chinook Salmon and UCR Steelhead

The following sections describe the effects that interim operation of Wanapum and Priest Rapids Dams will have on juvenile UCR spring-run chinook salmon and UCR steelhead. NOAA Fisheries reviewed the analysis contained in the biological assessment and considers additional data in the following sections, expecially PIT-tag estimates which NOAA Fisheries considers to be the best information available on juvenile project survival. PIT-tag studies at mid-Columbia River dams rely primarily on subsequent detections at McNary Dam (and other lower Columbia River FCRPS projects). Therefore, survival estimates derived from PIT-tag studies are more likely to capture any direct, indirect, or delayed effect of the project than radiotelemetry, acoustic tag, or balloon tag studies. However, PIT-tag studies do not provide route-specific survival data (e.g., turbine passage vs. spill) because they rely upon subsequent detections in downstream bypass systems (i.e., PIT-tags cannot be detected in spillways or turbine units). Radiotelemetry studies have been conducted by Grant PUD to attain route-specific survival estimates. Both route-specific survivals (radiotelemetry studies) and project-level survivals (PIT-tag studies) are discussed below.

6.3.1 Juvenile Passage, Wanapum Development

6.3.1.1 Radiotelemetry Studies

Results from the most recent series (1999-2003) of radiotelemetry studies for juvenile yearling chinook salmon and steelhead are summarized in Table 2, below. The provisional survival standard of 95% at the dam (Section 3.1.1) was satisfied in 1 of the 5 years.

Table 2. Summary of estimated pool, dam, and project survival for juvenile steelhead and chinook salmon passing the Wanapum Development, 1999-2003.

Year	Species (Rearing Type)	Method	Survival Estimate Pool	Survival Estimate Dam	Survival Estimate Project
1999[a]	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.896	0.907	0.813
2000[b]	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.8451	0.8911	0.7499
2001	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.8857	0.8627	0.7641
2002[c]	Yearling Chinook Salmon (Run-of-River)	Radiotelemetry Paired Release	0.9123	0.9093	0.8296
2003[d]	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.6623	1.0353	0.6857

[a]Sensitivity analyses indicated that severe model violations had occurred, which invalidated the survival estimates (Miller et al. 2000). NOAA Fisheries reports these estimates for the sake of comparison, and notes that,despite the violation of model assumptions, the results appear to be consistent with subsequent studies.
[b]As reported in English et al. (2001b).
[c]Survival estimates from English et al. 2003. Test fish in 2002 were released roughly 4 miles upstream of Wanapum Dam, thus eliminating nearly 90% of the Wanapum pool; therefore, NOAA Fisheries does not believe this to be a valid estimate of total pool survival.
[d]Survival estimates from English et al. 2003; results are preliminary and subject to further analysis.

1999 Study
A pilot radiotelemetry study was conducted with run-of-river steelhead smolts during the spring passage season in 1999. The purpose was to examine this evaluation technique for estimating survival past both developments. The point estimates for pool, dam, and project (pool x dam) survival were 89.6%, 90.7%, and 81.3%, respectively. However, sensitivity analyses indicated that severe model violations had occurred, which invalidated the survival estimates (Miller et al. 2000). NOAA Fisheries reports these estimates for the sake of comparison, and notes that, despite the violation of model assumptions, the results appear to be consistent with subsequent studies.

2000 Study
Having gained some experience with the pilot study, Grant PUD again employed radiotelemetry of steelhead smolts for the 2000 spring migration season. Route-specific estimates were added to compare relative survival between spill, skim spill (sluiceway), and turbine passage.

Spill deflectors were installed on the Wanapum spillway prior to the 2000 fish passage season. Grant PUD attempted to implement the proposed spring spill levels at both Priest Rapids and Wanapum Dams – up to 61% and 43%, respectively. However, it was necessary to restrict spill to stay within the 120% TDG limit; spring spill averaged 37.6% at Wanapum (Grant PUD 2000, 2001).

Wanapum Dam and pool survival estimates were 89.1% and 84.5%, respectively, with a combined survival estimate for the Wanapum Development of 75% (English et al. 2001b). Route-specific survival estimates (Table 3) for passage through the turbines, spillway, and sluiceway were 87.5%, 88.8%, and 92.9%, respectively. The proportion of juveniles per route was estimated to be 22.6% through the spillway, 31% through the sluiceway, and 46.4% through the turbines (Skalski et al. 2000). Fish passage efficiency (calculated as 1 minus portion of fish using the turbine route) was approximately 54%.

2001 Study

In 2001, the Pacific Northwest experienced drought conditions, combined with a power emergency. Below normal flows in the Columbia River and the high cost of electricity resulted in reduced spill at hydroelectric facilities upstream of Wanapum. Thus TDG levels coming into Wanapum were reduced, allowing Grant PUD to maintain the proposed spill levels for the entire spring fish passage season without exceeding the TDG cap of 120%. Spill averaged 43.2% at Wanapum Dam.

Radiotelemetry work for 2001 was carried out using hatchery yearling chinook salmon smolts. The survival estimates for Wanapum Dam and pool were 86.3% and 88.6%, respectively, with a combined survival estimate of 76.4%. Route-specific survival estimates for passage through the turbines, spillway, and sluiceway were 91.2%, 87.9%, and 83.8%, respectively (Table 3). The proportion of juveniles per route was estimated to be 26.9% through the spillway, 35.5% through the sluiceway, and 37.6% through the turbines. Fish passage efficiency was approximately 62%.

2002 Study

Grant PUD continued the yearling chinook salmon radiotelemetry studies in 2002 with an added element of testing a top spill route in a single bay of the Wanapum spillway. The tainter gates at the Wanapum spillway open from the bottom, thus spilling water at a depth of approximately 50 ft. In general, smolts are surface-oriented during their migration and must sound to pass through either the spillway or powerhouse at Wanapum. Furthermore, the sluiceway, which skims roughly 2,000 cfs from the surface, has shown to provide good passage efficiencies (up to 3:1 [fish:water]). Based on this data, Grant PUD installed a bulkhead in spill bay 12 – adjacent to the sluiceway – designed to spill water from the top 20 ft and to pass 10,000 to 13,000 cfs, depending on forebay elevation.

The bulkhead was installed and tested for injury and mortality rates and TDG production prior to the onset of the spring fish passage season. Biological and TDG test criteria were satisfied during initial testing and the MCCC determined that Grant PUD should proceed with a full passage season test of the top spill route. This was accomplished in conjunction with the radiotelemetry study. The radiotelemetry study included five replicates with two test blocks in each replicate. One test block consisted of 4 days of proposed spill (43% of flow or TDG limit) and the second block consisted of 4 days of top spill only.

After two replicate tests, the MCCC reviewed preliminary fish guidance efficiency data, based on radio-tag detections, to determine if training spill[9] was needed. It was decided that additional spill was needed (due to unsatisfactory results) and Grant PUD provided roughly 22,000 cfs of training spill through the adjacent five spill bays (bays 11 through 7).

Route-specific survival estimates for passage through the turbines, spillway, sluiceway, and top spill were 95%, 86%, 89%, and 88%, respectively (Table 3). The proportion of juveniles per route was estimated to be 66.4% through the turbines, 21.5% through the spillway, 2.3% through the sluiceway, and 9.8% through top spill. Fish passage efficiency was approximately 34%. Point estimates for survival through the Wanapum Dam and pool were 91% and 91%, respectively, with a combined survival estimate of 83% (Table 2)

It should be noted that the estimate for portion of fish passing via top spill is a combined estimate for the spring passage season as a whole. The estimate for percentage of fish that used this route during top spill only had not been reported at the time this Opinion was completed. Furthermore, the test fish were released in the Wanapum pool at Vantage Bridge in 2002, roughly four miles upstream of Wanapum Dam. This release point was chosen to ensure tag life through the whole Priest Rapids Hydroelectric Project. However, because this eliminated the effect of passage through nearly 90% of the Wanapum pool, NOAA Fisheries does not consider the pool survival (point estimate of 94.1%) to be a valid estimate of total pool survival.

2003 Study

The radiotelemetry results reported for 2003 are still under evaluation by Grant PUD and subject to change. Spring spill configurations were considerably different from the previous study years (2000-2002) in that different spill patterns were used in an effort to improve survival. Route-specific survival estimates for passage through the turbines, spillway, and top spill were 98.3%, 88.3%, and 100.1%, respectively (Table 3). The sluiceway was not analyzed in 2003. Point estimates for survival through the Wanapum Dam and pool were 103.5% and 66.2%, respectively, with a combined survival estimate of 68.6%. The greater than 100% survival estimate through the dam is likely due to control groups experiencing greater mortality than the upstream release groups.

[9]Training spill entails additional release of water through adjacent spill bays to potentially improve fish guidance efficiency as well as egress from the tailrace.

Table 3. Summary of route-specific survival estimates at Wanapum Dam.

Year	Study Technique	Species (Rearing Type)	Percentage Route-Specific Survival Estimates			
			Turbine	Spillway	Sluiceway	Top Spill
2000	Radio-telemetry	Steelhead (Run-of-River)	87.5	88.8	92.9	
2001	Radio-telemetry	Yearling Chinook Salmon (Hatchery)	91.2	87.9	83.8	
2002[a]	Radio-telemetry	Yearling Chinook Salmon (Run-of-River)	94.7	85.5	89.0	87.6
2003[b]	Radio-telemetry	Yearling Chinook Salmon (Hatchery)	98.3	88.3		100.1

[a]English et al. 2003.
[b]English et al. 2003; results are preliminary and subject to further analysis.

6.3.1.2 Gatewell Dipnetting

Juvenile UCR spring-run chinook salmon and UCR steelhead can be entrained in the turbine unit gatewells at Wanapum Dam. There are a total of 60 gatewells (6 per unit). Grant PUD dipnets 3 gatewells per unit on a daily basis (30 gatewells total) during the spring fish passage season. Fish removed from the gatewells are quickly transported by truck to a point downstream of the dam and released. Typically, gatewells associated with turbine units that have been offline for over 24 hours are not dipnetted, but are normally dipnetted twice within 24 hours after shutdown to remove as many remaining fish as possible. On days where wind exceeds 20 or 25 miles per hour, dipnetting ceases for safety reasons.

Monitoring records indicate that, on average, over 56,000 juvenile spring-run chinook salmon and 10,000 juvenile steelhead are removed annually from the gatewells and transported to the tailrace. The fate of fish that are not successfully removed from the gatewells is unknown. These fish either remain in the gatewells, exit the powerhouse through the turbines, or move back into the forebay. The gatewell dipnetting program provides a means to monitor downstream migration timing and density, and NOAA Fisheries assumes that removing roughly half of the juveniles caught in the gatewells increases the survival of UCR spring-run chinook salmon and UCR steelhead passing the dam.

6.3.1.3 Predator Control Program

The predation rates of the northern pikeminnow on juvenile salmon and steelhead in the Wanapum tailrace are among the highest of the mid-Columbia River projects (Ward et al. 1995).

Studies estimate that annual losses of salmonids in the Wanapum Reservoir are approximately 200,000 fish, although most are probably non-listed summer migrants (NOAA Fisheries 2000b).

Grant PUD implements predator control measures to increase juvenile passage survival through the reservoir. A northern pikeminnow population reduction program has been underway since 1995 and will continue as part of Grant PUD's fish passage program. During 2002, the program removed 41,413 northern pikeminnow from the Wanapum tailrace and the Priest Rapids pool (Grant PUD 2002). While the resultant change in juvenile survival has not been quantified, it is likely that Grant PUD's pikeminnow removal program has had a positive effect on survival through the Priest Rapids Hydroelectric Project .

FERC's 1999 biological assessment stated that avian predation on juvenile salmonids may be significant. Ruggerone (1986) estimated that up to 2% of smolts passing the Wanapum Development are consumed by gulls. FERC proposes to ensure that wiring strung across the tailrace to interfere with avian predators is maintained, and proposes to continue with hazing, which is an important part of the predator control program.

6.3.2 Juvenile Passage, Priest Rapids Development

Results from the most recent series (1999-2003) of radiotelemetry studies for juvenile yearling chinook salmon and steelhead are summarized in Table 4, below. The provisional survival standard of 95% at the dam was satisfied in 1 of the 5 years.

6.3.2.1 Radiotelemetry Studies

1999 Study
A pilot radiotelemetry study was conducted with run-of-river steelhead smolts during the spring passage season in 1999. The purpose was to examine this technique for evaluating survival past both developments. The point estimates for pool, dam, and project (pool x dam) survival were 95.8%, 89.8%, and 86.0%, respectively (Table 4). Grant PUD implemented its proposed spring spill passage program per the LSOP. The proposed spill level was 80% of total flow at the Priest Rapids Development. Over the spring passage season, spill averaged 76.2% of total river flow.

2000 Study
Grant PUD again employed radiotelemetry of run-of-the-river steelhead for the 2000 spring migration study and added route-specific estimates to compare relative survival between spill, skim spill (sluiceway), and turbine passage routes. Also, starting with the spring fish passage season in 2000, Grant PUD implemented the proposed spill level of 61% at the Priest Rapids Development. Actual spring spill averaged 55.6% (Grant PUD 2000, 2001), which reflects spill restrictions to within the 120% TDG limit.

Priest Rapids Dam and pool survival estimates were 98.5% and 90.0%, respectively, with a combined survival estimate for the Priest Rapids Development of 88.6% (Table 4). Route-specific survival estimates for passage through the turbines and spillway were 99.4% and 98.8%, respectively (Table 5). The proportion of juveniles per route was estimated to be 70.3% through the spillway and 29.7% through the turbines. Fish passage efficiency was approximately 70%. There was no sluiceway estimate in 2000 due to difficulty with deploying antenna arrays at this location (Skalski et al. 2000).

2001 Study

As described for Wanapum Dam, the Pacific Northwest experienced drought conditions and power emergencies in 2001, resulting in reduced spill at hydroelectric facilities upstream of the Priest Rapids and Wanapum Developments. Thus TDG levels coming into Priest Rapids Dam were reduced, allowing Grant PUD to maintain the proposed spill levels for the entire spring fish passage season without exceeding the TDG cap of 120%. Spill averaged 61.2% at Priest Rapids Dam.

Radiotelemetry work for 2001 was carried out using hatchery yearling chinook salmon smolts. Point estimates for survival through the Priest Rapids Dam and pool were 91.2% and 95.1%, respectively, with a combined survival estimate of 86.7%. Route-specific survival estimates for passage through the turbines, spillway, and sluiceway were 85.9%, 94.8%, and 92.6%, respectively. The proportion of juveniles per route was estimated to be 65.1% through the spillway, 19.4% through the sluiceway, and 15.4% through the turbines (English et al. 2001c). Fish passage efficiency was approximately 85%.

2002 Study

Grant PUD continued with yearling chinook salmon radiotelemetry studies in 2002, with the added element of a 1-week test of a full open gate at spill bay 17 (gate 17) of the Priest Rapids spillway. A full open gate passes approximately 60,000 cfs. Grant PUD proposed the 7-day test to take advantage of the ongoing radiotelemetry study to assess the potential of this route as a future juvenile passage alternative. Grant PUD consulted with the MCCC, which concurred with the evaluation. Gate 17 was chosen due to its central location in the spillway, and because it was located far enough from the right bank that the heavy flow line through the tailrace would not collide with a bedrock outcropping roughly 1,000 ft downstream. Gate 17 was opened at 10:00 hours on May 8 and closed at 10:00 hours on May 15. TDG was also monitored during this evaluation.

Route-specific survival estimates for passage through the turbines, spillway, sluiceway, and gate 17 were 80.5 %, 97.0%, 91.4%, and 91.5%, respectively (Table 5). The proportion of juveniles per route was estimated to be 12.7% through the turbines, 64.0% through the spillway, 1.5% through the sluiceway, and 21.7% through gate 17. Fish passage efficiency was approximately 87%. Point estimates for survival through the Priest Rapids Dam and pool were 93.0% and 88.9%, respectively, with a combined survival estimate of 82.6% (Table 4).

