3.0 ENVIRONMENTAL ANALYSIS

3.1 GENERAL DESCRIPTION OF THE PROJECT AREA

The two-development Priest Rapids Project is located on the Columbia River in central Washington (Figure 1). The Columbia River is one of the largest rivers in North America. It is approximately 1,214 miles long, with 460 miles of the river in Canada and 754 miles in the United States. Originating in British Columbia, the river enters the United States in the northeastern corner of the State of Washington. From there it flows south, then east, then south again to its confluence with the Snake River near Richland, Washington. The Columbia River then turns westward, forming the Washington-Oregon border for 320 miles and eventually entering the Pacific Ocean near Astoria, Oregon. The Columbia River drains an area of approximately 260,000 square miles in the Pacific Northwest. Most of the states of Washington, Oregon, and Idaho, the northwestern portion of Montana, the southeastern portion of British Columbia, and small areas of Wyoming, Nevada and Utah lie in the Columbia River Basin.

Much of the Columbia River Basin is located east of the Cascade Mountain Range, in a generally semi-arid region lying between the Cascades and the mountain ranges to the east. The average annual rainfall in the region varies from a high of about 150 inches on the western slopes of the Cascades to less than 8 inches at the Ephrata Airport, located approximately 30 miles east of the Project.

In Grant County, the heaviest precipitation usually falls between November and March, whereas July through September is the driest season (average of less than ½-inch of precipitation per month). Accordingly, vegetation is sparse and restricted to low-lying shrubs and native grasses. Air temperatures are warmest between June and September, with an average maximum temperature of 87 degrees Fahrenheit (°F) occurring in July. The area is moderately cold in winter; the coldest temperatures occur in December and January with an average maximum of 33° to 35°F.

Wind data collected by Grant PUD at the east end of the Priest Rapids Dam between 1977 and 1982 shows that winds are predominantly from 240° to 310° azimuth (southwest to northwest) for wind speeds of 20 miles per hour (mph) or less. Wind speeds exceeding 20 mph were on average oriented from the west (270° azimuth).

The Priest Rapids Project is situated along the western edge of a vast basalt plateau that dominates the landscape of central Washington. The geology of the region is volcanic and prevailing geologic theory indicates that during glaciation, spectacular catastrophic floods raged through this area, carving canyons known as coulees. Many of

these coulees are dry, evidence of where waters flowed in the distant past. The result of this climate and geology is a dramatic and stunning open setting.

Several streams flow into the Columbia River within the Project Boundary. Colockum (RM 450), Douglas (RM 448), Tarpiscan (RM 445), Johnson (RM 416), Skookumchuck (RM 428), Tekison (RM 438), Whiskey Dick (RM 426), Sand Hollow (RM 419), Quilomene (RM 433 right bank), and Trinidad (RM 441), Casey (RM 433 left bank) creeks enter the Columbia River upstream of Wanapum Dam. These are relatively small creeks, some of which are dry part of the year. Below Wanapum, Crab Creek (RM 411) is a meandering waterway with its headwaters west of Spokane, Washington, that enters the Columbia River between Wanapum Dam and Priest Rapids Dam. Hanson Creek (RM 406), which drains a large part of the Department of the Army, Yakima Training Center west of the Project, is the only other natural perennial stream along the Columbia River between Wanapum and Priest Rapids Dams.

Each of the two project reservoirs can be considered to have a riverine section and a lacustrine section. The component of the reservoir that is lacustrine exhibits lake-like properties; that is, the slope of the water surface remains relatively flat over most flow conditions. Conversely, the water levels in the riverine sections are more dependent on flow, and the reservoir levels will vary from one location to another. A more prominent current exists in the riverine environment, and a surface water gradient from upstream to downstream can be readily measured. On the Wanapum Reservoir, the riverine section extends from about RM 434 to Rock Island Dam at RM 453; the lacustrine section extends downstream of the riverine section to Wanapum Dam. On the Priest Rapids Reservoir, the riverine section extends from about RM 404 to Wanapum Dam at RM 415; the lacustrine section exists between the Priest Rapids Dam and RM 404. In each reservoir, water surface gradients of 10 to 15 ft may occur between the upper and lower reaches of the riverine section at high river flows (greater than 500,000 cubic feet per second (cfs)).

The Project area is largely undeveloped except for a few irrigated orchards and some small residential communities. Developments at Crescent Bar, Sunland Estates, Desert Aire and the towns of Vantage and Beverly are exceptions to the predominantly undeveloped character of the 58-miles of Project reservoirs. The Project area retains a natural character with substantial undeveloped areas provided by the Colockum, Quilomene, and Quincy Wildlife Areas and the Ginkgo/Wanapum State Park.

Grant County is in the center of the State of Washington. The Columbia River forms part of the county's western and southwestern boundary between the White Bluffs area in the Hanford Reach and Crescent Bar, and touches again at the county's most northern corner at Grand Coulee Dam. The Project is located on the portion of the

Columbia River that makes up the western boundary of Grant County and also forms partial boundaries of Benton, Yakima, Kittitas, Douglas, and Chelan counties.

3.2 CUMULATIVELY AFFECTED RESOURCES

Cumulative effects are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR э 1508.7). Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Based on information in the license application, agency comments, other filings related to the project, and preliminary staff analysis, we have identified the following resources that have the potential to be cumulatively affected by the continued operation of the Priest Rapids Project in combination with other activities in the Columbia River Basin: (1) water quality; (2) fisheries; (3) terrestrial; (4) recreation; and (5) cultural resources.

3.2.1 Geographic Scope

The geographic scope of the analysis defines the physical limits or boundaries of the proposed action=s effects on the resources. Because the proposed action would affect the resources differently, the geographic scope for each resource may vary.

In this case, the geographic scope for water quality, fisheries, and terrestrial resources encompasses the Columbia River from the tailrace of Rock Island dam to the lower end of the Hanford reach, a distance of about 107 miles. We chose this geographic scope because of the influence of the Federal projects and upstream projects on hydrologic conditions in the project area, heavy recreational pressures from adjoining land uses, mitigation measures associated with the Columbia River Basin Project, and adjoining land uses practices. Figure 2 shows the location of the Priest Rapids Project in relation to the seven upstream dams (including the 2 project dams) that constitute the mid-Columbia projects and the Hanford Reach.

This DEIS evaluates recreation resources on the Columbia River from the tailrace of Rock Island Dam to the lower end of the Hanford Reach, a distance of approximately 107 river miles. This important mid-Columbia geographic area supports anadromous fish spawning, rearing and migration which contribute to a popular recreation fishery. The project area receives an estimated quarter million visits annually (Grant County Public Utility District, 2003, ES-23), and the Interagency Committee for Outdoor Recreation

(2002) finds that Washington State's population has increased about 20 percent since the last statewide recreation survey, which was conducted in 1990.

The geographic scope for cultural resources is proposed to include the same geographic area as for fisheries and terrestrial resources. We chose this geographic scope because the potential effects of flow augmentations by the coordinated operation at the dams located upstream from the Hanford Reach, the proposed mitigation measures associated with the Priest Rapids Project, and adjoining land use practices.

3.2.2 Temporal Scope

The temporal scope of our cumulative analysis in the EIS will include past, present, and future actions and their possible cumulative effects on each resource. Based on the license term, the temporal scope will look 30 to 50 years into the future, concentrating on the effect on the resources from reasonably foreseeable future actions. The historical discussion will, by necessity, be limited to the amount of available information for each resource.

3.3 GEOLOGY AND SOILS

In this section we address geologic and soils resources within the context of the following issues identified during the scoping process that relate to project effects on geology and soils resources: (1) effects of project operation, recreation, land use and other events (such as, wind-induced waves, high flow events) on the geological and soil resources; (2) cumulative effects of the Priest Rapids Project and upstream dam operations on bank erosion in the Hanford Reach; and (3) cumulative effects of the Priest Rapids Project and other river damming and development on the decline of sand dunes and the unique terrestrial habitat they provide in the Columbia River Basin. A comprehensive overview of geology and soils including detailed descriptions of the geologic history, bedrock geology, faults and seismic activity can be found in Exhibit E9 of the license application (Grant PUD, 2003).

3.3.1 Affected Environment

The Priest Rapids Project is located in a largely undisturbed setting, flanked on both shorelines by near vertical basalt cliffs extending north of the Interstate-90 (I-90) freeway crossing. There is very limited residential and commercial development along the shoreline, and the distinct geologic features in the area are a significant part of the Project's appeal and aesthetic character.

The project reservoirs are carved through a thick succession of basalt lava flows

known as the Yakima Basalt Formation. Approximately 27 miles of the Wanapum Development shoreline (about 34 percent) is composed of this exposed basalt, and the majority of this basalt shoreline is evident in steep cliffs rising 700 feet above the reservoir level. Minor spalling of the basalt cliffs that rim much of the Columbia River floodplain and the project reservoirs has produced talus slopes at the base of the bedrock cliffs that extend to the waters edge along much of the shoreline. The talus consists predominantly of sand, gravel, cobble and boulder-sized particles of basalt and is the result of freeze-thaw spalling of basalt from cliff faces. Basalt talus slopes make up about 25 percent of the reservoir shoreline.

The basalt formation is less prevalent along the immediate Priest Rapids Reservoir shoreline where the basalt is overlain by surface deposits of glaciofluvial and fluvial origin. Many of these deposits were the result of catastrophic Pleistocene flooding caused by glacial meltwater released by the bursting of glacial lakes impounded by ice in valleys of the Rocky Mountains. The resulting deposit forms a large part of the shoreline of the reservoirs, and exhibits a high resistance to erosion in part due to its granular composition. Subsequent to this catastrophic flooding, the Project area was subject to more recent Holocene fluvial deposition (Holocene terrace deposits). This landform is exposed above reservoir level most typically in the riverine sections of each reservoir and presumably is inundated in the lacustrine section of each reservoir. The Holocene terrace deposits are generally fine-grained and more susceptible to erosion than the Pleistocene catastrophic flood deposits. The Holocene terrace deposits make up about 28% of the Project shorelines. A detailed description of bedrock and surface geology at the Project is included in the license application (Grant PUD 2003, Technical Appendix E-9.A).

Other surface deposits along project shorelines consist of alluvium, alluvial fans, talus, dune sand, loess, riprap and fill. Alluvium consists of clay, silt, sand, and gravel deposited by the Columbia River and the streams emptying into it. The alluvium is variable in thickness and gradation, and includes reworked loess, outburst flood deposits, Mazama tephra, and other sediment formations. It is typically found at tributary mouths, and is found between elevation 450 ft and 600 ft along the Project reservoirs. Alluvium makes up 8% of the shoreline. Alluvial fans consist of very deep, well-drained soils consisting of clay, silt, sand, and gravel material that have been deposited by running water, usually at the mouths of tributaries or gullies. These soils were formed in colluvium derived from loess and basalt on slopes of 25 to 65% at elevations ranging between 450 ft to 1,500 ft. Alluvial fans make up about 5% of the reservoir banks.

Talus is predominately sand, gravel, cobble and boulder-sized particles of basalt that form a steep slope at the base of basalt cliffs. The talus material is the result of freeze-thaw spalling of basalt from cliff faces, and includes colluvium in places. It consists of a very deep, well-drained soil/aggregate on hillsides and steep slopes at the

base of basalt cliff faces, and is typically encountered at elevations ranging between 450 ft to 1,500 ft. Basalt talus makes up approximately 25% of both reservoir shorelines and is more typically found along the Wanapum Reservoir shoreline.

Dune sands consists of eolian (wind deposited) medium to fine sand and silt composed of quartz, basalt, and/or feldspar grains, and volcanic ash. Dune sand generally consists of deep, well-drained soils along the margins of the alluvial floodplain, on terraces and high bars, and is found to cap many other soil types. These soils formed from sand derived from mixed sources. They comprise approximately less than 2% of the shoreline and form shoreline slopes from 5 degrees up to 35 degrees where they overlay the basalt talus. In the project area, dune sand has been mapped on the right bank near Crescent Bar (on West Bar at RM 441), along the left bank east of the YTC at RM 404, along the left bank near Sand Hollow Creek (RM 419), and along Crab Creek.

Loess is a homogeneous, nonstratified, unconsolidated silt with lesser amounts of sand and clay. The silt has been winnowed from alluvium and glaciofluvial material along the Columbia River by the prevailing westerly winds and deposited as a veneer over the basalt and gravel east of the river. It consists of variable depth, well-drained soils on hills and areas of topographic relief and elevation. It is found at elevations between 600 ft and 1,300 ft (above the elevation of the shoreline in the project area). Although there are no loess exposures along the shoreline, this material is found at several locations along the Project transmission corridors.

Riprap ranging in size from gravel to boulders 4-ft in diameter, is composed of basalt or broken concrete that has been placed by man, generally as a veneer, along the shoreline for bank protection. Riprap armored slopes range between 30 and 40 degrees in the Project area. Riprap is found at Wanapum Dam (RM 416), Priest Rapids Dam (RM 397), at the base of the railroad embankment across from West Bar (RM 443), along the left bank adjacent to the railroad downstream of Rock Island Dam (RM 451 to RM 453) around the Vantage Bridge (RM 420), and occasionally along the abandoned railroad on the right bank of Priest Rapids Reservoir between Hanson Creek and the Priest Rapids Dam (RM 398 to RM 406).

Fill ranges in size from silt, sand, and gravel to cobbles and boulders, and is composed of excavated deposits of alluvium and/or Pleistocene catastrophic flood deposits. Fill is a result of deliberate human activity typically relating to construction of the dams and adjacent transportation systems (roads and railroads). It is generally found adjacent to both Wanapum and Priest Rapids Dams and along roadways that approach the reservoirs, and can often cover relatively large areas and be significantly thick.

Hanford Reach

The U.S. Department of Energy Hanford Site (Hanford Site) and the Hanford Reach National Monument contain all the main geologic characteristics of the Columbia Basin as described above for the lands occupied by the Priest Rapids Project. In addition, the Hanford Site lies within a topographic depression referred to as the Pasco Basin. The Pasco Basin is bounded by the Saddle Mountains to the north, Naneum ridge to the west, Rattlesnake Hills to the south, and the Palouse Slope to the east (Figure 4).

Sediments overlying the basalt in the Pasco Basin include the Ringold Formation, Cold creek unit, and the Hanford formation from oldest to youngest. The Hanford Reach of the Columbia River is carved into these sediments, the oldest of which (the Ringold Formation) were laid down by the ancestral Columbia River between 8.5 and 3.0 million years ago and the youngest of which (the Hanford formation) were deposited by ice-age floods as recent as 12,000 years ago (Neitzel, D.A., ed. 2004).

Regional uplift associated with the Cascade Mountains caused the Columbia River to cut through the Pasco Basin sediments, which consist of gravel, sand, silt and clay deposits, exposing up to 900 feet of the Ringold Formation at White Bluffs in the Hanford Reach National Monument. The White Bluffs extend for about 30 miles along the east side of the Columbia River and vary in height from 150 to 500 feet above the river. Since the late 1960s, landslide activity along the White Bluffs has noticeably increased and has become a subject of considerable interest and scientific investigation because of its potential effects on fish habitat and Indian cultural resource materials in the Hanford Reach.

Sand Dunes

Since the end of the ice age, winds in the semi-arid climate of the Columbia River Basin have reworked the deposits of sand and silt, creating sand dunes in the lower elevations. An area known as the Moses Lake dune field, located in the Quincy Basin to the south and west of Moses Lake, Washington, and 20 kilometers east of the Wanapum reservoir on the Columbia River, appears to be the nearest dune field to the Priest Rapids Project. Prevailing winds at the end of the glacial period drove the Moses Lake sands in an east-northeast direction, and eventually dammed a portion of Rocky Ford Creek creating Moses Lake. The dunes rate of advance is thought to have been significantly slowed during the past century. Among the reasons cited are the extensive amount of irrigated land brought about by the Columbia Basin Project and the inundation of a large fraction of the dune field by Potholes Reservoir, which was built in 1952 to catch irrigation runoff.

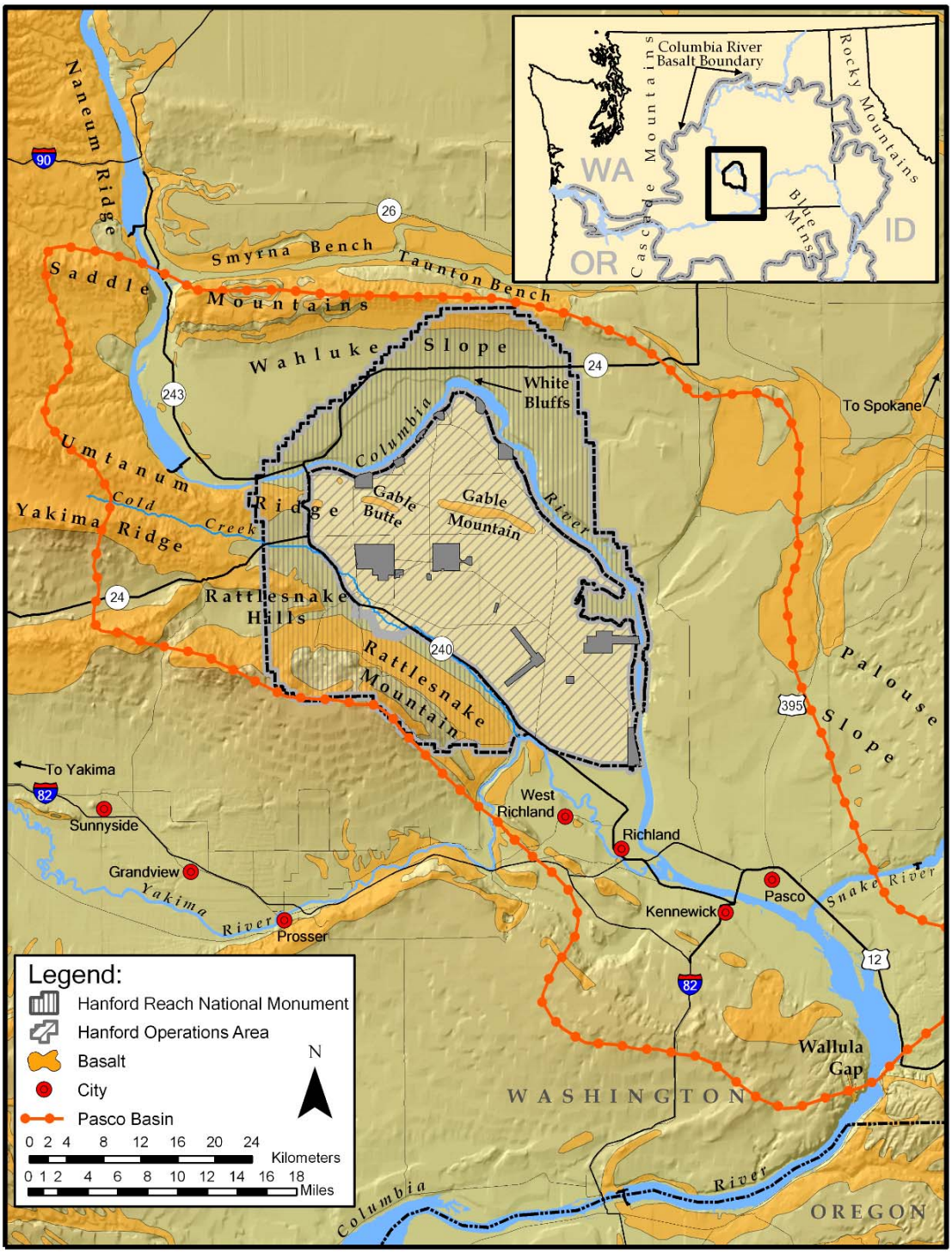

Figure 4. Geologic Elements of the Pasco Basin Portion of the Columbia Basin, washington. (Source: Neitzel, D.A., ed. 2004)

Dunes west of the reservoir became much more wet and vegetated while dunes to east of the reservoir, although located at a higher elevation above the water table, receive a reduced supply of sand from the east. These influences together with local farmers attempts to stabilize the dunes with bales of hay and planted grasses, have contributed to a reduction in active dunes. However, a small portion of the Moses Lake dune field between northeastern Potholes Reservoir and southern Moses Lake remains active and is reserved for off road vehicle recreational use. (Banfield, J. A., et. al., 2002)

The Pasco Basin, which lies to the south of the Quincy Basin and in which the Hanford Site is located, contains dune sands at the lower elevations around its margins. Although anchoring vegetation has stabilized many of the dunes in this area, some of them were reactivated by the removal of vegetation caused by fire in June and July, 2000. (Neitzel, D.A., ed. 2004)

3.3.2 Environmental Effects and Recommendations

Project operations and facilities, together with the presence and operation of upstream hydropower dams, have altered the natural stream channel and flow regime of the Mid-Columbia River. These altered stream flow conditions affect the interaction of the river with the geologic formations and soils of the river bed, the adjoining floodplain and, to a much lesser extent, the surrounding valley walls. Reservoir operations designed to capture and store high flow events for power and irrigation purposes have reduced the magnitude of seasonal high river flows and floods. Because major changes to river bed and floodplain geology and soils are caused by high flow and flood flow conditions, the project and upstream reservoirs have tended to reduce the force of the river to change its course by lateral cutting (meander) or deepen its valley by bottom scour. The reservoirs trap coarse sediments, changing the channel substrate composition in the reservoirs and the downstream river reaches. This section discusses the effects of the proposed project and alternatives on this altered geologic environment with particular attention to the geologic and soils issues identified during NEPA scoping.

Effects of Project Operation, Recreation, and Land Use

Project operations that result in frequent fluctuation of flows and reservoir water surface elevation to help meet the daily peak energy needs of power customers contribute to erosion and sloughing of soils within the zone of fluctuation where the shoreline consists of unconsolidated soil materials. With prevailing wind direction from the west, wave action from wind contributes to erosion along exposed sections of unconsolidated deposits on the left (westward facing) shoreline. Wave action from recreational boating also contributes to erosion of susceptible shoreline soils.

Any new construction on project lands or public use of existing lands can result in soil disturbance, loss of protective vegetation and soil erosion caused by wind or surface water runoff. Because of the semi-arid climate in which the project is located (total annual rainfall is about 7 inches per year), rainfall events of sufficient magnitude to cause erosion from surface water runoff would be rare.

Field studies of reservoir shoreline erosion conducted for Grant PUD in 2002 provide a detailed documentation of erosion sites along the project shoreline (Grant PUD 2003, Technical Appendix E-9.A). Sites that exhibited historic erosion characteristics were recorded as erosion sites, even where there was no evidence of recent or active erosion activity. A total of 131 erosion sites representing approximately 11% of the shoreline were documented by the study. The sites were mapped and the type of erosion, soil type, scarp dimensions, beach characteristics, vegetation details, land use details, and level of erosion activity (active, moderately active, or in-active) documented. The erosion sites are shown on Figures E9-15 through E9-27 in Exhibit E9 of Grant PUD's final license application. The following paragraphs summarize the major results and conclusions of this study.

A total of 106 erosion sites along the Wanapum Reservoir represent approximately 11% of the total reservoir shoreline. Approximately 5% of the total length was considered active. A total of 66 sites were recorded on the left (west) bank (61% of the eroded length), and 40 sites were recorded on the right (east) bank (39% of the eroded length). The majority of the erosion was observed in the Pleistocene catastrophic flood and Holocene terrace deposits, with a significantly lower number of sites observed in alluvium and alluvial fan deposits.

A total of 25 erosion sites on the Priest Rapids Reservoir represent approximately 12% of the total reservoir shoreline. Approximately 28% of the eroded length, or 3% of the total length, is considered active. One additional site has been recorded by Grant PUD downstream of Priest Rapids Dam on the right bank (Grant PUD 2002b). In general, a relatively low amount of erosion was observed on the impoundment shoreline. The most significant erosion on the left bank was observed near Desert Aire (RM 398 to RM 400), with virtually no erosion on this bank above RM 400. The most significant erosion on the right bank was observed south of Sentinel Gap (RM 410) adjacent to existing orchards and at the mouth of Hanson Creek. Erosion was nearly equally divided between Pleistocene catastrophic flood and Holocene terrace deposits. Virtually no erosion was observed in alluvium, which is considered significant, given its extent along the shorelines of both reservoirs.

The greatest amount of overall erosion along the Project shoreline occurs in Pleistocene catastrophic flood deposits, which contributes over twice the length of

shoreline erosion as the Holocene terrace deposits. Pleistocene catastrophic flood deposits make up 62% of the total erosion, Holocene terrace deposits make up 23% of the total footage of erosion, and the remaining 15% of the total eroded length occurs in the remaining soils.

In the lacustrine sections of the reservoirs (RM 397 to RM 404, and RM 416 to RM 434), erosion occurs primarily in Pleistocene catastrophic flood deposits, with lesser erosion in alluvium and alluvial fans. Each of these soil deposits appear to be generally resistant to erosion, and mapped erosion sites are anticipated to change little over time. The resistance to erosion is primarily due to the very granular composition of these deposits. Each of these deposits appears to have a high internal friction angle (and angle of repose), allowing each to stand at a steeper angle when disturbed. Further, scarps in these deposits tend to become armored with larger gravel, cobbles, and boulders over time. One notable exception to this observation is at "black sand beach" (RM 417) where several feet of erosion have been observed each year (Grant PUD 2001 and Grant PUD 2002b).

The study finds that erosion in the lacustrine areas is primarily caused by waves induced by winds and boat traffic. The predominant wind direction at the Project is from between southwest and northwest. Typically, wind-generated waves exceed the magnitude of waves induced by boat traffic. Based on this fact, the predominant wind direction in the area, and direct observations made at the Project, the study finds that the primary cause of erosion in lacustrine areas along the left (east) bank is from wind-induced waves. Similarly, it finds that erosion on the right bank is primarily caused by waves induced by boat traffic.

The study finds that erosion in the riverine sections of the reservoirs (RM 404 to RM 416 and RM 434 to RM 453) is induced predominantly by littoral or riverine current, and by changes in water surface elevation. Erosion in these areas is especially aggravated by flood flow conditions, as would be expected; such increased erosion occurred during a surcharge pool event in 1997, which was the wettest year on record at the Project. During the 1997 surcharge event, the maximum forebay levels at Wanapum Dam and Priest Rapids Dam were elevation 572.3 ft and 488.4 ft, respectively, compared to the normal operating ranges of 560.0 to 571.5 for Wanapum and 481.5 to 488.0 for Priest Rapids. The peak daily flow for that event was 410,000 cfs.

Project operations may continue to cause active shoreline erosion during moderate to high flows at some of the active erosion site locations. Erosion processes generally consist of shoreline undercutting, bank toppling, and minor slumping associated with shallow surface erosion (less than about 6 ft in height) of exposed soils. Some of these sites may continue to erode until the beach projects to the top of the deposit. The amount

of eroded material is considered small relative to flows in the Columbia River.

No conditions were documented by Grant PUD's studies that would suggest the potential for mass movement of the bedrock or soil that would affect operation or safety of the Project. Similarly, soils along the reservoirs pose very low to non-existent potential for larger-scale slope instability.

Grant PUD proposes to continue to monitor the reservoir shorelines and update erosion location, rate, and process information. Where new facilities are proposed that would involve land disturbance, Grant PUD proposes to implement sediment erosion and control measures as part of its construction management program.

CRITFC, the Yakima Nation, and the Confederated Tribes of the Umatilla Reservation jointly recommend that Grant PUD be required to establish a cultural resources management program which includes an analysis and plan for erosion control at cultural resource sites within the area of potential affects and in the Hanford reach. The recommended plan would include monitoring and detailed mapping of sites, and a report describing recommended mitigation for site erosion.

Our Analysis

Continuing project effects on reservoir shorelines under a new license would consist of localized areas of shoreline erosion, especially during high flow events in the Holocene terrace deposits along the shores of the riverine sections of the impoundments. Some land-disturbing activities would occur as a result of Grant PUD's implementation of proposed protection, mitigation and enhancement measures that involve construction or maintenance of new facilities. To minimize erosion from construction activity, Grant PUD proposes to include the design and implementation of erosion and sediment control measures as part of its project construction management program.

In the cultural resources section, we discuss tribal concerns related to the potential for shoreline erosion to expose cultural resources, possibly including human remains. Identification and protection or documentation of shoreline areas most susceptible to erosion and most likely to contain cultural resource materials would help to avoid the potential for loss of such material or sites to erosion. We analyze Grant PUD's proposals for protection of cultural resources in the cultural resources section.

Most of the reservoir shoreline consists of geologic formations and soil materials that are relatively stable and resistant to large scale erosion problems. Grant PUD's proposal to continue to monitor erosion along the reservoir shorelines would identify areas that may require structural soil stabilization measures where the project purposes or

other uses of project resources may be compromised by active erosion. This monitoring program together with a plan for implementing structural measures where needed would adequately protect the shoreline geology and soils resources. For new construction projects, Grant PUD's construction management program includes provisions for the implementation of erosion and sediment control measures. For the protection of cultural resource material and sites along the reservoir shoreline, Grant PUD's cultural resources management plan would provide a plan of action for sites subject to erosion.

We conclude that Grant PUD's proposed project would protect geology and soils resources on project lands and is consistent with CRITFC and the tribes' recommendation.

Hanford Reach

CRITFC, the Yakima Nation, and the Confederated Tribes of the Umatilla Reservation jointly filed comments during NEPA scoping alleging that flow fluctuations in the Hanford Reach from Priest Rapids operations are eroding cultural resource sites in the Hanford Reach and that this issue should be evaluated in the DEIS (May 7, 2004 letter from Olney Patt, Jr., Executive Director of CRITFC to Commission Secretary). On May 27, 2005, these same parties filed recommended terms and conditions in response to the Commission's March 30, 2005 Notice of Application ready for Environmental Analysis. Recommendation No. 19 recommends that Grant PUD be required to establish a cultural resources management program which includes an analysis and plan for erosion control at cultural resource sites in the Hanford Reach.

In its response to CRITFC and the tribes recommendation relative to sites in the Hanford Reach, Grant PUD maintains that the Hanford Reach is outside the Area of Potential Effects and Grant PUD would have no authority or obligation to implement comprehensive cultural resources programs there (July 8, 2005, letter from Laurel Heacock, Manager, Licensing and Regulatory Compliance to the Commission). In addition, Grant PUD says that flow patterns in the Hanford Reach are the result of operation of the entire Mid-Columbia system of dams and mitigation for the effects of these flow patterns is not the sole responsibility of the Priest Rapids Project. Grant PUD says it is willing to work cooperatively with the other Mid-Columbia dam owners and interested parties to address cultural resources (in the Hanford Reach), with the understanding that responsibility must be shared.

Our Analysis

Triangle Associates, Inc. conducted an assessment of the causes and impacts of landslides along the White Bluffs in the Hanford Reach National Monument. The

Triangle Associates assessment was based on information from interviews of people with knowledge of the White Bluffs landslides, published literature on the subject, and a series of technical workshops. The report by Triangle Associates concludes that most observers attribute the onset of recent landslide activity to the Columbia Basin Project, which developed the Columbia River for irrigation in the 1953-1964 time period.[18] Irrigation increased the effective annual precipitation in this semi-arid region from an average of about 7 inches to 60 inches, in the early years, and 40 inches more recently with the advent of more efficient methods of irrigation.

The increase in surface water caused the groundwater table to raise an average of 200 feet. Over time, the elevated groundwater levels saturated the unconsolidated sediments on the steep slopes above the river, resulting in increased pore pressures, reduced shear strength, and slope failures. The Triangle Associates report also concludes that the cause of the White Bluff landslides is a complex interaction of three factors: (1) the underlying geologic composition of the Ringold Formation that makes steep slopes highly susceptible to sliding when wetted; (2) elevated groundwater levels (as a result of irrigation water) that saturate the soils of the Ringold Formation making them susceptible to landslide failure; and (3) erosion caused by the Columbia River washing away the toe of the steep bluffs, which undercuts and reduces the stability of the slope above.[19]

The report notes that the effect of the Columbia River is significant only in the Lock Island landslide area, where an existing landslide extends 150 yards into the river towards Lock Island. The narrowed channel on the east side of the island causes an increase in velocity and corresponding increase in erosion on the east shoreline. Erosion was particularly acute in the high flow years 1996 and 1997. Lock Island is located 34 miles downstream from the Priest Rapids Project. Elsewhere, erosion of the bank by the Columbia River is not thought to play a role in recent landslide activity, since the upstream storage projects have eliminated or greatly reduced high river flows. The Triangle Associates report also states that erosion in the Locke Island landslide area is not caused by river level fluctuations from upstream power operations.[20]

Stream flows at the high end of the frequency distribution have the greatest

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[18] Triangle Associates, Inc., White Bluffs Landslides Assessment Report, prepared for US institute for Environmental Conflict Resolution and US Fish and Wildlife Service for the Hanford Reach National Monument, March 2003.

[19] Triangle Associates, 2003, p.23.

[20] Triangle Associates, 2003, p.47.

capacity for stream bank erosion and sediment transport. The construction and operation of upstream storage reservoirs in the Columbia River Basin have greatly reduced the magnitude and frequency of high flow events in the Hanford Reach. So with respect to high flows, we conclude that upstream reservoirs have actually reduced the potential for shoreline erosion in the Hanford Reach relative to pre-development conditions.

With respect to flow fluctuations from project operations, the Triangle Associates report concludes that river level fluctuation from power operations is not the cause of the landslide at Locke Island. We find no evidence linking flow fluctuations from power operations to shoreline erosion in the Hanford Reach. If future studies discover a relationship between flow fluctuations from upstream power operations and stream bank erosion, responsibility for mitigation of those effects should not be the sole responsibility of the Priest Rapids Project. Flows in the Hanford Reach are set by operating criteria established by the Hourly Coordination Agreement for the entire system of Mid-Columbia projects as a unit. If future studies find that upstream dam operation is causing excessive stream bank erosion in the Hanford Reach, the Commission could require Grant PUD, as well as the other upstream hydroelectric projects under its jurisdiction, to provide appropriate mitigation and protection.

Sand Dunes

The Washington Department of Natural Resources (WDNR) commented during scoping for the EIS that damming of the Columbia and Snake Rivers has stopped the seasonal deposition of sand that served as a source for replenishment of existing sand dunes or formation of new dunes (April 16, 2004, letter from Rex C. Crawford, Ph.D, Natural Heritage Ecologist, WDNR). This, together with the loss of active dunes to agriculture and urban development, has greatly diminished sand dune habitat and associated rare plant and animal species. WDNR states that the loss of this habitat along the Columbia River following dam construction is contributing to the decline of many species and the contribution of the Priest Rapids Project to this decline should be documented and an assessment made of potential mitigation.

Grant PUD is not proposing any specific mitigation for project effects on the amount of active sand dunes in the Columbia Basin. It is, however, proposing measures for the protection of sensitive dune habitat, which we discuss in the terrestrial and recreation resources sections.

Our Analysis

Clearly, the development of the Columbia River Basin water resources for agricultural irrigation and power generation has changed the geomorphology of the river

and the vegetative cover of the Basin landscape in a manner that has reduced conditions conducive to forming and sustaining active sand dunes. The Columbia River impoundments and reservoirs, including the Priest Rapids Project reservoirs may have inundated river channel sand deposits which could have contributed source sands to dune formation prior to dam construction. Some fairly large patches of dune sands overlay other deposits, predominately on the valley walls and terraces of the east bank of the river, above the current floodplain of the river (Grant PUD 2003, Volume TA 18).

The previously cited study by Bandfield et al concludes that the Columbia River is not a likely source of sands found in the Moses Lake dune field, which lies some 20 kilometers (km) east of the river. The researcher's conclusion is based on the physical distance of the river from the dune field and the mineral composition of the sands, which suggests that the Grand Coulee to the north is the more likely source of sands found at the Moses Lake dune field. The report does note several small dune fields immediately east of the Columbia River appear to be migrating east toward the Moses Lake dune field. The river is the likely source of sands for these small dune fields.

We conclude that the Priest Rapids Project adds to the cumulative effect of dam construction, land development and irrigation on the amount of active sand dune area in the Pasco Basin. We believe that the effects of the Priest Rapids Project are small compared to the direct effects of man's efforts to convert arid lands to agricultural uses and prevent wind erosion by planting vegetation or building structural controls. We also conclude that there would be no practical way for Grant PUD to create active sand dunes to mitigate its contribution for the loss of this habitat. We analyze project effects on terrestrial and recreation resources at existing sand dunes within and adjacent to the project in the respective sections of this EIS.

3.3.3 Cumulative Effects

The Priest Rapids Project would continue to have a small effect on the amount of lands occupied by active sand dunes under all of the alternatives: no action; proposed project; and proposed project with modifications recommended by the staff. We find the effect has occurred as a result of past actions (construction of the dams) and would not increase as a result of future actions under any of the alternatives.

3.3.4 Unavoidable Adverse Impacts

None.

3.4 WATER QUALITY AND QUANTITY

The EIS scoping process identified the following issues related to project effects on water quality and quantity resources: (1) effects of project flow modifications in combination with upstream project flow modifications on downstream (Hanford Reach) fish habitat; (2) effects of project operations and proposed replacement turbines on TDG concentration, including methods to comply with the total maximum daily load (TMDL) for TDG established by WDOE; (3) effects of project operations on water temperature, including methods to comply with any future temperature TMDL established by WDOE or EPA; (4) effects of project operations on organics, metals, dissolved oxygen, fecal coliform, pH, and other parameters; and (5) effects of project operations on aquatic macrophyte growth, especially the invasive and non-native Eurasian watermilfoil, in project reservoirs. In this section, we describe the affected environment with respect to water resources and the environmental effects, including cumulative effects, of the project as related to these issues.

3.4.1 Affected Environment

The Columbia River is 1,214 miles long with 460 miles in Canada and 754 miles in the United States. The Columbia River watershed covers an area of approximately 260,000 square miles in the Pacific Northwest.

In Canada, the Columbia River is regulated through a series of storage and power generating facilities. The large storage reservoirs are at the Duncan, Mica, Revelstoke, and Keenleyside projects. Flows across the U.S.-Canadian border are regulated through the Columbia River Treaty.

The first two hydroelectric projects encountered on the Columbia River in the United States (traveling downstream from the United States-Canadian border) are Grand Coulee Dam, located at RM 597 and Chief Joseph Dam located at RM 544. Both are federally owned and operated.

The next five dams have comparatively little useable storage which is used for minor reshaping of the daily reservoir inflow for power and non-power purposes. The first is Wells Dam at RM 516, owned and operated by Douglas County PUD, the second is Rocky Reach Dam located at RM 474, the third is Rock Island Dam, located at RM 453, with the latter two being owned and operated by Chelan County PUD. The next two dams comprise the Priest Rapids Project, with Wanapum Dam at RM 415 and Priest Rapids Dam at RM 397. These dams are owned and operated by Grant PUD and are the subject of this DEIS.

There are approximately 157 tributary streams that flow into the Columbia River in the United States. Between Chief Joseph Dam and the Priest Rapids Project there are four significant tributaries - the Okanogan, Methow, Entiat, and the Wenatchee Rivers. In addition, 106 point sources with individual National Pollutant Discharge Elimination System (NPDES) permits directly discharge into the mainstem Columbia River above the Priest Rapids Project.

Surface Water

Two U.S. Geological Survey (USGS) streamflow gages located in the vicinity of the Wanapum and Priest Rapids dams measure and record Columbia River flows in the Priest Rapids Project area. For flows downstream from the project, Grant PUD contracts with the USGS to operate the Columbia River below Priest Rapids Dam gaging station (USGS Gage No. 12472800) located approximately 2.6 miles below Priest Rapids Dam (at river mile (RM) 394.5). The total drainage area above the gage is approximately 96,000 square miles. Flows are recorded on a continuous basis and average daily flows are calculated and published by the USGS. The station has been in continuous operation at its present location since 1959.

Columbia River flows coming into the project are computed directly from operation records of the Rock Island Dam. A USGS streamflow gage (Columbia River below the Rock Island Dam, USGS Gage No. 12462600) located in the tailrace just downstream of the Rock Island Dam (RM 452.4) was discontinued in 1988, but is still used to "spot check" the computed flows at Rock Island Dam approximately six times per year.

Streamflow data for the Columbia River prior to the construction of the Priest Rapids Project is also available from the now abandoned USGS gages at Wenatchee, Vernita and Trinidad. A non-recording gage was located at Wenatchee for the period January 1910 through December 1916, published as "at Wenatchee." A non-recording gage was located at RM 391.1, six miles downstream of Priest Rapids Dam, during the period January 1917 to October 1930. This was published as "at Vernita." A water-stage recorder was located at RM 441.7 near Trinidad during the period October 1930 to May 1961 and was published as "at Trinidad."

The flow regime of the Columbia River in the project area is controlled primarily by releases at upstream storage reservoirs. This limits the potential for flood damage, and provides a relatively stable seasonal hydrograph to provide power when it is most needed by consumers. This is demonstrated by the average monthly flow data since construction of Priest Rapids Dam (1960-2001). During this period of record, the lowest average monthly flow of 80 kcfs occurs in October, with peak monthly average discharge of 206

kcfs in June (Table 4). The relatively high average minimums across the year also demonstrate the effect of upstream storage.

Table 4. Summary statistics for monthly Columbia River flows (in kcfs) measured at USGS Gage No. 12472800 from 1960-2001.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	55.1	72.7	58.2	57.9	59.2	78.8	56.6	66.7	60.1	61.5	56.1	52.6
Maximum	168.4	195.0	201.8	189.1	271.7	461.4	294.3	191.0	126.7	118.3	121.2	163.9
Median	109.8	104.4	104.7	103.2	156.7	176.9	146.3	107.4	75.6	80.0	88.1	98.6
Average	107.7	111.5	109.6	117.0	163.4	206.5	157.3	111.4	80.9	80.3	88.3	101.1

Daily flow regimes for Priest Rapids and Wanapum reservoirs are controlled by hourly coordination of the seven dam system from Priest Rapids Dam to Grand Coulee Dam. A typical day begins with Grand Coulee Dam releases at very low (0 to 20 kcfs) levels during the 0000 to 0600 hours period. From 0600 hours to 2200 hours, flows increase to relatively high levels, most often in the 150 to 200 kcfs range, before dropping again. This fluctuation is passed through Chief Joseph, Wells, Rocky Reach and Rock Island dams, with relatively small sideflow additions from the Okanogan, Methow, Entiat and Wenatchee rivers before reaching the project.

Typical water travel time[21] within each reservoir in the mid-Columbia River system, as provided in the HCA, ranges from 45 minutes at Priest Rapids to nearly three hours at Chief Joseph Dam (Table 5). This creates a lag time of several hours before Grand Coulee releases reach Wanapum Dam and keeps flows at higher levels into the evening. In addition, typical weekday flows from Grand Coulee Dam may fluctuate significantly within a day, and are re-shaped to maintain minimum flows below Priest Rapids Dam. The minimum flow is 36 kcfs from May through October, with higher minimums (ranging from 50 to 70 kcfs) set during the Vernita Bar Settlement Agreement (VBA) operations from November into May.

[21] Travel times represent the time it takes for a change in outflow from one dam to begin to affect the forebay level in another dam, all other factors being equal.

Table 5. Water travel time estimates for mid-Columbia reservoirs as estimated in the Hourly Coordination Agreement. (Source: Grant PUD 2003)

Project	Reservoir Length	Travel Time
Chief Joseph	52 miles	2 hr 45 min
Wells	29 miles	1 hr 15 min
Rocky Reach	38 miles	2 hr 45 min
Rock Island	21 miles	45 min
Wanapum	38 miles	1 hr 30 min
Priest Rapids	18 miles	45 min

Description of Project Reservoirs

Wanapum and Priest Rapids reservoirs are operated to meet a variety of power and non-power objectives. Typical power operations are geared towards meeting daily load requirements through assignment of coordinated generation under the HCA, as described in Exhibit B5.1.5 of the Application. Power and non-power operations are also coordinated on a regional scale under the Pacific Northwest Coordination Agreement (PNCA; Application, Exhibit B5.1.3). Priest Rapids Project reservoirs are also operated to meet non-power demands including flood control surcharges, minimum flow requirements, flow re-shaping for fall Chinook spawning and rearing protection, and maintenance of reservoir elevations for recreation purposes. Key physical characteristics of each reservoir are summarized in Table 6 below.

Table 6. Estimated physical characteristics of Wanapum and Priest Rapids reservoirs. (Source: Grant PUD 2003)

Characteristic	Wanapum Reservoir	Priest Rapids Reservoir
Surcharge elevation (ft)	575.0	491.5
Normal maximum operating elevation (ft)	571.5	488.0
Minimum operating elevation (ft)	560.0	481.5
Storage at normal maximum elevation (acre-feet)[1]	693,600.0	237,100.0
Surface area (acres)	14,680.0	7,725.0

Characteristic	Wanapum Reservoir	Priest Rapids Reservoir
Maximum depth (ft)	185.0	135.0
Mean depth (ft)	50.11	32.21
Mean width (ft)	3200.0	3440.0
Length (miles)	38.0	18.0
Shoreline (miles) at normal maximum elevation	124.1	73.9
Average flushing rate at 120,000 cfs (hours)	69.9	23.9

[1] Storage at normal maximum elevation (acre-feet) includes both the volume of the original channel storage plus the volume of the storage caused by impoundment.

The minimum operating elevation for Priest Rapids Reservoir is 481.5 ft with a maximum surcharge elevation of 491.5 ft. The normal maximum operating elevation for Priest Rapids Reservoir is 488.0 ft. Thus, Priest Rapids Reservoir may fluctuate up to 6.5 feet during normal operations, although in practice fluctuations are typically much lower. The minimum operating elevation for Wanapum Reservoir is 560.0 ft with a maximum surcharge elevation of 575.0 ft. The normal maximum operating elevation for Wanapum Reservoir is 571.5 ft. Wanapum Reservoir may have elevation fluctuations up to 11.5 ft. The widest fluctuations at each reservoir occur primarily as a result of non-power operations to re-shape flows under the VBA and Hanford Reach Agreement.

Sediment sampling during descriptive limnology surveys was used to classify substrate for the Priest Rapids Project area. Substrate samples were taken in each reservoir, forebay and tailrace. These samples showed that cobble predominated in each tailrace with silt, sand and finer sediments more common in reservoir and forebay areas with some boulder and larger materials present (Table H-17 of Normandeau et al. 2000; Technical Appendix E-3.A).

Existing and Proposed Use of Project Waters

This section describes the anticipated use of project waters for the next license period. The primary project use is and will continue to be generation of electricity. Miscellaneous other water rights exist within the project area and are supported to varying degrees by continued operation of the project.

Project Water Rights

Grant PUD has water rights for non-consumptive use of 188,350 cfs for power generation purposes at Wanapum Dam, and 192,500 cfs at Priest Rapids Dam. These

rights are for non-consumptive uses of the water and do not preclude or interfere with any other surface water rights. Grant PUD also holds additional water rights for impoundment of the reservoirs behind each development, in the amount of 541,000 acre-feet (AF) at Wanapum Dam and 200,000 AF at Priest Rapids Dam. According to WDOE guidelines at the time these water rights were acquired, the term "impoundment" was defined as the amount of water stored between the design operating level (normal maximum elevation) and the unimpounded river level at normal high water level. Grant PUD does not anticipate that additional water rights will be necessary to support future operation of project facilities.

Existing Minimum and Maximum Flow Releases

Since commencement of operations, Grant PUD has maintained a minimum release at Priest Rapids Dam of 36,000 cfs at the Hanford Works of the Atomic Energy Commission in accordance with License Article 45[22] of the current project License. In the 1970s, after the Department of Defense no longer required continuous minimum flow levels, the Washington Public Power Supply System (now Energy Northwest) constructed a commercial nuclear electric generating facility, the Columbia Generating Station, on the Hanford Reservation. The cooling water intakes and discharge pipes for the project were designed and installed based on a water level resulting from a flow of 36,000 cfs and a minimum water level elevation at McNary Reservoir of 335 feet. The maximum flow of record on the mid-Columbia River occurred in June of 1894, when peak flows reached approximately 740,000 cfs at Trinidad. In 1948, flood flows reached 692,600 cfs at the Trinidad gage, with flows remaining above 600,000 cfs for 20 days. While peak flows since 1948 have been much lower, both Wanapum and Priest Rapids dams are designed to pass flows up to 1,400,000 cfs, corresponding to the Probable Maximum Flood (PMF) for the Columbia River in the project area.

Habitat Protection Flows

Downstream of the Priest Rapids Project, flows for the protection of fall Chinook were established in June of 1988 through a settlement agreement as part of the Mid-Columbia Proceeding. The agreement requires operations termed "reverse load factoring" in the fall Chinook spawning period and sets a minimum flow during hatching and emergence periods based on redd counts from the Vernita Bar area. Under the

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[22] Article 45 states: "The Licensee shall so regulate the flow from Project No. 2114 that it will not result in flows of less than 36,000 cubic feet per second of water at the Hanford works of the Atomic Energy Commission except when conditions are beyond the Licensee's control."

agreement, minimum flows from late fall through the end of emergence in the spring are set between 50 and 70 thousand cubic feet per second (kcfs), depending on the elevation of spawning activity in a given year.

Since 1999, Grant PUD and upstream operators (Bonneville Power Administration (BPA), U.S. Army Corps of Engineers (COE), and Chelan and Douglas PUDs) have implemented an experimental re-regulation operation to protect fall Chinook fry rearing downstream of Priest Rapids Dam. This operation entails use of Priest Rapids and Wanapum storage to re-shape upstream flow fluctuations to within specified fluctuation limits.

Other Water Rights

Most water uses along the Columbia River in the project area are not metered or have only recently had meters installed. Actual water consumption is not quantified. Water rights and claims filed with the WDOE provide indicators of water use and demand. The WDOE water right tracking system indirectly provides data on water use for a variety of purposes by tracking surface water rights, including claims, permits and certificates.

The consumptive use of surface water within the project area is authorized by WDOE for the following purposes: (1) single and multiple domestic; (2) general domestic; (3) stock watering; (4) irrigation; (5) commercial, industrial & manufacturing; (6) fish propagation; (7) environmental quality; (8) heat exchange; and (9) frost protection.

The extent of use of water for these various purposes is provided in Table 7. The amount of water extracted is based on an assumption that recorded water rights and claims are fully used. Groundwater use or surface water withdrawals from sources outside of the Columbia River are not included in this table.

Table 7. Consumptive surface water rights within the Priest Rapids Project area of the Columbia River, Washington. (Source: Grant PUD 2003)

Purpose	Total Flow (cfs)	Total Volume (ac-feet/year)	Total Irrigation (acres)	Number of Rights
Domestic Multiple	0.414	67.277	15.17	7
Domestic Single	0.142	18.93	3.847	5
Domestic General	N/A	N/A	73.40	6

Purpose	Total Flow (cfs)	Total Volume (ac-feet/year)	Total Irrigation (acres)	Number of Rights
Frost Protection (Orchards)	14.42	985.37	718.33	2
Fish Propagation	102.00	N/A	N/A	1
Irrigation	63.124	8,123.807	3,226.64	32
Stock Watering	1.572	282.857	89.310	11
Commercial & Industrial Manufacturing	N/A	1,433.00	N/A	1
Environmental Quality	31.92	4,016.00	1,583.343	2
Heat Exchange	0.18	28.55	N/A	1
Recreation and Beautification	0.18	28.55	N/A	1
Claims (specific use unknown)	0.28	1,488.00	409.00	33

Presently, the waiting period to obtain a new water right certificate in the state of Washington is several years. In 2003, the Washington State legislature approved legislation intended to provide greater certainty that existing water rights will meet existing and future municipal water supply purposes. Apart from Grant PUD, there are no surface water withdrawals for water supply to municipalities within the Priest Rapids Project Boundary.

Power Generation

The day-to-day operations of the mid-Columbia River hydroelectric system are coordinated through a set of agreements and policies to optimize the power and non-power benefits of the seven dam system. The agreement that most directly affects day-to-day operation of the Priest Rapids Project and the entire system is the Hourly Coordination Agreement (HCA).

Under the HCA, power operations are coordinated to meet daily load requirements through the assignment of "coordinated generation" through Central Control at Grant PUD. Automatic control logic maintains preset reservoir levels in order to meet load requirements and prevent involuntary spill. These preset reservoir levels are maintained at each project through management of a positive or negative "bias" which assigns a project more or less generation depending on whether the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill.

Involuntary Spill

Reservoir control and power operations decisions made by upstream operators may cause involuntary spill at the project in the following situations: (1) when project inflows exceed hydraulic capacity; and (2) when potential power generation from available water supplies exceeds demand. Grant PUD receives projected daily average flow information on a weekly basis at Chief Joseph Dam. However, actual flows may vary significantly from the projections. Flows within each day may fluctuate widely. In order to stay within normal maximum operating elevations, project operators may be required to adjust discharge. This may require short periods of involuntary spill.

Fish Spill

Grant PUD currently spills water during the spring and summer to provide a non-turbine passage route for downstream migrating juvenile salmon, steelhead and lamprey. From 1994 through 1998, spill was provided pursuant to a Federal Energy Regulatory Commission (FERC) Interim Order issued May 25, 1994. This order required Grant PUD to spill water to ensure non-turbine passage of 70 percent of the spring migrants over 80 percent of the run, and 50 percent of the summer migrants over 80 percent of the run (67 FERC 61,225). With the listing of steelhead as endangered under the Endangered Species Act (ESA), Grant PUD voluntarily increased spill rates in 1998. However, spill levels for fish passage are typically limited by existing water quality standards for TDG.

In July of 2000, Grant PUD entered into a Memorandum of Agreement (MOA) that defined spill levels designed to achieve 95 percent dam passage survival and 80 percent fish passage efficiency. The MOA establishes spring spill objectives of 61 percent at Priest Rapids and 43 percent at Wanapum with summer spill of 39 percent at Priest Rapids and 49 percent at Wanapum. Grant PUD was ordered to implement the MOA in the Order Amending License and Terminating Proceedings, issued December 16, 2004.

Flood Control

The Wanapum and Priest Rapids reservoirs provide storage space for flood control operations as required by Articles 34 and 35 of the current License.

Article 34 states:

"The Licensee shall, each year before May 15, by direction of Grant PUD Engineer, Corps of Engineers, in charge of the locality, make available in the Priest Rapids and Wanapum reservoirs, storage space in the amount necessary to compensate

approximately for valley storage that may be expected to be lost during the ensuing flood season: Provided that said required storage space may be provided in either or both of the reservoirs in such manner as to least affect the interests of power generation: Provided, Further, that refill of this storage space shall be as directed by Grant PUD Engineer on the basis of forecasts of time and magnitude of flood flows and may be allowed any time between May 15 and June 30."

Article 35 states:

"The Licensee shall provide for flood control storage space in addition to that required to compensate for valley storage, as provided for in Article 34 up to a total of 500,000 acre-feet by additional drawdown as may be requested by the Corps of Engineers, such drawdown to be based on forecasts of peak flow and time of occurrence: Provided, that suitable arrangements have been made to compensate the Licensee for the use of the additional storage space and, Provided Further, that such compensation shall be determined by the Federal Power Commission, based on the value of the additional storage space for other uses or upon payment in kind for power loss, and at the discretion of the Commission."

Ground Water

There are two major groundwater sources in the project area. One lies within the Columbia River basalts and the other within the unconsolidated glacial and alluvial deposits contained within the river valley. These unconsolidated deposits include alluvial sand and gravel deposits and coarser-grained layers of sand and gravel within glacial outwash and drift.

Grant PUD uses groundwater sources for domestic and project purposes at both the Wanapum and Priest Rapids developments. Groundwater quantity is metered and the quality is monitored monthly in accordance with the requirements of the Washington State Department of Health. The largest volume of groundwater used for project-related purposes is taken from eight wells that provide a total flow of up to 9,450 gallons per minute (gpm) (about 21 cfs) for use at the Priest Rapids Hatchery facilities.

Water Quality

Several reports cover water quality issues relevant to the Columbia River within the project area. Historical concentrations and trends for key parameters were based on samples collected monthly by the USGS and WDOE below Rock Island Dam and at Vernita Bridge.

Normandeau et al. (2000) and Juul (2003) reviewed temperature, dissolved oxygen (DO), pH, and turbidity data from 1961 to 2001. In 1999, Grant PUD prepared a limnological investigation of the reservoirs that measured over 21 parameters (Normandeau et al. 2000). Hourly temperature, TDG, pH, DO, and turbidity data from five fixed-monitoring sites, historical turbine scrollcase data, thermistor arrays, and water-column profile data at eight transects were examined in Juul (2003). The data in these studies were collected from 14 different sites within the project area (Table 8).

Table 8. Location by river mile of various water quality data sources. (Source: Grant PUD 2003)

Location (Station Abbreviation)	Normandeau et al. (2000)		Fixed Monitoring Sites	WDOE/ USGS	2001 Profiles/ Thermistors
Below Rock Island Dam (RIST)	452.0		452.2	452.2	
Dry Gulch		451.0			451.5
Crescent Bar	440.0	440.5			440.2
Scammon's Landing	428.0	428.0			427.5
Ginkgo Park	416.0	417.5			417.4
Wanapum Dam Forebay (WANF)			415.8		
Wanapum Dam Tailwater (WANT)	414.0	415.5			413.20
Beverly Bridge (WANT)			412.2		
Hanson Creek	406.0	405.5			404.2
Goose Island	398.0	398.5			398.1
Priest Rapids Dam Forebay (PRDF)			397.1		
Priest Rapids Tailwater (PRDT)	396.0	396.0			396.2
Below Priest Rapids Dam (PRDT)				394.5	
Vernita Bridge (PRDT)			388.1	388.1	

To evaluate project impacts on water quality, Perkins et al. (2002) conducted a computer simulation of reservoir temperatures and the Corps of Engineers Waterways Experiment Station conducted pre- and post-deflector evaluations at Wanapum Dam (COE 2001) and recently completed field work on a TDG study for Priest Rapids Dam (COE 2003). This section summarizes these studies.

Physical Water Quality Parameters

Physical parameters describe water quality in terms of easily measured attributes and provide a way to compare and track seasonal and historical trends in water quality. Key physical parameters include temperature, TDG concentrations, DO concentrations, acidity (pH) and turbidity. Other physical parameters commonly collected from reservoirs are conductivity, alkalinity and light attenuation measurements. More detailed information on these parameters is provided in Normandeau et al. (2000; Technical Appendix E-3.A) and Juul (2003; Technical Appendix E-3.B).

Temperature

Temperature is one parameter that is almost always measured as part of any water quality assessment. Values are influenced by factors such as latitude, altitude, season, time of day, wind, cloud cover, water depth, and discharge. Temperature in turn affects the physical, chemical, and biological processes in lakes, streams, and reservoirs. For example, as water temperatures increase, the rate of evaporation and volatilization from the surface also rises. The solubility of gases such as O_2, N_2, and CO_2 decreases at higher temperatures while the rate of most chemical reactions increases. The metabolic rate of aquatic organisms is also directly related to temperature. Warm water increases respiration rates that can lead to increased oxygen consumption and decomposition of organic matter. Additionally, the growth rates of bacteria, phytoplankton, and aquatic macrophytes also increase up to a certain level and can lead to algal blooms and greater turbidity if other growth factors are not limiting.

The historical database for water temperature is more extensive than for any other parameter. The oldest source is the daily scrollcase data from Rock Island Dam. It extends back to 1933 and provides insight into the annual temperature cycle of the water that enters the project. The data from 1933-1941 was combined to represent the period before Grand Coulee Dam was completed (Juul 2003). The information showed that mean water temperatures were ≤ 4 degrees Celsius (^{o}C) between late December and early March, $>18^{o}$C from late July through early September, and peaked in August at close to 19°C. Temperature data from 1943-1972 were also examined since it was recorded after the first phase of Grand Coulee Dam was completed, but before significant changes occurred to the flow regime of the entire Columbia River. Two important outcomes arose from this analysis. First, summer temperatures were less, reaching daily means of 17.9^{o}C. Second, the water warmed up slower during the spring and early summer than during the earlier period and remained warmer after late September by up to almost 4°C. The final period considered was from 1975-1997. The annual cycle was similar to the one for the 1943-1972 period, but average August and September values again approached 19°C.

Temperature data within the project area was also recorded at the WDOE and USGS long-term monitoring stations. The data set collected downstream from Rock Island Dam had a seasonally low mean of 3.6°C in January while the analogous values were close to 3°C in February below Priest Rapids Dam. The highest monthly values consistently occurred in August when the calculated means were between 19.0 and 19.2°C (Table 9).

Hourly temperature measurements were recorded at the five fixed monitoring sites from 1995-2001 or 1997-2001 depending on the location. This data yielded information that was in many ways similar to the historical analysis, displaying average minimum temperatures in February that ranged from 2.8 to 3.5°C and peaked in August between 18.8 to 19.5°C (Table 9). The detailed fixed monitoring site data also provided insight into longitudinal trends within the project. Average monthly temperatures below Wanapum Dam were up to 0.5°C less relative to the forebay during the summer, but there were no differences between the two sites on an annual basis. The only two locations where there was a perceptible difference were between Rock Island Dam tailwater and Vernita Bridge, where the average annual increase for the 1997-2001 interval was 0.3°C. The mean downstream temperature increase calculated for the 1961-1996 Rock Island Dam and Priest Rapids Dam scrollcase data using 7-day moving averages was determined to be 0.2 C.

The reservoirs did not stratify thermally during 1999 through 2002, although there was near-surface warming during the summer. The water-column data collected during these years showed that vertical temperature differences were typically <1°C. Temperature data collected during the summers of 2000 and 2001 at 1 meter, 3 meter, and 5 meter had an average seasonal vertical temperature variability of 0.4°C.

Table 9. Average monthly temperatures (°C) for fixed monitoring sites and long-term monitoring station data. (Source: Grant PUD 2003)

	1971-1990 WDOE	1997-2001 Fixed Monitoring Stations					1961-2001 WDOE	1974-1993 USGS
	RIST	RIST	WANF	WANT	PRDF	PRDT	PRDT	PRDT
Jan	3.6	3.8	3.2	4.3	4.1	4.2	4.0	3.8
Feb	3.9	2.8	3.2	3.3	3.5	3.4	3.0	2.9
Mar	5.4	4.0	4.5	4.4	4.9	4.5	4.4	4.4
Apr	8.0	7.0	7.1	7.0	7.2	7.3	7.1	7.2
May	11.0	10.4	10.9	10.7	11.0	11.0	10.5	10.7

	1971-1990 WDOE	1997-2001 Fixed Monitoring Stations					1961-2001 WDOE	1974-1993 USGS
	RIST	RIST	WANF	WANT	PRDF	PRDT	PRDT	PRDT
Jun	14.5	13.4	13.2	13.8	14.0	14.0	13.7	14.2
Jul	17.5	16.5	17.5	17.0	17.4	17.4	16.8	17.2
Aug	19.0	18.8	19.5	19.1	19.2	19.2	19.2	19.0
Sep	18.9	18.7	19.1	18.8	17.4	18.5	18.0	18.3
Oct	16.1	15.6	15.9	15.8	19.4	15.8	15.6	15.6
Nov	11.7	12.3	11.8	12.1	11.8	12.2	11.5	11.5
Dec	6.8	8.0	7.6	8.4	7.6	7.7	7.4	7.1

Cross-channel temperature differences and near-shore averages were also examined by Juul (2003) within the project area and found to be relatively small. The 1999 and 2001 profile data indicated that lateral differences did occur during the summer, but the location of the higher temperatures was not consistent with respect to the left bank, right bank, or thalweg. Average lateral differences at 0.5 meter were less than 1°C. Maximum differences at a depth of 1.0 meter were <2°C. In 2000 and 2001 temperature differences at 1-meter depth had a cross-channel difference that was typically <1°C. Diurnal temperature fluctuations were summarized in Juul (2003). The data from the eight transects showed that diurnal fluctuations in the well-mixed reaches below the dams averaged 0.3 to 0.5^{o}C per day during the summer with minor distinctions with depth. Forebay sites, or other low-velocity reaches, had greater diurnal variability with monthly averages reaching 1.5 to 1.7^{o}C, and up to 2.7^{o}C on individual days. Daily maximum temperatures at the forebay sites were most frequent in the 1600 hours (hrs) to 2300 hrs interval.

Total Dissolved Gas

TDG is the summation of the partial pressures of the individual gases in solution – primarily N_2, O_2, and CO_2. As water is spilled into the tailrace air becomes entrained. This air/water mixture is then forced to the bottom of the stilling basin and the increased hydrostatic pressure forces the air into solution. The result is that water becomes supersaturated with those gases normally found in the atmosphere.

Continuous TDG has been measured within the project area since 1995. Early data collection at the five fixed monitoring sites focused on the fish spill season (typically April through August) but data is now collected year round (Juul 2003). Intensive near-field work, conducted immediately below the powerhouse and spillway locations, at

Wanapum Dam has been completed to evaluate the effects of system operations (COE 2001). Additionally, vertical TDG profiles were completed at mid-channel and near the banks during a synoptic study conducted in 1999 (Normandeau et al. 2000). Gas saturation during non-spill events was usually close to 100 percent throughout the project (Table 10). Monthly averages varied by ±3 percent between October and March and spatial patterns were not evident. Higher values that exceeded 110 percent were usually associated with elevated runoff events such as those that occurred in 1996 and 1997. During spill periods to aid migrating juvenile salmonids, TDG values entering the Wanapum pool were at or above 115 percent for the months of June, July, and August (Table 10).

The combined April through August data for 1997-2001 showed very similar TDG saturation at each of the tailwater fixed monitoring stations. The overall averages showed a slight reduction from 115 percent below Rock Island Dam to 114 percent at Beverly Bridge, followed by a 1 percent increase at Vernita Bridge (Table 10). Monthly spill season differences between the project headwaters and Vernita Bridge ranged from a 0.2 percent increase in July to 1.7 percent in May, with a seasonal average of 0.7 percent. May was also the month when gas saturation was typically highest, with monthly averaging from 116 percent to 118 percent at the same three tailwater stations. Individual measurements did exceed 120 percent during some years at all three sites.

Table 10. Average monthly TDG values (%) for the 1997-2001 fixed monitoring station data. (Source: Grant PUD 2003)

	Rock Island Tailrace	Wanapum Forebay	Wanapum Tailrace	Priest Rapids Forebay	Priest Rapids Tailrace
Jan	N/A	99	99	100	101
Feb	N/A	101	101	102	101
Mar	N/A	102	102	103	103
Apr	110	109	110	110	110
May	117	114	116	115	118
Jun	115	112	114	113	116
Jul	115	112	114	114	115
Aug	113	110	110	111	113
Sep	106	104	103	105	105
Oct	N/A	99	100	100	101
Nov	N/A	98	98	98	99
Dec	N/A	98	98	99	99

Flow deflectors were installed on Wanapum Dam between September 1999 and March 2000. The available data indicate that gas saturation subsequently decreased below the dam. The forebay fixed monitoring stations had slightly lower averages than the tailwater reaches during the 5-yr period, but also showed a downstream increase. The mean for the station above Wanapum Dam was 112percent and increased to 113percent at the next forebay station 19 miles downstream. Monthly differences between these two locations ranged from 1.1 percent in April to 1.9 percent in July, with a seasonal downstream increase of 1.3 percent.

Correlation coefficients between spill and tailwater TDG were 0.91 for the combined 1996-1998 data and decreased to 0.73 for the 2000-2001 data set. Additionally, regression analyses of the hourly data showed that downstream TDG values were lower during most spill conditions. The data points diverged at higher spill when the TDG levels for the most recent period were almost 10 percent less. This value is very similar to the 11 percent determined by the COE (2001) during a study conducted immediately below the powerhouse and spillway locations. Flow deflectors have not been installed at Priest Rapids Dam, but a similar correlation coefficient/regression analysis was completed for that data set as a comparison. The correlation coefficients between spill and TDG at Vernita Bridge for the 1996-1998 and 2000-2001 periods were 0.81 and 0.82, respectively. The correlation coefficients for the entire 1995-2001 spill season data were also 0.81. The regression analyses for the hourly data were nonlinear and showed that TDG levels in the most recent set were about 3 percent lower for a given spill volume. It was also noted that when the 2000-2001 data sets for each facility were superimposed on each other they were very similar, demonstrating the effectiveness of flow deflectors for reducing TDG levels.

The 1999 survey by Normandeau et al. (2000) demonstrated that TDG values were essentially uniform throughout the water columns, but lateral differences were documented. Normandeau et al. (2000) found that the right bank between Wanapum Dam and Priest Rapids Dam had higher gas saturation than the corresponding mid-channel during spill events. Mid-summer differences of 13 percent were identified in the reach immediately below the dam, decreasing to 9 percent 17 miles downstream. The COE (2001) commented on this difference and the fact that little gas dissipation occurs between the dams. The reach below Priest Rapids Dam also displayed lateral differences. However, Normandeau et al. (2000) reported that higher gas saturation could occur either along the right bank or mid-channel. The location was a function of total flow and spill, and the extensive downstream assemblage of basalt outcrops and boulders appear to have a large influence on turbulence and degassing.

Dissolved Oxygen

DO is essential to all forms of aquatic life. The oxygen content of water varies with temperature, atmospheric pressure, turbulence, dissolved ions, and photosynthetic activity of algae and aquatic macrophytes. The solubility of oxygen decreases as temperature and ionic concentrations increase. Variations in DO can occur seasonally and diurnally in relation to temperature and biological activity. Biological respiration, including that related to decomposition, reduces DO concentrations.

The current DO standard indicates that concentrations must be >8 milligrams/liter (mg/L). Only two of the measurements from the long-term WDOE/USGS data sets were less than 8 mg/L. All of the measurements from the 1999 limnological study were also >8 mg/L (Normandeau et al. 2000). One percent or less of all measurements recorded at the fixed monitoring stations between 1995 through 2001 were <8 mg/L. The number of times when recorded values at the tailwater stations did not reach 8.0 mg/L was less than the thresholds calculated for the binomial distribution. This was true for the historical monthly WDOE/USGS data sets from below Rock Island Dam and Vernita Bridge, as well as the hourly fixed monitoring station data.

pH

The parameter pH is a measure of the acid/base balance of a solution and can theoretically run from 0 to 14, with 7 representing a neutral solution. It is recognized that pH is an important variable that influences, and is influenced by, many chemical and biological processes within a water body. The photosynthetic activity of algae and aquatic plants removes CO_2 from the water and this leads to an increase in pH. Conversely, respiration and decomposition decrease the pH of the water. These effects can be observed on seasonal and diurnal scales.

Virtually all of the pH measurements from the 1999 synoptic survey were between 6.5 and 8.5 units ─ the only exceptions were surface measurements of 8.6 units recorded in Lake Geneva, located about 7 miles north of Ellensburg, WA, during August and September. One hundred percent of the 1999 and 2000 fixed monitoring station data points were within the allowable range at each station. The 2001 fixed monitoring station data showed some measurements >8.5 units, but a review of equipment and calibration techniques suggest that this was related to the calibration standard used.

Turbidity

Turbidity results from the scattering and absorption of incident light by suspended particles. Values can vary seasonally as a result of biological activity in the water

column and surface runoff carrying soil particles. The water quality standard for turbidity states that turbidity should not exceed 5 nephelometric turbidity units (NTU) above the background when the background is 50 NTU or less. Juul (2003) estimated the background turbidity using the 1978 through 2001 WDOE/USGS Vernita Bridge data as 1.7 NTU.

The instrumentation used during recent studies had a detection limit of 5 NTU and a range of ±5 NTU. Most of the values recorded during the 1999 synoptic survey were <5 NTU. A few measurements at the bottom of the profiles at near-shore sites were higher but were probably influenced by re-suspension of sediments by the probe. The annual means for the combined 1999-2001 fixed monitoring station data were <5 NTU at all stations.

Light Attenuation

Light attenuation in the water column is related to incoming solar radiation and is measured by the depth of light penetration. Transparency is also affected by phytoplankton growth and suspended particulates; in turn, transparency affects macrophyte growth. Light attenuation was evaluated as part of the 1999 descriptive survey (Normandeau et al. 2000) through pelagic (open-water) and littoral (near-shore) measurements using a Secchi disc and underwater light meter.

The open-water and near-shore Secchi disc data showed several similarities. Both showed a temporal pattern but no significant longitudinal gradients. The thalweg system-wide averages were least in June (1.0 meter) during the spring run-off and greatest (5.3 meters) in the fall.

The photic zone is defined as that part of the water column where the photosynthetically available radiation is >1 percent of the light at the surface. Open-water photic zone depths displayed a mean longitudinal increase from Dry Gulch (7.5 meters) to Ginkgo Park (9.2 meters), followed by a subsequent decrease towards the Priest Rapids tailwater site (7.7 meters). The July through October data for the same three reaches displayed the same pattern, with calculated means of 9.4 meters, 10.7 meters, and 8.4 meters, respectively.

Conductivity

Specific conductance, or conductivity, is a measure of the capacity of water to conduct an electric current. Its magnitude is dependent on the concentration of the major ions in solution and total dissolved solids (TDS). The historical specific conductance data showed few changes over time (Normandeau et al. 2000). Average monthly values

at Vernita Bridge ranged from approximately 122 to 152 µS/cm, with annual maxima and minima generally occurring during February and June, respectively.

Total Alkalinity

Alkalinity is the buffering capacity of the water to neutralize pH. Bicarbonates represent the major form of alkalinity, followed by carbonates ($CaCO_3$) and hydroxides. The geology of the watershed is the primary factor that determines total alkalinity, but the form the alkalinity takes can be influenced by the phytoplankton. Historical mean monthly alkalinity data followed a seasonal pattern that paralleled the conductivity data. Monthly averages at Vernita Bridge ranged from 53 mg $CaCO_3$/L in August to 63 mg $CaCO_3$/L, with the higher values usually occurring during the first three months of the year (Normandeau et al. 2000).

The total alkalinity results from the 1999 study tracked the historical conductivity data in several respects. First, the system-wide average decreased from a high of 74 mg $CaCO_3$/L in April to a low of 45 mg $CaCO_3$/L in June, and was 51 mg $CaCO_3$/L by November. Second, there was a slight trend during the growing season of increasing alkalinity from Dry Gulch (47 mg $CaCO_3$/L) to Ginkgo Park (52 mg $CaCO_3$/L). However, the combined near-surface data from the Wanapum and Priest Rapids reservoirs for the entire sampling period were both 55 mg $CaCO_3$/L.

Free CO_2

Carbon dioxide (CO_2) is very soluble in water. CO_2 in solution can originate externally from absorption at the air/water interface. Alternatively, it is produced internally via respiration by aquatic biota and decomposition of suspended or sedimented organic matter. Free CO_2 was calculated for each alkalinity sample collected during 1999. The combined average for the Wanapum Reservoir was 2.3 mg/L compared to the 1.9 mg/L determined for the Priest Rapids Reservoir. Individual values ranged from <1 mg/L to 5.4 mg/L. At the locations where samples were collected at various depths through the water column, the samples from the deeper strata typically had higher CO_2 levels than surface samples.

Chemical Water Quality Parameters

Chemical parameters include the most common aquatic nutrients that are essential for aquatic life. However, excessive levels of these nutrients are indicative of polluted waters. This section describes nitrate-nitrite, phosphorous, TDS and total suspended solid (TSS) levels in project waters. In addition, this section describes the results of

heavy metal and priority pollutant analyses. More detailed information on these parameters is provided in Normandeau et al. (2000; Technical Appendix E-3.A).

Nitrate-Nitrite

The nitrate ion (NO_3) is the common form of combined nitrogen in natural waters. Nitrite (NO_2) may be present as well, but is rapidly oxidized to nitrate. Natural sources of nitrate include igneous rock, land drainage, along with plant and animal debris.

Average monthly historical NO_2+NO_3-N concentrations at Vernita Bridge ranged from 0.04 to 0.17 mg/L (Normandeau et al. 2000). No differences were identified between sampling periods. Annual maxima occurred during the early winter, concentrations gradually declined throughout the spring and summer until August, and then increased during the remainder of the year.

Total Phosphorus

Phosphorus is an essential nutrient for living organisms and is often the limiting nutrient for algal growth. Natural sources of phosphorus are mainly the weathering of phosphorus bearing rocks and the decomposition of organic matter. Historical average monthly total phosphorus (TP) levels below Priest Rapids Dam ranged from 0.02 to 0.05mg/L. Data collected during 1976-1982 averaged approximately 10 to 15 mg/L higher than that collected during 1988-1992 and 1994-1997. Concentrations showed a bi-modal distribution, with peaks of 0.030 to 0.040 mg/L in May and early-to-mid-fall, and lower concentrations during the summer.

Water samples for TP analyses were also collected in conjunction with the ones for NO_2+NO_3-N during the 1999 study. The results were very similar to the nitrogen analyses with respect to specific sampling reaches and depths during any sampling event. The combined TP averages for the near-surface samples were the same for both reservoirs; 0.013 mg/L.

Total Dissolved Solids

Monthly estimates of historical TDS levels were only available for 1976-1982 and 1988-1992. The monthly averages for both periods ranged from 70 to 95 mg/L (Normandeau et al. 2000). Maximum values were typically calculated for the months between February and April, and ranged from 83 to 93 mg/L. Monthly minimums usually occurred in July near 72 mg/L.

The 1999 TDS determinations displayed temporal and longitudinal trends that were analogous to the conductivity data. The near-surface average, based on all data points, for the Wanapum Reservoir was 77 mg/L. The corresponding value for the reach below the dam was slightly higher at 81 mg/L. The data also showed a seasonal trend. The overall average for the 1 meter data peaked at about 90 mg/L in March and April, declined to 58 mg/L in November, and rose to 90 mg/L in December again. As with the suspended solids data, the near-bottom TDS concentrations were not significantly greater than near-surface data (Normandeau et al. 2000).

Total Suspended Solids

TSS, also known as non-filterable residue, are the particles retained on a glass-fiber filter and subsequently dried at 103-105 ^{o}C. The material that remains on the filter can be either inorganic (e.g., soil particles) or organic (e.g., detritus and plant material). Historical mean monthly estimates of TSS at Vernita Bridge ranged from 2 to 7 mg/L (Normandeau et al. 2000). Concentrations were typically highest in May and June during spring runoff and lowest in October through November.

Samples collected for TSS analyses during the 1999 synoptic study showed that both reservoirs were very similar, with annual averages of about 3 mg/L near the surface. The maximum monthly average for the surface samples collected above and below Wanapum Dam was approximately 6 mg/L and occurred in June. The highest near-surface concentrations at individual stations also occurred during June but they did not differ from each other substantially (Normandeau et al. 2000).

Sediment Metals and Priority Pollutants

Sediment samples were collected in September 1999 (Normandeau et al. 2000). Eight cross-channel transects were evaluated between the reach below Rock Island Dam and the one below Priest Rapids Dam.

Cross-channel and deepwater sediments ranged from boulders down to sand and silty loam; large particles (coarse sand, cobbles, and boulders) were most common, although pockets of finer sediments were identified near shore, with one sample consisting of 97 percent sand and silt.

No priority pollutants were present in the open channel sediments of the Priest Rapids Project. One priority pollutant, 4-methylphenol, was isolated in five of the twelve samples collected at the off-channel site near Crescent Bar at concentrations ranging from 2.4 to 5.7 mg/kg. No other littoral samples contained priority pollutants.

Sediment analyses were performed for a full range of heavy metals. The majority of the samples were within regional background ranges, with a few exceptions for copper and zinc. Sediment copper averaged 34, 21, 42, 43, and 50 µg/kg below Rock Island Dam, Crescent Bar, Scammon's Landing, Ginkgo Park, and Goose Island, respectively. The zinc content of the sediments averaged 180, 182, 426, 456, and 715 µg/kg at the same five transects. As a comparison, sediment no-observable-effect concentrations (NOEC) for *Hyalella azteca*, an amphipod shrimp and common fish food item in shallow wetland and shoreline waters of the Columbia River system, were determined to be 1,300 µg Zn/g in other studies. The zinc concentrations within the project area were somewhat elevated at the fine sediment sites, but below sediment NOECs.

Biological Water Quality Parameters

Biological water quality parameters include measurements associated with many important aquatic organisms that serve as water quality indicators. The most important of these are fecal coliform bacteria that provide an index of pollution included in Washington's water quality standards. A description of various algae, zooplankton and aquatic insects found in the project area is also covered in this section.

Fecal Coliforms

Fecal coliforms (FC) are a group of bacteria used to indicate pollution in natural waters. These nonpathogenic microorganisms typically reside in the intestinal tract of humans and are egested with the feces. Pathologic bacteria and viruses that cause enteric diseases in humans can also originate in fecal discharges. Therefore, water contaminated by fecal pollution is considered to be potentially unsafe by the presence of the coliform bacteria. However, the correlation between coliforms and human pathogens is not absolute since these organisms can originate from any warm-blooded animal and even from the soil. Thus, the significance of fecal coliform testing results depends on knowledge of the river basin and the probable source of the observed coliforms.

Historical FC data were available from the WDOE long-term monitoring site at Vernita Bridge. Fecal coliform evaluations were also completed three times (June, July, and August) at five locations (Crescent Bar, Sunland Estates, Ginkgo Park, Lake Geneva, and at Desert Aire) during the 1999 study.

The standard for class A water is a geometric mean of 100 cfu/100 ml, and less than 10 percent of the values used to calculate that mean can be greater than 200 cfu/100 ml. The monthly samples collected at Vernita Bridge by WDOE between 1975–2001 had a geometric mean of 2 cfu/100 ml and a maximum of 63 cfu/100 ml; both below the threshold. The June, July, and August 1999 samples also had relatively low FC counts.

The geometric means for these events ranged from 4 cfu/100 ml to 7 cfu/100 ml while discrete values ranged from 0 cfu/100 ml to 30 cfu/100 ml.

Chlorophyll a

Chlorophyll *a* is present in most photosynthetic organisms and provides an indirect measure of the trophic status of a water body. The chlorophyll *a* levels in the reservoirs were in the mesotrophic zone. The WDOE has also established a set of nutrient criteria that would place the project area between lower and upper mesotrophic states.

Chlorophyll *a* values averaged about 3 µg/L for the entire Priest Rapids data set but did show seasonality. Concentrations peaked in April, were lower and relatively stable from June through October, and then declined in December.

Phytoplankton

Phytoplankton, or algae, comprises the small plants or photosynthetic bacteria in the water column. They have a very limited, or in some cases, no ability to regulate their position in the reservoir, and their spatial orientation is dependent on water movement. They are important within the aquatic ecosystem not only because they form the base of the food chain, but also because the species composition is indicative of the physical and chemical environment.