2003 Study

The survival estimates for 2003 are preliminary and subject to further analysis by Grant PUD. Gate 22 was tested at full open for 2003 (as opposed to gate 17 in 2002). Gate 22 is adjacent to the powerhouse and this test was done to take advantage of the bulk flow that moves toward the powerhouse. Test blocks were alternated between gate 22 and the proposed spill of 61%. Route-specific survival estimates for passage through the turbines, spillway, sluiceway, and gate 22 were 99.0 %, 98.5%, 82.2%, and 99.7%, respectively (Table 5). Point estimates for survival through the Priest Rapids Dam and pool were 94.3% and 71.9%, respectively, with a combined survival estimate of 67.8% (Table 4).

Table 4. Summary of estimated pool, dam, and project survival for juvenile steelhead and chinook salmon passing the Priest Rapids Development, 1999-2003.

Year	Species (Rearing Type)	Method	Survival Estimate Pool	Survival Estimate Dam	Survival Estimate Project
1999	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.9576	0.8979	0.8598
2000[a]	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.8998	0.9847	0.8860
2001	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.9506	0.9121	0.8670
2002[b]	Yearling Chinook Salmon (Run-of-River)	Radiotelemetry Paired Release	0.8888	0.9299	0.8264
2003[c]	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.7187	0.9431	0.6779

[a]As reported in English et al. (2001b).
[b]Survival estimates from English et al 2003; results were reported for early passage season and late passage season, NOAA Fisheries averaged the results between early and late passage survival estimates.
[c]Survival estimate from English et al. 2003.

Table 5. Summary of route-specific survival estimates and portion of juvenile steelhead and chinook salmon through each route at Priest Rapids Dam.

Year	Study Technique	Species (Rearing Type)	Percent Route-Specific Survival Estimates			
			Turbine	Spillway	Sluiceway	Gate 17
2000	Radio-telemetry	Steelhead (Run-of-River)	99.4	98.8	N/A	
2001	Radio-telemetry	Yearling Chinook Salmon (Hatchery)	85.9	94.8	92.6	
2002	Radio-telemetry	Yearling Chinook Salmon (Run-of-River)	80.5	97.0	91.4	91.5
2003[a]		Yearling Chinook Salmon (Hatchery)	99.0	98.5	82.2	Gate[b] 22 99.7

[a]Estimates are preliminary and may change upon further analysis.
[b]Gate 22 was operated full open in 2003.

6.3.2.2 Gatewell Dipnetting

Juvenile UCR spring-run chinook salmon and UCR steelhead can be entrained in the turbine unit gatewells at Priest Rapids Dam. There are a total of 60 gatewells (6 per unit). Grant PUD dipnets 3 gatewells per unit on a daily basis (30 gatewells total) during the spring fish passage season. Fish removed from the gatewells are quickly transported by truck to a point downstream of the dam and released. Typically, gatewells associated with turbine units that have been offline for over 24 hours are not dipnetted, but are normally dipnetted twice within 24 hours after shutdown to remove as many remaining fish as possible. On days where wind exceeds 20 or 25 miles per hour, dipnetting ceases for safety reasons.

Monitoring records indicate that on average over 62,000 juvenile spring-run chinook salmon and 20,000 juvenile steelhead are removed annually from the Priest Rapids gatewells and transported to the tailrace. The fate of fish that are not successfully removed from the gatwells is unknown. These fish either remain in the gatewells, exit the powerhouse through the turbines, or move back into the forebay. The gatewell dipnetting program provides a means to monitor downstream migration timing and density, and NOAA Fisheries assumes that removing roughly half of the juveniles caught in the gatewells increases the survival of UCR spring-run chinook salmon and UCR steelhead passing the dam.

6.3.2.3 Predator Control Program

FERC proposes to use predator control measures to increase juvenile passage survival through the reservoir. A northern pikeminnow population reduction program has been underway since

1995 and will continue as part of Grant PUD's fish passage program under FERC's proposed action. During 2002, 35,422 northern pikeminnow were removed from the Priest Rapids pool (Grant PUD 2002b). Fishing will be concentrated in different locations within years and from year to year. While the extent of juvenile survival has not been quantified, NOAA Fisheries believes that Grant PUD's pikeminnow removal program has a positive effect on survival through the Priest Rapids Hydroelectric Project.

FERC's 1999 biological assessment reports that avian predation on juvenile salmonids may also be significant at Priest Rapids. It has been estimated that up to 2% of smolts passing the Wanapum Development and the upper Priest Rapids pool are consumed by gulls. FERC proposes to ensure that wiring strung across the tailrace is maintained and to continue with hazing to discourage gull predation, elements that are expected to enhance juvenile salmonid survival.

6.3.3 Middle Columbia Juvenile PIT-Tag Studies

In addition to the radiotelemetry studies conducted by Grant PUD, a number of PIT-tag studies have been carried out through the mid-Columbia reach (Wells Dam to McNary Dam). As stated in Section 6.3 above, NOAA Fisheries considers PIT-tag estimates to be the best information available on juvenile project survival. PIT-tag studies at mid-Columbia River dams rely primarily on subsequent detections at McNary Dam and other lower Columbia River projects. Therefore, survival estimates derived from PIT-tag studies are more likely to capture any direct, indirect, or delayed effect of the project than radiotelemetry, acoustic tag, or balloon tag studies.

NOAA Fisheries summarized several years worth of PIT-tag studies conducted by Grant, Douglas, and Chelan County PUDs, Entiat Hatchery, Winthrop Hatchery, and Wells Hatchery (Appendix A, Table A-2). Most of these studies were conducted using the single release method. The per project survival estimate is calculated by taking the *nth* root of the reach estimate where *n* is the number of projects a fish migrates through between release and point of detection. For instance, a group of PIT-tagged fish that are released in the tailrace of Rocky Reach Dam must pass through four projects—Rock Island, Wanapum, Priest Rapids and McNary Developments—before detection within the juvenile bypass system at McNary Dam. The per project survival estimate is then calculated by taking the fourth root of the reach survival estimate. This method does assign equal survival rates to each project within the reach.

The average estimated juvenile steelhead survival for the action area (Wanapum and Priest Rapids Developments combined) is 76.7%, or 87.6% survival for each development (Appendix A, Table A-2). For yearling chinook salmon, the action area survival is 82%, or 90.5% survival for each development.

Survival estimates vary considerably between radio-tag and PIT-tag studies. Hockersmith et al. (2003) compared travel times and survival rates of hatchery-reared yearling chinook salmon tagged with either gastrically or surgically implanted sham radio tags (with an imbedded PIT-tag) with those tagged with PIT-tags only. Survival between differentially tagged groups was similar for median travel times of roughly 6 days (migration distance of 106 kilometers [65.9 miles]). However, for both gastrically and surgically radio-tagged fish, survival was significantly less than for PIT-tagged fish for which median travel times exceeded approximately 10 days (migration distance of 225 kilometers [139.8 miles]).

Survival studies conducted in 2000 by Chelan County PUD using radio-tagged hatchery and run-of-river yearling chinook salmon, yielded median travel times of 5.8 days and 4.8 days, respectively, for fish traveling a distance of 122.7 kilometers (76.1 miles) between Rock Island Dam and a detection point downstream of Priest Rapids Dam. Thus, based on Hockersmith et al. (2003), survival estimates using radio tags should be at least as reliable as those estimates resulting form PIT-tag studies. Yet when comparing average action area survival estimates between radio-tag and PIT-tag techniques, there is a discrepancy of 8.5% for juvenile steelhead and 21.6% for yearling chinook salmon, with radio-tag estimates being the lower of the two for both species (Table 6 and Table A-2).

Table 6. Action area passage survival estimates using radio-tag techniques.

Year	Species (Rearing Type)	Method	Proj. Survival Estimate Wanapum	Proj. Survival Estimate Priest Rapids	Survival Estimate Action Area
1999	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.813	0.8598	0.6990
2000	Steelhead (Run-of-River)	Radiotelemetry Paired Release	0.7499	0.8860	0.6644
				Steelhead Average:	0.6817
2001	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.7641	0.8670	0.6625
2002	Yearling Chinook Salmon (Run-of-River)	Radiotelemetry Paired Release	0.8296	0.8264	0.6856
2003[c]	Yearling Chinook Salmon (Hatchery)	Radiotelemetry Paired Release	0.6857	0.6779	0.4648
				Yearling Chin. Average:	0.6043

6.3.4 Adult Passage, Wanapum Development

Adult pre-spawning mortality can be caused by delay and injury at the Wanapum Dam. Issues currently identified for adult chinook salmon and steelhead include delay in locating the fishway entrances from the tailrace, passage delay through the transition pools at the fishway entrances, and fallback. In addition, unforeseen impacts that affect adult passage (e.g., harvest) can occur throughout the migration. Due to various factors, such as fisheries, fallback, and tributary turnoff, it is difficult to use the results of adult radiotelemetry studies to estimate project-specific mortality.

Stuehrenberg et al. (1995) estimated that the median time it took for adult spring-run chinook salmon to pass Wanapum Dam was 36.6 hours, plus 22.6 hours to travel the Wanapum pool to Rock Island Dam. The observed fallback rate in this study was 8.1% (17 of 211). Of the 17 fallbacks, 6 returned to below Priest Rapids Dam, with 2 of these being captured at the Ringold Spring Chinook Salmon Facility. Nine fish migrated back over Wanapum and entered tributary streams (8 to the Wenatchee River and 1 to the Okanogan River) and 2 fish were last detected downstream of Wanapum (i.e., Priest Rapids Pool). In comparison, Peery et al. (1998) observed a median passage time of 18.2 hours for adult spring-run chinook salmon and a fallback rate of 4.1% (spring-run and summer-run chinook salmon combined). Eight fish were known to fall back across Wanapum Dam and 7 of these reascended the dam after an average of 48.5 hours. Stuehrenberg et al. (1995) observed that the highest fallback rates among the mid-Columbia River projects were at Wanapum and Priest Rapids Dams.

English et al. (2001a) conducted a radiotelemetry study of adult steelhead migrating through the mid-Columbia River in 1999-2000. Radio tags were placed on 395 steelhead that were captured at Priest Rapids Dam and released in the Columbia River roughly 7.6 miles downstream. Of the 395 radio-tagged steelhead, 328 (83%) were detected at Wanapum Dam and 99% of these fish migrated over the dam into the Wanapum pool (detected at the exit end of the adult fishway). Approximately 79% used the left bank fishway and 21% used the right bank fishway. The median passage time was 9.7 hours. Roughly 11.6% (or 38) of the 326 fish detected at the fishway exits fell back below Wanapum. Approximately 95.3% of the adult steelhead detected in the vicinity of Wanapum Dam were either tracked to known spawning areas or otherwise ascended and remained above the dam. However, English et al. (2001a) cautioned against using the 95.3% figure as a dam passage survival estimate. Because radio tags can be regurgitated, a tag that appears to be stationary does not necessarily represent a mortality. Stationary tags were classified as either pre-spawning mortality, regurgitated tags, or tags removed and discarded by fishermen.

Mortality rates of 8% have been observed for adults falling back through spillways (Bjornn et al. 1998) and 14% to 26% for fallback through turbines at FCRPS projects on the Snake River (Mendel and Milks 1995). However, due to the limited amount of radiotelemetry information available for the mid-Columbia River and the problems with using radiotelemetry data to assess site-specific survival, it is not possible to clearly differentiate between natural and hydrosystem caused mortality at this time.

It appears likely that significant numbers of downstream migrating adult steelhead, or kelts, are migrating through the Priest Rapids Hydroelectric Project. Recent estimates of the proportion of UCR adult steelhead outmigrating as kelts in the vicinity of the project range from 34% to 69% (English et al. 2001a). The resulting downstream passage mortality from operation of the Priest Rapids Project is unknown, but is probably comparable to that observed at the lower Snake and lower Columbia River projects. In 2001, when spill levels at lower Snake and Columbia River projects were low or non-existent, presumably most, if not all, kelts had to pass downstream though turbines. Only 3% of the 212 radio-tagged kelts released at Lower Granite Dam in 2001 survived to reach the Bonneville Dam tailrace under these conditions. This translates to an estimated mean per-project mortality of nearly 40%, which is comparable to direct estimates of adult survival through turbines reported in NOAA Fisheries (2000a). During the 2001 spring fish passage season, Grant PUD spilled 43% of average flow at Wanapum. Although not measured, it is likely that steelhead kelt mortality was something less than 40% as estimated for lower Snake and Columbia River projects, where little to no spill occurred. The spring spill program could improve kelt survival by providing a non-turbine route of downstream passage.

6.3.5 Adult Passage, Priest Rapids Development

The median project passage times reported from adult spring-run chinook salmon radiotelemetry studies at Priest Rapids Dam are 44.9 hours in 1993 (Stuehrenberg et al. 1995), 58.6 hours in 1997 (Peery et al. 1998), and 74.7 hours in 1998 (English et al. 1999). By comparison, the median time for radio-tagged chinook salmon to bypass a project on the lower Snake River during an average flow year is 20.6 hours (Bjornn et al. 1995). Reported fallback rates from the 1993, 1997, and 1998 studies are 17.7%, 3.0% (spring-run and summer-run chinook salmon combined), and 20.0%, respectively. English et al. (1999) noted that the longer passage times observed in the 1997 and 1998 studies may have been related to flow and spill, both of which were higher than in 1993.

As stated in the preceding section, it is difficult to estimate project-related mortality. However, mortality rates of 8% have been observed for adults falling back through spillways (Bjornn et al. 1998) and 14% to 26% for fallback through turbines at Snake River projects (Mendel and Milks 1995). Stuehrenberg et al. (1995) did estimate mortality from their 1993 radiotelemetry study, assigning a 22% mortality estimate to the study area as a whole (all five mid-Columbia River projects). Stuehrenberg et al. (1995) further deduced that if all fish with unknown fates below Priest Rapids Dam were from the Ringold Facility the mortality estimate would be 11.1%.

Of the 395 radio-tagged adult steelhead released by English et al. (2001a) roughly 7.6 miles downstream of Priest Rapids Dam, 353 were detected at the dam, with 335 (95%) detected at the fishway exit points. Of these, 34 (10%) fallbacks were detected. The median project passage time for adult steelhead was 20.2 hours. Of the 353 radio-tagged adult steelhead detected at

Priest Rapids Dam, 13 were known to have been removed (harvested) prior to spawning, leaving 340 fish available to spawn. Of the 340 fish, 281 (82.6%) were tracked to known spawning areas and 40 were tracked to Columbia River reaches above Priest Rapids Dam. Therefore, English et al. (2001a) concluded that 321 (94.4%) successfully passed and remained upstream of Priest Rapids Dam.

Recent estimates of the proportion of UCR adult steelhead outmigrating as kelts in the vicinity of Priest Rapids Dam range from 34% to 69% (English et al. 2001a). The resulting adult downstream passage mortality is unknown, but likely comparable to that observed at the Snake and lower Columbia River projects (Section 6.3.3). The spring spill program could potentially improve kelt survival by providing a non-turbine route of downstream passage.

6.3.6 Effects on Water Quality

Spring spill is provided by Grant PUD as a means of routing juvenile migrants away from turbines. From a biological perspective, the major drawback to spill is the entrainment of atmospheric gases into the water column to a depth where gas is forced into solution at concentrations greater than expected under atmospheric pressure. At high saturation levels (over 120%) fish can develop GBD, which can cause stress, injury, and mortality in juvenile and adult salmon and steelhead. Because there are five hydroelectric developments on the mainstem Columbia River upstream of the Priest Rapids Hydroelectric Project, dissolved gas levels generated upstream can limit spill at Wanapum and Priest Rapids Dams.