Algal samples were collected at each station following the same regimen established for the Chlorophyll *a*. Cells were identified to species where practical and quantified (Normandeau et al. 2000).

Total algal biovolume in Priest Rapids Reservoir was slightly greater than in Wanapum Reservoir. However, the magnitude of the distinction varied depending on how the data were viewed. The combined average for algal data from above Wanapum Dam versus downstream showed a 10 percent downstream increase. Seasonally, the documented biovolumes were highest during April and June and decreased by 50 to 70 percent during the last three sampling events.

The pelagic phytoplankton communities of both reservoirs were dominated by the Bacillariophyta (diatoms). Diatoms are characteristically most abundant in the spring and fall, and this was also the case in this section of the Columbia River.

As the year progressed, the biovolume and percentage of the division Cryptophyta (cryptomonads), increased in both reservoirs. Their biovolume in each reservoir during

the first field event in April was ≤4 percent of the total, but their presence increased during the next series of sample events. The Chlorophyta (green algae) and Cyanophyta (blue-green algae) were everywhere but minor components of the algal community at both reservoirs. July was the only month when the green algae made a significant contribution to the total biovolume.

Zooplankton

Zooplanktons are secondary producers in the aquatic food web, foraging on items such as bacteria, detritus, algae, and other zooplankton. Any zooplankter can be consumed by fish, but fish are typically sight feeders and show a preference towards larger zooplankton species.

Photic zone samples for zooplankton analyses were collected in 1999 following the same schedule used for the phytoplankton. Samples were identified to species where possible (Normandeau et al. 2000). The structure of the zooplankton data, however, showed greater differences between the reservoirs and more longitudinal trends than the algal information did.

Despite the similar percent distributions, zooplankton biomass in the upper reservoir was noticeably greater than in the lower reaches. The reasons for some of the differences observed in the zooplankton communities in each reservoir were hypothesized to be due to zooplankton/phytoplankton interactions rather than zooplankton/fish interactions (Normandeau et al. 2000).

Attached Benthic Algae

The attached benthic algae (ABA) are, like the pelagic forms, at the base of the food web. Species composition varies seasonally, but is also influenced by factors such as light, temperature, substrate, nutrients, current velocity, and grazing. Since they are sessile and inhabit the interface between the abiotic and biotic components of the river they are also good water quality indicators. Their relatively short life cycle results in the ability to rapidly respond to changing environmental conditions. The extant communities are typically very representative of present conditions, as well as those of the recent past.

The ABA communities were evaluated during six months of 1999 between February and November (Normandeau et al. 2000). Natural rocks were dredged from the 0 to 2 meter and 2 to 6 meter zones at each end of eight transects. The sampled periphyton were subsequently analyzed for monochromatic chlorophyll *a*, pheophytin, trichromatic chlorophyll *a*, *b*, and *c*, and ash-free oven-dry weight. Autotrophic Indices for both monochromatic and trichromatic chlorophyll *a* values were calculated as well.

The ABA annual mean monochromatic chlorophyll *a* concentration for all sites was close to 19 mg/m^2 during 1999, placing the benthic algae in this reach of the Columbia River in the mesotrophic range.

The ABA Autotrophic Index was relatively high, averaging 462. The magnitude of this index suggests organic loading to the reach. The eight-fold ratio of oven dry weight to ash-free oven-dry weight was also high, further suggesting heavy inorganic siltation or loading of fine particles to ABA communities during the growing season.

Aquatic Macrophytes

Aquatic macrophytes, or plants, serve many purposes. Some of the beneficial uses include habitat for fish, invertebrates, and waterfowl, minimizing bank erosion and the resuspension of sediments, as well as adding oxygen to the system, while removing nutrients. However, in some cases, invasive species such as Eurasian watermilfoil can grow to the extent that they out-compete the native species and become a nuisance. Aquatic macrophytes were assessed at eight transects in early September 1999, the time of expected peak annual density.

Fourteen species of aquatic macrophytes were found in the littoral zones of Priest Rapids and Wanapum reservoirs. The plant community composition was dominated by the exotic Eurasian watermilfoil (*Myriophyllum spicatum*), at 42 percent of the littoral plant biomass. Samples containing 100 percent Eurasian watermilfoil and greater biomass were found in the upstream reaches of Wanapum Reservoir.

Average macrophyte biomass was higher in the Wanapum Reservoir. The upstream Wanapum Reservoir averaged about 57 g/m^2 while the Priest Rapids Reservoir was 10 g/m^2. Maximum density was also greater upstream, reaching 700 g/m^2 compared with 90 g/m^2 in the Priest Rapids Reservoir.

Benthic Macroinvertebrate Community

Benthic macroinvertebrates (BMI) are invertebrates that are retained by a 500-µmeter mesh and are associated with the bottom habitats. There are at least two reasons why they are an important component of water quality studies. First, they form a fundamental link between organic matter resources (e.g., algae, detritus, and leaf litter) and the fish. Second, the life history characteristics of individual species show adaptations to specific environmental characteristics. The benthos are excellent environmental monitors that integrate information regarding their surroundings.

Oligochaetes and Chironomids dominated the BMI communities studied (Normandeau et al. 2000). A project maximum of 63,000 organisms/m^2 was reached at Crescent Bar while the minimum was 133 organisms/m^2 in the reach below Wanapum Dam. In comparison, Normandeau et al. (2000) noted that previous studies found maximum Oligochaete densities in the lower Snake River were approximately 20,000 organisms/m^2 and that Columbia River Oligochaetes tended to be much smaller individuals than those found in the lower Snake River.

The molluscan community composition in the fine sediments was unremarkable. The forms found were representative of taxa previously identified above and below the Priest Rapids Project reach.

Water Quality Standards

The WDOE has established surface water quality standards that contain numeric criteria and designated uses. This section compares measured values for key parameters with numerical criteria set by the state standards. Washington has defined criteria for fecal coliform bacteria, DO, TDG, temperature, pH and turbidity. Detailed information on these standards is also provided in this section.

Clean Water Act

Water quality standards consist of designated uses of the water body and the water quality criteria necessary to support those uses [33 USC§1313(2)(A)]. Environmental Protection Agency (EPA) regulations also added a third formal element, that of an anti-degradation policy [*See* 40 CFR §131.12, 42 USC §1313(d)(4)(B)], which is now incorporated in Washington Administrative Code (WAC)173-201A-300. Substantively, water quality standards, wherever attainable "shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this chapter" [33USC§1251(a)(2), 33USC§1313(c)(2)(A)]. In addition, §303(c)(2)(A) of the Clean Water Act (CWA) states that: "such standards shall be established taking into account their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation."

The Clean Water Act is implemented by the WDOE by authority of the State Water Pollution Control Act (WPCA), Revised Code of Washington (RCW) 90.48, and the Water Resources Act of 1971 (WRA), RCW 90.54. Both statutes explicitly state that industrial development, and specifically hydroelectric power generation, is in the public interest and will be given consideration in developing water quality standards that will

meet public interest values associated with the use of Washington State waters for hydroelectric power generation, recreation, industrial uses, fish, and wildlife.

Beneficial Uses

Until recently, Washington established various classifications and criteria for surface waters of the state. The classifications include Class AA (extraordinary), A (excellent), B (good), C (fair) Lake Class, and Outstanding Resource Waters [WAC 173-201A-130]. WDOE has designated the Columbia River from its mouth to RM 596 (Grand Coulee Dam) as Class A, excellent [WAC 173-201A-130(20), (21)]. Above Grand Coulee Dam to RM 745 (the U.S. – Canadian border), the water is classified as Class AA, extraordinary.

On July 1, 2003, the WDOE adopted new water quality standards and anti-degradation policy for waters within Washington State. These new standards are pending EPA approval. Under the new standards, Washington moved from a class-based format to a use-based format for identifying uses and criteria associated with water bodies in Washington. The key difference between these two approaches is the way in which uses are assigned. Rather than assigning waters having predetermined sets of beneficial uses (regardless of what the water body can actually support), WDOE would assign beneficial uses to a water body independently of each other. WDOE views this change as providing it greater flexibility in designating a combination beneficial uses for protection appropriate to the water body and particular localized conditions.

The new use designations for the Columbia River from the Washington Oregon border to Grand Coulee Dam include: non-core salmon and trout migration, primary contact recreation, and water supply for domestic, agricultural, industrial and stock watering purposes. Miscellaneous uses include wildlife habitat, harvesting, commercial navigation, boating and aesthetics (WAC 173-201-602, Table 602).

Comparisons with Water Quality Criteria

Specific criteria for the surface waters of the State of Washington are set for temperature, TDG, DO, pH, turbidity and fecal coliform bacteria [WAC 173-201A-030]. In addition, special conditions are set for temperature and TDG. Although the new criteria are pending EPA approval, a comparison of existing and new criteria is detailed in the sections below.

Temperature

Certain Columbia River segments have special temperature conditions that contain temperature criteria specific to that river segment. The special condition from the Washington-Oregon border to Priest Rapids Dam is that temperature shall not exceed a one-day maximum of 20°C due to human activities. When natural conditions exceed 20° C, no individual increase will be allowed to raise the receiving water by more than 0.3° C nor shall the cumulative of such increases be allowed to exceed t = 34/(T+9) (WAC 173-201A-602, Table 602, Note 2). This does not reflect any change from the previous criteria for temperature.

Above Priest Rapids Dam, the water temperature criteria changed from a daily maximum of 18° C to a 7-day average of the daily maximum (7DADMax) of 17.5° C (or within 0.3° of the criteria), due to human activities (WAC 173-201A-200). When natural conditions cause the receiving water to exceed the numeric criteria, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C [WAC 173-201A-200(1)(c)]. Incremental temperature increases resulting from point sources shall not exceed t=28/(T+5) (previously t=28/(T+7) [WAC 173-201A-030(2)(c)(iv)] but the criteria for non-point source activities did not change and permits a cumulative temperature increase from all non-point source activities not to exceed 2.8°C [WAC 173-201A-200(1)(c)(ii)(iii)]. Where previously an incremental temperature increase was allowed up to 0.3° C, the antidegradation policy defines a "measurable change" from any new or expanded action to be a temperature increase of 0.3°C or greater [WAC 173-201A-320(3)(a)]. Since the temperature standard includes reference to the "natural condition" of the river as in the previous standard and, as discussed below, the natural condition frequently exceeds the numeric criteria, the temperature standard applicable to the Columbia River in which the project is located has not materially changed.

Several segments of the Columbia River are listed on the state's 303(d) list for temperature. The Priest Rapids Project, however, is located in Water Resource Inventory Areas 40 and 41, which are not included in the final 1998 §303(d) list. In response to those listings, the United States EPA is undertaking an effort to develop a TMDL for temperature for the Columbia and Snake Rivers. While the TMDL methodology is under development, it is anticipated that it will include those water body segments that are listed on Washington State's §303(d) list. Grant PUD intends to work within a regional framework to ensure that large existing hydroelectric dams are included as part of the "natural condition" in the TMDL. Apart from the development of a TMDL, Grant PUD recognizes the importance of temperature monitoring and has developed a detailed program and will continue to participate in the refinement of its program. This program will be consistent with the new temperature monitoring regulations that specify

temperature measurements shall be taken from well mixed portions of the rivers and streams and shall not come from stagnant backwater areas, within isolated thermal refuges, at the surface or at the waters edge [WAC 173-201A-(c)(vi)].

The oldest set of water temperature data available has been recorded at the Rock Island Dam scrollcase between 1933 and 1997. Fifty-eight percent and 43 percent of the August and September daily values were >18°C, respectively, during the period from 1933 to 1996. The 1933-1941 data also showed that daily August values were >18°C for 80 percent of the time while 41 percent of the September values were above this threshold before construction of Grand Coulee Dam, Chief Joseph Dam, Rocky Reach Dam, or the Priest Rapids Project.

The USGS/WDOE long-term monitoring station data showed similar trends. Monthly data collected below Rock Island Dam from 1971-1990 showed that 50 percent of July, 78 percent of August, and 69 percent of September temperature measurements were >18°C. The 1961 to 2001 monthly data from Vernita Bridge showed that 13 percent of the August values were >20°C, but in several of these cases the standard was only exceeded by a few tenths of a degree. Seven percent of the daily August USGS data collected below Priest Rapids Dam (1974-1980) was >20°C, while July and September each exceeded the standard about 1 percent of the time.

Hourly data recorded at the fixed monitoring station sites and thermistor transects in the reservoirs provided the most recent and detailed picture of the temperature regimen in the reservoirs and how they relate to the standards. The combined 1997-2001 data from each of the five fixed monitoring station sites revealed that 20-25 percent of the measurements were >18°C. As with the monthly data, the percentage of data points >18°C was about 1 percent in June at any station.

Warmer temperatures in July, August, and September increased the amount of events that exceeded the standard. The July 1997-2001 fixed monitoring station and 2000-2001 thermistor transect data from the station farthest upstream were >18°C from 4-7 percent of the time. These averages increased downstream resulting in 23-32 percent of values >18°C below Wanapum Dam. Overall, August was the warmest month of the year; fixed monitoring station data showed that water inflows to the project during that month surpassed 18°C 49 percent of the time in 1999 but 100 percent of the time in 1998. Water temperatures generally cooled slightly in September such that over the 5-yr period for the fixed monitoring station below Rock Island Dam the value of 18 °C was exceeded about 67 percent of the time. The thermistor data from the same site, as well as both September data sets from below Wanapum Dam averaged 83 percent >18°C. The number of measurements >20°C below Priest Rapids Dam were typically <2 percent

during the summer of any year. The one exception was the unusually warm year of 1998 when up to 98 percent of the values were >20°C.

Total Dissolved Gas

Prior Washington State water quality standards provided for a temporary special condition for TDG in the Columbia River to aid fish passage over hydroelectric dams. The temporary status has been removed in the new revisions. Both the former temporary and new standard states that when spilling water at dams to aid fish passage, TDG must not exceed an average of 115 percent as measured in the forebay of the next downstream dam and also must not exceed an average of 120 percent as measured in the tailrace of each dam [WAC 173-201A-200(f)]. These averages are based on the 12 highest consecutive hourly readings per day rather than the 12 highest hourly readings. In addition, the maximum one-hour average 125 percent TDG allowed in WAC 173-201A-200(f) is the same as in the former rule [WAC 173-201A-060(4)(b)]. Outside fish spill season, the standard remains at 110 percent TDG [WAC 173-201A-030(2)(c)(iii)]. In addition, the TDG standard does not apply when the total river flow exceeds the seven-day, ten-year frequency flood (7Q10) [WAC 173-201(f)(i)]. The 7Q10 flood flow for the project was estimated at 264,000 cfs at both Wanapum at Priest Rapids dams (WDOE In Press).

Hourly measurements recorded during the non-fish spill season between Wanapum Dam forebay and Vernita Bridge in 1995 and from 1999–2001 were <110 percent saturation for more than 98 percent of the time. During the high flow period of 1996 and before installation of flow deflectors at Wanapum Dam, up to 27 percent of hourly TDG measurements below Wanapum Dam were >110 percent. Below Rock Island Dam, from 6-30 percent of TDG measurements were >110 percent during 1999-2001. The maximum percentages ranged from 0-6 percent at the Priest Rapids Project tailwaters during the same time period.

The TDG data from the fish spill periods also varied considerably. The 125 percent 1-hr maximum was surpassed 0-4 percent of the time at any location in 1995 and between 1998 and 2001. Three percent to 31 percent of the 1996 and 1997 data points were above this threshold when river discharge was high but less than the 7Q10. These were also the two years when the binominal distribution criteria at the tailwater stations were surpassed; Beverly Bridge and Vernita Bridge in 1996 and Beverly Bridge again in 1997. The highest percent exceedences of the 115/120 percent standard also occurred in 1996 and 1997 ranging from 28 percent to 83 percent. The 1998 through 2000 data sets had fewer values above these thresholds. The percentages were generally highest near the Priest Rapids Dam facility where 25 percent to 42 percent of the forebay measurements were greater than the 115 percent standard and 18 percent to 23 percent

were above the 120 percent mark in the tailwater. The COE (2001) study noted that the short travel time between the Wanapum Dam tailrace and Priest Rapids forebay minimized reductions in gas saturation, and concentrations at the Beverly Bridge fixed monitoring station site would have to be below 116 percent to assure compliance with the 115 percent standard at Priest Rapids. The very low flows of 2001 reduced exceedences to between zero and 9 percent at all sites.

It is important to note that fish spill and TDG are monitored and managed by the Mid-Columbia Coordinating Committee (MCCC) which includes representatives from Chelan and Douglas PUDs, National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), Washington State Department of Fish and Wildlife (WDFW), WDOE, Yakama Nation, Columbia River Inter-Tribal Fish Commission (CRITFC) and Confederated Tribes of the Colville Nation. Fish spill is adjusted regularly based on TDG monitoring but the approach has previously been geared towards maximizing spill which is presumed to aid fish passage survival rather than absolute compliance with TDG criteria. Thus, spill levels are often set based on the tailrace 120 percent criteria that can result in frequent exceedences of the 115 percent forebay criteria. While the analysis of historical data presented here reflects this spill management policy, the change in the standard to the 12 highest consecutive hourly readings is designed to improve compliance with the applicable TDG criteria. In this regard, the 12 highest consecutive hourly readings will be less likely to be affected by involuntary spill events that are beyond Grant PUD's control. Additionally, with a 12 consecutive hour metric and the use of real time data gathering techniques, Grant PUD and other operators will be in a better position to reduce spill before the standard is exceeded.

Dissolved Oxygen

The Washington State water quality criteria for dissolved oxygen (DO) has not changed. The criteria require that concentrations exceed 8 mg/L [WAC 173-201A-200(f)]. Only two of the measurements from the long-term WDOE/USGS data sets were less than 8 mg/L. All of the measurements from the 1999 limnological study were >8 mg/L (Normandeau et al. 2000). One percent or less of all measurements recorded at the fixed monitoring stations between 1995 through 2001 were <8 mg/L. Additionally, the number of times when recorded values at the tailwater stations did not reach 8.0 mg/L was less than the thresholds calculated for the binomial distribution. This was true for the historical monthly WDOE/USGS data sets from below Rock Island Dam and Vernita Bridge, as well as the hourly fixed monitoring station data.

pH

The Washington State water quality criteria for pH has not changed. The criteria requires pH values between 6.5 and 8.5 units [WAC 173-201A-200(f)]. Ninety-one percent of the historical monthly WDOE/USGS data collected below Rock Island Dam were within this range, as were 97 percent of the analogous data from Vernita Bridge. Virtually all of the pH measurements from the 1999 synoptic survey were between 6.5 and 8.5 units - the only exceptions were surface measurements of 8.6 units recorded in Lake Geneva during August and September. One hundred percent of the 1999 and 2000 fixed monitoring station data points were also within the allowable range at each station. The 2001 fixed monitoring station data showed some measurements >8.5 units, but a review of equipment and calibration techniques suggest that this was related to the calibration standard used.

Turbidity

Washington State water quality standards for turbidity have also not changed. The criteria state that turbidity should not exceed 5 NTU above the background when the background is 50 NTU or less [WAC 173-201A-200(e)]. Juul (2003) estimated the background turbidity using the 1978 through 2001 WDOE/USGS Vernita Bridge data as 1.7 NTU. Only seven data points were greater than the 6.7 NTU threshold, well below the 36 prescribed by the 90 percent binomial distribution criterion.

The instrumentation used during recent studies had a detection limit of 5 NTU and a range of ±5 NTU. Most of the values recorded during the 1999 synoptic survey were <5 NTU and the highest mainstem value was 11 NTU. A few measurements at the bottom of the profiles at near-shore sites were between 15-21 NTU, but were probably influenced by re-suspension of the sediment by the probe. The annual means for the combined 1999-2001 fixed monitoring station data were <5 NTU at all stations.

Fecal Coliform

Washington State water quality standards for fecal coliform in freshwater are designated for the protection of recreational uses. Within the project area, primary contact recreation is the designated use and contains a criteria for fecal coliform which is the same as the previous standard [WAC 173-201A-200(2)]. This criterion requires that a geometric mean be less than 100 cfu/100 ml, and not more than 10 percent of the values used to calculate that mean can be greater than 200 cfu/100 ml [WAC 173-201A-200(2)(b)]. The monthly samples collected at Vernita Bridge by WDOE between 1975–2001 had a geometric mean of 2 cfu/100 ml and a maximum of 63 cfu/100 ml; both below the threshold. The June, July, and August 1999 samples also had relatively low

FC counts. The geometric means for these events ranged from 4 cfu/100 ml to 7 cfu/100 ml while discrete values ranged from 0 cfu/100 ml to 30 cfu/100 ml.

Summary of Water Quality Criteria Comparisons

WDOE's Water Quality Program Policy 1-11 sets forth an approach for assessment of water quality compared to water quality criteria given the precision and accuracy of the sampling methods used as well as existing conditions. For TDG, pH and turbidity, WDOE's policy guidance is based on persistence at levels in excess of the water quality standard for 10 percent of the time. Analysis is based on use of a binomial distribution with a 90 percent confidence interval, to identify whether the true exceedence percentage is greater than 10 percent. If, for example, monitoring data were available for an entire year (365 samples), a parameter would need to exceed the criteria for 45 days to violate the standard. Juul (2003) applied this technique to analysis of available data.

For temperature and DO, WDOE examines periods of highest temperature and lowest DO. It is important to note, that under WDOE policy, an exceedence of a standard is not a violation if it results from natural conditions. For purposes of this comparison, temperature data are summarized based on comparisons to 1933-41 Rock Island temperature data as an indicator of natural conditions for temperature on the Columbia River.

WDOE's policy for evaluating fecal coliform data describes a violation as any exceedence of the geometric mean of 100 cfu/100 ml or 10 percent of available samples exceeding 200 cfu/100 ml when at least 5 samples were collected within an assessment period.

Grant PUD performed detailed comparisons of available water quality data with criteria for state standards. Juul (2003; Technical Appendix E-3.B) compared TDG, pH and turbidity to binomial distribution exceedence limits described in WDOE Policy 1-11. This comparison showed that TDG failed to meet the binomial distribution limits (Table 11), but pH and turbidity were well within the binomial distribution limits for all data analyzed. However, as noted earlier, one must understand that MCCC representatives attempt to maximize spill levels and manage for compliance with the 120 percent tailrace criteria while tending to deemphasize the 115 percent forebay criteria.

WDOE uses different comparison methods for fecal coliform bacteria, but all samples were well below the standard (Table 11). In addition, nearly all DO measurements were above 8 mg/L with only two historical measurements of 7.6 mg/L and 7.5 mg/L taken in 1969 and 1987, respectively. The remaining 457 measurements were all above 8.0 mg/L (Juul 2003).

Comparisons of temperature data to standards are much more complex, because the standards contain both special conditions and exceptions for situations where natural conditions already exceed the standard. The 20°C special condition below Priest Rapids Dam allowed for straightforward comparisons. From 1999 through 2001, over 22,000 hourly temperature measurements below Priest Rapids Dam contained not one hourly measurement greater than 20°C; showing remarkable compliance with the special condition standard (Table 11). During warmer weather in 1995 and 1998, 12-13 percent of hourly measurements were in excess of 20°C, with maximum measurements being about 1°C above the 20°C special condition (Juul 2003). However, naturally warm water conditions are not considered violations of water quality standards.

Table 11. Comparison of Project water quality data with surface water quality standards of the State of Washington.

Parameter	Standard	Results of Studies
TDG	Non fish-spill ≤110%	<2% of values exceeded 110% (Juul 2003). Did not exceed binomial limits.
	Fish spill: 115% next forebay, 120% tailrace (12 highest consecutive hours per day), 125% 1 hr maximum	Did not exceed binomial limits for 125% criteria. Did not exceed binomial limits for 120% at WAN in 5 out of 7 years analyzed (Juul 2003; Table TDG-13). Did not exceed binomial limits for 120% at PRD for 2 out of 7 years analyzed (Juul 2003; Table TDG-13). Did not exceed binomial limits for 115% at PRD in 2001; limits exceeded in 1998, 1999 and 2000 (Juul 2003).
pH	Between 6.5 and 8.5	All data sets analyzed less than binomial limits (Juul 2003).
Turbidity	Not to exceed 5 NTU over background, or 10% over background of ≥50 NTU	All data less than binomial limits; only seven data points were greater than the 6.7 NTU threshold (Juul 2003).
Fecal Coliform	Not to exceed geometric mean of 100 coliform forming unit (cfu)/100 ml, less than 10% of all samples exceeding 200 cfu/100 ml	All values less than criteria; geometric mean value was 2 cfu/100 ml; highest sample was 63 cfu/ml (Normandeau et al. 2000).
DO	Must exceed 8.0 mg/L	Only 2 of 459 measurements from 1961-2001 below 8 mg/L (Juul 2003).
Temperature	≤17.5°C above PRD ≤20°C below PRD	Natural conditions greater than 17.5°C in summer (Juul 2003). 0% >20°C from 1999-2001; 12%>20°C in 1998 (Juul 2003).

Comparisons to the 18°C are not as simple because the policy guidance and temperature standard considers natural conditions. To estimate natural conditions, Juul (2003) used historical data from Rock Island Dam during the 1933-41 time period when it was the only mainstem Columbia River dam and its very limited storage and low height

would have minimal effects on temperature. Review of this data showed that high percentages of temperature readings were greater than 18°C with some July through September periods showing nearly 100% of temperature measurements greater than the present-day standard. While large percentages of available data (Juul 2003) are greater than the 18°C criteria, because of the natural conditions, these values are not considered violations of water quality standards.

3.4.2 Environmental Effects and Recommendations

This section describes the effects of the project on water quantity and quality identified during the scoping process (section 3.4); summarizes Grant PUD's proposed measures to protect and enhance water quantity and quality; describes the measures recommended by agencies and interested parties; and presents our staff analysis and conclusions regarding the effects of the alternative measures. The key water quality parameters of interest for the Columbia River are TDG levels and temperature. All other water quality parameter measurements are indicative of excellent water quality.

Project Effects on Total Dissolved Gas

Dissolved gas supersaturation is a condition that exists in many natural and man-made water bodies throughout the world. It occurs when partial pressures of atmospheric gases in solution exceed their respective pressures in the atmosphere. Water flowing over the spillway at hydroelectric projects can result in gas supersaturation of river water with atmospheric gases when the air bubbles are forced into solution at depth (Weitkamp and Katz 1980).

Temperature and pressure are the primary factors affecting gas solubility in water. As the temperature of a volume of water increases, the volume of TDG it will hold decreases. Increased pressure increases the solubility of gases in water. Because of the hydrostatic pressure found at depth, there is a greater capacity for dissolved gases to be held. Water plunging over a spillway entrains air bubbles; the gases are then forced into solution at depth. The result is water that is supersaturated with the gases normally found in the atmosphere.

Individual atmospheric gases (primarily oxygen, nitrogen, and trace gases such as argon and carbon dioxide) can often be supersaturated without adverse effects on fish or other aquatic organisms. However, when the sum of partial pressures of all of the gases exceeds the atmospheric pressure, there is the potential for gas bubbles to develop in water and in aquatic organisms that inhabit the water. This causes a condition known as gas bubble trauma (GBT) or gas bubble disease (GBD), which can be lethal or harmful to fish and other aquatic organisms (Weitkamp and Katz 1980).

Fish may not display adverse effects as a result of this phenomenon if the higher water pressures offset the elevated TDG levels passing through their gills. Fish that are able to sound to the gas pressure compensation point can avoid GBT symptoms. Each meter of depth creates additional pressure that increases the solubility of dissolved gases approximately 10 percent. The detrimental formation of gas bubbles is reduced as solubility increases. A fish at 2 meter would experience a 20 percent reduced effect of GBT. With TDG at 120 percent, fish below 2 meter would not experience adverse effects because they would be below the gas pressure compensation point.

Grant PUD conducted regular monitoring of GBT since 1996. These data show that 4-11 percent of spring migrating and 2-6 percent of summer migrating juvenile salmonids exhibit signs of GBT. Incidence of GBT is evident even in years with TDG levels under the 120 percent and 115 percent state standard levels for periods of fish spill (Table 12). There is no reliable methodology available to translate these samples of GBT incidence to mortality rates, although it is likely that the effects of GBT increase salmonid mortality with the severity of the symptoms observed (Weitkamp and Katz 1980). The severity of the symptoms observed are almost uniformly at the lowest level of detection (Duvall et al. 2002).

Table 12. Summary of gas bubble trauma incidence and average total dissolved gas levels for salmon and steelhead smolts monitored at Priest Rapids Dam from 1996-2002. (Source: Duvall et al. 2002)

Year	Average Spring % TDG	Average Spring GBT %	Average Summer %TDG	Average Summer GBT %
1996	124	8.5	117	1.8
1997	130	11.1	116	2.3
1998	116	3.9	113	4.7
1999	114	3.7	113	1.7
2000	114	8.3	113	5.8
2001	112	3.2	110	2.7
2002	116	4.3	120	6.0

Effect of Operations on Total Dissolved Gas

Dissolved gas saturation can result from a wide variety of causes. While dams have received the most attention in the literature, excess TDG can also result from warm-

water discharges, oxygen production by aquatic plants (enhanced by nutrients associated with industrial effluents, municipal discharges, and agricultural runoff), solar heating of water bodies, ingestion of air into pumping systems, supplemental oxygen in hatcheries, and air lift re-aeration systems.

Water flowing through turbines does not entrain air whereas spillway flows plunge to depth and force air into solution. Studies to date demonstrate that turbine operation does not contribute significantly to TDG supersaturation, based on unchanged TDG pressure for forebay and powerhouse tailrace measurements (COE 2003). However, low water conditions, such as minimum operating elevation, may result in vortex formation and dramatically increase air entrainment. Data available indicates that this not an issue at either Wanapum or Priest Rapids developments.

Wanapum Dam

At Wanapum Dam, the flow split between powerhouse and spillway shows that powerhouse turbine flows account for the majority of water passed. The period with the largest spill percentages occurs in June with a monthly average of 56 kcfs spill and average flow of 122 kcfs through the turbines. The estimated TDG level associated with this volume of spill is 124.1 percent.

Priest Rapids Dam

At Priest Rapids Dam, the period with the highest spill percentage occurs in May, with a monthly average of 89 kcfs through the spillway and 90 kcfs through the powerhouse. The estimated TDG level associated with this volume of spill is 120.5 percent. Both these estimates are in excess of water quality standards for fish spill.

Effect of Flow Deflectors on TDG

To address elevated TDG levels caused by spill, Grant PUD worked from 1996 through 2000 to develop spillway flow deflectors at Wanapum Dam. The objective of the flow deflectors is to produce a skimming flow across the water surface instead of allowing spill to plunge. After testing several designs in consultation with the MCCC, FERC approved construction of a full set of 12 flow deflectors (1 for each spillbay) on November 15, 1999 (89 FERC 62,123). Construction was completed in time for 2000 fish spill operations.

Juul (2003) evaluated relationships between spill levels and TDG for pre- and post-deflector time periods at Wanapum Dam. Prior to the installation of the flow deflectors, gas saturation increased non-linearly with spill. After the deflectors were

installed, TDG levels were reduced by as much as 10 percent. Both pre- and post-deflector regressions explained a large percentage of observed TDG levels in the tailrace using the volume of spill as a predictor (Table 13).

Table 13. Estimated tailrace TDG levels for Wanapum and Priest Rapids spill up to 7Q10 flows. (Source: Grant PUD, 2003)

Development	Regression	R^2	7Q10 Flow (kcfs)	Approximate Powerhouse Flow (kcfs)	Spill Volume (kcfs)	Estimated TDG %
Wanapum (1996-98)	%TDG=8.153ln (spill in kcfs) +91.308	0.85	264	160	104	129.2
Wanapum (2000-01)	%TDG=0.00007 (spill in kcfs)^2 +0.106 (spill in kcfs)+108.39	0.73	264	160	104	120.2
Priest Rapids (1995-2001)	%TDG=93.782 (spill in kcfs)$^{0.056}$	0.73	264	160	104	121.2

The spill/TDG relationships at Priest Rapids Dam are somewhat different than Wanapum Dam. During the 1996-1998 interval, TDG levels at Vernita Bridge below Priest Rapids Dam were typically about 4-8 percent lower than those at Beverly Bridge below Wanapum Dam. Average spill at Priest Rapids for this period of analysis was 41 percent compared to 26 percent at Wanapum, however the Vernita Bridge monitoring station is about 6 miles farther downstream of Priest Rapids Dam than Beverly Bridge is of Wanapum Dam and some TDG equilibration is expected to occur over this distance. The comparison after installation of Wanapum Dam flow deflectors narrowed the difference to approximately 2 percent.

The regressions describing the relationship between spill volume and TDG provide a tool to estimate TDG levels expected at various spill volumes. The 7Q10 flow for Wanapum and Priest Rapids dams is estimated at 264 kcfs (WDOE 2002). The maximum flow capacity at both Priest Rapids and Wanapum dams is approximately 160 kcfs with nine units operating at each dam, so each dam has to spill up to 104 kcfs before reaching the 7Q10 flow volume. The regression relationships developed by Juul (2003) estimate tailrace TDG levels from a spill of 104 kcfs at Wanapum, with flow deflectors, at 120 percent (Table 13). Without flow deflectors, the same spill volume at Wanapum Dam would have been nearly 129 percent. At Priest Rapids, 104 kcfs spill is expected to result in Vernita Bridge TDG readings just over 121 percent (Table 13).

Grant PUD also funded a near-field TDG study completed between Wanapum Dam and Priest Rapids Dam during late-April and early-May 2000. The objective of this study was to determine the performance of the 12 spillway deflectors installed on

Wanapum Dam during late 1999 and early 2000. This evaluation showed that installation of flow deflectors at Wanapum Dam resulted in an average decrease in TDG saturation at Beverly Bridge of 11 to 11.5 percent over the entire range of conditions (COE 2001). The resulting volume of spill at Wanapum Dam that would keep tailrace TDG levels below 120 percent increased to 100 kcfs with the installation of flow deflectors. Prior to the installation of the flow deflectors at Wanapum Dam, the TDG values in Priest Rapids Dam forebay were consistently above the 115 percent threshold. The rate of change in TDG saturation from Beverly Bridge to Priest Rapids forebay was nearly identical for both pre- and post-deflector conditions, but the flow-weighted TDG averaged 4 percent less at both locations during the post-deflector study. This effect also means that the Priest Rapids Dam forebay standard was met for Wanapum Dam spill of up to 40 kcfs after the deflectors were installed.

While the Wanapum flow deflectors appear to be quite effective at reducing TDG, there may be issues related to fish passage that create concern about fish passage survival. Although tests of direct mortality showed little injury to smolts, more recent evaluations suggest that skimming surface flow and edge effects associated with spill across the deflectors may expose smolts to bird predation that appears to lower survival rates below that of smolts passing through the turbines (Robichaud et al. 2003).

Total Dissolved Gas Exchange at Priest Rapids Dam

To investigate the total dissolved gas exchange at Priest Rapids Dam, the spatial and temporal patterns of TDG gas pressures were investigated in the region upstream and downstream of Priest Rapids Dam during the weeks of July 21 – August 4, 2002 using an array of water quality logging instruments. Standard and alternative spill patterns were monitored during spillway releases ranging from 20.7 to 198.7 kcfs (COE 2003; Technical Appendix E-3.E).

The testing schedule for TDG exchange study at Priest Rapids Dam encompassed a combination of spillway and powerhouse operating scenarios that were scheduled around routine project operations. The range of flow conditions targeted was based on a design spill rate required during the 7-day 10-year frequency flood (7Q10) at Priest Rapids Dam, which is approximately 264 kcfs. A powerhouse capacity of 164 kcfs was assumed, with the design spill discharge of about 100 kcfs required to pass the 7Q10 spill event. Spillway releases from Priest Rapids Dam are managed to stay within TDG standards for river flows less than the 7Q10 flood flow.

The test schedule called for spillway and hydropower discharges to be systematically varied to achieve a range of operating conditions while maintaining commitments to hydropower production. The test schedule included a wide range of

project operating conditions for tailwater elevation, spill pattern, unit spillway discharge, gate operation, and variations in powerhouse loadings. The duration of each test treatment or spill event was a minimum of 3 hours (COE 2003).

TDG saturation below the spillway was related to a number of factors including spill discharge, spill pattern, and tailwater elevation. During this evaluation, the maximum TDG saturation was consistently observed on a transect located immediately downstream from the center portion of the spillway. At this location the maximum instantaneous TDG saturation of 134.5 percent occurred (during a standard spill pattern) at 144.8 kcfs spill. COE (2003) found that the maximum TDG saturation attenuated quickly below the dam through the development of the mixing zone between powerhouse and spillway flows. The maximum TDG saturation observed during the study (in the mixing zone) was 124.4 percent.

Average TDG saturation immediately below the stilling basin was determined by averaging across all stations, except during the non-standard spill, where only the two bounding stations were used to represent the TDG content of spill. Of the 91 events identified during the study period, 22 events resulted in an average TDG saturation of greater then 125 percent, 63 events greater than 120 percent, and 80 events greater than 115 percent. The average change in TDG over the entire study period was 2.3 percent saturation (ranged from -1.1 to 10.6 percent). During two events, a small net reduction in the TDG saturation was caused by spill at Priest Rapids Dam.

The relationship between total spillway discharge and average TDG saturation observed at the transect immediately below the stilling basin was poor. A general trend was apparent for the standard spill pattern. Spillway total dissolved gas exchange was related to TDG delta pressure increasing in direct proportion to total spill discharge up to about 100 kcfs (Figure 53 of Technical Appendix E-3.E).

The relationship between specific spill discharge or discharge per spillbay and average TDG saturation immediately below the stilling basin tended to account for many of the differences between the standard and non-standard spill patterns (Figure 54 of Technical Appendix E-3.E). The non-standard spill events generally tended to fall within the range of data defined by the standard spill events. These combined data define a loose relationship between unit spillway discharge and average spill TDG saturation. The TDG exchange in spillway flows was found to be an exponential function of unit spillway discharge. In addition, the effective stilling basin depth is a second determinant of TDG exchange. As the specific discharge increases, the TDG saturation becomes a function of the effective depth of aerated flow in the stilling basin and tailwater channel. For small discharges, the TDG exchange becomes much more dependent on the specific discharge.

The alternative spill patterns had a significant impact on the average TDG exchange associated with spillway flow. The higher specific discharges of these events generated larger TDG pressures when compared to comparable discharges using the standard spill pattern. Higher powerhouse releases were found to increase the TDG saturation at stations below the spillway while holding the spill discharge constant. Higher powerhouse releases will increase tailwater elevation and the depth of flow in the stilling basin and adjoining tailwater channel. During the study period, a 10 kcfs increase in powerhouse flow resulted in a 0.6 percent saturation increase in the TDG content of a 50 kcfs spill. The entrainment of powerhouse flows into the aerated spillway releases is not a measurable source of TDG exchange at Priest Rapids Dam. The training wall between the powerhouse and stilling basin reduces the interaction of these project flows.

In comparison to other projects, it was determined that the TDG exchange at Priest Rapids Dam is similar to the TDG exchange at Lower Granite Dam, which has been modified with spillway flow deflectors. This comparison was based on the spill discharge producing TDG levels of 115 and 120 percent in spillway flows. The moderate TDG exchange observed at Priest Rapids Dam is likely attributed to the efficient energy dissipation in the shallow stilling basin and adjoining tailwater channel.

Grant PUD's Proposals to Improve TDG

Reservoir Management

Based upon the results of ongoing monitoring and evaluations, Grant PUD proposes to continue its reservoir management and maintenance operations, and the use of spill patterns to minimize ambient TDG levels at the project when feasible, subject to hydraulic conditions, total river flow, construction activity, maintenance requirements or other emergency conditions. Grant PUD intends to coordinate the spill program for the project with the spill activities of other projects through the MCCC or its successor (anticipated to be the Priest Rapids Coordinating Committee (PRCC)).

Flow Deflectors at Wanapum Dam

Grant PUD completed installation of spillway flow deflectors at Wanapum Dam as provided in the existing TDG Abatement Plan approved by WDOE in April 2000. As indicated, Grant PUD will be proposing measures to reduce reliance on Tainter gate spill to aid fish passage; however, there will be times when such spill will be required. Based on existing information, Grant PUD plans to continue to operate each Tainter gate with flow deflectors during the next License term.

Advanced Turbines at Wanapum Dam

The turbines at Wanapum Dam are approaching the end of their useful life and require replacement. Grant PUD is testing an Advanced Design turbine at Wanapum Dam in 2005 with the installation of one new turbine. Based on testing results for fish survival and efficiency and other operational measures, Grant PUD anticipates that full installation of all ten turbines will be completed by 2012. The new turbines will increase plant hydraulic capacity to approximately 188 kcfs. This in turn, would reduce periods of involuntary spill and result in fewer turbine unit outages. Using TDG regressions from Juul (2003), this would provide an estimated TDG reduction from levels near 120 percent to approximately 117 percent (Table 14).

Table 14. Estimated tailrace TDG levels for Wanapum spills up to 7Q10 flows with existing and Advanced Turbines.

Turbine	Regression	R^2	7Q10 Flow (kcfs)	Approximate Powerhouse Flow (kcfs)	Spill Volume (kcfs)	Estimated TDG %
Existing	%TDG=0.00007(spill in kcfs)^2 +0.106(spill in kcfs)+108.39	0.73	264	160	104	120.2
Advanced	%TDG=0.00007(spill in kcfs)^2 +0.106(spill in kcfs)+108.39	0.73	264	188	76	116.9

Fish Passage Proposal – Wanapum

Grant PUD is proposing a new downstream fish passage measure for Wanapum Dam that would replace the current spillway fish spill program with a 20 kcfs surface spill design located adjacent to the powerhouse. This proposal includes features specifically designed to reduce TDG levels by preventing the spill from plunging into the tailrace from the top of the spillway. Design of the proposed spill structure includes extending a submerged chute downstream and widening the discharge end to approximately 90-feet. The spreading spillway will allow the turbulent energy in bypass discharge to be reduced, thereby minimizing negative tailrace effects. Under the proposed construction schedule, this measure would be completed by August of 2008.

Spill Operations at Priest Rapids Dam

Changes in spill operations at Priest Rapids Dam will be based on the outcome of near field TDG studies performed in 2002. Grant PUD will continue to identify and implement experimental spill regimes as may be warranted to test opportunities for improving survivals with less spill flow and/or reducing TDG levels at either Priest Rapids or Wanapum Dams. These efforts will be designed, implemented and evaluated

in coordination with the PRCC.

During fish spill periods, Grant PUD will monitor TDG levels in the Priest Rapids Project area at its four existing fixed sites (an additional site is operated jointly with Chelan County PUD - Rock Island Tailrace). This monitoring will focus on the following objectives: 1) to manage TDG levels within the relevant operating criteria at the project; 2) to evaluate the success of the TDG Abatement Plan toward reducing ambient levels of TDG at the project; and 3) to evaluate alternative fish passage strategies and their effect on passage survivals and ambient TDG levels. Grant PUD also proposes to provide biological monitoring to determine the incidence of GBD symptoms in downstream migrating juvenile salmonids and continue development of its "real time" TDG monitoring system at the fixed sites.

Fish Passage Proposal - Priest Rapids

Grant PUD conducted a detailed analysis evaluating various downstream fish passage alternatives for Priest Rapids Project (Voskuilen et al. 2003; Technical Appendix E-4.K). Results from the detailed design phase showed that the highest ranked concept at Priest Rapids was a full-open spillway gate passing approximately 60 kcfs. The next highest ranked concept for Priest Rapids was a split-spillbay concept.

The Priest Rapids fish bypass at Spillbay 22 consists of a new intermediate pier in Spillbay 22 and future tailrace enhancements, if required. This creates two smaller full-depth spillways, a 20-foot wide spillway on the powerhouse side (east side) and a smaller 12-foot wide spillway on the west side (Figure 5).

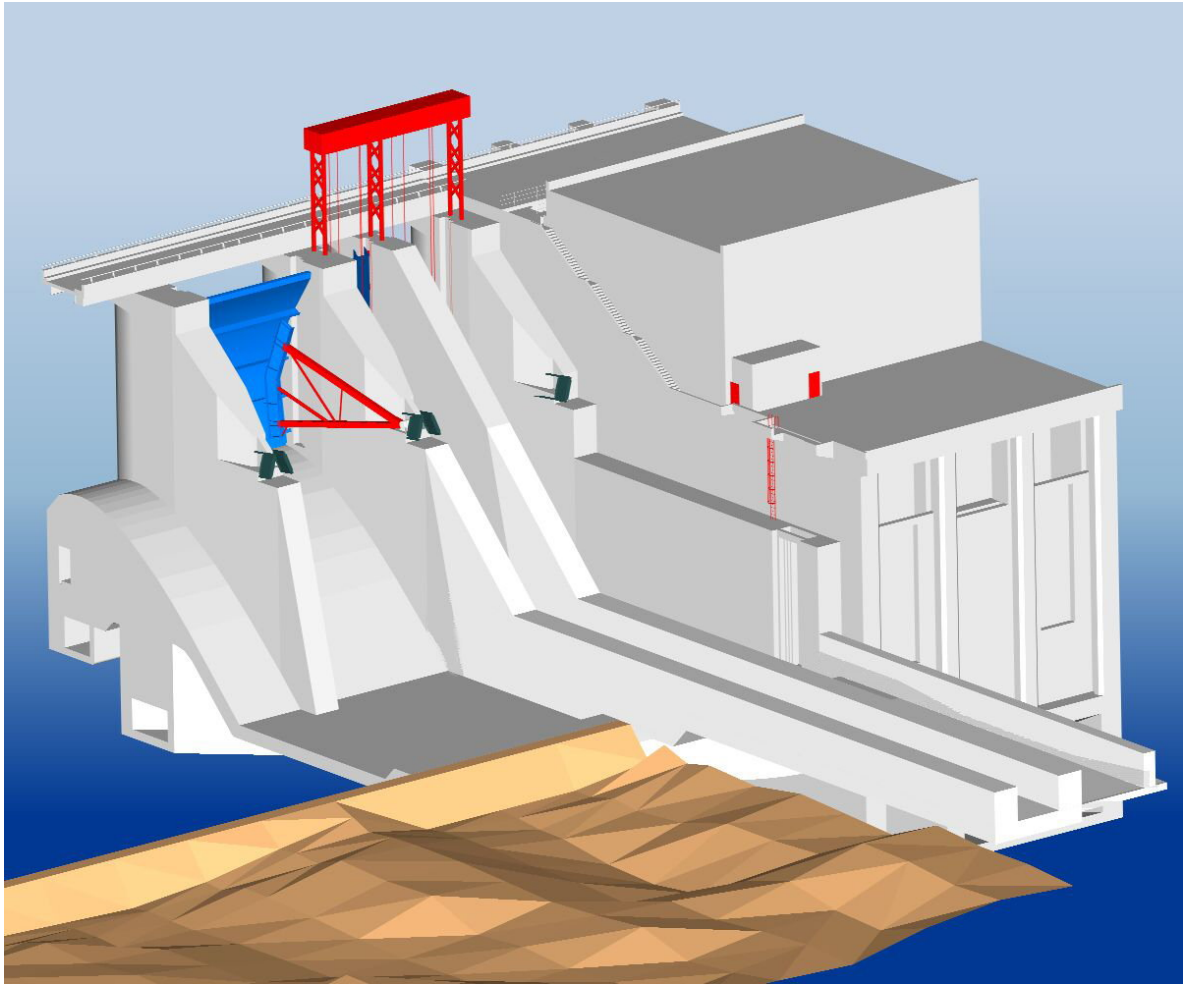

Figure 5. Graphical depiction of fish passage modification for Priest Rapids Dam showing training walls and spillway apron additions designed to reduce TDG levels during operation. (Source: Grant PUD, 2003)

During full-open gate operations, the east bay can discharge as much as 25,000 cfs while the west bay can discharge as much as 15,000 cfs for a combined flow of 40,000 cfs. The key feature of the proposed Priest Rapids bypass is the downstream feature of an extended stilling basin with training walls. This feature will be designed based on use of physical model to produce a surface skimming flow that would prevent the 40 kcfs of surface spill from plunging to depth. Under the current plan of developing this system in 2 phases, the downstream features designed to reduce TDG levels would be completed in 2010. The expected TDG benefits of this proposal cannot be estimated at this time because numerous efforts have shown that TDG uptake cannot be accurately modeled. However, past experience has shown that developing surface skimming flows results in substantial (up to 10 percent) reductions in TDG. Once this is constructed, Grant PUD's monitoring program would provide a more precise estimate of the effects on TDG levels.

Flow Deflectors - Priest Rapids Dam

Grant PUD recognizes that flow deflectors are the most widely used and arguably the most effective measure for reducing TDG levels during periods of spill. Because TDG levels during spill at Priest Rapids are relatively modest (COE 2003) and because of concerns about the effects of flow deflectors on downstream passage survival of smolts (Giorgi et al. 2002), Grant PUD believes that other methods could be used initially at Priest Rapids Dam. If the tailrace features designed for the Priest Rapids fish bypass system do not allow spill at Priest Rapids Dam up to 7Q10 flows to remain within standards, Grant PUD could investigate use of flow deflectors at Priest Rapids Dam, as necessary to meet the TDG standards.

Advanced Turbines at Priest Rapids Dam

Since the turbines at Priest Rapids Dam are in relatively good working order, installation of new turbines is proposed as part of a longer term replacement schedule. Similar to the situation at Wanapum Dam, new turbines at Priest Rapids Dam would also increase hydraulic capacity, which will eliminate many periods of forced spill and the resulting elevated TDG levels. For example, a hydraulic capacity increase to 184 kcfs would cut the amount of spill to reach 7Q10 flows by approximately 24 kcfs.

Agencies' Recommendations to Improve TDG

In its May 26, 2005, preliminary prescriptions for downstream fishways at Wanapum and Priest Rapids Dams, NOAA Fisheries states that Grant PUD must construct a surface bypass facility in future unit 11 at Wanapum Dam which is capable of spilling a maximum volume of 20,000 cfs. Until the new surface bypass facility is operational, Grant PUD must continue to maintain a spring and summer spill program at Wanapum Dam for 95 percent of the run during the spring and summer fish passage seasons. The spill targets must be 43 percent of the river flow in the spring and 49 percent in the summer. At Priest Rapids Dam, Grant PUD must continue to explore a juvenile bypass design. Until a new surface bypass facility is operational, Grant PUD must continue to maintain a spring and summer spill program at Priest Rapids Dam for 95 percent of the run during the spring and summer fish passage seasons. The spill targets must be 61 percent of the river flow in the spring and 39 percent in the summer. Any new bypass facility at Wanapum Dam must not violate the project's Section 401 certification. The facility's discharge at Priest Rapids must not create a plunging flow that would lead to TDG levels that violate the project's Section 401 certification.

Our Analysis

Grant PUD is currently in the process of replacing the turbines at the Wanapum development with 10 new, fish friendly turbines. On July 23, 2004, the Commission issued an order[23] approving operation and testing of the previously authorized new advanced turbine in Unit No. 8. Replacement of the 9 remaining units was approved provided that the operating criteria and biological testing results indicate at least equal or better survival for migrating smolts over the existing turbines, and after Commission approval of the study results. Commission staff reviewed this proposal in its environmental assessment dated July 2004,[24] and concluded that replacing these generating units would have the potential benefits to water quality by increasing the hydraulic capacity of the powerhouse, thereby reducing uncontrolled spillage, and in turn TDG levels downstream of the dam.

In June 2004 WDOE and EPA developed a TMDL report for TDG in the mainstem Columbia River from the Canadian border to the Snake River confluence, near Pasco, Washington (EPA and WDOE 2004). Washington State issued the TMDL for state waters below Grand Coulee Dam, including Wanapum and Priest Rapids Dams, which was approved by EPA in July 2004.

A TMDL is a planning tool, not a rule of law or other stand-alone enforceable document, and can be used to condition 401 water quality certificates. The goal of the TMDL is to achieve all of the TDG criteria established within the state's water quality standards. Implementation of the TMDL is expected to be developed as each PUD project applies for new licenses from the Commission and Section 401 water quality certificates from WDOE. Any allocation or exemption for fish passage may be used only after approval of a gas abatement plan. WDOE will consider the measures of Grant PUD's TDG Abatement Plan when it issues the 401 certificate for relicensing of the Project.

The RPA Actions of the BO filed May 6, 2004, require that Grant PUD implement project measures while maintaining water quality standards within TDG limits. Staff concludes that the measures proposed by Grant PUD, along with the requirements of the BO, and those that may be required based on the TDML report, assure that the project would meet the state's TDG standards.

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[23] 108 FERC ¶ 62,075.

[24] Attached to 108 FERC ¶ 62,075.

Project Effects on Temperature

Several different comparisons of empirical data show that the average downstream increase of water temperature through the project area is 0.2°C (Juul 2003). A similar analysis using the Rock Island Dam scrollcase and USGS daily average temperature data collected below Priest Rapids Dam showed an overall increase of 0.1°C for the period 1975-1992. In addition, the 1997-2001 fixed monitoring station data showed that the overall temperature changes between forebay and tailrace monitoring stations were all < 0.1°C. In comparison, WDOE defines a "measurable" increase in water temperature as 0.3 °C or greater [WAC 173-201A-320(3)(a)].

While the data above may imply that the project causes a small but unmeasurable increase in Columbia River water temperatures, staff believes this is not a correct interpretation because these data are not controlled for natural warming effects that occur in large rivers. To more accurately demonstrate the effect of Wanapum and Priest Rapids reservoirs on water temperature, Grant PUD funded model simulations using a one-dimensional unsteady flow and water quality model, Modular Aquatic Simulation System 1D (MASS1) for the reach of the Columbia River extending from the Canadian Border to McNary Dam (Perkins et al. 2002; Technical Appendix E-3.C). The calibrated model simulated three hypothetical scenarios: current conditions; project reach with reservoir effects removed; and removal of the effects of all seven mid-Columbia reservoirs.

The period from 1973 to 2000 was simulated and the resulting daily mean and maximum water temperatures were compared statistically. With all seven Mid-Columbia reservoirs removed, water temperatures warmed up faster than under current conditions during the early summer, reached peak values at the beginning of August, and then decreased faster than under current conditions for the remainder of the year. The scenario with only the effects of project reservoirs removed was nearly identical to the current condition scenario. The results of this analysis show that the shift in seasonal water temperatures is caused by the impoundment behind Grand Coulee Dam. Given the uncertainties of the simulation model, inflow temperatures, and meteorological data, the results showed little or no effect of project reservoirs on Columbia River temperatures.

Perkins et al. (2002) used seven-day moving averages to estimate temperature changes within the Priest Rapids Project area under each scenario. The exercise revealed that during the period from March through August, the current conditions and seven-day moving average reservoir effects removed scenarios had average temperature increases of about 0.3°C. This compares with the water quality standard allowing cumulative increase from all nonpoint source activities up to 2.8°C. The model simulations estimated that the overall effect of the Priest Rapids Project reservoirs on water temperature is near zero. Both of these values are well within the mean absolute error of

the models, which is 0.3° to 0.9°C. This shows that the overall effect of Priest Rapids Project reservoirs on water temperature was negligible.

The effects of the Priest Rapids Project on exceedences of the current water temperature standards were also negligible when either the mean or maximum temperatures were modeled. With the seven reservoir effects removed, the frequency that the daily maximum temperature exceeded the standard at Priest Rapids Dam was 10 percent of the time, with an average increase of 0.8°C above the standard. The same analysis shows that maximum temperatures with the effects of the project reservoirs removed is essentially unchanged, with temperatures exceeding the standard about 11 percent of the modeled time period and with an average increase of 0.9°C above the standard. Similarly, the average daily maximum simulated temperatures are actually slightly higher with the reservoir effects removed (Table 15). The differences are slight, but the smaller water volumes of the project area with no impoundment effects would result in smaller water volumes that would be more responsive to the thermal inputs of high ambient air temperatures during late summer.

Table 15. Comparison of simulated average daily maximum temperature by month under current conditions and with project reservoirs removed. (Source: Perkins et al. 2002)

	Average Daily Maximum Temperature				
	Jul	Aug	Sep	Oct	Nov
Rock Island Dam					
Current Conditions	17.3	19.3	18.8	15.8	11.3
Project Reservoir Effects Removed	17.3	19.3	18.8	15.8	11.3
Wanapum Dam					
Current Conditions	17.6	19.4	18.7	15.5	11.0
Project Reservoir Effects Removed	17.6	19.5	18.8	15.7	11.1
Priest Rapids Dam					
Current Conditions	17.8	19.5	18.6	15.3	10.7
Project Reservoir Effects Removed	17.9	19.7	18.9	15.5	10.9
Below Priest Rapids Dam					
Current Conditions	17.8	19.5	18.6	15.3	10.7
Project Reservoir Effects Removed	17.9	19.7	18.9	15.6	10.9

Grant PUD also completed an analysis of water temperatures in the Priest Rapids and Wanapum fishways from early August 2002 through early December 2002 (Brush and Juul 2003; Technical Appendix E-3.D). Three temperature monitors were installed in both fishways at each facility – one at the top, a second near the middle of the passage, and a third at the bottom. The analysis included a comparison of temperatures at these three locations in each ladder to the forebay fixed monitoring stations of Priest Rapids and Wanapum.

The temperature information from each location, along with the data recorded by water quality monitors in each forebay was evaluated along different routes. First, the data from within each passage were examined for longitudinal and temporal trends. Second, the combined averages from the two fish ways at each dam were compared to determine if there were cross-channel differences. Finally, the daily averages from each passage were compared to the information recorded by the nearest forebay fixed-monitoring site.

Water temperatures within the Wanapum and Priest Rapids ladders averaged less than 0.1 ^{o}C different than the fixed monitoring stations, which was less than the stated precision of the temperature meters used (Brush and Juul 2003). The primary trend observed in these data was the tendency to have greater temperature variability during later summer with the differences converging in the fall.

Mean temperature differences for the complete data sets recorded within the two Priest Rapids Dam fish ladders and the left one at Wanapum Dam were ± 0.1 °C. Some of the measurements from the right fish passage at Wanapum Dam appeared questionable, but estimated daily differences ranging from -0.1 °C to 0.2 °C were consistent with the other three fish ladders and still within the instrument accuracy of ± 0.2 °C. Temperature differences between the right and left ladders, as well as between the forebay water quality monitors and each fishway averaged ± 0.1°C. The primary trend observed in these data was the tendency to have greater temperature variability during later summer with the differences converging in the fall (Figure 6).

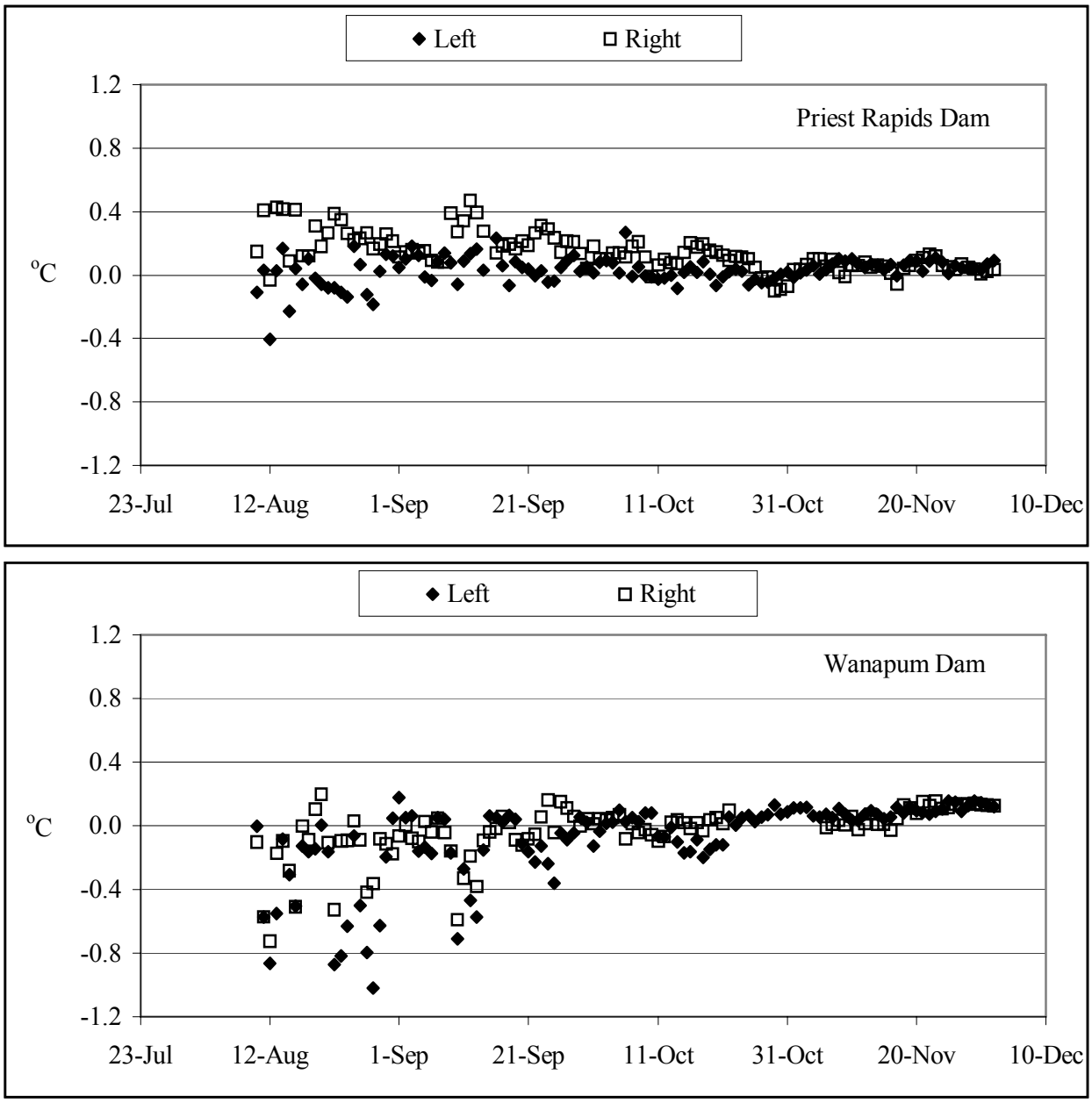

Figure 6. Daily average temperature differences for Priest Rapids and Wanapum fishways when compared to forebay fixed monitoring stations.

Grant PUD's Proposal to Improve Water Temperature

Priest Rapids Fishway

Grant PUD is proposing to modify the water supply for the Priest Rapids fishways, which currently receive a portion of their supply water from the reservoir by means of a

gravity intake gate. The modification would involve installation of low head pumps in the tailrace to supply part of the fish attraction water requirements at the fishway entrance from the cooler (by approximately 0.3°C in late summer) tailwaters. This would improve ladder conditions, which are known to have elevated water temperatures.

Water Temperature Monitoring Plan

Grant PUD is proposing a water temperature monitoring plan at its four fixed sites (a fifth site is jointly shared with Chelan PUD in the Rock Island Tailrace) to evaluate temperature in the portions of the Columbia River affected by the project. Grant PUD may also conduct additional monitoring necessary for specific construction projects. Grant PUD will report the results of these monitoring efforts to WDOE and to the PRCC on an ongoing basis.

Agencies' Recommendations to Improve Water Temperature

In its letter filed May 26, 2005, WDFW recommends that Grant PUD fund annual redd counts and carcass surveys for steelhead in the following streams, tributaries to the Columbia River within the Wanapum and Priest Rapids reservoirs: Colockum Creek, Tarpiscan Creek, N. Fk. Tarpiscan Creek, S. Fk. Tarpiscan, Trinidad Creek, Quilomene Creek, Brushy Creek (tributary to Quilomene Creek), and Skookumchuck Creek. WDFW recommends that Grant PUD fund the monitoring of water temperature and stream discharge for these survey streams throughout the year.

In its letter filed May 27, 2005, CRITFC recommends (recommendation no. 17) that Grant PUD complete all modeling and implement all project modifications needed to ensure that Washington state water quality standards will be met throughout the license period while achieving quantitative and qualitative standards and goals for salmon, steelhead, Pacific lamprey and white sturgeon. CRITFC's recommendation includes a provision that Grant PUD proceeds with the installation of TDG structures, and investigates methods and means to reduce water temperatures in the Hanford Reach.

In its letter filed May 26, 2005, FWS recommends that Grant PUD develop and implement a plan to monitor and evaluate the effects of project operations on primary and secondary productivity and resident fishes in the Hanford Reach. The plan should include measuring and quantifying Reach-wide water temperatures in entrapments from the start of emergence for fall Chinook salmon (about March 1) through October 31.

Our Analysis

Implementation of spill regimes and the operation and maintenance of the Priest

Rapids and Wanapum reservoirs has historically increased overall temperatures in the reservoirs, but the project has little impact on water temperatures in the downstream Hanford Reach (see section 3.4.1).

WDOE and the Environmental Protection Agency (EPA) are working cooperatively to craft a TMDL for temperature in the Columbia River from the British Columbia border downstream to its mouth. Once the TMDL is finished, WDOE may require Grant PUD to devise a strategy for reducing the temperature increases at Priest Rapids and Wanapum dams to meet the requirements of the TMDL. This strategy, or temperature management plan, would also need to include a compliance schedule and a plan for follow-up monitoring. The temperature-monitoring program proposed in the WQMP should serve this purpose, but the details of the program would need to be consistent with the TMDL.

Staff disagrees with WDFW's recommendation that Grant PUD monitor water temperature and discharge for the streams where they are recommending that Grant PUD fund annual steelhead redd counts and carcass surveys (see WDFW's May 26, 2005, recommendation above). Staff believes there is no clear nexus between the project and WDFW's recommendation. Grant PUD should not be required to evaluate water quality parameters for streams that are affected by a wide variety of environmental factors beyond the PUD's influence or control.

Staff is unaware of any measures at the project that would result in reductions in downstream water temperatures. CRITFC suggested that selected cool water releases from Lake Roosevelt may decrease downstream water temperature, but staff is unaware of any information that shows that this measure has significant merit. The water behind Grand Coulee does not stratify; therefore, there is no available source of upstream cool water. Although the Columbia River is not currently listed as impaired by temperature within the project area, staff is aware that WDOE and EPA intend to develop a temperature TMDL for segments of the Columbia River Basin located above and below the project in the near future. Grant PUD intends to continue participation in the development of temperature TMDL to assure that major hydroelectric dams are part of the "natural condition" baseline. Additionally, temperature monitoring associated with the operation of the Priest Rapids Project will meet the quality assurance and control guidelines established by WDOE. Grant PUD will also be coordinated with the PRCC to identify, implement and evaluate measures to contribute to the continued attainment of temperature standards at the project.

Staff concludes that the project does not affect the average water temperatures downstream of the Priest Rapids Project. Model simulations conducted by Grant PUD estimated that the overall effect of the project reservoirs on downstream water

temperature is near zero (Perkins et al. 2002). The modeling conducted by Grant PUD on the effects of all seven mid-Columbia dams showed that the shift in seasonal water temperatures is caused by the impoundment behind Grand Coulee Dam, and that the Mid-Columbia dams have little or no effect on Columbia River temperatures.

Project Effects on Other Water Quality Parameters

The Priest Rapids Project has minimal impact on most of the remaining water quality parameters. Downstream changes in physiochemical and biological factors are expected according to the river continuum concept. The concentrations of TSS and nutrients were found to be reasonably uniform throughout this reach of the Columbia River. There were some increases in conductivity, TDS, and alkalinity that were probably influenced more by irrigation return flow than reservoir effects. The increased residence time of the reservoirs facilitates algal development – particularly in the forebays or near the shore. The extent varies from year-to-year depending on river discharge, weather conditions, and the structure of the fish community. In turn, enhanced algal productivity can lead to elevated pH. One of the concerns associated with higher pH values is related to fish and ammonia toxicity. As temperature and pH increase, the ammonium ion shifts to ammonia that can be detrimental to fish. However, the majority of the 1994-2001 NH_3-N data reported by WDOE for the Vernita Bridge site were about 0.01 mg/L. As such, the potential for ammonia toxicity within the project area is very low.

WDOE provided detailed requests and comments on the draft license application concerning various measures to address project effects on water quality. Grant PUD responded to those comments in the final license application, which included a Water Quality Management Plan as an Exhibit of the application. In their comments on the draft license application, WDOE requested a Water Quality Management Plan (WQMP) be prepared to serve as a basis for the 401 water quality certification required for a new license. An eight-part WQMP was submitted with the final license application which covers the following subjects:

1. TDG abatement;
2. temperature;
3. monitoring for other parameters;
4. habitat protection flows;
5. aquatic plant monitoring;
6. zebra mussel monitoring;
7. construction, maintenance and emergency conditions; and
8. fixed site quality assurance project plan.

The following summarizes each of the above listed components of Grant PUD's Water Quality Management Plan.

1. Proposed TDG Abatement Measures

Based upon the results of ongoing monitoring and evaluations, Grant PUD plans to continue its reservoir management and maintenance operations. The use of spill patterns to minimize ambient TDG levels at the project, when feasible, would be subject to hydraulic conditions, total river flow, construction activity, maintenance requirements or other emergency conditions. Grant PUD intends to coordinate the spill program for the project with the spill activities of other projects through the MCCC or its successor (anticipated to be the Priest Rapids Coordinating Committee (PRCC)).

2. Proposed Temperature Measures

Grant PUD is proposing a water temperature monitoring plan at its four fixed sites (a fifth site is jointly shared with Chelan PUD in the Rock Island Tailrace) to evaluate temperature in the portions of the Columbia River affected by the project. Grant PUD may also conduct additional monitoring necessary for specific construction projects. Grant PUD will report the results of these monitoring efforts to WDOE and to the PRCC on an ongoing basis.

3. Proposed Monitoring for Other Parameters

Within the project area, fecal coliform, DO, pH, and turbidity all meet water quality standards developed by WDOE. With respect to fecal coliform specifically, all sanitary sewerage systems at the dams use contained septic systems with off-site disposal and do not contribute to loading of fecal coliform in the area affected by the project. Grant PUD intends to continue this measure.

Grant PUD also proposes to continue to monitor DO, turbidity and pH through use of HydroLab multi-probes installed at the four fixed site monitoring stations and Rock Island Tailrace during non fish-spill season (September 15 through April 1). Each of these parameters would be measured hourly with the results posted to Grant PUD's website.

4. Proposed Habitat Protection Flows

Grant PUD and upstream operators have been managing flow regimes downstream of the Priest Rapids Project pursuant to the Vernita Bar Agreement (VBA) since 1988 to protect fall Chinook salmon redds and pre-emergent fry. Upon reaching agreement with

the upstream operators, Grant PUD proposes to continue to operate according to the terms of the VBA. The purpose of this program is to manage flows to encourage fall Chinook spawning at elevations that can be protected by minimum flows ranging from 50 to 70 kcfs during the spawning to emergence periods (typically October to May). In addition, as part of the same agreement with the upstream operators, Grant PUD is proposing to expand VBA coverage to include rearing period operations. From 1999 to present, Grant PUD and upstream operators have been re-shaping flow fluctuations to protect rearing fall Chinook fry from being stranded due to water level fluctuations after their emergence. If successful in gaining upstream operator support, Grant PUD would continue to implement re-shaping operations to manage flow fluctuations.

Grant PUD proposes to maintain a minimum release of 36,000 cfs or inflow, whichever is less, from Priest Rapids Dam, as measured at USGS Gage No. 12472800. This minimum flow would be maintained during all time periods except when Vernita Bar minimum flow requirements are in effect and require a higher minimum flow.

5. Proposed Aquatic Plant Monitoring

The overall biomass of aquatic macrophytes is not at nuisance levels within the Priest Rapids Project area (Normandeau et al. 2000). However, Grant PUD proposes to develop a plan for managing nuisance aquatic plants at key recreation sites within the project area. This plan, to be developed within one year of license issuance, will include the use of biological, mechanical, and/or chemical control (depending on regulatory issues, such as ability to obtain necessary permits) at heavily-used boat launches and swimming areas where aquatic plants interfere with boating and swimming. This plan will also include information and signage intended to educate boaters and local residents about strategies to avoid spreading nuisance aquatic macrophytes to other waters.

Grant PUD also proposes to assess aquatic macrophyte density at eight transects within the Priest Rapids Project every 4 years. Transects sampled in 1999 by Normandeau et al. (2000) as part of the evaluation of water quality and limnology for the Priest Rapids Project area will be re-sampled every 4 years. A total of 24 Peterson dredge samples will be taken at each transect.

Oven dry weight (biomass), ash-free oven-dry weight (organic content), and species composition by percentage weight for each sample will be computed. Other information collected will be near-bottom water velocity and substrate particle size. Additional samples will also be collected between the eight transects and used to provide further information on the coverage of macrophyte distribution and density in the Priest Rapids Project area to ensure coverage of the patchy distribution of aquatic macrophytes along the shorelines.

Photographic coverage of littoral areas will be obtained with a low-elevation over-flight during the peak aquatic macrophyte growth period (typically August) and will coincide with field sample collection. Full coverage of each side of the reservoirs will be obtained. This information will be used to extrapolate composition and density data to the project area. Information will to be incorporated into GIS maps of macrophyte coverage through the reservoirs.

6. Proposed Zebra Mussel Monitoring

Over the last three years Grant PUD has worked cooperatively with Washington Department of Fish and Wildlife (WDFW) to monitor for zebra mussels (veliger monitoring) within the Priest Rapids Project area. To date, all plankton samples collected from the Priest Rapids Project Area have been negative. Grant PUD is committed to continue working cooperatively with the WDFW on this effort.

7. Proposed Construction, Maintenance, and Emergency Plans

Grant PUD has developed plans for consultation with, and notification of, resource agencies and tribes, as well as for standardized protection and monitoring actions associated with construction, maintenance, or emergency activities. The purpose of this plan element is to reduce or eliminate the impact of project-related maintenance, construction, and emergency activities on water quality parameters in order to ensure that the project continues to meet applicable water quality standards.

Grant PUD proposes the following measures to address potential short-term water quality impacts associated with construction activities at the project, emergency situations and routine maintenance activities:

- Before undertaking any new construction that might reasonably and significantly impair water quality (other than routine maintenance and operations or other new construction contemplated in this Application), Grant PUD will notify WDOE and develop, at WDOE's request and subject to its approval, specific protection monitoring and measures as may be warranted by such action.

- Properly dispose of construction debris in a manner such that materials and debris cannot enter into the Columbia River or impact the water quality of the Columbia River.

- Maintain and implement current Spill Prevention, Containment and Countermeasure (SPCC) plans for oil, hazardous materials, and non-hazardous

materials prepared in accordance with the CWA requirements of 40 CFR 112. These plans shall address all locations at the project facilities where project operations may potentially result in a spill of these materials to the Columbia River. In the event of a spill or release or threatened spill or release to project reservoirs, Grant PUD shall immediately implement the site's SPCC plan and notify the WDOE Emergency Response system.

- Allow WDOE such access as necessary to monitor the project area and project records required by the 401 Certification at reasonable times as necessary to monitor compliance with these conditions.

8. Proposed Fixed Site Quality Assurance Project Plan (QAPP)

Grant PUD currently operates and maintains four fixed site water quality stations that continuously monitor TDG, temperature (°C), DO (mg/l), pH (units), and turbidity (NTU's). These stations are located midway across the river channel in the forebay and tailrace of each dam. Grant PUD also maintains a fixed site monitoring station located near the tailrace of Rock Island Dam from approximately September 1 through April 1 (during non spill periods) each year. The Public Utility District No.1 of Chelan County operates and monitors this site through during spring and summer spill seasons as part of their water quality data collection requirements.

Each station is equipped with a water quality monitor with multi-parameter probe (probe) enclosed in a submerged conduit or standpipe. The depth of each probe varies with site and river conditions, but generally ranges between 3-5 meters deep. The standpipes were modified in the spring of 2003 by increasing the length of them at each of the 4 sites. This was to allow the probes to be below the compensation depth, as well as to function in the event of a low water year.

Except for the Rock Island fixed site, which has a different data communication and data transmission system, these probes are connected to an automated system that allows Grant PUD to monitor water quality data on an hourly basis. Data is collected and recorded every hour seven days a week and is transmitted each hour via radio/antenna links to a PC at each dam. From the PC, the data is transferred to a database where daily reports can be generated and distributed. From these daily water quality reports, decisions are made regarding spill for fish passage and water quality issues.

Probe maintenance and calibration follow protocols and guidelines established by equipment suppliers, the USGS, and COE. Calibration is conducted in a controlled laboratory environment using certified equipment and recommended calibration standards. Detailed maintenance and calibration procedures are presented in Duvall et al.

(2003; Technical Appendix E-3.F). Grant PUD proposes to develop additional details following issuance of the 401 Certification by WDOE.

Our Analysis

Grant PUD's proposed WQMP addresses monitoring of water quality parameters; habitat protection flows; aquatic plant monitoring; zebra mussel monitoring; construction, maintenance and emergency conditions; and a fixed site quality assurance project plan. The WQMP was proposed at the request of WDOE and is intended to serve as the basis for the 401 certification. Grant PUD has completed all modeling studies and all project modifications to ensure that the project meets Washington state water quality standards. Staff concludes that the WQMP would ensure that the project continue to meet the state water quality standards and provide an adequate means for addressing project-related water quality issues throughout the next licensing period.

Project Effects on Water Quantity

Water quantity can be affected when water is consumed or when a non-consumptive use takes water out of the river channel over some distance, reducing flows in a bypassed reach. The project does not take water away from the river channel for power generation; therefore, there is no bypassed reach. The existing and proposed amount of water consumed by Grant PUD for project purposes is minimal.

Grant PUD's Proposals to Improve Water Quantity

Grant PUD proposes to continue operating the project under the Hourly Coordination Agreement to optimize the management of flows and power generation through the seven dams from Grand Coulee to Priest Rapids. Grant PUD would also continue to abide by the Vernita Bar Agreement, or the Hanford Reach Agreement, which the parties propose to replace the Vernita Bar Agreement in a new license. The Hanford Reach Agreement allows use of active storage from the project reservoir to assist Grant PUD in meeting the discharge requirements for the Project. The Hourly Coordination Agreement allows the Project to meet a high proportion of the peaking load of Grant PUD's power purchasers when the Priest Rapids and Wanapum developments are constrained by the Hanford Reach Agreement's fish stranding provisions.

Agencies' Recommendations to Improve Water Quantity

In its letter filed May 26, 2005, FWS recommends that Grant PUD control the flow releases from the Priest Rapids Dam from RM 397 to RM 340 from March 1 through June 15 of each year to limit the magnitude of daily flow fluctuation (max Q –

min Q) measured at Priest Rapids Dam and coordinated at USGS Gage No. 12472800. This recommendation is designed to minimize the entrapment and stranding of juvenile fall Chinook salmon below Priest Rapids Dam, to no more than 10 kcfs around the estimated weekly average outflow target. Grant PUD is to use the physical capabilities of only Priest Rapids and Wanapum developments to dampen flow fluctuations downstream into the Hanford Reach. The responsibility for meeting this recommendation is not be transferred to any federal hydroelectric facility through manipulation of the MCCC or other legal avenue.

In its letter filed May 31, 2005, CRITFC recommends (recommendation no. 7) that Grant PUD control the flow releases from the Priest Rapids Dam from March 1 through June 15 of each year to limit the magnitude of daily flow fluctuation below Priest Rapids Dam to no more than 10 kcfs around the estimated weekly average outflow target (similar to FWS recommendation above). CRITFC recommends that Grant PUD utilize the storage capacity of the Project, and coordinate with Douglas and Chelan PUDs as necessary to accomplish this protective flow criteria.

On May 6, 2004, NOAA Fisheries filed its biological opinion (BO) for Grant PUD's proposal to amend its license in order to implement an Interim Protection Plan (IPP), defining a set of short-term actions that would begin to immediately improve the survival of listed for Upper Columbia River steelhead and Upper Columbia River spring-run Chinook salmon. On December 16, 2004, the Commission issued an Order Amending License and Terminating Proceedings for the project which required Grant PUD to implement the Reasonable and Prudent Alternative (RPA) (Actions 1 through 25) contained in the BO, along with the summer spill provisions of the Memorandum of Agreement, filed on September 13, 2000. The BO recommends other measures that influence how the project is operated, and includes an RPA action item for Grant PUD to establish a Priest Rapids Coordination Committee (PRCC) composed of NOAA Fisheries, FWS, WDFW, the Confederated Tribes of the Colville Reservation, the Yakima Nation, the Confederated Tribes of the Umatilla Reservation, and Grant PUD (Action 39). The PRCC would oversee the implementation of anadromous fish activities, water quality parameters associated with the fisheries activities, and the requirements of the BO.

The May 6, 2004, BO applies to the current license and to any annual license issued after the current license expires through December 31, 2013. The issuance of a new license would result in a new BO for the project.

NOAA Fisheries worked closely during the pre-filing period with Grant PUD, other state and federal resource agencies, and Tribes in developing the water quality measures needed to protect, mitigate and enhance the anadromous fisheries in the project

area. The results of these efforts are contained in the Water Quality Management Plan, filed in the final license application. NOAA Fisheries agrees with Grant PUD's proposed water quality measures at the project.

The COE requested that conditions equivalent to those in the current License relating to flood control be included in the new license (see section 3.4.1, *Existing and Proposed Use of Project Waters*, Flood Control).

WDFW recommends that the Commission include NOAA Fisheries's BO RPA's in the new license. The RPA water quantity and quality actions are discussed above in the section describing NOAA Fisheries's recommendations.

Our Analysis

The current Hanford Reach flows result from a system that is operated to balance power generation, flood control, fisheries, and other beneficial uses. The current operation of the Priest Rapids Project is largely driven by upstream releases from the federal Grand Coulee Project. As such, the Priest Rapids Project buffers and moderates the flows that would otherwise affect downstream reaches.

The only way to implement FWS's recommended flow conditions would be for Grant PUD to use the active storage available in the project reservoirs. FWS's changes in flow levels may result in a periodic failure of the reservoirs to refill, with associated power and natural resource impacts.

The FWS report cited as a basis for their flow recommendations (Anglin et al. 2005) is only a Draft report. Once the FWS completes the development of spawning habitat models for each of the significant spawning areas in the Hanford Reach, FWS should be providing the Commission with additional information and analysis regarding target flows and the benefits for spawning fall Chinook salmon.

Several agreements, treaties, and natural resource requirements govern how the project is operated and what flows pass below the project. These include the Columbia River Treaty, Columbia Storage Power Exchange, Canadian Entitlement Allocation Agreements and Extension Agreements, Non-treaty Storage Agreement, Pacific Northwest Coordination Agreement, Power Purchases Agreement, Hourly Coordination Agreement, and the Vernita Bar Agreement.

In addition to the agreements and regulatory requirements discussed above, Grant PUD designed and implements a variety of other adjustments to their operations to protect and enhance water quality and fisheries resources at the project. Primary among

these is the Hanford Reach Juvenile Fall Chinook Protection Program. The program is designed to address resource agencies' concerns about stranding of juvenile fall Chinook salmon in the Hanford Reach during the spring rearing period, identified in 1997 from on-going fisheries studies. Starting in 1999, the mid-Columbia licensees (Grant, Chelan, and Douglas PUDs) provided an experimental re-shaping program to limit flow fluctuations in the Hanford Reach, which has continued to evolve.

Operations to minimize juvenile fish stranding have been accomplished primarily through the use of available active storage at Priest Rapids and Wanapum reservoirs, which results in a reduction of peak generating capacity at these two developments. Peak generation requirements are then shifted to upstream projects under Hourly Coordination operations. The limited storage ability of the project often results in the inability to operate within the Hanford Reach Juvenile Fall Chinook Protection Program fluctuation limits. Without the use of coordinated operations from upstream projects under the Hourly Coordination Agreement, this program would not be possible because the reduced peak generation and increased off-peak generation at the Priest Rapids Project can't be brought into balance without upstream coordination. Implementation of the Hanford Reach Juvenile Fall Chinook Protection Program is a seven dam operation that even then can't always be successfully implemented.

Due to the nature of the mid-Columbia system, Grant PUD and the16 other regional utilities' needs are integrated into the operation of the entire mid-Columbia River. The flow releases from the upstream federal Grand Coulee Project affect the flow regime at each of the downstream dams, and ultimately the Hanford Reach. Staff concludes that it is not Grant PUD's sole responsibility to dampen the flow fluctuations downstream into the Hanford Reach. This would disrupt the existing, highly coordinated operation of the mid-Columbia projects.

3.4.3 Cumulative Effects

The project's cumulative effects on water quality are dependent on the water quality of the inflows. Specific actions taken by Grant PUD will produce varying results, depending on the future condition of inflows.

TDG and temperature have exceeded the numeric criteria at varying times as Columbia River water entered the project from Rock Island Dam. However, modeling of water temperature for the mid-Columbia River shows that the strongest effect on temperature is the effect of the large volume of water impounded by Grand Coulee Dam. The net effect of Lake Roosevelt on water temperature is much greater than that of all downstream projects. Thus, the amount of solar radiation necessary to heat Grand Coulee Reservoir appears to result in delayed springtime warming of Columbia River

water downstream. By fall, the effect reverses itself, with river temperatures cooling more slowly than they would without the effects of Grand Coulee storage (Perkins et al. 2002). Similar effects are also observed at other large upstream storage projects in the U.S. and Canada.

WDOE is developing a TMDL temperature plan for the Columbia River Basin for water body segments above the project that may affect the condition of inflows to the Wanapum Reservoir. This TMDL is intended to identify, evaluate and implement plans to improve the condition of the water for temperature entering the project so that it will attain appropriate targets identified in the TMDL.

TDG is also the subject of various regional efforts throughout the Columbia River Basin. The Transboundary Gas Group has developed a framework to facilitate and coordinate cooperative efforts to address TDG throughout the Columbia River Basin, including Canada. NOAA Fisheries also coordinates water quality monitoring issues (Water Quality Team) and spill implementation and timing (Technical Management Team), primarily at federal projects.

3.4.4 Unavoidable Adverse Impacts

None

3.5 AQUATIC RESOURCES

The EIS scoping process identified the following issues related to project effects on aquatic resources: (1) effects on the upstream movement of migratory fish species (adult salmon steelhead, lamprey, bull trout, sturgeon and American shad); (2) effects on the downstream movements of migratory fish species (juvenile salmon and juvenile and adult steelhead, lamprey, and bull trout); (3) effects on adult and juvenile salmon and steelhead in the Hanford reach; (4) effects on white sturgeon in the project reservoirs and the Hanford Reach; and (5) effects on lamprey rearing within the project reservoirs; (6) effects on resident fish species; (7) effects of project-related hatchery programs on fish populations, including abundance and stock integrity; (8) effects on fish populations and fish habitat in tributaries to the project area; (9) effects of project-related predator control efforts on salmon, steelhead, and other fish species. In this section, we describe the affected environment with respect to aquatic resources and the environmental effects, including cumulative effects, of the project as related to these issues.

3.5.1 Affected Environment

The fish community of the Priest Rapids Project area is composed of more than 40 species, including individuals from 14 of the 24 recognized families of North American freshwater fishes. Among these species are both anadromous and resident fishes. Families represented include the jawless fishes of Petromyzontidae (lampreys), the cartilaginous Acipenseridae (sturgeons and paddlefishes), and the class Osteichthyes, otherwise known as the bony fishes, Clupeidae (herrings), the widely distributed family Salmonidae (salmon and trout), and rare samples of the family Esocidae (pikes). The most abundant groups of fishes found in the Project area are Cyprinidae (minnows) and Catostomidae (suckers). Less common are the family Ictaluridae (catfishes) and Gadidae (cods). Also represented are the families Percopsidae (trout-perches), Centrarchidae (sunfishes), Percidae (perches) and Cottidae (sculpins).

Included among the species present in the Project area are two anadromous salmonid populations listed as endangered (spring Chinook salmon and summer steelhead) and one resident salmonid (bull trout) listed as threatened under the Endangered Species Act (ESA).

Anadromous Fish

Six anadromous fish species are known to inhabit or migrate through the Priest Rapids Project area. Four of these species are anadromous salmonids including: spring, summer, and fall Chinook salmon (*Oncorhynchus tshawytscha*); summer steelhead (*O. mykiss*); coho salmon (*O. kisutch*) and sockeye salmon (*O. nerka*). Of these, only fall Chinook salmon are known to both spawn and actively rear within the Project area. Spring and summer Chinook salmon, steelhead, coho salmon and sockeye salmon migrate through the Project area as adults returning to upriver spawning areas and the smolts of these species travel through the Project area on their downstream migrations. Pacific lamprey *(Lampetra tridentata*) follow migratory patterns similar to those of the anadromous salmonids. American shad (*Alosa sapidissima*) is an introduced species (Scott and Crossman 1971) that is currently restricted to the Columbia River below Priest Rapids Dam because they do not use or are unable to negotiate the submerged orifices of the upper sections of Priest Rapids fishways. With the exception of American shad, the anadromous species listed above are endemic to the Columbia River and are considered culturally, economically, and commercially important. The following sections provide more detailed information on each species and focus on the abundance data available from Priest Rapids Dam counts since 1960.

Sockeye Salmon

Sockeye salmon upstream of the Priest Rapids Project currently inhabit Lake Wenatchee of the Wenatchee River system and Lake Osoyoos of the Okanogan River system. Adult sockeye salmon return to the mid-Columbia River during the summer, with peak adult passage at Priest Rapids Dam during mid-July. Peak spawning activity occurs in mid-September for Lake Wenatchee sockeye salmon, while peak spawning is during mid-October for Lake Osoyoos sockeye salmon. The difference in spawning time is most likely related to higher water temperatures in the Okanogan River system. Adult sockeye salmon spawn in lake tributaries and outlet streams, lake beaches, or deep-water rubble. The eggs and embryos incubate throughout the winter in the spawning gravel or in the cracks and crevices of larger substrates. The actual rate of development depends primarily on water temperature, with colder water temperatures requiring a longer incubation period prior to hatching. Typical incubation times for sockeye salmon range from 50 to more than 150 days under winter water temperatures ranging from 2 to 13 degrees Celsius (°C).

Sockeye salmon from the Wenatchee and Okanogan river basins emerge from the gravel at night during the period from late March through April. The newly emerged fry typically migrate downstream to reach the rearing environment of Lake Wenatchee or Lake Osoyoos. Juvenile sockeye salmon spend the next one or two years feeding on zooplankton. Most juveniles emigrate from Lakes Wenatchee and Osoyoos during the spring of their second year of life. These young sockeye salmon then migrate downstream through the Wenatchee and Okanogan rivers to reach the Columbia River. Juvenile sockeye salmon from Lake Osoyoos must pass Wells, Rocky Reach, and Rock Island dams and reservoirs before passing the Priest Rapids Project, whereas sockeye salmon juveniles from Lake Wenatchee only have to pass Rock Island Dam before reaching the Priest Rapids Project. The peak of the downstream migration of sockeye smolts past Wanapum and Priest Rapid dams occurs during mid-May, with a majority passing during the month of May.

The total number of sockeye salmon returning to the mid-Columbia River has varied significantly since counts began at Priest Rapids Dam (Figure 7). The average number of sockeye passing Priest Rapids Dam annually from 1960 to 2004 was 61,672. The highest number of sockeye returning to pass Priest Rapids Dam was 170,071, which occurred in 1966, while the historical low was 9,216 in 1995. These total dam counts do not distinguish between Lake Wenatchee and Lake Osoyoos stocks of sockeye, but Lake Wenatchee sockeye were identified recently as the only healthy sockeye population in the Pacific Northwest (Huntington et al. 1996).

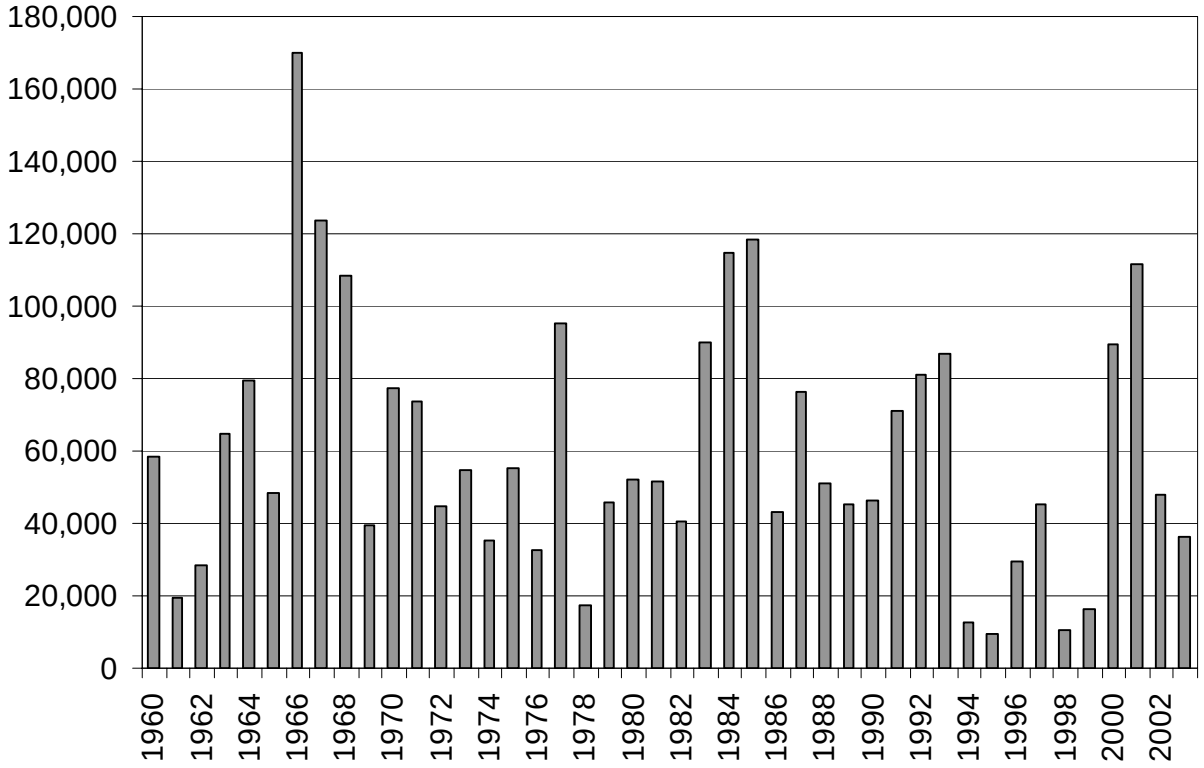

Figure 7. Annual number of sockeye counted past Priest Rapids Dam from 1960 to 2003.

Steelhead

Steelhead are the same species as rainbow trout but have different life histories. Steelhead are anadromous, while rainbow trout generally remain in freshwater throughout their lives.

Steelhead life history is similar to that of the salmon, with some differences. Steelhead adults, like salmon, return to freshwater in the late summer with most passing Priest Rapids and Wanapum dams during August and September. However, steelhead spawn in the spring rather than the fall and not all adults die after spawning. While many steelhead adults die from the upstream migration or spawning, some adult steelhead survive and after spawning return downstream to the ocean. Post-spawn adult steelheads that are returning to the ocean are called kelts.

Spawning in tributary streams takes place from March through June, but may occur as late as July. The eggs incubate within the spawning gravel for four to seven weeks following spawning, and fry emerge from the gravel about two to three weeks after hatching. For most of the mid-Columbia steelhead streams, emergence occurs

during the period from June through September. Juvenile steelhead remain in freshwater while they feed and grow to a smolt size of about 150-200 millimeters (mm) and make their spring-time outmigration to the ocean. It may take one to seven years to reach smolt size depending on growth rate and the productivity of the tributary stream, although the majority of steelhead smolts are two to three years of age. Most smolts migrate past Wanapum and Priest Rapids dams during the month of May, although considerable numbers may be migrating in late April or early June.

Adult steelhead returns have varied considerably since counts began at Priest Rapids Dam (Figure 8). The average number of steelhead passing Priest Rapids Dam from 1960 to 2004 was 11,370 fish, with the lowest return of 2,462 fish occurring in 1975 and a peak run of 34,589 fish in 1985. Prior to construction of Priest Rapids Project, steelhead passage was enumerated at the upstream Rock Island Dam. Rock Island counts from 1933 to 1959 were typically between 2,600 and 3,700 fish, with most of these being wild or naturally spawned fish. Expanded hatchery production in the 1960s increased run sizes to approximately 6,700 fish. In the 1970s dam counts dropped to average about 5,400 then increased dramatically in the 1980s, and again from 2000 through 2002.

In order to address possible spawning and rearing by steelhead in project tributaries, Grant PUD conducted an evaluation to determine whether the genetic structure of redband/rainbow trout populations in the Priest Rapids Project area is indicative of pure, native trout populations or indicative of populations that have undergone introgression with hatchery rainbow trout or steelhead. Tissue samples from *O. mykiss* electro-fished from seven different project tributaries[25] were evaluated using standard DNA analysis techniques (Dresser et al. 2003). The results of these analyses showed no genetic similarity to steelhead reference samples. These genetic data suggest that all tributary streams with the exception of Johnson Creek contain rainbow trout populations derived from known populations of hatchery rainbow trout (Dresser et al. 2003). Johnson Creek showed unique genetic characteristics not similar to known rainbow, redband or steelhead populations.

National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) classifies steelhead populations by "evolutionarily significant unit" (ESU). ESUs represent "distinct population segments of any species of vertebrate fish or wildlife which interbreeds when mature." The only ESU of steelhead that commonly occurs in the Priest Rapids Project area is the Upper Columbia River (UCR) steelhead. UCR steelhead

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[25] Johnson, Skookumchuck, Whiskey Dick, Tarpiscan, Trinidad, Quilomene and Colockum Creeks; see Figure E4-10 in volume 3 of the license application for specific location of each of these tributaries.

include fish from the mainstem Columbia River and its tributaries upstream of the confluence of the Columbia and Yakima rivers. On October 17, 1997, NOAA Fisheries listed the Upper Columbia River steelhead ESU as endangered under the Endangered Species Act (ESA).

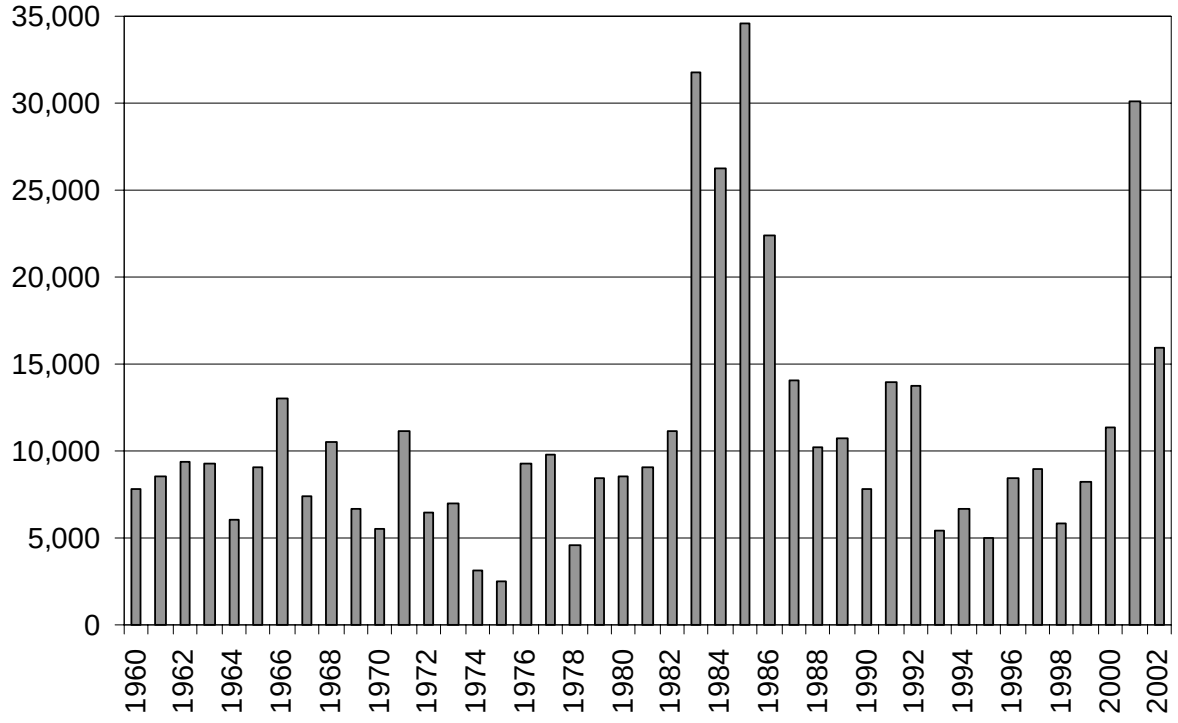

Figure 8. Annual number of steelhead counted past Priest Rapids Dam from 1960 to 2002.

Chinook Salmon

Chinook salmon exhibit more variability and variety in their life history and biology than other anadromous fishes of the mid-Columbia River. Chinook salmon in the project area are classified into three different runs based on the time of year that the adults pass Priest Rapids Dam. Adult Chinook salmon returning from April 17 through June 13 are classified as "spring Chinook salmon," adults returning from June 14 through August 13 are "summer Chinook salmon," and adults returning from August 14 through November 15 are "fall Chinook salmon."

Similar to steelhead, NOAA Fisheries has also applied ESU designations to Chinook salmon. Spring Chinook salmon found in the Priest Rapids Project area are part

of the UCR spring-run Chinook salmon ESU. Summer and fall Chinook salmon found in the project area are treated as the same ESU and are called the UCR summer/fall-run Chinook salmon ESU.

Spring Chinook salmon are referred to as "stream-type" fish because they spawn and rear in tributaries that have cooler water temperatures and lower levels of productivity than the mainstem Columbia River or its larger tributary rivers (e.g., the Wenatchee River). Spring Chinook salmon spawn the earliest of the three runs, and the eggs incubate in the gravel the longest. After emerging from spawning gravels, spring Chinook salmon juveniles typically spend one year rearing in small tributary streams before migrating downstream to larger rivers and eventually reaching the Columbia River. Yearlings, referred to as smolts, outmigrate through the mid-Columbia River in April through June, with peak numbers typically passing Wanapum and Priest Rapids dams during mid- to late-May.

The number of spring Chinook salmon returning to the mid-Columbia region has generally fluctuated between 5,000 and 15,000 since counts began at Priest Rapids Dam (Figure 9). The average annual return of spring Chinook salmon from 1960 to 2004 was 13,067 fish. The highest return occurred in 2001 when 51,133 adults passed Priest Rapids Dam, while in 1995 the adult return was only 1,130. Low returns in the early to mid-1990s resulted in NOAA Fisheries listing the UCR spring Chinook salmon ESU as endangered in March 1999.

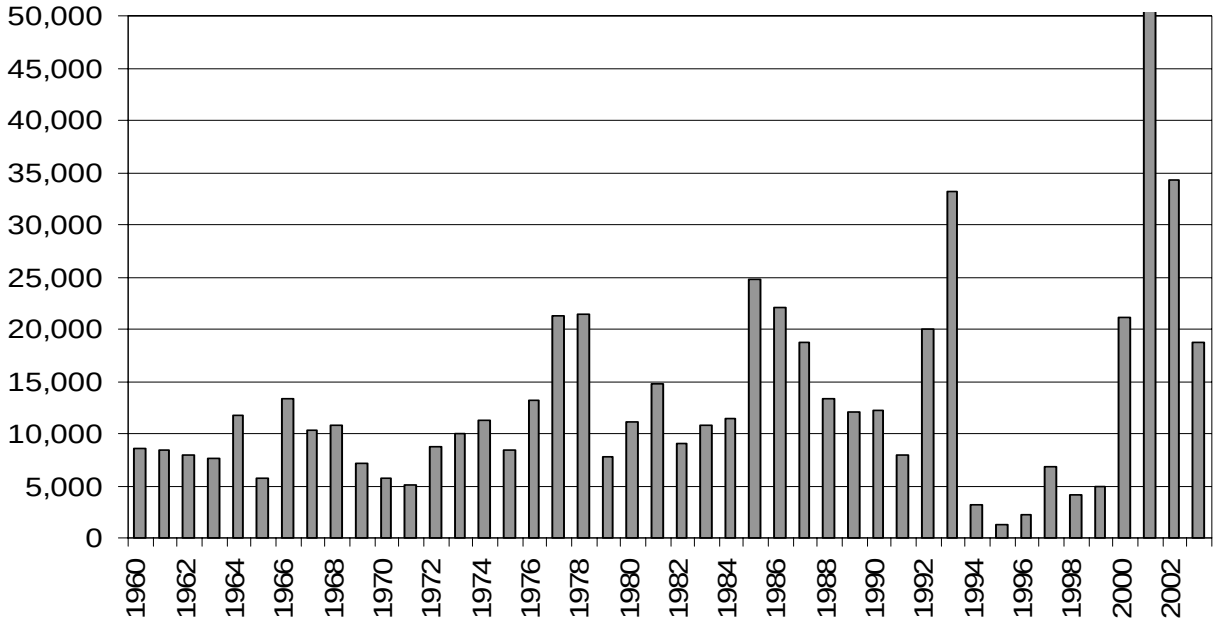

Figure 9. Annual number of spring Chinook salmon counted past Priest Rapids Dam

from 1960 to 2003.

With the exception of the past three years when returns increased dramatically, summer Chinook salmon returns have been relatively stable since counts began at Priest Rapids Dam (Figure 10). The average return from 1960 to 2004 was 23,498 fish. The lowest return was 9,564 fish in 1983 and the highest return was 97,781 fish in 2002.

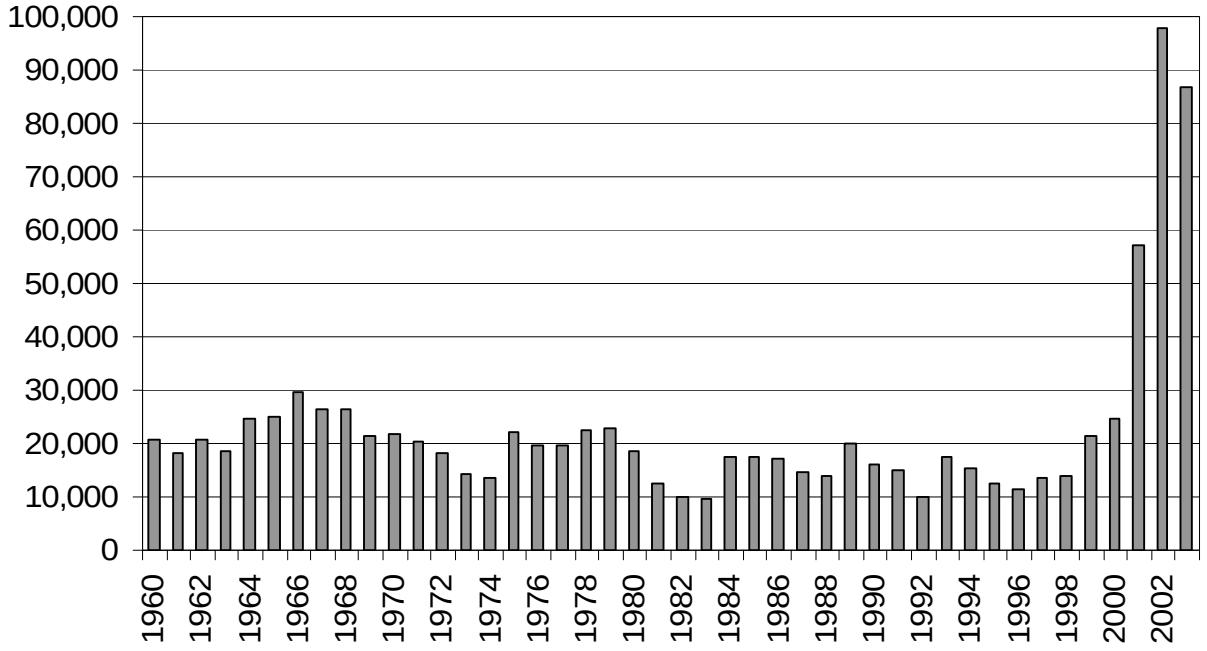

Figure 10. Annual number of summer Chinook salmon counted past Priest Rapids Dam from 1960 to 2003.

With the exception of a period of increased abundance in the late 1980s and again in recent years, the number of fall Chinook salmon returning to pass Priest Rapids Dam has been relatively stable since counts began (Figure 11). The average number of fall Chinook salmon passing Priest Rapids Dam from 1960 to 2002 was 16,623 fish. The lowest return was 5,437 fish in 1981 and the highest return was 48,546 fish in 2003.

In comparison to the fall Chinook salmon passing over Priest Rapids Dam, a much larger number of fall Chinook salmon spawn in the Hanford Reach of the Columbia River downstream of Priest Rapids Dam. The abundance of this stock has been increasing in recent years and it is considered the healthiest inland stock of Chinook salmon in the Pacific Northwest (Huntington et al. 1996). From 1964 to 1982 the average escapement of fall Chinook salmon (excluding jacks) to the Hanford Reach was 25,178, whereas from 1983 to 1996 the average escapement of fall Chinook salmon nearly doubled to 49,977. The exact reason for this increase is not known; however, it may be related to

improvements in mitigation and protection programs for this stock. One such measure is the Vernita Bar Settlement Agreement (VBA) which has been implemented from 1983 to the present. This measure increases the stability of spawning flows in the Hanford Reach and maintains a minimum flow with the intent of keeping a very high percentage of fall Chinook salmon redds inundated until after emergence. In addition to the VBA, the original Priest Rapids spawning channel was converted to a conventional hatchery that releases nearly 8 million fall Chinook salmon smolts annually. Many of these hatchery fish return and spawn in the Hanford Reach. Spawning by fall Chinook salmon in the Project area occurs primarily in the tailrace of Wanapum Dam.

The downstream migration of juvenile summer and fall Chinook salmon is different than for juvenile spring Chinook salmon. Rather than migrating to the ocean as one year old fish, juvenile summer and fall Chinook salmon migrate to the ocean during their first year of life as sub-yearlings. Because of their early migration, these fish are referred to as ocean-type salmon. During their migration, sub-yearling ocean-type Chinook salmon use the mainstem Columbia River, including both reservoirs of the Priest Rapids Project, as rearing habitat. The migration of ocean-type salmon typically begins in May and peaks during July.

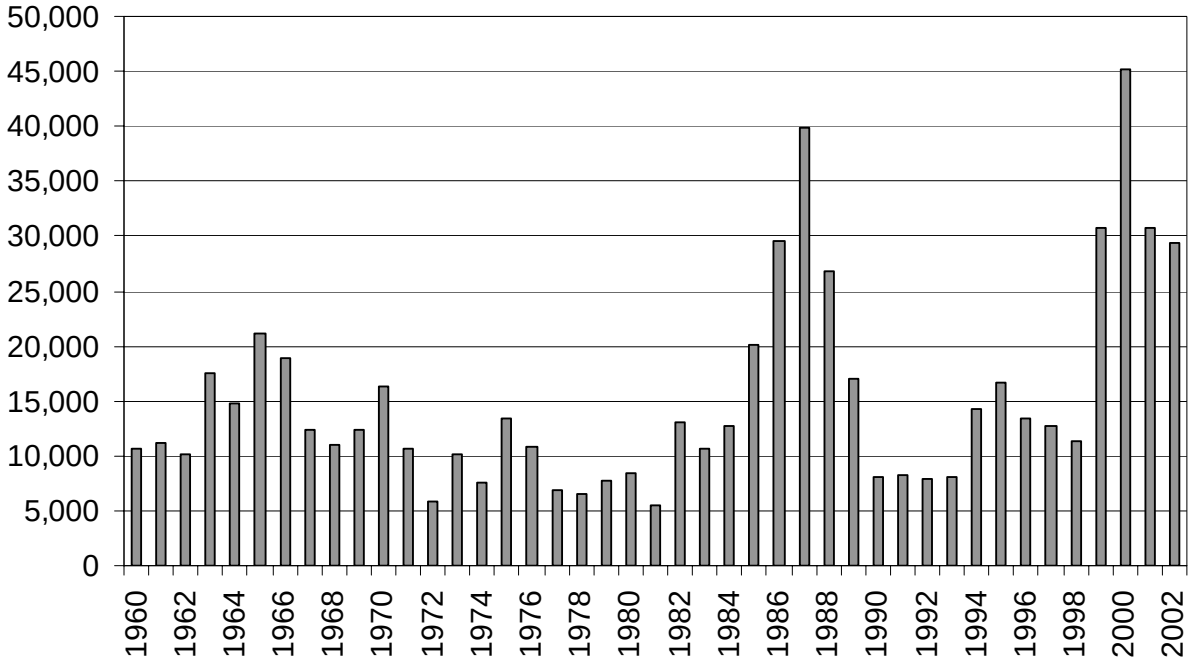

Figure 11. Annual number of fall Chinook salmon counted past Priest Rapids Dam from 1960 to 2002.

Coho Salmon

The endemic stock of coho salmon from the mid-Columbia River is considered extinct (Nehlsen et al. 1991); however, coho salmon have been reintroduced through hatchery programs. Hatchery coho returned to the mid-Columbia region in considerable numbers in the late 1960s (Figure 12) with a 1968 peak return of 13,212 fish. During the 1970s and 1980s, the hatchery run declined dramatically, and in 1993 and 1994, no coho were counted at Priest Rapids Dam. Reintroduction efforts have begun again in recent years and in 2001, over 10,000 coho were counted past Priest Rapids Dam.

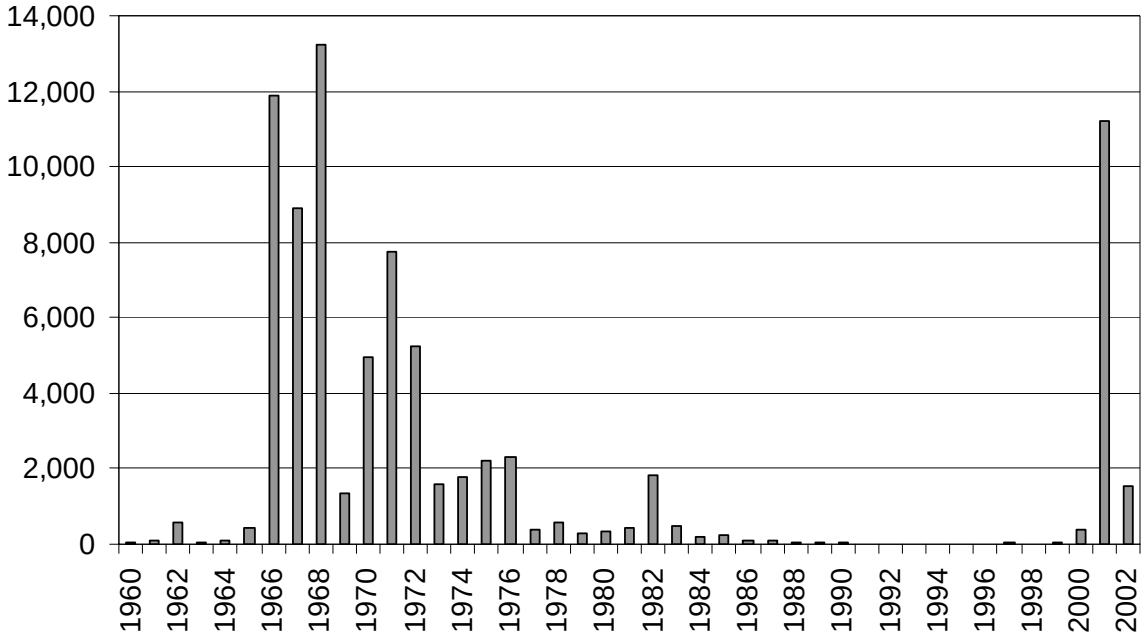

Figure 12. Annual number of coho salmon passing Priest Rapids Dam from 1960 to 2002.

Pacific Lamprey

The Pacific lamprey is a prehistoric jawless fish with a cartilaginous skeleton. Pacific lamprey are anadromous, and their distribution encompasses the areas that have upstream passage in the Columbia River Basin. Adult lamprey begin an upstream migration in late summer and then overwinter in rocky areas of the river. During June and July, the adult lamprey spawn in sandy gravel on the upstream side of riffles. The male and female both dig a shallow nest of gravel that covers the eggs after spawning. The eggs incubate for two to three weeks, and the larval lamprey then emerge from the gravel and settle into backwater areas. The young larvae spend the next four to six years feeding on detritus, diatoms, and algae that are suspended above and within the substrate.

These young lamprey, called ammocoetes, eventually migrate toward the ocean in much the same way as juvenile salmon. This ocean migration occurs in the spring and summer. Upon reaching saltwater, Pacific lamprey begin a transformation to parasitic feeding behavior. In the ocean Pacific lamprey attach to other fish and feed on the blood and body fluids. After a period of two to four years, the adult Pacific lamprey return to freshwater to spawn. Adult lamprey die within a month after spawning.

Pacific lamprey abundance in the Columbia Basin has declined over the past 40 years; however, the magnitude of this decline is difficult to determine. Historical dam counts for adult lamprey are not widely available and are affected by different counting methods and frequency of counting. Another primary reason for uncertainty regarding dam counts is the behavioral tendency for adult lamprey to avoid count boards or viewing windows during their upstream passage. Because of this all dam count data are likely to be biased low. Counts at Priest Rapids Dam have shown increases compared to more than 10 years ago. In 1993 only 322 Pacific lamprey were counted at Priest Rapids Dam but more recently passage numbers have been between 2,000 and 4,000.

The most consistent dam count data for Pacific lamprey are from Rocky Reach Dam. Counts at Rocky Reach Dam have shown a steady decline from over 17,000 fish in 1969 to counts continuously less than 500 during the 1970s, 80s and 90s. Counts at Rock Island Dam show a similar decline. A combination of factors is associated with this decline, including poor habitat conditions, fish poisoning operations, water pollution, dam passage problems, ocean conditions, and food availability (Close et al. 1995).

American Shad

American shad were introduced to the Sacramento and Columbia rivers in 1871 (Scott and Crossman 1971) and have become widely established up and down the Pacific coast. American shad ascend freshwater rivers and streams in the spring to spawn. Spawning occurs in open water at temperatures from 12 to 20°C. Spawning probably occurs in the tailraces below Columbia River dams. Each female shad produces from 20,000 to 150,000 eggs. Fertilized eggs are carried by current and settle out to hatch in eight to 12 days. Adult American shad die after spawning in some locations, but may also return to the ocean and have been known to spawn as many as five times. The young shad spend one summer in freshwater and drift downstream to reach the ocean in the fall when they are two to three inches in length. American shad are plankton feeders, and adults grow to a size of 20 inches or more and weigh in excess of six pounds.

The total number of American shad returning to Priest Rapids Dam increased dramatically in the 1970s and 1980s (Figure 13). The peak returns of American shad reached 121,806 in 1992, although returns over recent years have dropped to fewer than 10,000. The possible effects that introduced American shad have on native fishes are

unknown, and it is generally believed that range expansions of non-native fishes should be limited if possible. American shad do not pass upstream of Priest Rapids Dam as the submerged orifices of the fishway prevent them from reaching the upstream reservoir.

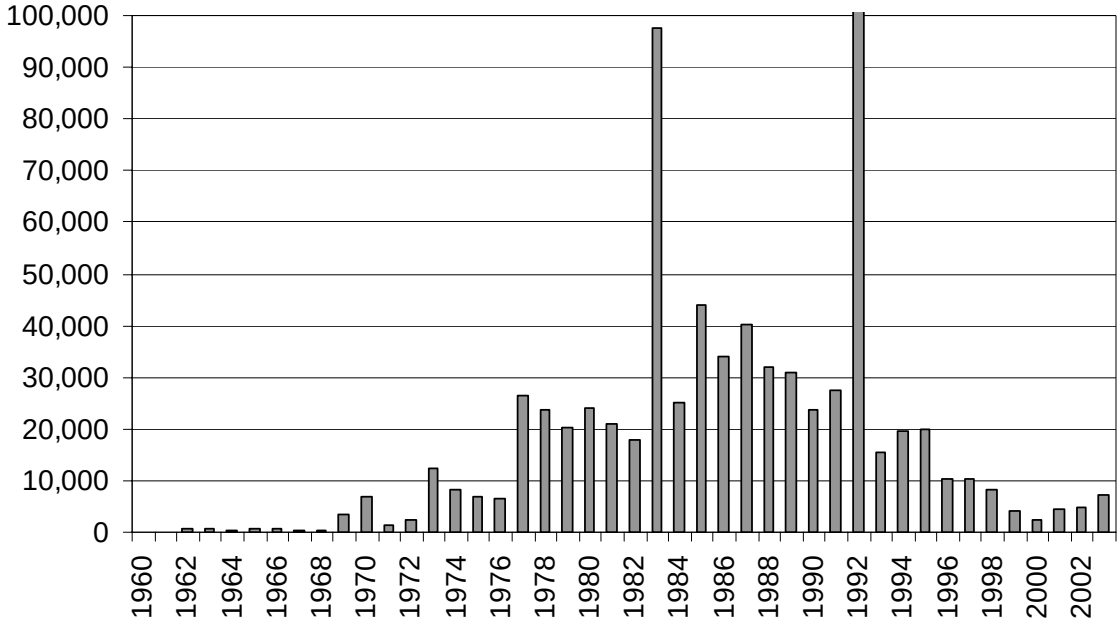

Figure 13. Annual number of American shad passing Priest Rapids Dam from 1960 to 2003.

Summary of Anadromous Fish Resources for the Project Area

Adult anadromous salmonids migrate through the Project area from April through November (Table 16), although steelhead may overwinter in the Project area and there can be some movement during winter and early spring. Juvenile salmon and steelhead move downstream through the project area during spring and summer months, with most migrating downstream during the April through June time period (Table 16). The migration of fall and summer Chinook salmon is typically later in the summer during the June through August time period. Over 80% of all smolts pass Rock Island Project (RIS) from April 15 to June 15 with over 95% of all smolts monitored passing by August 1 (Figure 14). The upstream and downstream migrations of Pacific lamprey are generally similar to that of anadromous salmonids.

The most abundant anadromous fish in the Project area is sockeye salmon with average annual returns of over 60,000 since counts began at Priest Rapids Dam. Average returns of steelhead, spring, summer and fall Chinook to the Project area are somewhat similar, with abundance for these runs in the range of 10,000 to 20,000 fish per year

(Table 16). Average abundance of Pacific lamprey is difficult to determine, but appears to be generally lower than the other species of anadromous fish returning to the mid-Columbia River.

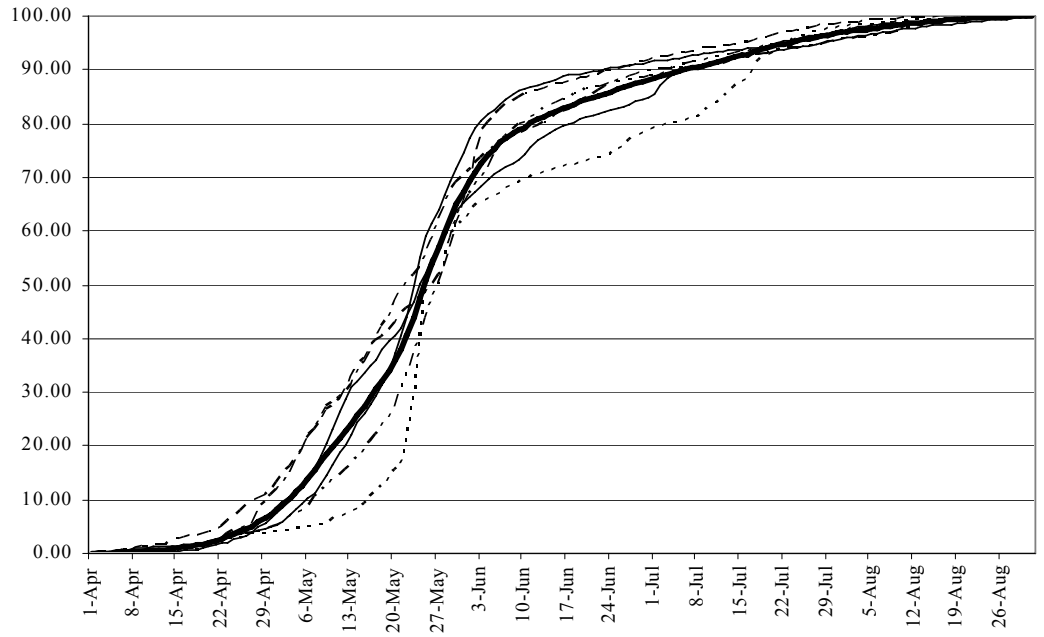

Figure 14. Cumulative frequency distribution of the mid-Columbia River composite smolt outmigration measured at Rock Island Dam (solid black line represents average of index counts from 1997 to 2002).

Table 16. Summary showing average abundance and migration timing for anadromous fishes in the Priest Rapids Project area.

Species/Run	Avg. Return 1960-2002	Upstream Migration Timing	Downstream Migration Timing
Sockeye salmon	60,785	mid-May to mid-August	April through June
Steelhead	11,053	July through November	April through June
Spring Chinook salmon	12,923	mid-April to mid-June	April through June
Summer Chinook salmon	21,010	mid-June to mid-August	June through August
Fall Chinook salmon	15,255	mid-August through November	June through August

Species/Run	Avg. Return 1960-2002	Upstream Migration Timing	Downstream Migration Timing
Coho salmon	1,878	September through November	April through June
Pacific Lamprey	1,195[1]	May through October	April through August
American Shad	17,704	June through August	No Juveniles above PRD

[1] This is a 1993-2002 average of the dam counts at Priest Rapids. It is very likely that this is an underestimate because many lamprey pass the count station undetected.

Resident Fish

Resident fish species include a diverse mix of species that are native to the Columbia River and a variety of non-native fish that were introduced to the Columbia River. Resident fishes are important to the ecology and food web of the Columbia River and some species may serve as indicator species that help to describe the basic condition of the river ecosystem. Piscivorous resident fish, such as northern pikeminnow, walleye, and smallmouth bass, are important because they are known to prey on anadromous salmonid smolts. Resident game fish, such as walleye and smallmouth bass, supports recreational sport fisheries.

A total of 38 resident fish species are known to occur in the Priest Rapids Project area. Grant PUD obtained resident fish presence data (Table 17) through an intensive multi-gear sampling effort conducted in 1999 (Pfeifer et al. 2001). The species in Table 17 can be divided into four groups: native game fish, native non-game fish, introduced (non-native) game fish, and introduced non-game fish. There are six species of native game fish, 14 species of native non-game fish, 11 species of introduced game fish, and two species of introduced non-game fish inhabiting the project area. The six species of native game fish include: rainbow, cutthroat and bull trout, lake and mountain whitefish, and turbot. Of these species, rainbow trout and mountain whitefish are common throughout the project area, while the other species are either uncommon or rare.

Table 17. Resident fishes sampled in the Priest Rapids Project area during multiple gear surveys. Source: Pfeifer et al. 2001.

Common Name	Scientific Name	Species category and general
White Sturgeon	*Acipenser transmontanus*	native game fish, common
Bull Trout	*Salvelinus confluentus*	native game fish, ESA threatened,
Rainbow Trout	*Oncorhynchus mykiss*	native game fish, common
Cutthroat Trout	*Oncorhynchus clarki*	native game fish, uncommon
Brown Trout	*Salmo trutta*	introduced game fish, uncommon
Mountain Whitefish	*Prosopium williamsoni*	native game fish, common
Lake Whitefish	*Coregonus clupeaformis*	native game fish, rare
Northern	*Ptychocheilus*	native non-game fish, abundant
Peamouth	*Mylocheilus caurinus*	native non-game fish, abundant
Chiselmouth	*Acrocheilus alutaceus*	native non-game fish, abundant
Redside Shiner	*Richardsonius balteatus*	native non-game fish, abundant
Longnose Dace	*Rhinichthys cataractae*	native non-game fish, common
Speckled Dace	*Rhinichthys osculus*	native non-game fish, common
Leopard Dace	*Rhinichthys falcatus*	native non-game fish, rare
Carp	*Cyprinus carpio*	introduced non-game fish, common
Tench	*Tinca tinca*	introduced non-game fish,
Bridgelip Sucker	*Catostomus columbianus*	native non-game fish, abundant
Largescale Sucker	*Catostomus*	native non-game fish, abundant
Longnose Sucker	*Catostomus catostomus*	native non-game fish, common
Channel Catfish	*Ictalurus punctatus*	introduced game fish, common
Black Bullhead	*Amiurus melas*	introduced game fish, uncommon
Burbot	*Lota lota*	native game fish, rare
Three-Spined	*Gasterosteus aculeatus*	native non-game fish, abundant
Sandroller	*Percopsis transmontana*	native non-game fish, rare
Largemouth Bass	*Micropterus salmoides*	introduced game fish, common
Smallmouth Bass	*Micropterus dolomieu*	introduced game fish, common
Black Crappie	*Pomoxis nigromaculatus*	introduced game fish, common
White Crappie	*Pomoxis annularis*	introduced game fish, common
Bluegill	*Lepomis macrochirus*	introduced game fish, uncommon
Pumpkinseed	*Lepomis gibbosus*	introduced game fish, uncommon
Torrent Sculpin	*Cottus rhotheus*	native non-game fish, common

Common Name	Scientific Name	Species category and general
Prickly Sculpin	*Cottus asper*	native non-game fish, common
Walleye	*Stizostedion vitreum*	introduced game fish, common
Yellow Perch	*Perca flavescens*	introduced game fish, common

The 14 native non-game species include seven cyprinid species, with the northern pikeminnow, peamouth, chiselmouth, and redside shiner being abundant throughout the project area. Also included in this group are three sucker species, with largescale and bridgelip sucker being abundant in the project area. Other native non-game species include several sculpin species and the three-spined stickleback.

The 11 introduced game species contain representatives from four families. Brown trout and brook trout are relatively rare, whereas the two catfish species, six sunfish species, and two percid species are more common in the project area. Of these species, the smallmouth bass and walleye are the most common.

Pfeifer et al. (2001) describes reservoir habitat use by resident fish species. Habitat within the Wanapum and Priest Rapids reservoirs appears to be different that some other Columbia River reservoir systems. Most species sampled were associated with finer substrates and shallower depths; however, some of the more abundant fish species in the Priest Rapids Project area are habitat generalists that can successfully complete their life cycles under either riverine or lacustrine conditions.

Bull Trout

Specific information regarding bull trout populations in the mid-Columbia River region is limited and the species is not abundant within the Priest Rapids Project area. In a letter dated January 18, 2000, the FWS indicates that there are 16 subpopulations of bull trout inhabiting the mid-Columbia River region, primarily occurring in the Yakima, Wenatchee, Entiat, and Methow river basins. Historically, bull trout occurred in larger areas of these four river basins and the Columbia River; however, the FWS believes that bull trout have been extirpated from nine streams within the mid-Columbia area.[26]

[26]In a letter filed with the Commission on January 18, 2000, the FWS reported that bull trout have been extirpated from Satus Creek, Nile Creek, Orr Creek, Little Wenatchee River, Napecqua River, Okanogan River, Eightmile Creek, South Fork Beaver Creek, and the Hanford reach of the Columbia River.

Bull trout exhibit several life-history forms including migratory and resident forms; however, even resident bull trout are known to make seasonal movements to overwintering areas (Jakober, 1995 as cited in the FWS letter filed January 18, 2000). Migratory corridors link seasonal habitats for all bull trout life-history forms and the ability to migrate appears to be a significant factor affecting the persistence of local bull trout subpopulations (Rieman and McIntyre, 1993).

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Migratory bull trout frequently begin spawning migrations as early as April, and have been known to move upstream as far as 155 miles (250 kilometers) to spawning grounds (Fraley and Shepard, 1989).

In 1999, Grant PUD completed an intensive survey of the Priest Rapids Project area using multiple gear types. During this survey, only two bull trout were sampled. Both were caught during boat electrofishing; on November 4, 1999, a 280-mm bull trout was captured in Priest Rapids Reservoir about two miles above the dam, and on November 6, 1999, a 230-mm bull trout was captured in Wanapum Reservoir at RM 430 (Pfeifer et al. 2001).

On June 10, 1998, the U.S. Fish and Wildlife Service (FWS) listed the Columbia River population segment of bull trout as a threatened species under the Endangered Species Act.

To describe the migration patterns and movements of bull trout past mid-Columbia hydroelectric projects, Chelan, Douglas and Grant PUDs co-funded a telemetry evaluation of movement and distribution of bull trout in the mid-Columbia River (BioAnalysts 2003). All bull trout tagged for this study were trapped at Rock Island, Rocky Reach and Wells dams. The occurrence of bull trout at the Priest Rapids Project was too low to allow for any tagging at this site. During the study no tagged bull trout passed through Wanapum or Priest Rapids dams; however, several fish entered the upstream end of the Wanapum reservoir (i.e., the Rock Island tailrace).

White Sturgeon

White sturgeon inhabit most of the Columbia River and its larger tributaries, most notably the Snake River. White sturgeon can exhibit an anadromous life history, although due to isolation of dams and other factors many populations have adapted to an entirely freshwater life history. This is most likely the case for white sturgeon in the Priest Rapids Project area.

The white sturgeon is the largest North American sturgeon species and may be the world's largest species of freshwater fish. White sturgeon can reach lengths greater than 10 feet (ft), and there is a record of a white sturgeon weighing 1,387 pounds.

White sturgeon are spring spawners. Spawning in the project area occurs during the month of July in the tailraces of Wanapum and Rock Island dams. The Hanford Reach downstream of Priest Rapids Dam also contains important white sturgeon spawning habitat. The eggs are brown and sticky and adhere to the bottom. Adults survive spawning and may spawn many times during their lives, which can last over 100 years. White sturgeon probably feed primarily on the bottom, although white sturgeon are often seen breaching the water's surface and are likely capable of a variety of feeding behaviors.

Grant PUD initiated a three-year study of white sturgeon in 2000. The results of this study show that sizable populations of white sturgeon reside in the Project area. A total of 115 white sturgeon were captured during set-line sampling, with 94 sampled in Wanapum Reservoir and 21 captured in Priest Rapids Reservoir (Porto et al. 2003). All of the 21 sturgeon sampled from Priest Rapids Reservoir were sub-adult or adult, with no juveniles (fish <100 cm) observed in samples. Catches were greater in Wanapum Reservoir, and 22 juvenile white sturgeon were sampled. These fish were as small as 20 inches length and two pounds in weight. The sex ratio for Priest Rapids sturgeon was skewed towards females, while the sex ratio for Wanapum was nearly 1:1. White sturgeon from 16 to 42 years of age were sampled from Priest Rapids Reservoir, with sturgeon from 4 to 37 years of age from Wanapum Reservoir.

Results of the study suggested that white sturgeon tend to occupy deep mid-reservoir areas and make periodic feeding or spawning movements to shallower and faster habitats. During the study, fish in Priest Rapids Reservoir tended to use the Wanapum tailrace area year-round while Wanapum Reservoir sturgeon tended to spend more time in deeper areas further away from Rock Island Dam with late-spring movements upstream to spawning areas. Key overwintering areas were identified in both reservoirs at some of the deepest locations within the reservoirs.

The population of white sturgeon in Wanapum Reservoir was estimated at 817 fish with a 95% confidence interval from 398 to 1,711. To few fish were recaptured at Priest Rapids Reservoir to allow calculation of a population estimate.

Spawning was documented at both the Wanapum and Rock Island tailraces through egg and larval collections in each year of this study. Multiple spawning events were documented in 2000 and 2002, with a lower level of spawning observed during the drought year of 2001. Spawning took place in late June through July at water

temperatures ranging from 15-18°C. In 2002, sub-samples of the eggs collected were placed in incubation capsules to evaluate whether the eggs were fertilized. Successful hatching to the larval lifestage was observed at both spawning areas. These data show that reproduction is occurring in both reservoirs although the lack of juvenile fish in Priest Rapids Reservoir suggests recruitment may be poor at this site.

3.5.2 Environmental Effects and Recommendations

Salmon and Steelhead – Passage Standards

As part of their license application, Grant PUD proposes to provide 91 percent combined adult and juvenile passage survival through the project area, including 95 percent dam passage survival for juvenile fish moving downstream past the project. If the proposed downstream bypasses for Priest Rapids dam or Wanapum dam fail to achieve 95 percent dam passage survival, Grant PUD would consult with the joint fisheries parties to improve survival through additional operational or structural modifications. Grant PUD proposes to compensate for unavoidable losses with hatchery supplementation (7 percent) and habitat mitigation (2 percent) which are evaluated below.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD achieve 98 percent adult upstream passage survival per development for salmon and steelhead by no later than 2013. If this level of passage survival is not achieved by 2013, Grant PUD must consult with NOAA Fisheries and other agencies and tribes and investigate alternatives for achieving the adult passage standard for anadromous fish at the Priest Rapids Project. NOAA Fisheries also prescribes that for each development, Grant PUD must achieve 93 percent juvenile downstream passage survival over 95 percent of the run by no later than 2013. If this level of passage survival is not achieved by 2013, Grant PUD must consult with NOAA Fisheries and other agencies and tribes and investigate alternatives for achieving passage of juvenile anadromous fish at the Priest Rapids Project.

Under section 18 of the FPA, Interior prescribes that Grant PUD make progress towards achieving at least 91 percent combined adult and juvenile salmonid survival at each project dam by 2010. Interior indicates that 91 percent survival standard applies to each dam and includes achieving 95 percent dam passage survival and 93 percent combined dam and reservoir passage survival. Interior indicates that Grant PUD should have measures in place to achieve these performance standards by 2010 and shall have measured survival for UCR spring-run Chinook salmon and UCR steelhead by 2013.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD be required to comply with the reasonable and prudent measures contained in NOAA Fisheries' May 3, 2004, Biological Opinion (BO) for UCR spring-run Chinook salmon and UCR steelhead. Because the reasonable and prudent measures contained in the BO are the same as NOAA Fisheries recommendations described above, WDFW is essentially recommending the same measures recommended by NOAA Fisheries and described above.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD be required to develop and implement a plan to meet a passage standard whereby direct and indirect juvenile salmon mortality through the reservoir, dam, and tailrace would not exceed 8.5 percent by 2013. CRITFC recommends that Grant PUD achieve 80 percent fish passage efficiency by 2013 and 90 percent fish passage efficiency by 2020.[27] CRITFC recommends that Grant PUD design and implement a plan to provide 97-98 percent quantitative survival for upstream and fallback passage of adult salmon and steelhead by 2013. CRITFC recommends that Grant PUD develop a detailed fishery operations plan to meet the performance goals and objectives for salmon, lamprey, and other aquatic species.

Our Analysis

The project passage survival standards proposed by the Grant PUD, NOAA Fisheries, Interior, and WDFW for anadromous salmon and steelhead survival are essentially the same standards being implemented as part of the Habitat Conservation Plans for the upstream Rock Island, Rocky Reach, and Wells projects. These standards were developed based on the results of extinction risk modeling and are generally consistent with the performance standards included in the 2000 Federal Columbia River Power System biological opinion for the Lower Snake and Columbia River projects (NOAA Fisheries; 2000). These survival standards are a significant component of a region-wide effort to keep federally-listed fish species from becoming extinct and non-listed species from being listed.

The existing license for the Priest Rapids Project was amended to require achievement of these survival standards on December 16, 2004.[28] In comments filed on

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[27] Fish passage efficiency represents the proportion of fish passing a dam via non-turbine routes.

[28] The survival standards were included as Action 1 of the reasonable and prudent alternative for interim operation of the Priest Rapids Hydroelectric Project in NOAA Fisheries' May 3, 2004, Biological Opinion.

July 8, 2005, Grant PUD indicated that it has already begun to design and implement measures to meet the required performance standards.

The survival standards proposed by Grant PUD and the agencies include alternative means for measuring the achievement of the targeted survival levels. For instance, the 91 percent survival standard combines the adult and juvenile fish survival through the project; however, because it is not currently possible to conclusively differentiate hydro-related mortality from natural adult mortality, the survival standard would likely be measured through alternative means relative to juvenile fish passage. One approach would assume 98 percent adult survival through each development (dam and reservoir) which NOAA Fisheries (2002) reports is reasonable based on the best available data throughout the region. To achieve the 91 percent combined adult and juvenile survival standard when adult mortality is assumed to be 98 percent, the juvenile passage survival for each development would need to be at least 93 percent.[29] In comments filed on May 27, 2005, NOAA Fisheries indicates that the 93 percent juvenile survival standard would include downstream passage through the reservoir and dam over 95 percent of the migration.

Various types of tagging studies have demonstrated that measurement of the juvenile passage survival through each development may be feasible; however, if Grant PUD were unable to measure juvenile survival through each development, Grant PUD and the agencies propose that juvenile dam passage survival could be measured instead. Grant PUD and the agencies indicate that to achieve the combined adult and juvenile dam passage survival standard, juvenile dam passage survival would need to be at least 95 percent.[30] NOAA Fisheries (2002) reports that this measurement would not include indirect or delayed mortality resulting from project operations.

Achieving the combined adult and juvenile survival standard in combination with the proposed hatchery and habitat mitigation (both discussed below) would mitigate for project effects on anadromous salmon and steelhead stocks to the maximum extent practicable. NOAA Fisheries (2002) reported that implementing the survival standards at

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[29] Under this scenario adult mortality would be 2 percent and juvenile mortality would be 7 percent per development. The combined adult and juvenile mortality would be 9 percent (i.e., 2 + 7 = 9) which achieves the combined 91 percent adult and juvenile survival standard.

[30] This scenario assumes 2 percent adult mortality and 2 percent juvenile mortality per reservoir. At 95 percent survival, juvenile dam passage mortality would be 5 percent resulting in combined adult and juvenile mortality of 9 percent (i.e., 2 + 2 + 5 = 9) which achieves the combined 91 percent adult and juvenile survival standard.

all five PUD-operated dams would increase juvenile downstream passage survival by 116 and 135 percent. Implementation of the habitat improvements would further increase survival to a total of between 123 and 149 percent of the recent survival levels. These increases should result in increased adult returns of all mid-Columbia River anadromous salmon and steelhead stocks and would reduce the extinction risk to federally-listed endangered UCR spring-run Chinook salmon and UCR steelhead.

For other mid-Columbia River projects NOAA Fisheries (2002) reported that if neither form of juvenile passage survival described above can be measured accurately, juvenile dam passage survival would be estimated based on the best available data. NOAA Fisheries (2002) indicates that this process may be necessary for juvenile sockeye salmon and sub-yearling Chinook salmon since measuring dam passage survival for these species is not currently possible based on existing technology. During their outmigration, these fish are generally smaller than outmigrants of the other anadromous salmonid species and there are currently no effective methods conducting a survival study of these species. Under Section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD achieve 80 percent fish passage efficiency at each Priest Rapids Project dam for sub-yearling migrants.[31] Fish passage efficiency is the percentage of the run that passes the dam via non-turbine routes (i.e., spillways, sluiceways, and fishways).

At many hydroelectric projects, non-turbine passage routes generally provide higher survival rates than turbine passage routes. This appears to be the case for Priest Rapids dam; therefore, achieving an 80 percent fish passage efficiency would likely result in higher survival rates for these species than would occur if more fish were passing the dam via turbine routes. However, at Wanapum dam, English et al. (2001) present results suggesting that spillway passage survival may be lower than turbine passage survival. Additionally, in comments filed on May 27, 2005, NOAA Fisheries stated that at Wanapum dam spill has consistently been the most lethal route to pass fish. Therefore, increasing the use of non-turbine passage routes such as spillways to achieve 80 percent fish passage efficiency may not increase the overall passage survival of these species at Wanapum dam.

CRITFC recommends that Grant PUD be required to develop and implement a plan to meet a passage standard whereby direct and indirect juvenile salmon mortality through the reservoir, dam, and tailrace would not exceed 8.5 percent by 2013. CRITFC

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[31] In its letter filed on May 27, 2005, NOAA Fisheries uses the phrase "fish guidance efficiency" which it defines as the proportion of fish passed via non-turbine routes. This definition is the same as Grant PUD's and CRITFC's definitions for "fish passage efficiency". For consistency, we use "fish passage efficiency" throughout this document.

was unclear about whether this standard would be applied to the entire project or each development. We assume they intend for it to apply to each development, in which case it would be that same as achieving 91.5 percent juvenile passage survival at each development.

In comments filed on July 8, Grant PUD states that CRITFC's recommended standard represents an unrealistic and extreme position that attempts to impose arbitrary, impossible standards on the project. Grant PUD provides no evidence why this standard is extreme or unrealistic and does not specifically address why they believe the standard is arbitrary or impossible.

There are two apparent differences between the survival standard recommended by CRITFC and the standard proposed by Grant PUD and the agencies. The standard proposed by CRITFC would include mortality in the reservoir, dam, and tailrace whereas the standard proposed by Grant PUD would only address mortality within the reservoir and at the dam. Additionally, the survival percentage recommended by CRITFC is 1.5 percent lower than the standard proposed by Grant PUD and the agencies. CRITFC does not provide any discussion of the derivation of their recommended standard or any explanation why their standard differs from the agency standard. Including tailrace mortality would make the CRITFC standard somewhat more comprehensive; however, the CRITFC standard is more lenient in that it would allow 1.5 percent more mortality than the standard proposed by Grant PUD and agencies. It is unclear how much additional benefit, if any, there would be from adopting the survival standard proposed by CRITFC. Depending on the level of direct and indirect mortality that occurs within the tailrace, the CRITFC standard would be more or less protective than the standard proposed by Grant PUD and the agencies.

CRITFC also recommends that Grant PUD achieve 80 percent fish passage efficiency by 2013 and 90 percent fish passage efficiency by 2020. This standard would be in addition to achieving the survival standard recommended by CRITFC. As indicated above, achieving 80 percent fish passage efficiency would likely increase juvenile survival at Priest Rapids dam but it could decrease survival at Wanapum dam. Achieving 90 percent fish passage efficiency by 2020 could further increase downstream passage survival at Priest Rapids dam and further decrease survival at Wanapum dam. Regardless of the effect, it is not clear why CRITFC believes a fish passage efficiency would be necessary if the survival standards discussed above would be in place. The 91.5 percent survival standard recommended by CRITFC and the 93 percent survival standard recommended by the agencies would be indicators of the true survival of juvenile fish passing through the project area regardless of what routes they used. Once these standards would be achieved, there would be no need or benefit to measuring fish passage efficiency or to work towards further reductions in turbine passage (i.e., 90

percent by 2020). This standard would appear to only have merit if survival cannot be measured in the project area, which does not appear to be the case for most species.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD achieve 98 percent adult passage survival at each development by 2013. CRITFC recommends that Grant PUD provide 97-98 percent quantitative survival for upstream and fallback passage of adult salmon and steelhead by 2013. In response to CRITFC, Grant PUD states that the suggestion of a passage standard of 97-98 percent is inconsistent with virtually every other plan for salmon and steelhead currently being implemented. Grant PUD also states that the CRITFC recommendation is an unrealistic and extreme position that attempts to impose arbitrary, impossible standards.

Measurement of adult passage survival through each development is currently limited by the available technology. Currently, the numbers of adult fish necessary for statistically valid survival estimates can only be tracked from dam to dam and various non-project-related factors may cause fish to "disappear" between adjacent dams. These factors include, but are not limited to, spawning within the reservoir, migration into tributaries for spawning, harvest, and natural mortality. At this time, NOAA Fisheries suggests that assuming 98 percent adult survival through each development (dam and reservoir) is reasonable based on the best available data throughout the region. However, as newer technologies are developed, it may become possible to track large numbers of adult fish moving through the project area which could provide a method for accurately measuring adult survival. Providing 97 or 98 percent adult passage survival through each development would help Grant PUD achieve the combined adult and juvenile passage survival standard which would help to prevent extinction of the federally-listed endangered species and prevent listing of non-listed species.

CRITFC recommends that Grant PUD develop a detailed fishery operations plan to meet the performance goals and objectives for salmon, lamprey, and other aquatic species. CRITFC indicates that this plan would address turbine operations, fishway operations, inspections, and modifications, spill gate inspections, and bypass system operations and inspections. Development and implementation of a fishery operations plan would ensure that protocols are developed for operation and inspection of project facilities. It would also consolidate all operational protocols and inspection procedures in a single document which would simplify any necessary reviews and updating. Implementation of such a plan would ensure that project facilities are operated in a manner to minimize project effects on fisheries resources.

Salmon and Steelhead – Upstream Passage

As part of its license application, Grant PUD proposes to continue to operate and maintain two adult fishways at each dam according to Fishway Operating Plans and seek solutions and cost-effective corrective actions if monitoring and evaluation identifies adult fish passage problems. Grant PUD would operate the sluiceways at both Priest Rapids and Wanapum dams to provide fallback routes for adult salmon and steelhead and downstream passage for kelts (i.e., post-spawned steelhead adults). Grant PUD would operate and maintain adult trapping facilities at Priest Rapids dam and fund fish counting at Priest Rapids and Wanapum dams and provide daily fish counts for both facilities.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD operate and maintain upstream passage for anadromous fish species at their own expense for the full term of the license. NOAA Fisheries also indicates that modification of existing upstream fishways or design and construction of new upstream fishways requires approval from NOAA Fisheries. NOAA Fisheries prescribes that Grant PUD be required to investigate methods for improving hydraulic conditions in the project fishways. NOAA Fisheries prescribes that Grant PUD design and construct an off-ladder adult trapping facility by May 4, 2007. NOAA Fisheries prescribes that Grant PUD develop and install video monitoring capability for counting adult salmon and steelhead migrating through the right and left bank fishways at Priest Rapids and Wanapum dams. NOAA Fisheries prescribes that Grant PUD operate the sluiceways at Priest Rapids and Wanapum dams continually from April 15 to November 15 to provide a safe anadromous fish fallback route and a safe steelhead kelt passage route.

Under section 18 of the FPA, Interior prescribes that Grant PUD shall continue to construct, operate, maintain, and monitor all of the upstream passage structures, facilities, and devices contained in the existing license. Additionally, Interior prescribes that Grant PUD provide for the construction, operation, maintenance, and effectiveness monitoring of improvements to the Wanapum and Priest Rapids fish ladders. Interior prescribes that Grant PUD shall manage the project to provide effective upstream fish passage over the full range of river flows and that Grant PUD develop a fishway operation and maintenance plan.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD be required to comply with the reasonable and prudent measures contained in NOAA Fisheries' May 3, 2004, BO for UCR spring-run Chinook salmon and UCR steelhead. Because the reasonable and prudent measures contained in the BO are the same as NOAA Fisheries recommendations described above, WDFW is essentially recommending the same measures recommended by NOAA Fisheries and described above.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD develop and implement a measures-based upstream passage and fallback assessment and implementation plan. CRITFC recommends that Grant PUD provide safe, timely, and effective passage for steelhead kelts.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD investigate the impact of peaking operations on adult passage through the project dams.

Our Analysis

Priest Rapids and Wanapum dams have fishways located on both the right (east) and left (west) sides of each dam. Grant PUD has conducted a variety of studies of upstream salmon and steelhead passage through these ladders. In the license application, Grant PUD reports that the majority of Chinook salmon passage occurs over the left bank fishways at both dams. Grant PUD reports that the amount of time required for adult salmon and steelhead to pass Priest Rapids and Wanapum dams has ranged from 8 to 45 hours. Some delay in passage appears to have historically occurred between the collection channel and the entrance to the left bank fishway at the Priest Rapids dam (Stuehrenberg et al.; 1995). In comments filed on May 27, 2005, NOAA Fisheries indicates that this delay was associated with a fishway entrance water elevation differential that Grant PUD addressed by closing the collection channel orifice gates and modifying the fishway entrance gate configurations.

Grant PUD is proposing to operate and maintain the two adult fishways at each dam according to the existing Fishway Operating Plans. These plans where developed in coordination with the agencies and tribes and are being implemented under the existing license. The plans include: 1) measures to enhance entrance attraction at the fishway through planned operation of spill gates and turbines; 2) an investigation of modifications to improve the ability of the ladders to operate within the specified criteria; 3) modeling or other evaluations to determine the best action for correcting delay problems in the junction pool areas; 4) development of solutions and implementation of corrective actions in consultation with NOAA Fisheries when adult passage problems are identified; 5) operation of spillways and sluiceways to provide downstream passage routes for kelts and adult fallback; 6) evaluation of steelhead passage using radiotelemetry, and 7) development and testing of a video fish counting system at Wanapum dam. Implementation of the Fishway Operating Plans would provide a mechanism for managing and monitoring the four project fishways and would maintain or improve upstream passage for adult salmon and steelhead at the project. We discuss several of the specific measures included in the plans below.

In comments filed on May 27, 2005, NOAA Fisheries indicates that while delays to the left-bank entrance at Priest Rapids dam have been reduced, channel velocities do not meet standards used at other mainstem dams in the Columbia River basin. NOAA Fisheries recommends that Grant PUD investigate methods to improve hydraulic conditions in the Priest Rapids collection channel, junction pool, and entrance pools. Specifically, NOAA Fisheries recommends that Grant PUD maintain a water velocity of 1.5 to 4 feet per second in the powerhouse collection channel and a water surface differential of 1 to 1.5 feet among the entrance pools and the tailrace. Grant PUD is currently conducting an assessment to determine what modifications may be necessary to comply with these criteria. Improving hydraulic conditions in the Priest Rapids collection channel, junction pool, and entrance pools would improve the ability of fish to locate and enter the fishway thereby reducing the passage time at Priest Rapids dam for adult salmon and steelhead.

Fallback occurs when fish that have passed upstream of a project return downstream. This can happen when fish migrate upstream past their intended spawning destination (i.e., overshoot) or when fish become disoriented and involuntarily return downstream (i.e., entrained passage through a spillway or turbine). In the license application, Grant PUD indicates that fallback rates vary from as much as 15-20 percent for spring and fall Chinook salmon to as low as 1-5 percent for summer Chinook salmon and sockeye salmon. Fallback rates are generally lower at Wanapum dam and other dams upstream of the Priest Rapids dam. Stuehrenberg et al. (1995) attributed some of the Priest Rapids dam fallback to returning adult fish overshooting the Ringhold Hatchery.[32] Grant PUD suggested that some of the fall Chinook salmon fallback may be fish that have overshot their destination within Hanford Reach.

In addition to fallbacks, a large proportion of adult steelhead move downstream past the Priest Rapids Project after spawning. These fish are referred to as kelts. English et al. (2001) estimated that approximately 34 to 69 percent of the steelhead run survives spawning and returns downstream through the project area as kelts.

No project specific survival estimates are available for adult salmon and steelhead passing downstream at the Priest Rapids Project. In comments filed on May 27, 2005, NOAA Fisheries reports that at the Snake River projects, fallback through spillways can result in 8 percent mortality and fallback through turbines can result in 14 to 26 percent mortality of adult fish. In the license application and in comments filed on July 8, 2005, Grant PUD indicated that the majority of steelhead and a large number of other adult

[32] The Ringhold Hatchery is located in the downstream end of the Hanford Reach near the cities of Richland, Kennewick, and Pasco, Washington

salmonids use the project sluiceways for downstream passage. Grant PUD indicates that it has operated the project sluiceways for fallback and kelt passage since 1998. Additionally, Grant PUD has constructed a concrete chute at the Wanapum dam sluiceway to provide a smoother transition for downstream migrating adult fish. Currently Grant PUD operates the project sluiceways continually from April 15 to November 15 each year. This is consistent with the recommendations of the agencies and would provide a safe route for downstream passage of adult fallbacks and kelts during the time when these fish may be present in the project area.

During the adult migration season, Grant PUD reports adult passage counts through the Priest Rapids fishways. Historically, Grant PUD has not reported adult counts at Wanapum dam. Recently Grant PUD has begun testing of video count systems in the project fishways. In comments filed on July 8, 2005, Grant PUD indicates that a video count system has been installed and is operational at Priest Rapids dam. Grant PUD indicates that further testing and refinement of the system occurred during the 2005 migration season. At Wanapum dam, Grant PUD is also developing a video counting system and refinement of this system is ongoing. Grant PUD and the agencies recommend that these video counts systems be used to provide adult passage counts at both project dams. Implementation of these systems would provide more accurate and reliable information for in-season fisheries management.

Grant PUD operates and maintains PIT tag detection equipment in the left and right bank fishways at Priest Rapids dam. This equipment provides NOAA Fisheries and the other agencies with information regarding smolt-to-adult returns of UCR spring-run Chinook salmon and UCR steelhead. In comments filed on May 27, 2005, NOAA Fisheries indicates that PIT tag detection equipment at Ice Harbor dam (first mainstem dam on the Snake River), McNary dam (first dam downstream of the confluence of the Snake and Columbia Rivers), and Priest Rapids dam comprises a "triangle of detection" that allows fisheries managers to conduct long-term assessments of adult survival and track adult straying. Continued operation and maintenance of this equipment would enhance the information available in regard to adult salmon and steelhead survival and allow valuable fisheries management studies to continue.

CRITFC recommends that Grant PUD install PIT tag detection equipment at Wanapum dam. CRITFC indicates that installation of PIT tag detection facilities at Wanapum dam would reduce critical uncertainties regarding fallback rates and the ultimate fate of adults passing Wanapum dam and would allow calculation of smolt-to-adult returns from returning adults from juvenile survival studies. Grant PUD indicates that installation of PIT tag detection facilities at Wanapum dam is unnecessary. Facilities already installed at Priest Rapids dam serve to provide accurate information regarding smolt-to-adult survival which is influenced by many factors that are indistinguishable

from project effects. Installation of PIT tag detection facilities at Wanapum dam would allow tracking of individual adult fish that have passed from Priest Rapids dam to Wanapum dam. However, it would provide little additional insight regarding fallback or the ultimate fate of adults since many other factors such as natural mortality, harvest, or straying could not be accounted for by PIT tag detection alone.

CRITFC recommends that Grant PUD examine and correct fishway temperature problems within the project fishways. CRITFC provides no evidence to indicate that any water temperature problem exists within the project fishways. Normandeau (2003) monitored water temperatures within the project fishways and found no significant longitudinal temperature changes in any of the 4 ladders (i.e., less than 0.2 °C). Grant PUD is proposing to modify the water supply for the Priest Rapids fishways. The modification would involve replacing a portion of the water supply to the ladders that comes from the gravity intake gate with water that would be pumped from the tailrace. Grant PUD suggests this would provide a slightly cooler water source (approximately 0.3 °C cooler) in addition to developmental benefits.

Grant PUD operates a fish trap on the left bank fishway at Priest Rapids dam. Originally, this was a temporary facility designed to trap outmigrating smolts for transportation studies from 1984 to 1992. Subsequently the facility was used by WDFW to trap summer steelhead migrating upstream and by the Yakama Nation to collect adult coho salmon for the reintroduction program. NOAA Fisheries indicates that the temporary facility is obsolete and lacks acceptable fish handling facilities for continued collection of adult fish. They indicate that the existing trap should be replaced with an off-ladder adult trapping facility. In comments filed on July 8, 2005, Grant PUD indicates that it is in the process of designing an off-ladder trap, in consultation with the agencies and tribes, for the left-bank fishway at Priest Rapids dam. Construction of an off-ladder trap would provide regional fishery decision-makers with an important management tool for upper Columbia River fisheries research, passage studies, and other management activities.

CRITFC recommends that Grant PUD develop and implement a measures-based upstream passage and fallback assessment and implementation plan for the project. They indicate that in addition to the measures discussed above, the plan should include: 1) an assessment of new fishway designs to decrease energy expenditure; 2) evaluation of extending the fishway exits into the project forebays to reduce fallback; 3) creation of additional attraction flows at ladder entrances to reduce adult tailrace delay; 4) evaluation of the effects of the surface bypass superstructure at the Wanapum sluiceway on fallback adults and kelts; 5) evaluation of extended spill periods for providing fallback and kelt passage; 6) investigation of the impacts of power peaking on adult passage; 7) implementation of measures that would allow independent operation of the left and right

bank fishway water supply systems; and 8) estimation of adult salmon energy expenditure during upstream passage through the fishway.

In general, these studies and evaluations would increase the available information regarding upstream fish passage at the project and could result in some improvements that would increase the efficiency of the upstream passage facilities. However, CRITFC does not provide any evidence that the requested information is needed or how it would be used. Additionally, some of these measures appear to be unnecessary since other measures are already being implemented to address suspected project effects. Examples include extended operation of project sluiceways for adult fallback and kelt passage instead of extended spill and exploration of measures to improve hydraulic conditions at the fishway entrances which would reduce adult delays. Implementation of the studies recommended by CRITFC would result in collection of substantial amounts of new specific information; however, there is little evidence to indicate that this information is necessary to improve upstream passage conditions or to address project effects on upstream passage.

CRITFC recommends that Grant PUD study the effects of peaking operations on adult fish passage through the project dams. CRITFC suggests that increased powerhouse discharge increases adult passage delay and may increase adult mortality during upstream passage. Increases in project discharge could influence the ability of adult salmon or steelhead to locate fishway entrances by creating confusing flow conditions that conceal fishway attraction flows. However, Grant PUD has studied adult passage at both dams and found that the most significant delay problems occurred between the collection channel and the fishway entrance. This delay appeared to be associated with the fishway entrance water elevation differential, which Grant PUD has addressed through modifications. The monitoring results collected by Grant PUD do not suggest that there is any significant delay of adult fish related to fluctuating flows. As part of the Fishway Operating Plans mentioned above, Grant PUD is proposing to implement measures to enhance entrance attraction through planned operation of spill gates and turbines and to investigate modifications that would improve the ability of the ladders to operate within the specified criteria. While there is no evidence of an effects, both of these actions should minimize any potential effects from short-term changes in hydrologic conditions resulting from peaking operations. Additionally, Grant PUD proposes to continue monitoring adult upstream passage and implement corrective actions if problems are identified. We would expect that any significant delay problems associated with adult passage would be identified through this monitoring.

Salmon and Steelhead – Downstream Passage

As part of their license application, Grant PUD proposes to modify spillbay 22 of Priest Rapids dam to create a downstream fish bypass consisting of two smaller, full-depth spillways. If the initial modifications to spillbay 22 are successful in improving downstream passage survival, construct new training walls and apron slabs in the tailrace downstream of spillbays 21 and 22 to improve tailrace egress conditions for smolts using the bypass. After consultation with the Priest Rapids Coordinating Committee, Grant PUD would provide spill for downstream passage at Priest Rapids dam until the proposed downstream bypass is operational. Grant PUD also proposes to use spill to provide downstream fish passage if the survival objectives can not be met by the proposed downstream bypass. To improve turbine passage survival at Priest Rapids dam, Grant PUD would develop and implement operating criteria to avoid settings that have been shown to result in poor survival and, in the future, install new Advanced Design Turbines. To prevent smolts from entering the emergency wheelgate or bulkhead slots in Priest Rapids dam, Grant PUD would install gatewell exclusion screens. Grant PUD proposes to construct a downstream fish bypass at Wanapum dam consisting of an ogee-crested weir through the center of future unit 11 and a submerged tailrace chute. After consultation with the Priest Rapids Coordinating Committee, Grant PUD would provide spill for downstream passage at Wanapum dam until the proposed downstream bypass is operational. To improve turbine passage survival at Wanapum dam, Grant PUD would develop and implement operating criteria to avoid settings that have been shown to result in poor survival and install new Advanced Design Turbines. To prevent smolts from entering the emergency wheelgate or bulkhead slots in Wanapum dam, Grant PUD would install gatewell exclusion screens.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD construct and operate a surface bypass facility in future unit 11 of Wanapum dam by April 15, 2007. NOAA Fisheries prescribes that Grant PUD must continue to explore a juvenile bypass design for Priest Rapids dam and NOAA Fisheries indicates it does not currently support Grant PUD's proposal to modify spill bay 22. NOAA Fisheries prescribes that Grant PUD adhere to the decision process described on page E4-132 of Grant PUD's license application for the Wanapum dam bypass facility and any bypass system that may ultimately be approved for Priest Rapids dam. Until the Wanapum downstream bypass is operational, NOAA Fisheries prescribes that at Wanapum dam Grant PUD must spill 43 percent of the river flow for 95 percent of the spring outmigration and 49 percent of the river flow for 95 percent of the summer outmigration. Until a downstream bypass is approved and operational at Priest Rapids dam, NOAA Fisheries prescribes that at Priest Rapids dam Grant PUD must spill 61 percent of the river flow for 95 percent of the spring outmigration and 39 percent of the river flow for 95 percent of the summer outmigration. NOAA Fisheries also prescribes that Grant PUD

investigate the gate seals at the Wanapum spillway as a source of mortality. NOAA Fisheries prescribes that Grant PUD operate the turbines at both dams to maximize survival during the spring and summer outmigrations.