Flow spilled at Wanapum plunges to sufficient depth to drive dissolved gas to supersaturation levels. To reduce this effect, deflectors can be used to direct spill at a more shallow angle. Grant PUD proposed to continue developing a flow deflector for the Wanapum spillway that would satisfy both biological and TDG test criteria. As previously discussed (Section 2.2), Grant PUD installed flow deflectors on the Wanapum spillway during the winter of 1999/2000. The flow deflectors have been successful at reducing TDG, allowing for significant increases in voluntary spill to pass juvenile migrants. Even so, voluntary spill levels must still be limited during the fish passage season to ensure that TDG does not exceed 120% of saturation in project tailraces or 115% of saturation in project forebays for more than 12 hours over a 24-hour period.

The plunge pool at the Priest Rapids spillway is relatively shallow and does not create nearly the same level of TDG as at the Wanapum spillway. Therefore, spill can be used as a passage route for juvenile migrants more effectively than at Wanapum.

6.4 Summary of Effects

6.4.1 Wanapum Development

NOAA Fisheries (2000a) calculated, based on numerous studies, survival rates through Kaplan turbines and spillways at FCRPS projects. Survival through Kaplan turbines ranged from 90%

to 93% for juvenile spring-run chinook salmon and steelhead. The estimates for turbine survival at Wanapum range between 87.5% to 98.3%, with an average survival estimate of 93.6%.

Spillway survival through FCRPS dams ranges between 90% and 100% for juvenile spring-run chinook salmon and steelhead. The average combined survival for these species through the Wanapum spillway (bottom spill) is approximately 87.0% (English et al. 2003), although higher survival levels were expected based on direct survival studies with the flow deflectors in place. It is not known at this time if the lower than expected survival rates are due to indirect effects (e.g., predation), direct effects of project passage, or a combination of factors.

Given the limited amount of project-specific information available to date, an estimate of total adult mortality through the Wanapum Development is best provided by the larger body of information derived from the Snake and Columbia River mainstem FCRPS projects. These estimates are 1.9% to 2.4% for UCR spring-run chinook salmon and 2.7% to 3.2% for upstream migrating adult UCR steelhead. At present, there is no way to distinguish between natural mortality and project-related mortality at the Priest Rapids Project or FCRPS projects, but it is close to what is observed in undammed rivers in British Columbia (NOAA Fisheries 2003). Adult spring-run chinook salmon fallback rates are higher at the Project than other mid-Columbia River dams further upstream. The Project's proximity to the Snake and Yakima Rivers and the Ringold Hatchery probably leads to more volitional fallback than that experienced at other upstream dams.

During the winter of 2002, Grant PUD closed and sealed all orifice gate entrances to the powerhouse collection channel. This was done with concurrence from the MCCC and is expected to slightly improve hydraulic conditions in the channel, therefore reducing the time it takes adults to pass through the left bank fishway. The specific operational criteria for operating the adult fishways have been developed, and are supported by the professional judgment of fishery experts in the resource agencies and in the management and research communities. Grant PUD will continuously operate the fishways throughout the adult fish migration period (March through November).

While not quantified, predator control activities probably improve survival of juvenile UCR spring-run chinook salmon and UCR steelhead migrating through the Wanapum Development. Predator control measures in this reach do not affect the survival of adult salmonids (i.e., compared to sea lion predation below Bonneville Dam).

Juvenile and adult UCR spring-run chinook salmon and juvenile UCR steelhead could be negatively affected by high TDG levels resulting from involuntary spill due to large flow events. However, due to the infrequency of these events, the overall magnitude of this effect will probably be small at the Wanapum Development. Grant PUD holds regular conference calls with members of the MCCC during the fish passage season to determine the necessary adjustments to voluntary spill volumes to maintain TDG levels at ≤120% while maximizing fish passage.

6.4.2 Priest Rapids Development

NOAA Fisheries (2000a) calculated, based on numerous studies, survival rates through Kaplan turbines and spillways at FCRPS projects. Survival through Kaplan turbines ranges from 90% to 93% for juvenile spring-run chinook salmon and steelhead. The estimates for turbine survival for Priest Rapids range from 80.5% to 99.4%. English et al. (2003) calculated the average survival estimate to be approximately 90.8%, but cautioned that this calculation required violation of assumptions because the year-to-year variation was too great relative to the measurement error.

Spillway survival through FCRPS dams ranges between 90% to 100% for juvenile spring-run chinook salmon and steelhead. The average combined survival for these species through the Priest Rapids spillway (bottom spill) is roughly 96.3% (English et al. 2003) compared to the 88.7% observed for the Wanapum spillway.

Based on the limited amount of information available to date, an estimate of total adult mortality through the Priest Rapids Hydroelectric Project is best provided by the larger body of information derived from the Snake and Columbia River mainstem FCRPS projects. These per project estimates are 1.9% to 2.4% for UCR spring-run chinook salmon and 2.7% to 3.2% for upstream migrating adult UCR steelhead. Adult spring-run chinook salmon fallback rates are higher at the Project than other mid-Columbia River dams further upstream. The Project's proximity to the Snake and Yakima Rivers and the Ringold Hatchery probably leads to more volitional fallback than that experienced at other upstream dams.

During the winter of 2002, Grant PUD closed and sealed all orifice gate entrances to the powerhouse collection channel. This was done with concurrence from the MCCC and is expected to slightly improve hydraulic conditions in the channel, therefore slightly reducing the time it takes adults to pass through the left bank fishway. The PUD will continuously operate the fishways throughout the adult fish migration period (March through November).

While not quantified, predator control activities probably improve survival of juvenile UCR spring-run chinook salmon and UCR steelhead migrating through the Wanapum Development. Predator control measures in this reach do not affect adult UCR spring-run chinook salmon or UCR steelhead.

Juvenile and adult UCR spring-run chinook salmon and juvenile UCR steelhead could be negatively affected by high TDG levels resulting from involuntary spill due to large flow events. However, due to the low frequency of these events at the Wanapum Development, the overall magnitude of this effect will likely be small. Grant PUD holds regular conference calls with members of the MCCC during the fish passage season to determine the necessary adjustments to voluntary spill volumes to maintain TDG levels at ≤120% while maximizing fish passage.

6.4.3 Performance Compared to FERC's Juvenile Survival Standard

The studies described in Sections 6.3.1.1, 6.3.2.1, and 6.3.3 were conducted to determine if operations under the proposed action, implemented from 1999 through 2003, were adequate to satisfy the 95% juvenile dam passage survival standard for both developments. For Wanapum Dam, the only year that this standard would appear to have been fulfilled is 2003, when the dam passage survival estimate was 103.5% for yearling chinook salmon.[10] For Priest Rapids Dam, the only year that this standard would appear to have been fulfilled is 2000, when the dam passage survival estimate was 98.5% for juvenile steelhead. NOAA Fisheries believes that for juvenile UCR steelhead and UCR spring-run chinook salmon, the proposed action (Section 3) would not consistently meet the 95% dam passage survival standard at either Wanapum Dam or Priest Rapids Dam.

6.4.4 FERC's Performance Standard Compared to Biological Requirements

NOAA Fisheries believes that even if the 95% juvenile dam passage survival standard was consistently met, it would still be likely to result in an appreciable reduction in the likelihood of both survival and recovery. This is because NOAA Fisheries assumes that the essential features of juvenile steelhead and spring-run chinook salmon habitat (i.e., biological requirements) within the action area are better captured in a summary reach statistic, which accounts for the effects of reservoirs, as well as dam passage. NOAA Fisheries developed juvenile and adult survival standards during development of the HCPs for the Wells, Rocky Reach, and Rock Island Developments (all upstream of the Priest Rapids Hydroelectric Project). These standards were determined to account for the listed species biological requirements under the environmental baseline such that the species would survive and recover. These standards, 93% juvenile project survival and a juvenile and adult combined survival of 91%, are described in Cooney (2002) and are applied to the analysis of effects of Grant PUD's IPP.

As a reference for determining the adequacy of conditions within the action area, NOAA Fisheries estimates survival levels within the action area that would result if there were no impoundments (i.e., in a free-flowing reach; Appendix A). This analysis assumes that the listed species are best adapted to, and would experience maximum survival in, a free-flowing river.[11] For juvenile steelhead passing the Priest Rapids Hydroelectric Project (two dams and reservoirs), the current survival rate is approximately 79.1% of the estimate for a free-flowing reach of equal length; for juvenile spring-run chinook salmon, the survival rate is roughly 84.6% of the estimate for a free-flowing reach of equal length (Appendix A). NOAA Fisheries expects that project survival rates of 93% for juveniles and 91% combined juvenile and adult survival do not

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[10] In all likelihood, this point estimate is biased high (English et al. 2003), and the most plausible explanation is that the control release groups suffered higher mortality than the upstream release groups.

[11] For the purpose of an ESA Section 7(a)(2) evaluation of the effects of a proposed action, biological requirements are not necessarily represented by survival through a free-flowing reach.

represent a significant reduction from rates in an unimpounded river reach. Therefore, the proposed action would be likely to appreciably reduce the likelihood of both survival and recovery for both UCR spring-run chinook salmon and UCR steelhead.

6.4.5 Interrelated and Interdependent Effects

NOAA Fisheries has not identified any interrelated and interdependent effects that must be considered in the context of an ESA Section 7(a)(2) evaluation of the Project.

7. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as "those effects of future State, tribal, local or private actions, not involving Federal activities, that are reasonably certain to occur in the action area considered in this biological opinion." Future Federal actions, including the ongoing operation of hatcheries, fisheries, and land management activities, are not considered within the category of cumulative effects for ESA purposes because they require separate consultations pursuant to Section 7 of the ESA after which they are considered part of the environmental baseline. Future non-Federal actions which are most notable include Washington State TMDL (total maximum daily load) development and implementation, Washington State legislation to enhance salmon recovery through tributary enhancement programs, and recent human population trends in the action area. However, after considerable review, NOAA Fisheries has determined that these actions cannot be deemed reasonably likely to occur based on its ESA implementing regulations.

The Endangered Species Consultation Handbook describes this standard as follows:

> "Indicators of actions 'reasonably certain to occur' may include, but are not limited to: approval of the action by State, tribal or local agencies or governments (e.g., permits, grants); indications by State, tribal or local agencies or governments that granting authority for the action is imminent; project sponsors' assurance the action will proceed; obligation of venture capital; or initiation of contracts. The more State, tribal or local administrative discretion remaining to be exercised before a proposed non-Federal action can proceed, the less there is a reasonable certainty the project will be authorized."

There are, of course, numerous non-Federal activities that have occurred in the action area in the past, which have contributed to both the adverse and positive effects of the environmental baseline. This step of the analysis for application of the ESA Section 7(a)(2) standards requires the consideration of which of those past activities are "reasonably certain to occur" in the future within the action area.

First, any of these actions that involve Federal approval, funding, or other involvement are not considered "cumulative effects" for this analysis (see ESA definition, above). The Federal involvement will trigger ESA Section 7(a)(2) consultation in the future. Once the consultation on those actions is completed, the effects may be considered part of the environmental baseline, consistent with the ESA regulatory definition of "effects of the action" (50 CFR §402.02). Thus, for example, State efforts to improve water quality in compliance with the Federal Clean Water Act would not be considered because of the involvement of the U.S. Environmental Protection Agency, until separate ESA consultations are completed. Others examples include irrigation water withdrawals involving the U.S. Forest Service (right-of-way permits for irrigation canals) or agricultural practices that receive Federal funding through the U.S. Department of Agriculture.

Next, actions that do not involve Federal activities must meet the "reasonably certain to occur" test for NOAA Fisheries to consider their effects in this Opinion. NOAA Fisheries finds that currently few, if any, of the future adverse or beneficial State, tribal or private actions qualify for consideration in this analysis as "cumulative effects." Therefore, when evaluating the status of the listed species, including their likelihood of survival and recovery, NOAA Fisheries concludes that most of the factors for the decline of these species are not eligible for consideration in determining whether the authorization of incidental take under the proposed action is likely to jeopardize their continued existence. Thus the future abundance and productivity of the listed UCR steelhead and UCR spring-run chinook salmon, against which the effects of this action are considered, are likely to be improved, although to an unknown or possibly minor extent, over those reflected by the historical trends under the environmental baseline.

8. CONCLUSIONS

This section presents NOAA Fisheries' opinion regarding whether the aggregate effects of the factors analyzed under the environmental baseline, effects of the proposed action, and the cumulative effects in the action area, when viewed against the current rangewide status of the species, are likely to jeopardize the continued existence of UCR spring-run chinook salmon and UCR steelhead. To "jeopardize the continued existence of" means 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 (CFR §402.02). As previously discussed in Section 1 of this Opinion, critical habitat designations for UCR spring-run chinook salmon and UCR steelhead were withdrawn on April 30, 2002. Therefore, this Opinion does not address critical habitat for these two species.

As determined in Section 4, the status of the listed ESUs is characterized by low abundance and downward population growth rates. Irrespective of the strong returns in 2001, both recent 5-year and long-term productivity trends remain well below replacement. Were NOAA Fisheries to simply project this status forward over the term of this Opinion, these population growth rates would need to substantially improve for them to survive with an adequate potential for recovery. As determined in Section 5, however, the effects of the environmental baseline, while responsible for this current status, cannot be assumed to continue over the term of this Opinion given the fact that few Federal actions that contributed to the environmental baseline in the past have completed ESA Section 7 consultation for more than the next few years. As determined in Section 7, there are few, if any, State or private projects that meet the ESA definition of "reasonably certain to occur" and therefore their effects cannot be assumed for this analysis.

As stated in Section 6.3, NOAA Fisheries considers PIT-tag estimates to be the best information available on juvenile project survival. The survival estimates derived from PIT-tag studies are more likely to capture any direct, indirect, or delayed effect of the project than radiotelemetry, acoustic tag, or balloon tag studies. Based on findings by Hockersmith et al (2003), NOAA Fisheries does not discount the radio-tag work done thus far at both developments; however, survival estimates produced from radio-tag studies are consistently lower than those of the PIT-tag studies.

8.1 Conclusions for UCR Steelhead

The following conclusions are also based on recent project survival estimates (Section 6) and the anticipated continued effects of the proposed action. Thus while the current rangewide status of the listed ESUs is poor and declining, NOAA Fisheries cannot presume that this condition and trend will continue for the term of this Opinion. Instead, without factoring in future harmful activities that have occurred in the past, natural processes are likely to result in an improvement in the species' status.

- Project-related adult mortality is approximately 3%, based on the larger body of information derived from the Snake and Columbia River FCRPS projects, used as a surrogate for information regarding adult UCR steelhead survival through the Wanapum and Priest Rapids Developments, given the paucity of project-specific information (Sections 6.3.5 and 6.3.6).

- Project-related mortality for downstream migrating kelts is estimated to be approximately 40% at Snake and Columbia River FCRPS projects. NOAA Fisheries assumes that this level of mortality is similar at Wanapum and Priest Rapids Developments as well. While there is no quantitative estimate, it is reasonable to expect that spill operations for juvenile spring migrants likely provide a safer route for steelhead kelts migrating downstream, and therefore improves survival compared to that of kelts forced to pass through turbines (Sections 6.3.5 and 6.3.6).

- It is difficult to quantify mortality resulting from entrainment into gatewells, or the contribution to overall survival resulting from the gatewell dipnetting program. Roughly 30,000 juvenile steelhead are removed annually from the gatewells at Wanapum and Priest Rapids Dams. Continuation of this program is expected to contribute to overall juvenile survival (Sections 6.3.1.2 and 6.3.2.2).