Under section 18 of the FPA, Interior prescribes that Grant PUD shall continue to construct, operate, maintain, and monitor all of the downstream passage structures, facilities, and devices contained in the existing license. Interior prescribes that Grant PUD shall manage the project to provide effective downstream fish passage over the full range of river flows. Additionally, Interior prescribes that Grant PUD provide for the construction, operation, maintenance, and effectiveness monitoring of the future unit 11 bypass system at Wanapum dam, the proposed new spillbay 22 juvenile bypass at Priest Rapids dam (subject to approval by NOAA Fisheries and FWS), the unit 8 fish-friendly turbine at Wanapum dam, and the potential 9 additional fish-friendly turbine units at Wanapum dam.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD be required to comply with the reasonable and prudent measures contained in NOAA Fisheries' May 3, 2004, BO for UCR spring-run Chinook salmon and UCR steelhead. Because the reasonable and prudent measures contained in the BO are the same as NOAA Fisheries recommendations described above, WDFW is essentially recommending the same measures recommended by NOAA Fisheries and described above. WDFW also recommends that Grant PUD develop and fund a passage program and operational measures to achieve the downstream passage survival standards for juvenile fall Chinook salmon, summer Chinook salmon, and sockeye salmon. WDFW recommends that until measures are implemented that provide improved or equivalent survival rates for fall Chinook salmon to the current summer spill program, Grant PUD shall provide 39 percent spill at Priest Rapids dam and 49 percent spill at Wanapum dam from approximately June 15 to August 15.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD index-test all individual turbines at each dam and operate each individual turbine within its peak efficiency range to maximize downstream fish passage protection.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD investigate the impact of peaking operations on juvenile passage through the project dams.

Our Analysis

In this section, we only address downstream passage survival of juvenile salmon and steelhead at the project dams. Passage survival through the project reservoirs is addressed below in the section entitled *salmon and steelhead - predator control*.

Juvenile salmon and steelhead move downstream past the Wanapum and Priest Rapids dams via three primary routes: turbines, spillways, and the sluiceways. Juvenile passage through the turbines is possible anytime the dams are generating electricity. Spillway passage occurs when river flows exceed the capacity of the project or when river flow is intentionally released over the spillway to provide an alternative to turbine passage. The project sluiceways are available for fish passage during the periods when spill flows are released to provide fish passage and at times when an accumulation of ice or debris is being passed via the sluiceways from the forebay to the tailwater of the dam.

Other less utilized routes include the fish ladders and gatewell collection and transport. Some juvenile salmon and steelhead move downstream past the dams through the fish ladders. It is believed that this route is used by relatively few juveniles compared to the routes listed above. Gatewell collection and transportation is another way that juveniles can access the tailwater. During the migration period, a portion of the fish moving through the turbine intakes become trapped in the intake gatewells due to the hydraulic conditions in these areas. During the outmigration period, Grant PUD nets the gatewells at regular intervals and manually transports the juveniles to the tailwater for release.

In the license application, Grant PUD reported that the percentage of steelhead and Chinook salmon smolts passing through the turbines ranged from 8-30 percent at Priest Rapids dam, while a much higher percentage of smolts used turbine routes at Wanapum dam. A portion of the fish passing the project dams via turbines are injured or killed. Common external injuries include scale loss and damaged eyes, gills, or operculum while common internal injuries include ruptured air bladders and hemorrhaged organs. Injuries that occur during turbine passage are believed to primarily occur from contact with moving parts of the turbine, exposure to rapid pressure changes, or exposure to hydraulic conditions with high shear forces. Some injuries are severe enough to result in immediate or delayed mortality, while others may have little effect on the survival of the smolt.

In the license application, Grant PUD presents data indicating that turbine passage survival for steelhead and Chinook salmon smolts at Wanapum dam ranges from 88 to 98 percent. At Priest Rapids dam turbine passage survival ranged from 81 to 99 percent.

Historically, fish management agencies have attempted to increase downstream survival of salmonid smolts by reducing the number of fish passing through hydroelectric turbines. Estimates of the proportion of outmigrating fish passing a dam through non-turbine routes are referred to as fish passage efficiency. At Priest Rapids and Wanapum dams, the primary non-turbine routes available for downstream passage are the project

spillways and sluiceways.[33] In the license application, Grant PUD presents recent estimates of fish passage efficiencies at Wanapum and Priest Rapids dams. In 2000, passage efficiency[34] for steelhead smolts was 54 percent at Wanapum dam and 71 percent at Priest Rapids dam. For yearling Chinook salmon, passage efficiencies at Wanapum dam were 62, 41, and 29 percent in 2001, 2002, and 2003, respectively. Yearling Chinook salmon passage efficiencies at Priest Rapids dam were 85, 92, and 75 percent in 2001, 2002, and 2003, respectively.

Spillway passage survival at Wanapum dam tends to be lower than at Priest Rapids dam. Grant PUD reports that testing from 2000-2003 indicated that Wanapum dam spillway passage survival for steelhead and salmon smolts ranges from 85-89 percent. At Priest Rapids dam, spillway passage survival ranges from 95-98 percent. Sluiceway passage survival ranged from 84-93 percent at Wanapum dam and 92-93 percent at Priest Rapids dam.

Over the years, Grant PUD has explored a variety of approaches to providing safe and effective downstream passage to salmon smolts. These include installation of downstream passage structures, barging, and spillway releases. To date, the most effective technique for providing downstream passage has been unforced spillway releases (i.e., spillway releases that occur when river flows are below the capacity of the turbines). At Wanapum dam, annual average spill flows during the spring migration period generally range from 30-45 percent of the river flow and at Priest Rapids dam spill flows range from 50-60 percent of the river flow. These spill flows are primarily limited by total dissolved gas conditions within the river (see section 3.4 Water Quality and Quantity) and higher spill flows would result in exceedences of water quality standards that may harm migrating smolts or other aquatic resources. In addition to concerns and limitations associated total dissolved gases, unforced spills reduce project generation. Therefore, in an attempt to develop a more biologically effective and cost effective technique for passing smolts downstream of the project, Grant PUD, in consultation with the agencies, has experimented with top-spill passage facilities. These structures allow Grant PUD to concentrate releases through a single spillbay and draw water from surface

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[33] In addition to normal spillway and sluiceway operations, Grant PUD has been testing the effectiveness of top-spill devices at both dams since 2002. Top-spill devices are structural modifications to the project spillways that result in the release of water from surface depths in the forebay.

[34] Although it is not specified in the application, it appears that these fish passage efficiencies account for both spillway and sluiceway passage. It is unclear if downstream passage via the project fish ladders or if fish collected via gatewell dipping have been included in these estimates.

portions of the forebay.

Testing of top-spill devices in 2002 and 2003 demonstrated high fish passage efficiencies at Priest Rapids dam (65-77 percent). Results at Wanapum dam were less successful with fish passage efficiencies ranging from 15-27 percent. Using the information from the top-spill experiments and applying a general understanding of smolt behavior, Grant PUD designed downstream passage facilities for both Wanapum and Priest Rapids dams.

At Wanapum dam, Grant PUD, NOAA Fisheries, Interior, and WDFW propose that Grant PUD construct a surface bypass at the location of future unit 11. Future unit 11 is a turbine bay that was constructed as part of the original dam construction but was never occupied by a turbine. This unoccupied turbine bay is between the spillway and powerhouse, immediately adjacent to the operational turbines. Grant PUD would construct the bypass by creating a 20-foot-wide, ogee-crested weir through the middle of future unit 11. Flows passing through the opening would gradually accelerate to the highpoint of the ogee and then descend via a spillway-like structure to a submerged chute in the tailrace. The downstream opening of the tailrace chute would widen to approximately 90 feet. The Wanapum dam surface bypass would be constructed to release flows up to 20,000 cfs.

Grant PUD indicates that the proposed Wanapum surface bypass was designed to capitalize on smolt migration behavior. The location of the bypass near the powerhouse may be beneficial because the bulk of the surface flow would be directed to this area and it may deliver the greatest number of smolts to that area. Hydraulic modeling performed by Grant PUD indicated that a 20,000 cfs capacity for the surface bypass would be adequate to create a discernable flow field in the forebay area where it would need to compete, in terms of fish attraction, with powerhouse and possibly spillway flows. The surface-oriented design would draw water from the shallow depths at which smolts tend to migrate and eliminate the need for smolts to sound, which they appear to resist. The upstream side of the ogee-crest would be shaped to gradually increase velocities without creating areas of turbulence or rapid decelerations or accelerations that smolts tend to avoid. At the high point of the ogee, the velocities would exceed the swimming velocity of the migrating smolts and the fish would become entrained in the bypass flows and unable to return to the forebay. The tailrace portion of the bypass is designed to provide rapid egress from the tailrace and potential predators while minimizing fish injuries. The tailrace structure is also designed to minimize erosion of the riverbed and limit air entrainment and turbulence that could cause increased total dissolved gases.

At Priest Rapids dam, Grant PUD proposes to modify spillway 22 into two smaller, full-depth spillways. Construction of this facility would consist of two phases.

During the first phase, Grant PUD would construct an intermediate pier that would divide spillway 22 into two smaller spillways; one being 20 feet wide and the other being 12 feet wide. Each spillway would be equipped with its own independent gate for controlling releases. The larger spillway would be capable of passing 25,000 cfs while the smaller spillway would be capable of passing 15,000 cfs. If testing of the phase 1 design demonstrated high fish passage efficiencies that could result in improved dam passage survival, Grant PUD would initiate phase 2. Phase 2 would involve construction of tailrace features including training walls and apron slabs.

Similar to the proposed Wanapum bypass, Grant PUD designed the Priest Rapids downstream passage facility to capitalize on smolt migration behavior. Spillway 22 is located near the center of the dam and adjacent to the powerhouse. This area may provide the largest numbers of fish since this is the area where the bulk of the river flow is directed during turbine operations and flows approach spillway 22 from the side opposite of the powerhouse (i.e., at a slight angle from the spillway side towards the powerhouse side). The split spillway design with independent gate operation would allow Grant PUD to release various combinations of flows up to 40,000 cfs. Modeling performed by Grant PUD suggested that these flows would be adequate to create a discernable flow field in the forebay area capable of attracting smolts to the spillway 22. The surface-oriented design would draw water from the shallow depths at which smolts tend to migrate and eliminate the need for smolts to sound. The tailrace portion of the bypass is designed to provide rapid egress from the tailrace and potential predators while minimizing fish injuries. The tailrace structure is also designed to limit air entrainment and turbulence that could cause increased total dissolved gases.

Because the Wanapum and Priest Rapids dam bypasses are unconstructed facilities, it is impossible to quantify any potential increases in downstream passage survival. Studies conducted by Grant PUD have indicated that spillway passage survival at Wanapum dam is generally below 90 percent. Available information indicates that continued use of spillflows at Wanapum dam would prevent Grant PUD from achieving the downstream passage survival standards (discussed above) proposed by Grant PUD and the agencies; therefore, some change in the approach to providing downstream passage at Wanapum appears to be warranted.

We would expect that downstream passage survival through the proposed Wanapum surface bypass facility would be relatively high since it would be designed specifically for providing fish passage. This facility would be constructed to minimize the possibility of fish impacting hard or abrasive surfaces or exposing fish to turbulent, high energy areas with high shear forces or other unfavorable hydraulic conditions that could cause fish injuries or disorientation. In comments filed on May 27, 2005, NOAA Fisheries indicated that Grant PUD conducted survival experiments on a sluiceway that

was modified to simulate the proposed bypass. No mortalities and less than 1 percent injuries were recorded during experiments with this facility. These data suggest that the proposed Wanapum bypass should result in downstream passage survival rates near 100 percent.

The ability of the proposed Wanapum bypass facility to attract migrating smolts is uncertain. Top-spill experiments conducted at Wanapum dam provided relatively low fish passage efficiencies ranging from 15-27 percent; however, these experiments were conducted in existing spillway 12, which is located approximately 600 feet away from the nearest operational turbine (unit 10). The location of the proposed bypass at future unit 11 would be immediately adjacent to unit 10 and would be much closer to the bulk flows approaching the powerhouse than spillway 12. We would expect that a bypass located at future unit 11 would attract more fish than the experimental top-spill device tested in spillway 12 and it would result in significantly higher fish passage efficiencies.

At Priest Rapids dam, the ongoing spillway and sluiceway releases appear to provide safe and effective passage for downstream migrating smolts. These spilled flows result in relatively high fish passage efficiencies (i.e., 71-92 percent) and high passage survival rates (i.e., 95-98 percent). However, these spilled flows reduce generation and power sales and can result in increased total dissolved gases, albeit not as much as spills at Wanapum dam. To increase power generation and decrease adverse effects on total dissolved gases, Grant PUD is proposing to construct a downstream bypass facility in spillway 22 of the Priest Rapids dam. This facility could potentially reduce the total amount of spill necessary to meet the downstream passage survival standards.

We would expect that downstream passage survival for the proposed Priest Rapids bypass facility would be relatively high since it would be designed specifically to pass fish. This facility would be constructed to minimize the possibility of fish impacting hard or abrasive surfaces or exposing fish to turbulent, high energy areas with high shear forces or other unfavorable hydraulic conditions that could cause fish injuries or disorientation. While no specific data are available to suggest potential smolt survival through the proposed Priest Rapids facility, it would not be unreasonable to anticipate that survival through this facility would approach 100 percent and could exceed spillway passage survival at this dam.

The attraction of smolts to spillway 22 was tested by Grant PUD in 2003. Top-spill experiments at spillway 22 resulted in approximately 65 percent fish passage efficiency with the gate fully opened (i.e., approximately 60,000 cfs). Grant PUD has also tested top-spill at spillway 17 which resulted in fish passage efficiency of 77 percent. These data suggest that a substantial proportion of the outmigrating smolts would be attracted to Grant PUD's proposed downstream fish passage facility for Priest Rapids

dam. If the proposed facility achieves the survival rates and fish passage efficiencies suggested here, modification of spillway 22 of the Priest Rapids dam to pass fish would likely improve downstream passage survival of smolts, assist Grant PUD in achieving the proposed downstream fish passage survival standards, decrease the dam's influence on total dissolved gases, and increase power generation.

In comments filed on May 27, 2005, NOAA Fisheries indicates that at this time it is not convinced that Grant PUD's proposal to modify spillway 22 is the "right" design for providing fish passage at the Priest Rapids dam. NOAA Fisheries indicates that additional review and study of this proposal is needed. The recommendations of Interior and WDFW are consistent with NOAA Fisheries recommendation. NOAA Fisheries does not provide any specific concerns about the proposed design. NOAA Fisheries recommendations suggest that they are reasonably satisfied by the effectiveness of the ongoing spill program since they have recommended continuation of this program until a downstream passage design that is acceptable to them is developed.

Grant PUD indicates that it anticipates that both proposed downstream passage facilities would enable each dam to achieve the downstream passage survival standards; however, if monitoring demonstrates that the standards are not being met, Grant PUD would implement, in consultation with the agencies and tribes, an adaptive management approach to further increase downstream passage survival. The adaptive management approach would include a stepwise decision process that could result in modifications to the proposed facilities or construction of additional facilities or modifications to project operations if the standards are not being achieved. Grant PUD indicates that if the bypasses are not passing all the fish near the opening of the bypasses, the entrance conditions could be modified to improve fish collection hydraulics. If these modifications fail to result in achievement of the passage standards, other more significant modifications would be considered. At Wanapum dam, these would include installation of floor plates, construction of a J-block, or experimentation with different bypass flow volumes. At Priest Rapids, construction of a guidance wall or guidance curtain would be considered. At Wanapum dam, if the passage standards are still not met after implementing these modifications, Grant PUD would consider installing a top-spill device along the left-bank (western side) of the dam. At Priest Rapids dam, Grant PUD would consider providing more flow through additional spillways. Implementation of this adaptive management program would provide a logical and practical approach to ensuring that the proposed bypass designs evolve to meet the proposed passage standards.

As indicated above, the agencies are not currently recommending Grant PUD's proposed downstream bypass design for the Priest Rapids dam. The agencies did not provide a specific basis for this position; however, it appears that they have some concerns about the effectiveness of the proposed design and its ability to outperform the

existing spill program. The agencies are recommending continuation of the ongoing spill program, suggesting that spill is a safe and effective means of providing downstream fish passage at Priest Rapids dam. This program results in relatively high fish passage efficiencies and survival rates (see above) and if the turbine survival rates are also high (studies in 2000 and 2004 reported 98-99 percent), Grant PUD may already be achieving the passage standards at this Priest Rapids dam.

In comments filed on May 27, 2005, NOAA Fisheries indicated that until the Wanapum bypass facility is operational, Grant PUD should continue the ongoing spill program to provide downstream passage for smolts. Based on the available data it is not clear why NOAA Fisheries is making this recommendation. The best available survival data collected at the Wanapum dam suggests that passage survival through the turbines is higher than survival via the spillways. In general, spillway passage survival at Wanapum dam is approximately 85 to 88 percent while turbine passage survival is 88 to 98 percent. In comments filed on May 27, 2005, NOAA Fisheries acknowledges that spillway survival is lower than turbine passage survival and states that "spill has been consistently the most lethal route to pass fish" at Wanapum dam. Based on this information, it is unclear why NOAA Fisheries would recommend continuation of this program since it would seem that more fish would survive during downstream passage if the spill program would be discontinued and all fish passed the dam via the turbines. Additionally, discontinuation of the spill program would reduce adverse effects on total dissolved gases and increase project generation. Based on this information, it appears that continuation of the proposed spill program at Wanapum dam until the proposed bypass facility is operational would result in lower dam passage survival rates than if the spill program were discontinued and all fish were passed via the turbines.

In comments filed on May 27, 2005, NOAA Fisheries states that involuntary spills will continue at Wanapum dam even after the downstream bypass through future unit 11 becomes operational. These spills would not be intended to pass fish; however, it is likely that some smolts would pass via the spillways when they occur during the outmigration periods (i.e., spring and summer). We are unable to quantify how many fish would pass via the spillways during involuntary spills with the proposed downstream bypass at future unit 11 operating; however, it is probable that large spill volumes would attract significant numbers of smolts to the spillways and expose these fish to reduced survival rates.[35] NOAA Fisheries suggests that the poor survival associated with spillway passage at Wanapum dam may be related to the spillway gate seals and recommends that Grant PUD investigate the effects of the seals on spillway survival. Investigating and

[35] We are assuming that spillway survival would be less than turbine passage survival or survival through the proposed future unit 11 bypass.

potentially eliminating the cause of poor spillway survival at Wanapum dam would increase dam passage survival during involuntary spills and could aid Grant PUD in achieving the passage survival standards.

In comments filed on May 27, 2005, CRITFC recommends that Grant PUD index-test all individual project turbines to identify peak efficiency ranges. CRITFC states that fish survival is generally higher when turbines are operated within 1 percent of peak efficiency and they recommend that the project turbines be operated at near peak efficiency to maximize fish passage survival. Grant PUD indicates that any new turbines installed at Wanapum dam would be index-tested and this information would be used to operate the new turbines at near peak efficiency to maximize passage survival. At Priest Rapids dam, Grant PUD indicates that for the existing turbines they have developed a fish mode of operation based on the results of passage survival studies under varying conditions. Grant PUD did not indicate if it has developed a fish mode for operation of the existing turbines at Wanapum dam; however, in comments filed on May 27, 2005, NOAA Fisheries indicated that the Wanapum turbines are operated in fish mode to maximize survival. Index-testing and operating the turbines at near peak efficiency as recommended by CRITFC may not result in a significant improvement of turbine passage survival at the project dams. The existing project turbines are already restricted to operating ranges intended to maximize survival and these ranges were derived from empirical passage survival data. We would expect these empirical data to be more reliable for maximizing survival than the more theoretical relationship between operating efficiency and survival that would be employed through index-testing. Based on this information, we conclude there would be little benefit, if any, to index-testing the existing project turbines. Index-testing of any new advanced turbines installed at the project would provide a basis for operating the turbines to maximize survival, at least until actual passage survival estimates are measured.

As part of it license application, Grant PUD proposed to improve downstream passage survival at Wanapum dam by replacing the existing turbines with new advanced design turbines which are expected to reduce smolt mortalities during turbine passage. Installation and operation of the 10 advanced design turbines at Wanapum dam was approved by the Commission in orders issued July 23, 2004, and December 14, 2005[36]. Grant PUD indicates that at Priest Rapids dam the turbines are in good shape and any necessary replacement would not occur until some time in the future. We do not address replacement of the Priest Rapids turbines in this EIS. The effects of that action would be evaluated when Grant PUD proposes replacement.

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[36] 108 FERC ¶ 62,075 (2004) and 113 FERC ¶ 62,205 (2005), respectively

Smolts moving past the project dams can become trapped within the intake gate slots due to hydraulic conditions in these areas. Each year during the outmigration, Grant PUD nets the gatewells and collects smolts for release in the tailrace. On average, Grant PUD collects and transports 56,000 smolts from the Wanapum gatewells and 62,000 smolts from the Priest Rapids gatewells. In its license application, Grant PUD suggests that injuries and stress associated with gatewell collection and transport probably exceeds what occurs during turbine passage. Therefore, Grant PUD is proposing to install gatewell exclusion screens to prevent smolts from entering the gate slots. These screens would ensure that all smolts entering the intakes would pass through the project turbines. No specific survival rates are available for smolts that pass the project via gatewell collection and transport; however, it does not seem unreasonable to assume that turbine passage survival would be greater than smolt survival during gatewell collection and transport since stress from netting and handling is likely to be significant.

CRITFC recommends that Grant PUD study the effects of peaking operations on juvenile fish passage through the project dams. CRITFC suggests that decreased discharge that occurs during peaking operations increases delay in the downstream passage of juvenile salmonids and exposes them to increased predation mortality in the project forebay. CRITFC provides no details regarding the mechanism for this delay; however, it is possible that reduced flows (i.e., dam discharge) would reduce steering flows in forebay areas and cause juvenile fish to be unable to locate available passage routes. Studying the effects of flow fluctuations on the ability of juvenile salmonids to locate available passage routes could be useful for improving downstream survival.

Salmon and Steelhead – Predator Control

As part of its license application, Grant PUD proposes to fund a northern pikeminnow removal program to improve smolt passage survival through the reservoirs and tailraces of Priest Rapids and Wanapum dams. Grant PUD would also fund and implement an avian hazing and control program to improve smolt passage survival through the tailraces of Priest Rapids and Wanapum dams.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD reduce avian and piscivore predation at the Wanapum and Priest Rapids developments as much as feasible.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement an Avian Predator Control and Effectiveness Monitoring Plan that would include: 1) describing measures to control avian predators, 2) describe methods, techniques, and schedules for measuring the effectiveness of avian control measures, and 3) provide for modification of the measures based on effectiveness monitoring.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD determine what impact the northern pikeminnow removal program is having on resident fish. This recommendation is evaluated in the resident fish section.

Our Analysis

Predation by avian predators and piscivorous fish species likely influences the ultimate survival rate of juvenile salmon and steelhead moving downstream through the project area. In comments filed on May 27, 2005, NOAA Fisheries indicates that up to 2 percent of smolts passing through the project area are consumed by avian predators at both Wanapum and Priest Rapids dams. NOAA Fisheries indicates that California gulls are the primary avian predator of smolts.

NOAA Fisheries also states that smolts are concentrated in the dam forebays, which makes predation by piscivorous fish species more efficient. The northern pikeminnow is considered the primary piscivorous fish species that preys on smolts; however, other species such as smallmouth bass and walleye are also known to consume juvenile salmon and steelhead. In response to NOAA Fisheries comments, Grant PUD states that past studies have found that northern pikeminnow densities are greatest in the dam tailraces and lowest in the dam forebay areas (Burley and Poe, 1994). Additionally, Grant PUD indicates that consumption indices[37] were very low in the dam forebay areas and were greatest in the dam tailraces.

Regardless of where predators are most concentrated, reducing the number of predators or their ability to prey upon smolts would reduce predation mortality and likely increase smolt survival through the project area. To reduce or discourage avian predation, Grant PUD maintains wire arrays over the tailrace area downstream of each dam's powerhouse. Additional wires were added to the powerhouse arrays in 2004 at each dam and Grant PUD is exploring the potential for installing wire arrays below the spillway areas of each dam. Continued maintenance of the existing arrays would discourage avian predation of smolts in the area below the project powerhouses. The installation of wire arrays below the spillway areas would provide similar protection for smolts during times when spillways are used to provide alternatives to turbine passage or when flows are beyond the capacity of the powerhouses.

[37] A consumption index is a relative measure of the number of smolts consumed by predators.

Grant PUD initiated a multi-year northern pikeminnow removal program in 2003 and over 230,000 northern pikeminnow have been removed as a result of this program. Continuation of this program would reduce the number of northern pikeminnow in the project area. These reductions in the abundance of northern pikeminnow would reduce predation on juvenile salmon and steelhead and likely increase survival rates during passage through the project reservoirs and tailraces.

Development and implementation of the Avian Predator Control and Effectiveness Monitoring Plan, as recommended by Interior, would provide documentation of the measures that should be implemented to control avian predators and outline methods for determining the effectiveness of any program modifications.

Salmon and Steelhead – Hatchery Programs

To help recover natural populations to self-sustaining and harvestable levels and to mitigate for 7 percent unavoidable losses for each development, Grant PUD proposes to fund and develop the hatchery facilities necessary to annually produce 600,000 yearling spring Chinook salmon, 833,000 yearling summer Chinook salmon, 1,143,000 sockeye salmon smolts, and 100,000 steelhead smolts. Grant PUD would upgrade and renovate the Priest Rapids Hatchery and annually produce 6,000,000 fall Chinook salmon smolts and 1,000,000 fall Chinook salmon fry. Grant PUD would consult on options to develop equivalent alternative mitigation programs if annual production of 1,143,000 sockeye salmon smolts is unattainable.

Under section 10(j) of the FPA, NOAA Fisheries and WDFW recommend that Grant PUD develop separate Hatchery and Genetic Management Plans (HGMP) to rear up to 600,000 yearling UCR spring-run Chinook salmon, 833,000 yearling summer Chinook salmon, and 100,000 yearling UCR steelhead. NOAA Fisheries and WDFW recommend that the initial production levels specified in the HGMPs for steelhead, spring-run Chinook salmon, and summer Chinook salmon would be reviewed in 2013 and every 10 years thereafter. NOAA Fisheries and WDFW recommend that Grant PUD continue to provide 5,000,000 fall Chinook salmon sub-yearling smolts annually and provide facilities at the Priest Rapids Hatchery to produce an additional 1,000,000 fall Chinook salmon sub-yearling smolts. NOAA Fisheries and WDFW recommend that Grant PUD implement a program to produce and release 1,000,000 fall Chinook salmon fry into the project reservoirs annually. NOAA Fisheries and WDFW recommend that Grant PUD update the existing HGMP for fall Chinook salmon. NOAA Fisheries and WDFW recommend that Grant PUD write a HGMP and develop a hatchery program to produce 1,143,000 sockeye salmon smolts. NOAA Fisheries and WDFW indicate that if the sockeye propagation program is not feasible, Grant PUD should use flow augmentation to improve instream conditions for sockeye salmon or conduct habitat

improvements for increasing natural production of sockeye salmon. WDFW recommends that the sockeye salmon HGMP should be reviewed in 2013 and every 10 years thereafter.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD establish hatchery management plans to improve existing facilities to state-of-the-art status, including bioengineering and other applicable methods and standards.

Under section 10(j) of the FPA, ADFG recommends that Grant PUD establish revised hatchery management plans and initiate funding of improved state-of-the-art facilities at the Priest Rapids Hatchery.

Our Analysis

In the license application, Grant PUD states that it annually produces 5,000,000 fall Chinook salmon smolts at the Priest Rapids Hatchery for mitigation for the effects of project construction. These hatchery releases supplement the fall Chinook salmon population that primarily spawns in the Hanford Reach and in the tailwaters of several mid-Columbia River dams. Grant PUD is proposing to increase the production capacity of the Priest Rapids Hatchery to accommodate an additional 1,000,000 fall Chinook salmon smolts and to begin producing 1,000,000 fall Chinook salmon fry for release into the Wanapum and Priest Rapids reservoirs. The total number of fall Chinook salmon smolts released annually would be 6,000,000 which Grant PUD indicates would meet the production objectives of the mid-Columbia River Hatchery Program (Bugert 1998). The annual release of 1,000,000 fall Chinook salmon fry would take advantage of available rearing habitat within the project reservoirs and would serve to mitigate for mortalities that occur within the Hanford Reach due to project operations.

Grant PUD is also proposing to annually release 600,000 yearling spring-run Chinook salmon, 833,000 yearling summer Chinook salmon, 1,143,000 sockeye salmon smolts, and 100,000 steelhead smolts. Grant PUD is exploring a variety of options for producing these fish, including the construction of new hatchery facilities or the use of existing facilities operated by other entities. These releases would supplement the existing populations of spring-run Chinook salmon, summer Chinook salmon, sockeye salmon, and steelhead and would meet the production objectives of the mid-Columbia River Hatchery Program (Bugert 1998).

Grant PUD, NOAA Fisheries, and WDFW acknowledge that artificial propagation of Columbia River sockeye salmon could be unsuccessful. Grant PUD indicates that other entities have attempted to artificially propagate Columbia River sockeye salmon and it has been difficult, if not impossible, to develop the proper facilities. Grant PUD

indicates that if it is unable to develop facilities or a program to meet the sockeye salmon production goal, they would consult with consult with the agencies and tribes to develop equivalent alternative mitigation programs. NOAA Fisheries and WDFW indicate that if the sockeye propagation program is not feasible, Grant PUD should use flow augmentation to improve instream conditions for sockeye salmon or conduct habitat improvements for increasing natural production of sockeye salmon. Implementing alternative measures would be appropriate for mitigating for project effects on this species. If a strong flow versus survival relationship exists for sockeye salmon smolts, flow augmentation could increase survival of outmigrating sockeye salmon smolts. Additionally, if habitat conditions or availability is limiting sockeye salmon production levels, habitat improvements could increase sockeye salmon production. Other as-yet undefined measures may also be appropriate. The specific measures that would be employed should be developed in consultation with the agencies and tribes and should correspond to the magnitude of the project effects on sockeye salmon and the unachieved sockeye salmon production goals. Implementing these alternative measures would help to mitigate for project effects on sockeye salmon.

Grant PUD, NOAA Fisheries, and WDFW indicate that HGMPs should be prepared and implemented for each hatchery production program. The HGMPs would describe hatchery practices for breeding and rearing each fish species. These plans would detail monitoring, evaluation, and performance indicators to address critical uncertainties associated with each program. Development and implementation of the HGMPs, in consultation with the agencies and tribes, would formalize the specific methods for production and monitoring of hatchery reared salmon and steelhead and help to maximize the physical and genetic condition of fish used to supplement that existing populations.

Grant PUD indicates that the production objectives for each species should be reviewed and adjusted as necessary at 10-year intervals. NOAA Fisheries and WDFW also recommend 10-year reviews and specify that the first review should take place in 2013. Conducting periodic reviews during the license term would provide an opportunity for adjusting production goals in response to possible changes in the magnitude of project effects or the success of the production programs. These periodic reviews would ensure that the production goals for each species are maintained at appropriate levels that correspond to the magnitude of project effects.

In the license application, Grant PUD indicates that achieving the various hatchery program objectives would have two purposes: 1) to help recover natural populations to self-sustaining and harvestable levels throughout the mid-Columbia River region; and 2) to mitigate for a 7% per development unavoidable loss of upriver stocks.[38] Recovering

[38] Unavoidable losses are the portion of the adult and juvenile salmon and steelhead

populations to sustainable or harvestable levels may be a reasonable goal for fisheries management agencies, but because many non-project-related factors affect the fish species of the mid-Columbia River region, attaining sustainable or harvestable population levels is not an reasonable goal for defining appropriate mitigation for the effects of the Priest Rapids Project. The supplementation proposed by Grant PUD and recommended by the agencies, would serve to mitigate for unavoidable losses that occur within the project area and may indirectly help the agencies recover populations to sustainable or harvestable levels. However, failure of these populations to achieve sustainable or harvestable levels would not necessarily indicate that the proposed mitigation was inadequate since many other non-project-related factors influence their status.

ADFG recommends that Grant PUD establish revised hatchery management plans and initiate funding of improved state-of-the-art facilities at the Priest Rapids Hatchery. CRITFC recommends that Grant PUD establish hatchery management plans to improve existing facilities to state-of-the-art status, including bioengineering and other applicable methods and standards. CRITFC recommends that these state-of-the-art facilities should be employed at the Priest Rapids Hatchery and essentially any other hatcheries used to produce fish as mitigation for the Priest Rapids Project.

The Priest Rapids Hatchery is a project facility that is located immediately downstream of Priest Rapids dam, within the project boundary. The hatchery was originally constructed as a spawning channel; however, it has been converted into a series of rearing ponds that annually produce over 6,000,000 fall Chinook salmon smolts.

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population that fail to survive passage through the project area due to project effects. Even if the 91 percent performance standard is achieved through implementation of all the project-specific mitigation measures, there would still be 9 percent unavoidable losses. Under the various proposals, a portion of these unavoidable losses would be mitigated through hatchery supplementation and the remainder would be addressed through habitat improvement projects. In multiple filings the applicant and agencies use language indicating that hatchery supplementation will "mitigate for a 7 percent per development unavoidable loss of upriver stocks" and the habitat account will "mitigate for a 2 percent per development unavoidable loss." For consistency we use similar language throughout this document. However, we note that the level of hatchery mitigation could also be described as addressing 78 percent (i.e., 7/9ths) of the unavoidable losses occurring at each project dam and the proposed habitat mitigation would address 22 percent (i.e., 2/9ths) of the unavoidable losses at each dam, thereby resulting in 100 percent mitigation for unavoidable losses.

Grant PUD acknowledges that many of the facilities at the Priest Rapids Hatchery are approaching the end of their useful life and Grant PUD is proposing to renovate the hatchery. Grant PUD's proposal includes construction of a new incubation and office building, an emergency power system to provide an uninterruptible water supply to the hatchery building, new early rearing raceways, an additional rearing pond, new adult trapping and holding facilities, a new weir on the return channel, predator control features, and a pollution abatement settling pond. These renovations would allow Grant PUD to produce the additional fall Chinook salmon discussed above and it would improve the functionality and efficiency of the hatchery. Many of the measures recommended by CRITFC and ADFG would be directly or partly addressed by Grant PUD's proposed renovations to the Priest Rapids Hatchery. Some measures proposed by CRITFC and ADFG appear to be operational measures that we would expect to be resolved as part of the development of the HGMP for fall Chinook salmon. Other measures appear to be exploratory measures such as investigating water chiller installation and use of ozone filtration. Improving the Priest Rapids Hatchery facilities to state-of-the-art status could increase the efficiency of hatchery operations and may improve the condition of fish produced at the hatchery. However, we have no evidence to indicate that the condition of the fall Chinook salmon produced at the Priest Rapids Hatchery is unsatisfactory and the increased efficiency, capacity, and production of fall Chinook salmon proposed by Grant PUD would likely improve on existing conditions. Based on the available information, it is not apparent that state-of-the-art facilities are necessary to achieve the proposed production goals for fall Chinook salmon at the Priest Rapids Hatchery.

Grant PUD indicates that the hatchery production goals for spring-run Chinook salmon, summer Chinook salmon, sockeye salmon, and steelhead would likely be achieved by hatcheries located in other portions of the Columbia River watershed. These hatcheries are not owned or operated by Grant PUD and hatchery production at these facilities would likely be contracted by Grant PUD to some other entity. CRITFC suggests that the facilities at these hatcheries should be improved to state-of-the-art status. Implementing state-of-the-art measures would help to ensure that healthy fish are produced efficiently wherever they are raised. However, at this time Grant PUD appears to be exploring a variety of hatchery options for producing these fish. The hatcheries that are ultimately selected may include state-of-the-art facilities or, at least facilities capable of producing healthy fish that meet the targeted production goals in which case there would be no need for implementing state-of-the-art measures as suggested by CRITFC.

Salmon and Steelhead – Habitat Mitigation for Upriver Stocks

As part of its license application, Grant PUD proposes to annually provide $1,096,552 to the Priest Rapids Project Habitat Fund to mitigate for a 2 percent per development unavoidable loss of upriver stocks.

NOAA Fisheries and WDFW recommend that Grant PUD establish a Priest Rapids Fish Habitat Conservation Account to fund fish habitat projects for mitigating for a 2 percent unavoidable loss of salmon and steelhead resulting from project operations. NOAA Fisheries and WDFW recommend that Grant PUD develop a habitat plan to direct the habitat mitigation program. NOAA Fisheries and WDFW recommend that Grant PUD use existing habitat evaluation and assessment tools and prioritization frameworks already developed for the upper Columbia region to target and efficiently spend funds from the habitat account.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD establish habitat management plans and provide funding for the implementation of these plans.

Our Analysis

Large areas of historic salmon and steelhead spawning and rearing habitat in the mid-Columbia River basin are currently either inaccessible or in degraded condition. Grant PUD proposes to make annual contributions to a habitat account that would be used to fund projects that would increase the amount of salmon and steelhead habitat in the mid-Columbia River basin. Grant PUD, NOAA Fisheries, WDFW, and CRITFC indicate that contributions to the habitat account would be intended to provide habitat improvement programs that would mitigate for unavoidable effects of the project on salmon and steelhead. The proposed amount of funds to be annually contributed to the habitat account is based on the estimated cost of implementing habitat improvements that would offset a 2 percent per development unavoidable loss of upriver stocks. In comments filed on May 27, 2005, NOAA Fisheries indicates that it is not possible to statistically demonstrate that habitat improvements would result in a 2 percent increase in salmon and steelhead production; however, they indicate that the program would be designed to ensure that funds are utilized in a beneficial, efficient, and effective manner.

Grant PUD, NOAA Fisheries, and WDFW indicate that the habitat mitigation funds would be administered by the PRCC. Habitat improvement projects associated with the Priest Rapids Project would be coordinated with habitat mitigation efforts that are underway at the Rock Island, Rocky Reach, and Wells projects. Whenever feasible, the funding of projects would be coordinated with other programs to provide cost-sharing or matching funds. The selection and prioritization of habitat mitigation efforts would be

based on the biological and cost effectiveness of each project. The use of habitat evaluation and assessment tools and prioritization frameworks that are already developed for the upper Columbia River region would be an efficient way to target specific sites and identify cost-effective projects.

In regard to specific habitat improvement projects, funds from the habitat account could be used provide access to blocked streams or oxbows, remove or modify irrigation/diversion dams and other barriers on tributary streams, improve or increase hiding and resting cover habitat, and improve instream flow conditions by correcting problematic water diversion or withdrawal structures. Implementing these measures would increase available salmon and steelhead habitat within the mid-Columbia River basin and would likely result in increased production of juvenile and adult salmon and steelhead.

NOAA Fisheries, WDFW, and CRITFC recommend that Grant PUD develop a habitat plan to direct the habitat mitigation program. The plan would include identification of goals and objectives, description of a process for coordination, and description of a process to identify and implement habitat projects. Development and implementation of a habitat plan would provide structure for the implementation of the habitat program and ensure efficient and effective use of the funds.

Salmon and Steelhead – No Net Impact

Under section 10(j) of the FPA, WDFW recommends that Grant PUD develop, fund, and implement comprehensive protection programs for fall Chinook salmon, summer Chinook salmon, and sockeye salmon. WDFW indicates that the objective of these comprehensive protection programs is to achieve no net impact (NNI) of the operations of the Priest Rapids Project on these species.

Under section 10(j) of the FPA, NOAA Fisheries and WDFW recommend that Grant PUD establish and administer a NNI Fund to provide compensation during the near-term when annual survival rates for salmon and steelhead are less than the performance standards.

Our Analysis

NOAA Fisheries and WDFW indicate that they have a goal of NNI for the Priest Rapids Project. They indicate that NNI should be achieved through a combination of meeting project survival standards, habitat mitigation, and hatchery supplementation. Specifically, NNI would be achieved if combined adult and juvenile passage survival is 91 percent and the remaining 9 percent unavoidable loss is made up through 7 percent

hatchery mitigation and 2 percent habitat mitigation. These are the same standards and goals used in the HCPs for the Wells, Rocky Reach, and Rock Island projects.

NOAA Fisheries and WDFW also indicate that the passage survival standards may not be achieved through current operations for certain stocks; therefore, the project may fail to achieve NNI for these stocks. NOAA Fisheries and WDFW recommend that Grant PUD contribute to a NNI fund to compensate for providing passage survival at rates less than the survival standards. They indicate that these funds would provide the agencies with additional financial capacity to undertake measures to improve survival of stocks failing to meet the survival standards.

In comments filed on July 8, 2005, Grant PUD states that the NNI was established as a goal for the HCPs for Wells, Rocky Reach, and Rock Island projects and that NNI is not an appropriate standard or goal for relicensing a project. Grant PUD also indicates that it is opposed to making contributions to the NNI fund. They indicate that the FPA requires balancing of environmental and developmental values and state that this balance includes minimizing or avoiding environmental impacts while facilitating developmental benefits. Grant PUD indicates that licensed projects may result in unavoidable losses.

As recommended by NOAA Fisheries and WDFW, the NNI goal would consist of eliminating project effects to the greatest practical extent and then mitigating for any remaining project effects through hatchery supplementation and habitat mitigation. Achieving NNI or compensating for failure to achieve NNI through contributions to a NNI fund would essentially provide 100 percent mitigation for project effects on salmon and steelhead species affected by the project. Achieving these goals would result in increased adult returns of salmon and steelhead to the mid-Columbia River and would help to prevent extinction of federally-listed species and prevent listing of non-listed species.

NOAA Fisheries and WDFW indicate that the existing data suggest that the project fails to achieve the passage survival standards for spring Chinook salmon, summer Chinook salmon, steelhead, and sockeye salmon. Based on their estimates of survival for these four species and hatchery production costs, NOAA Fisheries and WDFW estimate that Grant PUD should annually contribute $2,562,206 to the NNI fund.[39] NOAA Fisheries and WDFW do not specifically indicate how the NNI funds would be used to make up for failure to achieve the survival standards. It is possible these funds would be used to supplement ongoing hatchery production, provide for

[39] Fund contributions would be $322,400 for spring Chinook salmon, $1,017,645 for summer Chinook salmon, $46,057 for steelhead, and $1,176,104 for sockeye salmon.

additional habitat improvements, or some other measures. NOAA Fisheries and WDFW indicate that when the survival standards are achieved for a species, NNI fund contributions for that species would be discontinued.

Salmon and Steelhead – Future Populations

Under section 10(j), WDFW recommends that if a long-term hatchery program or a threshold population of naturally reproducing coho salmon and/or Okanogan spring-run Chinook salmon is established, Grant PUD should develop, fund, and implement comprehensive protection programs for these species.

Our Analysis

The endemic stock of coho salmon from the mid-Columbia River is considered extinct. Recent reintroduction efforts have resulted in the return of adult coho salmon, including over 10,000 adults in 2001. WDFW recommends that if the coho salmon reintroduction is successful, Grant PUD should provide hatchery funding to mitigate impacts to juvenile coho salmon in the project area. Grant PUD indicates it is concerned about the effects of coho salmon reintroduction efforts on the efforts to restore UCR spring-run Chinook salmon and UCR steelhead and they believe it is more prudent to focus efforts on restoring existing salmon and steelhead runs. However, Grant PUD also indicates that if the reintroduction program for coho salmon is successful, they would reconsider their position in regard to hatchery funding.

Okanogan spring-run Chinook salmon are considered extinct. This run of Chinook salmon historically spawned in the Okanogan River, which is a tributary to the Columbia River that is upstream of the Priest Rapids Project. WDFW indicates that there is an ongoing program to reintroduce spring-run Chinook salmon to the Okanogan River. WDFW states that as these efforts proceed, the same mitigative measures afforded to other upper Columbia River salmon and steelhead should be provided to spring-run Chinook salmon that are produced from the Okanogan River. Grant PUD indicates that the measures that would be implemented for UCR spring-run Chinook salmon would address impacts to any Okanogan River spring-run Chinook salmon. WDFW indicates that hatchery mitigation of 7% per dam would be necessary for Okanogan River spring-run Chinook salmon if the run establishes a threshold population.

The measures that would be implemented at the Priest Rapids Project to protect and restore the existing salmon and steelhead populations would provide similar benefits for any reintroduced populations of coho salmon or Okanogan River Chinook salmon. If reintroduction efforts reach some as-yet unspecified threshold population level, hatchery mitigation may be warranted and would have some benefit towards maintaining

or enhancing these populations. However, because there is no evidence that either population has established a threshold population, including a requirement for hatchery mitigation in any new license would have no immediate or near-term effects on either species and if reintroduction efforts are unsuccessful, it would ultimately have no effect on either species.

Salmon and Steelhead – Studies and Monitoring

As part of its license application, Grant PUD proposes to operate and maintain PIT-tag detection equipment at the Priest Rapids fishways. Grant PUD proposes to use radiotelemetry or other techniques to evaluate upstream and downstream route-specific survival at Priest Rapids and Wanapum dams. Grant PUD would conduct survival studies using PIT-tag technology to obtain dam and project passage survival estimates.

Under section 18 of the FPA, NOAA Fisheries prescribes that Grant PUD conduct biological evaluations of the Wanapum dam bypass facility and any bypass system that may ultimately be approved for Priest Rapids dam. NOAA Fisheries prescribes that Grant PUD obtain NOAA Fisheries approval of any biological studies related to upstream or downstream passage studies before testing commences. NOAA Fisheries prescribes that Grant PUD continue to operate and maintain PIT tag detection capability in the left and right bank fishways at Priest Rapids Dam.

Under section 18 of the FPA, Interior prescribes that Grant PUD develop plans for and conduct periodic evaluations of fishway effectiveness. Interior prescribes that Grant PUD conduct dam and reservoir passage studies to evaluate progress towards meeting survival standards. Interior also states that they retain the right to review and approve all biological testing methods for evaluating fishway effectiveness.

Under section 10(j) of the FPA, NOAA Fisheries and WDFW recommend that Grant PUD conduct survival studies for anadromous fish species to measure the progress towards meeting survival standards and to adjust the NNI Fund. NOAA Fisheries recommends that Grant PUD produce a Performance Evaluation Program, in coordination with other hydropower operators in the Columbia basin and the Northwest Power Planning Council, for the Project to assess improvements in passage survival, habitat, and the hatchery program. NOAA Fisheries recommends that Grant PUD summarize the results of the Performance Evaluation Program in a Performance Evaluation Report every 3 years. NOAA Fisheries recommends that Grant PUD produce annual Progress and Implementation Plans that describe the implementation of measures for anadromous fish. NOAA Fisheries and WDFW recommend that Grant PUD develop and fund a monitoring and evaluation program to assess the effectiveness of the spring, summer, and fall Chinook salmon and steelhead hatchery programs. WDFW also

recommends that Grant PUD develop and fund monitoring and evaluation programs to assess the effectiveness of the sockeye salmon hatchery program.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD assess indirect mortality and injury rates for juvenile salmon and assess direct and indirect survival via smolt-to-adult evaluations. CRITFC recommends that Grant PUD contribute funding to regional evaluations of salmon stocks affected by the project, including life-cycle analyses, genetic assessments, and stock productivity and carrying capacity analyses.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD fund redd counts and carcass surveys for steelhead in 8 streams that are tributary to the Columbia River within the project area. WDFW also recommends that Grant PUD fund monitoring of water temperature and discharge in the 8 survey streams.

Our Analysis

Grant PUD proposes and NOAA Fisheries, Interior, WDFW, and CRITFC recommend that Grant PUD conduct a variety of studies to assess salmon and steelhead passage survival through the project area. These assessments would include studies of adult passage through the project fishways and studies of juvenile passage through the project reservoirs and various routes through the project dams. The results of these studies would be used to determine if the passage survival standards are being achieved and they would provide route-specific survival rates that could be used to review and refine of the operation of passage facilities and other project features used for fish passage (e.g. spillways). Juvenile survival through the project area and route-specific juvenile survival rates could be derived from PIT-tagging or radiotelemetry studies. Detection of PIT-tagged adults would allow for some estimation of smolt-to-adult survival rates and may provide additional information about juvenile route-specific survival. In general, the survival studies proposed by Grant PUD and the agencies are necessary for estimating achievement of the survival standards and they would provide useful information for any possible refinement that may be necessary to achieve these standards.

NOAA Fisheries and WDFW recommend that Grant PUD monitor the effectiveness of the hatchery programs for spring, summer, and fall Chinook salmon and steelhead. WDFW also recommends that Grant PUD monitor the success of the sockeye salmon hatchery program. NOAA Fisheries and WDFW indicate that to evaluate the success of these hatchery programs, Grant PUD should develop and implement a monitoring and evaluation plan within one year of license issuance and update the plan every 5 years. The agencies indicate that monitoring and evaluation is necessary to

ensure that the hatchery programs are mitigating project effects and meeting program goals. Sex, age, and coded wire tag sampling of hatchery returns would allow assessment of the contribution of hatchery fish to the natural population, the influence of hatchery strays, and population estimation. A monitoring and evaluation plan would be useful for tracking the success of the hatchery programs and would allow for any adjustments in hatchery production levels if the contribution of hatchery fish differs significantly (i.e., lower or higher) from what is expected.

NOAA Fisheries recommends that Grant PUD develop a Performance Evaluation Program to assess improvements in passage survival, habitat mitigation, and the hatchery program. NOAA Fisheries recommends that Grant PUD summarize the Performance Evaluation Program in a Performance Evaluation Report every 3 years. NOAA Fisheries recommends that Grant PUD produce annual Progress and Implementation Plans describing the implementation of measures for anadromous fish.

NOAA Fisheries indicates the Performance Evaluation Program would allow for measurement and evaluation of the effects of individual mitigation measures, assessment of the contribution of mitigation measures in meeting overall goals, and identification of new efforts or measures that would help to meet mitigation goals. They indicate that an annual Progress and Implementation Plan would enable use of an adaptive management approach by describing the results of measures that have been implemented and defining the measures that would be implemented during the upcoming year. They also indicate that the annual plans would include updates to the operation, inspection, and maintenance of all juvenile and adult fishways. Development of a Performance Evaluation Program including the preparation of annual Progress and Implementation Plans would help to ensure that progress is made towards achieving the project mitigation goals for salmon and steelhead and would allow effective implementation of an adaptive management approach.

CRITFC recommends that Grant PUD contribute funding to regional evaluations of salmon stocks affected by the project. They suggest that these funds could be used to perform life-cycle analyses, genetic assessments, stock productivity analyses, and carrying capacity analyses.

CRITFC states that these studies are needed to quantify or ground-truth the benefit of the passage survival standards proposed by Grant PUD and the agencies. They state that assessment of the survival standards is needed to determine if the standards are adequate for achieving regional productivity/escapement goals for salmon and steelhead.

Specific juvenile production or adult escapement levels may serve as goals for agencies and tribes managing these species; however, in the context of relicensing, they

are not an appropriate means for identifying measures that serve project purposes or mitigate project effects. The specific benefits of achieving the passage survival standards, providing hatchery supplementation, and improving tributary habitat conditions as part of relicensing the Priest Rapids Project is discussed elsewhere in this section. In general, the combination of these efforts would mitigate for virtually all project effects on salmon and steelhead stocks, and as such, both NOAA Fisheries and WDFW indicate that implementation and achievement of these measures would result in the Priest Rapids Project having no net impact.

The ability to achieve regional salmon and steelhead production goals or escapement goals encompasses numerous factors that are unrelated to effects of the Priest Rapids Project; therefore, these goals have little utility in identifying or defining conditions for relicensing the project. Rather it is more useful to identify measures that mitigate for or eliminate project effects or measures that serve project purposes. The studies recommended by CRITFC would provide general biological information about salmon and steelhead stocks that occupy the project area but they have no specific nexus to the project because they are unrelated to identifying or mitigating project effects and they would not serve project purposes.

WDFW recommends that Grant PUD conduct redd counts and carcass surveys of steelhead in 8 tributary streams that enter the project area. They also recommend that Grant PUD monitor temperature and discharge in these 8 streams.

WDFW states that the steelhead that spawn in the tributaries to the project area are part of the UCR steelhead population. They suggest that the information gathered through these surveys would contribute to understanding what role these fish play in maintaining the viability of the UCR steelhead population. They state that collection of the temperature and discharge data would not cost much but it would add a lot to the understanding of steelhead distribution within and among the tributaries.

There is not much information in the Commission's record describing the fish communities of the tributaries in the project area. Pfiefer et al. (2001) conducted some sampling in these streams and found rainbow trout to be the most common salmonid species. Genetic analysis of these fish suggests they are not steelhead (Dresser et al.; 2003).

Conducting specific surveys for steelhead in these tributaries would provide general information about a portion of the UCR steelhead population and this information may be useful to the agencies and tribes that manage this species. However, there is no evidence that the project has any effects on the habitat within these tributary streams and WDFW did not provide any evidence that the project is affecting these steelhead any

differently than other portions of the UCR steelhead population that migrate through the project area. We conclude that the project effects on the steelhead that may be using project tributary streams would be the same as for any other steelhead that migrate through the project area. Our analysis of project effects on UCR steelhead and measures to mitigate these effects is presented elsewhere in this section.

Salmon and Steelhead – Hanford Reach and Project Operations

In the license application, Grant PUD proposed several operational measures to reduce flow fluctuations and their effects on fall Chinook salmon in the Hanford Reach. Grant PUD also indicated that they were attempting to develop agreements with other mid-Columbia River dam operators to address the cumulative effects of dam operations on Hanford Reach flows.

On April 19, 2004, Grant PUD filed an offer of settlement and the Hanford Reach Fall Chinook Protection Program Agreement (Hanford Reach Agreement). The Hanford Reach Agreement was signed by Grant PUD, Chelan PUD, Douglas PUD, Bonneville Power Administration, NOAA Fisheries, WDFW, and the Confederated Tribes of the Colville Indian Reservation. Under the Hanford Reach Agreement, Grant PUD would coordinate with the upstream dam operators to provide a minimum flow of 55 to 70 thousand cubic feet per second (kcfs) during the fall Chinook salmon spawning period. Through monitoring of redd locations on Vernita Bar[40] within the Hanford Reach, Grant PUD would annually establish a Critical Flow for protection of fall Chinook salmon during the pre-hatch, post-hatch, and emergence periods. Flows within the Hanford Reach would be maintained at or above the Critical Flow by drafting water from Priest Rapids, Wanapum, Rocky Reach, and Wells reservoirs. Contributions from the Rocky Reach and Wells projects will be coordinated with Grant PUD's releases from the Priest Rapids Project.

Additionally, the Hanford Reach Agreement provides that Grant PUD would coordinate dam operations with upstream operators to limit fluctuations in outflow from Priest Rapids dam during the fall Chinook rearing period within the Hanford Reach. The specific limits on day-to-day fluctuations are outlined on pages 4-142 and 4-143 of the license application. Generally, these limits restrict operations to small fluctuations (i.e., 20 kcfs) during periods of low flows and larger flow fluctuations (i.e., up to and exceeding 60 kcfs) during periods of high flows. Grant PUD would maintain a minimum flow of 36 kcfs in the Hanford Reach, although higher minimum flows would be released

[40] Vernita Bar is an important spawning area for Fall Chinook salmon located in the Hanford Reach downstream of the Priest Rapids dam.

throughout much of the year to protect spawning, incubating, or rearing fall Chinook salmon. Grant PUD would also investigate the feasibility of habitat modifications in the Wanapum dam tailrace to increase the amount of high quality fall Chinook salmon habitat.

Under section 10(j) of the FPA, NOAA Fisheries and WDFW recommend that Grant PUD implement the flow regimes and river operations specified in the Hanford Reach Agreement.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD survey Vernita Bar to determine the initiation of fall Chinook salmon spawning, the location of redds, and the extent of spawning. WDFW recommends that Grant PUD conduct aerial surveys of the Hanford Reach to determine the initiation of spawning and to identify spawning at higher elevations than present at Vernita Bar. WDFW recommends that Grant PUD conduct a study to estimate fry stranding losses in the Hanford Reach in 2011, 2012, and 2013.

Under section 10(j) of the FPA, Interior recommends that Grant PUD limit daily flow fluctuations from the Priest Rapids Project to no more than 10,000 cfs around an estimated weekly average outflow target from March 1 to June 15 of each year. Interior recommends that the outflow target be derived using the Single Trace Procedure of the National Weather Service River Forecast System or a similar forecasting procedure. Interior specifies that the responsibility for meeting these flow requirements shall not be transferred to a federal hydroelectric facility. CRITFC also recommended these measures.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a plan to conduct annual juvenile Chinook salmon entrapment loss assessments for the entire Hanford Reach. Interior also recommends that Grant PUD develop and implement a comprehensive investigation of juvenile Chinook salmon stranding in the Hanford Reach. Under Section 10(a) of the FPA, CRITFC also recommends that Grant PUD conduct a survey to assess stranding and entrapment.

Under section 10(j) of the FPA, Interior recommends that Grant PUD maintain flows from the Priest Rapids Project from October 15 through November 30 to provide and maintain suitable spawning habitat conditions in all spawning areas of the Hanford Reach to accommodate the expected escapement fall Chinook salmon. Interior also recommends that Grant PUD be required to maintain flow releases for the successful incubation of eggs in redds from November 30 to the end of fall Chinook salmon emergence. Under section 10(a) of the FPA, CRITFC also recommends these measures

and states that Grant PUD should not release flows less than 50,000 cfs until after emergence.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a plan to conduct aerial orthophotography surveys each year during the spawning season at all known spawning areas within the Hanford Reach. Under section 10(a) of the FPA, this measure is also recommended by CRITFC. Interior also recommends that Grant PUD develop and implement a monitoring plan to determine the effect of fluctuating flows on spawning behavior, redd placement, the extent of daytime and nighttime spawning, and the extent of deep-water spawning.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a plan to monitor and evaluate project effects on primary and secondary productivity and resident fish in the Hanford Reach. Under section 10(a) of the FPA, CRITFC also recommends this measure, although they did not indicate a need to study effects on resident fish.

Under section 10(j) of the FPA, Alaska Department of Fish and Game (ADFG) recommends that Grant PUD operate the project and conduct studies and monitoring as recommended in Anglin et al. (2005). ADFG recommends that new conditions be included in the license that reduce stranding and entrapment of juveniles and increase productive spawning habitat of Hanford Reach fall Chinook salmon. ADFG recommends that Grant PUD operate the project consistent with the operational strategy or framework described in Anglin et al. (2005). ADFG recommends that Grant PUD conduct annual loss assessments and a comprehensive study of stranding in the Hanford Reach. ADFG recommends that Grant PUD provide suitable spawning conditions to accommodate expected adult escapement. ADFG recommends that Grant PUD conduct additional research, monitoring, and evaluations to better assess the spawning needs of adult fall Chinook salmon.

Our Analysis

The Hanford Reach is the longest unimpounded portion of the mainstem Columbia River that is still accessible to anadromous salmon. This reach is important spawning and rearing habitat for fall Chinook salmon. Hanford fall Chinook salmon are the largest and most productive population of wild salmon remaining in the Pacific Northwest (Huntington et al., 1996). Hanford fall Chinook salmon are a component of the Upper Columbia River summer/fall Chinook salmon ESU, which is one of the few populations of Chinook salmon within the Columbia River system that has not warranted listing under the endangered species act.

Hanford fall Chinook salmon support Columbia River Treaty Indian subsistence fisheries and commercial fisheries. Additionally, because these fish are abundant and not protected under ESA, they make significant contributions to non-Indian sport and commercial fisheries. In the ocean, Hanford fall Chinook salmon migrate as far north as southeast Alaska. Hanford Reach fall Chinook salmon make significant contributions to sport and commercial ocean fisheries, making up a large percentage of the ocean Chinook salmon harvest occurring off the coast of Canada and southeast Alaska (7-16% of total catch; Anglin et al., 2005). Fall Chinook salmon are an indicator stock used by the Pacific Salmon Commission to regulate ocean salmon harvest under the Pacific Salmon Treaty.[41] As an indicator stock, increases or decreases in the abundance of Hanford fall Chinook salmon can affect the magnitude of the ocean harvest recommended by the Pacific Salmon Commission to the United States or Canada.

Flows released from Priest Rapids dam influence the quantity and quality of fall Chinook salmon habitat within the Hanford Reach. Additionally, short-term flow fluctuations that occur within the Hanford Reach have been shown to result in stranding and entrapment of juvenile fall Chinook salmon (McMichael et al., 2003; Anglin et al., 2005).

During periods of high flows, spawning fall Chinook salmon create redds in areas of the Hanford Reach that may be dewatered or exposed at lower flows. Dewatered redds generally have lower hatch rates and survival rates and freezing or desiccation can result in loss of the entire redd. To reduce the likelihood of redd dewatering, Grant PUD, NOAA Fisheries, and WDFW recommend implementation of the HRA. In general, the HRA includes guidelines for establishing a minimum flow (i.e., protection flow) for each spawning season. During the onset of spawning, Grant PUD would use reverse load factoring[42] or other methods to manipulate flows and encourage redd formation at elevations below the 70,000 cfs flow level. To determine the location and number of redds, a monitoring team composed of a Grant PUD biologist, a WDFW biologist, and one other biologist from another agency or tribe would survey portions of Vernita Bar. Additionally, the monitoring team would conduct aerial surveys of the Hanford Reach to identify spawning locations. Based on this information, the parties of the HRA would establish a minimum protection flow for the remainder of the spawning season.

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[41] The Pacific Salmon Treaty is an agreement between the governments of the United States and Canada that established the Pacific Salmon Commission. The Pacific Salmon Commission advises the two counties on approaches for promoting the optimum production and equitable exploitation of Pacific salmon stocks.

[42] In general, reverse load factoring is the intentional reduction of power generation during the day and increased power generation at night.

Monitoring and flow manipulation would minimize the formation of redds above the 70,000 cfs level and should prevent or reduce redd dewatering during spawning.

Interior, CRITFC, and ADFG also make several recommendations for the fall Chinook spawning season which include 1) providing flows that would maintain enough suitable spawning habitat to accommodate expected escapement (i.e., returning spawners), 2) conduct aerial orthophotography surveys of all spawning areas within the Hanford Reach, and 3) monitor and study the effects of flow fluctuations on spawning behavior, redd placement, spawning time (within-day), and the extent of deep-watering spawning. In comments filed on May 26, 2005, Interior suggests that redd superimposition[43] during the fall Chinook salmon spawning season reduces redd survival and limits overall juvenile production. They suggest that increasing the amount of available habitat would reduce redd superimposition and improve red survival. Interior states that eliminating flow fluctuations and releasing constant flows from Priest Rapids dam would substantially increase the available spawning habitat within the Hanford Reach. They recommend that each year, fishery representatives from the agencies and tribes should use escapement and water availability predictions to establish a flow regime for the forthcoming spawning season.

Anglin et al., (2005) estimated that available spawning habitat in the Hanford Reach increased within increased flows and suggested that approximately 944 to 1329 acres of spawning habitat would be needed to accommodate 100,000 spawners. The flow versus habitat relationship presented by Anglin et al. (2005) suggests that approximately 80-100 kcfs would create the approximately 1000 acres of spawning habitat which would be needed for 100,000 spawners. These are general estimates taken from Anglin et al. (2005) and are based on calculations and modeling presented in Anglin et al. (2005) that has not been validated or verified. Maintaining flows at 80-100 kcfs during the spawning season may increase fall Chinook salmon spawning habitat within the Hanford Reach and may increase overall production through increased spawner success and reduced redd superimposition. However, neither Interior nor Anglin et al., (2005) provided any evidence that spawner success is related to available habitat. Additionally, there is no information in the record to indicate that available habitat is limiting production or that redd superimposition is a substantial factor influencing production. Lastly, some redd superimposition would likely occur regardless of amount of habitat available since late arriving spawners are likely to select the same preferred habitat areas that early spawners selected.

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[43] Redd superimposition is when late arriving adult spawners spawn in the same locations as early spawners, thereby disturbing and potentially destroying the early spawner redds.

From a practical standpoint, it is not clear that providing steady state flows to accommodate predicted spawning escapement is possible. Interior suggests that by using predictions of water availability and escapement, fisheries managers could establish a flow level that would provide spawning habitat to accommodate the number of returning spawners. However, while Anglin et al. (2005) explored the relationship between flow and spawning habitat, currently there is no reliable or verified method for predicting the amount of spawning habitat within the Hanford Reach as it relates to flow. Without this tool, managers would be unable to determine the appropriate flow level. Additionally, the current ability to predict escapement and to a lesser extent, water availability is imprecise and often unreliable. It is very likely that escapement predictions would significantly over- or under-estimate the number of returning spawners which would often result in selection of flows that would provide too little or too much spawning habitat. While the ability to predict water availability is generally more reliable than escapement predictions, it is possible that inaccuracies in water prediction would also result in selection of inappropriate or even unachievable flow levels.

Lastly, the ability of Grant PUD to reregulate inflows from the upstream projects is limited. Inflows to the Priest Rapids Project vary dramatically on an hourly, daily, weekly, and seasonal basis and the useable storage within the Priest Rapids Project is generally not great enough to fully reregulate inflows from the upstream projects for much more than a few days. To release steady state flows from Priest Rapids dam throughout the entire spawning season, modifications to the operation of some or all of the seven mainstem mid-Columbia River dams would need to be considered. While the operation of all seven dams could be modified to provide steady state flows to the Hanford Reach, these changes would affect the ability of the system to provide load following energy generation and they would likely have indirect effects on reservoir fisheries, recreation, and other resource areas.

Interior, CRITFC, and ADFG also recommend that Grant PUD conduct aerial orthophotography surveys at all known spawning areas within the Hanford Reach during the spawning season. They suggest these surveys should be conducted to help quantify the progression, extent, and geographic location of fall Chinook salmon redds within the Hanford Reach. Interior indicates that this information would provide managers with additional data regarding the physical conditions of the habitats selected by spawners and it could be used to fine-tune project operations.

It is not clear if the survey recommended by Interior, CRITFC, and ADFG differs from the aerial survey proposed in the HRA. Both surveys would determine the timing and location of spawning and could be used to assess and adjust flow releases to the Hanford Reach.

Interior, CRITFC, and ADFG recommend that Grant PUD be required to monitor and study the effects of flow fluctuations on spawning behavior, redd placement, spawning time (within-day), and the extent of deep-watering spawning. Interior indicates that this information would be used to make management decisions regarding the specific hydrograph that would provide adequate amount of spawning habitat in the Hanford Reach.

While this information would be useful to fisheries managers, Interior has not provided any evidence that flow fluctuations adversely affect spawning behavior or site selection. Additionally, because flow fluctuations are the cumulative result of operations of the seven dam system, it is not apparent that the existing flow fluctuations are entirely related to project effects (i.e., if Grant PUD were required to operate the Priest Rapids Project in run-of-river mode, substantial flow fluctuations would still occur within the Hanford Reach).

In the Hanford Reach, fall Chinook salmon spawning generally takes place from October through December. The eggs incubate within the redds for several months before hatching as yolk sac fry, which are called alevins. Alevins remain within the redd for several more weeks or months until they have consumed the yolk sac and then emerge from the redd between late March and the end of May. The survival of eggs, alevins, and emerging fry can be reduced by exposure from dewatering during flow fluctuations. To address this, Grant PUD, NOAA Fisheries, and WDFW recommend implementation of the HRA which includes several measures to reduce the potential of dewatering redds or emerging fry. These operational measures are the same as the terms of the Vernita Bar Agreement that has been implemented since 1988.

Under the HRA, Grant PUD would use storage within the Priest Rapids Project during the incubation period to maintain the protection flow established by the monitoring team during the spawning season. Maintenance of the protection flow would keep redds inundated. Under the terms of the HRA, Grant PUD could reduce outflow below the protection flow to 36 kcfs for short periods of time.[44] Reductions in outflow to 36 kcfs would expose or dewater redds during the incubation period. While long-term exposures or dewatering could result in desiccation and freezing of redds and reduce egg survival, the shorter and less frequent exposures contemplated by the HRA would not likely to result in significant egg mortality since bank storage would prevent desiccation or freezing during the short exposure period.

[44] The HRA specifies that reductions to 36 kcfs should be for no more than 8 hours on weekdays and 12 hours on weekends.

Under the HRA, the monitoring team would track the timing of hatching on Vernita Bar. Once hatching begins, Grant PUD would maintain the protection flow so that the intergravel water level is no less than 15 centimeters (cm; approximately 6 inches) below the protection flow elevation on Vernita Bar.[45] Flows maintained at or above this level would prevent exposure of alevins within the redds to desiccation or freezing. The 15 cm reduction below the protection flow level would still maintain protection of the redds since it corresponds to the approximate depth of the alevins within the shallowest protected redds.

Under the HRA, the monitoring team would track the timing of emergence at Vernita Bar. Once emergence begins, Grant PUD would maintain the protection flow in the Hanford Reach for the remainder of the emergence period.[46] Flows maintained at or above this level would prevent exposing emerging fry to desiccation or freezing.

To protect incubating eggs, alevins, and emerging fry, Interior, CRITFC, and ADFG recommend that Grant PUD maintain flow releases for the successful incubation of eggs in redds from November 30 through the end of emergence. They indicate that the specific operations and flows would be determined by the agencies, tribes, and dam operators, which is similar to the approach proposed in the HRA. Interior, CRITFC, and ADFG did not provide specific information on how the appropriate flows would be selected or how often they would be modified (i.e., once annually or multiple times per spawning season). It appears that the flows would be based on some form of ongoing seasonal monitoring, which is similar to the methods proposed in the HRA. Without additional specific information regarding the flow selection, we are unable to evaluate the specific effects of this recommendation, although it appears that it would provide similar or equivalent protection for incubating eggs, alevins, and emerging fry as the HRA.

After emergence, juvenile fall Chinook salmon spend several weeks or months rearing within the Hanford Reach before they begin their outmigration during the summer months. During the rearing period, fluctuating flows within the Hanford Reach can result

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[45] The HRA provides that flows can be reduced to 15 cm below the 50 kcfs elevation when hatching has only occurred below this point. Once hatching occurs above the 50 kcfs elevation, the flows could only be reduced to 15 cm below the protection flow elevation.

[46] The HRA provides that flows can be reduced to the 50 kcfs elevation when emergence has only occurred below this point. Once emergence occurs above the 50 kcfs elevation, the flows could not be reduced below the protection flow elevation.

in stranding and entrapment of juveniles along shoreline areas. McMichael et al. (2003) estimated the number of fall Chinook salmon fry mortalities from stranding or entrapment in the Hanford Reach from 1999 to 2003. Over this time, annual mortality estimates averaged 1.62 million fry and ranged from 155,703 to 6,864,851 fry per year. McMichael et al., (2003) estimated that these mortalities represented 0.3 to 10.6 percent of fall Chinook salmon fry produced in each study year. Annual average fry mortality during the study period was 2.5 percent. Excluding the results from 2001, which was an extreme low flow year,[47] McMichael et al. (2003) estimated that the annual average fry mortality from stranding or entrapment in the Hanford Reach was 0.5 percent.

Anglin et al. (2005) estimated that the number of fall Chinook salmon fry mortalities from entrapment in the Hanford Reach in 2003 was 1,320,169. This estimate is approximately 2.5 times greater than the 527,922 mortalities predicted by McMichael et al. (2003) for the 2003 spawning season.[48] Anglin et al. (2003) also estimated that these entrapment mortalities for 2003 likely represented 4 to 31 percent of the fry production in the Hanford Reach.[49] Anglin et al., (2005) predicted that the estimated fry losses from entrapment could reduce fall Chinook salmon returns from the 2003 spawning year by approximately 4,000 to 13,000 adults. Anglin et al. (2003) also derived flow-related models to estimate the amount of fall Chinook salmon spawning and rearing available within the Hanford Reach.

To reduce stranding and entrapment of juvenile salmon in the Hanford Reach, Grant PUD, WDFW, and NOAA Fisheries recommend implementation of the rearing period operations specified in the HRA. Under the HRA, Grant PUD would limit flow fluctuations from Priest Rapids dam based on the anticipated inflow to the project area.[50]

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[47] The March to June Columbia River flows recorded at the Dalles Dam in 2001 were the second lowest since 1879.

[48] Anglin et al. (2005) indicate that their estimate includes only entrapment mortality, while the McMichael et al., (2003) estimate represents both entrapment and standing mortality.

[49] We were unable to replicate the percentages given by Anglin et al. (2003) using the numbers provided in the draft report. Using the numbers provided by Anglin et al. (2003), we estimated that the percentages ranged from 5 (26,692,310/1,320,169 x100) to 42 (3,114,103/1,320,169 x 100) percent.

[50] Specifically, the flow fluctuation range for Priest Rapids dam on weekdays would be determined by the previous day's average inflow to Wanapum reservoir. Weekend flow fluctuations would be based on the average of BPA's Friday Chief Joseph outflow estimates plus tributary inflow estimates for Saturday and Sunday.

For example, when the anticipated inflow would be between 36 and 80 kcfs, releases from Priest Rapids dam would not fluctuate by more than 20 kcfs each day. As inflow estimates increase, the allowable fluctuation range would also increase.[51] At inflows greater than 170 kcfs, Grant PUD would maintain a minimum flow of 150 kcfs and there would be no limit on daily flow fluctuations. The HRA also specifies measures that would be implemented by Chelan PUD, Douglas PUD, and BPA to assist Grant PUD in achieving these flow fluctuation requirements.

McMichael et al. (2003) reported the daily flow conditions in the Hanford Reach from 1999 to 2003. A review of this data shows that occasionally flow fluctuations in the Hanford Reach have been as high as 140 kcfs during the rearing period. These appear to be somewhat uncommon events that primarily occur at higher flows (i.e., flows averaging 150 - 200 kcfs). Flow fluctuations in the 60-90 kcfs range appear to be more common and to some extent, fluctuations in this range appear to be independent of the magnitude of average daily flow. Fluctuations less than 60 kcfs were the most frequent type during 1999-2003.

McMichael et al. (2003) reported that higher numbers of fall Chinook salmon fry per unit area were entrapped or stranded from fluctuations of lower flows than from fluctuations at higher flows. Based on this information, reducing the range of fluctuations at lower flows would have more benefit than reducing fluctuations at higher flows. This conclusion appears to be the basis for the flow fluctuation protocol proposed in the HRA.

Prior to 2002, Grant PUD attempted to limit flow fluctuations to 40 kcfs or 60 kcfs depending on the average flow and the need for fish passage spills at Priest Rapids dam. However, in 2002 Grant PUD added additional fluctuation restrictions at lower flows that were essentially the same as the requirements of the HRA. These additional operational restrictions have been voluntarily implemented by Grant PUD since 2002. Without conducting a thorough hydrologic modeling analysis, it is difficult to determine how significant the operational changes were in reducing the potential flow fluctuations. However, the data presented by McMichael et al. (2003) suggests that in both 2002 and 2003, flow fluctuations were generally less than 20 kcfs during the early part of the rearing period. Later in the rearing period as average flows increased, the range of fluctuations also increased as allowed by the protocol. While year-to-year variations in flows conditions and energy needs make comparisons among years somewhat tenuous, the data presented by McMichael et al. (2003) suggests that the operational changes

[51] Specifically, allowable daily fluctuations would be 20, 30, 40, and 60 kcfs based on inflow ranges of 36-80 kcfs, 80-110 kcfs, 110-140 kcfs, and 140-170 kcfs, respectively.

implemented by Grant PUD in 2002 and 2003 resulted in an increase in smaller flow fluctuations (i.e., less than 20 kcfs) during the rearing period.

The operational protocol proposed by Grant PUD, NOAA Fisheries, and WDFW would require Grant PUD to limit flow fluctuations to 20 kcfs at flows less than 80 kcfs. This would be a significant restriction when compared to historic operations and would reduce the occurrence of stranding and entrapments within the Hanford Reach during low flows. Under the HRA, somewhat larger fluctuations would be allowed at higher flows. As indicated by McMichael et al. (2003), fluctuations at higher flows appear to be less significant in terms of stranding and entrapments; therefore, incremental increases in the allowable fluctuation range as flows increase should maintain adequate protection for rearing fall Chinook salmon fry and limit strandings and entrapments at these flows. While the operational changes proposed in the HRA would reduce stranding and entrapments of fall Chinook salmon fry in the Hanford Reach, these measures would not eliminate all mortalities caused by flow fluctuations. Therefore, to mitigate for losses in the Hanford Reach associated with operation of the Priest Rapids Project, Grant PUD proposes to annually stock 1,000,000 fry in the project reservoirs. As indicated above, annual estimates of losses from flow fluctuations in the Hanford Reach range from 155,703 to 6,864,851 fry per year (McMichael et al., 2003; Anglin et al., 2005). These losses resulted from a mixture of less strict operational limits and voluntary implementation of the current proposal. It is likely that fewer losses would occur with full implementation of the HRA, including coordination with and participation by the upstream operators. Based on this information, it appears that the proposed level of hatchery mitigation is reasonable and would fully mitigate the Priest Rapids Project's share of the impact on fry in the Hanford Reach. We evaluate the benefit of the proposed hatchery mitigation earlier in this section under *Salmon and Steelhead – Hatchery Programs*.

A review of the flow data presented by McMichael et al. (2003) indicates that each year from 1999-2003, there were occurrences where Grant PUD's operation of the Priest Rapids Project resulted in flow fluctuations that exceeded the limits specified in the operational protocol. Several of the exceedences were classified as a "narrow miss", meaning the fluctuation exceeded the allowable limit by a small amount (i.e., less than 5 kcfs) for a short period of time (i.e., 1 - 3 hours). A few exceedences resulted from dispatcher errors. The majority of the exceedences were caused by high inflows that could not be reshaped by the available storage of the Priest Rapids and Wanapum reservoirs (McMichael et al., 2003). While it is possible that some exceedences may occasionally occur under the HRA due to unforeseen circumstances, we would expect that Grant PUD's ability to comply with the flow fluctuation limits would improve if the HRA became a requirement of a new license. In part, this would be because Grant PUD's previous efforts to comply with the fluctuation limits were voluntary and Grant

PUD likely treated the flow fluctuation limits as targets or guidelines as it experimented with protocols and systems for meeting these fluctuation limits. If the HRA became a requirement of a new license, we would expect that Grant PUD would have a strict and precise operational protocol in place to avoid problems with "narrow misses" and dispatcher errors. Additionally, and perhaps more importantly, problems with excessive inflows to the Priest Rapids Project that exceeded Grant PUD's ability to store water would be remedied by measures in the HRA that would be implemented by Chelan PUD, Douglas PUD, and BPA. These measures include use of storage within the Rocky Reach and Wells projects and monitoring and coordination of generation needs and flow releases at Chief Joseph dam. Through these efforts, Chelan PUD, Douglas PUD, and BPA would help Grant PUD to meet its flow fluctuation obligations for the Priest Rapids Project.

To limit entrapments and strandings in the Hanford Reach during the rearing period, Interior, CRITFC, and ADFG recommend that Grant PUD be required to limit flow fluctuations to no more than 10 kcfs around an estimated weekly average outflow target. Anglin et al. (2005) presented modeling results that predicted the number of fry entrapped under alternative operational schemes that restricted fluctuations to 10, 20, 30, and 40 kcfs. For each fluctuation range, Anglin et al. (2005) tested a fluctuation frequency of 5 and 10 fluctuations per week. Anglin et al. (2005) predicted that 10 fluctuations of 40 kcfs per week would entrap approximately 2,009,414 fry during the rearing period. Five fluctuations of 10 kcfs per week would entrap 82,739 fry during the rearing period and 10 fluctuations of 10 kcfs per week would entrap 99,373 fry (Anglin et al., 2005). These predictions suggest that smaller, less frequent fluctuations in the Hanford Reach would entrap fewer fall Chinook salmon fry during the rearing period. This predicted trend is reasonable and somewhat intuitive since complete elimination of fluctuations (i.e., release of a constant flow) would by definition eliminate fluctuations and any corresponding entrapments. While the overall trend predicted by Anglin et al. (2005) is reasonable, the accuracy (i.e., predicted benefit) of the predicted entrapment estimates is less certain. Anglin et al. (2005) described the collection of field data and development of the entrapment model; however, they provided little explanation or evidence that the model was either validated or verified. In comments filed on July 8, 2005, Grant PUD listed concerns with the entrapment estimates and stated that Anglin et al. (2005) failed to: 1) randomize the selection of entrapment sites for sampling, 2) account for the location of entrapments within each flow band, 3) account for the duration of entrapment events, 4) differentiate daytime from nighttime events, 5) differentiate flow increases from flow decreases, 6) explain the selection of an entrapment mortality rate, and 7) "ground-truth" predicted individual entrapment events. Failure to "ground truth" or validate the predictability of individual entrapment events is the most apparent and perhaps substantial deficiency of Anglin et al. (2005). Without validation, the accuracy of the entrapment predictions is unknown. Anglin et al. (2005)

indirectly acknowledges the uncertainty associated with the entrapment estimates in stating that the results "provide information on the relative impact that the alternative operations would be expected to have" (emphasis added).

Interior, CRITFC, and ADFG recommend a flow fluctuation range (i.e., 10 kcfs) that is lower than any of the fluctuation limits proposed in the HRA (i.e., 20 – 60 kcfs). Intuitively, it would seem that smaller and fewer fluctuations would reduce fall Chinook salmon fry stranding and entrapment; therefore, it is likely that 10 kcfs fluctuation limit would result in less stranding and entrapments than operations that would occur under the HRA. However, as indicated above, because of uncertainty associated with the Anglin et al. (2005) model, the incremental benefit of limiting fluctuations to 10 kcfs is unknown.

Interior, CRITFC, and ADFG recommend that flow fluctuations be no more than 10 kcfs around an estimated Priest Rapids weekly average outflow target. They suggest that the weekly average outflow target should be derived using the Single Trace Procedure of the National Weather Service River Forecast System or a similar forecasting procedure. Additionally, Interior specified that the responsibility for meeting the flow requirements shall not be transferred to a federal hydroelectric facility.

It is unclear why Interior would stipulate that the responsibility for meeting the flow requirements can not be transferred to a federal hydroelectric facility. In general, compliance with a license condition is the responsibility of the licensee. In the case of flow fluctuations, any operational requirement that would be imposed on Grant PUD would need to account for physical limitations of the project and inflows to the project area. Accounting for these factors as part of a license requirement would ensure that if excessive inflows released from upstream federal or non-federal projects upstream forced Grant PUD to exceed fluctuation limits, Grant PUD would not be in violation of the license. This would not be equivalent to Grant PUD transferring responsibility to a federal entity, but rather a practical acknowledgement of the physical limitations of the Priest Rapids Project.