- The proposed predator control program is expected to continue contributing to overall project juvenile survival at both developments. Considerable numbers of northern pikeminnow are removed each year. In addition, hazing is conducted to discourage avian predators (Sections 6.3.1.3 and 6.3.2.3).

- TDG levels resulting from voluntary spring spill operations will not exceed expected TDG waivers from the state of Washington and should not affect adult or juvenile survival at either development (Section 6.3.6).

- TDG levels resulting from involuntary spill (e.g., high river discharges) would likely increase the incidence of mortality or other sublethal effects related to gas bubble trauma; however, the overall magnitude of this effect will be relatively small considering the infrequent occurrence of these events (Section 6.3.6).

- The 95% juvenile dam passage survival, under the proposed action, is not being consistently met and NOAA Fisheries concludes that a dam passage standard, on its own, is likely to result in an appreciable reduction in the likelihood of both survival and recovery.

- NOAA Fisheries further concludes that the comparison of existing survival rates to those estimated for a free-flowing river of equal length, demonstrates a level of survival that would not be likely to jeopardize the listed stocks.

After reviewing the current status of UCR steelhead (Section 4), the environmental baseline for the action area (Section 5), the effects of the proposed action (Section 6), the cumulative effects (Section 7), and the best available information regarding current impacts from project operations (e.g., project-level juvenile survival rates), NOAA Fisheries concludes that the proposed action is likely to jeopardize the continued existence of UCR steelhead. Measures must be implemented in the near term (10 years) to improve UCR steelhead survival at the Priest Rapids Hydroelectric Project.

8.2 Conclusions for UCR Spring-Run Chinook Salmon

The following conclusions are also based on recent project survival estimates (Section 6) and the anticipated continued effects of the proposed action.

- Project-related adult mortality is approximately 2%, based on the larger body of information derived from the Snake and Columbia River FCRPS projects, and given the paucity of information regarding adult UCR spring-run chinook salmon survival through the Wanapum and Priest Rapids Developments (Sections 6.3.5 and 6.3.6).

- Observed adult fallback rates have been as high 20% at Priest Rapids Dam. Adult fallback in the mid-Columbia River tend to be highest at Wanapum and Priest Rapids Dams. The Project's proximity to the Snake and Yakima Rivers and the Ringold Hatchery probably leads to more volitional fallback than that experienced at other dams upstream. In addition, the spring spill program for juvenile migrants probably affects adult migration by increasing fallback rates while at the same time providing a non-turbine route for volitional fallback (Sections 6.3.5 and 6.3.6).

- It is difficult to quantify juvenile mortality resulting from entrainment into gatewells, or the contribution to overall survival resulting from the gatewell dipnetting program. Roughly 118,000 juvenile spring-run chinook salmon are removed annually from the gatewells at Wanapum and Priest Rapids Dams. Continuation of this program is expected to contribute to overall juvenile survival (Sections 6.3.1.2 and 6.3.2.2).

- The proposed predator control program is expected to continue contributing to overall project juvenile survival at both developments. Considerable numbers of northern pikeminnow are removed each year. In addition, hazing is conducted to discourage avian predators (Sections 6.3.1.3 and 6.3.2.3).

- TDG levels resulting from voluntary spring spill operations will not exceed expected TDG waivers from the state of Washington and should not affect adult or juvenile survival at either development (Section 6.3.6).

- TDG levels resulting from involuntary spill (e.g., high river discharges) would likely increase the incidence of mortality or other sublethal effects related to GBT; however, the overall magnitude of this effect will be relatively small considering the infrequent occurrence of these events (Section 6.3.6).

- The 95% juvenile dam passage survival, under the proposed action, is not being consistently met and NOAA Fisheries concludes that a dam passage standard, on its own, is likely to result in an appreciable reduction in the likelihood of both survival and recovery.

- NOAA Fisheries further concludes that the comparison of existing survival rates to those estimated for a free-flowing river of equal length, demonstrates a level of survival that would not be likely to jeopardize the listed stocks.

After reviewing the current status of UCR spring-run chinook salmon, the environmental baseline for the action area, the effects of the proposed action, the cumulative effects, and the best available information regarding current impacts from project operations (e.g., project-level juvenile survival rates), NOAA Fisheries concludes that the proposed action is likely to jeopardize the continued existence of UCR spring-run chinook salmon. Measures must be implemented in the near term (10 years) to improve UCR spring-run chinook salmon survival at the Priest Rapids Hydroelectric Project.

9. REASONABLE AND PRUDENT ALTERNATIVE

The regulations implementing Section 7 of the ESA (50 CFR 402.2) define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that 1) can be implemented in a manner consistent with the intended purpose of the action, 2) can be implemented consistent with the scope of the action agency's legal authority, 3) are economically and technically feasible, and 4) would not jeopardize the continued existence of the listed species.

This RPA defines a set of short-term actions that would begin to improve the survival of listed UCR steelhead and UCR spring-run chinook salmon immediately. It also requires the early implementation of longer-term elements that may extend beyond the time period of this Opinion. Some of these relate to continued improvements in juvenile and adult passage survival at the Project. Others are off-site measures that will be the responsibility of Grant PUD, such as the design, construction, and operation of substantially expanded hatchery programs over the next several decades, and the rehabilitation of tributary habitat.

This RPA is based upon the best scientific information available. Scientific knowledge is continually evolving, and NOAA Fisheries acknowledges the importance of adaptive management guided by reliable science. Each of the RPA actions described below, particularly those related to juvenile passage, anticipate monitoring and evaluation to compare the success of the actions to performance standards. Quantifiable biological performance standards (in this case, project survival performance standards) are the appropriate measure for evaluating the adequacy of fishery conservation measures for hydropower projects over time. NOAA Fisheries expects that the following RPA actions will result in operations that meet or exceed the project survival standards by 2010 (and will be reported per the requirement in Section 9.6.1 of this RPA by 2013). NOAA Fisheries employed identical performance standards in evaluating the adequacy of the anadromous fish conservation programs for Columbia River dams upstream of the Priest Rapids Project that are operated by Chelan and Douglas County PUDs, as described in the HCPs for Rock Island, Rocky Reach, and Wells Dams, and in the August 2003 biological opinions for the HCPs, and determined that they would not appreciably reduce the likelihood of both survival and recovery. These survival standards are 93% juvenile project survival and 91% combined adult and juvenile survival at the Priest Rapids and Wanapum Developments (i.e., at each dam) by 2010, per Action 1, below.

NOAA Fisheries has consulted with other Federal and State resource agencies, affected Tribes, and Grant PUD in the development of this RPA. The actions under this RPA are largely an outcome of those consultations.

9.1 Performance Standards

Action 1: Performance Standards. Grant PUD shall make steady progress towards achieving a minimum 91% combined adult and juvenile salmonid survival performance standard at the Priest Rapids and Wanapum Developments (i.e., each dam), and shall have passage measures in place, as specified in actions comprising this RPA, that are expected to achieve this performance standard by 2010. The 91% standard includes a 93% project-level (reservoir and dam) juvenile performance standard. NOAA Fisheries recognizes that it is not currently possible to measure the 91% combined adult and juvenile survival standard. To address this issue, Grant PUD is directed to use dam and reservoir smolt survival studies to evaluate progress towards meeting 95% juvenile dam passage survival and 93% juvenile project passage survival. Upon issuance of this Opinion, Grant PUD shall develop and begin implementation, with steady progress, a plan to achieve the 93% juvenile project passage survival standard by 2010, and shall have measured survival for UCR spring-run chinook salmon and UCR steelhead by 2013, as specified below. The performance standard can also be accomplished as a composite; Grant PUD can compensate for a failure to achieve the performance standard at one of its developments by exceeding the performance standard at the other development (i.e., at a minimum, by the same percentage amount below the survival performance standard at the development failing to meet performance standards). If at-project survival exceeds the minimum combined adult juvenile and adult performance standard specified above, as measured per the specifications listed below, off-site mitigation obligations can be reduced by a commensurate amount.

While FERC (1999) proposed that the IPP would accomplish a 95% juvenile dam passage survival, FERC did not propose criteria for juvenile reservoir and adult survival. A juvenile dam passage survival standard does not account for reservoir passage survival, and therefore does not encompass all of the resulting adverse effects to the listed species occurring within the action area. Based on consideration of survival rates in an unimpounded reach of similar length, NOAA Fisheries has decided upon a project-level juvenile survival standard of 93%, including juvenile passage survival through a single project reservoir and dam, and an adult mortality rate of 2% per dam, representing a combined adult and juvenile project survival performance standard of 91%. NOAA Fisheries' analysis for UCR spring-run chinook salmon and UCR steelhead suggests these per-project survival levels are the minimum required from each of the five mid-Columbia PUD dams to avoid jeopardizing each listed species.

This action requires Grant PUD to develop an implementation plan so that it will make steady progress towards achieving the survival standards throughout the duration of this Opinion. NOAA Fisheries recognizes that, at this time, adult fish survivals cannot be accurately measured because of the inability to differentiate between sources of adult mortality. Until the Priest Rapids Coordinating Committee[12] (PRCC), as described in Action 39, determines that the

[12]The PRCC would consist of NOAA Fisheries, the USFWS, the WDFW, the Yakama Nation, the Confederated Tribes of the Colville Reservation, the Confederated Tribes of the Umatilla Reservation, and Grant PUD.

combined adult and juvenile survival standard is measurable with an adequate degree of confidence, compliance with this RPA action shall be based upon the measurement of juvenile survivals to achieve the 93% juvenile project standard.

Steady progress will be estimated using survival studies designed and developed by Grant PUD in consultation with the PRCC and approved by NOAA Fisheries, and implemented annually until 2013 (or until performance standards are met) for each ESA-listed anadromous salmonid species. Survival estimates shall be measured at the 95% confidence level with a standard error of not more than plus or minus 2.5%. For any specific study, a less precise estimate of not more than plus or minus 3.5% may be acceptable if the PRCC agrees. When the arithmetic average of three consecutive survival estimates (meeting the protocol specified above), meets or exceeds the performance standard, then the standard is met for that species. If the average is within 0.5%, the PRCC can allow 1 additional year of study. In the event that 3 consecutive years of juvenile survival studies meeting the precision levels set forth above have not been completed, NOAA Fisheries will determine whether steady progress has been achieved based on the best available information and by the status of implementation of all of the actions described in this RPA. In the event that steady progress is not made, NOAA Fisheries must consider whether reinitiation of this consultation is still necessary based on the best science then available.

In the event that NOAA Fisheries agrees that it is not possible to measure incremental improvements in survival with sufficient precision as described above, steady progress will be assumed if the measures identified in the RPA action items below have been implemented on schedule.

9.2 Juvenile Passage, Wanapum Development

***Action 2*:** Downstream Passage Alternatives Action Plan. FERC shall require that Grant PUD, in coordination with the PRCC, develop and annually revise a Downstream Passage Alternatives Action Plan (DPAAP) designed to contribute to the achievement of applicable performance standards for the Project over time. The DPAAP shall be approved by NOAA Fisheries and shall consist of the implementation and testing of capital measures designed to improve juvenile survivals at the Wanapum Development, as well as the implementation and testing of alternative operational measures outlined in the actions that follow. The objective of these capital or operational modifications shall be to improve juvenile passage survivals while remaining within TDG limits.

At the conclusion of the implementation and testing of Actions 3-10 below, Grant PUD, in coordination with the PRCC and with NOAA Fisheries' approval, will update its DPAAP to identify the combination of measures that results in the greatest survival. Additionally, the plan will identify other prospective high priority research and development to further improve survivals, where necessary.

Additional work needs to be completed to identify the capital or operational improvements at Wanapum to improve project survivals and help achieve overall survival performance standards. Current information suggests that spillway passage survival may be lower than turbine passage survival, and neither is adequate to achieve applicable survival performance standards. Hence, Grant PUD, in coordination with the PRCC and with NOAA Fisheries' approval, will update its DPAAP to identify capital improvements to improve juvenile downstream survivals.

The first component of this DPAAP shall be the design, testing, and installation of a future unit top spill prototype (Action 3) to improve passage survivals. Other capital improvements shall include advanced turbines, avian predator controls, gas reduction devices, and such other measures as the PRCC shall identify from time to time. Involvement of the PRCC during design reviews, selection and prioritization of capital alternatives, and review of testing chosen alternatives, should result in alternatives that optimize fish passage survival rates and provide for more efficient and timely implementation.

Action 3: Top Spill through Future Units. As part of the first phase of the DPAAP described above, FERC shall require that Grant PUD design, construct, and test downstream passage through a prototype top-spill unit in a vacant bay of the future units section of Wanapum Dam (future unit top spill). The specific measures and bypass flows will be developed through a design process conducted by Grant PUD in consultation with the PRCC and approved by NOAA Fisheries.

Prior to the testing and construction of the prototype future unit top spill, Grant PUD shall, in consultation with the PRCC, prepare and submit to NOAA Fisheries detailed design and engineering plans and schedules for its review and approval. This schedule shall include conducting hydraulic modeling of the prototype future unit top-spill device and completing the design work for the prototype within the first year after issuance of this Opinion. Subject to confirmation in the approved schedule, Grant PUD shall award the construction contract within 2 years of issuance of this Opinion and commence construction of the prototype promptly thereafter. Biological testing shall begin during the 2007 outmigration, followed by additional testing or the completion of the unit, as may be appropriate.

The design of the future unit top spill will provide at least an approximate 20,000 cfs discharge from the forebay for the purpose of juvenile fish bypass. The installation of the future unit top spill will include a transition chute that will allow bypass flow to be introduced into the tailrace in the optimal configuration (as determined by hydraulic model testing) to provide improved juvenile fish egress from the tailrace and to minimize TDG uptake or de-gas bypass flow. Biological testing will include evaluation of forebay migration through the use of radiotelemetry or acoustic tags and survival tests utilizing PIT-tags. Additional passage measures may be required if biological testing shows that performance standards are not being met (Action 1). Biological study plans will be developed in coordination with the PRCC and approved by NOAA Fisheries. This schedule can be modified through consultation with the PRCC and with the concurrence of NOAA Fisheries.

Grant PUD is currently analyzing downstream passage alternatives for the Wanapum Development. Radiotelemetry studies at Wanapum Dam indicate an average dam passage survival of 89.9% for steelhead and have ranged from 86.3% to 103.5% for yearling chinook salmon (see Table 2). The 103.5% survival estimate is clearly biased high and may be the result of control group fish released in the Wanapum Dam tailrace suffering higher mortality than the upstream release groups. The average survival estimate from the 2001 and 2002 studies is 88.8%.

Use of PIT-tags during the 2001 drought year gave a dam passage survival estimate of 89.8% for yearling chinook salmon. The weighted average survival estimate from the 2003 PIT-tag survival study for the Wanapum Development was 92.2%[13] with a 95% CI of 84.3-100.0 (Anglea et al. 2003). The paired release data show that some replicate estimates greater than 100% were gathered when control group fish released in the Wanapum tailrace suffered greater mortality than the upstream release group. A determination of whether Wanapum facilities and operations are meeting standards will be made based on 3 years of studies as described in Action 1. Involvement of all the fisheries parties during design reviews, selection and prioritization of alternative capital improvements, and review of testing of the alternatives, is expected to result in decisions on those alternatives that optimize fish passage survival rates and provide for more efficient and timely implementation.