Regardless of Interior's intent, without substantial coordination and involvement of both the federal and non-federal operators of the upstream projects, it is likely that Grant PUD would occasionally be unable to maintain the recommended fluctuation limits for the Hanford Reach. Grant PUD indicates that this is because the physical limitations of the Priest Rapids Project (i.e., reservoir storage and release capacity) can easily be exceeded by flows that could be released by the upstream projects, especially Grand Coulee dam. Grand Coulee dam is the furthest dam upstream and has the greatest total storage ability and generation capability of all seven dams. Grant PUD indicates that the maximum flow capacity of the turbines at Grand Coulee dam is significantly greater than that of each of the downstream hydroelectric projects. Therefore, to operate the system

efficiently, a sophisticated operational plan was developed to allow all of the projects to achieve their operational purposes. Grant PUD indicates that these purposes include flood control, fish migration, navigation, agriculture, recreation, municipal and industrial use, cultural resources, thermal plant cooling water, and power generation and regional electrical system support.

In general, flows released from Grand Coulee dam vary depending on energy demands and the need to meet other project purposes. Through an operational scheme known as the Hourly Coordination Agreement, the operation of Grand Coulee dam and the other six dams is coordinated to optimize hydropower generation and achieve other project purposes. As a result of Grand Coulee dam's significant physical capacity to store and release flows, flow fluctuations are often greatest in the mid-Columbia River immediately downstream of Grand Coulee dam. Through coordination of the seven dams, these fluctuations generally decrease as they pass downstream. Incrementally, each of the six downstream dams reshapes the flows released from Grand Coulee demand cumulatively these operations result in flow fluctuations in the Hanford Reach that are generally smaller than would occur if the six dams operated as true run-of-river projects (i.e., each dam maintaining flow releases that are essentially equal to its inflow). Through coordination with the other mid-Columbia River dams, the Priest Rapids Project reduces or mitigates flow fluctuations that originate at Grand Coulee dam while optimizing project energy production. In comments filed on July 8, 2005, Grant PUD suggests that in order to efficiently operate the seven dam system and achieve project purposes while adhering to the 10 kcfs fluctuation limitation, there would need to be substantial modifications to the coordination between Grant PUD and the other upstream operators, including the federal entities.[52]

With or without coordination with the upstream projects, complying with the 10 kcfs limitation would likely increase fluctuations in Priest Rapids reservoir levels since Grant PUD would need to use the active storage within the reservoirs to reregulate inflows. Without hydrologic modeling that incorporates potential changes to Priest Rapids Project operations or operation of the upstream projects, we are unable to quantify potential changes in reservoir fluctuations. However, it is apparent that additional use of the project's active storage to reregulate upstream flows would increase the frequency and magnitude[53] of reservoir fluctuations. These changes could adversely affect reservoir

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[52] In a letter filed on December 5, 2005, BPA indicated that Grant PUD has the capability to re-regulate flows and accommodate the 10 kcfs restriction; however, BPA acknowledged that this reregulation would require use of the Priest Rapids Project's active storage which could have adverse effects on other resources and project purposes.

[53] We assume that the reservoir operating requirements would be unchanged; therefore,

resources in shoreline areas including fisheries habitat, recreational use, erosion, and cultural resources.

Both the fluctuation restrictions proposed in the HRA and the 10 kcfs restriction recommended by Interior, CRITFC, and ADFG would improve conditions in the Hanford Reach during the rearing period for fall Chinook salmon. However, neither approach would completely eliminate the effects of Priest Rapids Project operations on the Hanford Reach. As suggested above, to completely eliminate the effects of the Priest Rapids Project on Hanford Reach flows, the project would need to be operated in a true run-of-river (ROR) mode. In ROR mode, project outflows would essentially equal project inflows on a short-term basis and the project would have no effect on the flows conveyed to the Hanford Reach. While this mode of operation would eliminate project effects on flows, it would not improve conditions for rearing fall Chinook salmon in the Hanford Reach. Conversely, implementing the HRA restrictions or the 10 kcfs restriction would result in positive (i.e., beneficial) project effects on releases to the Hanford Reach. Both approaches would utilize Priest Rapids Project storage to reduce flow fluctuations before they enter the Hanford Reach, thereby mitigating upstream project effects on flows.

As part of the HRA, Grant PUD, NOAA Fisheries, and WDFW propose that during the rearing periods of 2011, 2012, and 2013, follow-up monitoring would be conducted to estimate fry losses. This monitoring would use the protocols developed for the monitoring conducted by McMichael et al. (2003) during the 1999 – 2003 rearing periods. Monitoring during 2002 and 2003 essentially documented the effects of the HRA.[54] Follow up monitoring would document the effects of the flow program and provide information that could be used to evaluate program effectiveness and consider modifications.

Interior, CRITFC, and ADFG recommend that Grant PUD conduct annual assessments to estimate fall Chinook salmon fry entrapment and stranding losses.

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the total range of reservoir fluctuations would be unchanged. However, maintaining the 10 kcfs fluctuation limit would likely result in an increased frequency of the reservoirs fluctuating from the upper limit to the lower limit. Additionally, some small fluctuations that occur under current operations, may need to be increased to adhere to the 10 kcfs restriction and could encompass the entire reservoir operating range (i.e., increased magnitude of fluctuation).

[54] Grant PUD implemented the terms of the HRA in 2002 and 2003; however, this implementation was voluntary and did not involve the efforts of Chelan PUD, Douglas PUD, and BPA that are outlined in the HRA to assist Grant PUD in meeting the flow requirements.

Interior indicates that Grant PUD should use the methods of Anglin et al. (2005) to estimate entrapment losses and develop a survey design to estimate stranding. Similar to the monitoring proposed in the HRA, this program would document the effects of the flow program and provide information that could be used to evaluate program effectiveness and consider modifications. However, unlike the HRA proposal, Interior's monitoring would allow annual tracking and evaluation of program success. In general, the monitoring proposed by Interior, CRITFC, and ADFG would be more labor intensive than the program described in the HRA.

Interior and CRITFC recommend that Grant PUD monitor and evaluate the effects of project operations on primary and secondary production and resident fish in the Hanford Reach. Interior specifies that Grant PUD should measure and quantify the effects of project operations on periphyton[55] and macroinvertebrates. Interior also indicates that Grant PUD should use the techniques of Anglin et al. (2005) to derive entrapment estimates for resident fish. Interior indicates that this information is needed to determine the acceptable level off flow fluctuations that should be allowed during the June through October time period. Interior states that shoreline dewatering does not allow establishment of viable and persistent periphyton or macroinvertebrate communities that serve as the primary food source for rearing fish. Interior also indicates that entrapment of resident species can result in mortality of these species due to elevated summer water temperatures.

Neither Interior nor CRITFC provide any evidence that either fall Chinook salmon fry or resident fish within the Hanford Reach are food limited, of poor condition, or exhibiting poor growth rates. While it may be reasonable to assume that short-term flow fluctuations influence productivity along the river margins, there is no evidence that the available food supply is limiting fish growth or survival.

As documented by McMichael et al. (2003) and Anglin et al. (2005), resident fish can be entrapped by receding flows. Dewatered entrapments or elevated water temperatures likely result in the mortality of some unknown proportion of these entrapped resident fish. However, while some mortality of resident fish may be occurring within the Hanford Reach, there is no evidence that any of the resident fish species inhabiting the Hanford Reach are declining in abundance as a result of stranding or poor food availability. Collection of this information may be useful for fishery managers as indicated by Interior; however, because there is no evidence that these

[55] Periphyton is an assemblage of microscopic organisms, primarily algae, which grow on substrate surfaces in the aquatic environments. In streams and rivers, periphyton production is often used as an indicator of primary productivity.

potential effects are adversely affecting fall Chinook salmon fry or resident fish, it appears that the information is unnecessary.

Grant PUD proposes to investigate the feasibility for habitat modifications in the Wanapum dam tailrace area to increase the amount of high quality fall Chinook salmon spawning habitat. Grant PUD indicates that potential measures include scarification of cobble bars and creation of a new bar of cobble-sized material. Scarification would decrease imbeddedness and improve hyporrheic conditions in the areas where fall Chinook salmon could spawn within the tailrace. Grant PUD also indicates that modeling indicates that flows from the proposed Wanapum downstream bypass would redistribute material in the tailrace and form a new bar of cobble-sized material. These actions could increase fall Chinook salmon spawning habitat downstream of Wanapum dam.

Bull Trout

Under section 18 of the FPA, Interior prescribes that to provide for bull trout passage, Grant PUD should operate the Priest Rapids Project upstream and downstream fish passage facilities as prescribed for salmon and steelhead.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a Bull Trout Management Plan (BTMP) that includes: 1) monitoring, evaluating, and mitigating project effects on upstream and downstream movements of bull trout, 2) an assessment of juvenile rearing in the project reservoirs, 3) monitoring off-season bull trout passage through the project area, 4) PIT-tagging of sub-adult bull trout that are incidentally collected in the project area, 5) information exchange with regional efforts to evaluate upstream and downstream movements of bull trout in the mid-Columbia River, and 6) reporting monitoring and evaluation results and any incidental take.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD develop a BTMP that incorporate the terms and conditions proposed by the FWS for bull trout and is consistent with the FWS' bull trout recovery plan. WDFW specifies that the BTMP should include a monitoring and adaptive management element.

Our Analysis

Available information suggests that the bull trout abundance in the Priest Rapids Project area is extremely low. Pfeifer et al. (2001) conducted an extensive multi-gear, multi-season fish sampling survey of the project area and reported collecting only two juvenile bull trout among more than 58,000 fish that were collected. One of the bull trout

collected by Pfeifer et al. (2001) was collected in the Priest Rapids reservoir, approximately 2 miles upstream from the dam, and the other was collected within the Wanapum reservoir. In a letter filed on July 8, 2005, Grant PUD indicated that there have been "only a handful" of documented fishway observations of bull trout within the project area over the past 43 years. Grant PUD participated in a combined effort with Chelan and Douglas PUDs to study bull trout movements in the mid Columbia Region. The effort focused on collecting bull trout passing through the project fish ladders, implanting the fish with radio-tags, and tracking their movements after release. During this study (BioAnalysts; 2003), no bull trout were collected from the Priest Rapids or Wanapum fish ladders. All tagged fish were collected from the fish ladders at the upstream Rock Island, Rocky Reach, and Wells dams. A small number of the tagged bull trout were recorded using the upper portion of the Wanapum reservoir (i.e., the first few miles downstream of Rock Island dam) during the winter period (BioAnalysts; 2003). These data suggest that a portion of the mid-Columbia River bull trout population may overwinter in the upstream portions of the Wanapum pool.

Interior and WDFW indicate that bull trout from the Snake River distinct population segment (DPS) occur within the Hanford Reach downstream of the Priest Rapids Project. WDFW suggests that movement of individuals between the upper Columbia River DPS and the Snake River DPS is critical to supporting genetic diversity; however, they provide no evidence that mixing of the two DPSs occurs or fails to occur due to the project. In fact, they state that the effect of the project on the ability of fish to move between the DPSs is unknown. Other migratory salmonids readily utilize the fish ladders at both project dams and based on bull trout movements through the upstream ladders at the Chelan and Douglas PUD projects we would expect that bull trout from the Hanford Reach to be able to access upstream areas inhabited by upper Columbia River bull trout if necessary.

Interior prescribed under section 18 that Grant PUD provide safe, timely, and effective upstream and downstream passage for bull trout by operating the project's upstream and downstream passage facilities in accordance with the measures required for salmon and steelhead. Measures that would be implemented to maintain or improve upstream salmon and steelhead passage would likely benefit bull trout moving upstream or downstream through the project area; however, because all available information suggests that very few bull trout actually move past the project dams, this measure would have little to no real effect on the Snake or upper Columbia River DPSs.

Both Interior and WDFW propose that Grant PUD develop and implement a BTMP. WDFW suggests the BTMP should include monitoring and an adaptive management element to identify and mitigate project effects. Interior specifically suggests that the BTMP include a monitoring program to assess the project affects on

upstream and downstream bull trout passage, assess juvenile rearing in the reservoirs, implement modifications to correct any passage problems that are identified, assess off-season passage counts, PIT tag incidentally collected sub-adult fish, and participate in information exchange and regional monitoring efforts.

In general, implementation of a BTMP may be useful to identify project effects on bull trout and develop measures for implementation; however, there is no evidence that the project has any effects on bull trout since they rarely occur within the project area. Bull trout may overwinter in the upstream end of Wanapum reservoir; however, there do not appear to be any adverse project effects on these fish or this habitat. Additionally, there is no evidence that bull trout are actively migrating either upstream or downstream past the project dams or that the project is adversely affecting the ability of bull trout to move through the project area. Grant PUD indicated that "only a handful" of bull trout have been observed within the project fish ladders over the past 43 years. Additionally, there is no documentation in our record of the occurrence of juvenile or adult bull trout in gate well samples or other samples that might suggest substantial numbers of bull trout are moving downstream through the project area. Lastly, Interior prescribed that Grant PUD provide safe, timely, and effective passage for bull trout by implementing the measures prescribed for salmon and steelhead. We interpret this prescription to mean that no additional measures would be needed to provide safe and effective passage for bull trout. However, because bull trout rarely occur within the project area and because bull trout passage needs are not well documented at any dam on the mid-Columbia River, it is unclear what benefit, if any, salmon and steelhead passage measures would have for bull trout.

Interior recommended several studies and monitoring as part of the BTMP that appear to be unachievable and unnecessary. For example, Interior recommends that Grant PUD monitor upstream and downstream passage effects on bull trout and assess juvenile rearing in the project reservoirs. However, because bull trout are virtually non-existent within the project area or at least extremely rare, it would be essentially impossible to conduct the recommended studies with any level of statistical validity. Additionally, the low occurrence of this species in the project area and the lack of evidence demonstrating any adverse project effects, suggests that the recommended studies are unnecessary.

Pacific Lamprey

As part of its license application, Grant PUD proposes to modify diffusion chambers on both fishways at Priest Rapids to improve adult lamprey passage. Grant PUD also proposes to modify the design of the fish count stations at Priest Rapids and

Wanapum dams to improve adult lamprey passage and enumeration. If appropriate, Grant PUD would reduce fishway flows at night to improve adult lamprey passage.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD develop, fund, and implement a Pacific lamprey management plan (PLMP) with the goal of assessing project effects on Pacific lamprey and rebuilding Pacific lamprey populations within the project area. WDFW also recommends that Grant PUD exchange information and coordinate Pacific lamprey management activities with WDFW and other relevant entities. Lastly, WDFW recommends that Grant PUD fund a qualified biologist to participate in the development and implementation of the PLMP and regional coordination activities related to Pacific lamprey management.

Under section 18 of the FPA, Interior prescribes that for upstream Pacific lamprey passage, Grant PUD should operate the Priest Rapids Project upstream fish passage facilities as prescribed for salmon and steelhead. Additionally, Interior prescribes that Grant PUD complete the formulation of the adult upstream passage elements recommended in the PLMP described below. Interior does not prescribe downstream passage measures for lamprey at this time because they conclude that the methods to evaluate downstream passage and survival of lamprey is still under development and the form and function of an effective downstream fishway for juvenile lamprey is unknown based on available evidence.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a PLMP that includes: 1) monitoring and evaluation of juvenile lamprey rearing in the reservoirs, outmigration timing, and downstream passage route selection and survival, 2) modifying existing structures and project operations to improve juvenile and adult lamprey passage survival, and 3) sharing information and participating in and funding regional efforts to establish adult survival standards, develop techniques for juvenile lamprey radio-tagging, identify lamprey habitat use, and habitat mitigation.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD refine, fund, and implement a PLMP to meet qualitative and quantitative performance goals for juvenile and adult lamprey passage. CRITFC recommends that Grant PUD develop and provide a plan to prepare to implement structural and operational modifications to the Priest Rapids Project to protect, mitigate, and enhance adult Pacific lamprey during upstream passage. CRITFC specifies that Grant PUD should achieve 80 percent dam passage effectiveness by 2013 and 97-98 percent dam passage effectiveness by 2030. CRITFC recommends that Grant PUD fund adult lamprey studies to evaluate passage improvements and to assess adult lamprey passage from the project into upstream tributary spawning areas.

Under section 10(a) of the FPA, CRITFC indicates that Grant PUD should provide safe, timely, and effective downsteam passage for juvenile lamprey. CRITFC recommends that Grant PUD meet downstream passage standards for juvenile lamprey once they are developed by regional fisheries managers. CRITFC recommends that Grant PUD assess indirect and direct mortality and injury rates for Pacific lamprey.

Our Analysis

The numbers of adult Pacific lamprey entering the Columbia River have declined over the past 40 years or so (Grant PUD; 2005a). These declines have been attributed to a variety of factors including poor habitat conditions, past fisheries management practices including poisoning operations, water pollution, dam passage problems, ocean conditions, and food availability.

Priest Rapids and Wanapum dams include fish ladders that were designed for salmon and steelhead passage, but are also used by adult lamprey for upstream passage. Nass et al. (2003) conducted two years of monitoring radio-tagged lamprey during upstream passage through the project fish ladders. Overall, the median time for successful passage through the Priest Rapids and Wanapum dam fish ladders was between 1.1 and 1.8 days. Nass et al. (2003) reported that a large proportion of the radio-tagged lamprey failed to enter the fish ladders and several areas within the ladders appeared to cause delays or terminate[56] lamprey migrations. At Priest Rapids dam the areas of delay include the visual counting stations and the first orifice walls. At Wanapum dam, the only area where delay occurred appeared to be the visual counting station in the left-bank fishway (i.e., no areas of substantial delay in the right-bank fishway).

Nass et al. (2003) reported that while diffusion gratings in the fish ladders appeared to delay lamprey passage at Bonneville dam, the gratings in the Priest Rapids Project ladders did not cause any measurable delay. Nass et al. (2003) reported that lamprey encountering a visual counting station were more likely to terminate their migration or be substantially delayed compared to any other location within the project fishways. Moser et al. (2002) attributed delays at counting stations to bright lighting and

[56] Lamprey either moved downstream from this point in the fish ladder or remained in place throughout the completion of the data collection period. Lamprey can remain in place for prolonged periods because their mouths function as a suction disk and allow lamprey to attach to smooth areas within the ladders. Using this technique lamprey can remain in areas of relatively high velocities for prolonged periods of time without expending significant amounts of energy.

disrupted water flow conditions. Nass et al. (2003) also suggested that the combination of high velocities and passage through an orifice at the first orifice wall may cause delays.

Grant PUD is proposing to bolt aluminum plating along the edges of the diffuser gratings in the project fish ladders to provide better attachment areas for adult lamprey moving upstream. This measure is also prescribed by Interior under Section 18. While Nass et al. (2003) did not report measurable delays in the areas around the diffuser gratings, it is possible that providing the grating will either increase lamprey movements through these areas or reduce energy expenditure thereby enhancing upstream passage facilities for adult lamprey.

Grant PUD also proposes to modify the areas around the visual counting stations to improve upstream passage conditions for lamprey. Specifically, Grant PUD would eliminate the spaces between the counting board and counting window and the areas between the frame and concrete orifice wall. These modifications would create more laminar flow through the counting area and remove gaps where lamprey apparently become trapped or confused by irregular flows. Grant PUD also proposes that upon approval of a video count system, they would remove the counting stations including the picket leads and trashracks. These modifications would likely reduce delays of upstream lamprey movements in these areas. Lastly, Grant PUD proposes to consult with the agencies to determine the benefit of reducing fishway flows at night when lamprey movements are greatest. While this may reduce passage conditions for salmon and steelhead, these species are generally less active at night and the overall potential benefit to lamprey may outweigh any minor effects on salmon and steelhead passage.

Under section 18, Interior prescribes that Grant PUD modify the fish ladders for lamprey by improving orifices for passage, rounding sharp edges, constructing rest areas in front of submerged orifices, reducing diffuser grating spacing, and installing collection devices for adults. As indicated below, the corners of the fish ladder are already rounded; however, there may be other areas of sharp edges that could be rounded consistent with Interior's prescription. While it is possible that rounding all sharp edges would somehow benefit adult lamprey within the fish ladder, we have no evidence to indicate that sharp edges result in either delayed lamprey movements through the fish ladder or harm to lamprey. Construction of rest areas in front of submerged orifices may allow lamprey to regain energy before swimming through a submerged orifice. Nass et al. (2003) reported that the submerge orifice has a high velocity profile that may delay lamprey passage or cause lamprey to turn around. Providing resting areas in these areas may reduce delays or improve passage efficiency. Reducing the diffuser grating spacing would have similar benefits to adding the aluminum plating as described above; however, as indicated by Nass et al. (2003) the diffuser grating did not appear to impede upstream migration at

either dam. Lastly, Interior recommends installing collection devices for adults. Interior provides no explanation why such a device would be needed or how it would address project effects or project purposes.

WDFW and CRITFC recommend that Grant PUD pursue actions to achieve 80 percent dam passage effectiveness by 2013 and 97 percent dam passage effectiveness by 2030. Neither WDFW nor CRTIFC provide any substantial evidence to support these goals. Based on data collected by Nass et al. (2003), the 80 percent passage effectiveness appears to be potentially achievable; however, there is no evidence in our record to indicate that a 97 percent passage effectiveness goal is attainable. More importantly, it is not clear what level of dam passage effectiveness is necessary for successful reproduction of adult lamprey in the upper Columbia River system. Hatch et al. (2001; as cited by Nass et al.; 2003) reported that unlike salmon and steelhead, lamprey do not appear to have strong homing tendencies and will stray to other locations during their migration. Therefore, it is possible that fish that fail to pass the project dams, either by failing to enter fishways or by returning to the tailwater after partially ascending a fishway, may move downstream into project tributaries or other areas to spawn. Recent annual returns to the project area range from about 1000-4000 adult lamprey. We have no evidence in the record to suggest that the habitat in areas downstream of the dams is either unsuitable or inadequate to support the numbers of lamprey that occur within the project area and may fail to pass the project dams. More importantly, we have no information to indicate that 80 percent or 97 percent passage effectiveness is necessary for the successful maintenance or restoration of Pacific lamprey in the upper Columbia River basin.

Interior prescribed under section 18 that Grant PUD evaluate the feasibility of a capture-and-haul program. Interior indicates capture-and-haul would be implemented if modifications to the fish ladders do not provide adult lamprey passage rates similar to the best passage rates found at other hydroelectric project in the Columbia River Basin. While "best passage rates at other projects" appears to be an arbitrary standard and perhaps a moving standard, we believe that the 80 percent passage effectiveness standard recommended by WDFW and CRITFC would be representative of Interiors intended goal based on currently published passage rates within the Columbia River system. Development of a capture-and-haul program would benefit adult lamprey if passage through the modified fish ladders is inadequate and habitat downstream of the project dams is either unsuitable or inadequate to support the numbers of lamprey that fail to pass the project dams. However, as we indicated above, the agencies have not provided any evidence to indicate what level of passage success, if any, is necessary to support or increase the lamprey population. While lamprey appear to have an innate behavior that drives them to attempt upstream passage through the project fish ladders and occupy habitats throughout their natural range, there is no evidence in our record to indicate that unsuccessful passage at the Priest Rapids Project is either limiting reproductive success

or population numbers of lamprey returning to the upper Columbia River. Additionally, there is no evidence in our record that the existing habitat downstream of the project dams is either unsuitable or unavailable to support the current numbers of lamprey that fail to pass the project dams.

Interior prescribes under section 18 that Grant PUD develop a plan to install additional or new adult lamprey volitional passage facilities in year 8 of the new license in the event that modifications to the existing fish ladders and implementation of the capture-and-haul program do not achieve the best passage rates found at other hydroelectric projects in the Columbia River Basin. As indicated above, there is no evidence in our record to indicate what level of passage success is necessary at the Priest Rapids Project for maintenance or growth of the lamprey population inhabiting the upper Columbia River. Regardless, of the lack of biological evidence to support Interior's arbitrary passage standard (i.e., "best passage rates found"), Interior's prescription for lamprey passage facilities appears to assume effective lamprey specific upstream passage designs would be discovered within the next few years and includes potentially problematic timing constraints.

At this time, we are not aware of any lamprey specific upstream passage facilities that have been constructed at dams comparable in size to the Priest Rapids dams. Additionally, there is no evidence in our record to indicate that a theoretical lamprey specific upstream passage facility could achieve Interior's arbitrary "best passage rate" standard. Lastly, there is no evidence in our record to suggest that lamprey specific upstream passage facilities would outperform existing facilities located at the Priest Rapids Project. Based on our record, Interior's prescription seems to rely on the optimistic assumption that a new, highly effective upstream passage facility design for adult lamprey will be discovered within the next 3-5 years.

Interior prescribes that Grant PUD complete preliminary design work and develop a plan to install the lamprey specific upstream passage facilities by year 5 of a new license. This requirement would likely require Grant PUD to perform preliminary design of upstream lamprey facilities during the first 1-3 years of the license and then draft the plan and formalize the final designs in consultation with the agencies during years 4 and 5 of the new license. Grant PUD would be implementing and monitoring the effects of modifications to the existing passage facilities during these first 5 years. As written, Interior's prescription appears to require Grant PUD to conduct preliminary design work and development of the plan regardless of what progress may be made toward achieving Interior's passage goals using the existing facilities. Additionally, Interior prescribes that Grant PUD implement the capture-and-haul program in year 5 of a license and construct the lamprey specific fish passage facilities in year 8 of a new license. This timing does not appear to allow adequate time for testing and refinement of the capture-and-haul

program since Interior's prescription specifies that Grant PUD must complete installation of the new facilities by year 8 of a new license (i.e., begin construction in year 6 or 7). In general, the stepwise decision sequence for measures prescribed by Interior appears to be hasty or rushed. Providing more time between critical decisions (e.g. implementation of the capture-and-haul program and construction of the new fish passage facilities) would allow adequate time for testing and refinement of existing measures and would ensure that unnecessary measures are not implemented prematurely.

Interior recommends that Grant PUD assist in regional efforts to establish upstream passage survival standards for adult lamprey. While development of regional passage standards may be useful for fisheries managers, it would not address project effects and would not result in the identification or mitigation of project impacts on lamprey.

WDFW recommended that Grant PUD round all corners within the fishway that are problematic for adult lamprey. WDFW provided no evidence that any corners are problematic for lamprey. Additionally, Grant PUD indicates that all corners in the Priest Rapids and Wanapum fishways are already rounded.

WDFW recommends that Grant PUD perform further analysis of the data collected by Nass et al. (2003) to identify problem areas, identify causes, and implement solutions. We would anticipate that any existing data, including the data collected by Nass et al. (2003), would be considered during development and implementation of any upstream passage measures that might be considered as part of the Pacific lamprey management plan (PLMP; discussed below). Consideration of all existing data would be appropriate in any effort towards improving conditions for lamprey and would thereby benefit the species.

Interior prescribes under section 18 and WDFW recommends under section 10(j) that Grant PUD conduct radio-telemetry studies to measure the effectiveness of any measures implemented to improve upstream lamprey passage. Modifications made to the fishways or their operation would likely have some uncertainty associated with them. Occasionally monitoring upstream passage efficiency would be beneficial to lamprey by identifying effective, ineffective, or adverse passage measures.

WDFW and CRITFC recommend that Grant PUD use radio-telemetry to track adult lamprey movements through the reservoir and into tributaries. Neither WDFW nor CRITFC provide any substantial evidence indicating a need for this information. Nass et al. (2003) demonstrated that lamprey moved freely through the project reservoirs with migration speeds ranging from 1.9 to 6.6 miles per day. We have no evidence to suggest that the project adversely effects lamprey movements through the reservoir and it is

unclear how the recommended study would reveal any project effects if they exist. Tracking of lamprey movements into tributaries upstream of the project may benefit fisheries managers by identifying occupied habitats or key spawning areas; however, there is no apparent nexus between the need for this information and project effects since the project has no apparent effect on the movements of adult lamprey in tributary habitats.

WDFW recommends Grant PUD develop a monitoring plan using radio-telemetry to evaluate lamprey fishway passage every ten years after achievement of the recommended 97 percent passage efficiency goal. As indicated above, the 97 percent passage goal is unsupported and possibly unattainable. Additionally, while it is both reasonable and appropriate to test the effectiveness of modifications made to the fish passage facilities, these tests should be performed in response to the changes to structures or operations rather than based on an arbitrary recurrence interval of once every ten years. In other words, if no significant changes to fishway structures or operations are made over a ten year period there would not necessarily be any need to conduct effectiveness testing. Conversely, if several major changes are made to fishway operations over a period of several years it may be reasonable to conduct effectiveness during each season that new measures are being implemented. Regardless of the frequency of effectiveness testing, this effort would be beneficial to lamprey by identifying effective, ineffective, or adverse passage measures.

Interior prescribed under section 18 that Grant PUD conduct a hydraulic study of fish ladder entrance conditions, diffusion areas, and submerged orifices. Interior indicates that these results would be used to implement modifications to the fish ladders to improve upstream passage conditions. Nass et al. (2003) indicated that lamprey movements through the areas with diffuser gratings did not appear to be delayed; however, entrances and submerged orifices were associated with some apparent delays. Studying the hydraulic conditions in areas that may be challenging to lamprey would allow for quantification of modifications (e.g., such as Grant PUD's proposal to reduce flows at night) that are being considered.

Interior prescribed and WDFW recommended that Grant PUD develop a protocol for lamprey salvage during fish ladder dewatering. Dewatering would typically occur during seasonal inspections and maintenance, but could also occur in response to emergency conditions or to perform unanticipated and critical structural repairs. Few lamprey would be expected within the ladders during the typical time for seasonal inspections (January or February); however, emergency dewatering could occur during peak migration periods. Developing a protocol to address possible stranding of lamprey within the fish ladders during dewatering would likely reduce any mortalities potentially associated with these events.

Interior prescribes under section 18 that Grant PUD continue to enumerate adult lamprey passage through the project fish ladders. Grant PUD has proposed to continue counting all species passage through the fish ladders and is in the process of switching to a video count system that would, as described above, allow for modification of the counting stations and may improve adult lamprey passage through these areas.

Downstream passage at the Priest Rapids Project may occur via several routes including the turbines, spillways, gatewell slots, or fish ladders. In its additional information response filed on October 15, 2004, Grant PUD indicates that the tendency of juvenile lamprey to travel low in the water column may result in high turbine entrainment rates. However, Grant PUD suggests that turbine passage survival is likely at least as high as for juvenile salmonids passing through the project dams (i.e., generally greater than 90 percent). Moursund et al. (2000; 2001) simulated the effects of turbine passage on lamprey and reported no injuries or deaths from exposing lamprey to either high shear stress water velocities or abrupt pressure spikes. These results support the possibility that juvenile lamprey experience high turbine passage survival rates.

Grant PUD is proposing to implement a variety of measures to improve downstream passage for salmon and steelhead. These measures include construction of downstream fish bypasses in spillbay 22 of Priest Rapids dam and future unit 11 of Wanapum dam, installation of new advanced design turbines at both dams, implementation of optimum turbine settings, installation of gatewell exclusion screens and continued spill until other downstream passage measures achieve passage survival goals. While all of these measures are being implemented to improve downstream passage conditions for salmon and steelhead, it is possible that they would indirectly benefit lamprey through improved downstream passage survival. However, because it is likely that a large proportion of lamprey pass the project via the project turbines and already experience generally high survival rates (i.e. likely greater than 90 percent), these measures would likely only result in a minor improvement, if any, in downstream passage survival of lamprey.

WDFW recommends that Gant PUD evaluate lamprey downstream passage routes using PIT tags and hatchery-raised lamprey, if available. Interior also recommends that Grant PUD study passage routes, although they do not specify what techniques should be used. Grant PUD indicates that PIT tag technology has not been proven as an effective means for addressing juvenile lamprey passage. Grant PUD indicates that studies with lamprey and PIT tags at the Willamette Falls Project (FERC No. 2233) were inconclusive because of extremely low recovery of tagged individuals (6 percent or less with live animals). In its letter filed on May 26, 2005, Interior also indicated that the methods to evaluate juvenile lamprey passage and survival are still under development. Grant PUD

also indicates that aquaculture techniques for Pacific lamprey are not currently known; therefore hatchery-raised lamprey are not currently available. While a study of downstream lamprey passage and survival would be useful in regard to identifying project effects and possibly measures for improving lamprey survival, it does not appear that a reliable method, including PIT tagging, exists at this time.

Interior recommends that Grant PUD develop and implement techniques to estimate juvenile lamprey survival through the project. Development of such techniques could be useful to quantify project effects on juvenile lamprey survival. However, in general, the risks of technology development include consumption of vast resources that may either result in failure or results that have no direct or indirect benefits to lamprey. More importantly, available information suggests that experimentation to develop methods to assess juvenile lamprey survival would be unnecessary since the current the project has little to no effect on juvenile lamprey.

Interior recommends that Grant PUD identify the timing of juvenile lamprey outmigration through the project. WDFW recommends that Grant PUD develop a plan to assess juvenile lamprey out-migration timing characteristics through the project area, including the reservoirs, in relation to flows. Neither agency provides any evidence to indicate that the timing of lamprey out-migration is related to stream flow or project effects. Mainstem flows may have some unknown effect on the timing of lamprey out-migration; however, it is unclear how knowledge about this relationship could be used to improve juvenile lamprey survival or to benefit the species. Regardless, Grant PUD indicates that flows in the project area are the result of cumulative effects of upstream storage dams and the coordinated operation of the seven dam system (i.e., Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids). Because the Priest Rapids Project is only partly responsible for the magnitude and timing of flows in the project area and there is no evidence of a relationship between flow and outmigration timing, there appears to be little or no nexus between the operation of the Priest Rapids Project and juvenile lamprey out-migration timing.

WDFW recommends that Grant PUD conduct an assessment of the relative abundance of juvenile lamprey in the project reservoir and its tributaries. WDFW provides no information to indicate how this information would be used. Annual abundance indices are a common fisheries tool used to monitor fish populations and track the success of management practices. This information may be useful to WDFW in addressing its management responsibilities towards Pacific lamprey; however, it is not necessary to address project effects or project purposes.

Interior and WDFW recommend that Grant PUD identify and map the extent of suitable juvenile lamprey habitat within the project reservoirs. The agencies do not

indicate how this information would be used to benefit lamprey. Additionally, Grant PUD indicates that the agencies have not provided evidence or established a nexus between the impacts of the project on juvenile lamprey and available habitat in the reservoir. It appears that this information is not necessary to address project effects or project purposes.

Interior and WDFW recommend that Grant PUD evaluate the effects of reservoir fluctuations on lamprey rearing areas and evaluate options for avoiding or eliminating detrimental effects. The agencies provide no specific information or evidence to indicate that the reservoir contains substantial rearing habitat or that fluctuations affect this habitat. In fact, the wording of WDFW's recommendation (i.e., "Evaluation of effects …, if any") suggests there may be no project effects on juvenile lamprey rearing habitat. If juvenile lamprey rearing habitat in the reservoir is adversely affected by project operations, it is possible that changes in project operations could result in reduced effects on juvenile habitat. However, at this time there is no evidence to suggest a relationship exists between project operations, available juvenile lamprey habitat, and juvenile lamprey survival.

CRITFC recommends that Grant PUD be required to meet downstream passage standards that are currently being developed by regional fisheries managers. CRITFC provides no evidence to indicate that current passage conditions for juvenile lamprey are inadequate. To the contrary, Grant PUD provided evidence suggesting that downstream passage of juvenile lamprey may have little or no effect on the species. Because the recommended standards are in development and because there is no evidence of adverse project effects on juvenile lamprey, there is no way to assess the benefit, if any, of achieving these standards on the lamprey population. As a result, there would be no benefit at this time to requiring Grant PUD to comply with undetermined passage standards.

Interior, WDFW, and CRITFC recommend that Grant PUD develop and implement a Pacific Lamprey Management Plan (PLMP). Grant PUD proposes to develop a PLMP in consultation with the resource management agencies, tribes, and other stakeholders. The agencies and CRITFC provided a list of specific upstream and downstream passage measures and studies to be performed as part of the PLMP. We discuss and evaluate these measures above. Goals, objectives, or non-specific measures recommended for inclusion in the PLMP are described below.

In regard to the goals of the PLMP, Interior indicates that the PLMP should be designed to direct the improvement of adult upstream passage and juvenile downstream passage through the project. WDFW indicates that plan should address providing safe and effective juvenile and adult lamprey passage, mitigating for project effects on

passage and habitat, and rebuilding populations to levels that would sustain harvest. Grant PUD indicates that rebuilding the lamprey population to harvestable levels is an inappropriate goal for the PLMP because several factors other than the Priest Rapids Project have contributed to the decline of lamprey. Non-project-related factors such as overharvest, habitat degradation, and migration barriers have contributed to the decline of lamprey throughout the Columbia River system; therefore, while attaining harvestable levels may be a reasonable goal for the agencies in their management of Pacific lamprey, this goal appears to be unrelated to the magnitude of project effects on the resource.

It would be more appropriate for the goals of the PLMP to include identifying and quantifying the projects effects on the resource while simultaneously developing and implementing measures to mitigate for these effects. Many of the actions recommended by WDFW, Interior, and CRITFC would be useful in identifying project effects or appropriate mitigation measures and may be appropriate for inclusion in the PLMP; however, achieving harvestable population levels, as suggested by WDFW, goes beyond addressing the effects of continued operation and maintenance of the Priest Rapids Project.

In addition to the measures listed above, WDFW recommends that the PLMP include several "elements" for Grant PUD to implement during the first ten years of any new license. These elements consist of three additional plans, including a plan to assess migration timing as it relates to flow and temperature, a plan to evaluate whether flow alterations would assist outmigration, and a plan to conduct off-site mitigation for project impacts. We address the need to study project effects on migration timing above. In regard to evaluating the effect of flow alterations on outmigration, WDFW has provided no evidence to indicate that such a relationship might exist or to explain how the project may currently be affecting juvenile outmigration through project effects on flows. Grant PUD indicates that flows in the project area are the result of cumulative effects of upstream storage dams and the coordinated operation of the seven dam system (i.e., Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids). Because the Priest Rapids Project is only partly responsible for the magnitude and timing of flows in the project area and there is no known relationship between lamprey outmigration and flow, there appears to be little or no nexus between the operation of the Priest Rapids Project and juvenile lamprey out-migration.

Interior recommends that Grant PUD develop schedules or implementation dates for modifying existing structures or operations to address project effects on lamprey. The timing of actions is generally determined as part of the Commission approval of the action. In this case, any actions not approved at relicensing, but anticipated as part of future actions could be described in a PLMP and accompanied by a schedule. This effort would have little or no direct or indirect benefit to lamprey, but it would likely be useful for tracking and documenting possible future actions.

Interior and WDFW also recommend that the PLMP include off-site mitigation, such as habitat improvements, to mitigate for the adverse impacts of project operations that cannot be addressed at the project. While offsite mitigation could be beneficial to lamprey if available habitat is limiting, the agencies have not described any specific effects of the Priest Rapids Project that are not otherwise mitigated or addressed through other measures. Additionally, there is no information to indicate that the available habitat is inadequate or limiting lamprey population numbers. It is possible that current population levels are well below the numbers that could be supported by available habitat; therefore, offsite habitat mitigation may have little or no benefit. Regardless, because there are no known project effects that would not be addressed through other mitigation or enhancement, there appears to be no benefit to requiring Grant PUD to implement offsite mitigation.

WDFW, Interior, and CRITFC recommend that Grant PUD coordinate Pacific lamprey mitigation efforts with regional experts and managers. WDFW specifically suggests that Grant PUD seek cost sharing, matching funds, and integrate project efforts with regional lamprey programs. Some coordination of lamprey mitigation efforts with WDFW, Interior, and CRITFC would be inherent in implementing lamprey mitigation measures. Additionally, consultation with WDFW, Interior, and CRITFC would likely be required by the Commission as part of the development of the PLMP if it is adopted in the license. However, coordination with regional experts and managers and integrating project efforts with regional lamprey programs would not be necessary to address or mitigate for project effects on lamprey. Additionally, while cost-sharing and matching funds could be helpful in reducing costs to Grant PUD or in the implementation of measures beyond those required by the Commission, requiring Grant PUD to seek cost-sharing and matching funds would not be necessary to address or mitigate for project effects on lamprey.

WDFW recommends that Grant PUD fund a qualified biologist to participate in the development and implementation of the PLMP and regional coordination activities related to lamprey management. A biologist with expertise in lamprey biology could potentially benefit lamprey populations affected by project operations by evaluating data and making lamprey management recommendations. However, the benefit of funding a biologist for a resource cannot be quantified or qualified with any degree of certainty.

White Sturgeon

As part of its license application, Grant PUD proposes to address the effect of the Priest Rapids Project on white sturgeon and construct a white sturgeon conservation facility at the Priest Rapids Hatchery. White sturgeon broodstock would be obtained

from the Hanford Reach or Wanapum Reservoir and the conservation facility would be designed to produce yearling white sturgeon for stocking into the Priest Rapids Project reservoirs. This effort would include experimentation with hatchery supplementation to develop optimal rearing and release strategies and to monitor and evaluate the effectiveness of hatchery releases.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD develop, fund, and implement a white sturgeon management plan (WSMP) with the objective of increasing the white sturgeon population to levels commensurate with available habitat within the project area. WDFW specifies that the plan should include details describing acquisition of broodstock, breeding and hatchery procedures, and evaluation of hatchery success, natural reproductive success, emigration rates, and carrying capacity. WDFW also recommends that Grant PUD exchange information and coordinate sturgeon management activities with WDFW and other relevant entities. Lastly, WDFW recommends that Grant PUD fund a qualified biologist to participate in the development and implementation of the WSMP and regional coordination activities related to white sturgeon management.

Under section 10(j) of the FPA, Interior recommends that Grant PUD develop and implement a WSMP to increase white sturgeon populations in Wanapum and Priest Rapids reservoirs and the Hanford Reach commensurate with available habitat. Interior indicates the plan should include: 1) monitoring to determine natural and hatchery survival of egg, larval, juvenile and adult white sturgeon, 2) evaluation of natural recruitment rates in the project reservoirs and the Hanford Reach, 3) determination of year-class distributions, 4) genetic analysis, 5) measurement of growth rates, condition factors, and sex ratios, 6) implementation of measures to increase white sturgeon populations in the project reservoirs and the Hanford Reach, and 7) coordination with regional white sturgeon experts and managers. Interior also recommends that Grant PUD develop and implement a White Sturgeon Conservation Aquaculture Plan (WSCAP) to be incorporated into the WSMP. Interior indicates that the WSCAP would include a schedule whereby Grant PUD would design, fund, construct, operate and maintain a white sturgeon hatchery facility that would be operational within 4 years of license issuance and begin supplementing the project reservoirs with white sturgeon within 5 years of license issuance.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD establish white sturgeon action plan to rebuild white sturgeon populations in the project area that are impacted by the project. CRITFC recommends that the white sturgeon action plan include the same measures specified by WDFW in their recommended WSMP.

Our Analysis

Throughout much of the Columbia River, the numbers of white sturgeon are considered to be lower than they were prior to the construction of the mainstem dams. Declines in white sturgeon numbers have been attributed to a variety of factors. Dam-related factors include fragmentation of the contiguous population into numerous apparently isolated populations, reduced diversity of white sturgeon habitat by creating a series of homogenous reservoirs, reduced seasonal variation in habitat by controlling flows, and reduced or eliminated access to different habitat types by limiting fish movements. Non-dam factors associated with reduced numbers of white sturgeon include overfishing, prolonged droughts, and reduced water quality.

We have reviewed the information provided by Grant PUD, the federal and state agencies, and CRITFC to identify effects of the project on white sturgeon. WDFW suggests that there is a need to immediately intercede with hatchery supplementation to mitigate for the detrimental effects of the ongoing project operations but does not describe any specific effects of the project on white sturgeon. Interior states that mid-Columbia River white sturgeon require immediate action and suggests that the species has been in an ongoing decline; however, while they indicate hatchery supplementation would offset the project's continuing effects, they do not specifically identify any of these effects. CRITFC states that the white sturgeon population in the Hanford Reach is imperiled and states that the populations within the project area must be supplemented in order to continue to exist over the next license term; however, CRITFC does not identify any specific effects of the project on white sturgeon within or downstream of the project area. Grant PUD's license application states that the proposed measures for white sturgeon are intended to address the potential effect of the Priest Rapids Project on limiting sturgeon recruitment, yet they provide no specific information as to how the project effects recruitment.

In regard to white sturgeon abundance in the Priest Rapids Project area, the populations of white sturgeon are estimated to be 134 fish in Priest Rapids Reservoir and 551 fish in Wanapum Reservoir. The 95 percent confidence intervals for these estimates (48 – 2680 for Priest Rapids and 314 – 1460 for Wanapum) indicate the lack of precision in the population estimates and suggest that the actual numbers of sturgeon inhabiting the reservoirs could be lower or much higher. We are not aware of any information estimating the numbers of white sturgeon within the Hanford Reach.

Based on these numbers it is difficult to determine the actual status of white sturgeon within the project area and downstream. It is entirely possible that white sturgeon are in a state of decline and their numbers are greatly reduced at this time. However, with no evidence to the contrary, it is also entirely possible that white sturgeon numbers have been stable at the current levels for many years. In comments filed on July

8, 2003, Grant PUD indicated that in the mid 1990s WDFW changed the white sturgeon sport fishing regulations in the project area (i.e., upstream of Priest Rapids dam) from allowing harvest to catch-and-release only. This suggests that concern about the abundance of white sturgeon was an issue at this time, although it is not entirely clear if this was a reaction to reduced catch rates and a corresponding concern about sturgeon abundance or if it just represents a shift in the policies and management approach of WDFW.

Grant PUD, the agencies, and CRITFC suggest that primary issue related to white sturgeon abundance in the project area is low or infrequent recruitment of juvenile sturgeon. The year-class composition of white sturgeon within Priest Rapids Reservoir suggests that no fish have been recruited to the population since the mid 1980s (Golder; 2003). In Wanapum Reservoir there appears to have been some recruitment through the 1997 year class;[57] however, only approximately 20 percent of the population consisted of juvenile fish (Golder; 2003) which is probably less than would be expected in a healthy sturgeon population.

It is unclear what factors are limiting white sturgeon recruitment in the project area. Golder (2003) collected data to indicate that some successful spawning takes place within both reservoirs, suggesting that suitable spawning habitat and viable adult sturgeon exist within both reservoirs. Additional, testing by Golder (2003) demonstrated that the eggs produced during spawning hatched within the time required for normal embryo development. This information suggests that reduced survival during the larval or early juvenile stage (rather than reproduction or incubation) may be influencing recruitment.

Golder (2003) presented several theories to address poor recruitment in the project area. Golder (2003) suggested that after hatching, white sturgeon larvae originating in the upper end of Priest Rapids Reservoir may actively seek river currents and due to a lack of a substantial settling area within the Priest Rapids reservoir, the larvae may pass through the entire reservoir and be lost to the Hanford Reach or areas downstream.[58] This would explain the poor recruitment within Priest Rapids Reservoir, although it seems unlikely that no larvae would remain within reservoir and that no larvae from

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[57] Golder (2003) reported that the sampling gear used in this study was likely only effective on fish spawned through 1997; therefore, the lack of data from later year classes may not indicate a lack of recruitment but rather a lack of effective sampling of these potential year classes.

[58] Apparently this would be less likely to occur in Wanapum Reservoir since it is a larger and longer body of water than the Priest Rapids pool.

upstream areas would enter the reservoir. Golder (2003) also suggested that there may be a lack of suitable juvenile rearing habitat within Priest Rapids Reservoir.

Golder (2003) noted that recruitment within Priest Rapids Reservoir apparently ceased at the time the juvenile salmonid spill program began in the mid 1980s. While the timing of these events does appear to be somewhat correlated, we are unable to identify a mechanism associated with the spill program that would be responsible for reduced survival of larval or juvenile white sturgeon and Golder (2003) did not provide any additional speculation regarding the possible causes of this association.

Golder (2003) found that recruitment from the mid 1980s to the mid 1990s was generally poor in both project reservoirs. During this period, recruitment was apparently also poor for white sturgeon inhabiting the Snake River upstream of Hells Canyon dam. Lepla and Chandler (2001) suggested that the poor recruitment upstream of Hells Canyon corresponded to a prolonged period of drought from 1987 to 1994. Golder (2003) suggested that basin-wide conditions, such as a prolonged drought, may have influenced recruitment in the project area during this same period.

In addition to the suggestions made by Golder (2003), other factors such as available food supply or predation may be influencing the survival of the larval or juvenile life stages, although it is not clear that the project is affecting these factors.

In regard to specific project effects on white sturgeon, construction of the two dams and creation of the project reservoirs has affected, at least to some extent, the ability of fish to move upstream and access other available habitat. White sturgeon have been observed within both the Priest Rapids and Wanapum fish ladders. Golder (2003) reported that one tagged fish from the Priest Rapids Reservoir was documented to move 37 miles upstream to a spawning location within the Wanapum Reservoir. This is evidence that white sturgeon are capable of moving upstream through the Wanapum fish ladder. The ability of white sturgeon to pass upstream through the Priest Rapids fish ladders or how often and efficiently sturgeon may use the ladders at either dam is unknown. The information provided by Golder (2003) suggests that the dams may not be absolute barriers to upstream movements; however, it is likely that they inhibit the ability of sturgeon to access upstream areas.

Construction of the dams likely modified habitat within the project area, primarily by increasing depths and reducing velocities within the project reservoirs. We have no information to indicate how much change in available habitat may have occurred or which habitat types may have increased and which types decreased in availability. However, sampling by Golder (2003) revealed that both project reservoirs contain spawning, overwintering, and feeding habitat for white sturgeon. Wanapum Reservoir also appears to contain suitable juvenile rearing habitat. Because they did not collect any

juvenile sturgeon within Priest Rapids Reservoir, Golder (2003) was unable to conclusively identify any juvenile rearing habitat within Priest Rapids Reservoir; however, they speculate that some suboptimal[59] juvenile rearing habitat may exist at three locations within the reservoir.

In addition to the continuation of the effects described above, project-related effects of relicensing the project may include habitat modification through flow regulation and turbine entrainment and mortality. Flows from the Wanapum and Priest Rapids dams vary in response to inflow and project operating requirements. Changes in flows can influence available white sturgeon habitat by increasing or decreasing depths and velocities in the project reservoirs and the Hanford Reach. Golder (2003) described spawning, overwintering, rearing, and feeding habitat within both reservoirs. Based on Golder (2003), the depths and velocities of overwintering, rearing, and feeding habitat for white sturgeon can be generally described as deep (greater than 30 feet) and slow or moderate velocity (less than 2 ft/s). Spawning habitat, however, appears to be shallower (less than 30 feet) and provide greater velocities (generally more than 2 ft/s; Golder, 2003). Short-term, project-related flow fluctuations would change depths and velocities throughout the reservoir and would likely have some effect on all white sturgeon habitat types; however, we would expect the effects would be most pronounced in shallow, high velocity areas that white sturgeon use for spawning. In these areas, hourly or daily changes in flow would result in changes in depths and/or velocities that could make previously suitable spawning habitat less desirable or perhaps unusable and, to the contrary, unsuitable habitat may be become useable. Because deeper, slower velocity areas generally occur in areas of less channel confinement, they respond more slowly to changes in flow. Therefore, we would expect that the effects of project-related flow fluctuations on overwintering, rearing, and feeding areas would be less significant than the effects on spawning habitat.

Daily and seasonal flow fluctuations within the reservoirs and the Hanford Reach are primarily the result of the coordinated operation of the seven mainstem dams in the mid-Columbia River. As part of this coordinated system, the Priest Rapids Project has some influence over the flows within and downstream of the project area; however, the projects upstream of the Priest Rapids Project control the amount of inflow to the project area and thereby dictate much of the operation of the Priest Rapids Project due its limited storage capabilities. Flows entering the project area often vary on an hourly basis and while Grant PUD can utilize some storage in the project reservoirs to reregulate these

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[59] Golder (2003) described three locations within Priest Rapids Reservoir that may serve as juvenile rearing habitat, although they suggested that velocities in each of these areas may be at the upper end of the preferred range and that the substrate sizes may be larger than preferred.

flows, efficient operation of the project in coordination with the other projects does not generally correspond to complete reregulation of upstream flow fluctuations (i.e., flattening hydrologic pulses). As a result, only part of the flow fluctuations that occur within the Priest Rapids Project area can be attributed directly to Grant PUD and much of the flow-related effects on white sturgeon habitat are attributable to the coordinated operation of the upstream projects.

It is likely that some entrainment of white sturgeon occurs at each project dam, although the frequency or consequences of these events are not known. The trash racks at each dam have a 7.375 inch clear spacing which would likely exclude large adult sturgeon, but allow smaller juvenile and sub-adult fish to pass through. We have no project-specific estimates of the amount of entrainment or turbine passage survival rates for white sturgeon; however, based on general patterns and trends seen in other species we would expect reasonably high survival of larval and small juvenile sturgeon and lower survival rates for larger juvenile and sub-adult fish. Some fish that survive turbine passage may be capable of returning upstream through the project fish ladders; however, most fish passing downstream through the turbines are probably permanently lost from the reservoir population whether they survive or not. It is possible that similar events would occur at upstream reservoirs and result in some replenishment of lost individuals to the project reservoirs. As indicated above, it is likely that some turbine entrainment of white sturgeon occurs at the Priest Rapids Project; however, we have no information to indicate the overall magnitude or significance of this effect.

To address the potential effect of the Priest Rapids Project on limiting recruitment of white sturgeon, Grant PUD proposed to construct and operate a white sturgeon conservation facility at the Priest Rapids Hatchery to produce yearling white sturgeon for stocking in the Priest Rapids Project reservoirs. Grant PUD proposes that through experimentation they would develop optimal rearing and release strategies and monitor and evaluate the effectiveness of hatchery releases. As part of the license application, Grant PUD filed a White Sturgeon Conservation Aquaculture Plan (WSCAP) that outlines a conceptual plan for the development of a middle Columbia River white sturgeon conservation facility and population supplementation.

Construction and operation of a white sturgeon hatchery facility that produces yearling fish for release into the project area would likely improve white sturgeon recruitment and lead to an increase the abundance of adult white sturgeon in the project area. While no specific cause for poor recruitment has been identified, the greater size and swimming ability of yearling fish, as compared to larval fish, would likely enhance their chances of survival in the project reservoirs. When compared to larval or sub-yearling sturgeon, we would not expect yearling sturgeon to be as vulnerable to predation or being flushed through the Priest Rapids Reservoir as was suggested by Golder (2003). Additionally, yearling fish would likely be better able to avoid entrainment if they

approach areas near the penstock openings. Grant PUD has indicated that it would use broodstock from the project reservoirs to the extent possible. The use of local broodstock would aid in maintaining any potential genetic uniqueness of the existing stock and could perhaps take advantage of any genetic adaptation that the local stock may possess for this portion of the Columbia River. Monitoring by Grant PUD would be useful for establishing the effectiveness of these releases and may provide valuable information that could be used to shape the future direction of the hatchery program. Finalization of the WSCAP, in consultation with the agencies and tribes would ensure adequate consideration of management goals and hatchery design and logistics.

WDFW, Interior, and CRITFC[60] recommend that Grant PUD develop and implement a WSMP. WDFW, Interior, and CRITFC each outlined actions that they believe should be implemented as part of the WSMP. These measures include actions such as 1) monitoring to determine natural and hatchery survival of egg, larval, juvenile and adult white sturgeon, 2) evaluation of natural recruitment rates 3) determination of year-class distributions, 4) genetic analysis, 5) measurement of growth rates, condition factors, and sex ratios, and 6) implementation of measures to increase white sturgeon populations. In a letter filed May 27, 2005, WDFW stated that through monitoring and evaluation of effects of project operation and facilities on white sturgeon, a WSMP would allow for the identification of ongoing project-related impacts. In a letter filed July 8, 2005, Grant PUD indicated that they agreed that any project impacts should be addressed through a WSMP; however, they also suggested that the goals laid out by WDFW, Interior, and CRITFC do not appear to correspond to or be related to mitigating project effects.

As part of the WSMP, both WDFW and Interior indicate that Grant PUD should be responsible for increasing sturgeon abundance to levels commensurate with available habitat. Additionally, WDFW and CRITFC suggest that Grant PUD should increase sturgeon abundance to levels that can support reopening a harvest-based fishing season. While these may be reasonable goals for WDFW, Interior, and CRITFC in their management of white sturgeon, they appear to be unrelated to the magnitude of project effects on the resource.

In regard to relicensing the Priest Rapids Project, it would be more appropriate to establish goals for the WSMP that include identifying and quantifying the projects effects on the resource while simultaneously developing and implementing measures to mitigate

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[60] CRITFC calls their plan a white sturgeon action plan; however, it appears to be the same recommendation as WDFW and Interior. For the purpose of our analysis, we assess the effects of CRITFC's recommendation along with the plan recommended by WDFW and Interior.

for these effects. Many of the actions recommended by WDFW, Interior, and CRITFC as details of the WSMP would be useful in identifying project effects or appropriate mitigation measures and may be appropriate for inclusion in the WSMP; however, the overall goals suggested by WDFW, Interior, and CRITFC go beyond addressing the effects of continued operation and maintenance of the Priest Rapids Project.

WDFW, Interior, and CRITFC recommend that Grant PUD coordinate white sturgeon mitigation efforts with regional experts and managers. WDFW specifically suggests that Grant PUD seek cost sharing, matching funds, and integrate project efforts with regional white sturgeon programs. Some coordination of white sturgeon mitigation efforts with WDFW, Interior, and CRITFC would be inherent in implementing white sturgeon mitigation measures. Additionally, consultation with WDFW, Interior, and CRITFC would likely be required by the Commission as part of the development of the WSMP if it is adopted in the license. However, coordination with regional experts and managers and integrating project efforts with regional white sturgeon programs would not be necessary to address or mitigate for project effects on white sturgeon. Additionally, while cost-sharing and matching funds could be helpful in reducing costs to Grant PUD or in the implementation of measures beyond those required by the Commission, requiring Grant PUD to seek cost-sharing and matching funds would not be necessary to address or mitigate for project effects on white sturgeon.

WDFW recommends that Grant PUD fund a qualified biologist to participate in the development and implementation of the WSMP and regional coordination activities related to white sturgeon management. A biologist with expertise in white sturgeon biology could potentially benefit sturgeon populations affected by project operations by evaluating data and making sturgeon management recommendations. However, the benefit of funding a biologist for a resource cannot be quantified or qualified with any degree of certainty.

Resident fish

Grant PUD proposes to provide funding for upgrades, improvements, and operating costs at the Columbia Basin Hatchery which currently raises 1.4 million fish for stocking in roughly 140 lakes throughout the region (the majority of the lakes are within Grant County, WA). Grant PUD also proposes to enhance and improve fisheries and fishing opportunities in the lower five miles of Crab Creek (a tributary that enters the Columbia River in the project area).

Under section 10(j) of the FPA, WDFW recommends that Grant PUD prepare, fund, and implement a Columbia Basin Hatchery Management Plan (CBHMP) with the goal of upgrading Columbia Basin Hatchery facilities to modern standards and increasing annual production from 65,000 pounds to 132,000 pounds. WDFW recommends that

Grant PUD develop and fund additional water supply to meet the goals of the CBHMP. WDFW recommends that Grant PUD fund the upgrades to the Columbia Basin Hatchery facilities specified in the CBHMP.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD conduct population analyses of resident fish stocks in the project reservoirs. CRITFC recommends that Grant PUD determine what impact the northern pikeminnow removal program is having on resident fish.

Our Analysis

Effects of the Priest Rapids Project on resident fish are not well documented or described; however, project effects likely include turbine entrainment and effects on shoreline habitat within the reservoirs and tailwater areas due to hydropower operations. It is likely that both native and introduced resident fish species occasionally become entrained at the project turbines. Grant PUD reported that resident young-of-the-year cyprinids (minnows) and catastomids (suckers) and large numbers of stickleback were collected during limited fyke net sampling of the turbine intakes at Priest Rapids dam. Similar sampling at Wanapum dam resulted in very few resident fish being collected. Grant PUD speculated that the higher rates at Priest Rapids dam may result from the presence of Goose Island immediately upstream of the turbine intakes. Goose Island likely provides littoral resident fish habitat, whereas no similar feature exists at Wanapum dam. Grant PUD reported that large resident fish were rarely collected at either dam.

Some fish that are entrained at the project dams are likely killed or injured. The remainder either continue moving downstream or become part of the existing resident fish community of the downstream area. We would expect that few resident fish return upstream via the ladders. The loss of resident fish from the reservoir communities has been ongoing during the current license with no documented effect. It is likely that resident fish are recruited to the project area from upstream projects, which may help to offset any losses that occur at the project dams. Regardless, based on the entrainment information reported above, we would expect the loss of stickleback and young-of-the-year minnows and suckers to have little affect on the overall health or size of the reservoir fish communities.

Flows within the project area fluctuate on an hourly, daily, and weekly basis. These flow effects are the result of the Priest Rapids Project operations in combination with upstream operations at 5 other mainstem dams including Grand Coulee dam. These flow fluctuations can influence water depths and velocities in shoreline areas typically inhabited by resident fish. Rapid changes in these parameters may affect feeding or spawning behavior, dewater nests, or expose juvenile fish to increased predation. These

effects have been ongoing during the current license term and there are no documented adverse effects on resident fisheries. Grant PUD is proposing some modifications to project operations to improve conditions for fall Chinook salmon in the Hanford Reach (discussed above). These modifications generally consist of providing an increased minimum flow and reducing the magnitude of fluctuations during portions of the year. Interior has proposed more substantial operational modifications that would greatly reduce fluctuations in the Hanford Reach, but would likely have much more significant effects on reservoir fluctuations. No specific information is available to quantify the effect of these potential operational changes on resident fish habitat within the reservoirs; however, the more substantial operational changes recommended by Interior would likely result in greater changes in shoreline depths and velocities, thereby having a greater potential to influence the suitability of shoreline resident fish habitat within the project reservoirs.

Grant PUD proposes and WDFW recommends that Grant PUD fund improvements to the Columbia Basin Hatchery and develop and implement a Columbia Basin Hatchery Management Plan. The Columbia Basin Hatchery is located near Moses Lake, Washington, outside the project boundary. The hatchery was constructed as a condition of the original license. Fish reared at the hatchery were initially stocked into the project area as mitigation for the effects of project construction and operation on sport fisheries. In a letter filed on May 26, 2005, WDFW reported that initial efforts to recreate sport fisheries within the project reservoirs were unsuccessful; therefore, fish from the hatchery have been stocked in many local lakes throughout Grant County.

Upgrading the Columbia Basin Hatchery and developing and implementing a hatchery management plan would modernize the operation of the hatchery and increase the production of healthy fish for stocking in the local lakes. However, because it appears that the fish reared in the hatchery would be stocked in lakes outside the project boundary, there would be no benefit to fish or recreational resources within the project area.

Grant PUD proposes to improve fish resources and fishing opportunities in the lower 5 miles of Crab Creek. We have no information that indicates that the operation or maintenance of the project has any effect on resident fisheries resources within Crab Creek. It appears that Grant PUD is proposing this measure to provide fisheries enhancements or mitigation in the project area that would offset ongoing project effects to resident fish and sport fisheries. In its AIR response filed on January 14, 2005, Grant PUD indicated that while some measures may be implemented in Crab Creek, the primary measures they are now considering include enhancing the stocked trout program and installing recreational fishing enhancements at Burkett Lake. Burkett Lake is a 78-acre lake that lies entirely within the project boundary and is located adjacent to Crab

Creek. Implementation of these measures would improve fishing opportunities within the project area and would provide fisheries enhancements that could offset ongoing project effects on resident fish.

CRITFC recommended that Grant PUD conduct a population analyses of resident fish stocks in the project reservoirs and determine what impact the northern pikeminnow removal program is having on resident fish. CRITFC states that Grant PUD should conduct these assessments to determine the ecological effect of removing significant portions of the pikeminnow population. They suggest that the "true impact" of pikeminnow predation impacts on salmonids needs to be re-examined and compared to the potential ecosystem impacts on other native species.

Grant PUD has not performed a population analysis of resident fish stocks; however, they did conduct a fisheries survey of the project area (Pfeifer et al.; 2001) that included many of the population parameters requested by CRITFC (i.e., catch per unit effort, condition, length and weight relationships). CRITFC suggests that Pfeifer et al. (2001) is inadequate for assessing effects of the pikeminnow removal program on resident fish and suggests that Grant PUD needs to conduct a more scientifically rigorous study that would provide population projections. The type of study requested by CRITFC would be extremely labor intensive and because the project area is not a closed system and annual physical conditions (such as temperature and flow) vary widely, it is unlikely that accurate population estimates could be obtained.

We evaluate the effects of the pikeminnow removal program on anadromous salmonids elsewhere in this section and conclude that it likely increases survival of outmigrating smolts. In regard to effects on resident fish, CRITFC suggests that because pikeminnow are the major predator of white sturgeon egg predators, their removal indirectly results in increased predation of sturgeon eggs. CRITFC does not specify which species that are considered sturgeon egg predators might benefit from pikeminnow removal. While it is apparent that white sturgeon reproduction within the project reservoirs is low or unsuccessful, we have no specific evidence to indicate that this is the result of egg predation.

In spite of the fact that the intent is to reduce predation on anadromous salmonids, it is probable that the pikeminnow removal program has some indirect effects on the abundance of other species within the project area. Likely effects would include increased abundance of likely pikeminnow prey species such as resident salmonids and other soft-rayed fishes (e.g. minnows and suckers). Other predator species that may compete with pikeminnow, such as smallmouth bass and walleye, may also increase in numbers as they fill in the niche opened by the removal of pikeminnow. While these changes in abundance could have some minor cascading effects within the reservoir

ecosystem, there is no evidence that pikeminnow removal has significantly harmed any other species or that the proposed studies would have the accuracy to identify such effects if they were occurring.

Administrative and Procedural Recommendations

As part of its license application, Grant PUD proposes to implement and assess anadromous fish measures using an adaptive management process that would include establishment of a Priest Rapids Coordinating Committee (PRCC), formation of various technical committees, and a dispute resolution process. Grant PUD would continue to use Standard Operating Procedures at both dams to provide operators with turbine operating criteria, spill patterns for use during downstream passage operations, fishway operation criteria, and other criteria pertaining to upstream and downstream passage of salmon and steelhead.

Under section 10(j) of the FPA, NOAA Fisheries and WDFW recommend that Grant PUD establish a PRCC, including a hatchery subcommittee and a habitat subcommittee.

Under section 10(a) of the FPA, CRITFC recommends that Grant PUD establish a PRCC that would: implement protection, mitigation, and enhancement measures; guide the adaptive management process for Pacific lamprey, sturgeon, Chinook salmon, coho salmon, sockeye salmon, and steelhead; and coordinate the 401 requirements.

Under section 10(j) of the FPA, WDFW recommends that Grant PUD be required to implement the Reasonable and Prudent Measures contained in NOAA Fisheries' Biological Opinion dated May 3, 2004.

Our Analysis

Grant PUD proposes to implement an adaptive management process for achieving the fish passage standards discussed elsewhere in this section. Grant PUD proposes and NOAA Fisheries, WDFW, and CRITFC recommend that Grant PUD establish a PRCC that would include various technical committees. Comments filed by NOAA Fisheries on May 27, 2005, indicate that a PRCC already exists and is currently addressing a variety of project-related issues. Continuation of PRCC meetings would provide a forum for review and discussion of monitoring and study results that would be necessary to determine if the fish passage standards or other goals are being achieved. A PRCC would also serve as a forum for discussing potential changes in project operations or facilities that need to be implemented to improve fish passage conditions.

Grant PUD proposes to provide operators at both dams with Standard Operating Procedures for turbine operations, spillway passage operations, fishway operations, and other facilities that affect upstream and downstream passage of salmon and steelhead. Providing standardized procedures to dam operators would help to ensure that intended measures for providing safe and effective passage conditions for salmon and steelhead would be implemented in a timely and efficient manner.

WDFW recommends that Grant PUD implement the Reasonable and Prudent Measures contained in NOAA Fisheries' Biological Opinion dated May 3, 2004. WDFW indicates that these measures need to be implemented to ensure that project operations do not jeopardize the continued existence of UCR spring-run Chinook salmon and UCR steelhead. Many of the specific measures included in the NOAA Fisheries Biological Opinion are encompassed by their Section 18 prescriptions and Section 10(j) recommends and are evaluated elsewhere in this section. To the extent that any ESA consultation would be necessary as part of this proceeding, the Commission will work with NOAA Fisheries to complete that process.

3.5.3 Cumulative Effects

The Priest Rapids Project contributes to cumulative effects on salmon, steelhead, bull trout, Pacific lamprey, and white sturgeon. Other factors that affect these species include other dams within the Columbia River system, commercial and sport fisheries, agriculture, human development, and stochastic changes in environmental conditions. The effects of these other factors are accounted for in our baseline description of these species which is provided in section 3.5.1. In Section 3.5.2, we described the effects of the Priest Rapids Project on these species and the potential effects of the proposed and recommended measures. Implementation of the proposed and recommended measures would reduce the effect of the Priest Rapids Project on fisheries resources, thereby reducing the cumulative effects on these species.

3.5.4 Unavoidable Adverse Effects

The proposed and recommended actions considered in section 3.5.2 would reduce fisheries losses associated with operation and maintenance of the Priest Rapids Project; however, adverse project effects would not be eliminated and some unavoidable adverse impacts would continue. Specifically, unavoidable adverse impacts on fisheries resources would include 1) continued entrainment and mortality of fish through the project turbines, 2) continued upstream passage delays, and 3) continued flow fluctuations in the Hanford Reach that affect habitat availability and quality and potentially dewater redds or fry.

3.6 TERRESTRIAL RESOURCES

The EIS scoping process identified the following issues related to project effects on terrestrial resources: (1) effects of daily and seasonal pool level fluctuations and downstream flow fluctuations on riparian and wetland habitats, and the wildlife dependant on these habitats; (2) effects of daily and seasonal pool level fluctuations, downstream flow fluctuations, and transmission line corridor maintenance on the spread of noxious weeds; (3) effects of recreation and other project-related human activities on riparian and upland wildlife habitats and wildlife dependant on these habitats; (4) avian collision and electrocution along project transmission lines; (5) effects of project operations (daily and seasonal pool level fluctuations, downstream flow fluctuations, transmission line maintenance) on populations of state-listed and rare plants and animals, including northern wormwood and persistentsepal yellowcress. In this section, we describe the affected environment with respect to terrestrial resources and the environmental effects, including cumulative effects, of the project as related to these issues.

3.6.1 Affected Environment

Historical accounts [61] of the Columbia River Basin recognized the importance of fish and wildlife resources to trappers and settlers in the social and economic development of the river basin. Game and fur animals provided food and clothing, and served as a medium of exchange. With the exception of antelope that inhabited the sage-brush, other big-game species (*e.g.*, mule deer, black bear, mountain bighorn sheep, and Rocky Mountain elk) inhabited the mountainous and timbered sections of the river basin. Muskrat, beaver, river otter, and raccoon occurred throughout the river basin; nesting and resting grounds for migrating waterfowl and upland game birds inhabited the lowland and cultivated areas.

Although the number of native grouse (*e.g.*, blue, ruffed, and sage grouse) decreased due to loss of shrub-steppe habitat, agriculture resulted in the development of habitat favorable to introduced game birds (*e.g.*, ring-necked pheasants, valley and bob-white quails). Wooten (no date) notes past (pre-settlement ca. 1850) and current shrub-steppe habitat in Washington State. The estimated original extent of shrub-steppe was 24,437 square miles. An estimated 11,315 square miles of shrub-steppe habitat remain. In a recent study, WDFW (2003) notes that Washington State's historic shrub-steppe vegetation has been adversely affected by habitat conversion for crop production, roads,

[61] H.R. Doc. No. 81-531, at 2874-2878 (1950); H.R. Doc. No. 87-403, at 99 (1962).

power-lines, and fences; overgrazing; invasion by exotic plants; and changes in fire frequency.

Vegetation

The existing Priest Rapids Project boundary consists of the Priest Rapids and Wanapum developments and an estimated 12,000 acres of shoreline. The project boundary encompasses 58 miles of the Columbia River, from Chelan Public Utility District Rock Island Dam at RM 453 downstream to the trailrace of Priest Rapids Dam at RM 395. The Wanapum development is located at RM 415. We also include, in our analysis, areas likely to be affected by project operations; in this instant, Hanford Reach. Thus, an estimated total distance of 107 miles, from the tailrace of Rock Island Dam to the lower end of Hanford Reach, has been identified for our cumulative effects analysis.

The Priest Rapids Project is located in the Palouse Grassland Province as defined by Bailey (1980). This province includes central Washington, extending to eastern Oregon, and is characterized as a steppe ecosystem with short grass and shrubs. The vegetation is tolerant of semi-arid conditions; precipitation is a limiting factor, in that, precipitation usually occurs between November and April. The driest season occurs from July through September with an average of less than one-half inch of precipitation per month. Wooten (no date) notes that the height of the Cascade Range to the west presents a barrier to prevailing coastal moisture systems, leaving the east side of the mountains in a rain-shadow. "The effect of the rain-shadow is low precipitation and relative humidity in the Columbia [River] Basin, with some areas receiving only 6 inches per year" (Wooten, no date: page 7). Soils in the Columbia River Basin have been formed under grassland or shrub-steppe vegetation and vary from sands to fine sandy loams, and silt loams developed on alluvial, lacustrine, and glaciofluvial (glacial river) materials (Bureau of Reclamation, 1998). For further discussion see section 3.3, Geology and Soils.

In 1999, a Habitat Based Terrestrial Inventory, conducted by Grant PUD, summarized available wildlife and botanical literature and also included a field effort to identify known populations of rare, threatened, or endangered plants. During 2000 and 2003, additional wildlife and botanical evaluations were conducted, including a Terrestrial Habitat Assessment (Framatome ANP, 2003). Survey results indicate the vegetative community within the Priest Rapids Project area is diverse and can be characterized as: upland (shrub-steppe);[62] riparian, wetland, and mesic; and developed

[62] Plant communities of shrub-steppe are usually recognized according to the dominate shrub and grass species found within the community. Typical shrubs include sagebrush species, rabbitbrush, and bitterbrush. Dominate grasses include bluebunch wheatgrass, needle-and-thread grass, and Sandberg's bluegrass. Different shrub-steppe cover types

cover types (see Table 18). Upland cover types (80.2 percent of the project area, not including rivers and streams) and developed cover types (16.7 percent of the project area) occupy most of the project area.

As identified in Table 18, there are three primary shrub-steppe cover types (loamy, sand, and lithosol) and a minor shrub-steppe cover type (alkaline). Habitat at some of the sites surveyed included both loamy and lithosol shrub-steppe cover types. Steep slopes, cliffs, or insufficient soils limit the extent of riparian vegetation adjacent to the Priest Rapids Project reservoirs. When present, riparian habitat supports Siberian elm, black cottonwood, white alder, and tree-of-heaven. The most common shrub adjacent to the reservoirs is coyote willow. Understory plant species include Baltic rush, reed canarygrass, meadow fescue, and red-osier dogwood.

Table 18. Summary of Cover Types and Distributions in the Priest Rapids Project Area (source: Framatome ANP, 2003b).

Cover Type	Description	Distribution in Project Area
Upland Cover Types:		
Loamy shrub-steppe	Deep loamy soils (sometimes with sand, rock, or silt component) supporting upland vegetation exceeding 18" in height. Typically dominated by big sagebrush and bluebunch wheatgrass.	Widespread throughout the Project area.
Sand shrub-steppe	Deep sandy soils supporting upland vegetation exceeding 18" in height. Typically dominated by rabbit-brush (green or gray), Indian ricegrass, and needle-and-thread. Includes some areas of bare dunes.	Well represented on east side of Priest Rapids Reservoir, but uncommon elsewhere. Often occurs in mosaics with other types.
Lithosol shrub-steppe	Shallow soils supporting upland vegetation less than 18" in height. Typically dominated by stiff sagebrush, desert buckwheat, and Sandberg's bluegrass.	Concentrated east of the Project, especially Lower Crab Creek drainage and Babcock Bench.
Alkaline shrub-steppe	Deep alkaline soils supporting upland vegetation exceeding 18" in height. Typically dominated by black greasewood, Great Basin wildrye, and saltgrass.	Uncommon, limited to Lower Crab Creek drainage and small patches on YTC. Small areas may also occur on Babcock Bench.

exist according to climatic and topographic conditions, soil type and depth, and land disturbance history (Sackschewsky and Downs, 2001).

Cover Type	Description	Distribution in Project Area
Rock/talus	Rock and talus slopes or patches with limited vegetative cover. Sub-types are vegetated (spiny hopsage and serviceberry are typically dominant) and non-vegetated.	Most prevalent on east side of Wanapum Reservoir. Large talus slopes on west side of Priest Rapids Reservoir are outside of mapped area.
Cobble/cobble bar	Cobble-sand soils in river corridor supporting sparse upland and riparian vegetation. Occasionally to frequently flooded. Found in Columbia River below Wanapum and Rock Island Dams.	Uncommon, limited to Priest Rapids Reservoir between Wanapum Dam and Lower Crab Creek, and Gravel Bar Island south of Rock Island Dam.
Riparian, Wetland, and Mesic Cover Types:		
Tree-shrub mosaic (TSM)	Shrub or tree cover exceeding 48" in height, in riparian or wetland, seasonal drainage, or upland setting.	Widespread, especially along Columbia river shoreline and major tributaries. Large patches on east bank of Priest Rapids Reservoir
Palustrine emergent wetland	Emergent vegetation in wetland areas. Tule, cattail, Baltic rush, common spike-rush, and purple loosestrife are typical dominants. Sites vary by inundation duration (short to long duration) and alkalinity (freshwater or alkali).	Widespread at margins of open water (large patches on Goose Island and at the Irrigation Return Channel) and in depressions outside of riparian influence (numerous in Lower Crab Creek corridor and on Babcock Bench).
Open water	Permanently inundated lands, sometimes supporting aquatic plants. Sub-types are palustrine and riverine.	Riverine includes Columbia River, Lower Crab Creek, Sand Hollow Creek, and Johnson Creek. Palustrine includes West Bar Slough, Quilomene Island Pond, Irrigation Return Channel, Moran Slough, and portions of other large ponds in Lower Crab Creek corridor and on Babcock Bench.
Riparian or wetland herbaceous	Herbaceous areas under riparian, wetland, or groundwater influence.	Narrow strips adjacent to the reservoir shoreline, tributaries, or ponds.
Mesic herbaceous	Herbaceous upland areas under riparian, wetland, or groundwater influence	Narrow strips partially removed from the reservoir shoreline, tributaries, or ponds. Occurs in larger patches in shallow, non-wetland basins and areas of elevated groundwater (*e.g.*, Lower Crab Creek corridor).
Unconsolidated shoreline	Frequently or usually inundated, poorly vegetated mudflats and cobble shores	Occurrence varies with water level, but present on both shores of Priest Rapids and Wanapum reservoirs
Developed Cover Types:		
Agricultural	Cultivated lands, including orchards	Widespread, but concentrated on east side of Priest Rapids Reservoir.
Other Developed	Roads, railroads, mines and quarries, commercial and industrial areas, riprap, residential developments, and developed recreation sites.	Widespread, but concentrated on east side of Wanapum Reservoir.

Grant PUD (2003) notes that due to groundwater seepage or flow some cliffs within the project area form "hanging gardens" that support Himalayan blackberry, purple-stemmed monkey flower, and yellow monkey flower.

To identify unique habitat for fish and wildlife resources and guide management of such areas, WDFW developed priority habitat designations.[63] Using these designations, WDFW identified four priority habitats located within the Priest Rapids Project boundary and vicinity: riparian; wetlands; cliffs, caves, and talus;[64] and shrub-steppe. For a description of the priority habitats, see Grant PUD (2003) at exhibit E5, section 5.4.1. While we identify some federal and state listed species associated with these habitats see section 3.7, Threatened and Endangered Species, for further discussion.

Wanapum Development

Grant PUD (2003) notes that shrub-steppe cover type is predominate throughout the Wanapum development area. Riparian vegetation is located around the mouths of creeks and the shores of West Bar, Quilomene Bar, Quilomene Island, Crescent Bar, and an area near the Town of Vantage. Black cottonwood, coyote willow, and Siberian elm are present. The vegetative community also includes cattail, tule, reed canary grass, and various forbs (*e.g.*, showy milkweed, knapweed species).

There are 10 islands in Wanapum Reservoir greater than one acre. The largest island is Quilomene Island (approximately 184 acres) composed of shrub-steppe, riparian vegetation, and an estimated 8-acre pond (Quilomene Island Pond). A state sensitive plant, Hedgehog cactus, occurs throughout the shrub-steppe interior of Quilomene Island (Framatome ANP, 2003b). A state-sensitive plant, shining flatsedge (*Cyperus bipartitus*), occurs on Quilomene Island and Crescent Bar, in addition to perennial tributaries. Other islands, ranging in size from 2 to 50 acres, are located near Crescent Bar, West Bar, Stockdale Slough, and south of Rock Island Dam. West Bar contains the largest area of sand shrub-steppe in Wanapaum Reservoir (Framatome ANP, 2003b) and a shallow depression that is a semi-permanently flooded emergent wetland (West Bar Slough). High cliffs occur along the southwest edge of West Bar. The Crescent Bar

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[63] A priority habitat must have at least one of the following characteristics: the area has high wildlife density or high species diversity; the area is an important breeding habitat, seasonal range, or migration corridor; the habitat is limited in availability or highly vulnerable to alteration; and the habitat has unique or dependent species.

[64] A cliff is defined as any vertical rock face greater than 25 feet high. Talus is predominately sand, gravel, cobble and boulder-sized particles of basalt that form a slope at the base of basalt cliffs.

area, designated as a riparian priority habitat, provides habitat for wintering bald eagles (*Haliaeetus leucocephalus*), a federal and state-listed species. See Table 19 for the Crescent Bar area and other riparian priority habitats.

Table 19. Summary of WDFW Riparian Priority Habitats in the Priest Rapids Project Area (source: adapted from WDFW, 2002).