Action 4: Advanced Turbines. As a second component of its DPAAP described above, Grant PUD shall, within 90 days of the issuance of this Opinion, file an application with FERC for an amendment to its license to replace the 10 turbines at its Wanapum Development with 10 new advanced turbines, as developed by the Department of Energy's Advanced Hydro Turbine Program. Subject to the approval of the application by FERC, Grant PUD shall first install a single advanced turbine unit beginning in 2004 and evaluate its ability to meet criteria developed in consultation by the PRCC and approved by NOAA Fisheries. Grant PUD shall, prior to installation, develop an appropriate scientific protocol for evaluating the physical and biological performance of this advanced turbine in consultation with the PRCC and approved by NOAA Fisheries. Grant PUD shall implement such protocols in 2005 and coordinate the evaluation of the performance of the test unit with the PRCC. If the results demonstrate that the

[13]The 2003 survival study results are paired-release estimates based on John Day PIT-tag detections.

advanced turbine unit will achieve juvenile passage survivals that are equivalent to or better than the survivals through the existing turbine units, and is otherwise achieving applicable operating criteria, Grant PUD shall develop a schedule for implementation of the remaining 9 units and, subject to the approval of NOAA Fisheries and in consultation with the PRCC, shall proceed to install the remaining units accordingly.

The Wanapum turbines have reached the end of their useful life and need replacement. Grant PUD has been investigating turbine runners that are designed to improve juvenile salmon survival through turbine routes and to improve water quality by reducing the amount of water that must be spilled. Grant PUD is proposing to install one new runner beginning in 2004 for testing (S. Brown, Grant PUD, pers. comm. to S. Carlon, NOAA Fisheries, Sept. 13, 2002). Biological testing of the new runner will determine if all Wanapum turbines should be replaced with the new runner design. If testing of the new unit reveals that juvenile survivals will be equivalent to or better than survivals associated with the existing units, and the unit is otherwise meeting applicable operating criteria, NOAA Fisheries expects that Grant PUD will proceed to install the remaining units according to an approved schedule. This schedule of installation may extend beyond the period of the existing license and into annual licenses, or into a new license that may be issued for the Project. NOAA Fisheries expects that the annual licenses or a new license shall, in this circumstance, authorize the continued installations consistent with the approved schedule so as to capture the biological and hydro generation benefits as promptly as possible.

An inwater construction plan shall be developed by Grant PUD and shall be subject to approval by NOAA Fisheries. NOAA Fisheries expects that some take may occur during the turbine shutdown and dewatering phase of the installation process (Section 12). Once the unit is dewatered, all construction activities of the new turbine unit will be isolated from waters containing listed species. Operation of the new turbine runners is expected to benefit listed species by reducing the potential for strike injury and mortality and by improving water quality (e.g., reduce TDG).

Action 5: Spill. Subject to the identification of better measures to improve downstream survivals through the implementation of Actions 2 through 4, FERC shall require Grant PUD to implement a spill level of 43% of average daily total river flow, or TDG limits, whichever is less, for spring migrants. This spill level will remain in effect for spring migrants until a better downstream passage alternative is identified, tested, and approved by NOAA Fisheries, in consultation with the PRCC. This spill level will be in effect for 95% of the spring migrants passing Wanapum Dam as determined by in-season monitoring at Rock Island Dam or June 15, whichever is earlier, with monitoring of the downstream migration to begin annually on or before April 1. In consultation with the PRCC and with approval by NOAA Fisheries, Grant PUD may reduce spill as necessary to remain at or under TDG limits. Implementation and in-season management of spill shall be conducted as described in Section 3.2.1.2. Grant PUD, in consultation with the PRCC and subject to approval by NOAA Fisheries, may replace interim spill at Wanapum Dam if more biologically efficient and effective measures are designed, tested and implemented.

Action 6: Alternative Spill Measures. While construction takes place on the downstream passage alternatives, FERC shall allow Grant PUD to evaluate further modifications to the spill regime currently in place (spill occurs during the outmigration up to the TDG limits or 43% of total river flow, whichever is less) to evaluate potential improvements in juvenile survival. The evaluation will be based upon the best available route-specific and dam passage survival monitoring and testing information from previous evaluations. The evaluation may include the use of top spill or other passage routes as alternatives to standard tainter gate or sluiceway spill to improve downstream survivals within applicable TDG limits. Such study proposal(s) shall be developed in consultation with the PRCC and subject to NOAA Fisheries' approval, and studies shall be implemented in consultation with NOAA Fisheries and the PRCC. FERC shall require Grant PUD to report on the results annually, as provided in Action 31. Implementation and in-season management of spill shall be conducted as described in Section 3.1.1.2. This spill level will be in effect for 95% of the spring migrants passing Priest Rapids Dam as determined by in-season monitoring at Rock Island Dam or June 15, whichever is earlier, with monitoring of the downstream migration to begin on or before April 1. If testing indicates that equivalent or higher project survival can be achieved via alternative spill measures as compared to the current spill regime utilized during the spring outmigration, FERC shall require that the alternative spill measures be utilized by Grant PUD for the downstream passage of listed species until replaced by a permanent downstream passage program that achieves the project survival standards for juveniles as specified in Action 1. If testing indicates that equivalent or higher project juvenile survival cannot be achieved via alternative spill measures as compared to the current spill regime utilized during the spring outmigration, FERC shall require spill amount up to the TDG limits or 43% during a minimum of 95% of the spring outmigration of ESA-listed species, until biological testing indicates that other passage measures are sufficient to meet project survival standards indicated in Action 1.

Estimates of spillway passage survival at Wanapum have been less than expected based on biological testing of the spillway gates with flow deflectors, which indicated that direct survival could exceed 98% (Table 3). The average spillway survival is roughly 3% less (91.6% vs. 88.6%) than the average turbine survival. A better understanding of mortality mechanisms through the Wanapum spillway is needed; therefore, the evaluations of spill effectiveness utilizing various spill levels/spill devices, spill timing, and other potential mortality mechanisms, such as fish impacting the spillway gate seal structure, and predation, will be closely examined.

Evaluation of spill at Wanapum Dam shall continue while passage alternatives are being constructed and tested, per the direction of the PRCC and with approval by NOAA Fisheries.

Action 7: Alternative Spill Patterns. While testing alternative spill measures, FERC shall also require Grant PUD to investigate changes to the spill patterns at Wanapum Dam to explore methods to improve juvenile survival through the spillway. Any changes to the spill pattern shall be implemented only after consultation with the PRCC and subject to approval by NOAA Fisheries.

On November 13 and 14, 2002, NOAA Fisheries staff visited Grant PUD's physical models of the Priest Rapids Project in Iowa. Based on observations of the Wanapum tailrace model during simulated spill, there is evidence that a change in spill pattern could result in higher spillway survival. Dye traces flowing through the right bank spill gates tended to roll and stay within the stilling basin and were drawn laterally toward the left side (east side) of the spillway where more spill was concentrated. This suggests that juvenile fish passing via the right bank spill gates may be experiencing poor tailrace egress, and may be entrained in turbulent flow as it is drawn toward the left-side spill gates (i.e., similar to the dye movement). This would prolong fish exposure to predation, make them more susceptible to predation through increased disorientation, and increase potential for injury. Decreasing these effects is expected to improve survival, pending on-site biological evaluations.

Action 8: Total Dissolved Gas Abatement. FERC shall require Grant PUD to continue to implement the 2000 TDG Abatement Plan and coordinate any changes to the plan with NOAA Fisheries and the PRCC, subject to approval by the Washington State Department of Ecology and by NOAA Fisheries. Implementation and in-season management of spill and water quality monitoring shall be conducted as described in Section 3.1.1.3 unless modified in consultation with NOAA Fisheries and the PRCC.

Even though flow deflectors are in place at the Wanapum spillway and are effective at reducing TDG, spill at Wanapum continues to generate substantial dissolved gas downstream of the dam. Proposed changes to Grant PUD's TDG Abatement Plan shall be coordinated with NOAA Fisheries and the PRCC to determine possible effects on survival and recovery of UCR spring-run chinook salmon and UCR steelhead.

Action 9: Turbine Operations. While construction takes place on the downstream passage alternatives, FERC shall require Grant PUD to promptly reassess operation of the existing turbines at Wanapum Dam to optimize juvenile survival through the turbines. Grant PUD shall coordinate study proposals with NOAA Fisheries and the PRCC. Any subsequent changes to turbine operations to improve survival will require approval from NOAA Fisheries and consultation with the PRCC.

Average juvenile survival through the Wanapum turbines is comparable to survival through FCRPS turbines. Even so, the combined project survival is less than what is needed to achieve applicable performance standards for the Project. Further refinement of turbine operations should optimize turbine passage survival and contribute to increases in overall project survival. Increases in overall project survival could be realized in the short term with potential operational changes implemented beginning in 2004.

***Action 10*:** Avian Predator Control. FERC shall require Grant PUD to continue to develop and fund an overall programmatic approach to the reduction of avian-related mortalities to salmon populations affected by the Priest Rapids Project. The Avian Predator Control Program shall articulate the goals and objectives of the program, the measures to be undertaken by Grant PUD to achieve those goals and objectives, and the methods by which the success of those measures will be evaluated from time to time as determined by the PRCC and with concurrence by NOAA Fisheries.

As part of this Program, Grant PUD shall maintain in good condition wires across the Wanapum powerhouse tailrace area to discourage feeding behavior by avian predators. FERC shall also require Grant PUD to evaluate the feasibility of installing additional wire arrays across the spillway tailrace areas by the end of the first year following issuance of this Opinion. If NOAA Fisheries determines that wire installation is feasible, and regulatory approvals are granted, Grant PUD shall install wires across the spillway tailrace area before the 2006 juvenile fish passage season begins.

There are critical uncertainties regarding the magnitude of the impacts avian predators are having on listed Columbia River salmonids. As noted in Section 6.3.2.3, Ruggerone (1986) estimates that up to 2% of smolts are consumed by avian predators at Wanapum Dam. For instance, California gulls are the primary avian predator at Wanapum Dam, and this species is thought to consume tens of thousands of smolts at Columbia and Snake River dams each year (NOAA Fisheries 2000b). Enhancing the wire arrays over the tailrace should reduce losses to avian predators. Moreover, installation of wires across the spillway should further reduce juvenile losses and increase project passage survival. Annual reporting of the biological effectiveness of this measure shall be included in Action 32.

Action 11: Northern Pikeminnow Removal Program. FERC shall require that Grant PUD continue to develop and annually fund an overall programmatic approach to the reduction of juvenile salmon mortality associated with predation by the northern pikeminnow in the area of the Priest Rapids Project. This Northern Pikeminnow Removal Program shall articulate its goals and objectives, the measures to be undertaken by Grant PUD to achieve those goals and objectives, and the monitoring and evaluations, consistent with other means and measures undertaken by Grant PUD to improve juvenile passage survivals as developed pursuant to

Action 2, above. This Program shall be developed in consultation with the PRCC and approved by NOAA Fisheries.

Grant PUD shall continue to fund throughout the term of this Opinion, a northern pikeminnow removal program, and shall in consultation with the PRCC, develop and implement a monitoring and evaluation program to evaluate its effectiveness per Action 34 of this RPA.

9.3 Juvenile Passage, Priest Rapids Development

***Action 12*:** Downstream Passage Alternatives Action Plan. As part of Action 2, above, FERC shall require that Grant PUD complete and annually revise a DPAAP which addresses the testing, evaluation, and implementation of both capital and operational modifications at the Priest Rapids Dam and their expected effects on achieving the applicable performance standards for the Project. These capital or operational modifications shall improve juvenile passage survivals while remaining within applicable TDG limits. Priest Rapids Dam passage improvements are of lower priority than Wanapum Dam passage improvements, because recent evaluations of the current spill program indicate higher project survival at Priest Rapids Dam than at Wanapum Dam under existing facilities and operations (although performance standards have not been met).

***Action 13*:** Alternative Top Spill Concepts. As part of the first phase of the DPAAP above, FERC shall require that Grant PUD focus the specific designs upon alternative application of top spill concepts. Preliminary testing in 2002 and further testing in 2003 suggest that modification of tainter gates and the possible use of full-open tainter gate configurations may provide high fish passage efficiencies and survivals. Prior to testing and construction, Grant PUD shall, in consultation with the PRCC, prepare and submit to NOAA Fisheries detailed design and engineering plans and schedules for its review and approval. The results of these tests will be used to further develop a longer-term downstream passage program for the Priest Rapids Dam. Priest Rapids Dam passage improvements are of lower priority than Wanapum Dam passage improvements, because evaluation of the current spill program indicates higher project survival at Priest Rapids Dam than at Wanapum Dam.

Grant PUD is currently analyzing downstream passage alternatives for the Priest Rapids Dam to determine a passage alternative that could contribute to improvements in project survivals. The weighted average survival estimate from the 2003 PIT-tag survival study for Priest Rapids Development using yearling chinook salmon was 93.9%[14] with a 95% CI of 92.4-98.4 (Anglea et

[14] The 2003 survival study results are paired-release estimates based on John Day PIT-tag detections.

al. 2003). While this point estimate exceeds the 93% performance standard, the determination of whether Priest Rapids' existing facilities and operations are meeting standards shall be made based on 3 years of studies as described in Action 1. Involvement of the PRCC during design reviews, selection and prioritization of alternatives, and review of tests of chosen alternatives, should result in an alternative that optimizes fish passage survival rates and provides for more efficient and timely implementation. Additional testing of this and other alternatives must be developed in consultation with the PRCC and approved by NOAA Fisheries.

***Action 14*:** Alternative Spill Measures. Prior to construction of the long-term capital improvements identified in Action 12, FERC shall allow Grant PUD to evaluate further modifications to the spill regime at Priest Rapids Dam to evaluate potential improvements in juvenile survivals. FERC shall require that Grant PUD develop annual study plans for these evaluations. The studies shall be designed to evaluate possible alternatives to spill that may result in survival improvements over the basic spill program identified under Action 15, below. Such study proposals shall be developed in consultation with the PRCC and subject to NOAA Fisheries' approval. FERC shall require Grant PUD to report on the results annually, as provided in Action 32. In-season management of spill shall be conducted as described in Section 3.2.1.2. Priest Rapids Dam passage improvements are of lower priority than Wanapum Dam passage improvements, because evaluation of the current spill program indicates higher project survival at Priest Rapids Dam than at Wanapum Dam.

As discussed under Action 14, below, spill is currently assumed to be the safest route of passage for juvenile salmonids at Priest Rapids Dam. Grant PUD tested preliminary alternatives in 2002 with a full open tainter gate which showed high potential to provide an effective passage route that generates much lower levels of TDG in the tailrace. This alternative is undergoing more rigorous evaluation in 2003 and future passage alternatives are expected to build upon this information. Additional testing of this and other alternatives must be developed in consultation with the PRCC and approved by NOAA Fisheries.

***Action 15*:** Alternative Spill Patterns. While testing other spill alternatives, FERC shall also require Grant PUD to investigate changes to the spill pattern at Priest Rapids Dam to explore methods to improve juvenile survival through the spillway. Any changes to the spill pattern shall be implemented only after consultation with the PRCC and subject to approval by NOAA Fisheries. Priest Rapids Dam passage improvements are of lower priority than Wanapum Dam passage improvements, because evaluation of the current spill program indicates higher project survival at Priest Rapids Dam than at Wanapum Dam.

***Action 16*:** Spill. Subject to the identification of better measures to improve downstream survivals through the implementation of Actions 12 through14, FERC shall require Grant PUD to implement a spill level of 61% of average daily total river flow, or TDG limits, whichever is less, for spring migrants. This spill level will remain in effect for spring migrants until a better downstream passage alternative is identified, tested, and approved by NOAA Fisheries, in consultation with the PRCC. This spill level will be in effect for 95% of the spring migrants passing Priest Rapids Dam as determined by in-season monitoring at Rock Island Dam or June 15, whichever is earlier, with monitoring of the downstream migration to begin annually on or before April 1. With consultation with the PRCC and approval by NOAA Fisheries, Grant PUD may reduce spill as necessary to remain at or under the TDG limits. Implementation and in-season management of spill shall be conducted as described in Section 3.2.1.2. Grant PUD, in consultation with the PRCC and with approval by NOAA Fisheries, may replace interim spill at the Priest Rapids Development if more biologically efficient and effective measures are designed, tested, and implemented.

***Action 17*:** Total Dissolved Gas Abatement. In coordination with Action 12, FERC shall require Grant PUD to investigate alternatives for reducing TDG production in the Priest Rapids spillway. Results of the 2003 monitoring program shall be provided to NOAA Fisheries and the PRCC during the winter of 2004, or as soon as they are available, for discussion regarding possible alternatives for reducing TDG. In addition, development of fish passage alternatives at Priest Rapids Dam shall use the current 120% tailrace TDG limit as a design criterion. If NOAA Fisheries, in consultation with the PRCC, determines that gas abatement measures are warranted, study and design shall commence promptly (i.e., by 2005). Implementation and in-season management of spill shall be conducted as described in Section 3.2.1.3.

While juvenile survival rates are 95% to 98% at the Priest Rapids spillway, TDG levels occasionally exceed the current 120% criterion. Without alternative passage measures or gas abatement activities, spill may need to be reduced to stay within the TDG limits.

***Action 18*:** Turbine Operations. FERC shall require Grant PUD to conduct research, beginning within 1 year of issuance of this Opinion, to improve turbine survival at Priest Rapids Dam. Research proposals shall be reviewed and approved by NOAA Fisheries, in consultation with the PRCC before commencing. Biological testing shall begin in early spring of the year following the issuance of this Opinion and prior to the onset of the spring migration season. Research results and subsequent turbine operation plans shall be reviewed and approved by NOAA Fisheries in consultation with the PRCC. FERC shall make every reasonable effort to ensure that improved turbine operations shall begin by the 2005 spring migration season. Until a new operation plan is in place, FERC shall ensure that the Priest Rapids turbines are operated in a non-cavitation mode.

As noted in Section 6.4.2, the estimates for turbine survival for Priest Rapids range from 78.1% to 99.4%. The average of the three turbine survival point estimates is 87.8%. Turbine survival rates for spring-run chinook salmon and steelhead are 90% to 93% at FCRPS dams, respectively. Optimizing turbine operations for fish passage should increase survival rates comparable to that in the FCRPS and the Wanapum turbines. Operation of the Priest Rapids turbines in a range where cavitation does not occur, as implemented part of the time at Wanapum, would likely result in an incremental improvement in dam passage survival at Priest Rapids Dam.

Action 19: Avian Predator Control. In conjunction with the Avian Predator Control Program developed and implemented pursuant to Action 10, above, FERC shall require Grant PUD to maintain in good condition wires across the Priest Rapids powerhouse tailrace area to discourage feeding behavior by avian predators. FERC shall require Grant PUD to determine the feasibility of wire installation across the Priest Rapids spillway tailrace area. The feasibility study shall be developed and conducted in consultation with and subject to approval by NOAA Fisheries, by the end of the first year following issuance of this Opinion. If NOAA Fisheries determines that wire installation is feasible, and regulatory approvals are granted, Grant PUD shall install wires across the spillway tailrace area before the following juvenile fish passage season begins.

There are important uncertainties regarding the magnitude of the impacts avian predators are having on listed Columbia River salmonids. As noted in Section 6.3.2.3, Ruggerone (1986) estimates that up to 2% of smolts are consumed by avian predators at Wanapum Dam, and it can be inferred that there is considerable consumption at Priest Rapids Dam as well. For instance, California gulls are the primary avian predator at Priest Rapids Dam, and this species is thought to consume tens of thousands of smolts at Columbia and Snake River dams each year (NOAA Fisheries 2000b). Enhancing the wire arrays over the tailrace should reduce losses to avian predators. Moreover, if feasible, installation of wires across the spillway tailrace area should further reduce juvenile losses and increase project passage survival. Annual reporting of the biological effectiveness of this measure shall be included in Action 32.

Action 20: Northern Pikeminnow Removal. As a component of the Northern Pikeminnow Predator Reduction Program developed pursuant to Action 10, above, Grant PUD shall continue to fund throughout the term of this Opinion a northern pikeminnow removal program, and shall in consultation with the PRCC develop and implement a monitoring and evaluation program to evaluate its effectiveness.

9.4 Adult Fish Passage, Priest Rapids and Wanapum Developments

Action 21: Adult PIT-Tag Detection, Priest Rapids Dam. FERC shall require Grant PUD to continue to operate and maintain PIT-tag detection capability in the right and left bank fishways at Priest Rapids Dam.

PIT-tag detection capability at Priest Rapids is necessary to complete the triangle of detection within the Columbia and Snake River confluence at Ice Harbor, McNary, and Priest Rapids Dams, will significantly increase region-wide monitoring and assessment precision, and will provide a tool to determine smolt-to-adult returns for UCR steelhead and UCR spring-run chinook salmon. This research will also inform development of a long-term plan to assess adult survival through the Priest Rapids Development and identify where UCR spring-run chinook salmon and UCR steelhead stray in the system.

Action 22: Priest Rapids Adult Trap. FERC shall require Grant PUD to complete the design of an off-ladder adult trap in the left bank fishway at Priest Rapids Dam within 1 year of issuance of this Opinion. Design scoping shall commence within 90 days of this Opinion with a prompt construction schedule that will be developed in consultation with the PRCC and approved by NOAA Fisheries. Grant PUD, in coordination with the PRCC, may seek agreement on sharing the costs of constructing this facility with the Northwest Power Planning Council and other regional sources. Grant PUD shall construct the left bank fishway off-ladder trap within 3 years of issuance of this Opinion, after consultation with the PRCC, and subject to NOAA Fisheries approval of the design, regardless of funding commitments from other entities.

The existing adult trap is obsolete and lacks acceptable fish handling facilities. An off-ladder trap would reduce adverse effects on adult migration through the left bank fishway while allowing research and management activities to continue. NOAA Fisheries and the WDFW have developed a strategy to manage artificially propagated steelhead to meet the following goal:

> Recovery of ESA-listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.

To achieve this goal, assessment of annual adult returns is mandatory. Adult monitoring at Priest Rapids Dam has been conducted since at least 1977. Continuing the 26-year data set is critical in assessing the ESU by comparing current run sizes with historic run sizes. Furthermore, it will be useful in the future for determining the effectiveness of steelhead recovery efforts, such as habitat restoration and artificial propagation programs. The trap is necessary for the recovery efforts because of the co-managers' strategy to maintain and improve the genetic stock integrity and tributary adaptation of future generations, which provides regional fisheries decision-makers with an important management tool.

Grant PUD shall coordinate all design development and implementation phases with NOAA Fisheries and the PRCC, and the final design shall be approved by NOAA Fisheries. Because of the shared benefits associated with such a facility, NOAA Fisheries believes that a cost-sharing approach to the construction of the trap may be suitable and appropriate. However, the lack of ability of Grant PUD to attain cost-sharing agreements with other entities does not preclude any construction requirement for Grant PUD.

Action 23: Priest Rapids Project Adult Fishway Improvements. FERC shall require Grant PUD to investigate methods for improving hydraulic conditions in the Priest Rapids Project fishway collection channel, junction pool, and entrance pools. Assessment shall begin within 6 months of issuance of this Opinion and, if feasible, improvements will be implemented during the following season's ladder outage period. Schedule, design, and implementation shall be undertaken in consultation with the PRCC and subject to NOAA Fisheries' approval.

The objective of this action is to provide effective fishway debris management, powerhouse collection channel velocities between 1.5 and 4.0 ft per second, and 1 to 1.5 ft of head across the fishway entrances for all modes of fishway operation. Recent changes in fishway operation make it possible that the collection channel/junction pool objective may already be achieved. Minimally, velocity meter(s) shall be installed in easily observable locations that provide a reasonable representation of the average collection channel velocity at the Junction Pool.

Adult radiotelemetry studies (see Section 6.3.4) indicate that delay is occurring at the junction pool in the Priest Rapids left bank fishway. Necessary changes to the junction pool shall be implemented as soon as possible. Reducing delay could improve survival and spawning success for adult UCR spring-run chinook salmon and UCR steelhead. Passage improvements should also seek to minimize adverse impacts on lamprey passage. As specified in the IPP, as deficiencies are identified that preclude operation of project upstream passage facilities per operational criteria identified in the Annual Operation Plan (see Action 32), they shall be rectified as soon as practical.

Action 24: Adult Fish Counting. FERC shall require Grant PUD to develop video monitoring capability for counting adults migrating through the right and left bank fishways at Priest Rapids and Wanapum Dams. Video counting shall be in operation by 2006 at both dams, and reports submitted for inclusion in regional databases. The horizontal counting board at Priest Rapids Dam shall be removed once the video counting equipment is operational.

Accurate and reliable counting provides in-season and real-time run assessment information for regional fisheries managers, and provides in-season information regarding adult loss between dams. The existing adult counting facility at Priest Rapids Dam is in need of replacement. Video counting capability will provide more accurate and reliable information for in-season management. The video system is being tested at Wanapum Dam and the final production version shall be refined and in place by 2005.

Action 25: Adult Steelhead Downstream Passage. FERC shall require Grant PUD to operate project sluiceways at both dams continually from the end of summer spill until

November 15 to provide a safer passage route for adult steelhead fallbacks. If in-season monitoring indicates that these time frames could be modified to improve adult downstream fish passage, FERC shall require Grant PUD to discuss in-season study results with the PRCC, and upon approval by NOAA Fisheries modify the time frame for operating project sluiceways.

Sluiceways should be operated to provide a route of passage for steelhead fallbacks and steelhead kelts. Recent information from Upper Columbia River studies indicate that many more steelhead than previously thought survive spawning and begin migrating back to the ocean. Steelhead kelts will likely migrate out of the system at a different time than when chinook salmon fallback occurs. Thus protection or special project operations for steelhead kelts may be different than for fallback steelhead, and extended operation of the sluiceways at both dams is warranted. Adult telemetry studies (English et al. 2003) showed that steelhead kelts passed Wanapum and Priest Rapids after the initiation of spring spill.

9.5 Off-Site Mitigation Actions

Even with survival improvements in fish passage at and between dams, unavoidable mortality associated with project operations will continue to occur. The following suite of actions is directed toward offsetting mortality and habitat alteration associated with operation of the Priest Rapids Hydroelectric Project, so that overall operations do not jeopardize the survival and recovery of endangered UCR spring-run chinook salmon and UCR steelhead. NOAA Fisheries has worked with hydropower operators to develop supplementation and habitat restoration programs to assist in rebuilding endangered and threatened anadromous fishery resources. Off-site mitigation is intended to complement, not displace, actions by other Federal and non-Federal entities. Where overlap in supplementation and habitat activities occur, costs and implementation responsibilities should be coordinated as appropriate. These actions are longer-term in nature and may need to be implemented over the full term of the new license.

9.5.1 Artificial Propagation

Federal and State fisheries agencies, affected Tribes, and the PUDs of Chelan, Douglas, and Grant Counties developed a comprehensive artificial propagation proposal called the Biological Assessment and Management Plan (BAMP) (1998) which identifies stock propagation goals to aid in the rebuilding of at-risk anadromous fishery resources, including UCR spring-run chinook salmon and UCR steelhead. While the BAMP identifies production goals and responsibilities relevant to Grant PUD, the fisheries resource managers define the specific goals of the program and their appropriate use. The overall objectives pertaining to the BAMP are 1) to help recover natural populations to self-sustaining and harvestable levels throughout the mid-Columbia region, and 2) to mitigate for a portion of the continuing mortality.

After 2013, adjustment to the production levels may be made based on changes in average adult returns, adult-to-smolt survival rates, and smolt-to-adult survival rates from the propagation programs. The Hatchery Subcommittee (see Action 26) will be responsible for determining program adjustments considering methodology described in the BAMP and recommending modified implementation plans for Grant PUD funding. All program adjustments are subject to the approval of NOAA Fisheries. At this time, Actions 28 and 29 describe known program implementation actions that Grant PUD should initiate immediately. Implementation of production not identified in Actions 28 and 29 will be determined by the Hatchery Subcommittee.

***Action 26*:** Hatchery Subcommittee. Within 6 months of issuance of this Opinion, Grant PUD shall convene a Hatchery Subcommittee of the PRCC to undertake and oversee the planning and implementation of the programs described in Actions 27-29. Grant shall complete an Artificial Propagation Plan[15] for UCR spring-run chinook salmon and UCR steelhead. Grant PUD shall periodically assess modifications in these program plans with the approval of NOAA Fisheries and in consultation with the PRCC at intervals as described in Actions 26 and 27 or as otherwise agreed to by the Hatchery Subcommittee.

***Action 27*:** UCR Steelhead Supplementation Plan. FERC shall require Grant PUD to complete, in consultation with the PRCC and subject to NOAA Fisheries' approval, an Artificial Propagation Plan to rear and release up to 100,000 yearling UCR steelhead for release in the UCR Basin. The plan shall be consistent with recovery criteria for UCR steelhead and other artificial propagation programs. If new facilities are determined to be warranted for the implementation of this plan, then they shall be constructed to rear a minimum of the production level of this plan plus 10%. A comprehensive monitoring and evaluation program shall be included in the plan that includes monitoring in the natural environment. The monitoring and evaluation program may be implemented in conjunction with ongoing or future monitoring and evaluation programs with other entities such as Chelan and Douglas County PUDs through cost-sharing agreements external to this Opinion.

***Action 28*:** UCR Spring-Run Chinook Salmon. FERC shall require Grant PUD to complete, in consultation with the PRCC and subject to NOAA Fisheries' approval, an Artificial Propagation Plan to rear and release up to 600,000 yearling UCR spring-run chinook salmon for release in the UCR Basin. The plan shall be consistent with UCR spring-run chinook salmon recovery criteria and other UCR spring-run chinook salmon artificial propagation programs. New facilities are anticipated to be necessary for this program and shall be constructed to rear a minimum of the production level plus 10%. A comprehensive monitoring and evaluation program shall be included in the plan that includes monitoring in the

[15]The Artificial Propagation Plan can take the form of a Hatchery and Genetic Management Plan.

natural environment. The monitoring and evaluation program may be implemented in conjunction with ongoing or future monitoring and evaluation programs with other entities such as Chelan and Douglas County PUDs through cost-sharing agreements external to this Opinion.

Where two or more alternatives to achieving production levels exist, the Artificial Propagation Plan shall place priority on the basis of biological effectiveness, time required for implementation, and cost effectiveness. Hatchery program modifications shall make efficient use of existing facilities owned by Grant PUD or cooperating entities, including adult collection, acclimation, and hatchery facilities, provided that the existing facility or the existing facility as modified is compatible with and does not compromise ongoing programs. Grant PUD will be responsible for reaching agreements concerning shared use of facilities with cooperating entities. Grant PUD, in consultation with the Hatchery Subcommittee, shall make reasonable efforts to implement program modifications when needed to achieve overall and specific program objectives.

The Artificial Propagation Plan shall address land, water, and facility development, identify goals and objectives, and provide for coordination with similar programs undertaken by Chelan and Douglas County PUDs. The Artificial Propagation Plan shall include a schedule for prompt and steady implementation progress so as to have the necessary facilities available to commence production within 7 years of issuance of this Opinion. The plan shall be developed within 1 year of the date of the issuance of this Opinion. It shall seek to complete site evaluations and selections within 18 months of plan approval; facility design, permitting and contracting within 2 years of site approvals; and facility construction within 2 years following permit approvals.[16]

The purpose of these artificial propagation programs is to prevent extinction and immediately bolster UCR spring-run chinook salmon numbers in these systems. The goals, objectives, and responsibilities shall be consistent with NOAA Fisheries (2000a), the Basinwide Recovery Strategy, and the HCPs for Chelan County and Douglas County PUDs.