General Location	Description
Wanapum Reservoir:	
Sand Hollow area (RM 418.5-419.5)	Most of this area has limited riparian vegetation due to heavy use (recreational camping), but includes a small stand of dense willows. A few small trees occur.
RM 425.9-424.6 (left bank along Babcock Bench)	Thinly distributed riparian shrubs and very few small trees. Used by a variety of tree-nesting passerines.
RM 429.0 (adjacent to Sunland Estates)	Small tract of sandy riparian habitat (willows). May be used by game birds and shrub-nesting passerines.
Crescent Bar area	Narrow, but dense riparian habitat along eastern and western shore of Crescent Bar, with cottonwoods, water birch, and willows. Wintering bald eagle habitat used by 2-3 bald eagles annually.
Mouth of Trinidad Creek	Stand of Siberian elm at mouth of creek and a band of shrubby willows along the creek. Used by a variety of tree-nesting passerines.
RM 452.4-451.8 (left bank below Rock Island Dam)	Small stand of willows. May be used by shrub-nesting passerines, game birds, and furbearers.
Priest Rapids Reservoir:	
Goose Island	Riparian habitat consists of stands of common reed, bulrush, and willows. Scattered large cottonwoods occur in the interior of the island along with upland habitats. Supports a variety of nesting water birds including gulls, great blue heron, black-crowned night heron, and Canada goose.
Buckshot Ranch	Dense woody riparian habitat dominated by Russian olive and multiflora rose. The area is designated for wheel chair accessible hunting, is adjacent to a Canada goose forage area, and is likely used by upland game birds.
Irrigation Return Channel (IRC)	The IRC receives irrigation wastewater and is permanently flooded. A relatively narrow band of riparian vegetation encircles the IRC, including willows, common reed, and bulrush. Used by waterfowl and other water birds, including shorebirds during periods of low water.
RM 412.8-411.9 (left bank at Beverly)	Riparian habitat consists of Siberian elm, mulberry, willow, juniper, and occasional cottonwoods. Used by a variety of tree-nesting passerines.
North side of Lower Crab Creek (RM 0 to 2.75)	Riparian stands primarily consisting of willows and Russian olive between sand dune area and creek. Area supports upland game, tree-nesting passerines, beaver, and other species.

Priest Rapids Development

At Priest Rapids development, the approximate 80-acre Goose Island contains riparian habitat, shrub-steppe cover type, and stands of black cottonwood and coyote willow trees with scattered snags. The riparian habitat associated with Goose Island is a designated priority habitat that supports a variety of nesting water birds, including black-crowned night heron (*Nycticorax nycticorax*), a Washington State monitor species. See Table 19. Vegetation includes southern mudwort, pigmy-weed, smartweed, and needle spike rush. The area supports state-sensitive plants (*e.g.*, awned halfchaff sedge (*Lipocarpha aristulata*) and shiny flatsedge). Common reed, cattail, and forbs (*e.g.*, western goldenrod and hemp dogbane) are present. The 33-acre Railroad Island is primarily cobble or gravel, sparsely vegetated by herbaceous species or shrubs. Gray rabbitbrush is the dominant shrub with white sweet-clover, spike bentgrass, and reed canarygrass interspersed. The periodically flooded cobble sand peninsulas and gravel bars upstream from Railroad Island support northern wormwood (*Artemisia campestris* var. *wormskioldii*), a federal candidate and state-listed plant (Framatome ANP, 2003a).

To the east of Priest Rapids Reservoir, there are two tributaries: Lower Crab Creek and the Irrigation Return Channel. Lower Crab Creek, of which an estimated 5 miles lies within the project boundary, is a riparian corridor that contains a diversity of species - - peach-leaf willow, coyote willow, and black cottonwood; native species (*e.g.*, Baltic rush, common spike-rush); non-native species (*e.g.*, common cocklebur, diffuse knapweed, and purple loosestrife); tule; hornwort, and other floating aquatic plants. A state-sensitive plant, Grand redstem (*Ammannia robusta*), occurs near the mouth of Lower Crab Creek (Public Utility District No. 2 of Grant County, Washington, 2003). Also, the sandy shrub-steppe cover type supports the state-sensitive plant, Geyer's milk-vetch (*Astragalus geyeri*) (Framatome ANP, 2003a).

As identified in Table 20, a portion of Lower Crab Creek is a wetland priority habitat because the area represents high quality habitat for upland game, waterfowl, and other species. To the north of Lower Crab Creek, there are numerous ponds, including shallow alkaline playas and pothole ponds. To the south of Lower Crab Creek, Saddle Mountains is present - - an area of cliffs, extensive talus slopes, and shrub-steppe cover type. The WDFW considers the steep slopes with cliffs, talus, and shrub-steppe vegetation of Saddle Mountains as priority habitat because the area provides quality habitat for breeding raptors and non-game species. See Table 21 and Table 22.

Table 20. Summary of WDFW Wetland Priority Habitats in the Priest Rapids Project Area (Source: adapted from WDFW, 2002).

General Location	Description
Priest Rapids Reservoir:	
Moran Slough	Emergent wetlands dominated by cattails and bulrush, and open water areas. Used by an assortment of passerines, raptors, waterfowl, other water birds, and beaver.
Lower Crab Creek area (beginning at RM 4.5)	Numerous depression emergent wetlands (including alkali wetlands) dominated by cattails, bulrush, spikerush, and saltgrass; some with associated Russian olive. Represents high quality habitat for upland game, shorebirds, waterfowl, furbearers, amphibians, etc.
Wanapum Reservoir:	
Sand Hollow	The lower part of the creek is impounded and is fringed by a small stand of cattail and reed canarygrass. This site is adjacent to a busy road and habitat values are limited.
Babcock Bench (left bank 0.5 miles south of Casey Creek)	A single short-duration emergent wetland (vernal pond).
Babcock Bench (left bank, three scattered sites by Ancient Lake Road)	Five permanently flooded depression emergent wetlands supported by irrigation seepage. Dominated by cattail and bulrush. Possible waterfowl breeding sites and used by tiger salamanders and bullfrogs (at two of the sites).

A narrow band of riparian vegetation composed of willow, common reed, and bulrush occurs at the Irrigation Return Channel (Public Utility District No. 2 of Grant County, Washington, 2003). As identified in Table 19, the Irrigation Return Channel is a designated riparian priority habitat. Hanson Creek, a perennial tributary, is located to the west of the Priest Rapids Reservoir and supports state-sensitive plants, such as Beaked spike-rush (*Eleocharis rostellata*) and porcupine sedge (*Carex hystericina*) (Framatome ANP, 2003a). Washes (Corral Canyon, Cow Canyon, and Sourdough Canyon) cut through the hills of the west bank along the reservoir, but only contain water during the winter and spring (Public Utility District No. 2 of Grant County, Washington, 2003).

Table 21. Summary of WDFW Cliff and Talus Priority Habitats in the Priest Rapids Project Area (source: adapted from WDFW, 2002).

General Location	Description
Wanapum Reservoir:	
Lower Babcock Ridge (from 1.3 miles south of dam to Sand Hollow area)	Low basalt cliffs and outcrops. Provides habitat for upland game, non-game birds, and reptiles (whipsnake and night snake).

General Location	Description
Babcock Bench (from Sand Hollow to Crescent Bar area)	Series of cliffs flanking the river (left bank) and edge of Babcock Bench. Used by a wide array of cliff-associated raptors, passerines, and bats.
Ginkgo Petrified Forest State Park	High cliffs flanking the river (right bank). Area includes three prairie falcon nests.
High cliffs on right bank (RM 426.4 to 430.8)	Discontinuous high cliffs flanking the river (right bank). Area includes prairie falcon and peregrine falcon nest sites.
Quilomene Creek and Quilomene Bar area	High cliffs on west edge of Quilomene Bar and north of Quilomene Creek. Suitable habitat for prairie falcon and golden eagle.
Tekison Creek	Band of cliffs extending along the north side of Tekison Creek (most of this area is more than 1 mile from the Project). Includes golden eagle territory.
West Bar	High cliffs along southwest edge of West Bar. Includes golden eagle territory and prairie falcon nests.
Colockum WA	High cliffs along the river and on west edge of bench between Colockum Creek and Tarpiscan Creek. Includes a golden eagle nest.
Moses Coulee area	Cliffs and talus slopes at the terminus of Moses Coulee and north and south of the coulee. Provides habitat for an array of game species, raptors, and cliff-associated species.
Priest Rapids Reservoir:	
Saddle Mountains (left bank including south of Lower Crab Creek, and right bank)	Steep slopes with cliffs, talus and shrub-steppe vegetation, provides quality habitat for breeding golden eagle, prairie falcon and other raptors, chukar, deer, and other non-game species.

Table 22. Summary of WDFW Shrub-Steppe Priority Habitats in the Priest Rapids Project Area (source: adapted from WDFW, 2002).

General Location	Description
Priest Rapids Reservoir:	
Priest Rapids WA	Mostly poor quality shrub-steppe. Used for hunting and other recreational activities.
Saddle Mountains	Good condition shrub-steppe on steep slopes. Provides habitat for deer, chukar, and shrub-steppe passerines.
Babcock Bench	Extensive unbroken area from north of I-90 Bridge to Crescent Bar area, including Frenchman Coulee and Potholes Coulee. Remnant shrub-steppe habitat in nearly undisturbed condition.
Babcock Ridge (east of Sunland Estates)	Remnant shrub-steppe habitat in area otherwise converted to irrigated agriculture.

Other priority habitat areas include the dune complexes in the lower Crab Creek area (Beverly Dunes ORV Park) and south of Moran Slough (Vernita Dunes) known for unusual plant communities and the sand dunes' vulnerability to disturbance (Public Utility District No. 2 of Grant County, Washington, 2003).

Hanford Reach

As discussed in this DEIS, the 51-mile-long Hanford Reach and the approximate 195,000-acre Hanford Reach National Monument (Monument) are unique regional resources due to relatively undisturbed habitats that contribute to the diversity of aquatic and terrestrial resources.

Within the Hanford Reach there is gradation of aquatic, riverine, cobble, riparian, wetland, bluff, and shrub-steppe habitats (National Park Service, 1994). Specialized habitats that also contribute to the biodiversity of the Hanford Reach include basalt outcrops, cliffs, and sand dunes. The Hanford Reach area represents one of the largest undisturbed tracts of native shrub-steppe cover type in the State of Washington (U.S. Department of Energy, 2003; Sackschewsky and Downs, 2001). WDFW (2003) identifies three large blocks of remaining shrub-steppe cover type: (1) 400,000 acres on the Yakima Reservation in Yakima County; (2) 378,000 acres on and around the U.S. Department of Energy Hanford Site in Benton County; and (3) 124,000 acres on the U.S. Army Yakima Training Center in Yakima and Kittitas Counties. Of these areas sage grouse are found only on the Yakima Training Center lands.

The 25,000-acre River Corridor Unit of the Monument includes the Hanford Reach of the Columbia River along with the Columbia River islands and the Hanford Dunes. The sand dunes rise approximately 10 to 16 feet above the ground, creating sandy habitats raging in size from 2.5 acres to several hundred acres. The predominate vegetation are scurf pea and thick-spike wheatgrass. The Nature Conservancy (2003) notes the Monument has a diversity of lichen and moss that occur in shrub-steppe plant communities, as well as in a variety of other habitats. Microbiotic soil crusts, which are complex groupings of lichens, moss, algae, and bacteria living on the surface of the soil, are found in the Monument's shrub-steppe plant communities. The microbiotic soil crusts help stabilize the soil, retain water, decrease erosion, and promote reseeding of grasses and shrubs.

The shrub-steppe cover type is dominated by big sagebrush, which occurs on soils characterized as loams and sandy loams. Shrubs include gray rabbitbrush, green rabbitbrush, antelope bitterbrush, threetip sagebrush, and black greasewood (Sackschewsky and Downs, 2001). Plant communities on sandy soils and stone-loams are characterized by bitterbrush and desert buckwheat (The Nature Conservancy, 2003).

Soils characterized as sand and loamy sand support Indian ricegrass and needle-and-thread grass. Common native forbs include Carey's balsamroot, long-leaved phlox, and daisy fleabane. Riparian vegetation is primarily limited to portions of the Columbia River shoreline, islands and sloughs, and wetlands created by irrigation run-off. Riparian areas include black cottonwood, white mulberry, coyote willow, and a variety of grasses and forbs. Upland habitat includes dunes and bluffs. The cliffs at White Bluffs, composed of clay stone and siltstone, abut the Columbia River on the eastern shore; a large, relatively flat area of shrub-steppe occurs on the western side (Demarchi, *et al*., 2003).

During 2002, surveys conducted at the Hanford Site and the Monument documented more than 100 rare plant populations of 31 different taxa. Of these plant species, two are proposed as candidates for federal listing: Umtanum desert buckwheat (*Eriogonum codium*) and White Bluff's bladderpod (*Lesquerella tuplashensis*) (Searing, *et al.*, 2002; Caplow, 2003). Umtanum desert buckwheat and White Bluffs bladderpod occur, respectively, within the McGee Ranch-Riverlands Unit and the Wahluke Unit of the Monument. Persistentsepal yellowcress, a state-threatened and federal species of concern, occurs in the Hanford Reach. See our discussion on Species of Special Concern below.

Transmission line Corridor

Shrub-steppe cover type (big sagebrush-bluebunch wheatgrass) primarily occurs within the project transmission line corridor. Additional plant associations include stiff sagebrush-Sandberg's bluegrass or stiff sagebrush-round headed desert buckwheat. Sandy soils support shrubs (*e.g.*, gray rabbitbrush and green rabbitbrush) and grasses (*e.g.*, Indian rice grass and needle-and-thread). Although not common, saline soils support saltgrass, giant wildrye, and greasewood (Framatome ANP, 2003h). Pothole ponds are located under or adjacent to the transmission line corridor. Survey results (Framatome ANP, 2003a) indicate occurrences of federal candidate and state-listed plant species (*e.g.*, Geyer's milk-vetch) within the corridor.

Invasive Species

In this DEIS we refer to noxious weeds, other exotic plant species, and invasive species (*e.g*., zebra mussels) as invasive species. Noxious weeds are defined as those plants listed by the Washington State Noxious Weed Control Board under Washington Administrative Code 16-750 and adopted by local county boards. Noxious weeds are classified according to current distribution and degree of threat; however, numerous plant species have been identified to be too widespread to control (*e.g.*, cheatgrass) and are not listed (Public Utility District No. 2 of Grant County, Washington, 2003).

Table 23 identifies noxious weeds and other exotic plant species known to occur within the project and surrounding areas, some of which are known to occur near rare plants (Framatome ANP, 2003b). Within the project transmission line, noxious weeds were concentrated near agricultural and private lands. Noxious weeds and exotic plant species, such as purple loosestrife and Russian olive, have been linked either to seed dispersal from agricultural lands via Lower Crab Creek (Mastrogiuseppe, 1991) or as a windbreak and wildlife enhancement.

In 2002 and 2003 noxious weed surveys confirmed the presence of 23 invasive plant species on the Monument, including three species that had not previously been documented. Of these species, diffuse knapweed (*Centaurea diffusa*) was the most widespread and abundant invasive plant species at the Monument, infesting more than 3,600 acres (The Nature Conservancy, 2003). Diffuse knapweed is common along the Hanford Reach, including at the Vernita Bridge boat launch. To control invasive plant species and protect the biodiversity at the Monument, an invasive plant species management plan for the Monument has been developed, which utilizes manual, mechanical, and chemical methods, as well as monitoring the effectiveness of the method(s). As an example, an invasive species (yellow starthistle) was found in 2003 within an area of White Bluffs bladderpod, a species of special concern. The infestation was mapped and yellow starthistle plants were removed manually (Caplow, 2003).

Table 23. Noxious Weeds and Other Exotic Plant Species Recorded During 1999-2001 Surveys in the Priest Rapids Project Area (source: Public Utility District No. 2 of Grant County, Washington, 2003).

Common Name *(Latin Name)*	**2002 County Classifications[1]**	**Habitat and Project Area Occurrence**
Russian knapweed *(Acroptilon repens)*	B (Grant, Kittitas); B designate (Yakima); Unlisted (Benton); C (Chelan)	Mesic transition areas between riparian and shrub-steppe habitat. Common to dominant in appropriate habitats throughout the Project and surrounding area.
Diffuse knapweed *(Centaurea diffusa)*	B (Grant, Kittitas); Education (Yakima); Unlisted (Benton); C (Chelan)	Grazed or otherwise disturbed shrub-steppe; rarely found in undeveloped or minimally used areas. Common in appropriate habitats in the Project and surrounding area.
Rush skeletonweed *(Chondrilla juncea)*	B (Grant); B designate (Yakima, Benton, Chelan)	Upland shrub-steppe, especially sandy areas. A single infestation found on Project lands in 2001.
Canada thistle *(Cirsium ravense)*	C (Grant, Kittitas); Education (Yakima, Benton), B (Chelan)	Wetland and riparian areas. Common in appropriate habitats throughout the Project and surrounding area.
Common St. John's wort *(Hypericum perforatum)*	C (Grant, Kittitas, Chelan); Unlisted (Yakima, Benton)	Wetland and riparian areas. Common in appropriate habitats throughout the Project and surrounding area.
Yellow flag *(Iris pseudacorus)*	Unlisted (Grant, Kittitas, Benton, Chelan); C (Yakima)	Wetland and riparian area. Common in appropriate habitats throughout the Project and surrounding area.
Mexican-fireweed *(Kochia scoparia)*	B (Grant, Kittitas, Yakima); Education (Benton); C (Chelan)	Grazed or otherwise disturbed shrub-steppe, often in alkaline areas. Rarely found in undeveloped or minimally used lands. Common in appropriate habitats throughout the Project and surrounding area.
Broadleaved pepperweed *(Lepidium latifolium)*	B (Grant, Kittitas, Yakima, Chelan); unlisted (Benton)	Wet to mesic soils in riparian and wetland areas. Common and locally dominant in appropriate habitats in Lower Crab Creek.
Oxeye daisy *(Leucanthemum vulgare)*	B (Grant, Kittitas); B designate (Yakima, Benton, Chelan); C (Chelan)	Mesic or agriculturally developed areas; also occurs in riparian habitats. Uncommon in the Project area.

Common Name *(Latin Name)*	2002 County Classifications[1]	Habitat and Project Area Occurrence
Dalmatian toadflax *(Linaria dalmatica)*	B (Grant, Kittitas Yakima, Chelan); B designate (Benton)	Disturbed rangelands, fields, and roadsides. Uncommon in the Project area, but widespread in the inland Northwest.
Purple loosestrife *(Lythrum salicaria)*	B (Grant, Kittitas); B designate (Yakima, Benton, Chelan)	Wetland and riparian habitats. Common to dominant in appropriate habitats throughout the Project and surrounding area.
Eurasian watermilfoil *(Myriophyllum spicatum)* [2]	B (Kittitas); Unlisted (Grant); B designate (Yakima, Benton, Chelan)	Aquatic habitats. Common throughout Priest Rapids and Wanapum reservoirs.
Reed canarygrass *(Phalaris arundinacea)*	Unlisted (Grant, Kittitas, Benton, Chelan); C (Yakima)	Wetland and riparian areas. Common but rarely dominant in appropriate habitats in the Project and surrounding area.
Alkali swainsonpea *(Sphaerophysa salsula)*	B (Grant, Yakima, Chelan); Unlisted (Kittitas, Benton)	Wet to mesic soils in riparian and wetland areas. Uncommon, but locally dominant in parts of Lower Crab Creek.

[1] Douglas County's Noxious Weed Control Board is currently inactive, but state designations and requirements apply.

[2] This aquatic species is not addressed in E-5, license application.

[B] = Limited distribution, but well established in some parts of the state. Control required in uninfested areas (B designate); containment required in already infested areas (B non designate).

[C] = Widespread. Management requirements are determined locally.

Education = Widespread. Local education efforts are encouraged.

Wildlife

Diverse vegetative cover types, cliffs and talus slopes, as previously identified, provide habitat for breeding wildlife; perching and roosting sites for raptors; hibernacula where snakes den during winter; and protected crevices for roosting bats. In mesic habitats (riparian, wetland, and cottonwood stands), moist ground, leaf litter, and decaying woody debris provide protection from predators and food sources for wildlife.

As identified in Table 18, developed cover types consist of agricultural and other developed areas. Common wildlife species, which occur in the agricultural areas, include Great Basin pocket mouse, deer mouse, northern pocket gopher, burrowing owl, western meadowlark, and barn swallow (Bureau of Reclamation, 1998).

Based on wildlife surveys (Framatome ANP, 2003) and Grant PUD agency consultations, an estimated 251 wildlife species are known to or may occur within the

project area: amphibians (8 species); reptiles (9 species); waterfowl (30 species); water birds (52 species); birds of prey (27 species); upland game fowl (7 species); passerines (57 species); and mammals (61 species), which include big-game, furbearers, and bats.

Table 24 identifies some of the common wildlife species that occur within the project area. By letter filed May 26, 2005, Interior states that mammals utilizing the riparian habitat supported by the project include muskrat, beaver, river otter, raccoon, long-tailed weasel, and mink. See Grant PUD (2003) for a complete list of species.

Federally listed species also occur in the project area. See our discussion in the Threatened and Endangered Species section.

Table 24. Common Wildlife Species in the Priest Rapids Project Area (source: Public Utility District No. 2 of Grant County, Washington, 2003, as modified by staff).

Common Name *(Latin Name)*	**Occurrence**
Great Basin spadefoot toad (*Spea intermontanus*)	Breeds in floodwater pools along Lower Crab Creek, and also reportedly occurs in Vantage area, Sand Hollow, and Ginkgo State Park.
Pacific treefrog (*Hyla regilla*)	Widespread and common in seasonal to semi-permanently flooded wetlands in Lower Crab Creek area, Babcock Bench, Quilomene Island Pond, West Bar Slough, Wanapum substation. Also breeds in Tekison and Quilomene Creeks.
Bullfrog (*Rana catesbeiana*)	A non-native species. Found at flooded ponds in Lower Crab Creek area and on Babcock Bench; heard calling at Irrigation Return Channel, Priest Rapids Wildlife Recreation Area (WRA), and Moran Slough.
Side-blotched lizard *(Uta stansburiana)*	Found in shrub-steppe cover type with loam or sandy loam soils. Found in Lower Crab Creek area.
Yellow-bellied racer (*Coluber constrictor)*	The most commonly observed snake in the project area. Found in shrub-steppe and riparian habitats.
Gopher snake *(Pituophis catenifer)*	Widespread species. Found in both shrub-steppe and riparian habitats.
Western rattlesnake *(Crotalus viridis)*	Relatively common and conspicuous. Found in shrub-steppe, riparian, and mesic habitats. Found in Lower Crab Creek area.
Canada Goose *(Branta Canadensis)*	Breeding. Found on and near Goose Island; Priest Rapids WRA, Lower Crab Creek.
American wigeon *(Anas Americana)*	Non-breeding, migrant. Found on Goose Island.
Mallard *(Anas platyrhynchos)*	The most abundant species of dabbling duck in the project area. Mallard pairs observed in Moran Slough, Lower Crab Creek, and in riparian habitats along the project reservoirs.

Common Name *(Latin Name)*	**Occurrence**
American avocet *(Recurvirostra Americana)*	Migrant. Water bird documented to have bred in project area (Smith *et al*, 1997).
Common merganser *(Mergus merganser)*	Breeding. Found throughout the project area.
Lesser scaup *(Aythya affinis)*	Non-breeding, migrant.
American coot *(Fulica Americana)*	The most abundant waterbird in the project area. Occurs primarily during winter on the reservoirs, with small numbers remaining to breed.
Killdeer *(Charadrius vociferous)*	The most common shorebird species.
California gull *(Larus californicus)*	Breeding. Abundant in the Wanapum development area (Demarchi, *et al*., 2003).
Red-tailed hawk *(Buteo jamaicensis)*	Most commonly observed bird of prey. Nest records documented for the species throughout project area.
American Kestrel *(Falco sparverius)*	Most commonly observed falcon. Found in riparian, shrub-steppe, grassland habitats, residential and agricultural areas.
Prairie falcon *(Falco mexicanus)*	Associated with cliffs, shrub-steppe habitat.
Great horned owl *(Bubo virginianus)*	Breeding. Found in Lower Crab Creek, Quilomene Creek, Columbia and Midway Substations, and other areas. Nests on cliffs, in riparian habitats, and in old barns and building.
Barn owl *(Tyto alba)*	Breeding. Nests on cliffs, in riparian habitats, and in old barns and building.
California quail *(Callipepla californica)*	Breeding. Found in shrub-steppe habitat.
Rock wren *(Salpinctes obsoletus)*	Resident. Found in shrub-steppe habitat with rocky outcrops.
Common nighthawk *(Chordeiles minor)*	Breeding. Found in lithosol shrub-steppe habitat. Nests in sparse, open shrub-steppe habitat (Framatome ANP, 2003e).
Dark-eyed junco *(Junco hyemalis)*	Common winter. Found in mesic habitat.
Western meadowlark *(Sturnella neglecta)*	Found in shrub-steppe habitat. Among the most common nesting species in the river basin.
Rocky Mountain elk *(Cervus elaphus)*	Found on the western side of Wanapum Reservoir.
Mule deer *(Odocoileus hemionus)*	Found on the western side of the project area and on Goose Island. Occurs primarily in shrub-steppe habitat.

Common Name *(Latin Name)*	**Occurrence**
Beaver *(Castor canadensis)*	Found along the project reservoirs.
River otter *(Lutra Canadensis)*	Found along the project reservoirs.
Deer mouse *(Peromyscus maniculatus)*	Found in both mesic and shrub-steppe habitats.
Northern pocket gopher *(Thomomys talpoides)*	Found in shrub-steppe habitat. Requires loose soils for burrowing.
Great Basin pocket mouse *(Perognathus parvus)*	Found in shrub-steppe habitat. Requires loose, sandy soils for burrowing. Forages on cheatgrass and other winter annuals.
Yuma myotis *(Myotis yumanensis)*	Found at Babcock Bench and Quilomene Creek. Found at a bridge site utilized as a night roost. Potentially breeding.
Little brown myotis *(Myotis lucifugus)*	Recordings determined presence of species at Priest Rapids WRA and Moran Slough. Found at a bridge site utilized as a night roost.

Breeding habitat for amphibians (*e.g.*, Pacific treefrog) is generally standing or slow-moving water that persists until at least early summer (occasionally as early as late May) (Framatome ANP, 2003c). The non-native bullfrog has colonized most of the flooded ponds in the Lower Crab Creek area and on Babcock Beach (Grant PUD, 2003). In addition to the reptiles listed in Table 24, western painted turtles were observed at three sites: Lower Crab Creek; in a pond along the transmission line corridor on Babcock Beach; and near a pond in Potholes Coolee (Framatome ANP, 2003d).

Birds migrating between breeding grounds in the northern latitudes of Canada and wintering grounds in the U.S. and Central and South America utilize the Columbia River corridor (Public Utility District No. 2 of Grant County, Washington, 2003). During migration and in winter (from mid-October to February) waterfowl are abundant on the project reservoirs and associated wetlands. The WDFW identified 15 waterfowl and American coot concentration areas on Wanapum Reservoir (10 areas) and Priest Rapids Reservoir (five areas).

Relicensing studies conducted by Grant PUD for avian species consisted of the following: (1) a breeding bird survey (2002); (2) a migratory bird survey (autumn-winter 2001 and spring 2002); and (3) a Priest Rapids Project transmission line avian study (from February to November 2001). Furthermore, based on consultations with the U.S. Fish and Wildlife Service (FWS), Grant PUD notes more than 42,000 (up to 72,000) diving ducks (*e.g.*, lesser scaup) and more than 70,000 (up to 250,000) dabbling ducks (*e.g.*, American wigeon, mallard) were recorded during each winter census (from October to January).

American white pelican (*Pelecanus erythrorhynchos*), a Washington State endangered species, Caspien tern (*Sterna caspia*) and black-crowned night heron, both Washington State monitor species, and great blue heron are known to nest in clustered and identifiable locations, typically referred to as colonies (Smith, *et al*., 1997; Northwest Power and Conservation Council, 2004).

California gulls and ring-billed gulls are abundant in the Wanapaum development area. Colonies of Caspien terns were located near Wanapaum development, at Goose Island, and at other islands within the Columbia River. Study results (Demarchi, *et al*., 2003; Searing, *et al.*, 2002) indicate that these species and other fish-eating birds consume Chinook salmon smolts along a stretch of the Columbia River. The authors note that assuming predation rate on other species of salmon (for which the authors recognize no available data), coho salmon, steelhead, and sockeye salmon also would be consumed by birds.

In the Priest Rapids Reservoir, Goose Island supports the only known great blue heron rookery in the project area. Goose Island, as with other islands, is used by waterfowl (*e.g.*, Canada goose, American wigeon, California gull) for resting, foraging, and nest sites. Other species known to occur on or near the island include American white pelican, bald eagle, great horned owl, red-tailed hawk, mule deer, yellow-bellied racer, and beaver.

Moses Islands, which are gravel bar islands in the upper Priest Rapids Reservoir, and a sandy island near Crescent Bar are used by foraging bald eagles and used or possibly used by nesting Canada geese. Gulls and double-crested cormorant have been observed on these islands.

Cliffs, caves, and talus slopes provide unique habitat for birds and reptile species (Northwest Power and Conservation Council, 2004). Along the Columbia River, cliffs and adjacent shrub-steppe cover type provide nesting and foraging areas for these species, as well as, provide potential roost sites for bats. Survey results (Framatome ANP, 2003f) identified four bat species within the project area: Yuma myotis, little brown myotis, pallid bat (*Antrozous pallidus*), and spotted bat (*Euderma maculatum*). The pallid bat and spotted bat are Washington State monitor species.

Passerine (*e.g.*, rock wren, western meadowlark) and non-passerine (*e.g.*, northern flicker, common nighthawk) birds occur within the project area. Some species are residents, while other species only occur during the breeding season or wintering period. Upland game fowl (*e.g.*, mourning dove, California quail) are managed by the WDFW for hunting purposes. For further discussion, see section 3.9, Recreation and Land Use.

Survey results (Framatome ANP, 2003g) identified eight species of small mammals in which deer mouse and Great Basin pocket mouse were the most abundant species. Generally, deer mouse occurred in both mesic and shrub-steppe, whereas the Great Basin pocket mouse occurred in shrub-steppe. In the shrub-steppe habitat at Lower Crab Creek, deer mouse, Great Basin pocket mouse, and Ord's kangaroo rat were found.

Hanford Reach

The Hanford Reach supports an estimated four species of amphibians, nine species of reptiles, 200 species of birds, 42 species of mammals, 1,500 species of insects, and 44 species of fish (U.S. Department of Energy, 1999; U.S. Fish and Wildlife Service, 2003). See section 3.5, Aquatic Resources, for a discussion on the fishery resources. From 1994 to 2000 the Hanford Site was surveyed for insects. While numerous insect species are awaiting identification, a total of 1,679 species had been identified, primarily moths and beetles. Four new species of moths were discovered on the sand dunes and in the Wahluke Wildlife Area (Zack, *et al*., 2003). A darkling beetle not found in previous studies, a ground beetle and a rare beetle were discovered at the White Bluffs Ferry site (The Nature Conservancy, 2003).

Some of the wildlife species that occur within the Priest Rapids Project area also occur at the Hanford Reach section (*e.g.*, side-blotched lizard, gopher snake, Great Basin pocket mouse, western meadowlark, little brown myotis, and mule deer). Black-tailed jackrabbits occur within the sagebrush. Coyote are also common. Although the islands associated with Hanford Reach are utilized by Canada geese and mule deer for nesting and fawning habitat, respectively, coyotes are a primary cause of destruction for the nests of Canada geese on the islands (U.S. Department of Energy, 1999). Wetlands provide habitat for a variety of waterfowl, such as mallard, green-winged teal, and bufflehead. Migratory species include the long-billed curlew, loggerhead shrike, sage thrasher, and Brewer's sparrow.

Four species of colonial nesting birds occur in the Hanford Reach area: Forester's tern (*Sterna forsteri*), a Washington State monitor species; California gull; ring-billed gull; and great blue heron. The black-crowned night heron formerly nested in the area and may re-establish a colony in the future (National Park Service, 1994). The Hanford Reach provides habitat for several federal and state-listed threatened and endangered species. In particular, the reach provides habitat for wintering bald eagles.

Transmission line Corridor

The avian transmission line study (Framatome ANP, 2003h) assessed the use of

habitats by raptors and waterfowl along the project transmission line. The study was conducted during the spring 2001 migration period (February to March), nesting period (April to early-May), summer (July to August), and fall/winter migratory period (mid-September to November). Results identified 88 species of birds, some of which are raptors (*e.g.*, red-tailed hawk, American kestrel, prairie falcon, and northern harrier); waterfowl (*e.g.*, Canada goose, mallard, American wigeon); "swimmers" (*e.g.*, American coot, pied-billed grebe); passerines (*e.g.*, cliff swallow, western meadowlark) and non-passerines (*e.g.*, rock dove, northern flicker); and aerialists (*e.g.*, California gull, Caspian tern, Forster's tern); wading birds (such as, great blue heron); and shorebirds (*e.g.*, killdeer, spotted sandpiper). The variety of species can be attributed to the diverse vegetative community, including associated wetlands.

The study (Framatome ANP, 2003h) also found raptors (*e.g.*, red-tailed hawk, American kestrel) and other birds (*e.g.* common raven) use transmission towers as nest sites along the Priest Rapids transmission lines. Further, the study found red-tailed hawk, American kestrel, house finch, white-throated swift, or doves perched on the towers, the wires associated with the transmission line, substations, etc., or other items, such as vegetation, fences or posts, and cliffs.

Species of Special Concern

From 2000 to 2002 Framatome ANP (2003a) conducted surveys and documented several occurrences of 20 different rare plant species located in the vicinity of the Priest Rapids Project. Results indicate one Washington State endangered species, four threatened species, 11 sensitive species, and four species under review. Four of the state-listed species are considered federal candidate. See Table 25.

Table 25. State and federal vascular plants documented during surveys of the Priest Rapids Project area (Source: Framatome ANP, 2003a).

Name	Federal Status	State Status	Occurrence in Project Area
Grand redstem *Ammannia robusta*	--	T	One occurrence in the T-Line ROW near the mouth of Lower Crab Creek.
Northern wormwood Artemisia campestris var. wormskioldii	C	E	One occurrence on BOR land.
Columbia milkvetch *Astragalus columbianus*	SOC	S	One occurrence on Grant PUD land.
Geyer's milkvetch *Astragalus geyeri*	--	T	Two occurrences in T-Line ROW on private, federal, and Grant PUD land.
Dwarf evening-primrose *Camissonia pygmaea*	--	T	Two occurrences in the T-Line ROW on Grant PUD land.

Name	Federal Status	State Status	Occurrence in Project Area
Porcupine sedge *Carex hystericina*	--	S	Five occurrences distributed across both project reservoirs, wetlands in the T-Line ROW, and a partially vegetated gravel pit near Priest Rapids dam.
Annual paintbrush *Castilleja exilis*		SR	Occur at three separate locations within the T-Line ROW and at two seeps near the Columbia River. Also documented in the Lower Crab Creek area, outside the project boundary.
Gray *cryptantha* *Cryptantha leucophaea*	SOC	S	Six occurrences in the T-Line ROW on federal, Grant PUD fee-owned and private land. One population on dunes to the south of SR 26.
Miner's candle *Cryptantha scoparia*	--	S	One occurrence in T-Line ROW on WDFW land.
Shining flatsedge *Cyperus bipartitus*	--	S	Seventeen occurrences, although boundaries unclear. On Priest Rapids Reservoir, wetland complex, sloughs of Priest Rapids WA, west side of Goose Island; On Wanapum Reservoir, east side of Crescent Bar; Quilomene Bar.
Beaked spike-rush *Eleocharis rostellata*	--	S	Four occurrences in Moran Slough (two populations), near Borden Springs and Buckshot Slough.
Giant helleborine *Epipactis gigantean*		S	Thirteen occurrences documented in the project area; suitable habitat is widespread in the project area.
Sagebrush stickseed *Hackelia hispida var. disjuncta*	--	S	One occurrence in T-Line ROW on private land.
Awned halfchaff sedge *Lipocarpha aristulata*	--	T	Three occurrences: Goose Island (WDFW land), Feather Slough (Grant PUD land), and south of Priest Rapids Dam.
Hoover's desert-parsley *Lomatium tuberosum*	SOC	S	One occurrence in the T-line ROW on Grant PUD land.
Suksdorf's monkeyflower *Mimulus suksdorfii*	--	S	Two occurrences in the T-Line ROW on federal and private land.
Small-flowered nama *Nama densum var. parviflorum*		SR	Eight occurrences found in T-Line ROW below Priest rapids dam on federal, private, and Grant PUD fee-owned land.
Coyote tobacco *Nicotiana attenuate*	--	S	One occurrence in the T-Line ROW near Frenchman Coulee.
Brittle pricklypear *Opuntia fragilis*	--	SR	One occurrence in the T-Line ROW near Frenchman Coulee.
Hedgehog cactus *Pediocactus simpsonii* var. *Robustior*	--	SR	Two occurrences: one in T-Line ROW near Babcock Bench on private land; one on Quilomene Island.

E = Federal status is endangered, Washington State status is endangered

T = Federal status is threatened, Washington State status is threatened

C = Federal status is candidate species

SOC = Federal status is species of concern

S = Washington State sensitive

SR = Washington State review

Although the staff preliminary identified the state-threatened and federal species of concern persistentsepal yellowcress (*Rorippa columbiae*) as potentially occurring in the Priest Rapids Project area, survey results (Framatome ANP, 2003a) indicate the plant does not occur within the project area. Persistentsepal yellowcress occurs in the Hanford Reach on islands. Habitat for persistentsepal yellowcress is inundation for part of the year, seasonal fluctuation of water level, wet soil into the growing season, and open habitats with low cover of competing vegetation. The plants grow and reproduce in late summer and early fall, when water levels are lowest (Caplow, 2003). Survey results (Caplow, 2003) indicate plants are submerged during daylight hours on the lower Hanford Reach even after Reverse Load Factoring begins in mid-October, due to the 6 to 8 hour lag time from Priest Rapids dam to the lower Hanford Reach. Caplow (2003) notes Reverse Load Factoring is a river management strategy designed to keep river levels low over Vernita Bar to allow for redd counting, and it begins in mid-October and continues until mid-November. See section 3.5, Aquatic resources, for further discussion. Caplow (2003) notes hydrologic changes on the Hanford Reach and possible impacts on persistentsepal yellowcress are unknown at this time.

By letter filed May 3, 2005, the FWS identified two candidate species, Washington ground squirrel (*Spermophilus washingtoni*) and northern wormwood (*Artemisia campestris ssp. Borealis* var. *wormskioldii*), and a species of concern, Pacific lamprey (*Lampetra tridentate*) that may occur in the vicinity of the Priest Rapids Project. See section 3.5, Aquatic Resources, for our discussion on the Pacific lamprey.

Washington Ground Squirrel

The Washington ground squirrel (*Spermophilus washingtoni*) is a federal candidate species. In Washington, the species is listed as a State candidate. Historically, the species occurred in shrub-steppe habitat of southeastern Washington and northeastern Oregon, but its range has decreased due to habitat loss. Decline of the Washington ground squirrel has been attributed to poisoning and/or shooting (Rulofson *et al*., 1993). Ongoing agricultural conversion eliminates Washington ground squirrel habitat, resulting in fragmentation of habitat and isolation of colonies (Nolin, 2005; and Betts, 1990, 1999 In: U.S. Fish and Wildlife Service, 2004).

The Washington ground squirrel occurs at sites with greater vegetative cover, but soil type may be the most important feature. The species selects soil with high silt content, such as Warden Soils, and very deep, allowing for deeper burrows that would maintain their structure compared to sandy or shallow soils (U.S. Department of Agriculture, 1983).

The Washington ground squirrel is diurnal and spends much of its time underground. Adults emerge from hibernation between January and early March, depending on the elevation and microhabitat conditions (Sherman, 2000 In: U.S. Fish and Wildlife Service, 2004). The species is known to feed on bluebunch wheatgrass, needle-and-thread grass, Sandberg bluegrass, and cheatgrass. Crops (*e.g.*, cabbage, peas, and oats) and insects are also consumed when available (Bailey, 1936; Howell, 1938; Carlson *et al.*, 1980 In: U.S. Fish and Wildlife Service, 2004).

Although suitable habitat exists, the Washington ground squirrel is not known to occur in the Priest Rapids Project area (Public Utility District No. 2 of Grant County, Washington, 2003). Currently, Washington ground squirrels occur east of the Columbia River in two populations in the State of Washington and one population south of the Columbia River in the State of Oregon. The three populations are separated by an estimated 30 miles of unoccupied land (U.S. Fish and Wildlife Service, 2004). However, an increased number of detections in the populations suggest the species is more broadly distributed throughout its range than was previously known. Recent, site-specific studies (Sherman, 2001; Musser *et al*., 2002 In: U.S. Fish and Wildlife Service, 2004) indicate the Washington ground squirrel occurring on the BLM Wenatchee Resource Area, located in Douglas and Grant Counties and on the federal Columbia National Wildlife Refuge and State Seep Lakes Wildlife Management Area, near Othello, Washington. The BOR (1998) notes eight occurrences of the Washington ground squirrel on scattered tracts; however, the records are old (circa 1950) and unconfirmed.

Northern Wormwood

Northern wormwood (*Artemisia campestris ssp. borealis* var. *wormskioldii*), a perennial, is a federal candidate species and is considered endangered in Washington. Historically, the distribution for northern wormwood was known from sites along the banks of the Columbia River near the mouth of the John Day River in Wasco County, Oregon to the vicinity of Hood River County, Oregon, a distance of approximately 50 miles (McCarthy, 2004). Construction of dams and subsequent flooding of habitat, and possibly railroad and highway construction resulted in the loss of habitat as well as individuals and populations (Carlson, 1997). Recent factors contributing to an impact on the species include recreation (ORV use, trampling of plants), competition of non-native plant species (*e.g*., diffuse knapweed), thereby displacing native vegetation, and other factors (*e.g.*, winds known to scour the area, river levels and flow patterns).

Habitat for northern wormwood is exposed basalt, cobble-sandy terraces, and sand habitat along the banks of the Columbia River at an elevation ranging from 160 feet to 500 feet. The species' flowers are noticeable usually between mid-April and the first week in May.

Currently, northern wormwood occurs only at two sites: (1) Miller Island, in the lower Columbia River, Klickitat County, Washington- -population occurs on National Forest land, managed by the Columbia River Gorge National Scenic Area of the Gifford Pinchot National Forest; and (2) the Beverly site, upstream from the Hanford Reach, Grant County, Washington- -population occurs on land owned and managed by the BOR along the shore of the Columbia River and on several islands. These two populations are separated by an estimated 200 miles of the Columbia River; Priest Rapids dam, McNary dam, and John Day dam are located between the two sites.

At the Miller Island site existing information documents 109 plants in 1995, a substantial increase from the 75 plants reported earlier in 1989; however, the population has fluctuated with 87 plants recently documented in 2004. At this site, the northern wormwood population is immediately adjacent to an area suitable for landing a boat, which is used as a beach. The small size of the population and its proximity to the boat landing site make it vulnerable to trampling of the plants (McCarthy, 2004). The Beverly site supports the largest known population of northern wormwood (Caplow, 2003), with 1,260 plants (McCarthy, 2004).

Caplow (2003) surveyed the islands in the Hanford Reach for northern wormwood in 2002. The area surveyed included all the islands from Richland upstream to Vernita Bridge, except for one island in the vicinity of Coyote Rapids and one island upstream of Locke Island (both of which have some contamination issues). No populations of northern wormwood were found. The Nature Conservancy (2003) concludes no existing populations of northern wormwood were found in surveys along the Hanford Reach. Potential habitat for the species occurs on several islands and is mapped as potential reintroduction sites.

In 2001 Framatome ANP (2003i), on behalf of Grant PUD, surveyed the Priest Rapids Project area for northern wormwood, including Gravel Bar, parts of Quilomene Island, Railroad Island (and unnamed islands to the south), various shoreline areas, and the vicinity of the Beverly population. In 2000 and 2001 the shorelines of Priest Rapids and Wanapum Reservoirs were surveyed. Two separate extensions of the Beverly population were found, numbering over 250 individuals. The combined northern wormwood population at Beverly is estimated between 1,500 and 2,000 individuals.

In 2001 Grant PUD initiated a multi-year demographic modeling study to describe population changes of northern wormwood at Beverly. Results would be used to guide future efforts to protect northern wormwood. Further, Grant PUD worked cooperatively with BOR to eliminate vehicular access to the area of the Beverly population because of recreation impacts; approximately 5,000 linear feet of fencing was installed. Other

efforts to protect the Beverly population of northern wormwood include invasive plant species control measures (*e.g.*, hand-pulling diffuse knapweed) and funding various research efforts (*e.g.*, ground water investigations, germination and propagation testing, and mapping) (letter filed July 8, 2005, from Laurel Heacock, Public Utility District No. 2 of Grant County, Washington, responding to the U.S. Department of the Interior's May 26, 2005 comments).

Grant PUD proposes to develop and implement a northern wormwood conservation plan to protect and monitor populations within the Priest Rapids Project area that would include: continuing annual demographic monitoring for 10 years; working with BOR to maintain 5,000 linear feet of fencing to eliminate vehicular access; and funding of ongoing noxious weed control, access control, data management, taxonomic investigations, and research to support long-term conservation of the species in the amount of $40,000 per year.

3.6.2 Environmental Effects and Recommendations

In this section, we assess the effects of daily and seasonal pool level fluctuations and downstream flow fluctuations on terrestrial resources, including species of special concern. We assess the project transmission line corridor on avian collision and electrocution and maintenance of the corridor on the spread of noxious weeds and other exotic plant species. The effects of public recreation on terrestrial resources are discussed in Section 3.9, Recreation and Land Use.

Vegetation

Grant PUD proposes to provide WDFW with $60,000 per year to support a fire suppression program on WDFW lands (Colockum, Quilomene, and Whiskey Dick Wildlife Areas) near the reservoirs; assuming that the funds would be used to suppress fires that start on or near Priest Rapids Project land. Fire suppression funds not used at the end of the year would be allocated for habitat rehabilitation. The program would also include provisions for signage at key locations that describe the hazards and costs of wildfire.

Grant PUD proposes to assess aquatic macrophyte density at eight transects within the Priest Rapids Project every 4 years. Samples also collected between the eight transects will be used to provide information on the coverage of macrophyte distribution and density in the Priest Rapids Project area. Photographic coverage of littoral areas will be obtained with a low-elevation over-flight during the peak aquatic macrophyte growth period (typically August) and will coincide with field sample collection. The estimated cost of this program conducted at 4-year intervals is $100,000 (letter filed July 8, 2005,

Laurel Heacock, Manager, Licensing and regulatory Compliance Manager, Grant County Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington).

To enhance riparian/wetland habitat within the lower 5 miles of Crab Creek and the Priest Rapids Wildlife Area, Grant PUD proposes the following items: (1) provide funding in the amount of $30,000 per year for O&M related to the enhancement measures and provide funding in the amount of $7.2 million for capital costs, including associated materials and labor; (2) rehabilitation of existing vegetation to the extent practical; (3) enhancement of waterfowl migration, wintering, and breeding habitat; (4) wetland development through re-connection of side channels; and (5) controlling unregulated ORV access. Recreational fishing enhancements would also be provided.

Pursuant to section 10(j) of the FPA, WDFW recommends the following conditions for terrestrial resources that the licensee: (1) makes available $15 per acre per year to WDFW for O&M of WDFW lands within the Priest Rapids Project boundary, for lands conveyed by the licensee to WDFW in the original license, for WDFW wildlife area lands in the vicinity of the project, and for lands acquired for mitigation under the new license; (2) makes available to WDFW $2,160,000 for the replacement of the lost wildlife values associated with the section of land along Wanapum Reservoir known as Crescent Bar; (3) makes available to WDFW $6,500,000 to fund implementation of habitat restoration and enhancement projects as mitigation for on-going project impacts as a result of project operations and project-related recreation impacts; (4) provides to WDFW $4,500,000 for the purpose of acquiring wildlife resource lands to (a) ensure the protection of the wildlife and recreation values associated with the original mitigation lands, and (b) acquire habitat to preserve quality habitats and wildlife; and (5) develop, implement, and fund a Priest Rapids Project habitat management and monitoring plan in order to guide and facilitate the management of habitat and associated wildlife on lands within the project boundary and on land conveyed to WDFW as mitigation in the original license.

WDFW recommends, pursuant to section 10(j), that the licensee makes available to the WDFW $120,000 annually for obtaining professional fire suppression services and for WDFW fire suppression services. WDFW states that Colockum, Quilomene, and Whiskey Dick Wildlife Areas border the western shore of Wanapum reservoir for approximately 38 miles. The wildlife areas provide winter and spring habitat for Rocky Mountain elk, mule deer, cougar, California quail, and other species. WDFW has records of eight wildfires on these areas, which can be correlated with recreational use or the Fourth of July celebrations.

In a filing of July 8, 2005 and in response to WDFW comment on the $15 per acre per year, Grant PUD notes the ambiguity of the recommendation in that WDFW provides

no indication as to the specific activities covered by the funding level. Further, Grant PUD notes that in 1963 it conveyed lands to the State as mitigation for project construction and inundation. Grant PUD also notes it provided to the State $150,000 for O&M and up to an additional $20,000 per year for 20 years for reimbursement to the State for monies spent on mitigating game losses. Consequently, Grant PUD argues that it has already satisfied its requirement for mitigation in the prior license term.

Regarding Crescent Bar Island, Grant PUD notes WDFW comment pertains to pre-project impacts. From Wanapum Dam to Crescent Bar the distance is 24 miles; the majority of the shoreline is vertical basalt bluffs with approximately 3 miles of sandy beaches. To address indirect effects of development and recreation at Crescent Bar Island and other cumulative effects, Grant PUD notes $1 million is proposed for land acquisition and other enhancements for terrestrial resources. Also, Grant PUD proposes funding of $288,500 per year for O&M, monitoring and research associated with various capital improvements. The draft shoreline management plan stipulates Crescent Bar Island be managed under two land classifications: (1) 105 acres in Planned Development, and (2) 65 acres in Conservation. An additional 47 acres of immediate adjacent lands (smaller islands and the shore of the mainland) would be classified Conservation. See Section 3.9, Recreation and Land Use, for a discussion of the land use classifications.

By letter filed January 14, 2005, Grant PUD proposes to develop and implement a single habitat management plan, rather than two separate plans (Upper Wanapum management plan and Lower Crab Creek management plan). The single habitat management plan would include five separate programs: (1) habitat maintenance; (2) habitat restoration and enhancement; (3) rare, threatened, and endangered species protection; (4) land acquisition and preservation; and (5) resource integration and coordination. Measures related to fire suppression, noxious weeds, other exotic plant species, invasive species, and recreation management would be identified. In a response letter to WDFW filed July 8, 2005, Grant PUD reiterated its proposal for a habitat management plan in that following submittal of its final license application for the Priest Rapids Project, Grant PUD and the stakeholders determined that a single plan would be more appropriate for the project rather than two separate plans. In particular, monitoring and management of recreation impacts on terrestrial resources would be a component of the plan, and as such, the plan would be coordinated with the RRMP and shoreline management plan.

In response to WDFW's request for $120,000 annually for fire suppression, Grant PUD notes that WDFW provides no rational for its request and states that WDFW's estimated cost of fire protection at the Colockum Wildlife Area was $39,855 annually for the period from 1997 to 1999; costs for Quilomene Bay and Whiskey Dick Wildlife

Areas were not provided. Grant PUD notes the summer 2001 fire at Quilomene Bay was 50 acres and estimated to cost $24,640.

Invasive Species

Potential impacts of invasive species on environmental resources include, but are not limited to, the following: (1) out-compete natives and dominate undisturbed native communities; (2) reduce or eliminate resources (*e.g.,* food, cover, nesting sites) used by native animals; (3) inhibit root growth of neighboring plants; (4) decreased water quality; and (5) stunted fish populations due to dense biomass of introduced species (The Nature Conservancy, 2003; WDFW, 2001). As previously discussed, noxious weeds and other exotic plants are known to occur within the project boundary and surrounding areas, some of which occur near rare plants. For example, diffuse knapweed is known to occur near the federal candidate species northern wormwood. Although not found in the project area, yellow starthistle, an invasive plant, has been observed on the Hanford Site, and suitable habitat is widespread for this species in the mid-Columbia River Basin. Project effects on yellow starthistle are limited to the dispersal vector by Grant PUD vehicles (Framatome ANP, 2003a). Another invasive plant, rush skeletonweed, was found on project lands south of Priest Rapids dam in 2001, near an occurrence of the state-listed gray cryptantha (*Cryptantha leucophaea*). All of the rush skeletonweed were hand-pulled in 2001.

As a component of its draft RRMP, Grant PUD proposes to develop and implement an aquatic plant nuisance management program for the project area. The program would include information and signage about noxious weeds and other exotic plant species at key recreation sites. The program also contains a provision for review and selection of prioritized sites where aquatic nuisance plant control efforts would be located, such as Crescent Bar swimming area and boat launch. The costs for this program would be $15,000 (equipment lump sum) and $350,000 annual labor.

Grant PUD also proposes to continue to monitor for zebra mussels (*Dreissena polymorpha*) within the Priest Rapids Project area. Grant PUD notes that at present all plankton samples collected from the Priest Rapids Project area have been negative for zebra mussels. Grant PUD's estimated cost to monitor for zebra mussels is $2,000 annually.

WDFW, pursuant to section 10(j) of the FPA, recommends the licensee develop, fund, and implement a mid-Columbia River Aquatic Invasive Species Prevention Program. The plan would address provisions to educate recreational watercraft operators about aquatic invasive species prevention and impacts, including development and distribution of educational materials during the peak boating season (May 1 through

October 30); a plan to direct boat inspections including documenting the findings; and identification of boat access points. As part of the plan, WDFW recommends various components, including a recommendation for Grant PUD to fund an aquatic invasive species program inspector at an estimated cost of $6,000 per year. In addition to the salary, Grant PUD should also provide office space and storage area.

Our Analysis-Vegetation

Grant PUD proposes to allocated $1 million for land acquisition, which may be applied to the purchase of private or WDNR lands within or adjacent to the WDFW wildlife areas, or to purchase additional shrub-steppe habitat near the project. Grant PUD proposes to work cooperatively with the agencies and stakeholders to identify specific lands for acquisition.

In its letter filed July 8, 2005, Grant PUD reiterates that acquisition of private in-holdings within the lower 5 miles of Crab Creek would preserve lands for wildlife and provide for more efficient management of the Lower Crab Creek and Priest Rapids Wildlife Areas. Potential enhancement measures include the acquisition of two privately-owned parcels of land: (1) the 98-acre Crab Creek in-holdings; and (2) the 37-acre Johnson Creek/Getty's Cove. Both parcels consist of shrub-steppe habitat and palustrine wetlands. Species of special concern (*e.g.*, loggerhead shrike, chukar, common loon) are known to inhabit the areas. The parcels were selected based on proximity to the Priest Rapids Project; the ability to provide contiguous public ownership; and the value for public access for recreation. The Crab Creek in-holdings would increase protected habitat along Lower Crab Creek; Johnson Creek/Getty's Cove would increase protected habitat along Wanapum shoreline.

By letter filed January 14, 2005, Grant PUD states that specific parcels to be acquired would be selected based on owner's willingness to sell and because they best meet stakeholder interest (Laurel Heacock, Manager, Licensing and Regulatory Compliance, Grant County Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington). Grant PUD has allocated $1 million for land acquisition.

From the maps provided by Grant PUD in its letter filed January 14, 2005, it appears that the two above-mentioned parcels are located partially inside and outside the Priest Rapids Project boundary. We note that if measures at the non-project sites are found to be necessary for the project purposes then lands dedicated to project purposes must be included in the project boundary.

The WDFW-owned lands mentioned in its recommended $15 per acre per year include: (1) project east-side lands- -Lower Crab Creek (includes Priest Rapids WA and

vicinity and Quincy WA, Grant County); and (2) project west-side lands- -Colockum, Whiskey Dick, and Quilomene WA, Kittitas County and vicinity. For project east-side lands, the estimated current acreage of WDFW-owned lands within the Lower Crab Creek Wildlife Area is 14,300 (including the Priest Rapids Wildlife Area at 2,250 acres. The acreage recommended for acquisition is 880 acres of inholdings and 815 acres of WDNR-owned land. The estimated current acreage of the Quincy Wildlife Area is 7,600 acres. In total and for the existing project east-side lands we estimate 21,900 acres, not factoring in any potential land acquisition. For project west-side lands, the estimated current acreage of WDFW-owned lands within Colockum, Whiskey Dick, and Quilomene Wildlife Areas is 46,000 acres, 17,000 acres, and 13,100 acres, respectively. The acreage recommended for acquisition is 2,483 acres of private holdings and 5,072 acres of WDNR-owned lands within the project boundary or adjacent to the project. In total and for the existing project west-side lands we estimate 76,000 acres, not factoring in any potential land acquisition. WDFW states that mitigation potential as intended has not been realized. WDFW states the level of funds previously agreed upon 40 years ago for the term of the license are inadequate to provide for O&M activities such as weed control, road maintenance, fencing, litter pick-up, and signage.

In addition, WDFW states that the majority of Crescent Bar Island no longer provides the wildlife mitigation benefits originally intended. WDFW requests its standard mitigation practice of four-to-one replacement ratio to mitigate for lost wildlife values. Based on the approximate area of Crescent Bar, post inundation to be 600 acres, WDFW estimates the Crescent Bar replacement cost over a 50-year license totals $3,960,000 ($2,160,000 (600 acres x 4 x $900 per acre) plus $1,800,000 O&M).

The WDFW recommends Grant PUD make available to WDFW $6,500,000. The WDFW states that restoration and enhancement projects identified in the Lower Crab Creek WA would restore and enhance wildlife areas and provide recreation opportunities lost as a result of project development for which the Lower Crab Creek WA was originally intended to mitigate. Funds provided under the terms of the original license provided to be inadequate to meet O&M costs. Further, WDFW states that during high-density recreation use periods (*e.g.*, holiday weekends) recreationists "spill-over" from the Priest Rapids Project to the mitigation lands (wildlife areas) originally conveyed to WDFW by Grant PUD in the 1960's, resulting in a loss of wildlife benefit values. See Section 3.9, Recreation and Land Use, for further discussion on effects of public recreation use on undeveloped dispersed recreation sites.

In Grant PUD's proposed habitat management plan, fire suppression would be addressed under its habitat maintenance program. Given the arid climate of the mid-Columbia River Basin we recognize the importance in having fire suppression measures in place. Survey results (Newell, 2003) indicate that subsequent to a 2000 wildfire and 2

years later revealed an impacted stream and riparian zone (Rattlesnake Spring of the Columbia River). The wildfire burned the riparian vegetation and deposited ash and charred material into a stream. Newell (2003) notes that vegetation not burned was killed by the heat and the material fell into the stream channel. With the loss of riparian habitat, winds blew sand, silt, ash, and dead vegetation into the stream, resulting in increased sedimentation and reduced flow velocities. Such sediments could disrupt populations of filter filters and smother certain species (e.g., *Pisidium* clams). Grant PUD's proposed fire suppression measure, including provisions for signage at key locations that describe the hazards and costs of wildlife, could reduce fire incidents through public education.

See Section 5.0, Staff's Conclusions, for a discussion on WDFW's above recommendations, including its request for $120,000 annually for fire suppression.

Invasive Species

We note WDFW efforts to coordinate aquatic nuisance species management practices in partnerships with private and public entities, and tribes. In its plan, WDFW (2001) proposes to publish an aquatic plant identification manual for Washington State. The manual would enable lake residents and managers to identify non-native aquatic plant species, as well as common native plant species. Further, TNC (2003) adopts an integrated approach that addresses invasive species issues for the Monument.

In Section 3.9, Recreation and Land Use, we discuss the effects of recreation use (*e.g.*, boating) and the potential to spread aquatic invasive plant species. The aquatic nuisance management program, as proposed by Grant PUD in its draft RRMP, could compliment the efforts of WDFW; and, therefore, reach a broader range of the public through information to prevent, eradicate or control introductions of aquatic nuisance plants more effectively. Ongoing monitoring of invasive species by Grant PUD within its Priest Rapids Project transmission line corridor is another effective method of controlling invasive plant species, which could compliment TNC's efforts. Instead of an aquatic nuisance management program as a component of a final RRMP, we find that a separate invasive species plan for the Priest Rapids Project would be more effective in addressing noxious weeds, other exotic plant species, and invasive species (*e.g.*, zebra mussels). Elements of the plan could include a summary of baseline surveys conducted for noxious weeds and other exotic plant species; monitoring methods; monitoring schedule; a schedule for providing monitoring results to the agencies; consultation with the agencies; information and signage about invasive species at key recreation sites; training Grant PUD staff on noxious weeds, other exotic plant species, and invasive species; and an identification of measures to control such species that would be consistent with other licensees and entities within the mid-Columbia River Basin.

Further, Grant PUD proposes to continue to work cooperatively with WDFW and monitor for zebra mussels. The WDFW (2001) states that the most probable path of introduction for zebra mussels into Washington is either from adult mussels attached to the hull of boats transported from affected areas or from larvae found in untreated bilge water in these transported vessels. The Columbia River is a likely location for such an introduction. Grant PUD's monitoring efforts for zebra mussels, therefore, could be a component of an invasive species plan.

With respect to WDFW's recommendation that Grant PUD fund the services of an aquatic invasive species program inspector position to implement the tasks required in WDFW's aquatic invasive species protection program, we note the recommendation cannot be quantified or qualified with any degree of certainty. We address this issue further in Section 5.0, Staff's Conclusions.

Wildlife

Grant PUD proposes to develop and implement a transmission line avian collision protection plan; and, provide capital funding in the amount of $500,000 over the term of the license to support the measures including marking transmission lines, over-head ground wires at specific crossings.

Interior's recommendation no. 12, pursuant to section 10(j) of the FPA, recommends Grant PUD develop and implement an avian protection plan within 2 years of license issuance to protect against collisions by waterfowl and raptors with the project's transmission lines and structures. The plan would include measures for installing power line identifiers on transmission line and overhead ground wires and/or guy wires at the following sensitive sites: Midway crossing located on the Columbia River below Priest Rapids dam; North and South Moran Slough; Crab Creek crossing; the Wanapum dam tailrace; the Wanapum switchyard; Frenchman Coulee; and Moses Coulee.

WDFW recommends that Grant PUD develop, implement, and fund a Priest Rapids Project habitat management and monitoring plan for lands within the project boundary and for lands conveyed to WDFW as mitigation in the original license. According to WDFW, mitigation for original project impacts would entail a monitoring strategy to outline timelines and actions appropriate to restore damaged habitat to pre-existing conditions and a plan for restoring the original habitat and wildlife values of the lands. WDFW does not provide any costs associated with its recommendation.

Grant PUD, in a filing of July 8, 2005, states that the RRMP and habitat management plan would be coordinated to ensure adequate monitoring and management

of recreation impacts on terrestrial resources. A monitoring program is already included in its draft RRMP. Required funding and timelines would be included in its habitat management plan.

Our Analysis-Wildlife

Based on surveys conducted during the relicensing and other information, at least 24 species of raptors (*e.g.*, red-tailed hawk, State-listed northern goshawk and peregrine falcon, federally-listed bald eagle) and 40 species of waterfowl (*e.g.*, ring-necked duck, bufflehead, common loon) have been documented or potentially occur in the vicinity of the Priest Rapids Project transmission line corridor. The species include residents and migrant species that potentially breed in the project area. Habitats (*e.g.*, wetland, riparian, cliff) utilized by these species have been identified along the transmission line corridor. Over the last 12 years Grant PUD employees have observed 25 to 35 waterfowl collide with the transmission lines at South Moran Slough (Framatome ANP, 2003h). Framatome ANP (2003h) observed species adjusting their altitudes and maneuvering to avoid striking the overhead ground wires.

As summarized in a study (Framatome ANP, 2003h), Table 26 identifies eight sites where Grant PUD should evaluate the feasibility of installing line markers in order to reduce the potential for avian collisions. In particular, since the Columbia River is a major migratory pathway, two points where the transmission lines cross the river (Midway Crossing and Wanapum Dam) should be considered for marking.

Table 26. Sites where tranmission line marking should be considered at the Priest Rapids Project (Source: Framatome ANP, 2003h)

Site	Number of Overhead ground wires	Comments
Midway Crossing (Site 24)	8	High number of transmission lines cross Columbia River; numerous water-associated birds; high number of altered flights.
Wanapum Switchyard	18	Transmission lines cross wetlands (waterfowl habitat); numerous waterfowl and other water-associated birds.
Moses Coulee (Site 1)	2	Transmission lines ascend cliffs with updrafts (raptor habitat); numerous raptors.
Frenchman Ponds (Site 12)	0	Transmission lines cross over ponds and wetlands (waterfowl habitat); numerous waterfowl and other water-associated birds.
Wanapum Dam (Site 14)	6	High number of transmission lines cross Columbia River; numerous waterfowl and other water-associated birds.
Lower Crab Creek (Site 16)	0	Transmission lines cross Crab Creek (waterfowl and raptor habitat); numerous waterfowl and

Site	Number of Overhead ground wires	Comments
		raptors.
North Moran Slough (Site 21)	2	Transmission lines cross open water and wetlands (waterfowl habitat); numerous waterfowl; altered flights.
South Moran Slough (Site 23)	3	Transmission lines cross open water and wetlands (waterfowl habitat); numerous waterfowl; reports of avian collisions.

We note Grant PUD's proposal to develop and implement a transmission line avian collision protection plan, including marking transmission lines, over-head ground wires at specific crossings. While Framatome ANP (2003h) states that Grant PUD transmission lines are among Bonneville Power Authority transmission lines, and therefore the effectiveness of marking the transmission lines remain uncertain, we find a transmission line avian collision protection plan is necessary for the Priest Rapids Project.

Since invasive plants are known occur in the Priest Rapids Project area and the project can influence invasive plant species populations via maintenance activities along the transmission line corridor, Grant PUD should coordinate its transmission line avian collision protection plan with an invasive species plan. This coordinated effort, along with agency consultation, could minimize invasive plant seed dispersal, thereby limiting their distribution.

We identified the effects of daily and seasonal pool level fluctuations and downstream flow fluctuations on riparian, wetland habitats, and associated wildlife as a cumulative effect. Such effects can occur as a result of the complex and interrelated set of operating regimes, as discussed in Section 2.0, Proposed Action and Alternatives. The typical daily power operations of both Wanapum and Priest Rapids include a drawdown of approximately 1 to 3 feet below the normal maximum pool elevation. The reservoirs are typically restored to maximum reservoir elevations overnight and may be drafted again the following morning.

Riparian, wetland habitats, and associated wildlife occur throughout the Priest Rapids Project area and along the Hanford Reach. See our previous discussion under riparian and wetland priority habitats, as identified by WDFW. Based on existing information, riparian and wetland habitats within the project area appear to be adapted to the water-level fluctuations associated with project operation and other upstream operating regimes. Mastrogiuseppe (1991) suggests that shining flatsedge, a Washington State sensitive species, has increased in numbers in response to the Priest Rapids Project reservoir conditions. The plant species occurs in wetlands and mouths of perennial tributaries.

The shoreline riparian in the project area and in the Hanford Reach provides wildlife species nesting, feeding (*e.g.*, terrestrial and aquatic insects), and foraging opportunities. Waterfowl that feed over aquatic vegetation in shallow water must adjust to shifts in the location of suitable foraging habitats. Although foraging habitat for waterfowl may be reduced, increased access to areas by waterfowl that are usually too deep may benefit certain species (Public Utility District No.2 of Grant County, Washington, 2003). The National Park Service (1994) finds different species use the riparian habitat of the Hanford Reach in winter than in summer, indicating that the shoreline riparian communities are important year round in maintaining wildlife populations. In addition, after the irrigation season ends in October, some of the smaller wetlands dry out, and water levels of the lakes and larger wetlands recede, leaving exposed shoreline as resting areas for migrating and wintering waterfowl.

Grant PUD proposes to develop and implement a single habitat management plan instead of developing and implementing two plans (Upper Wanapum management plan and Lower Crab Creek management plan). Proposed measures included installation and maintenance of 48 wood duck (*Aix spona*) boxes around the project reservoirs; maintenance of 12 structures for raptors, and installation of up to 50 waterfowl nesting platforms. Although the details of Grant PUD's new proposed habitat management plan are not clearly defined, we assume the wildlife-related structures would be a component of the habitat management plan. Grant PUD estimates O&M costs for wildlife-related structures at $15,500 per year. To be effective, the structures should be maintained and monitored and if necessary, modified accordingly. We find Grant PUD's proposal to develop and implement one plan instead of two plans would accomplish the same goals of protection and enhancement for wildlife and associated habitat affected by daily and seasonal reservoir fluctuations and downstream flow fluctuations. The measures originally proposed as part of Grant PUD's Upper Wanapum management plan and Lower Crab Creek management plan should be considered in a habitat management plan. Grant PUD's original efforts for noxious weed control on elk, mule deer, and bighorn summer and winter ranges should be factored into a separate invasive species plan. See our discussion under Invasive Species.

With respect to WDFW's recommendation that Grant PUD develop and implement a habitat management and monitoring plan, see Section 5.0, Staff's Conclusions.

Species of Special Concern

Grant PUD proposes to fund a rare, threatened, and endangered botanical species protection plan that could include (a) budgeting $7,000 per year to defray O&M costs in

order to address potential habitat disturbances resulting from maintenance activities within the project transmission line corridor and any future modifications or additions in the number and/or configuration of transmission lines and structures; (b) a construction schedule of any future projects to avoid disturbance of rare, threatened, and endangered species; (c) a provision for conducting pre-construction surveys; (d) an identification of measures to protect any rare, threatened, and endangered botanical species found during the surveys; (e) an implementation schedule; and (f) a monitoring plan to evaluate the effects on rare, threatened, and endangered species and their habitat.

Grant PUD proposes to develop a long-term plan to monitor rare, threatened and endangered plants within the project area that could include (a) a description of the methods to be employed, (b) a provision to map and quantify population trends, (c) an implementation schedule, (d) a provision and schedule for reporting and consulting with appropriate agencies regarding the monitoring results, and (e) providing $13,500 per year to the WDNR-Natural Heritage Program for funding and management of research information to further the knowledge of the ecology of rare plants in the Priest Rapids Project area. Grant PUD estimates the cost of program at $35,000 per year.

Pursuant to section 10(j) of the FPA Interior recommends (recommendation no. 10) Grant PUD develop and implement a northern wormwood conservation plan. Although Interior concurs with Grant PUD's proposal to develop and implement such a plan, Interior recommends the plan be developed and implemented within 90 days after license issuance.

Pursuant to section 10(j) of the FPA Interior recommends (recommendation no. 11) Grant PUD develop and implement a rare, threatened, and endangered botanical monitoring program. Interior concurs with Grant PUD's proposal to develop and implement such a plan.

Pursuant to section 4(e) of the FPA BOR recommends that the licensee develop a protection and monitoring plan for any and all listed and candidtate species on BOR-administered lands within the Priest Rapids Project boundary. BOR states that such a plan would ensure that populations of plants that may become listed under the ESA be provided to help preserve the species, in particular northern wormwood.

Our Analysis

As noted by Interior, the loss of rare, threatened, and endangered plant species can occur as a shrub community develops and herbaceous areas are invaded by woody vegetation, including noxious weeds and other exotic plant species. Grant PUD proposes to develop and implement a rare, threatened, and endangered botanical species protection

plan for the Priest Rapids Project transmission line corridor. Access through the transmission line corridor by Grant PUD service equipment and maintenance of the transmission line could spread invasive species and adversely affect species of special concern. Although the specificity of a rare, threatened, and endangered botanical species protection plan would be identified in consultation with the resource agencies and affected tribes, we find such a plan would compliment agencies' efforts toward recovery of identified plant species and as a result, protect and enhance the species and its habitat.

Grant PUD proposes to develop a long-term plan to monitor rare, threatened and endangered plants within the Priest Rapids Project area, which would provide a measure of protection for the botanical resources. The plan would entail a methodology for monitoring various rare, threatened, and endangered plant populations in the project area; provisions to map and quantify population trends; a schedule for agency consultation; and provisions for funding and management of research information. Interior concurs with Grant PUD's proposal. We find a monitoring plan for rare, threatened, and endangered plants at the Priest Rapids Project would compliment Grant PUD's above-mentioned rare, threatened, and endangered botanical species protection plan, thereby affording additional protection to the identified species.

We note BOR's recommendation for a protection and monitoring plan focuses on botanical resources, in particular the northern wormwood. BOR states that its recommendation is to protect BOR interests if the plan proposed by Grant PUD were not adopted in a new license. We find BOR's interests would be met by Grant PUD's proposed measures to protect and enhance rare, threatened, and endangered species, including a separate plan for the northern wormwood.

Environmental effects on terrestrial resources, including species of special concern primarily result from recreation (*e.g.*, ORV use) and other project-related activities, which we discuss in Section 3.9, Recreation and Land Use.

Northern wormwood

Hydrologic investigations conducted in 2002 indicate that inundation and scour are unlikely to pose an immediate threat to the Beverly population of northern wormwood (Public Utility District No. 2 of Grant County, Washington, 2003).

In addition to competition with invasive plant species, recreation-related impacts (*e.g.*, trampling of plants, camping, ORV use) on the Beverly population of northern wormwood and subsequent loss of habitat has been identified. Although the site is entirely fenced to exclude ORV use, the site is still accessible to boats (McCarthy, 2004). In separate but related actions, TNC's efforts and Grant PUD's proposal to remove

invasive plant species from sites occupied by and that are potential habitat for northern wormwood could enhance the species and its habitat, thereby potentially increasing the population.

Development and implementation of a northern wormwood conservation plan would protect the northern wormwood populations and associated habitat. Although Grant PUD proposes to develop and implement the plan in consultation with BOR, we find that Grant PUD should also consult with the FWS and WDNR- -Natural Heritage Program on the plan. A coordinated approach would further the Grant PUD's and the agencies' efforts in protecting the northern wormwood and its habitat.

3.6.3 Cumulative Effects

We identified terrestrial resources as a resource that could be cumulatively affected by relicensing the Priest Rapids Project. The cumulative effects of grazing, agriculture production, ORV recreational use, hydroelectric developments, residential development and infrastructures, and invasive species infestations have resulted in wildlife habitat loss and fragmentation in the mid-Columbia River Basin.

Relicensing the Priest Rapids Project with protection and enhancement measures would result in a negligible loss of wildlife habitat from constructing and operating public access and recreation facilities. While project lands generally provide a buffer along the shoreline, thereby preventing bank erosion and loss of riparian vegetation, public use (*e.g.*, recreational boating) can contribute to the potential spread of invasive plant species and subsequent loss of habitat due to access at public recreation sites. However, adverse effects would be minimized by Grant PUD's proposed measures and staff-recommended additional measures. Implementing an invasive species plan, along with other project-related specific plans, could protect rare, threatened, and endangered species; therefore, a cumulative beneficial effect on the species and their habitats could occur over existing conditions.

Under the no action alternative habitat would be maintained under existing conditions. There would be no plans to ensure protection and enhancement of vegetation, wildlife, and associated habitat. There would not be any plan to address invasive species, thereby potentially preventing the spread of, eradicating or controlling introductions of invasive species.

3.6.4 Unavoidable Adverse Impacts

None

3.7 THREATENED AND ENDANGERED SPECIES

The EIS scoping process identified the following issues related to project effects on federally-listed species and proposed critical habitat: (1) project-related resource issues affecting federally-listed salmon, steelhead, and bull trout are presented under Fisheries Resources; and (2) effects of project operations (daily and seasonal pool level fluctuations, downstream flow fluctuations, transmission line maintenance) on the federally listed bald eagle.

By letter filed April 26, 2005, NOAA-Fisheries indicates that two species of endangered anadromous fish occur in the Priest Rapids Project area: (a) Upper Columbia River spring-run Chinook salmon (*Oncorhynchus tshawytscha*), and (b) Upper Columbia River steelhead (*Oncorhynchus mykiss*). Critical habitat was proposed for both species on December 14, 2004. The project does occur within the area proposed for critical habitat designation.

By letter filed May 3, 2005, the FWS indicates the following federally-listed and candidate species, and proposed critical habitat may occur in the vicinity of the Priest Rapids Project and could be potentially affected by the project: (a) endangered: pygmy rabbit (*Brachylagus idahoensis*); (b) threatened: bald eagle (*Haliaeetus leucocephalus*); bull trout (*Salvelinus confluentus*); Ute ladies'-tresses (*Spiranthes diluvialis*); (c) proposed: critical habitat for the Columbia River distinct population segment of the bull trout; and (d) candidate: Washington ground squirrel (*Spermophilus washingtoni*) and northern wormwood (*Artemisia campestris ssp. Borealis var. wormskioldii*). We discuss the Washington ground squirrel and northern wormwood in Section 3.6, Terrestrial Resources.

3.7.1 Affected Environment

Upper Columbia River Spring-run Chinook Salmon

Upper Columbia River spring-run Chinook salmon were listed as endangered on March 24, 1999 (64 FR 14307). Critical habitat for this species was designated on September 2, 2005 (70 FR 52630). We describe the affected environment for this species in section 3.5.1.

Upper Columbia River Steelhead

Upper Columbia River steelhead were listed as endangered on August 18, 1997 (62 FR 43937). Critical habitat for this species was designated on

September 2, 2005 (70 FR 52630). We describe the affected environment for this species in section 3.5.1.

Bull Trout

The Columbia River distinct population segment of bull trout was listed as threatened on June 10, 1998 (63 FR 31647). Critical habitat for this species was designated on October 6, 2004 (69 FR 59996). We describe the affected environment for this species in section 3.5.1.

3.7.2 Environmental Effects and Recommendations

Our Analysis

Upper Columbia River Spring-run Chinook Salmon

Our analysis of the project effects on UCR spring-run Chinook salmon is presented in Section 3.5.2. In this section we describe the effects of the proposed project on upstream passage and downstream passage of this species. In addition, we describe the effects of the proposed hatchery programs, habitat mitigation efforts, predator control programs, and biological monitoring and studies. Overall, the proposed project operations and the associated mitigation efforts would reduce adverse project effects on UCR spring-run Chinook salmon. Under each of the scenarios evaluated upstream and downstream passage conditions would be improved, adult returns would be increased due to hatchery supplementation, available habitat would be increased or improved, and predator abundance or ability to access the species would be reduced. These efforts would increase the numbers of both juvenile and adult UCR spring-run Chinook salmon and would help to prevent extinction of this species.

In spite of the benefits of these measures, the proposed project would likely adversely affect UCR spring-run Chinook salmon because various proposed or continuing actions would result in take of this species.[65] Under the each alternative,

[65] The definition of take is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct; may include significant habitat modification or degradation if it kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. http://www.fws.gov/endangered/glossary.pdf

individual fish could be: 1) killed or wounded during downstream passage over or through the project dams; 2) killed or wounded during upstream passage through the project fishways; 3) killed, wounded, or harassed due to fluctuations in the project reservoirs or within the Hanford Reach; 4) harmed, killed, wounded, trapped, captured, or collected during biological studies and monitoring; 5) killed, wounded, or harassed during construction of the proposed bypass facilities or modifications to the project fishways or other facilities; and/or 6) harassed during habitat mitigation efforts.

Designated critical habitat for UCR spring-run Chinook salmon that could be affected by the proposed operation and maintenance of the Priest Rapids Project includes the Columbia River corridor. The primary constituent element of this designated critical habitat is to serve as a freshwater migration corridor.

Implementation of the proposed measures would increase adult and juvenile survival of UCR spring-run Chinook salmon during upstream and downstream migrations through the Priest Rapids Project area. Specifically, passage survival would be improved through a combination of spill, bypass system operations, predator control measures, and fishway modification and adjustments. Overall these measures would improve the ability of the designated critical habitat within the project area to serve as a freshwater migration corridor. Based on this information, we conclude that the proposed operation and maintenance of the Priest Rapids Project would not likely adversely affect any designated critical habitat for UCR spring-run Chinook salmon.

We intend to initiate formal consultation with NOAA Fisheries after issuance of this document.

Upper Columbia River Steelhead

Our analysis of the project effects on UCR steelhead is presented in section 3.5.2. In this section we describe the effects of the proposed project on upstream passage and downstream passage of this species. In addition, we describe the effects of the proposed hatchery programs, habitat mitigation efforts, predator control programs, and biological monitoring and studies. Overall, the proposed project operations and the associated mitigation efforts would reduce adverse project effects on UCR steelhead. Under each of the scenarios evaluated, upstream and downstream passage conditions would be improved, adult returns would be increased due to hatchery supplementation, available habitat would be increased or improved, and predator abundance or ability to access the species would be reduced. These efforts would increase the numbers of both juvenile and adult UCR steelhead and would help to prevent extinction of this species.

In spite of the benefits of these measures, the proposed project would likely adversely affect UCR steelhead because various proposed or continuing actions would result in take of this species. Under the each alternative, individual fish could be: 1) killed or wounded during downstream passage over or through the project dams; 2) killed or wounded during upstream passage through the project fishways; 3) killed, wounded, or harassed due to fluctuations in the project reservoirs or within the Hanford Reach; 4) harmed, killed, wounded, trapped, captured, or collected during biological studies and monitoring; 5) killed, wounded, or harassed during construction of the proposed bypass facilities or modifications to the project fishways or other facilities; and/or 6) harassed during habitat mitigation efforts.

Designated critical habitat for UCR steelhead that could be affected by the proposed operation and maintenance of the Priest Rapids Project includes the Columbia River corridor and the mouths of lower Crab Creek. The primary constituent element of this designated critical habitat is to serve as a freshwater migration corridor.

Implementation of the proposed measures would increase adult and juvenile survival of UCR steelhead during upstream and downstream migrations through the Priest Rapids Project area. Specifically, passage survival would be improved through a combination of spill, bypass system operations, predator control measures, and fishway modification and adjustments. Overall these measures would improve the ability of the designated critical habitat within the project area to serve as freshwater migration corridor. Based on this information, we conclude that the proposed operation and maintenance of the Priest Rapids Project would not likely adversely affect any designated critical habitat for UCR steelhead.

We intend to initiate formal consultation with NOAA Fisheries after issuance of this document.

Bull Trout

Our analysis of the project effects on the Columbia River distinct population segment of bull trout is presented in section 3.5.2. Based in this analysis, we conclude that a portion of the mid-Columbia River bull trout population may over winter in the upstream portions of the Wanapum reservoir. No specific project effects on these fish have been identified in our record and our analysis suggests there would be no project effects on these fish from the proposed action. There is some evidence that bull trout occur downstream of the over wintering area. Pfeifer et al (2001) conducted a comprehensive fish survey of the project area and reported collecting only two bull trout; one 2 miles upstream from the Priest Rapids dam and the other in the Wanapum pool. Grant PUD reports that “only a handful” of bull trout have been recorded within the

Priest Rapids fish ladders over the past 43 years. Grant PUD has conducted numerous fisheries studies in the project area and other than the few observations mentioned above, there is little evidence that bull trout regularly occupy the Priest Rapids Project area beyond the upstream end of the Wanapum pool. We conclude that the occurrence of bull trout in the downstream portion of the Wanapum pool and the Priest Rapids reservoir is incidental and rare.

Bull trout that occur within apparent over wintering area would not be affected by the proposed action. Bull trout that incidentally occur downstream of the over wintering area would likely benefit from some of the measures being implemented for salmon and steelhead. These measures would include improved upstream and downstream passage conditions, reduced predator abundance, and habitat mitigation. There is no evidence that any of the proposed measures would harm bull trout. Based on this information, we conclude that any effects on bull trout would be discountable or entirely beneficial and the proposed action would not likely adversely affect bull trout.[66]

The final rule designating critical habitat for bull trout excluded the mainstem Columbia River and all waters impounded behind dams (reservoirs and pools). As a result, no habitat within the project area or habitat that could be directly affected by operation and maintenance of the Priest Rapids Project was designated as critical habitat. Therefore, the proposed action would not affect designated critical habitat for bull trout.

Through informal consultation with Interior, we intend to request concurrence with our finding after issuance of this document.

Pygmy Rabbit

The pygmy rabbit was federally-listed as endangered on November 30, 2001 (66 FR 59734) and the State of Washington re-classified the species as State endangered in 1993. The distribution of the pygmy rabbit is within the range of the Washington ground squirrel, a federal candidate species (U.S. Fish and Wildlife Service, 2004). Historically, the pygmy rabbit occurred in dense shrub-steepe region of the Great Basin and likely included portions of Montana, Idaho, Wyoming, Utah, Nevada, California, Oregon, and Washington. The population in Washington is disjunct from those which occur in the

[66] The Endangered Species Consultation Handbook (FWS and NOAA Fisheries; 1998) indicates that "not likely to adversely affect" is the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Discountable effects are described as extremely unlikely to occur. Beneficial effects are described as contemporaneous positive effects without any adverse effects to the species.

other states (WDFW, 1995; Washington Department of Game, 1987). During the 1900's, pygmy rabbits probably occurred in five Washington counties: Adams, Benton, Douglas, Grant, and Lincoln.

A significant decrease in the pygmy rabbit populations has occurred as a result of habitat loss, disease, predation, and loss of genetic heterogeneity (Warren, 2001). Predators of pygmy rabbits include long-tailed weasels, coyote, great horned owls, prairie falcons, and northern harriers.

The pygmy rabbit occurs in dense sagebrush cover, and is highly dependent on sagebrush to provide both food and shelter throughout the year. The winter diet of the pygmy rabbit is composed of primarily sagebrush; grasses (*e.g.*, native bunch-grasses), forbs, and sagebrush are part of its spring and summer diet. Pygmy rabbit burrows are found in relatively deep, loose soils and occasionally use burrows abandoned by other species (Warren, 2001). During winter the pygmy rabbit has a small home range (approximately 98 feet from its burrow), and in spring and summer, a larger home range. Pygmy rabbits may travel up to 0.75 mile from their burrows (WDFW, 1995).

Pygmy rabbits are not known to occur in the Priest Rapids Project area. The only known populations in Washington exist in pockets of suitable habitat in Douglas County. Surveys in 1987 and 1988 discovered five small colonies of pygmy rabbits in southern Douglas County; three occurred on State lands and two on private lands (WDFW, 1995). A 1997 annual report for the Hanford Site concludes the pygmy rabbit is not likely occurring on the site [67] and there was no record of species occurrence within the Columbia Basin Project Area (Bureau of Reclamation, 1998). The Columbia Basin Project Area encompasses the scattered tracts that we discuss in this DEIS.

Bald Eagle

On July 12, 1995, the FWS re-classified the bald eagle from endangered to threatened in the lower 48 States. The bald eagle remained classified as threatened in five States, including Washington (43 FR 6233, February 14, 1978). In 1999 the bald eagle was proposed for removal from the list of threatened and endangered species because recovery goals had generally been met or exceeded through its range (64 FR 36543). That decision is pending. The bald eagle historically ranged throughout North America except extreme northern Alaska and Canada, and central and southern Mexico. A major decline in the bald eagle population probably began in the mid- to late-1800's, which coincided with declines in numbers of water-birds, shorebirds, and other prey

[67] http://www.hanford.gov/docs/annualrp97/appf.pdf, accessed September 28, 2005.

species. Direct bald eagle killing, loss of nesting habitat, and accumulation of dichloro-diphenyl-trichloroethane (DDT) in individual bald eagles from ingesting contaminated food (thus inducing thin egg shells and reproductive failure) contributed to its decline (Millar, 1995). Since use of DDT was stopped and recovery management plans were implemented, the bald eagle population is increasing.

The bald eagle inhabits aquatic ecosystems; however, such areas must have an adequate food base, perching areas, and nesting sites support bald eagles. In winter, bald eagles often congregate at specific wintering sites that are generally close to open water and offer perch trees and night roosts (Millar, 1995).

The Columbia River is a primary spawning area for fall-spawning Chinook salmon and a wintering area for waterfowl, primarily mallards. The bald eagle is known to winter in the Priest Rapids Project area. In addition, the bald eagle is a winter resident along the Hanford Reach and forages on dead salmon and waterfowl; it does not nest at the Hanford Site. The bald eagle uses groves of trees (*e.g.*, black locust, white poplar, and Siberian elm) along the Hanford Reach for winter perching, night roosts, and nesting sites (U.S. Department of Energy, 1999). Roost sites are generally in the tallest, most dominant trees that provide unobstructed views of the surrounding landscape (Anthony, *et al*., 1982). A communal night roost consisting of black locust and white poplars occurs on the White Bluffs Peninsula. This grove of trees is the site of a great blue heron nesting colony, and in the winter, the herons move from the site and bald eagles use the abandoned nests and trees for night roosts (U.S. Department of Energy, no date).

In 1991 a bald eagle nest was constructed near the White Bluffs boat launch; no eggs were laid. In 1993 bald eagles exhibited nest building behavior at the same location (U.S. Department of Energy, no date). The reasons for nest failure are uncertain, but may be related to human disturbance. The Department of Energy (DOE) (no date) states a 2,600-foot buffer and restriction in recreation use at White Bluffs boat launch from January through March could encourage the bald eagle to potentially construct a nest again. If bald eagles nest at the site, the restriction would apply until August 15. The DOE (no date), however, notes that recreational boating occurs primarily in summer and fall, which is prior to bald eagle use. A similar conclusion was drawn for recreational fishing. Usually the salmon fishing season occurs from mid-August through mid-to-late October; sturgeon season from mid-June through mid-to-late October (U.S. Fish and Wildlife Service, 2002).

During 2001 and 2002 there were 14 sightings of bald eagles in riparian habitat along the Priest Rapids Reservoir or its tributaries (Public Utility District No. 2 of Grant County, Washington). Four of the sightings were juvenile bald eagles. No bald eagles were observed during the summer and no nesting behavior was observed. Approximately

10 to 15 bald eagles typically winter along the Priest Rapids Reservoir. Other documented sites include Quilomene Bay, Scammon's Landing, Wanapum State Park, Sunland Estates, Frenchman Springs, Stockdale's Ranch, Petroglyph Island, and Goose Island (Duke Engineering & Services, Inc., 2000).

To protect the bald eagle, Grant PUD proposes the following measures: (1) develop and implement a bald eagle perching and roosting tree enhancement and protection program; and (2) future modification to existing and/or new transmission lines and structures would be accomplished in accordance to the guidelines set forth in Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996 (Avian Power Line Interaction Committee, Edison Electric Institute).

Ute Ladies'-tresses

Ute ladies'-tresses, a perennial orchid, was federally-listed as threatened on January 17, 1992 (57 FR 2048). The species is listed as threatened in Washington State. Ute ladies'-tresses is the common name given in recognition that the species' historic range coincides with the ancestral home of the Ute Indian Tribe (57 FR 2048). Historically, Ute ladies'-tresses was found in riparian areas in Colorado, Nevada, and Utah (England, 1992). Factors contributing to the species decline include urban development, stream channelization, increased demands for agricultural, municipal, and industrial water, recreation, and competition of non-native plant species, thereby displacing native vegetation (U.S. Fish and Wildlife Service, 1995).

The preferred habitat of Ute ladies'-tresses is low elevation riparian meadows, including perennial streams, floodplain, and open vegetative areas. The FWS (1995) notes Ute ladies'-tresses seem to require "permanent sub-irrigation", indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season and into the late summer or early autumn. The species' flowers are noticeable usually from the end of July until early September (Bureau of Reclamation, 2004).

Subsequent searches of potential habitat for the Ute ladies'-tresses revealed a greater number of populations and individual plants than was known. The species occurs in Colorado, Idaho, Montana, Nebraska, Nevada, Utah, Washington, and Wyoming (Bureau of Reclamation, 2004). In Washington, the species occurs at two sites, one of which is on the Columbia River on Rocky Reach Reservoir, approximately 35 RM upstream from the Priest Rapids Project. In a letter filed October 31, 2005, pursuant to the Rocky Reach Project No. 2145, Interior states that a new discovery of an additional population of Ute ladies'-tresses occurs in the Rocky Reach Project area. This new discovery increases the number of sub-populations of this plant that exist in the Rocky

Reach Project area from three to four (letter from Preston A. Sleeger, Regional Environmental Officer, U.S. Department of the Interior, Portland, Oregon).

At the Priest Rapids Project, surveys for rare plants including Ute ladies'-tresses were conducted in 1981, 1991, 2000, and 2001. Although suitable habitat exists, rare plant surveys did not locate Ute ladies'-tresses within the project area (Public Utility District No. 2 of Grant County, Washington, 2003).

Our Analysis

Based on the best available information, we conclude that relicensing the Priest Rapids Project with our recommended measures would not affect the endangered pygmy rabbit and threatened Ute ladies'-tresses. Further, we conclude that relicensing the Priest Rapids Project with our recommended measures would not likely adversely affect the threatened bald eagle. For the bald eagle, we intend to initiate formal consultation with the FWS after issuance of this document.

Bald Eagle

Pursuant to section 10(j) of the FPA Interior recommends (recommendation no. 13) Grant PUD develop and implement a bald eagle perching and roosting tree protection and enhancement program. Interior concurs with Grant PUD's proposal to develop and implement such a plan.

Grant PUD's proposed bald eagle perching and roosting tree enhancement and protection program includes measures that would be in concert with its draft shoreline management plan, dated August 2003. In the draft shoreline management plan, Grant PUD defines land use classifications in which one, Conservation, would retain and preserve a character of undeveloped, natural open space, thereby protecting fish and wildlife resources. There are approximately 3,021 acres (or 23 percent) of project lands classified as Conservation.

As part of its bald eagle perching program Grant PUD proposes to protect existing perching and roosting trees from beaver effects, and initiate tree enhancement through riparian plantings. Framatome ANP (2003) notes much of the shoreline along the project reservoirs is composed of cliffs, steep slopes, and narrow strips of riparian vegetation. The majority of riparian vegetation, totaling an estimated 1,490 acres, is located in lower Crab Creek, Priest Rapids WRA, Moran Slough, and the eastern shoreline of Priest Rapids Reservoir. An estimated 405 acres of riparian vegetation (tree/shrub mosaic) is associated with Wanapum Reservoir. Within the project area there are three ponds hydraulically connected to the project reservoirs: (1) West Bar Slough, (2) Quilomene

Island Pond, and (3) a small pond located at RM 406 within Priest Rapids WRA. Within these various habitats, bald eagles were observed.

As noted by Interior's section 10(j) recommendation the continual fluctuation of water levels in the Priest Rapids Project reservoirs results in the degradation of shoreline vegetation, including the development of large cottonwood trees. Grant PUD's proposal to protect existing perching and roosting trees, initiate tree enhancement through riparian plantings, and retain identified project lands under a Conservation land use classification would enhance bald eagle habitat. An increase in availability and distribution of perches would allow bald eagles to utilize more areas along the project reservoirs. As discussed in section 3.5, Aquatic Resources, fishery enhancement measures should benefit the bald eagle by enhancing its prey base. Therefore, a bald eagle perching and roosting tree protection and enhancement program would protect and enhance the bald eagle and its habitat, thus contributing to a beneficial effect on the species.

In the project area, study results indicate that recreational boating and fishing occur primarily in summer and fall, which is prior to bald eagle use. However, we find project-related effects on bald eagles could occur due to the proposed development of recreation facilities. To minimize effects on the bald eagle resulting from the construction of recreation facilities, Grant PUD should consult with the FWS and WDFW, along with WSPRC, BOR, and appropriate county, in developing and implementing its final Recreation Resource Management Plan (RRMP).

Pursuant to section 10(j) of the FPA Interior recommends (recommendation no. 12) Grant PUD develop and implement an avian protection plan. Interior states that transmission lines pose a hazard to passerines, waterfowl, and raptors, including the federally-listed bald eagle.

We previously address Interior's recommendation for an avian protection plan. To protect the bald eagle and other raptors, any future modification to existing and/or new transmission lines and structures for the Priest Rapids Project should be accomplished in accordance to the guidelines set forth in Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996 (Avian Power Line Interaction Committee, Edison Electric Institute).

3.7.3 Cumulative Effects

The cumulative effects of project operations on UCR spring-run Chinook salmon, UCR steelhead, and bull trout are addressed in section 3.5.

The cumulative effects of project operations on the persistentsepal yellowcress,

northern wormwood, Ute Ladies'-tresses, bald eagle, Washington ground squirrel, and pygmy rabbit are addressed in sections 3.6 and 3.7.

3.7.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts to UCR spring-run Chinook salmon, UCR steelhead, and bull trout are addressed in section 3.5.4.

Unavoidable adverse impacts to the identified fish could be to the benefit of the bald eagle by providing a larger food base.

3.8 CULTURAL RESOURCES

In this section we address cultural resources within the context of the following issues identified during the scoping process that relate to project effects on cultural resources: (1) effects of the project operation, implementation of protection, mitigation, and enhancement measures, and other events (such as wind-induced waves or loss of vegetation along the shoreline) on historical and archaeological resources within the project's area of potential effect (APE); and (2) combined effects of upstream dam operations on bank erosion and resulting disturbance of cultural resource sites in the Hanford Reach. A comprehensive overview of cultural resources located within the Project, including the prehistory and history of the mid-Columbia Region can be found in Exhibit E6 of the license application (Grant PUD, 2003) along with other supporting documents.

3.8.1 Affected Environment

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), requires that the Commission evaluate the potential effects on properties listed or eligible for listing in the National Register of Historic Places (National Register). Such properties listed or eligible for listing in the National Register are called historic properties. In this document we also use the term "cultural resource" for properties that have not been evaluated for eligibility for listing in the National Register. Cultural resources represent things, structures, places, or archeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic. Section 106 also requires that the Commission seek concurrence with the State Historic Preservation Officer on any finding involving effects or no effects to historic properties, and allow the Advisory Council on Historic Preservation (Council) an opportunity to comment on any finding of effects to historic properties. If Native American (i.e., aboriginal) properties have been identified, Section 106 also requires that the Commission consult with interested Indian tribes that might

attach religious or cultural significance to such properties. In this case, the Commission must take into account whether any historic property could be affected by a proposed new license within the Project's APE, and allow the Council an opportunity to comment prior to issuance of any new license for the Project.

For cumulative effects, the Commission staff took into account the potential downriver effects that the Project may have on historic properties in the Hanford Reach area. It is important to note that the Hanford Reach area has been designated as a National Monument; National Register-eligible cultural resources are contributing elements to the Monument. The primary effect on cultural resources in the Hanford Reach that the Priest Rapids Project may contribute to is shoreline erosion on National Register-eligible archeological properties.

The Project's Area of Potential Effects

The APE for the Priest Rapids Hydroelectric Project has been defined as including lands within the Project boundary as delineated in the current FERC license and lands outside the Project boundary where Project operations may affect the character or use of historic properties and/or traditional cultural properties. The FERC Project boundary for the Priest Rapids Hydroelectric Project encompasses close to 60 miles of the Columbia River from the tailrace of Rock Island Dam to the tailrace below Priest Rapids Dam, in addition to roughly 5 miles of lower Crab Creek drainage, and approximately 60 miles of transmission lines (Bruce et al. 2001:1.2; Shive, et al. 2004:7). The total estimated acreage for the APE is 12,236 acres; 3,806 in the Wanapum Development, 7,305 in the Priest Rapids Development, and 1,125 in the transmission line corridors (Shive et al. 2004:15). Approximately 40 percent of the APE is owned by Grant PUD, 20 percent is federal land, 20 percent is state lands, and the remaining 20 percent is privately owned.

Archeological Research and Background

The 60 mile stretch along the Columbia River that falls within the Priest Rapids FERC Project boundary has been extensively researched for more than 100 years, and contains a wealth of archeological information involving aboriginal occupations spanning thousands of years from roughly 11,000 years ago through the period of Euro-American contact and settlement. As a result, a large amount of published archeological research has been generated, and since 1955, Grant PUD has provided substantial financial support to these endeavors due to their stewardship of Priest Rapids and Wanapum hydroelectric developments. The following synopsis of archeological research in the Priest Rapids project area has been summarized from Vera Morgan in Bruce et al. 2001 (pages 4.1 – 4.46).

Pre-project archeological investigations

Archeological research in the vicinity of the Priest Rapids Project began as far back as 1903 with Harlan Smith of the American Museum of Natural History (Smith 1910). Along this section of the Columbia basin, Smith located and recorded a number of aboriginal archeological sites, including a pit house village at Priest Rapids, and other related sites such as shell middens, lithic scatters, and petroglyphs. In 1920, F.S. Hall of the Washington State Museum followed up on Smith's research and excavated several cemeteries and village sites, recovering large quantities of cultural material for the State Museum, some of which were ultimately returned back to the Wanapum Tribe in later years (Bruce et al. 2001:4.8). Hall's work was never systematically recorded or published, and very little information on site location, provenience of artifacts and features is available from his investigations. In the mid to late 1920s, Herbert Krieger from the Smithsonian Institution excavated and mapped a number of archeological sites in the middle and upper Columbia River, and integrated some of Hall's materials from the Priest Rapids area, along with the collections of artifacts found by amateur collectors associated with the Washington State Historical Society (Historical Society) who were now actively searching the area for archeological relics. From 1927 through 1938, Harold Cundy of the Historical Society recorded a number of rock art sites in the middle Columbia River area, including 11 sites in the Priest Rapids project area (Bruce et al. 2001:4.9).

Investigations related to the development of the Priest Rapids Project

Stemming from the initial planning for hydroelectric development in the Priest Rapids area, Louis Caywood in 1948 conducted a brief archeological reconnaissance survey of the Priest Rapids area for the U.S. Army Corps of Engineers. This was followed by more systematic work in 1950 by John Campbell's Smithsonian River Basin Survey. Systematic archeological excavations on sites in the Priest Rapids Project began in the late 1950s and continued into the early 1960s through the research of Earl Swanson and direction of Robert Greengo at the University of Washington (Bruce et al. 2001:4.11-4.18). Much of this work was the product of the Priest Rapids-Wanapum Archaeological Salvage Project which resulted in the recordation of nearly 200 sites of which many were excavated. The Priest Rapids-Wanapum Archaeological Salvage Project was a contract-sponsored university program involving field schools and scores of professional archeologists, students, and amateurs who in turn published a series of contract archeology reports over two decades.

Archeological investigations and excavations continued after the Priest Rapids and Wanapum developments went into operation in 1961 and 1964, respectively. Additional sites were located below Priest Rapids dam in the late 1960s by David Rice and members

of the Mid-Columbia Archaeological Society and later by Richard McClure in 1978. In 1981, Randall Schalk and other archeologists from Washington State University located 60 sites as a result of intensive surveys in the Priest Rapids flood pool where the water level was to rise an additional three and a half feet to increase power generation (Schalk 1982, Bruce et al. 2001:4.27). Fifteen of these 60 sites were summarily excavated by Glenn Hartmann and others associated with Eastern Washington University in 1981.

Investigations related to Grant PUD's relicensing effort

Preliminary archeological investigations in preparation for Grant PUD's license application were begun by Susan Freiberg in 1993 and continued into 1996 (Freiberg 1993 and 1997a, b, and c). Freiberg was contracted to relocate 169 sites in the project area, and in the process, she also discovered a number of unrecorded sites (Bruce et al. 2001:4.29). From September 2001 to March 2003, Grant PUD contracted Earth Imaging Associates, Inc. to conduct a comprehensive cultural resources inventory within the entire project boundary (Hackenberger et al. 2003).

Archeological Chronology

Based on the above research, a general archeological chronology can be established for the Priest Rapids Project area which essentially corresponds to the prehistory of the mid-Columbia Plateau (Nelson 1969, Galm et al. 1981). The archeological framework represents a continuum of aboriginal occupations along the mid-Columbia River and adjacent environs which can be subdivided into phases, the later of which are basically defined by distinctive and chronologically-sensitive spear and arrow points in association with other types of artifacts. The general socio-economic trend represented by these archeological phases over time depicts a transition from small nomadic bands of hunter-gatherer into more complex sedentary tribal groups consisting of large concentrations of populations living in settled villages, augmented with smaller satellite camps and staging areas used for specialized activities. Movements of different population groups from inside and outside the mid-Columbia Plateau also occurred which accounted for some cultural change as well. Nevertheless, fishing for salmon and other aquatic resources was probably one the most important social and technological developments involving peoples of the mid-Columbia Plateau that began thousands of years ago and which manifested into a common cultural theme shared among Indian tribes living in the region today.

The earliest evidence for occupation in the study area begins with the Paleo-Indian period dating sometime prior to 11,500 BP. However, to date, no intact archeological deposits dating to this initial period presently exist within the project area. This is probably attributed to the catastrophic floods associated with Lake Missoula (that began

in 12,700 BP) and other subsequent flooding events, which scoured much of the Columbia River basin. Nevertheless, Clovis points (associated with the earliest Paleo-Indian occupations in North America) have been found near Wenatchee farther upriver, and one such point was recovered at the surface near the confluence of Crab Creek, as well as other related Clovis type material in other portions of the project area (Bruce et al. 2001:5.34). Other later Paleo-Indian point types have also been found in the project area, as well. Populations associated with the Paleo-Indian period generally consisted of highly mobile small bands of hunter-gatherers who were associated with the hunting of Pleistocene big game animals such as mammoth and bison.

The Windust phase (ca. 11,000 to 8000 B.P.) defined by distinctive lanceolate-shaped spear points, represents the earliest documented archeological manifestation in the Priest Rapid Project area where social groups continue to organize into small bands of hunter-gatherers and who moved in and around the region on a seasonal basis. After the Windust phase, is the Vantage/Cascade phase (ca. 8000 to roughly 4500 B.P.), and is represented by stemmed and side-notched spear points, and can be further divided into two sub-phases. At this time, populations increased, and the phase appears to spread from north to south in the region. Archeological evidence indicates that groups focused more on extracting salmon in the Columbia River, and pithouses first appear, indicating some trends towards permanent settlements. The next phase is called the Frenchman Springs phase (ca. 4500 to 2500 B.P.). This phase represents more dramatic changes in settlement patterns and technology that may be related to a drying trend in the region. Increases in settled life among populations associated with this phase are also apparent, and spear points tend to become smaller and less carefully made. Ground stone artifacts for the processing of plants become more prevalent in this phase along with the presence of net sinkers and bone implements indicating an increase for catching of anadramous fish such as salmon. Following the Frenchman Springs phase, is the Cayuse phase (ca. 2500 BP to 250 BP), which represents a more diversified and prolific cultural manifestation that reflects a developed strategy of salmon fishing, bow and arrow hunting, inter-tribal territoriality and trading, and settled village life that persisted into the period of Euro-American contact. The Cayuse phase essentially resembles the traditional cultural complexion of modern-day tribal groups presently living in the mid-Columbia region.

Ethnographic Background

Towards to the latter millennia prior to Euro-American contact, the mid-Columbia River in the Priest Rapids project area was inhabited by two basic linguistic groups, one associated with interior Salish speakers, and the other with Sahaptin speakers (Miller 1998:253-282; Schuster 1998:327-351). Most of the Salish-speaking tribes who inhabited the mid-Columbia Plateau in the Priest Rapids vicinity are presently associated

with the Confederated Tribes of Colville Reservation, and were principally made up of the Sinkayuse (also referred to as the Moses Columbia Tribe or mid-Columbia) and to a lesser extent the Wenatchee. These Interior Salish speakers occupied the mid portion of the Columbia River and extended southward into the northern half of the project area probably past the present-day town of Vantage south of the Saddle Mountains. South of this area, Sahaptin speakers, principally associated with the modern-day Wanapum Tribe, occupied the southern half of the project area. Overall, there are strong indications of some overlapping of territories between these two language groups in this portion of the Columbia River; however, the Crab Creek and Saddle Mountain area of the Project seems to be a general boundary between these two groups (Bruce et al. 2001:6.4-6.13). Sahaptin speakers affiliated with the modern-day Yakama Reservation, also occupied areas just to the south of Priest Rapids dam, but probably entered into the project area from time to time.

In general, aboriginal peoples of the mid-Columbia Plateau region were heavily dependent on the catching of different species of salmon, in addition to other aquatic fish such as sucker and sturgeon. Although subsistence on salmon was central to these particular groups, other foods were exploited ranging from the hunting of wild game, to berry picking and the collecting of roots. Large groups of people congregated in the shallower rockier reaches of the river where access into the river was easiest and where salmon were plentiful during the spring and fall salmon runs. The Priest Rapids was one of the primary locations on the mid-Columbia for salmon fishing. Salmon were extracted in a number of ways, but principally by gill nets or by harpooned-tip spears, where bands of native fishermen would assemble complex scaffolds over a series of rocks in the river to catch and dispatch the fish. During the seasonal fish runs, a number of activities would be performed among the native peoples, ranging from catching the salmon in the river, to processing and drying of the flesh along the shoreline, where the fish meat would be used for consumption throughout the year and traded to other groups outside the Columbia Plateau. Thus, the fishing and processing of salmon was a strong social and cultural tradition with the mid-Columbia peoples, a tradition which exists today, despite the significant depletion of the salmon resource over the years.

Near the traditional fishing areas and close to confluence of tributaries emptying into the Columbia River, aboriginal groups established large permanent and semi-permanent villages. Living quarters in the main village tended to be semi-subterranean circular structures ranging from 6 to 10 meters in diameter, or longhouses consisting of timber frames covered with tule mats. These conical-roofed circular and pitched-roofed rectangular tule mat houses were very characteristic of villages along the mid-Columbia Plateau region. Satellite seasonal encampments with less permanent dwellings would be found in the higher elevations on the terraces above the river or up into the lateral drainages. Other sites were designated as special places used in ceremonies and other

related social events.

The Lewis and Clark Expedition of 1804-1806 represents the first time aboriginal peoples of the mid-Columbia Plateau came in direct contact with Euro-Americans. Although Lewis and Clark did not travel into the Priest Rapids project area, it is almost certain that they encountered representatives of the Wanapum, among other groups of Indians, at the confluence of the Columbia and Snake Rivers on their way back east in 1806 (Coues, ed. 1964:637; Bruce et al. 2001:6.3, :7.1). At this time, horses were introduced into the region and tribal groups became increasingly dependant on them for trade and transportation. Prior to Lewis and Clark, small pox epidemics were breaking out as early as the 1770s, devastating aboriginal populations in the Columbia Plateau and adjacent areas along the Northwest Coast, in the Great Plains and Rocky Mountain areas (Boyd 1985: 78; Bruce et al. 2001:6.1). Such epidemics persisted into the early 1800s through the 1840s resulting from fur trading in the region which added additional impacts to already significantly reduced populations who were in and adjacent to the Priest Rapids area.

When the Washington Territory was established in the 1850s by the United States, the Wanapum were grouped with the affiliated bands of the Yakama, the latter of which were reduced to about 600 persons (Bruce et al. 2001:7.1). After violent clashes between incoming white settlers and Native Americans in the Plateau region, a treaty among the bands associated with the Yakama was formulated in 1855 by Governor Stevens–the first governor of the newly formed Washington Territory. At this time, the Yakama bands were moved to their present-day reservation south of the Project area. As part of the 1855 Treaty, the Yakama agreed to cede much of their traditional territory (including all of Priest Rapids Project area) with the promise that they could continue to use these lands for hunting and fishing--a treaty right the Yakama maintain and exercise today. Groups associated with the Columbia and Wanapum never formally organized with the other affiliated bands of the Yakama Reservation, which signed the treaty in 1855. Instead, the Wanapum continued to occupy their principal villages which now extended throughout the Priest Rapids project area south of Crab Creek. The Wanapum lived in peace with the white settlers who arrived in the Priest Rapids vicinity after the 1855 Treaty. The effects of ranching and agriculture diminished the natural fishing areas and hunting of the Wanapum and they were reduced (stemming from some members relocating to other nearby reservations) to living in a single village at Priest Rapids by the late 1800s, where they remain today.

After a series of hostile engagements with the U.S. military, the Salishan Columbia under the leadership of Chief Moses were removed from their former homeland in the mid-Columbia River to the Colville Reservation which was established by a series of executive orders beginning in 1872 through the 1880s (Kennedy and

Bouchard 1998:250-251; Bruce et al. 2001:10.9-10.11). The original Coleville Reservation had been more extensive, but was reduced several times during this period, ending in the present-day boundaries along the north and west side of the Columbia River extending from Chief Joseph Dam to the Kettle Falls area. Prior to this, the Salishan peoples associated with the Columbia River were living throughout the mid and upper Columbia basin on both sides of the river extending northward into Canada and to the south past present-day Vantage. Prior to being removed to the Colville Reservation, the Columbia were adjacent to the Wanapum, engaging in the fishing of salmon and living in villages along the Columbia River near Crab Creek and north of the Saddle Mountains. Some of these Columbian peoples managed to stay in the northern part of the project area up until the 1880s (Bruce et al. 2001:9.9).

Historic Background

Shortly after the Lewis and Clark expedition, David Thompson of the North West Company (NWC) set out from his trading post at Spokane House in the search of new fur grounds and navigated down the Columbia River, passing through the Priest Rapids project area on his way to the Pacific Ocean in 1811. In July 1811, Thompson and his entourage camped at an important fishery at Cabinet Rapids situated in northern limits of the project area below the rapids at Rock Island (Bruce et al. 2001:7.3). There he encountered Columbia Indians associated with the Wenatchee and noted a longhouse more than 200 hundred feet long. Upon leaving, Thompson was informed that people south of Crab Creek spoke a different language, thus indicating the boundary between Salish and Sahaptin-speaking tribes. On his way south, Thompson and his group navigated a series of rapids that later became known as Priest Rapids. There, he encountered a large village (probably affiliated with the Wanapum) consisting of 60 families of which it was noted that the people spoke Sahaptin. A month later moving up the Columbia River from the south, Alexander Ross of the NWC encountered the same village at Priest Rapids. About a week later, 30 miles upriver from Priest Rapids, he encountered another group of Salish-speakers--later affiliated with the Columbia Indians of Chief Moses--at a place later identified as Gualquil Rapids.

In the first two decades of the nineteenth century, Priest Rapids became a rendezvous with other fur traders and different groups of Indians where tobacco and other European products were traded for fish (Bruce et al. 2001:7.4-7.15). Unlike trading establishments set up along the Columbia River at Fort Okanogon, Colville, and Fort Nez Perce, no established European settlement occurred in the Priest Rapids area, or in the other adjacent areas along the Columbia River between the Okanogon and Walla Walla Rivers. In the 1830s, European contact with Indians of the mid-Columbia basin began to change in character due to the diminishing fur trade in the region--a result of over-hunting, and Americans began to focus on the Northwest Territory (still considered

British) for permanent settlement (Bruce et al. 2001:9.1-9.5). In 1836, the American Board of Commissioners for Foreign Missions sent Samuel Parker to evangelize Indian groups within the territory, where he passed through the Priest Rapids area. He was followed by a scientific expedition sponsored by the United States Exploring Expedition led by Lieutenant Charles Wikes in 1838 where they mapped parts of the Northwest Territory associated with the Columbia Plateau, including the interior portions of the mid-Columbia River. In the beginning of the 1840s, the United States pressed for stronger claims in the Northwest Territory, precipitating a small but steady advancement of Anglo-American settlers into the region. This eventually lead up to the Treaty of 1846, where the boundary between the United States and Canada was established at the 49th Parallel, and the new Washington Territory came into existence.

Engineers associated with the Northern Pacific Railroad surveyed and examined the terrain for travel routes through the region (Bruce et al. 2001:9.2). However, the region in and around the Priest Rapids area was desolate and unattractive, and was bypassed for early rail development, which began more earnestly in the 1880s in the Yakima River Valley to the south, and through Wenatchee and Stevens Pass in the north. The shrub-steppe environment of the Priest Rapids area lacked good stands of forests for timbering, which made other areas in the mid-Columbia Plateau more attractive for settlement and development. Resulting from the trade associated with the emerging grain market in the Yakima Valley, steamboats were making landings upriver at Priest Rapid at this time, where wagon routes existed through the project area to transport grain on the way north to Wenatchee and other parts of Washington (Bruce et al. 2001:11.2). In fact, some of these wagon routes were established earlier as a result of the Canadian gold rush in the late 1850s. The gold rush had also spurred periodic cattle drives from Oregon, en route to Canada, through the project area, but the region remained sparsely settled. With the decline of the gold mining industry, and by the end of the 1800s, sheep ranching replaced cattle drives in the project area.

Small-scale agriculture was also being done at this time in the project area, where local inhabitants, including indigenous peoples such as the Wanapum grew vegetables for home use and other crops, such as alfalfa, to support their livestock (Bruce et al. 2001:13.1). Irrigation projects for larger scale agricultural practices were planned and implemented at the turn of the century, with varying degrees of success. The conveyance of water from the Columbia River for agricultural needs spurred interest for utilizing the river for hydropower in the Priest Rapids area. By the beginning of the 1900s, communities such as Vantage began to develop, many of them establishing themselves around one of the several ferry crossings in the region. The Vantage ferry in particular became a popular place for automobiles crossing the Columbia River in early 1900s, utilizing one of the first auto routes in the area where present-day I-90 now exists. Shortly afterwards, a bridge was built across the river at Vantage. The old town of

Vantage persisted through the twentieth century as a small community, supporting a Civilian Conservation Corp camp in the 1930s. In the 1960s, the old town was inundated by the construction of Wanapum Dam.

Cultural Resources Identified within the Project's Area of Potential Effect

In order to identify cultural resources within the Priest Rapids Project APE, a comprehensive inventory was conducted from September 2001 to March 2003 (Hackenberger et al. 2003). The cultural resources inventory was done by a standard pedestrian survey where crews of 3 to 5 individuals walked along parallel transects spaced 10 meters apart. Areas within the APE that were not systematically walked over included sections of riverbank that were rip-rapped, areas that were covered over by structures, areas under agricultural production, places where slopes were greater than 30 degrees, and private property where landowners did not grant permission to have their lands surveyed (Hackenbeger et al. 2003:46). In high probability areas where ground cover was greater than 50 percent, subsurface probes or soil auguring was used to find cultural materials not visible on the surface. More than 7,900 individual shovel probes were dug within the APE. The majority of these shovel tests were placed on Holocene period terraces situated above the riverbanks (close to 4,000 were excavated along Crab Creek) where there were higher probabilities of finding buried archeological deposits.

A total of 680 archeological sites were documented, of which 419 were located in the Wanapum Development, 218 in the Priest Rapids Development, and 42 along the transmission line corridors (Shive et al. 2004:17). Of these sites, 193 had been previously recorded involving past archeological investigations discussed above. The remaining 486 sites, along with 571 isolated artifact finds, were newly discovered as a result of the systematic surveys for this relicensing. Of the total archeological sites in the APE, approximate 70 percent are Native American in origin; the remaining 30 percent are Euro-American. The Native American sites consist of lithic scatters, shell middens, village sites, cemeteries, rockshelters, and associated petroglyphs. Many of the aboriginal sites have multiple components (represented by specific archeological phases) spanning thousands of years, including some that have both Native and Euro-American components. The Euro-American sites, tend to be less substantive, representing the remains of farmsteads, trash dumps, construction sites, tent camps, irrigation features, staging areas, roads, and trails. To date, no traditional cultural places have been identified; however, Grant PUD is currently working with the Wanapum Tribe, Confederated Tribes of the Colville Reservation, and Yakama Nation in order to locate such cultural resources in the APE.

Cultural Resources that are considered Eligible for the National Register of Historic Places

Only two cultural resources in the APE have been listed in the National Register. One consists of the Beverly Railroad Bridge (built in 1909), and the other is a portion of the Wa Pai Xie Archeological District (consisting of aboriginal archeological sites) which lies on property under the jurisdiction of U.S. Army Yakima Training Center (Shive et al. 2004: 21). Grant PUD has chosen to categorize the remaining archeological sites located in the APE as properties that are potentially eligible for inclusion in the National Register (Shive et al. 2004:23-24). Grant PUD proposes to formally evaluate these sites after license issuance to determine National Register eligibility. Nevertheless, Grant PUD was asked by Commission staff to identify 20 of the most significant archeological sites in the APE that can be determined eligible for inclusion in the National Register and are in eminent danger of being severely damaged or destroyed. In March 2005, Grant PUD submitted to the Commission 20 sites. All 20 sites represent aboriginal occupations that contain significant cultural information. Twelve of these sites consist of habitations ranging from dense lithic scatters to village sites. Four others are rockshelters, and the remaining are burial grounds.

Cultural resources within the Hanford Reach

Hanford Reach consists of approximately 585 square miles in total size and encompasses 51 miles of the Columbia River downriver from the Priest Rapids Dam. Stemming from investigations beginning in the 1920s, approximately 1,447 cultural resource sites and isolated finds have been documented there, in addition to 531 historic buildings and structures (PNNL 2004:4.93). The range of cultural resources in the Hanford Reach span more than 8000 years of human occupation reflecting similar chronologies and sequences as noted in the Priest Rapids project area to the north. Eight archeological historic districts associated with the Native Americans have been defined in Hanford Reach, along with three other historic districts associated with the development of the U.S. nuclear weapons program during and after WWII. A total of 459 aboriginal archeological sites have been located in the Hanford Reach, of which 70 contain historic occupations associated with early Euro-American settlement (HCRMP 2003:3-27). Traditional cultural properties are also present at Hanford Reach reflecting a broad spectrum of natural landscapes, archeological sites, ceremonial places, plant gathering areas, and trails (HCRMP 2003:2-28).

The most critical cultural resources that are in danger of being damaged or destroyed within the Hanford Reach are the archeological sites, especially those which have aboriginal deposits dating to the pre-contact period. These particular sites are located along the edges of the Columbia River, as well as along exposed sand bars within

the river. Such critical areas include the White Bluffs locality, and the archeological districts of Locke, Salvage, and Wooded Island.

3.8.2 Environmental Effects and Recommendations

In this section we highlight the particular management measures that Grant PUD proposes to resolve identified project-related adverse effects to significant cultural resources located within the Project's APE. We also point out other comments from the various agencies and tribes in response to Grant PUD's proposals, along with our own analysis on what measures are needed to insure that project-related effects to historic properties will be adequately resolved for the term of the new license.

Grant PUD's Proposal for Resolving Adverse Effects to Historic Properties for the Term of a New License

Historic Properties Management Plan

In December 2000, Commission staff authorized Grant PUD to initiate Section 106 consultation on the Commission's behalf pursuant to the relicensing of the Priest Rapids Hydroelectric Project. Earlier, in August 1999, Grant PUD organized a cultural resources solution group (CRSG) for the relicensing effort and was later formulated into a cultural resources work group (CRWG) in May 2002 due to sensitive-related cultural resource issues (Shive et al. 2004:2-4). Principal participating members in the CRWG included the Wanapum Band, Confederated Tribes of the Colville Reservation (CCT), Yakama Nation (Yakama), BLM, Grant PUD, Washington SHPO, US Fish and Wildlife Service, DOE, and Commission Staff. As a result of collaboration and efforts of the CRWG, Grant PUD produced several draft versions (November 2003 and June 2004) of a Historic Properties Management Plan (HPMP) and a final draft HPMP (August 2004) to resolve potential project-related adverse effects to potential and National Register-eligible properties located in the Project's APE (Shive et al. 2004). In their final draft HPMP, Grant PUD proposed after license issuance to determine formal National Register eligibility to all potential historic properties (i.e., the 680 properties identified in the Project's APE) and then determine the degree and extent of project-related effects to National Register-eligible properties (Shive et al. 2004:24-25, 33-44).

In order to facilitate National Register evaluations of all the potential historic properties located within the APE, Grant PUD proposed to use a multiple property documentation process. This process would streamline the documentation process where multiple sites could be organized and registered under one National Register form based on common site characteristics, as opposed to each site being listed on individual National Register forms. Upon license issuance, Grant County PUD also proposed in

their final draft HPMP to continue their ongoing efforts in maintaining their established cultural resource programs and practices which includes: (1) the Wanapum River Patrol, (2) Wanapum Dam Heritage Center, (3) Wanapum Dam Heritage Center Repository, (4) Wanapum Native American Discovery Unit, (5) Natural and Cultural Resources Review Process, (6) developed protocols for the treatment and disposition of human remains, and (7) compliance with specific state and federal laws in the protection and preservation of exposed and threatened cultural resources.

In the final draft HPMP, Grant PUD also proposes after license issuance to continue to work with the Wanapum, CCT, and Yakama in the identification and National Register evaluation of traditional cultural properties, and sponsor the requisite studies needed to identify, evaluate, and propose measures to resolve any project-related adverse effects to National Register-eligible TCP (Shive et al. 2004:23). Grant PUD also proposes to curate all collected cultural resource material in the Wanapum Dam Heritage Center Museum, and continue their program for public outreach including their sponsorship of the annual October archeology and heritage celebrations, of which involves many tribal participants from the Wanapum, CCT, and Yakama, along with other cultural resource experts from state and federal agencies, and visitors from the public (Shive et al. 2004:27-29). Finally, Grant PUD proposes to implement a training and information program to personnel that have O & M responsibilities involving day-to-day operation of the Project facilities, in order to insure the continued protection and preservation of significant cultural resources (Shive et al. 2004:29).

Table 27 lays out Grant PUD's proposed schedule for carrying out the various responsibilities discussed above involving the evaluation and resolution of adverse effects to historic properties as a result of ongoing Project operations.

Table 27. Proposed schedule for evaluation and resolution of adverse effects to potential historic properties (Source: Shive, et al. 2004).

Goal	Potential Historic Property Prioritization	Target Schedule
1) Develop multiple property documentation.	For all potential historic properties on the project.	Complete 1.0 year from execution of PA.
2) Identify potential historic properties potentially affected by project operations.	Primary priority potential historic properties secondary priority potential historic properties. Tertiary priority potential historic properties.	Conduct studies concurrent with 1) and complete within 1.5 years from execution of PA. Complete within 2.0 years from execution of PA.

Goal	Potential Historic Property Prioritization	Target Schedule
3) Prepare and submit documentation for consensus determinations of eligibility.	Primary priority potential historic properties.	Complete 2.5 years from execution of PA.
4) Prepare and submit documentation for consensus determinations of eligibility.	Primary priority potential historic properties.	Completed 3.0 years from execution of PA.
5) Prepare and submit documentation for consensus determinations of eligibility.	Secondary priority potential historic properties.	Complete 3.5 years from execution of PA.
6) Draft proposed measures to address effects on historic properties from project operation.	Secondary priority potential historic properties.	Complete 4.0 years from execution of PA.
7) Prepare and submit documentation for consensus determinations of eligibility.	Tertiary priority potential historic properties.	Complete if or when needed due to changes in Project operations or the proposal of specific project-associated actions which could affect such potential historic properties.
8) Implement measures to address effects.	High, secondary and tertiary priority potential historic properties.	Post licensing.

Grant PUD Responses to Commission Staff Additional Information Requests

In July 2004, the Commission staff requested that Grant PUD submit the following items: (1) a description and maps of the APE, (2) a short list of sites (ca. 20) that would be considered eligible for the National Register and suitable for treatment of adverse effects at the highest level of priority, and (3) copies of all of the individual site record forms (ca. 680) to FERC and OAHP. In August 2004, Grant PUD provided the Commission with a description and maps of the APE, a list of 20 high-priority National Register-eligible sites, and 680 Washington State Archeological Site Inventory Forms.

In October 2004, the Commission staff requested that Grant PUD submit a cultural

resource document (Harvey, D.W., Historic, archeological, and traditional cultural properties of the Hanford Site, Washington) that would aid in the Commission's staff analysis of the effects of project operations together with upstream dam operations on cultural resources in the Hanford Reach. This was related to Commission staff's request that Grant PUD provide additional information in regards to a December 24, 2003, FWS request for information on downstream project-related affects (i.e., streambank erosion) on cultural resources in the Hanford Reach National Monument . In January 2005 Grant PUD responded that the information was unavailable. By letter dated January 12, 2005, Grant PUD noted that five non-sensitive documents relevant to the Hanford Reach National Monument had been posted on Grant PUD's website, and that sensitive documents were provided separately to the Commission staff. Grant PUD noted that streambank erosion in the Hanford Reach National Monument was not due solely to project operations, but that the rate and timing of water releases involving the upstream Grand Coulee Project governed the amount of water Grant PUD released through the Wanapum and Priest Rapids Dams. Grant PUD also noted that some of the erosion occurring on archeological sites could be attributed to the natural processes of river currents, flows, wind, and shoreline runoff, in addition to wave action caused by recreational boating.

The Commission staff by letter dated November 24, 2004, requested that Grant PUD submit additional information describing: (1) potential historic properties that may be eligible for the National Register, (2) project-related effects on historic properties, and (3) proposed measures to resolve project-related adverse effects to historic properties. In compiling this information, Commission staff instructed Grant PUD to produce a report that focused its effort on 20 significant archeological sites that had been previously targeted as 'high-priority' for resolving adverse effects, and propose management measures. Commission staff also instructed Grant PUD to provide a schedule for completing National Register eligibility determinations on the remaining 660 cultural resource sites presently inventoried in the Project's APE. On January 28, 2005, Grant PUD filed a report (Narrative Report, dated March 15, 2005) and associated site descriptions of the 20 targeted archeological sites. Table 28 lists the 20 sites and shows the potential effects, proposed mitigation and schedule for implementation.

Table 28. Proposed protection measures for 20 high priority cultural resources sites in the Priest Rapids area of potential affects. (Source: Grant PUD 2005).

Site	Potential Project Associated Effects	Proposed Treatment/Mitigation	Timing/Schedule
1. 45KT1096.	Erosion.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.

Site	Potential Project Associated Effects	Proposed Treatment/Mitigation	Timing/Schedule
2. 45GR65.	Erosion.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
3. 45GR685.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
4. 45GR131.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
5. 45DO532.	Erosion.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
6. 45DO2.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
7. 45CH4.	Erosion.	Monitoring levels 1-3.	Immediate Action. Annual monitoring
8. 45CH1.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
9. 45KT382.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
10. 45KT1.	Erosion. Recreation.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
11. 45KT6.	Erosion. Recreation.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
12. 45GR688.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
13. 45KT44.	Erosion. Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
14. 45KT377.	Erosion. Recreation.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
15. 45GR50.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
16. 45KT20.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
17. 45GR686.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.

Site	Potential Project Associated Effects	Proposed Treatment/Mitigation	Timing/Schedule
18. 45KT12.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.
19. 45KT372.	Erosion. Recreation.	Monitoring levels 1-3 and formal erosion analysis.	Immediate Action. Annual monitoring.
20. 45KT48.	Recreation.	Monitoring levels 1-3.	Immediate Action. Annual monitoring.

Of the 20 sites listed above, Grant PUD identified four that are adversely affected by streambank erosion, 11 that are being affected by recreation-related activities, and the remaining five that are being affected by a combination of streambank erosion and recreational activities. Grant PUD also determined that all 20 sites need immediate attention in order to resolve project-related adverse effects occurring at each site. On all sites Grant PUD proposed to monitor sites by boat (level 1), on-site inspection (level 2), and intensive on-site inspection (level 3). Grant PUD also proposed to monitor all sites being affected by erosion on a monthly basis (Grant PUD 2005b:8). They also propose to conduct erosion analysis on some of the archeological sites, in order to assess what appropriate protective measures need to be taken for each of the affected sites (Heacock 2005b:7). Table 29 shows Grant PUD's proposed schedule for determining National Register eligibility and assessing/addressing adverse effects on all remaining cultural resource properties so far inventoried.

Table 29. Proposed schedule for completing National Register eligibilities/assessment of adverse effects on remaining cultural resource (Source: Grant PUD 2005).

Goal	Potential Historic Property Prioritization	Target Schedule
1. Develop multiple property documentation format for NRHP evaluations.	For all potential historic properties on the project.	Complete 1 year from execution of PA.
2. Identify potential historic properties potentially affected by project operation.	Primary priority potential historic properties. Secondary priority potential historic properties. Tertiary priority potential historic properties.	Conduct studies concurrent with item 1. and complete within 1.5 years from execution of PA. Complete within 2 years from execution of PA.

Goal	Potential Historic Property Prioritization	Target Schedule
3. Prepare and submit documentation for consensus determinations of eligibility.	Primary priority potential historic properties.	Complete 2.5 years from execution of PA.
4. Draft proposed measures to address effects on historic properties from project operation.	Primary priority potential historic properties.	Complete 3 years from execution of PA.
5. Prepare and submit documentation for consensus determinations of eligibility.	Secondary priority potential historic properties.	Complete 3.5 years from execution of PA.
6. Draft proposed measures to address effects on historic properties from project operation.	Secondary priority potential historic properties.	Complete 4 years from execution of PA.
7. Prepare and submit documentation for consensus determinations of eligibility.	Tertiary priority potential historic properties.	Complete if or when needed due to changes in project operations or the proposal of specific project-associated actions which could affect such potential historic properties.
8. Implement measures to address effects.	Primary, secondary and tertiary priority potential historic properties.	Post licensing.

Input from other Agencies and Tribes on Grant PUD's Proposed Project

Test excavations of the archeological sites and the inadvertent discoveries of culturally sensitive materials during Grant PUD's effort to inventory the Project's APE in 2001, led the CCT to express concern with the Priest Rapids Project relicensing effort. From 2002 through 2004, Commission staff, CCT, Grant PUD, and OAHP met to address the concerns raised by the CCT regarding the development of protocols for notification and disposition of culturally sensitive material, and improvement of the Section 106 consultation process between the CCT, Grant PUD, and other members of the CRWG. In order to resolve these issues, Grant PUD met separately with tribal representatives of the CCT, Yakama, and Wanapum, and cooperated with the tribes to

return culturally sensitive material in the appropriate places. Based on the established protocols, Grant PUD continues to consult with these three tribes involving the repatriation of culturally sensitive material.

Confederated Tribes of the Colville Reservation

In a letter dated May 17, 2004, the CCT commented that the final historic properties inventory report: (1) was poorly structured, (2) had no discussion on the APE, (3) did not follow OAHP or FERC guidelines, and (4) was overall incomplete. The CCT also requested that Grant PUD finalize and submit all cultural resource site record forms to them for review and comment.

In a letter dated June 4, 2004, the CCT commented on the draft HPMP (dated November 5, 2003) that: (1) the use of the multiple property documentation process was a concern, (2) a comprehensive research design was missing, (3) the APE was not defined, (4) the protocol for inadvertent discoveries of culturally sensitive materials should be simultaneously reported to OAHP, law enforcement, and the hydro director at the dams, (5) the inventory data base and site record forms were incomplete, and (6) the status of reporting project-related impacts to cultural resources located within the Project's APE.

The CCT, in a letter dated February 25, 2005 reiterated their concerns with the final historic properties inventory report, and final draft HPMP. The CCT's comments on the final inventory report and final draft HPMP were essentially the same as their earlier comments, but they reiterated their concerns that both documents needed to be significantly enhanced before they could be accepted as complete. The CCT commented that all 20 sites submitted by Grant PUD were eligible for the National Register, that there were many more properties that had been located in the Project's APE that could be determined as eligible for the National Register, and that Grant PUD needed to address project-related adverse effects to them. The CCT also stated that they did not receive the site record forms as requested. The CCT also contended that the site forms would provide information needed to assess National Register eligibility of many of the sites located in the Project's APE. The CCT also expressed concern on the length of time it would take Grant PUD to conduct further erosion studies on affected sites, and when measures could be implemented as a result of the erosion studies.

Yakama Nation and CRITFC

The Yakama have expressed concerns similar to those by the CCT, focusing on the effects that the Project has had on traditional and sacred sites. During the FERC-sponsored tribal consultation meetings held at the Yakama Reservation on June 29, 2004,

the Yakama's comments concerned the inundation of important tribal cultural resources by the Project, along with adverse effects occurring on existing archeological sites as a result of ongoing recreational use in the project area. The Yakama also presented formal comments involving the plenary-related meetings, such as the August 14-15 Moses Lake Dispute Resolution Meeting, where they commented on the disposition of human remains and burial sites, the curation of cultural materials, preservation and protection of tribally significant cultural resources, and the impacts on these resources from pool fluctuations caused by power generation of the Project (Final License Application, Volume CR5, Solution Group Meeting Record – 2003).

In a letter dated May 24, 2004, CRITFC filed comments and recommendations (in Recommendation No.19, as discussed below) for resolving adverse effects to significant cultural resources important to the Yakama and other resident tribes that are located within the Priest Rapids Project APE Along with commenting on project-related adverse effects on cultural resources above Priest Rapids Dam, CRITFC noted concerns involving active erosion along the shoreline in the Hanford Reach National Monument associated with 11 Special Protection and Management Units (SPMUs) that had been previously identified by Harford Reach cultural resource managers (Stapp et al. 2003). The SPMUs had been identified as important loci of aboriginal archeological deposits and associated land forms that were actively being affected by river-related erosion, looting, and recreational use. The 11 SPMUs were identified individually as the West and East Vernita Bridge, China Bar, Coyote Rapids, Ryegrass, Waluke, Locke Island, Hanford North Arch, Savage Island, Wooded Island, and 300 Area. These 11 SPMUs are of particular concern to the Yakama, Wanapum, Umatilla, and other tribes who had resided in the Hanford Reach National Monument. In these 11 SPMUs, CRITFC stated that 61 archeological sites have been documented in the Hanford Reach National Monument that are being adversely affected by shoreline erosion (Stapp et al. 2003) attributed by project operation.

To resolve adverse effects on cultural resources associated with the Hanford Reach National Monument and within the Priest Rapids Project boundary, CRITFC recommends (Recommendation No. 19) in consultation with the Yakama and Umatilla, Grant PUD should: (1) establish a cultural resources management program within 6 months after license issuance, and provide funding for this program within one year of license issuance, (2) regularly monitor all National Register-eligible and potentially eligible cultural resource sites located within the Project boundary and Hanford Reach National Monument,(3) develop a comprehensive program for the recordation, protection, monitoring and mitigation of all rock art sites within the Project boundary and Hanford Reach National Monument, (4) establish a comprehensive program with local law enforcement to monitor and take appropriate action involving vandalism on cultural resource sites within the Project boundary and Hanford Reach National Monument, (5)

establish a public awareness program to inform the public on the protection of tribal culturally-sensitive sites within the Project boundary and Hanford Reach National Monument, (6) institute a cultural sensitivity training program to its employees about the significance and importance in protecting tribal culturally-sensitive sites, and (7) establish an intensive monitoring and pro-active treatment program involving cut banks and associated cultural resource sites in the Project boundary and Hanford Reach National Monument.

Wanapum

The Wanapum expressed concern about the protection and preservation of aboriginal cultural resource sites, and the effects the Project might have on them. As with the other involved tribes, representatives from the Wanapum participated in consultations involving the CRWG. One of the major issues of the Wanapum is the continued need to protect tribally culturally sensitive material and information, and not allow the inadvertent release of such information into the public. The release of such information could have unintended adverse effects such as looting and vandalizing aboriginal archeological resources. The Wanapum have been engaged with Grant PUD in the Project's cultural resource program under the existing license, and expect to continue to do so in the same capacity with the new license. The Wanapum have been active in the preservation and protection of cultural resources involving the Project, since they have been the principal Native American community living and continuing their cultural tradition within the Wanapum and Priest Rapids developments. The Wanapum, which is not a federally recognized Indian tribe, plays an important role in ensuring that cultural resources in the Project's APE continue to be preserved and protected. In the new license, Grant PUD also proposes to continue their commitments with the Wanapum that have been ongoing since the beginning of the Project. Many items in the original 1957 agreement, and subsequent agreements between Grant PUD and the Wanapum, include the protection and preservation of culturally sensitive material and information important to the Wanapum.

Office of Archaeology and Historic Preservation (Washington State Historic Preservation Office) [68]

In a letter dated July 25, 2002, the OAHP provided 20 comments on Grant PUD's Interim Report for the Historic Properties Inventory, dated July 11, 2002. Eight of the comments, recommend that Grant PUD elaborate and make better use of GPS and GIS

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[68] The Office of Archeology and Historic Preservation has recently changed their name to Department of Archeology and Historic Preservation.

technology involving the recordation and data synthesis associated with the inventory. OAHP also requested Grant PUD define more clearly the APE in association to recreational and erosion impacts, and the extent of the APE downstream from Priest Rapids dam. Other OAHP comments included: (1) resolving conflicting site location information by various recorders over the years, (2) artifact curation procedures Grant PUD proposes vis-à-vis various private and public landowners, (3) refining specific protocol measures involving inadvertent discoveries, and (4) allowing for more in-depth consultation between OAHP's and Grant PUD's cultural resource staff.

By letter dated February 5, 2004, OAHP stated that the draft HPMP, dated November 5, 2003, did not: (1) adequately address the protection of cultural resources in the APE, (2) provide an empirically based program on the issues outlined in the management plan, and (3) have a robust schedule to evaluate National Register eligibility on the 680 archeological sites presently located within APE.

To address comments by the CRWG, Grant PUD revised the draft HPMP, dated June 10, 2004. However, in a letter dated June 22, 2004, the OAHP stated that the revised draft HPMP did not adequately define the APE, and that their earlier comments on the HPMP, along with Commission staff's comments (see below), had not been addressed. In this letter, the OAHP, reiterated their previous concerns, in addition to stating that Grant PUD should: (1) produce a robust schedule of completing all National Register eligibility determinations within two years of signing the programmatic agreement (PA) involving a new license for the Project, (2) file with the OAHP recommendations for resolution of adverse effects on archeological sites affected by erosion within 6 months after such effects have been determined for each respective site, (3) carry out the proposed resolution for any primary priority archeological site within one year of signing the PA, and (4) implement all treatment and protection plans for secondary priority sites within two years of signing the PA. The OAHP also reiterated their position that Grant PUD needs to develop a public program involving cultural resource education and training, and that this should be incorporated into the HPMP. In the same June 22, 2004 letter, OAHP made a number of additional comments on Grant PUD's final historic properties inventory report (dated September 5, 2003). In summary, OAHP believed that inventory report was incomplete regarding a number of factors relevant to understanding the scope and extent of sites located with the APE, and that it needed to be revised accordingly.

In a letter dated December 3, 2004, OAHP commented that the information compiled for determining the Project's effects on archeological sites located downstream from Priest Rapids dam in the Hanford Reach area was not sufficient. The OAHP reiterated their earlier concerns about the inadequacies of both the final historic properties inventory report and the final draft HPMP, and that both documents need further

revisions before they can be accepted by the OAHP.

In a follow-up letter, dated December 21, 2004, the OAHP reiterated the same points made in their December 3, 2004 letter, but added that the several hundred site record forms submitted to OAHP by Grant County PUD, were incomplete and that missing information was needed.

In a letter dated February 3, 2005, the OAHP responded to the Commission's November 2004 AIR involving the immediate treatment of 20 high priority archeological sites. In particular, they provided the following comments on the 20 individual National Register eligible archeological site record forms that they need: (1) corresponding signatures from the responsible federal officials, (2) the listing of the property owner for each site, relevant testing and evaluation reports on some of the 20 sites that have been previously excavated and evaluated, (3) a listing of specific information and artifacts that make particular site eligible to the National Register, and (4) to make sure all information on the site record forms is consistent. The OAHP also noted that there is ambiguity on whether Grant PUD intends to implement the multiple property documentation process or whether they will go with individual National Register eligibility determinations.

Our Analysis

Overall, the Commission staff concurs with Grant PUD's proposal in their license application to finalize the HPMP in consultation with the CRWG. We also concur with Grant PUD's proposal to continue their commitments to the Wanapum Indians as stated in their modified 1957 agreement. In their comments on the license application, the Wanapum proposed that a specific license article be put into the new license that ensures that Grant PUD maintain its commitment to the Wanapum required by the January 8, 1957 agreement and subsequent modifications, and through any future modifications agreed to by the parties. Many of the commitments associated with the 1957 agreement pertain to protecting and preserving cultural resources significant to the Wanapum, which are an important part of the cultural history of the project area. Including such measures and commitments in the final HPMP, which Grant PUD has done in previous drafts of the HPMP, would ensure the continued protection and preservation of the cultural heritage of the Wanapum, in addition to the protection and preservation of other significant cultural resources located within the Project's APE.

To insure that historic properties affected by the Priest Rapids Project are protected in accordance with the Commission's Section 106 responsibilities in issuing a new license for the Priest Rapids Project, the Commission staff recommends that upon issuance of a new license, Grant PUD take immediately steps to begin the process of

resolving adverse effects on known National Register-eligible properties that are presently in danger of being destroyed or damaged as a result of ongoing project-related adverse effects. Our recommendations correspond with Grant PUD intentions as stated in their March 15, 2005 response to us, where they target 20 archeological sites for immediate action.[69] With the recent inadvertent discovery of tribally-sensitive cultural materials, and supported by more than a half century of systematic archeological research, there is consensus among the CRWG that a significant number of aboriginal archeological sites in the APE, can be considered eligible for the National Register without further investigations or archeological testing. Based on a review of the existing individual site record forms, Commission staff also concludes that there is enough existing information on many of the inventoried sites (i.e., through previous archeological excavations, and information taken from the individual site record forms) to determine National Register-eligibility and to assess project-related effects on them.[70] Thus, justification for the 20 sites so far identified as being eligible for the National Register, including a number of additional sites, can be laid out in a narrative fashion where individual sites can be described in terms of their characteristics, associated artifacts, particular chronological phases, and associated site features. This information should be integrated into the final HPMP, which in turn, would support and augment Grant PUD's justification for how they propose to resolve adverse effects to specific National Register-eligible sites.[71]

As expressed by some of the members in the CRWG, it may be more effective to

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[69] Grant PUD identified 20 sites that are considered eligible for the National Register and proposes immediate action on these sites (see Pages 1-7 in Grant PUD's Narrative Report, dated March 15, 2005).

[70] In determining National Register eligibility, Grant PUD should also consider whether sites are eligible under Criterion A, and integrate relevant ethnohistoric information that the various involved tribes have on this matter, including information provided through the TCP studies. At this time, the CCT, Yakama, and Wanapum have already identified some of sites in the Project's APE that probably would be rendered eligible under Criteria A of the National Register.

[71] Grant PUD should begin with the group of 20 sites they submitted which are in the greatest danger of being severely damaged or destroyed by project-related effects. Add on to this group any additional sites that are considered eligible for the National Register and prioritize treatment measures based on the degree and severity of project-related affects. Integrating this kind of site-specific information into the final HPMP should be done in collaboration with others in the CRWG. Also modify existing site record forms during this time as well, based on missing, incomplete, or new information.

establish National Register historic districts among groups of such similar sites determined eligible under Criteria A and D, as opposed to going forward with a multiple property determination process. In deciding on which approach to take, Grant PUD can re-assess their decision when finalizing the HPMP in collaboration with members in the CRWG. In revising the HPMP, Grant PUD should continue to engage in work group discussions with the respective staffs of OAHP, CCT, Yakama, Wanapum, and other members of the CRWG.

Before the HPMP can be accepted as final, Commission staff finds that Grant PUD should make the following improvements to the document. They should describe in detail the steps they will take for resolution of adverse effects on all sites that can be presently considered eligible for listing in the National Register. Following this, Grant PUD should incorporate into the final HPMP an overall strategy to evaluate and address the remaining sites on a priority basis, based on the degree of project-related adverse effects occurring on them. Grant PUD should also add more detail into the final HPMP including background information and supporting data derived from the overview and inventory reports that would give a fuller understanding of all the sites located in the APE. A robust and data-rich final HPMP, supported by site-specific narrations, would allow the acting cultural resource manager and reviewers to adequately encompass all pertinent issues without having to refer back to either the overview or inventory report.[72]

Potential Effects of the Project on the Hanford Reach National Monument

With additional information gathered from DOE's Pacific Northwest National Laboratory, Commission staff has ascertained that approximately 1,447 cultural resource sites and isolated finds have been located within the Hanford Reach National Monument (PNNL 2004:4.93). It is important to note that less than half of the 51-mile stretch of the mid-Columbia River that falls within the Hanford Reach National Monument has been systematically inventoried for cultural resource sites (HCRMP 2003:3-51).

As mentioned above by CRITFC, 11 SPMUs in the Hanford Reach National Monument that are adversely affected by streambank erosion. These particular SPMU contain a number of aboriginal archeological sites that are important to the affected tribes. As discussed above, the operation of the Priest Rapids Project may contribute to cumulative effects (principally through streambank erosion) on archeological sites, as well as traditional cultural properties, in the Hanford Reach National Monument. Water

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[72] In adding such detail derived from the overview and inventory reports, Grant PUD should incorporate any additional corrections or modifications based on the comments made by the OAHP, CCT, and others of the CRWG involving these reports.

released from Priest Rapids Dam does to some degree contribute to downstream erosion that presently affects archeological sites located along the Columbia River in the Hanford Reach National Monument, especially to sites nearest the dam. However, as discussed in Section 2.0, Proposed Action and Alternatives, the volume of water flowing through the mid-Columbia River is principally governed by releases from the Grand Coulee Project and then passed through and controlled by the other hydroelectric projects upstream from the Priest Rapids Project.

In addition, as discussed in the Geology and Soils Section of this DEIS upstream storage projects have resulted in a reduction of the magnitude and number of extreme high flow events, which are the greatest cause of shoreline erosion. In fact some geomorphic studies conclude that most of the recent landslide activity in the Hanford Reach National Monument is attributed to the development of irrigation along the Columbia River Basin between 1953-1994 that has resulted in elevated groundwater levels, which in turn has caused slumping and slope failures valley walls (for more discussion on this see the geology and soils section 3.3). Thus, the overall effects of erosion on archeological sites downstream from Priest Rapids Dam are cumulative in nature, resulting in the release of water through several hydroelectric projects, including the Priest Rapids Project.

Grant PUD has proposed various measures to enhance water quality and aquatic resources downstream from Priest Rapids Dam that, by dampening the magnitude and frequency of flow fluctuations (which some believe contributes to shoreline erosion) could decrease the effects of streambank erosion on archeological sites in the Hanford Reach National Monument (see discussions along these lines in the other appropriate resource sections). Grant PUD participates in the Hanford Reach National Monument Federal Advisory Committee, where the committee makes recommendations and assists the FWS on management goals for the Hanford Reach National Monument. Through the continued implementation of the Hanford Reach cultural resources management plan, along with input from the committee, steps would continue to be taken by DOE and FWS to help minimize streambank erosion and therefore, protect archeological sites in the Hanford Reach National Monument.

On extending the Project's APE into the Hanford Reach National Monument, Commission staff at this time cannot discern project-related effects solely attributable to the Priest Rapids Project, since much of the water being released through the Project is based on the amount of water being released from other hydroelectric projects further upstream on the Columbia River. By continuing to co-operate with the Hanford Reach National Monument Advisory Committee and helping to develop a cooperative approach for resolving shoreline-related erosion effects to affected archeological sites in the Hanford Reach National Monument, Grant PUD would contribute to the mitigation of

any cumulative adverse effects on cultural resources attributable to stream bank erosion in the Hanford Reach.

Execution of a PA and Implementation of the Final HPMP

In order to comply with Section 106, Commission staff intends to craft and execute a PA with the Washington OAHP/SHPO and the Council--if the Council chooses to participate. In the event that the Commission issues a new license for the Project, Commission staff would stipulate in the PA that Grant PUD file a final HPMP within one year after license issuance. Along with the standard requisite tasks listed in the PA for completion of the HPMP, Grant PUD should incorporate into the HPMP: (1) a comprehensive program and schedule for prioritizing the resolution of adverse effects on known National Register-eligible sites, based on the severity of the effects, (2) a plan of action for the immediate treatment of the most-severely affected National Register-eligible sites that would be executed upon implementation of the HPMP, (3) individual treatment plans for resolving the effects on the remaining high priority National Register-eligible sites that would be implemented within one year of implementation of the HPMP, (4) a plan for determining the eligibility of the remaining sites that are being affected by the Project operations and maintenance within two years of implementation of the HPMP, and (5) a program to carryout treatment plans for other National Register-eligible sites that are, or could be, affected by Project-related effects, over the next three to five years after HPMP implementation.

The HPMP should also have a clear, contextually coherent and detailed map (or set of maps) showing the Project APE, areas inventoried, landownership, and locations of identified sites.[73] Corresponding narrative information, including individual descriptions of National Register-eligible sites should also be included in the final HPMP. Finally, additional contextual information and supporting data derived from the overview and inventory reports should be incorporated into the HPMP to make the management document as comprehensive as possible.[74]

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[73] The APE map(s) should also show as much as possible specific localities where different kinds of adverse effects occur, such as erosion and recreation activities.

[74] Along with finalizing the HPMP, all site record forms should be completed, corrected, or updated based on existing comments and additional input from the Washington OAHP, CCT, and others of the CRWG.

3.8.3 Cumulative Effects

Effects on cultural resource sites located along the Columbia River shoreline, both within the APE and below the Project in the Hanford Reach, are subject to cumulative effects from erosion caused by the Project and upstream dam operations. Grant PUD's proposed plan for protecting these resources along with the additional measures we propose would provide increased protection for these resources over the term of a new license. By continuing to co-operate with the Hanford Reach National Monument Advisory Committee, Grant PUD would contribute to the mitigation of any cumulative adverse effects on cultural resources attributable to stream bank erosion in the Hanford Reach.

3.8.4 Unavoidable Adverse Impacts

Stream bank erosion is a natural process that cannot be totally eliminated in fluvial rivers without structurally armoring the shoreline, which would be extremely costly and detract from the aesthetic value of the river. Adoption and implementation of a HPMP would provide for the phased documentation and protection of sites, but not totally eliminate the possibility of the loss of some cultural resource materials and sites caused by stream bank erosion.

3.9 RECREATION AND LAND USE

The EIS scoping process identified the following issues related to project effects on recreation resources: (1) effects of public recreation use on undeveloped dispersed recreation sites that could contain: (a) cultural sensitive area(s) of concern to the Yakama Nation, other federally recognized tribes and the Wanapum, or (b) species of special concern; (2) effects of project operations and facilities on recreational fishing; (3) effects of fluctuating impoundment surface elevations on recreation access, specifically boat ramps, at the Priest Rapids Project; (4) effects of project operation and operation of upstream developments on special designated areas, such as the Hanford Reach National Monument and wildlife areas managed by WDFW; (5) trails and project role in the restoration of Beverly Bridge to serve as part of the John Wayne Pioneer Trail; and (6) need for and project role in the development of horseback riding amenities. In this section, we describe the affected environment with respect to recreation resources and the environmental effects, including cumulative effects, of the project as related to these issues.

3.9.1 Affected Environment

In the Columbia River Basin, the Columbia River can be divided into three

sections: the tidal or lower section extending from the mouth to a point about 140 miles from the mouth; the middle section extending from the head of tidewater to the mouth of Snake River, a distance of about 180 miles; and the upper section extending from the mouth of Snake River to the U.S.-Canada border, about 424 miles (letter to the Speaker of the House of Representatives, from Mr. Elwood Mead, Commissioner, War Department, March 29, 1932).

The Priest Rapids Project, located in the middle section of the Columbia River (or mid-Columbia River), includes two developments- -Wanapum and Priest Rapids. The existing project boundary includes 58 miles of the Columbia River extending from river mile (RM) 453 to RM 395. The Wanapum development is located at RM 415.8; its approximate 38-mile-long impoundment extends upstream from the dam to Rock Island Dam at RM 453.4. The Priest Rapids development is located at RM 397.1; its approximate 18-mile-long impoundment extends upstream from the dam to the Wanapum development. The project boundary extends approximately 2 miles below the Priest Rapids dam into the upper portion of the free-flowing Hanford Reach (Public Utility District No. 2 of Grant County, Washington, 2003). The Columbia River flows through the 51-mile-long Hanford Reach to its confluence with the Snake River, which we also include in our analysis of potential project-related effects.

As part of the relicensing efforts for the Priest Rapids Project, Grant PUD conducted 10 recreation-related studies or surveys. See Grant PUD (2003) Exhibit E-7, Section 7.10, of the license application for a summary of the recreation-related studies or surveys. In addition, an analysis of aesthetics/visual resource was conducted, which compliments the recreation-related studies or surveys. See Grant PUD (2003) Exhibit E-8.A for the aesthetics/visual characteristics of the general region and the Priest Rapids Project area.

Regional Recreation Resources

The Columbia River and its tributaries offer a wide range of recreational opportunities for Washington residents and visitors. Recreational opportunities include boating, fishing, hunting, hiking, camping, horseback riding, picnicking, sight-seeing, and wildlife observation. A recent survey (U.S. Department of the Interior *et al.*, 2002) indicates that among anglers, hunters, and wildlife-watchers, there is a considerable overlap in activities. In 2001, 71 percent of hunters also fished, and 27 percent of anglers hunted. If we look at one recreational activity for Washington State, the data shows that 12,841,000 days of fishing (residents and nonresidents) occurred in 2001. For Washington State, the total expenditure [75] for fishing in 2001 was $853,761,000.

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[75] Expenditure - money spent in 2001 for wildlife-related recreation trips in the United

Expenditures included trip-related (*e.g.*, food and lodging), equipment, and other (*e.g.*, membership dues). During 2001, a total of 2,496,000 people in Washington State participated in wildlife-watching and, as a result, the total expenditure for wildlife-watching was $979,730,000. These expenditures can contribute toward jobs in industries that support wildlife-related recreation. Further, funds generated by licenses and taxes on hunting and fishing equipment can contribute toward conservation efforts.

Fourteen regional recreation resources, located approximately 30 to 90 miles from Wanapum development, offer a variety of facilities, public access, and recreational opportunities similar to those available at the Priest Rapids development (see Table 30). Associated with some of these regional recreation resources are scattered parcels of land managed by the U.S. Bureau of Reclamation (BOR). Known as "scattered tracts", this land consists of approximately 308 parcels scattered throughout the Columbia River Basin with an estimated total of 90,000 acres (U.S. Bureau of Reclamation, 1998). The area includes Adams, Franklin, and Grant Counties, with a portion in Walla Walla County located south of the Snake River. Scattered tracts are discussed in the Land Use section below.

States and wildlife-related recreational equipment purchased in the United States. Expenditures include both money spent by participants for themselves and the value of gifts they receive (U.S. Department of the Interior, *et al*., 2002).

Table 30. Regional Recreation Resources (source: Public Utility District No. 2 of Grant County, Washington, 2003; EDAW, Inc., 2000).

Development	Provided By	Recreation Facilities	Recreational Use
Rock Island Reservoir	Chelan PUD; WSPRC	Wenatchee Confluence State Park- (with 59 campsites); trails; 4 picnic areas; 2 boat launches	Camping; picnicking; swimming; hiking
Lake Entiat	Chelan PUD; WSPRC; Cities of Chelan Falls and Entiat; Port of Douglas County	276 campsites; 7 boat launches; 7 picnic areas; visitor center with fish viewing room	Camping; picnicking; swimming; boating; walking
Lake Chelan	Chelan PUD; NPS; Forest Service	435 campsites; 6 boat launches; 13 private marinas; 9 picnic areas	Camping; boating; fishing; hiking
Lake Pateros	Douglas PUD; Cities of Brewster, Pateros, and Bridgeport	43 campsites; 8 boat launches; 5 picnic areas; Wells Dam Overlook	Camping; picnicking; boating; swimming
Rufus Wood Lake	Corps; WSPRC	Bridgeport State Park- (with 42 campsites); boat launch; 3 picnic areas; 2 visitor centers	Camping; picnicking; boating; swimming
Franklin D. Roosevelt Lake (lies within Lake Roosevelt National Recreation Area)	NPS; Confederated Tribes of the Colville Reservation; Spokane Tribe of Indians	1,000 campsites; 24 boat launches; 9 picnic areas; 2 interpretive facilities	Camping; boating; fishing

Development	Provided By	Recreation Facilities	Recreational Use
Sun Lakes Area	WSPRC; private	Sun Lakes State Park- (with 202 campsites); 8 boat launches; picnic area; interpretive facility	Camping; picnicking; boating; fishing; hiking; wildlife observation; horseback riding
Billy Clapp Lake	BOR;WDFW;WSPRC	boat launch; picnic area	Boating; fishing; picnicking
Moses Lake	City of Moses Lake; Moses Lake Parks & Recreation Department; WDFW; Moses Lake Irrigation District	346 campsites; 7 boat launches; picnic area	Camping; boating; fishing; swimming; picnicking
Potholes Reservoir	BOR; WDFW; private	326 campsites; 10 boat launches; 2 picnic areas	Camping; boating; fishing; swimming; picnicking
Lake Wallula	Corps; WSPRC; Benton and Franklin Counties; FWS; Cities of Pasco and Kennewick; private	135 campsites; 13 boat launches; 18 picnic areas; visitor center	Camping; boating; fishing; swimming; picnicking; hiking
Lake Sacajawea	Corps	158 campsites; 7 boat launches; 7 picnic areas; interpretive facility	Camping; boating; fishing; swimming; picnicking; hiking
Lake West	Corps; Port of Columbia; WSPRC	110 campsites; 5 boat launches; 2 picnic areas	Camping; boating; fishing; swimming; picnicking; hiking

Special Designated Areas and the Hanford Reach

There are no federally designated Wild & Scenic River sites within the Priest Rapids Project boundary. Approximately 45 miles of "eligible" Columbia River flows through the Hanford Reach National Monument (Monument),[76] located downstream from the Priest Rapids Project (Public Utility District No. 2 of Grant County, Washington, 2003). Interior recommended that Congress designate federally owned and privately owned lands within 0.25 mile of the Columbia River, on both riverbanks from RM 396 to RM 346.5 as a Recreational River under the Wild and Scenic Rivers system; and, the portion of the Hanford Site that lies north of the river as a National Wildlife Refuge to be managed by the FWS. The actions are pending (U.S. Department of Energy, 1999).

The Monument, located in Adams, Benton, Franklin, and Grant Counties, is managed by the FWS. The land is part of the 586 square mile-Hanford Reach Nuclear Reservation (Hanford Site) located in Benton County and administered by DOE. A portion of the Hanford Site is within the Priest Rapids Project boundary, composed of an estimated 0.4-mile of the Columbia River shoreline.

The FWS (2002) notes that the natural features of the Monument and the historical importance of the area provide both opportunities and constraints to recreational activities and development at the Monument. Recreational opportunities include fishing, hunting, wildlife observation, hiking, and horseback riding. Both motorized and non-motorized (canoeing and kayaking) recreational boating occurs along the entire Hanford Reach.

Based on existing information and comments filed on the Priest Rapids Project, the Hanford Reach and associated habitat, along with the Monument, is a unique regional recreation resource due in part to its relatively undisturbed natural setting, migratory waterfowl, and its bass, salmon, sturgeon, and steelhead trout angling. Peak recreation use during the year occurs in the April to May fishing season; the August to October fishing season; and the fall (mid-October to mid-January) hunting season; however, other peak recreation use occurs during the summer sturgeon fishing season (Public Utility District No. 2 of Grant County, Washington, 2005). By letter filed December 30, 2003, the FWS states that recreational fishing opportunities for Pacific salmon, white sturgeon, and steelhead trout in the Hanford Reach draw an estimated 75,000 visitors annually. The Washington Department of Fisheries, *et al*. (1990) drew a similar conclusion regarding steelhead trout angling opportunities in the Hanford Reach.

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[76] The Hanford Reach National Monument was established by Presidential Proclamation on June 8, 2000.

Future (year 2020) participation in various recreation activities at the Monument indicates an increase, except for hunting which shows a minus 16 percent change. From 2000 to 2020 sightseeing (30 percent), camping (25 percent), hiking (24 percent), and fishing (14 percent) revealed positive changes in participation rates (U.S. Fish and Wildlife Service, 2002).

Public access to the Monument is limited to four of the six administrative units - - the Wahluke Unit; Vernita Bridge Unit; McGee Ranch/Riverlands Unit; and the River Corridor Unit. Big game and waterfowl hunters use certain areas of the Monument (primarily the Wahluke and River Corridor Units) for the fall hunting season. There are four boat launches that provide public access to the Columbia River: Vernita Bridge Unit; McGee Ranch/Riverlands Unit; and, the remaining two access points located within the Wahluke Unit at White Bluffs boat launch and at Parking Lot 7. The 800-acre Vernita Bridge Recreation Area, just north of the Vernita Bridge, is managed by the WDFW. The Vernita Bridge Recreation Area provides river access for fishing and boating. The White Bluffs boat launch has a single-lane concrete ramp and a developed parking area. The other boat launches are unimproved (gravel and/or dirt ramps) (U.S. Fish and Wildlife Service, 2002; Benton County Planning Department, 1998). Downstream from the Monument, public boat launches provide access to the 25,000-acre River Corridor Unit.