Action 29: White River Spring-Run Chinook Salmon Program. Consistent with Action 28 above, FERC shall require that immediately upon issuance of this Opinion, Grant PUD shall begin funding and otherwise supporting implementation of the White River spring-run chinook salmon captive brood program. This shall include, but is not limited to, the development of permanent rearing and acclimation facilities. This program shall be implemented to reach a yearling smolt production level of up to 250,000 fish, provided the spring-run chinook salmon program total

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[16]This schedule assumes that existing information on candidate sites is sufficient to support site selection, that the preferred sites have readily available water rights to support the proposed facility; and that the PRCC and its Hatchery Subcommittee meet regularly to ensure prompt approvals and active support for permitting the new facilities. The individual milestones in this schedule are subject to adjustments by the PRCC as the Artificial Propagation Plan is developed.

production is 600,000. The Hatchery Subcommittee shall develop a phased implementation schedule for the continuation of this program. The phased approach to the work shall include deadlines for site identification, facility design, Hatchery and Genetic Management Plan approval, the obtaining of necessary regulatory approvals, and the commencement of construction. The design of the required facilities should factor in a 10% increase in production capacity beyond the production levels required above.

The White River spring-run chinook salmon captive brood program may have real near-term benefits as this population segment has been at critically low adult return levels. This program was an element in the BAMP and considered an important safety net measure for recovery of UCR spring-run chinook salmon in terms of maintaining diversity and spatial distribution in the ESU. Therefore, the captive brood program must be funded immediately to succeed.

Action 30: Nason Creek Spring-Run Chinook Salmon Program. Consistent with Action 28 above, FERC shall require that immediately upon issuance of this Opinion, Grant PUD will begin supporting artificial propagation of spring-run chinook salmon in Nason Creek by the funding of permanent rearing and acclimation facilities. At this time, the development of an adult trapping facility and juvenile acclimation site to rear 250,000 yearling smolts, provided the spring-run chinook salmon program total production is 600,000, on Nason Creek is warranted. The Hatchery Subcommittee shall develop a phased implementation schedule for these actions. The phased approach to the work shall include deadlines for site identification, facility design, the obtaining of necessary regulatory approvals, and the commencement of construction. The design of the required facilities should factor in a 10% increase in production capacity beyond the production levels required above.

The Joint Fisheries Parties have identified the need to provide rearing and acclimation for spring-run chinook salmon in Nason Creek to increase spatial distribution and ensure full seeding of Nason Creek habitat for spring-run chinook salmon. This program was an element in the BAMP in the form of a captive brood rearing program. The change to an adult-based conventional supplementation strategy remains consistent with the intent to bolster the smolt production in Nason Creek to maintain spatial distribution and increase abundance in the ESU.

Action 31: Methow River Basin Spring-Run Chinook Salmon Program. Consistent with Action 28 above, FERC shall require that immediately upon issuance of this Opinion, Grant PUD shall begin funding and otherwise supporting the implementation of artificial propagation of spring-run chinook salmon in the Methow River Basin. This shall include, but is not limited to, development of permanent rearing and acclimation facilities. At this time, potential improvement of existing facilities in the Methow Basin owned by Douglas PUD should be explored as one avenue for Grant PUD to contribute to the recovery of UCR spring-run chinook salmon at a production level of up to 200,000 yearling smolts, provided the spring-run chinook salmon program total production is 600,000.

The Joint Fisheries Parties have identified the need to provide additional rearing and acclimation for spring-run chinook salmon in Methow River Basin to allow for optimal rearing conditions for endangered spring-run chinook salmon. The program is consistent with ongoing programs that are intended to maintain spatial distribution and increase abundance in the ESU.

9.5.2 Habitat Restoration and Conservation

Habitat restoration and conservation are intended to accelerate efforts to improve survival and recovery of UCR spring-run chinook salmon and UCR steelhead. This effort shall mitigate for a portion of unavoidable loss of UCR spring-run chinook salmon and UCR steelhead.

Action 32: Habitat Subcommittee. Within 6 months of the date of this Opinion, Grant PUD shall convene a Habitat Subcommittee of the PRCC to undertake and oversee the planning and implementation of the necessary program elements to support habitat protection and restoration programs.

Action 33: Habitat Plan. FERC shall require Grant PUD to develop, in consultation with the PRCC and subject to NOAA Fisheries' approval, a Habitat Plan designed to shepherd the development and implementation of spring-run chinook salmon and steelhead habitat protection and restoration. The Habitat Plan shall provide for coordination with other similar programs such as those undertaken by Chelan and Douglas PUDs. At a minimum, the Habitat Plan shall identify goals, objectives, a process for coordination, and a process by which habitat projects may be identified and implemented. The Habitat Plan shall give priority to restoring habitat functions important to listed stocks and other anadromous species in drainages occupied by UCR steelhead and UCR spring-run chinook salmon affected by the Priest Rapids Project. The Habitat Plan shall give priority to projects that can be implemented prior to 2010 with the available funding to provide maximum benefit to ESA-listed species during the term of this RPA. The purpose of the Habitat Plan is to establish and shepherd a habitat restoration program that promotes the rebuilding of self-sustaining and harvestable populations of UCR spring-run chinook salmon and UCR steelhead, and to mitigate for a portion of unavoidable losses resulting from project operations. The Habitat Plan shall be developed within 1 year of the date of this Opinion, and shall be revised from time to time as appropriate.

Action 34: Habitat Account. FERC shall require Grant PUD to establish within 1 year of the date of this Opinion a Priest Rapids Habitat Conservation Account in accordance with applicable requirements of Washington State law. Funds in the account shall be made available by Grant PUD to finance tributary or mainstem habitat projects. The amount of funds provided to the account annually shall be $288,600 (specified in 2003 dollars - annually adjusted per the U.S. Department of Labor, Bureau of Labor Statistics CPI for Western Region).

9.6 Reliability Mechanisms

9.6.1 Implementation and Reporting

Implementation plans, annual progress reports, and periodic program evaluations are necessary to track the success of actions under this RPA. NOAA Fisheries also expects that the development of annual progress reports, study plans, and periodic performance evaluations would be included in a settlement agreement or the new license. Such reports, plans, and evaluations provide important information to assure effective implementation of an adaptive management program for the Project. Preparation of these reports and evaluations during the period considered in this Opinion will also provide important information for determining the status of implementation of this RPA and whether reinitiation of consultation is warranted.

Action 35: Performance Evaluation Program Development. FERC shall require Grant PUD to develop, within 1 year of the date of this Opinion, an overall Performance Evaluation Program for the Project. The purpose of the program will be to provide a reliable technical basis to assess the degree to which Grant PUD is improving juvenile and adult passage survivals, habitat productivity improvements, and supplementation for the listed anadromous fishery resources affected by the Project as described in this RPA. Where appropriate, the Performance Evaluation Program shall measure and evaluate individual actions within each category, assess the contribution of the action to the desired objective, and provide a basis for identifying new options and priorities among those options for further progress in meeting objectives. This Performance Evaluation Program shall consist of annual progress and implementation reports and periodic performance evaluations to assess overall performance in meeting the survival standards described in this RPA. Grant PUD shall develop this Performance Evaluation Program in consultation with the PRCC and shall submit it to NOAA Fisheries for review and approval.

Action 36: Annual Progress and Implementation Plans. Within 1 year of the date of this Opinion and annually thereafter, FERC shall require that Grant PUD produce annual Progress and Implementation Plans that describe the implementation activities for the actions required in this RPA. These Plans will report on the status of the actions required by this RPA undertaken by Grant PUD during each calendar year and the anticipated schedule of future actions and studies in the next planning period in the areas of juvenile and adult passage, habitat, and supplementation. The Progress and Implementation Plans will also report the results of monitoring, modeling, or other analyses that take place in the calendar year to evaluate the degree to which the actions are likely to improve juvenile and adult survivals. The Progress and Implementation Plans will also provide an annual plan for the operation, inspection, and maintenance of all juvenile and adult fishways at both Priest Rapids and Wanapum Dams. Grant PUD shall provide these Progress and Implementation Plans to NOAA Fisheries and the PRCC by no later than February 15 of each year to assist in systems operational planning for that year.

***Action 37*:** Periodic Program Evaluation Reports. At 3-year intervals or as otherwise provided for in the approved Performance Evaluation Program developed pursuant to Action 35, above, Grant PUD shall prepare and submit to the PRCC a Performance Evaluation Report that will assess the ability of each program element to meet its program objectives and contribute to the overall achievement of the performance standards in Action 1, above. As may be provided in the approved Performance Evaluation Program, Grant PUD may incorporate independent peer review by recognized experts, as approved by the PRCC, as it evaluates alternative fish passage survival improvements.

***Action 38*:** Program Coordination. FERC shall require that Grant PUD coordinate the design of its Performance Evaluation Program with the development of relevant parallel monitoring or evaluation systems by other hydropower operators in the Columbia Basin and the Northwest Power Planning Council. The purpose of such coordination shall be to promote technical consistency and compatibility among these efforts to contribute to a comprehensive evaluation of stock performances throughout the Columbia Basin. This coordination shall also promote the use of the best available science and shall provide opportunities for the efficient sharing of monitoring activities, data management systems, analytical modeling, and other activities.

9.6.2 Implementation Mechanisms

***Action 39*:** Priest Rapids Coordinating Committee. Grant PUD shall establish and convene a PRCC comprised of NOAA Fisheries, the USFWS, the WDFW, the Confederated Tribes of the Colville Reservation, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and Grant PUD. The PRCC shall oversee the implementation of the anadromous fish activities associated with the Priest Rapids Project, including the requirements of this Opinion. Among other things, it shall approve or modify annual Progress and Implementation Plans, approve or modify the Performance Evaluation Program, review Performance Evaluation Reports, advocate decisions of the PRCC in all relevant regulatory forums, establish such subcommittees as it deems useful (in addition to the Habitat and Hatchery Subcommittees required above), resolve disputes elevated from subcommittees, and conduct other business as may be appropriate for the efficient and effective implementation of these measures.

9.6.3 Financial Capacity

***Action 40*:** Financial Capacity. Grant PUD shall undertake such actions as may be necessary to ensure that it will maintain the financial capacity to fulfill its fishery obligations under law, including the programs and measures required by this Opinion. Grant PUD undertakes financial forecasting over a decadal period every year to ensure the ability to meet financial obligations for implementing fish measures, honoring power purchase contractual obligations, making debt service payments, and the like. Grant PUD shall include in its financial forecast the projected cost of fully implementing all of its fishery obligations under existing law, including this Opinion and any new license obligations. Consistent with its new power sale contracts, Grant PUD shall allocate annually to each Power Purchaser equal to their proportional share, annual power costs, which include operating expenses and debt service requirements. This recouping mechanism will ensure that Grant PUD will have adequate funds to cover its power costs. Grant PUD shall also maintain senior, enhanced debt ratings by one or more major credit rating companies at or above investment grade (BBB or its equivalent). If there is not at least one investment grade rating for bonds for the Priest Rapids and Wanapum Developments, within thirty days after Grant PUD is notified that the ratings for these Developments have been downgraded below investment grade, Grant PUD shall make a good faith effort to secure a line of credit in an amount equal to the estimated cost of implementing the fish measures required by this Opinion during the next 12 months. Grant PUD shall have a final line of credit in place no later than 60 days after receiving the notification. Credit support may be in the form of a line of credit with a term of at least 1 year provided by a national bank or financial institution. Grant PUD's obligation to provide credit support shall terminate if it obtains an investment grade rating for the debt of the Priest Rapids and Wanapum Developments. As long as Grant PUD is obligated to maintain credit support, the amount of the credit support to be provided shall be adjusted annually.

9.7 Effects of RPA on Biological Requirements

The ESA imposes on Federal agencies a duty to ensure that their actions will not jeopardize listed species.[17] The preceding analysis in this Opinion supports a determination that FERC's proposed action is likely to jeopardize the continued existence of endangered UCR spring-run

[17] The ESA also requires that Federal agencies not destroy or adversely modify any designated critical habitat, but NOAA Fisheries has vacated critical habitat designations for these two species as described in Section 1.

chinook salmon and UCR steelhead. This determination results from evidence that the proposed 95% juvenile dam passage survival standard, even if consistently met, would nevertheless result in a reduction in numbers, reproduction, or distribution that would probably be an appreciable reduction in the likelihood of both survival and recovery. The RPA[18] avoids jeopardy by requiring Grant PUD to make steady progress toward a minimum 91% combined adult and juvenile survival performance standard at Priest Rapids Development and at Wanapum Development by 2010, including a 93% project-level (reservoir and dam) juvenile performance standard, which would result in a juvenile reach survival that is approximately 95% of that expected in a free-flowing river of equal length (0.93/0.97). It includes measures that Grant PUD can implement in the short term (within 2 years) to improve survival within the action area—spill; predator controls; turbine operations; spring-run chinook salmon captive brood programs for the White River, Methow River, and Nason Creek; and improvements to adult ladders and traps at the Project. Implementation of this RPA, while still resulting in mortality and other harm from the operation of the Project, would not constitute an appreciable reduction in the likelihood of both survival and recovery.

The RPA also includes measures that will be implemented over 3 to 10 years after issuance of this Opinion, such as developing new downstream fish passage facilities, replacing the turbines at Wanapum Dam with advanced models that are designed to improve juvenile survival, and monitoring and evaluation. Long-term habitat protection and restoration measures, which are designed to support natural spawning populations of UCR spring-run chinook salmon and UCR steelhead, will be implemented over a time frame of 10 years or more.

9.7.1 Environmental Baseline and Cumulative Effects in the Expanded Action Area

The action area for the proposed action was limited to a 56-mile reach of the mainstem Columbia River between a point 1,000 ft downstream of the tailrace of Rocky Reach Dam to 1,000 ft downstream of the tailrace of Priest Rapids Dam (Section 5.1). However, the action area for the RPA also includes spawning and rearing habitat in the Okanogan, Methow, Entiat, and Wenatchee subbasins that will be affected by off-site mitigation Actions 32 through 34 (described in Section 9.5.2, Habitat Restoration and Conservation). Therefore, NOAA Fisheries must consider the environmental baseline and cumulative effects over a larger area than that addressed in Section 5.1.

Baseline conditions for tributary spawning and rearing habitat are thoroughly described in the Federal Environmental Impact Study for the HCPs for the Wells and Rocky Reach Hydroelectric Projects (NOAA Fisheries 2002b), and the Upper Columbia Regional Technical Team report (2003). These impacts result from a wide array of past and present land management activities and natural phenomena (wildfires and flood events) in the Okanogan, Methow, Entiat, and

[18] NOAA Fisheries developed the RPA through considerable consultation with other Federal fishery resource agencies, Washington State resource agencies, Tribal representatives, and Grant PUD's technical experts.

Wenatchee subbasins including, but not limited to, the following:

- Habitat is eliminated, cut off, or blocked.
- Habitat is degraded.
- Reduced or altered flows (water withdrawls or water storage facilities).
- Reduced channel migration, complexity, and floodplain function.
- Altered channel morphology (increased width-to-depth ratios).
- Reduced gravel recruitment (armoring and/or loss of spawning substrate).
- Increased fine sediments (increased erosion).
- Reduced riparian vegetation (amount and quality).
- Reduced woody debris recruitment into streams.
- Water quality is degraded.
- Elevated levels of fecal coliform bacteria.
- Elevated nutrient loads and reduced dissolved oxygen levels caused by elevated nutrient loading.
- Elevated late summer and fall temperatures.
- Chemical runoff from roads and agricultural and urban areas.
- Water diversions and/or substandard fish screens at diversions kill or injure fish.

In addition, NOAA Fisheries searched its Public Consultation Tracking System (PCTS) for biological opinions completed since 2000 that were likely to affect UCR spring-run chinook salmon and UCR steelhead and found 20 and 25 opinions that affected each species, respectively. Although some effects were expected to be positive and some negative, in most cases the action was expected to affect one acre or less, and did not address subbasin limiting factors. Four projects, which affected both ESUs, would have negative effects on an area greater than one acre:

- Construction of 10 new residential docks in the Columbia River in Douglas and Chelan counties (between one and five acres).
- Foghorn Dam repair on the Methow River in Okanogan County (less than five acres).
- Breakwater/dock/pier construction at the Columbia Pointe Development Community in Douglas County (less than five acres).
- Breakwater/dock/pier construction and riparian work at Wells and Rock Island dams in Chelan County (greater than five acres).

With respect to State, local, tribal, or private activities, NOAA Fisheries is not aware of particular projects that are reasonably certain to occur in this action area contemporaneous with the term of this Opinion, other than the current levels of rural and urban land use that affect the listed species.

Therefore, when evaluating the status of the listed species, including the likelihood of survival and recovery, NOAA Fisheries concludes that there are few new Federal actions that could adversely affect (e.g., breakwater/pier/dock development) or benefit (habitat restoration or conservation easements) the listed species that are eligible to be considered in determining whether this RPA is likely to jeopardize the species' continued existence. Conditions that will affect the future abundance and productivity of listed UCR steelhead and UCR spring-run chinook salmon are likely to be in part improved, and in part degraded, compared to those reflected in the historical trends. It is NOAA Fisheries' judgment, based largely on the description of factors for the decline of these species (Section 4), that the net effect of the environmental baseline will be an improvement of future abundance and productivity of these species.

10. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, to prevent future listings of stocks under NOAA Fisheries' jurisdiction or to develop additional information for use in developing further protective measures. NOAA Fisheries has no recommendations at this time.

11. REINITIATION OF CONSULTATION

This concludes formal consultation for the interim operations of the Priest Rapids Hydroelectric Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded, 2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this Opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species not considered in this Opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, FERC must notify NOAA Fisheries and the USFWS and reinitiate consultation (50 CFR §402.14(i)(4)).

This biological opinion is intended to apply to the operation of the Project under its current license, which expires on October 31, 2005, and any annual licenses issued after that time up to 2013. Prior to that time, NOAA Fisheries intends to work with Grant PUD to complete and sign a comprehensive settlement agreement governing the operation of the Project over the term of a new license for the Project. FERC approval of that agreement will require initiation of a new consultation and the issuance of a new biological opinion associated with that agreement. In the absence of a settlement agreement, NOAA Fisheries intends to consult with FERC on the proposed issuance of a new license for the Project on or around October 2005. This biological opinion, RPA, and incidental take statement will therefore terminate at the expiration of the existing license in October 2005, but may be superseded if NOAA Fisheries issues a new biological opinion before that date. NOAA Fisheries may choose, based on the best available information, to extend this biological opinion, RPA, and incidental take statement if a settlement agreement has been reached and if initiation of ESA Section 7(a)(2) consultation appears imminent and if FERC issues annual licenses up until 2013.

12. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to Section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of the incidental take statement.

The measures described in this section are nondiscretionary and must be included by FERC in its amendment of the Project license. FERC has a continuing duty to regulate the activities of Grant PUD covered by this incidental take statement pursuant to the license as amended. If FERC fails to include these conditions in the license or Grant PUD fails to assume and implement the terms and conditions of this incidental take statement, the protective coverage of Section 7(a)(2) may lapse. To monitor the effect of incidental take, Grant PUD must report the progress of the action and its effect on each listed species to NOAA Fisheries, as specified in this incidental take statement (50 CFR §402.14(i)(3)).

12.1 Amount or Extent of Take

NOAA Fisheries expects that project-related mortalities (i.e., direct, indirect, and delayed mortality resulting from Priest Rapids Hydroelectric Project effects) of juvenile UCR spring-run chinook salmon will not exceed 24.5% for both developments combined; and for juvenile UCR steelhead will not exceed 23.2% for both developments combined. These estimates are the average estimated mortality derived from recent survival studies (1999-2003). NOAA Fisheries anticipates that the proposed action will result in mortality rates of no more than 2% per development, or 4% combined, for adult UCR spring-run chinook salmon, and 3% per development, or 6% combined, for upstream migrating adult UCR steelhead.

The Priest Rapids Hydroelectric Project-related mortality (absolute mortality minus natural mortality) of downstream migrating UCR steelhead kelts is unknown at this time. Based on the very limited information available at present, the absolute mortality rates for UCR steelhead kelts within the action area should not exceed 40% per project (Section 6.3). This is based on the best available information, but is likely a very conservative estimate for the Priest Rapids and Wanapum Developments. Spring spill at both developments probably results in mortality rates less than what was estimated for the lower Snake and Columbia River projects in 2001. NOAA Fisheries anticipates that implementation of the RPA will reduce take.

12.2 Reasonable and Prudent Measures

Reasonable and prudent measures (RPM) and implementing terms and conditions are non-discretionary measures to minimize take, that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in Section 7(a)(2) to apply. FERC has the continuing duty to regulate the activities covered in this incidental take statement. If FERC fails to require Grant PUD to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(a)(2) may lapse. Similarly, if Grant PUD fails to implement the actions set forth in this statement, protective coverage may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these RPMs, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant RPMs will require further consultation.

NOAA Fisheries believes that the following RPMs are necessary and appropriate to minimize take of listed fish resulting from implementation of the action.

1. Measures described in Section 9, the RPA actions numbered 1 through 25, are hereby incorporated by reference as RPMs imposed on the license for the Priest Rapids Project within this incidental take statement.

2. To minimize the amount and extent of incidental take during the shutdown phase of turbine unit 8, FERC shall ensure that measures are implemented to salvage any listed species that are entrained in the gatewells and draft tube of unit 8.

3. To minimize the amount and extent of incidental take from construction activities associated with the turbine replacement (RPA Action 4), measures shall be taken to isolate all toxic materials from the river.

12.3 Terms and Conditions

To be exempt from the prohibitions of Section 9 of the ESA, FERC must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

1. RPA Actions 1 through 25

   a. NOAA Fisheries has no further terms and conditions with respect to implementation of these RPA actions, except for action 4, which is addressed below.

2. Shutdown of Turbine Unit 8

   a. Prior to dewatering the unit, FERC shall require that the emergency wheel gate gatewells be dipnetted twice per slot using best management practices for gatewell dipping and transportation to avoid or minimize stress on listed fish.

   b. FERC shall require that Grant PUD install the downstream bulkhead as soon as reasonably practicable after installation of the upstream bulkhead to reduce the likelihood that listed species in the tailrace enter the draft tube and become entrapped after the installation of the downstream bulkhead.

   c. If the downstream bulkhead cannot be installed within 24 hours of the upstream bulkhead, FERC shall require Grant PUD to inspect the draft tube for the presence of listed fish and without delay remove and transport them for prompt reentry into the river using best management practices for dipnetting and transportation to minimize stress on listed species.

   d. FERC shall require that Grant PUD record and report the number and species, if any, of fish entrained during the shutdown phase.

3. Toxic Materials

   a. FERC shall require that Grant PUD implement best management practices to isolate and remove any toxic materials (oil, grease, concrete, waste water, etc.) occurring within the construction area (between the upstream and downstream gates) and ensure that these materials do not enter the river.

13. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

13.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).
- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Essential Fish Habitat consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities. The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

13.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

13.3 Proposed Actions

The proposed action and action area are described in Sections 3 and 5.1 of this Opinion. The action area includes habitats that have been designated as EFH for various life-history stages of chinook salmon (*O. tshawytscha*) and coho salmon (*O. kisutch*).

13.4 Effects of Proposed Action

As described in Section 6 of this Opinion, the proposed action may result in short- and long-term adverse effects to a variety of habitat parameters. These adverse effects are:

Mainstem Spawning Habitat

- Inundation of mainstem summer/fall chinook salmon spawning habitat upstream of both the Priest Rapids and Wanapum Developments.
- Altered mainstem summer/fall chinook salmon spawning habitat substrate within the Priest Rapids Hydroelectric Project (reduced proportion of gravels and cobbles).

Juvenile Rearing Habitat and Juvenile and Adult Migration Corridor

- Altered flow conditions (ramping) that can modify juvenile and adult fish distribution.
- Altered invertebrate (food) sources and production in the mainstem migration corridor for juvenile chinook salmon and coho salmon.
- Altered water quality, especially TDG resulting from uncontrolled spill at the Priest Rapids Hydroelectric Project.
- Higher than natural predation rates resulting from the enhancement of predator habitat or foraging opportunities at the Priest Rapids Hydroelectric Project.
- Altered riparian vegetation, which can influence cover, food production, temperature, and substrate.

- Altered juvenile behavior or reduced survival of juveniles migrating through the action area as a result of project inundation and operations.
- Altered adult behavior or reduced survival or spawning success of adults migrating through the action area as a result of project operations.

13.5 Conclusion

NOAA Fisheries concludes that the proposed action would adversely affect designated EFH for chinook salmon and coho salmon.

13.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions that may adversely affect EFH. While NOAA Fisheries understands that many of the conservation measures described in the biological assessment are being implemented by Grant PUD, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. However, RPA measures 1 through 25 (Sections 9.1-9.4) and the terms and conditions in Section 12.2 are generally applicable to designated EFH for chinook salmon and coho salmon and address these adverse effects to the extent practical. Consequently, NOAA Fisheries recommends that RPA measures 1 through 25 and the terms and conditions in Section 12.2 be adopted as EFH conservation measures.

13.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

13.8 Supplemental Consultation

FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920(k)).

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APPENDIX A

SURVIVAL AT THE PRIEST RAPIDS HYDROELECTRIC PROJECT COMPARED TO FREE-FLOWING REACH

The purpose of this appendix is to compare the current survival rates as a result of implementing the proposed action to the survival that might be expected in a hypothetical free-flowing or un-dammed river of equal length.

Estimates of survival have been made for wild spring-run chinook salmon smolts migrating from the Salmon River trap at Whitebird to Lower Granite Dam (1966 through 1968), and for wild spring-run chinook salmon and steelhead from 1993 through 1998. The estimates for both periods include survival through Lower Granite Reservoir. NOAA Fisheries, after factoring out mortalities resulting from Lower Granite Dam and Reservoir, has estimated that the per kilometer survival of Snake River steelhead and spring-run chinook salmon would be approximately 0.99966 and 0.99969, respectively, in a free-flowing Snake River.[19]

The distance from the tailrace of Rock Island Dam to Priest Rapids Dam is approximately 90.6 km. The assumption that per/km survival estimates based on information collected in the Snake River can be utilized as reasonable surrogates for likely per/km survival estimates in a hypothetical free-flowing Columbia River, yields the estimates of juvenile survival shown in Table A-1, below. These values are calculated by taking the per/km survival estimate to the X (# of kilometers in the reach) power. For example: 0.99966 to the 90.9th power = 0.970 or 97.0% survival for steelhead passing through a hypothetical free-flowing Priest Rapids Project reach.

[19]The methodologies used in this analysis are detailed in Appendix A (Annex 1) of the 2000 FCRPS biological opinion.

Table A-1. Estimated average per/km juvenile survival of steelhead and chinook salmon in a hypothetical free-flowing river through the Wanapum and Priest Rapids reaches (NOAA Fisheries 2000a).

Project	Length (miles)	Length (km)	Species:	Steelhead	Spring Chinook
			Per/km survival est.:	0.99966	0.99969
				Est. Reach Suv.	Est. Reach Suv.
Wanapum	37.6	60.5		0.980	0.981
Priest Rapids	18.7	30.1		0.990	0.991
Priest Rapids Project	56.3	90.6		0.970	0.972

Based on the single release method using PIT-tags, the estimated average project survival for juvenile steelhead is 79.1% of the free-flowing estimate for a reach of equal length to the Priest Rapids Project, i.e., the action area (Table A-2). Based on the single and paired release methods using PIT-tags, the estimated average project survival for yearling chinook salmon is 84.6% of the free-flowing estimate for the same reach (Table A-2). This comparison illustrates that survival of juvenile steelhead and spring-run chinook salmon are well below estimates for an undammed river of equal length, demonstrating the need for considerable improvements in juvenile passage survival.

Table A-2. Corrected PIT-tag survival estimates for yearling chinook and steelhead migrating through Wanapum and Priest Rapids Dams and Reservoirs.[1]

Stock	Year	Release Point (Project Tailrace)[2]	Number of Projects	Reach Survival	RIS Survival Estimates[3]	Reach Est Correcting for RIS Survival[4]	New Nth Root	Wanapum - Priest Rapids Survival Est[5]	Wanapum - Priest Rapids Free-Flowing Est	Wanapum - Priest Rapids Avg Per Project Survival Est
Yearling Chinook	**1998**	RRE	4	0.683	0.889	0.769	3	0.839		0.916
	2001	RIS	3	0.756		0.756	3	0.830		0.911
		RRE	4	0.703	0.922	0.762	3	0.834		0.913
	2002	RIS	3	0.810		0.810	3	0.869		0.932
		RRE	4	0.762	0.956	0.797	3	0.859		0.927
		RRE	4	0.601	0.956	0.629	3	0.734		0.857
		RRE	4	0.624	0.956	0.652	3	0.752		0.867
		RRE	4	0.689	0.948	0.730	3	0.804		0.896
		RRE	4	0.715	0.954	0.723	3	0.824		0.908
	2003	RIS	3	0.816	0.954	0.706	3	0.874		0.935
	AVG			**0.716**	0.953	**0.731**		**0.828**	**0.846**	**0.905**
Steelhead	**1999**	RIS	3	0.623	0.953	0.709	3	0.795		0.892
		RRE	4	0.583	0.952	0.720	3	0.803		0.896
		RRE	4	0.683	0.953	0.718	3	0.802		0.895
		RRE	4	0.712	0.953	0.717	3	0.801		0.895
	2000	RRE	4	0.648	0.953	0.679	3	0.773		0.879
	AVG			**0.650**	0.953	**0.708**		**0.795**	**0.791**	**0.891**

[1]Source: Skalski, John R. 2003. Historical Evaluation of PIT-Tag and Radio-Tag Survival Estimates at Wanapum and Priest Rapids Projects, 1998-2003, Table 1. Report prepared for Grant PUD. NOTE: survival estimates that did not encompass both RPD and WAN and non-sensical estimates (2000 yearling chinook) are not included.
[2]RRE = Rock Reachy Dam (Chelan County PUD); RIS = Rock Island Dam (Chelan County PUD)
[3]Source: NOAA Fisheries. 2002. Anadromous Fish Agreements and Habitat Conservation Plans - Final Environmental Impact Statement for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects, Table 3-5. NOTE: No 2000 steelhead survival estimate was made at RIS so the 1999 estimate was used as a surrogate.
[4]Logical Formula is: If no RIS survival estimate, then copy Reach Survival Estimate, else Reach Survival Estimate / RIS Survival Estimate.
[5]Equation is: "Wanapum - Priest Rapids Survival Est" = yx where y = "Reach Est Correcting for RIS Suvival" and x = (2 / "New Nth Root")

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Grant PUD	)	Project No. 2114
	)	
Application for Major New License	)	(Priest Rapids Hydroelectric Project)
	)	

CERTIFICATE OF SERVICE

I hereby certify that I have this day served, by first class mail, the National Marine Fisheries Service's Biological Opinion for ESA Section 7 Consultation on Interim Operations for the Priest Rapids Hydroelectric Project (FERC No. 2114). NOAA Fisheries Consultation No. 1999/01878; cover letter to Magalie Salas, FERC; and this Certificate of Service upon each person designated on the official service list compiled by the Commission in the above captioned proceeding.

Dated this 5th day of May, 2004.

Christopher D. Fontecchio
Attorney Adviser