The Pacific Crest National Scenic Trail is located approximately 50 miles west of the Priest Rapids Project. The State-designated Cross-State Trail route (known locally as the John Wayne Pioneer Trail) abuts the project boundary near the Town of Beverly (EDAW, Inc. 2000a). The trail extends approximately 110 miles from King County to the Columbia River just south of Wanapum dam, primarily along the former Chicago, Milwaukee, and St. Paul Railroad rights-of-way. The trail ends at the Beverly Junction approximately 2 miles south of Wanapum dam. In May 2002 the John Wayne Pioneer Trail was designated as a National Recreation Trail, which recognizes the trail as part of the United States national system of trails (Public Utility District No. 2 of Grant County, Washington, 2003). Besides hiking and other recreational opportunities, the trail is used for horseback riding. The Washington State Parks and Recreation Commission (WSPRC) manages the John Wayne Pioneer Trail, while the Beverly Bridge and its components east of the Columbia River are managed by the WDNR.

By letters filed May 3 and 31, 2005, the Washington State Office of the Interagency Committee (IAC) and WDNR, respectively, comment that the .5-mile-long Beverly Bridge is a link between the western and eastern portion of the John Wayne Pioneer Trail, and due to current bridge conditions and concerns for public safety, the bridge is closed to public use. Interstate-90 (I-90) is the only other public crossing of the Columbia River. The IAC (1995) identified walking as the most popular and rapidly-

growing outdoor recreation activity, and a need for connecting non-motorized trails, such as the Cross-State Trail.

The Gorge Amphitheater is situated on a high bluff above Wanapum Reservoir and outside the existing Priest Rapids Project boundary. The Gorge Amphitheater has 20 to 25 concerts or events per year in which an estimated 20,000 visitors attend per concert or event, thereby contributing to the recreational use of the region. A new campground, located adjacent to the amphitheater, will provide up to 7,800 campsites with limited facilities (portable toilets, no hook-ups) (EDAW, Inc., 2000). Grant PUD (2003) notes that a new outdoor concert venue, the White River Amphitheater located in Auburn, Washington, provides a second venue for concerts or events in the Pacific Northwest. Thus, a shift in future visitors from the Gorge Amphitheater to the White River Amphitheater may occur, thereby causing a decrease in visitors to the project area.

Public access to the regional recreation resources, as well as to the local recreation resources discussed below, is available via I-90, SR 243, SR 24, and SR 26. Grant PUD (2005) notes that Washington Department of Transportation (WDOT) manages a highway rest stop on SR 24 along the Columbia River and adjacent to Vernita Bridge. Facilities include parking, restrooms, picnic area, and informational signs. A user-defined pedestrian access to the river is also provided. Access to and use of Wanapum Reservoir is concentrated in the I-90 corridor and at Crescent Bar Resort and Sunland Estates. Downstream from Wanapum dam, the Columbia River flow through Sentinel Gap, which is a geological landmark formed by the river through Saddle Mountains, and continues parallel to SR 243.

Recreation Resources within the Priest Rapids Project Area

The Priest Rapids Project area [77] contains developed and undeveloped recreation sites, of which 23 sites are located along Wanapum Reservoir and 12 sites are located along Priest Rapids Reservoir. The sites are described in detail in the Final Recreation Site and Facility Inventory conducted by EDAW, Inc. (2000a). EDAW, Inc. (2000a) notes that Sentinel Gap was excluded from the inventory because the majority of users are migrant farm workers camping at the site; thus, use of this site is not related to recreation as an activity. Beverly Dunes Off-Road Vehicle (ORV) Park also was

[77] For recreation resources, the term "project area" includes all lands within the existing Priest Rapids Project boundary. In addition to developed recreation sites, there are shoreline dispersed undeveloped day use and overnight sites that are included in the project area (Public Utility District No.2 of Grant County, Washington, 2003, at page E7-3).

excluded because recreation at the site is not related to the project. The undeveloped dispersed recreation sites provide day-use for picnicking, hiking, boating, fishing, hunting, and swimming (EDAW, Inc., 2000). At some of the undeveloped dispersed recreation sites, boaters use the sites for camping (EDAW, Inc. 2001).

Developed Recreation Facilities

At Wanapum Reservoir there are 14 developed recreation facilities, including parking. In particular, the Wanapum Dam Overlook is situated on a hill overlooking Wanapum dam and the surrounding landscape. Views from this location are panoramic and spectacular (Public Utility District No. 2 of Grant County, Washington, 2003). The Ginkgo Interpretive Center, which is part of the Ginkgo/Wanapum State Park, also overlooks Wanapum Reservoir and the landscape. At the state park, there is a 3-mile-long interpretive hiking trail through a prehistoric lakebed, a portion of which exhibits petrified wood (EDAW, Inc., 2002). These facilities and some of their amenities are listed below.

(1) Wanapum Dam Picnic Area (Grant PUD)
(2) Wanapum Dam Heritage Center (Grant PUD)
- museum, fish ladder with viewing room, restrooms, trash receptacles

(3) Wanapum Dam Upper Boat Launch (Grant PUD)
(4) Wanapum Dam Overlook (Grant PUD)
(5) Getty's Cove (privately owned and operated)
- 130 campsites, restrooms, boat launch, swimming area with beach

(6) Wanapum Recreation Area, Ginkgo/Wanapum State Park (WSPRC)
- 50 campsites, restrooms, picnic area, boat launch, concession stand

(7) Ginkgo Interpretive Center, Ginkgo/Wanapum State Park (WSPRC)
(8) Sand Hollow-South (Grant PUD)
(9) Sand Hollow-North (Bureau of Reclamation)
(10) Kittitas County Boat Launch (Kittitas County operated/Grant PUD owned)
- boat launch, picnic area, 2 vault toilets, trash receptacle/dumpsters

(11) Vantage Riverstone Resort (privately owned and operated)
- 32 tent sites, restrooms, marina, playground area, restaurant

(12) Frenchman Coulee Boat Launch (Grant PUD/WDFW)
- boat launch, signs.

(13) Sunland Estates Boat Launch (WDFW)
- boat launch, portable toilet, signs

(14) Crescent Bar Resort (privately operated/Grant PUD owned)
- 35 tent sites, picnic area, beach, boat launch and fuel dock, restrooms.

At Priest Rapids Reservoir there are four developed recreation facilities, including

parking. These facilities and some of their amenities are listed below. EDAW, Inc. (2000a) notes that migrant farm workers camp at Buckshot Ranch, located at the Priest Rapids Wildlife Area.

(1) Desert Aire (privately operated/Grant PUD owned)
- 34 campsites, 2 boat launches, swimming area and beach, portable toilet

(2) Buckshot Ranch (WDFW operated/Grant PUD owned)
- day-use area, boat launch, dispersed camping area, 2 portable toilets

(3) Crab Creek (Grant PUD)
- day-use area with access to Crab Creek

(4) Wanapum Dam Lower Boat Launch (Grant PUD)
- provides boater access to Wanapum Dam tailrace area and the northern portion of Priest Rapids Reservoir; contains a boat launch, 2 portable toilets, signs.

Undeveloped Dispersed Recreation Sites

Public use of undeveloped dispersed recreation sites consists primarily of individuals who access the shoreline for picnicking, wildlife observation, swimming, or fishing. For example, the Priest Rapids tailrace area and the river reach extending outside the existing project boundary are used during the fall Chinook salmon fishing season. Three sites (Sand Hollow-South, Sand Hollow-North, and Crab Creek) contain various facilities, such as portable toilets (on a seasonal basis), trash receptacles, and dispersed campsites.

There are seven undeveloped dispersed recreation sites at or near Wanapum Reservoir: (1) Black Sand Beach (Grant PUD); (2) McCumber Beach (Grant PUD); (3) Sand Hollow-South (Grant PUD); (4) Sand Hollow-North (Bureau of Reclamation), just upstream from Sand Hollow-South; (5) Rocky Coulee (Grant PUD, WSPRC), accessed by Old Highway 10 West; (6) Quincy Wildlife Area (WDFW), located north of Sunland Estates; and (7) Quilomene Dune and Bay (WDFW). Black Sand Beach and Quilomene Dune and Bay are located on the western shoreline of Wanapum Reservoir; both McCumber Beach and Sand Hollow-South are located on the eastern shoreline.

Four undeveloped dispersed recreation sites at or near Priest Rapids Reservoir include: (1) Priest Rapids Tailrace (Grant PUD); (2) Goose Island (WDFW), about 1 mile upstream from Priest Rapids dam; (3) Haystack Rocks (Bureau of Land Management), just north of Sentinel Gap; and (4) Crab Creek (Grant PUD), near the town of Beverly. Grant PUD (2005) states that only the lower 5 miles of Crab Creek and its confluence with the Columbia River lies within the Priest Rapids Project boundary.

Lower Crab Creek (RM 411) is a perennial stream that flows into the Columbia River. The lower Crab Creek area supports emergent wetlands and pond communities not observed elsewhere in the project vicinity (Framatome ANP, 2003). Various fish species occur within the Crab Creek sub-basin that provides angling opportunities. See section 3.5, Aquatic Resources, for a discussion. Recreation and ORV use occur throughout lower Crab Creek, which can exacerbate local noxious weeds infestations. See section 3.6, Terrestrial Resources, for further discussion.

Recent improvements to Crab Creek include the installation of wooden posts to limit vehicle access to the shoreline area, thereby protecting riparian habitat. EDAW, Inc. (2000a) notes that migrant farm workers camp at Crab Creek.

Recreation Use within the Priest Rapids Project Area

EDAW, Inc. (2000b), on behalf of Grant PUD, conducted a recreation study to identify and characterize recreation use within the Priest Rapids Project boundary. The study area was defined as waters and adjacent lands within the project boundary and recreation facilities within and adjacent to the project boundary. The study area also included four privately operated recreation areas- -Crescent Bar Resort, Getty's Cove, Vantage Riverstone Resort, and Desert Aire. EDAW, Inc. also compared the 1999 data with earlier survey data collected in 1996.

The findings from the 1999 survey indicate that: (1) Wanapaum Reservoir is both the larger and more heavily used of the two reservoirs -- over 900 boats were observed on Wanapum Reservoir during one day of the July 4 weekend; in contrast, 21 boats were observed on Priest Rapids Reservoir; (2) although recreational use in the study area is high at times, visitors to the area did not feel overly crowded; (3) Crescent Bar Resort and the boat-in site at Quilomene Dune were perceived to be more crowded than other sites; (4) the most common activities included swimming (82 percent) followed by resting/relaxing (70.4 percent), camping (61.7 percent), power-boating (54.0 percent), picnicking (51.8 percent), and water-skiing (46.7 percent); and (5) the majority of visitors surveyed live in the Central Puget Sound area (King, Kitsap, Pierce, and Snohomish Counties), with King County residents leading in visitation at 42 percent. Sixteen percent of the visitors surveyed came from the counties within and bordering the study area.

Hunting and fishing are popular recreation activities in the project area, particularly during the fall season at which time, fish runs (primarily Chinook salmon and steelhead trout) and waterfowl hunting occur. In the Priest Rapids tailrace salmon fishing is popular with 1,050 recreation visitor days [78] (1996 data). The 1996 estimate includes

[78] Recreation user day/night - each visit by a person to a development for recreational

an approximate 210 overnight stays. At waterfowl hunting areas, an estimated 300 recreation visitor days occurred on Priest Rapids Reservoir and 700 recreation visitor days occurred on Wanapum Reservoir (Public Utility District No. 2 of Grant County, Washington, 2003).

Some major findings in comparing the 1999 data with earlier survey data collected in 1996 indicate that: (1) the percentage of visitors from the Central Puget Sound area has increased from 51 percent to 73 percent; (2) overall recreational use has increased accordingly since 1996- -campgrounds (32 percent); car accessible day use sites (13 percent); boat accessible day use sites (105 percent); and boat use on Wanapum Reservoir (111 percent); and (3) there were an estimated 294,800 recreation visitor days in the study area in 1999- -a 24 percent increase in recreation visitor days (1996-1999).

EDAW, Inc. (2000c), on behalf of Grant PUD, conducted a recreation capacity analysis to assess recreation capacity and identify limiting factors at 15 representative sites. The study area was defined as the Priest Rapids Reservoir and Wanapum Reservoir and the recreation facilities and sites immediately adjacent to the reservoirs.

In relation to the findings from the 1999 survey (EDAW, Inc., 2000b) discussed above, the recreation capacity analysis finds that 65 percent of the boating activity on Wanapum Reservoir occurred at Crescent Bar and Quilomene Dune and Bay areas. Boating use, therefore, was not evenly dispersed on the reservoir. Survey results also indicate that recreation use of Wanapum Reservoir is higher than that at Priest Rapids Reservoir, due in part to the reservoir's size, proximity to I-90 and The Gorge Amphitheater, and more existing recreation facilities. Other findings of the survey indicate that: (1) the primary limiting factor at Wanapum Reservoir is facility capacity (*e.g.*, the number of existing parking spaces, campsites); (2) of the 15 representative sites assessed, use levels at most facilities (9 sites or 60 percent) were below or approaching their capacity levels; of the remaining sites, one site (under 7 percent) was at capacity and five sites (33 percent) were exceeding capacity; and (3) most of the sites analyzed had more than one limiting factor (*e.g.*, physical/facility) for recreation capacity.

The six sites where use levels were at or exceeding capacity are: Getty's Cove; Wanapum Recreation Area; Ginkgo/Wanapum State Park (campground and day-use area); Sand Hollow-South; Quilomene Dune; and Crescent Bar Resort (campground). For further discussion, see EDAW, Inc. (2000c).

In a filing of December 29, 2003, the Yakama comment that the heaviest

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purposes during any portion of a 24-hour period.

recreational use area in the project, Quilomene Dune, was and remains one of the most culturally sensitive areas of concern to the Yakama. Further, the Yakama state that Quilomene Dune is located on the west side of the Columbia River and somewhat protected from the wind and wave erosion occurring on the east side of the river; however, allowing the number of boats in the area without any regulation for wake size creates significant and on-going shoreline erosion.

Land Use

There are seven hydroelectric projects and appurtenant facilities located on the mid-Columbia River. These projects, from upstream to downstream, are: (1) Grand Coulee Dam; (2) Chief Joseph Dam; (3) Wells Dam; (4) Rocky Reach Dam; (5) Rock Island Dam; (6) Wanapum Dam; and (7) Priest Rapids Dam (Washington Department of Fisheries, *et al*., 1990). Numerous transmission lines traverse the region, carrying electricity from the mid-Columbia hydropower projects to the metropolitan areas (Public Utility District No. 2 of Grant County, Washington, 2003).

Much of the region, however, is lightly developed or undeveloped and retains a natural setting. Section 3.6, Terrestrial Resources, herein discusses the vegetative cover types and distributions that contribute to the land use and aesthetic character. Climate and topography can have an influence on the aesthetic characteristics of the region, as well as, land uses can influence the region's aesthetic character. Since the development of Grand Coulee Dam and the Columbia Basin Irrigation Project, numerous wetlands have been created by impoundments, rising water tables, seepage, and irrigation activities (Bureau of Reclamation, 1998).

In addition to the hydroelectric projects, some of the other land uses include residential communities and/or commercial development; a 261,000-acre U.S. Department of the Army, Yakima Training Center (located to the west of the Hanford Site); recreation facilities and public access; livestock grazing; and agriculture. Over 600,000 acres of agricultural land in the Columbia River Basin are irrigated by the BOR Columbia Basin Irrigation Project. See section 3.10, Socioeconomics, for further discussion.

The Hanford Site consists of mostly undeveloped land, with industrial buildings located along the western shoreline of the Columbia River and in the interior of the site. The industrial buildings are interconnected by roads, railroads, and electric transmission lines. The major facilities and operations support occupy an estimated 6 percent of the total available land area (U.S. Department of Energy, 1999).

There are six residential communities adjacent to the project reservoirs: Crescent

Bar, Sunland Estates, and Vantage are located near Wanapum Reservoir, while the communities of Beverly, Schwana, and Desert Aire are located near Priest Rapids Reservoir. Public recreation facilities are provided at or near the residential communities (Public Utility District No. 2 of Grant County, Washington, 2003). The Wanapum Village occupies land adjacent to Priest Rapids Dam. See section 3.10, Socioeconomics, for further discussion.

Private homes at Sunland Estates have been constructed in close proximity to the boundary of the Wanapum development, 100 feet to 300 feet from the high water elevation of the reservoir. The town of Vantage is situated on a high cliff above Wanapum Reservoir. Public recreation facilities at Vantage include a RV campground, the Ginkgo Interpretive Center, and the Kittitas County boat launch. The Vantage Riverstone Resort is a popular campground on Wanapum Reservoir. The resort currently has a permit that allows use of Grant PUD-owned shoreline within the project boundary for recreation use. At Desert Aire the RV campground and boat launch are both operated under permit from Grant PUD to the Desert Aire Home Owner's Association.

Grant PUD-owned land within the Priest Rapids Project boundary consists of 4,490 acres. Grant PUD (2003) manages these lands and waters for the project facilities and issuances of permits, leases, and easements to other agencies and individuals for use and occupancy of project lands or waters consistent with project operation. The Priest Rapids Project occupies an estimated total 3,103.69 acres of federal land and 2,804 acres of state land (Table 31).

Table 31. Federal and State lands within the Priest Rapids Project Boundary (source: Public Utility District No. 2 of Grant County, Washington, 2003).

Federal Lands	**Acres**
Bureau of Reclamation	1,874.79
Bureau of Land Management	748.85
U.S. Department of the Army	378.98
U.S. Fish and Wildlife Service	49.83
Department of Energy	51.24
Total Federal Lands	3,103.69
State Lands	
Washington Department of Fish and Wildlife	2,490.0
Washington Department of Natural Resources	290.0
Washington State Parks and Recreation Commission	24.0
Total State Lands	2,804.0

Also, there are an estimated 2,291 acres of private shoreline land, within the

project boundary, which for most of it Grant PUD maintains flowage easements for project operations.

Grant PUD (2003b) assigned a land use classification to all lands and waters within the existing project boundary. These classifications include the following: (1) Project Facilities- -lands primarily used for electric power generation, transmission, and associated project-related facilities, and lands with the potential for such uses in the future; (2) Conservation- -contains fish, wildlife, scenic, historic and/or archaeological resources that have exceptional and specific value(s) that require protection; (3) Agriculture- -lands used for commercial agricultural purposes; (4) Public Recreation (dispersed)- -includes dispersed recreation use sites; (5) Public Recreation (general development)- -lands with developed recreation facilities that are used by the public and lands identified as appropriate for future public recreation development as needed; (6) Single-family Residential- -lands adjacent to existing or planned future residential areas not designated as planned development; and (7) Planned Development- -lands where intensive residential, vacation home, and/or commercial development have occurred (or could occur in the future) within or adjacent to the project. The acres for each classification are listed in Table 32.

Table 32. Land Use Classifications in the Priest Rapids Project Boundary (source: Public Utility District No. 2 of Grant County, Washington, 2003b).

Land Use Classification	**Acres**
Project Facilities	4,710[79]
Conservation	3,021
Agriculture	1,124
Public Recreation – Dispersed	3,250
Public Recreation - General Development	375
Single-family Residential	112
Planned Development	361

EDAW, Inc. (2002) notes there are six WDFW wildlife areas (WA) adjacent to or in close proximity to the Columbia River and within the project area: (1) Colockum WA; (2) Quilomene WA; (3) Whiskey Dick WA; (4) Quincy WA; (5) Priest Rapids WA; and

[79] We note that a difference in acres may exist for Project Facilities because Grant PUD (2003) cites 4,490 acres and in its 2003(b) document cites 4,710; however, the higher number may be due to lands with future potential uses.

(6) Lower Crab Creek WA. While the WDFW manages wildlife areas to protect specific wildlife species or habitats, opportunities for fishing, hiking, wildlife observation, camping, and picnicking occur. Most of the areas have undeveloped dirt roads, and undeveloped trails for hiking. See section 3.6, Terrestrial Resources, for further discussion.

Some of the land use on or in the vicinity of the BOR "scattered tracts" include wildlife habitat, agriculture, livestock grazing, material extraction (clay, sand, and gravel), and recreation. Hunting (waterfowl and upland game) and fishing are the primary recreational uses. The BOR finds that the visual quality of the scattered tracts is influenced by the: (1) size of the tract; (2) type of land cover; (3) condition of the habitat; (4) land use practices, such as livestock grazing, material extraction, and ORV use; and (5) surrounding land use, such as the presence of other undeveloped land (U.S. Bureau of Reclamation, 1998). The scattered tracts range in size from 0.27 acre to 6,400 acres. Of the estimated total 308 scattered tracts, 200 scattered tracts totaling 62,000 acres provide access for agriculture, livestock grazing, material extraction, and recreational activities. Further, BOR (1998) notes that livestock grazing is a primary land use in which large areas of open land occur (primarily shrub steppe/grassland) are used for grazing.

Grant PUD (2003) states that six scattered tracts are adjacent to the Priest Rapids Project reservoirs. Several other parcels are traversed by the project transmission line right-of-way corridor. In particular, Grant PUD states that the scattered tract located near Sand Hollow-North (BOR-owned parcel) has been identified for future recreation use in its draft recreation resource management plan. The Sand Hollow-North scattered tract is known to have high quality shrub-steppe habitat, thereby possibly limiting future recreation development. At Sand Hollow-North, the shoreline in the area is managed for dispersed recreation use and resource protection.

At the scoping meeting, Ron Sawyer, who owns two marinas- -one in Moses Lake and one in Pasco- -stated that the Columbia Basin Hatchery was constructed to mitigate for fish lost as a result from construction of the Priest Rapids Project and commented on the need to improve the hatchery.

In response to WDFW, filed July 8, 2005, Grant PUD notes the primary use of the Columbia Basin Hatchery is for the enhancement of recreational trout fisheries not associated with the Priest Rapids Project. WDFW owns and operates the Columbia Basin Hatchery. Grant PUD proposes a 1:1 match up to $100,000 per year in order to increase and improve the facility. The funding for the hatchery, as included in the original license, was agreed upon by Grant PUD and WDFW. For further discussion see section 3.5, Aquatic Resources.

By letter filed May 10, 2004, Grant County Tourism Commission comments that Grant PUD has included the Columbia Basin Hatchery and other facilities and programs that mitigate impacts attributed to the Priest Rapids Project. This entity further recognizes the importance of the fishing industry that provides jobs and contributes to the local economy. Grant County Tourism Commission views Grant PUD as its partner in economic viability.

At the scoping meeting, Bill Burke spoke on behalf of Grant County Tourism Commission and stated that an estimated 45 percent of visitors to Grant County fish and an estimated 2,500 jobs in the county are created through tourism. Bill Burke noted the importance of fishing to the tourism industry of Grant County. Local taxes raised amount to an estimated $1.8 million. Other commentors at the scoping meeting spoke on the importance of fishing to Grant County and surrounding areas, as well as its tax base derived from recreation-related expenditures. For further discussion see section 3.10, Socioeconomics.

3.9.2 Environmental Effects and Recommendations

Although the project is located within an area that offers a wide range of recreational opportunities, data (Interagency Committee for Outdoor Recreation, 2002) indicates that most recreation use generally occurs close to home; hence, the six counties in which the project partially lies. As a result, existing recreation facilities are being utilized to capacity, while at the same time the public expresses a need to preserve larger parcels of natural settings for dispersed recreation, and habitat for salmon and wildlife.

Recreation Needs

A study (EDAW, Inc. 2001a) identified recreation needs, both existing (current to 2005) and future (2005 to 2035, in 10-year increments). The study area included all waters and adjacent lands within the existing Priest Rapids Project boundary and all recreation resources within and adjacent to the project boundary. The study included developed and dispersed recreation sites, public and private managed sites. In summary, results indicate that the following additional facilities would be needed by 2035 to accommodate future demand: (1) an estimated total 226 campsites; (2) a total of 65 picnic sites; (3) a total of approximately four to six new boat ramp lanes; (4) one new designated swimming area; (5) interpretive signs and programs at campgrounds and day-use sites; (6) designated trails; (7) one to three new fishing piers; (8) designated wildlife viewing areas, such as Watchable Wildlife Sites; and (9) barrier-free facilities.

The public views lack of physical access to land and water as a more critical issue than lack of supply (Interagency Committee for Outdoor Recreation, 2002). The IAC

(1995) finds that development of water access should address pedestrian facilities, such as footpaths or trails, picnic sites, hand launch facilities, and view points with interpretive features.

Terry Garrick, in a filing of May 31, 2005, refers to the angler community who supports a need for the fishing access site and boat launch at Huntzinger Road, as well as, recommends a boat launch and fishing pier in the Crab Creek/Beverly area. In addition, the filing recommends a fishing pier at each of the project's two reservoirs and boating access to the tailrace of Priest Rapids Dam. Terry Garrick also states that while the "angler community" supports improvements at the Lenice/Nunnally/Burkett Lakes area such improvement does not fulfill a recreational need for a fishing pier and boat launch access on Priest Rapids Reservoir. We are unclear, however, who Terry Garrick refers to with respect to the "angler community."

By letter filed May 10, 2004, Barry Truman requests that grant PUD mitigate for the loss of whitewater boating opportunity as a result of the construction and operation of the Priest Rapids Project. Mr. Truman states that the construction of the Priest Rapids Project inundated 56 miles of the Columbia River.

Our Analysis

We assess recreation needs and address Terry Garrick's comments throughout the Recreation and Land Use Section. In response to Barry Truman's comment, our environmental analysis takes into account past, present, and reasonably foreseeable future actions, pursuant to NEPA. The discussion of past effects is in the context of historical changes in the resource where existing information exists; recognizing the data describing past conditions are usually scarce, the analysis of past effects is often qualitative. In a relicense the Commission evaluates and considers the appropriateness of requiring enhancement measures in the context of today's environment and in relation to today's needs and problems, not in the context of the world as it existed 50 years ago.[80] Therefore, the basis for our enhancement measures are evaluated and developed in the context of the existing project and the environment. We, therefore, do not find it necessary for Grant PUD to mitigate for the loss of whitewater boating opportunities.

Grant PUD's Proposed Measures

A Recreation Opportunities and Constraints Analysis (EDAW, Inc., 2001) was conducted to identify potential sites for accommodating existing and/or future recreation

[80] 47 FERC 61,225 (1989).

needs at the Priest Rapids Project and in the project vicinity. The results of the study were taken into account during development of the draft RRMP, dated August 2003, and the subsequent measures are identified below.

To enhance the recreation resources and to address future recreation needs, Grant PUD proposes to finalize its draft RRMP for the Priest Rapids Project. The draft RRMP was developed based on stakeholder input and on various studies conducted. The plan contains six programs: (1) recreation facility development; (2) recreation operations and maintenance; (3) recreation monitoring; (4) resource integration and coordination; (5) plan review and revision; and (6) interpretation and education. In particular, the Interpretation & Education Program would provide a system of interpretive and educational signs, kiosks, and brochures, and therefore improve public information.

The draft RRMP identifies recreation opportunities and needs along the mid-Columbia River, within or adjacent to the existing Priest Rapids Project boundary. In a filing of July 8, 2005, and in response to WDNR and WSPRC, Grant PUD proposes to contribute an estimated $300,000 per year in O&M toward cooperating with local, state, and federal agencies in developing, operating, and maintaining facilities for recreational use of public land administered by those agencies adjacent to the Priest Rapids Project.

Table 33 identifies the proposed recreation measures. Crescent Bar Public Use Area, Desert Aire, Getty's Cove Group Campsite, and Vantage Riverstone Resort are privately owned and operated recreation areas.

The 300-acre Beverly Sand Dunes ORV Park, owned and operated by WDNR, is a popular destination for ORV riders with peak use occurring in spring. Grant PUD proposes to contribute up to $3,000 per year for O&M at the Beverly Sand Dunes ORV Park, which WDNR supports. This effort would entail periodically monitoring Beverly Sand Dunes ORV Park for containment of ORV use, impacts of overnight use, and litter control. Grant PUD would also cooperate with WDNR to maintain fencing, barriers and/or signs (as needed) where ORV use may access sensitive shoreline areas and potentially cause damage outside the park (letter filed July 8, 2005, responding to Washington Department of Natural Resources from Laurel Heacock, Manager, Licensing and Regulatory Compliance, Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington).

Table 33. Proposed Recreation Measures for the Priest Rapids Project (Source: Public Utility District No. of Grant County, Washington, 2003, as modified by the staff).

Recreation Site	New Developed Campsites	New Primitive Campsites	Boat Launches	New Picnic Sites (Tables)	New Swimmin g Areas	New I&E Program Signs/Kiosks	Other New Facilities or Comments
Airstrip Site	100	10	1	25	1	2 kiosks 1 sign	Located south of the Vantage Bridge in Kittitas County, Washington; barrier-free fishing pier; reroute entrance road to south; vault toilets; restroom with showers; trail connection.
Apricot Orchard Boat Launch			Renovation			1 sign	1 single-vault toilet.
Beverly Sand Dunes OHV Park							Work with WDNR to provide monitoring and management assistance at Beverly Dunes OHV Park; provide site barriers.
Buckshot Ranch Boat Launch						1 sign	1 hand boat launch;1 single vault toilet; provide barrier-free hunting blind and trail on north end of site.
Crab Creek Corridor						2 kiosks, Watchable Wildlife sites (WW)	2 hand boat launches; 2 single vault toilets; barrier-free fishing pier; a water trail from the Crab Creek 5-mile bridge to a take-out at Crab Creek Park; interpretive loop trail and connections to Nunnally Lake and the Milwaukee Road Corridor (1 mile from Beverly).

Recreation Site	New Developed Campsites	New Primitive Campsites	Boat Launches	New Picnic Sites (Tables)	New Swimmin g Areas	New I&E Program Signs/Kiosks	Other New Facilities or Comments
Crescent Bar Public Use Areas	(-6)		Renovation, extension	15	Expansion	2 kiosks	1 restroom with shower; vault toilet; fuel dock renovation; improve access roads & parking lots; stripe & asphalt boat launch parking lot; channel dredging; trail connection.
Desert Aire Boat Launch			Renovation, extension			1 sign	Located 12 miles from Beverly; campground and day-use area; 1 double-vault toilet; new jetty; trail connection.
Frenchman Coulee Boat Launch			Renovation	5		1 sign	1 single vault toilet; improve jetty; trail connection.
Getty's Cove Group Campsite	-130				1	1 sign	1 hand boat launch; 1 double vault toilet; moorage next to launch trail connection. Assumes the 130 existing campsites are reconfigured to protect habitat.
Huntzinger Road Boat Launch			1			1 sign	1 single vault toilet; boat launch extended to low pool for year-round access (requires further study).
Huntzinger Road Fishing Access Site						1 sign	1 single vault toilet; barrier-free fishing pier; formalize gravel pullout for parking.

Recreation Site	New Developed Campsites	New Primitive Campsites	Boat Launches	New Picnic Sites (Tables)	New Swimmin g Areas	New I&E Program Signs/Kiosks	Other New Facilities or Comments
Kittitas County Boat Launch			Renovation	5		1 sign	Expand parking; existing (new) toilets/restroom; trail connection.
Lower Wanapum Dam Boat Launch			Renovation, extension			1 sign	1 single vault toilet; boat launch extended to low pool for year-round access (requires further study); provide boarding float.
Mattawa RV/Farm Worker Campground	70					1 sign	Located less than 8 miles from Beverly; Grant PUD proposes to provide funding for a shared use RV/Farm Worker Campground on Port of Mattawa-owned land; 3 restrooms with showers.
Priest Rapids Park				15	1	1 sign	Located 10 miles from Beverly; day-use area; 1 double vault toilet; trail linkage to Desert Aire.
Rocky Coulee		10		5		1 kiosk	1 hand boat launch; vault toilets; trail connection.
Sand Hollow-North				10		1 kiosk, 1 sign	1 double vault; improve parking and internal trails.
Sand Hollow-South	30	10		5	1	1 kiosk	4 double vault toilets.
Sunland Boat Launch			Renovation			1 sign	1 double vault toilet; improve access road & parking.

Recreation Site	New Developed Campsites	New Primitive Campsites	Boat Launches	New Picnic Sites (Tables)	New Swimmin g Areas	New I&E Program Signs/Kiosks	Other New Facilities or Comments
Priest Rapids Tailrace		10				1 sign	Located along the eastern shoreline below Priest Rapids Dam; 2 single vault toilets; improve road access.
Sunland Day Use Area				5	1	1 sign	1 double vault toilet; new gravel access road & parking; resolve access rights.
Upper Wanapum Dam Boat Launch			Renovation			1 sign	1 single vault toilet; expand parking at boat launch; barrier-free boarding float.
Vantage Riverstone Resort	75						New fuel dock/moorage; all actions by private owner; trail connection.
Wanapum Interpretive Center							Improve barrier-free access; interior of existing museum may be renovated.
Wanapum Dam Overlook Area				3		1 sign	1 single vault toilet; improve road & parking area.
Wanapum Dam Picnic Area				5		1 sign	1 double vault toilet; new gravel parking.

Recreation Site	New Developed Campsites	New Primitive Campsites	Boat Launches	New Picnic Sites (Tables)	New Swimmin g Areas	New I&E Program Signs/Kiosks	Other New Facilities or Comments
Wanapum Recreation Area	70		Renovation, extension	25	Expansion & barrier-free	2 kiosks, 1 sign	Located 4 miles south from Kittitas County Boat Launch; 3 restrooms with showers; 3 single vault toilets; potential day use expansion north of boat launch; expand boat launch lane to low pool level; trail connection.
Dispersed Shoreline Sites		Potential hardening, if needed (or closure)					Potential toilets, if needed.

The proposed recreation facilities (Table 33) are summarized in Table 34 by activity. Restrooms with showers and vault toilets are identified in Table 33. These facilities are in addition to the existing public access sites and recreation facilities. Study results (EDAW, Inc., 2001) indicate that by the year 2035 demand for interpretation and education is projected to increase significantly, *e.g.* 87 percent for visiting interpretive displays. Most of the existing interpretation and education facilities are underutilized. Increased visitor awareness of these facilities, through additional signs, brochures, and programs, could improve the overall recreational experience.

Table 34. Summary of Proposed Recreation Facilities by Activity for the Priest Rapids Project (source: Public Utility District No. 2 of Grant County, Washington, 2003a, as modified by the staff)

Recreation Activity	**Summary of Recreation Facilities**
Boating	2 new boat launches with 4 lanes, 9 renovations, 4 extensions; 5 hand boat launch sites; new directional and informational signs
Swimming	5 new swimming areas, 2 expanded swimming areas, 1 barrier-free swimming area.
Fishing	3 new fishing piers or platforms; 2 new boat launches with 4 lanes, 8 renovations, 3 extensions.
Hiking, biking, and other non-motorized trail uses	30 new miles of trail in 7 areas with connections to 12 existing or proposed recreation sites.
Interpretation & Education Facilities	11 new kiosks, 22 new signs.
Camping	Up to approximately 209 new developed RV and tent campsites, 40 new primitive walk-in sites, 4 new group sites with 64 total campsites, and barrier-free campsites.
Picnicking	128 new picnic tables.
Hunting, wildlife observation, and other uses of open space	Maintenance and management of shoreline access sites; 1 barrier-free hunting blind, hunting blind management, new directional and informational signs.

By letter dated May 27, 2004, CRITFC recommendation no. 19 states that Grant PUD should, as a component of a public awareness program, place signs regarding protection of cultural resources in heavily used recreation areas, such as campgrounds, boat launches, as well as dispersed recreation sites within the project area and the Hanford Reach. In addition, Grant PUD should make an effort to discourage use of dispersed recreation sites that are known to impact cultural resources.

In a filing of May 26, 2005, Interior recommends, pursuant to section 4(e) of the FPA, that Grant PUD implement a recreation resource management plan on BOR administered lands within the existing Priest Rapids Project boundary in order to protect terrestrial resources at Sand Hollow-North, in the vicinity of Wanapum Dam, and along Crab Creek. A provision of the plan would exclude ORV use in these areas because of increased visitor use and excluding ORV use would minimize adverse environmental effects. BOR through Interior states that if Grant PUD's RRMP is not adopted then BOR's said recommendation would protect its interests.

Our Analysis

Grant PUD's proposed recreation measures would enhance 15 recreation sites, as well as maintenance at and monitoring of publicly-owned areas where dispersed recreation occurs. Grant PUD (2003) proposes an estimated $20 million for recreation measures at the project and in its vicinity over a period of 30 years. The estimated costs do not include costs associated with land acquisition or capital facilities costs for years 2036-2055 of the new license (years 31 to 50). The proposed measures would also entail a project-wide Interpretation & Education Program and support for law enforcement at the project.

An estimated 1,874.8 acres of BOR-administered land are located within the Priest Rapids Project boundary. A separate RRMP on BOR-administered lands within the Priest Rapids Project boundary would not be necessary because Grant PUD would develop and implement a final RRMP for the project. The BOR's interests, therefore, would be met. We agree with BOR that a provision of Grant PUD's final RRMP should be to exclude ORV use in agreed-upon identified areas in order to protect terrestrial resources and potential historic properties; however, we recognize that Grant PUD has direct management over only those lands within the existing project boundary that is Grant PUD-owned. See our discussion concerning Effects of Public Recreation Use on Undeveloped Dispersed Recreation Sites herein.

As part of Grant PUD's proposal to develop and implement an Interpretation & Education Program, we find CRITFC's recommendation reasonable; therefore, Grant

PUD could install sign(s) at identified recreation sites within the existing project boundary to improve public awareness of and the need to protect cultural resources. Interpretive sign(s) could be implemented in conjunction with the interpretive component of the HPMP, which is a stipulation of the PA. The effort to discourage use of dispersed recreation sites that are known to impact cultural resources could be coordinated during implementation of the HPMP.

The WDFW-owned and managed Quilomene Dune and Bay is a popular recreation area with a boat-in site at Quilomene Dune. An estimated 1,000 to 1,500 visitors have been documented at the site. Boating capacity is an issue in the river reach, including Quilomene Dune and Bay (Public Utility District No. 2 of Grant County, Washington, 2003). In response to the Yakama comments on recreational use at Quilomene Dune and potential effects on culturally sensitive areas of concern to the Yakama, we recognize the projected increase of recreational use for the area and the need to protect potential historic properties. We find, therefore, that the final HPMP would take into account such impacts and those impacts would be lessened through recommended measures.

The final RRMP would be filed with the Commission for approval, and upon Commission approval, Grant PUD would be required to implement the plan. As part of the final RRMP we suggest a map(s) be provided that would clearly delineate all public access and recreation facilities in relation to the existing Priest Rapids Project boundary. The final RRMP would effectuate a continued effort among Grant PUD, BOR, WDFW, FWS, WSPRC, the affected tribes, and appropriate county to improve and enhance public access sites and recreation facilities. Through this coordinated effort, sensitive species and potential historic properties could be protected. The measures would help meet the projected demand for future recreation needs, as previously discussed. Consequently, a cumulative beneficial effect on recreation resources at the project and within the mid-Columbia River Basin would occur. Our recommendation regarding the RRMP is discussed in section 5.0, Staff's Conclusions.

Pursuant to section 10(a) of the FPA, Interior through BLM recommends that Grant PUD: (1) develop a coordinated recreation and wildlife management plan; and (2) develop a recreation monitoring plan for intermingled lands that BLM administers and which are affected by project operations. An estimated 748.8 acres of BLM administered land is located within the project boundary. We discuss Interior's recommendation for a coordinated recreation and wildlife management plan in section 5.0, Staff's Conclusions.

Interior's recommendation for developing a recreation monitoring plan specifically for BLM-managed lands may provide a basis to address recreational use of federal lands within the existing project boundary. Recreational use monitoring and

assessment of project-related effects on BLM lands as a component for gathering data for FERC Form 80-Recreation Report would allow Grant PUD and the interested parties to consider measures and address potential environmental and cultural resources concerns due to project-related recreational use.

Due to the potential for increased recreation demand at the project and due to the proximity of the project to nearby population centers, Grant PUD should monitor recreation use to determine the adequacy of the proposed facilities to meet recreation demand. Information collected and filed pursuant to the reporting requirements for FERC Form 80-Recreation Report, section 8.11 of the Commission's regulations, may be used in the monitoring program.

The IAC recommends, in its filing of May 3, 2005, that the RRMP be reviewed and amended, at a minimum, every 15 years through the life of the license. We note on page 8 of the draft RRMP that Grant PUD proposes to review and update, if necessary, the RRMP every 12 years. We find that reviewing and updating the RRMP every 12 years would provide an opportunity to factor in two cycles of recreation data collected and filed with the Commission every 6 years, pursuant to the reporting requirements for FERC Form 80-Recreation Report, section 8.11 of the Commission's regulations. Grant PUD's timeframe, therefore, is reasonable and should satisfy the IAC.

Existing Priest Rapids Project Boundary

In a filing of May 31, 2005, Pat Kelleher provided a variety of recommendations, including 20 measures specific to RM 460 (Columbia River Siding Area) through RM 397 (Priest Rapids Dam tailrace). In general and regard to the existing Priest Rapids Project boundary, Pat Kelleher recommends that Grant PUD purchase Kittitas County land holdings adjacent to the existing project boundary and expand the project boundary to include such holdings (RM 421). Regarding Sand Hollow-North (RM 420), Pat Kelleher recommends that Grant PUD purchase land from BOR, extend the project boundary to SR 26, and develop two 50-car parking lots for day use. Pat Kelleher also recommends that Grant PUD extend the existing project boundary to include Wanapum State Park and Black Sand Beach (RM 418). Further, Pat Kelleher asserts that Grant PUD should enter into an agreement with WDOT to use other adjacent land for vehicle trailer overflow and overnight parking of boat trailers only (RM 421). Regarding the Airstrip Site (RM 420), Pat Kelleher recommends Grant PUD acquire public access road rights from Huntzinger Road to the Airstrip Site through WDOT owned property and develop the site as a day-use from May through September that would support 300 vehicles.

In reply comments filed July 8, 2005, Grant PUD disagrees with Mr. Kelleher's

comment that the project boundary should be extended, in particular, at Wanapum State Park. The lands in this location are owned by Grant PUD and WSPRC, and Grant PUD does not believe that a project boundary change is warranted.

Our Analysis

We note that Pat Kelleher does not provide a map that clearly identifies the land holdings or other land in relation to the existing project boundary. Also, Pat Kelleher does not provide the necessary information or justification to support his recommendations for expanding the existing project boundary.

It is our understanding that Grant PUD does not intend to expand the existing Priest Rapids Project boundary; therefore, those access sites and recreation facilities that currently lie outside the project boundary would remain outside. In particular, we note Columbia River Siding Area (RM 460) is located approximately 63 RM upstream from Priest Rapids Dam (RM 397.1). Based on the best available information, including our review of U.S. Geological Topographic maps, we find that expanding the existing Priest Rapids Project boundary to include the sites identified by Pat Kelleher, along with the recreation facilities identified in his letter, is not warranted. We address Mr. Kelleher's other comments throughout the appropriate sections herein.

Public Access and Developed Recreation Facilities

The community of Beverly recommends that Grant PUD add a community park, beach swimming area, boat ramp, and developed campground to the RRMP. The community of Beverly states that there are no developed recreational facilities in its community. Pat Kelleher filed comments regarding the need for recreation facilities (*e.g.*, a boat launch, a barrier-free fishing pier) in Beverly (RM 412). Pat Kelleher notes that Beverly is the only community that does not have project recreational facilities.

In a response filed July 8, 2005, Grant PUD summarizes the proposed recreation measures that would contribute to meeting local recreation needs in the Beverly vicinity and nearby areas. These measures would improve four sites (Crab Creek Corridor, including Burkett Lake; Desert Aire boat launch; Mattawa RV/Farm Worker Campground; and Priest Rapids Park), which are located 1 mile to 12 miles from Beverly (Table 33). Consideration of potential effects on historic properties and limited public-owned land within the project boundary were taken into account for the proposed recreation measures.

EDAW, Inc (2001; 2000d) concludes that the Kittitas County boat launch at Vantage is currently the most heavily utilized boat launch in the study area because of its

location (directly adjacent to Interstate 90) and a fee is not required. The boat launch provides access to Wanapum Reservoir. The studies identified existing needs at the site, such as repairs to the parking area, providing barrier-free facilities, and improving maintenance (trash collection) to alleviate the litter problem. In particular, the dock does not adhere to accommodating disabled persons in that the low railings at the edges of the dock should be revised accordingly.

The Kittitas County boat launch is operated and maintained by Kittitas County under a land use permit issued by Grant PUD. For the boat launch, Kittitas County recommends that Grant PUD: (1) provide an upgrade at the boat launch; (2) dredge and lengthen the boat launch to allow boaters the opportunity to launch year round; (3) expand the boat launch parking lot; (4) create a swimming area; and (5) create a picnic area. In addition, Kittitas County recommends that Grant PUD: (1) construct an additional boat ramp with a dock; and (2) provide O&M costs for existing and new recreational infrastructure.

Pat Kelleher commented on the Kittitas County boat launch (RM 421) in that according to the 1999 FERC Form 80 Recreation Report an estimated 31,880 recreation visitors utilized the area. Currently, the area has a boat launch, parking area, and a restroom. Pat Kelleher states a need exists for improving the existing recreational facilities by adding a recreational vehicle dump station and extending the boat launch 558 feet.

In addition, Pat Kelleher recommends that Lower Wanapum boat launch (RM 415) should be closed because it is in a poor location, in poor condition and dangerous. Pat Kelleher suggests relocating the boat launch to the JWT crossing. In its response filed July 8, 2005, Grant PUD disagrees with Pat Kelleher's assessment of the boat launch.

In a response filed July 8, 2005, Grant PUD states the draft RRMP includes measures to improve the Kittitas County boat launch at Vantage, including expansion of the parking lot, five additional picnic sites, interpretation at the boat launch, and considering the needs of the disabled in the site renovation. Grant PUD proposes to contribute an estimated $139,000 for capital improvements and contribute $15,000 per year for O&M at Kittitas County boat launch subject to the Commission determination that such an effort would be appropriate, and looks to partnering with an entity, such as Kittitas County, at the boat launch.

Yakima County commented that the county has received no economic, environmental, recreational or other human benefits from the Priest Rapids Project. Further, the county notes the area surrounding the Priest Rapids dam is closed to public

access due to the Department of the Army, Yakima Training Center.

Our Analysis

Regarding comments received from the community of Beverly, we find that the proposed improvements at the four sites are appropriate measures and would provide recreational opportunities that are needed for the Beverly vicinity and nearby areas. Further, an indirect effect on the local economy should occur resulting from the influx of construction workers to construct the recreation facilities as well as from the public who would use the completed recreation facilities; both of whom would probably purchase items from local stores, restaurants, and gas stations.

We find Kittitas County's recommendations for Grant PUD to develop a swimming area and construct an additional boat ramp with a dock do not take into account the multiple goals of identifying and addressing recreation need, managing visitors' experiences, and protecting environmental and potential historic properties. Developing a swimming area could create a potential for conflicting recreation use. Further, we find that Pat Kelleher did not provide a justification for his recommendation, in light of Grant PUD's proposal. Consequently, we find Grant PUD's proposed measures to improve Kittitas County boat launch, as identified in its draft RRMP, are appropriate and would significantly improve public recreation use. Grant PUD's contribution for O&M at the boat launch would help address a need for general maintenance (trash collection). We discuss Kittitas County's recommendation for dredging and lengthening the boat launch under Effects of Fluctuating Impoundment Surface Elevations herein.

Regarding Pat Kelleher's recommendation to close the Wanapum Dam Lower boat launch, we find that Mr. Kelleher does not provide sufficient evidence to support his recommendation to close the facility. Further, we assume Mr. Kelleher's reference to the "JWT crossing" is the "John Wayne Trail". We note, however, that a study (EDAW, Inc., 2000a) conducted indicates the Wanapum Dam Lower boat launch is narrow and deteriorating at the end and recommends installation of a new, wider ramp. Further the study recommends a barrier-free parking space, barrier-free portable toilets, and installation of a sign on Highway 243 to indicate the presence and location of the boat launch. Based on the best available information, including Commission-approved comprehensive plans, we find such recommendations for the Wanapum Dam Lower boat launch may be warranted. However, measures contained in the study (EDAW, Inc., 2000a), along with an analysis of whether to close the facility rather than improve it, could be assessed during development of the final RRMP.

Pat Kelleher's additional comments include the need for: (1) boat-in day use park

at Columbia Cliffs (RM 442); (2) a campground and shoreline trail at Frenchman Coulee (RM 424); (3) potable water at Sand Hollow South (RM 419); (4) a trail segment from Airstrip Site to Wanapum Trail (RM 419); (5) improvement to the Huntzinger Road boat launch (RM 415) and fishing access (RM 416); and, (6) unrestricted public vehicle access and a boat launch to provide access to the tailrace of Priest Rapids Dam (RM 397). We discuss Pat Kelleher's comments throughout section 3.9, Recreation and Land Use.

Regarding Yakima County's comment on the lack of public access due to the Department of the Army, Yakima Training Center, we recognize the geographical constraints. However, according to existing information, the Washington Wildlife & Recreation Program (http://www.wildliferecreation.org) has assisted counties in central Washington, including Yakima County, in which the Priest Rapids Project is located. The program provides funds for recreation-related facilities that should benefit the counties, including Yakima County. Further, we note Hoover's desert-parsley (*Lomatium tuberosum* Hoover), a species of special concern, occurs on the Yakima Training Center lands (Alverson and Sheehan, 1986). Although the reproductive biology of Hoover's desert-parsley is not known, literature indicates pollination may be by insects and seed dispersal may be transported by animals, water, or by wind. Hence, minimizing public access could protect suitable habitat for this plant. In regards to Yakima County comments on the lack of economic benefits, see our discussion in section 3.10, Socioeconomics.

Survey results (EDAW, Inc., 2000a) indicate that recreation use at Beverly Sand Dunes ORV Park is not related to the Priest Rapids Project. The Beverly Sand Dunes ORV Park is located in the lower Crab Creek corridor and partially lies within and adjacent to the project boundary. As previously discussed, Grant PUD proposes to contribute up to $3,000 per year for O&M at the Beverly Sand Dunes ORV Park, which WDNR supports.

Effects of Public Recreation Use on Undeveloped Dispersed Recreation Sites

We identified the effects of public recreation use on undeveloped dispersed recreation sites that could contain cultural sensitive area(s) of concern to the Yakama Nation, the Confederated Tribes of the Colville Reservation, other federally recognized tribes, and the Wanapum or species of special concern.

Within the project area [81] there are seven undeveloped dispersed use shoreline

[81] The project area for the study (EDAW, Inc., 2001) is identified as all waters and adjacent lands within the existing Priest Rapids Project boundary and all recreation resources within and adjacent to the project boundary.

areas at Wanapum Reservoir: (1) Black Sand Beach (Grant PUD); (2) McCumber Beach (Grant PUD); (3) Sand Hollow-South (Grant PUD); (4) Sand Hollow-North (BOR); (5) Rocky Coulee (Private; WSPRC; and Grant PUD); (6) Quincy WA (WDFW); and (7) Quilomene Dune and Bay (WDFW). There are four undeveloped dispersed use shoreline areas at Priest Rapids Reservoir: (1) Priest Rapids Dam tailrace and lower river (Grant PUD); (2) Goose Island (WDFW); (3) Haystack Rocks (BLM); and (4) Crab Creek (Grant PUD). Thus, a total of 11 undeveloped dispersed use shoreline areas occur.

EDAW, Inc., (2000a) notes that there is a loss of vegetation throughout certain undeveloped dispersed recreation sites and soil erosion is evident. Soil erosion occurs at the sites associated with user-defined trails. At Wanapum Reservoir, public recreation use at Black Sand Beach, McCumber Beach, Sand Hollow-South, Sand Hollow-North, and Quilomene Dune and Bay was heaviest during the peak recreation season when the sites are occupied by boaters or by people attending a concert at The Gorge Amphitheater.

The study (EDAW, Inc., 2000a) noted that trash accumulation was an issue at some sites, particularly after a concert in which Grant PUD-contracted clean-up crews remove debris. However, the condition at Quilomene Dune and Bay was generally good given the high level of use that it receives. At this site, there are five dispersed campsites with user-defined rock fire ring, beach, and small shade trees. A concern at Sand Hollow-South is the continued development of new campsites, trails, and roads through existing vegetation near the shoreline and elsewhere (EDAW, Inc., 2000a). Similar to Sand Hollow-South, informal campsites, roads, and parking areas occur at Sand Hollow-North, which is located upstream. In reply comments filed July 8, 2005 to WDFW, Grant PUD states visitor impacts on Quilomene Dune and Bay were found to be limited to the immediate shoreline and dune area.

At Priest Rapids Reservoir, overall public use at Priest Rapids Dam Tailrace and Lower River was light, although use increased during the fall Chinook salmon fishing season. Goose Island and Haystack Rocks had few signs of recreation use; most visitors to Crab Creek were likely from the local area (EDAW, Inc., 2001). To minimize effects on the resource from public recreation use, some measures suggested in the study include periodically monitoring recreation use levels to determine if use exceeds the physical and ecological capacity of the site; formalizing dispersed camping by designating sites in suitable locations; and periodic site cleanup.

To provide public access to the river and protect project facility security and sensitive environmental resources, Grant PUD (2005) proposes to continue managing the left bank shoreline (below Priest Rapids dam) within the Priest Rapids Project boundary for dispersed recreation use. Grant PUD proposes to improve the site by adding 10

primitive walk-in campsites and (2) two single-vault toilets. Improvements to road access, signage, and litter clean-up and removal are also proposed.

By letter dated October 29, 2004, the WSPRC does not foresee impacts on current recreation use on the Hanford Reach, including fishing, dispersed primitive vehicle access camping and nature-based float trips from future Priest Rapids Project operations (Jim Harris, Eastern Region Manager, Washington State Parks and Recreation Commission, Wenatchee, Washington).

Our Analysis

As discussed in section 3.6, Terrestrial Resources, recreational ORV use can result in an adverse effect on terrestrial resources, including state-listed plant species such as Geyer's milk-vetch. Such recreational ORV use may have extirpated Geyer's milk-vetch from previously suitable habitat (*e.g.*, at the Beverly Sand Dunes) (Public Utility District No. 2 of Grant County, Washington, 2003). While Grant PUD (2003) states that it would consider supporting a coordinated management effort to address ORV and All Terrain Vehicle use in the project area, we find that such an effort is warranted to protect terrestrial resources, especially species of concern. This measure would also comport with Interior's section 4(e) recommendation to exclude ORV use in agreed-upon identified recreation areas.

A monitoring program, as a component of the draft RRMP, would address recreational use patterns and associated effects on sensitive resources. The monitoring program, contained in the draft RRMP, identifies potential management options, *e.g.*, redistribute boating use by providing information about alternative sites; develop alternative campground sites, in order to shape decisions regarding current and future recreation use. While we are unclear whether potential historic properties are known to occur at the undeveloped dispersed recreation sites, the staff-recommended HPMP would take into account the potential for undiscovered properties. The HPMP, along with the associated cultural resource inventory reports and Traditional Cultural Properties studies, would realize potential effects on a historic property or an important cultural resource site resulting from a proposed recreational development. We would ensure that both the RRMP and HPMP would have the requisite provisions to allow for the level of coordination between Grant PUD, the consulted agency, and affected tribes.

Grant PUD's proposal to develop and implement project-related soil erosion and sediment control measures (see Geology and Soils section) would minimize affects from current and future public recreation use on undeveloped dispersed recreation sites. Grant PUD also proposes to finalize its draft shoreline management plan, dated August 2003. This plan is a result of Grant PUD updating its 1992 Priest Rapids/Wanapum Land Use

Plan and the relicensing effort among Grant PUD and the stakeholders, which we previously discussed. This plan could be implemented in concert with Grant PUD's other management plans, thereby offering additional protection and enhancement measures to the resources.

Effects of Project Operations and Facilities on Recreational Fishing

To enhance an existing stocked trout fishery program, Grant PUD (2005) envisions working cooperatively with WDFW at the 78-acre Burkett Lake. Burkett Lake lies within the Priest Rapids Project boundary and BOR's Columbia Basin Project, adjacent to Lower Crab Creek. Burkett Lake receives inflow from Nunnally Lake, one of three seepage lakes upstream from Burkett Lake. The WDFW operates the three seepage lakes as a trout fishery. As identified in Table 7, Grant PUD proposes to install a barrier-free fishing pier at the Crab Creek Corridor. The proposed fishing pier would combine the Burkett Lake advantages of accessible terrain and relatively stable water levels to provide for an accessible fishery. For a discussion on Crab Creek, see the section entitled *Resident Fish* under the Aquatic Resources Section.

To address a need for boating access to the tailrace of Priest Rapids Dam, Grant PUD proposes to improve the undeveloped dispersed recreation site at the Priest Rapids tailrace (Table 33). Survey results (EDAW, Inc., 2000a) indicate that recreational use is heavy at the Priest Rapids tailrace area and the river reach extending outside the project boundary during the fall Chinook salmon fishing season.

Pat Kelleher commented that: (a) Mattawa RV/Farm Worker Campground has no nexus to the project and should be deleted from the draft RRMP; (b) Buckshot Ranch (RM 403) should be sold to WDFW and managed according to conservation standards; and (c) Apricot Orchard boat launch (RM 445) should be improved by constructing two small parking areas at the north and south end connected by a 3.2-mile-long trail with five to 10 campsites.

In a response filed July 8, 2005, Grant PUD reiterates the cost-share provision for the Mattawa RV/Farm Worker Campground and defers the matter of Buckshot Ranch to stakeholder input during the final RRMP. In the same filing, Grant PUD reiterates the proposed measures to improve Apricot Orchards boat launch by renovating the site.

Grant PUD proposes to cost-share for upgrades or replacement of the Vernita Bridge boat launch subject to completion of the Hanford Reach National Monument EIS. This facility is located at RM 388, approximately 8 miles below the existing project boundary and would provide safe boating access to project waters below Priest Rapids Dam (letter filed July 8, 2005, Laurel Heacock, Manager, Licensing and Regulatory

Compliance, Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington). In a response to NOAA Fisheries filed July 8, 2005, Grant PUD notes that during mid-October to early December each year, approximately 40,000 to 80,000 adult fall Chinook salmon return to the Hanford Reach to spawn. See section 3.5, Aquatic Resources, for further discussion.

The National Park Service (NPS) (1994) concludes that the Hanford Reach is an important area for migratory waterfowl and other birds and is a major spawning area for fall Chinook salmon in the main-stem of the Columbia River. Sport fishing and flat-water recreation were identified as regionally significant features within the Hanford Reach. In addition to fall Chinook salmon, anglers seek steelhead trout, sockeye salmon, Coho salmon, and summer Chinook salmon, which spawn and migrate through the reach. Hunting opportunities exist with over 150,000 waterfowl that migrate through or winter in the reach.

Regarding the Hanford Reach and the Monument, increased recreational use associated with the potential designation as a Recreational River under the Wild and Scenic Rivers system and recreation land-use designations could result in cumulative impacts on wildlife and habitats that are not currently accessible by the public. Human-related activities include habitat modification or destruction and habitat fragmentation. When habitat fragmentation occurs, biodiversity is affected because the smaller undisturbed areas may not be capable of supporting the same number of species (U.S. Department of Energy, 1999).

Visitors primarily access the Monument by vehicle or by boat on the Columbia River. Visitors can also access the Monument by horse, walking, or by bicycle. Off-road vehicles are not permitted in the Monument. The White Bluffs boat launch area has been and continues to be used as trailhead for trailer-in horse users.

By letter dated May 27, 2004, CRITFC recommendation no. 19 requests that Grant PUD provide for increased treaty fishing access in the project area. In its response filed July 8, 2005, Grant PUD states that although Grant PUD has no authority to regulate or manage fishing, Grant PUD's proposed measures provide for adequate treaty fishing access to the project facilities and waters.

The NPS (1994) recognizes that the Yakima, Confederated Tribes and Bands of the Umatilla Indian Reservation and the Nez Perce Tribe, under separate treaties (12 Stats., 945, 951 and 957) with the United States, have the right to fish at traditional fishing sites. All three tribes have access rights to the Columbia River. The NPS (1994) states the Hanford Reach contains traditional fishing sites, known as "usual and accustomed places". Each spring ceremonial salmon are taken from Hanford Reach and

each spring the salmon's return is recognized by a religious ceremony. The Monument preserves cultural resource sites and sensitive areas, including Traditional Cultural Properties that are significant to the three tribes, and to the Colville and Wanapum Indians (U.S. Fish and Wildlife Service, 2002). Therefore, existing and potential future public use areas and facilities should consider tribal concerns.

Our Analysis

Although we identified the effects of project operations and facilities on recreational fishing as a resource that could be cumulatively affected, we recognize other project-related recreation activities, as well as effects on the Hanford Reach. To address the need for fishing piers, Grant PUD proposes to develop three fishing piers or platforms within the project area to be located at the Crab Creek Corridor, Huntzinger Road Fishing Access Site, and Airstrip Site. These sites, as Grant PUD evaluated, are based on site topography and configuration that lend to fishing pier design accessible at all reservoir levels.

In particular, improvements at the Huntzinger Road Fishing Access Site would include a barrier-free fishing pier/platform, a single-vault toilet, an information sign, and improving the parking off Huntzinger Road. Improvements to the Huntzinger boat launch would include a one-lane concrete or concrete tie boat launch (with ramp extended to low pool), a single vault toilet, and an information sign. We find such improvements especially considering the needs of the disabled and providing a barrier-free fishing pier/platform would address a fishing-related need and significantly enhance the recreation opportunities at the Huntzinger Road Fishing Access Site and Huntzinger Road boat launch.

The proposed new Airstrip Site would also include a barrier-free fishing pier and other amenities. However, the proposed Airstrip Site is a fall and winter waterfowl concentration area. WDFW notes the area has a high quality riparian habitat. If recreation development were to occur at this site, seasonal closure of portions of the site may be appropriate. In order to protect sensitive habitats, species of special concern, and minimize adverse effects on terrestrial resources, Grant PUD should develop and implement a final RRMP in consultation with the resource agencies, affected tribes, and other appropriate parties.

Regarding the proposed Mattawa RV/Farm Worker Campground, Carol Conley spoke on behalf of the Port of Mattawa at the scoping meeting. Carol Conley stated that the Port of Mattawa is very poor and primarily an agricultural-based economy. Carol Conley further stated that there is a shortage of RV sites in the area to support both harvest workers that come to the area during fruit harvest and anglers who come to the

area during the fall Chinook salmon runs in October and November each year.

The draft RRMP and the Port of Mattawa (2003) identify a coordinated effort between Grant PUD and the Port of Mattawa on the duel use of Mattawa RV/Farm Worker Campground in order to address future recreation demand and to support seasonal farm-workers. See Table 33 for the proposed measures. EDAW, Inc. (2000a) notes that seasonal farm-workers also camp at Buckshot Ranch, which has a boat ramp, parking area, and two portable toilets. A Recreation Needs Analysis (EDAW, Inc., 2001) assessed Buckshot Ranch and recommended options for the site based on current low utilization, topography; the boat launch is not consistent with the existing project's land use plan.

One of the goals and objectives of the Port of Mattawa (2003) plan is "to ensure recreational potential, environmental integrity and high quality of life" by "providing necessary recreation services/infrastructure." We do not, therefore, find any basis for Pat Kelleher's recommendation to delete Mattawa RV/Farm Worker Campground from the draft RRMP because: (a) Grant PUD and the Port of Mattawa have initiated a cooperative effort to improve the site; (b) anglers are afforded an opportunity to utilize the no-fee site; and (c) the proposed RV campground with an estimated 70 developed campsites could address a local need within a community (see section 3.10, Socioeconomics). We agree with Grant PUD's assessment that a long-term plan and goal for Buckshot Ranch should be identified because Buckshot Ranch was permitted to WDFW in order to manage for wildlife, though Grant PUD retained ownership. The proposed measures for Apricot Orchards boat launch could improve the site and meet a recreation need.

By letter filed November 22, 2002, the FWS stated that the Hanford Reach fall Chinook salmon is of economic and cultural importance to commercial, sport, and tribal fisheries. At the scoping meeting the FWS commented on fall Chinook salmon and mentioned the Pacific Fishery Management Council under the Pacific Salmon Treaty with Canada and the Columbia River Fish Management Plan. The FWS reiterated the importance of the Hanford Reach fall Chinook salmon. For further discussion see section 3.5, Aquatic Resources and section 3.10, Socioeconomics.

Because the treaty fishing access measure is a component of CRITFC's recommended cultural resource management program for cultural resources within the project boundary and in the Hanford Reach, see section 3.8, Cultural Resources, for further discussion.

Potential recreation impacts from boating and foot traffic on species of special concern and sensitive habitats could likely occur resulting from public use associated

with the designation of the 45-miles of "eligible" Columbia River as a Recreational River under the Wild and Scenic Rivers system. Increased recreational use could result in impacts on historic properties from vandalism and losses to shoreline and island erosion from boat wakes.

Effects of Fluctuating Reservoir Surface Elevations on Recreation Access

The current operation of the Priest Rapids Project is influenced by actions (*e.g.*, upstream releases at the Grand Coulee Dam) and agreements (*e.g.*, the 1988 Vernita Bar Agreement), including the coordinated operations of the seven-dam system. The Vernita Bar Agreement provides for minimum flow releases below Priest Rapids Dam for the protection of fall Chinook salmon spawning areas on Vernita Bar. In responses to the parties, filed July 8, 2005, Grant PUD notes that upstream from the Priest Rapids Project water management decisions influence the rate and timing of downstream flows. See section 2.0 for a description of the Priest Rapids Project operation and its integral part of this system.

There are 10 boat launch facilities in the study area with a total of 18 boat ramp lanes. Seven of the boat launches are located on Wanapum Reservoir; three are located on Priest Rapids Reservoir. Grant PUD operates two boat launch facilities, while the other facilities are managed by WDFW, WSPRC, Kittitas County, or private entities.

EDAW, Inc. (2001a; 2000a) finds that at full pool all 10-boat launches meet the standard 3-foot minimum water depth requirement at the toe of the ramp. Survey results indicate that during the recreational use season (May to September), pool levels were maintained at a level that maintained minimum depth at all ramps, with the exception of a brief period in mid-May when pool levels decreased. Generally, pool levels were maintained near full for the majority of the recreation season. At low pool levels in late spring (early April to mid-May) and in late fall (mid-October to late November), none of the boat launches met the minimum standard. The study recommends at least one boat launch should be usable at each reservoir during the entire year for off-season use (October to April), which could be accomplished by lengthening an existing boat launch or constructing a new one.

Kittitas County recommends that Grant PUD dredge and lengthen the Kittitas County boat launch at Vantage in order to allow boaters the opportunity to launch year-round. In response to Kittitas County by letter filed July 8, 2005, Grant PUD notes the draft RRMP proposes four boat launches (two on each project reservoir) that would be lengthened to accommodate low pool conditions: (1) Desert Aire; (2) Huntzinger Road; (3) Wanapum Recreation Area; and (3) Crescent Bar. As a result boaters would have the opportunity to launch at varying reservoir levels.

Grant PUD recently partnered with WSPRC to lengthen the boat lanes at the Wanapum Recreation Area, which is located 4 miles south of the Kittitas County boat launch. This work has been completed, with Grant PUD's contribution of $50,000 to support the effort (letter filed July 8, 2005, Laura Heacock, Manager, Licensing and Regulatory Compliance, Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington).

By letter dated October 29, 2004, the WSPRC notes that recreation within the Priest Rapids Project has been impacted by the mitigation of biological need of anadromous fish in the Hanford Reach. These mitigation measures, while appropriate, have caused lower water levels within the reservoir and higher flow velocities during high use recreation periods (Jim Harris, Eastern Region Manager, Washington State Parks and Recreation Commission, Wenatchee, Washington).

Another recreation site located below the Priest Rapids dam is White Bluffs boat launch, which receives high recreational use during the fall Chinook fishing season. The White Bluffs boat launch is a developed concrete launch usable at all river flows and has a steeper incline, which facilitates easier launching of trailer boats. The boat launch is closed from November 1 until June 30 to provide winter waterfowl sanctuary. For non-motorized boats, the boat launch is usable at all river flows (Public Utility District No. 2 of Grant County, Washington, 2005). See section 3.7, Threatened and Endangered Species, for our discussion on the White Bluffs boat launch and effects on the federally-listed bald eagle.

Our Analysis

In light of the coordinated operations and agreements of the seven-dam system, Grant PUD proposes to address the effects of fluctuating impoundment surface elevations on recreational boating by lengthening certain boat launches. Grant PUD's proposal would result in a significant improvement to recreation access. We find Grant PUD's approach reasonable, which would compensate for the operational effects of the mid-Columbia River Basin system on recreation access. Grant PUD should consider the needs of the disabled in the design and implementation of its proposal. Since Grant PUD already proposes to improve the Kittitas County boat launch, as well as, lengthen certain boat launches to provide access we find no basis to recommend Grant PUD dredge and lengthen the Kittitas County boat launch.

Grant PUD (2005) states that minimum flow in the Columbia River below the Priest Rapids dam is 36,000 cfs; thus, the river reach is accessible for boating at all times. At the Vernita Bridge, launching a trailer boat is feasible during river flows ranging at

least from 50,000 cfs up to 200,000 cfs. However, Grant PUD notes that varying flows present certain hazards (*e.g.*, shallow areas, eddies and other dangerous currents, submerged objects). To improve access to the river below Priest Rapids dam, Grant PUD proposes to provide cost-share funding to WDFW/FWS for capital facility upgrades or relocation of the Vernita Bridge boat launch. Public use facilities at the boat launch consist of minimal entrance signs and a partial gravel road. There are no restrooms and no potable water.

The Vernita Bridge boat launch receives high recreational use, especially during the fishing seasons. Consequently, recreation use of the area has resulted in impacts on cultural and natural resources. Grant PUD proposes to cooperate in the upgrades or replacement of the Vernita Bridge boat launch. We note diffuse knapweed, an invasive species, occurs at the Vernita Bridge boat launch. Development and implementation of an invasive species plan for the Priest Rapids Project could compliment the overall efforts by WDFW and TNC to control the spread of noxious weeds, other exotic plant species, and invasive species (*e.g.*, zebra mussels) within the river basin, including at the Vernita Bridge boat launch.

Effects of Project Operation and Operation of Upstream Developments

In responses to the parties, filed July 8, 2005, Grant PUD notes the operation of the mid-Columbia River system has resulted in a coordinated effort to optimize the use of water for flood control, fish mitigation, navigation, agriculture, recreation, municipal and industrial use, power generation, etc. The current operation of the Priest Rapids Project is primarily driven by upstream releases from Grand Coulee Dam, combined with other operational agreements. See section 2.0, Proposed Action and Alternatives, for further discussion.

Because of the inter-relatedness of the environmental resources, we address the effects of project operation and operation of upstream developments within the appropriate environmental resource sections. We also recognize that operation of the upstream developments might contribute to a direct or indirect effect on an environmental resource associated with the Priest Rapids Project, including potential historic properties, and we take those effects into account, including measures proposed by Grant PUD and measures recommended by the parties.

Trails and Project Role in the Restoration of Beverly Bridge

A study (EDAW, Inc., 2002) indicates there are seven existing trails within the project vicinity: (1) Ginkgo Petrified State Park; (2) John Wayne Pioneer Trail; (3) Quincy Wildlife Area Shoreline Access; (4) Dusty Lake Trail; (5) Rocky Coulee; (6)

Milwaukee Road Corridor; and (7) Nunnally Lake. In another study (EDAW, Inc., 2000a) hiking/walking was ranked among the top 10 primary recreation activities. One of the potential suitable areas for new non-motorized trail development includes the John Wayne Pioneer Trail corridor with feeder trails. Longer, continuous trails could link with other regional trail resources, such as the John Wayne Pioneer Trail. Construction of short trails could link existing recreation sites (EDAW, Inc., 2001a). A need exists for non-motorized trails that connect populated areas to rural and remote areas, such as the Cross-State Trail (John Wayne Pioneer Trail) and its major spur routes (Interagency Committee for Outdoor Recreation, 1995).

In addition to the John Wayne Pioneer Trail, the study (EDAW, Inc., 2001a) identified six potential trail routes at: Crescent Bar (5.5 miles); Frenchman Coulee (1.0 mile); Vantage Area (2.4 miles); Vantage-Wanapum Recreation Area-John Wayne Pioneer Trail (9.2 miles); Crab Creek Corridor (7.4 miles); and Mattawa-Desert Aire (3.1 miles). The total length of all trail segments is 30.1. For the Crab Creek Corridor, the total length includes 1.6 miles of land trail and 5.8 miles of water trail.

Pat Kelleher recommends a trail segment from the Airstrip Site to Wanapum Trail (RM 419) and a shoreline trail at Frenchman Coulee (RM 424), which would replace Grant PUD-permitted exclusive use road for the adjacent property owner. Pat Kelleher also recommends a developed campground at the Frenchman Coulee site. In a response filed July 8, 2005, Grant PUD reiterates its proposed measure for trails at the project and within the project vicinity. Also, Grant PUD proposes to develop a non-motorized 1-mile-long shoreline trail at Frenchman Coulee, along with other measures such as, repairing and improving the access road and parking lot; providing one barrier-free single-vault toilet, a picnic area, and interpretation; and repairing the boat ramp toe or replacing the concrete ramp. Because Frenchman Coulee is difficult to find and unknown to visitors in the area (EDAW, Inc., 2000a), installing a sign(s) on a nearby road(s), where feasible, would inform visitors of the site and location.

Grant PUD proposes to provide a non-motorized trail (referred to as the Vantage Area Trail) linking the community of Vantage with recreation sites. Grant PUD proposes to contribute an estimated $67,250 for capital construction of the Vantage Area Trail and $5,000 per year for maintenance after the trail is constructed.

Grant PUD proposes to provide funds to develop a 9.2-mile-long non-motorized trail linking Vantage-Wanapum Recreation Area-John Wayne Pioneer Trail. The trail would link the town of Vantage and the Wanapum Recreation Area. The trail would also provide access to the Kittitas County boat launch and Ginkgo Museum. Grant PUD proposes to contribute an estimated $308,500 for capital construction of the Vantage Area-Wanapum Recreation Area-John Wayne Pioneer Trail. Grant PUD notes that these

costs are included in the proposal for the Wanapum Recreation Area. Grant PUD proposes to contribute an estimated $1.85 million for infill and expansion capital improvements at Wanapum Recreation Area (including the Vantage Area-Wanapum Recreation Area-John Wayne Pioneer Trail) (letter filed July 8, 2005, in response to the Washington Interagency Committee for Outdoor Recreation from Laurel Heacock, Manager, Licensing and Regulatory Compliance, Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington). Grant PUD looks to partnering with WSPRC at Wanapum Recreation Area.

The IAC, by letter filed May 3, 2005, recommends Grant PUD: (1) cost-share maintenance and operation of Airstrip Site and Getty's Cove Group Site; (2) fully fund the rehabilitation and on-going maintenance and operation costs for the Beverly Bridge trestle of the John Wayne Pioneer Trail; and (3) provide O&M funding for Vantage Area Trail, Vantage Area-Wanapum Recreation Area-John Wayne Pioneer Trail, and Wanapum Recreation Area.

During relicensing, studies were conducted to identify an alternative to public use crossing of the Wanapum Dam. The studies identified the 0.5-mile-long Beverly Bridge, part of the John Wayne Pioneer Trail, as the preferred Columbia River crossing due to natural and potential historic properties constraints associated with alternative routes, as well as public safety. The John Wayne Pioneer Trail abuts the Priest Rapids Project area near the town of Beverly. The IAC and WDNR state that Interstate 90 is the only other public crossing of the Columbia River within the project area. The IAC, WDNR, and Pat Kelleher recommend that Grant PUD fund the restoration and maintenance of the Beverly Bridge for use as the Columbia River crossing and thereby link the John Wayne Pioneer Trail. The WDNR states that the Beverly Bridge is the link between the western and eastern portion of the John Wayne Pioneer Trail; however, due to current bridge conditions and concerns for public safety, the Beverly Bridge is closed to public use.

In a response filed July 8, 2005, Grant PUD proposes to contribute an estimated $445,000 for capital improvements at the John Wayne Pioneer Trail crossing (Beverly Bridge) of the Columbia River, subject to the Commission determination that such an effort would be appropriate. The IAC supports Grant PUD's proposal to rehabilitate the Beverly Bridge trestle that would include adding safety measures (*e.g.*, new decks, rails, and gates); however, Grant PUD should fund the rehabilitation and on-going O&M costs. Grant PUD believes that the trail segment would best and most appropriately be maintained by the entities responsible for the 300-mile-long cross-state trail corridor of which the Beverly Bridge is a critical link.

Our Analysis

Commentors noted that prior to the events of September 11, 2001, Grant PUD allowed the public to cross the Columbia River by using a service road across Wanapum Dam. Since that time, additional security measures required by the Commission has closed access to the public. The commentors note the only other bridge to cross the Columbia River in the project area is I-90.

Due to public use restrictions at Wanapum Dam and due to the location of the Beverly Bridge in relation to the project we find an indirect effect exists between project operation and potential recreational use of the trail segment. We find Grant PUD's proposal to cooperate in the John Wayne Pioneer Trail crossing (Beverly Bridge) of the Columbia River appropriate, which would re-connect a 0.5-mile-long link in the trail system and allow safe public access across the river. Demand for non-motorized hiking is projected to increase 89 percent by 2035 (EDAW, Inc., 2001). Improving the Beverly Bridge would help meet this projected demand. Although we find Grant PUD's proposal appropriate, we recognize the potential for sensitive species or historic properties that may occur in the area and, therefore, Grant PUD should coordinate development of the Columbia River crossing (Beverly Bridge) with the FWS, WDFW, WDNR-Natural Heritage Program, WSPRC, affected tribes, and Washington SHPO.

Although the WSPRC states that it would continue to provide O&M at sites owned and operated by WSPRC (Wanapum Recreation Area and John Wayne Pioneer Trail) with respect to its budget authority, we suggest Grant PUD, WSPRC, IAC, WDNR, and/or other appropriate authority consider and perhaps define a cooperative approach for operating and maintaining the Beverly Bridge. As Grant PUD has stated in its responses to parties' comments, user fees, maintenance grants, and other sources should be sufficient to offset O&M costs.

As noted in the Oregon SCORP (Oregon State Parks and Recreation Department, 2003), which we find relevant in this instant, there may be a direct correlation between increasing use of recreation user fees and lower use by low-income families and household. Thus, it is important to ensure the region's low-income residents are not priced out of local recreational opportunities. The Commission's regulations at 18 CFR 2.7 allow a licensee to charge a reasonable fee to users of recreation facilities to help defray the cost of constructing, operating, and maintaining such facilities. Given the socioeconomics of the counties affected by the Priest Rapids Project, and at the same time, the ability to institute user fees, we will take into consideration Grant PUD's proposed project-related recreation measures recognizing the potential for Grant PUD to consider reasonable fees charged for public use and justification of those fees.

Overall, we find Grant PUD's proposed measures to develop an estimated 30 new miles of trail to be located within and adjacent to the project would contribute to a beneficial cumulative effect on recreation resources at the project and within the mid-Columbia River Basin. Development of the trails would address a need for non-motorized trails identified by the State of Washington SCORP (Interagency Committee for Outdoor Recreation, 2002; Washington State Parks and Recreation Commission, 2005). We suggest, where appropriate, that Grant PUD consider the needs of the disabled during the design of its proposed trails for the Priest Rapids Project. The proposed trails would provide recreational opportunities for disabled persons and help to meet the projected demand for non-motorized hiking.

We note several species of special concern (*e.g.*, miner's candle, coyote tobacco, brittle picklypear) occur near Frenchman Coulee. Although new recreational facilities may be installed at Frenchman Coulee, any such facilities should be developed and implemented in consultation with the resource agencies and affected tribes to protect the species and its habitat.

Other Recreation Facility Measures

Three recreation facilities (Airstrip Site (new), Getty's Cove Group Site, Wanapum Recreation Area, John Wayne Pioneer Trail) occupy lands that lie within and immediately adjacent to the project boundary. By letter filed May 31, 2005, WSPRC expressed concern that the draft RRMP identifies WSPRC as the entity to provide O&M at these sites. The WSPRC is unclear about the level of commitment by Grant PUD. The WSPRC recommends that either Grant PUD makes available to WSPRC $8 million for new recreation facilities, identified in the draft RRMP or Grant PUD commits to all costs associated with development of specific recreation facilities.

Grant PUD cites the draft RRMP contemplates partnerships and agreements with WSPRC and other entities responsible for certain public access and recreation facilities in the project vicinity. Grant PUD reiterates this cooperative approach in a response letter to WSPRC, filed July 8, 2005, wherein Grant PUD proposes to cost-share and cooperate with WSPRC at the three recreation facilities- -Airstrip Site, Getty's Cove Group Site, and Wanapum Recreation Area.

The IAC agrees with Grant PUD in its proposal to fund another entity for development of a new recreation area at the proposed Airstrip Site and to investigate the acquisition of and improvement to Getty's Cove Group Site. The IAC recommends Grant PUD also cost share O&M costs at these two sites and provide O&M costs at the Vantage Area Trail and Wanapum Recreation Area.

Grant PUD reaffirms its commitments to Airstrip Site, Getty's Cove Group Site and Wanapaum Recreation Area in a separate filing of July 8, 2005, to the IAC. In that letter, Grant PUD states that should demand studies indicate the need for the Airstrip Site, Grant PUD proposes to contribute an estimated $7.89 million for construction. In addition, Grant PUD proposes to contribute an estimated $512,000 for capital improvements at Getty's Cove Group Site, subject to the Commission determination that such an effort would be appropriate. Grant PUD further states that revenue generated at the sites, grants, and other sources of funding could offset O&M costs.

Our Analysis

In its letter filed July 8, 2005, Grant PUD appears to propose two license articles. The first one would include a requirement for Grant PUD to commit an estimated $10.3 million for the development, renovation, and operation of Airstrip Site, Getty's Cove Group Site, and Wanapum Recreation Area. The second one would include a provision for a recreation management plan to provide guidance for implementing the recreation enhancement measures at Airstrip Site, Wanapum Recreation Area, and John Wayne Pioneer Trail. We note, however, that while both proposed license articles identify Airstrip Site and Wanapum Recreation Area, each proposed article then identifies Getty's Cove Group Site or John Wayne Pioneer Trail. We would assume the second proposed license article should compliment the first proposed license article; yet, the recreation facilities differ. We would appreciate Grant PUD clarify the difference in the identified recreation facilities between what appear to be two proposed license articles.

We note WDFW has concerns regarding Airstrip Site (a fall and winter waterfowl concentration area; riparian habitat) and Wanapum Recreation Area (high quality shrub-steppe Priority Habitat). Until we receive clarification from Grant PUD on its two proposed license articles, we reserve our recommendation regarding the sites.

Need For and Project Role in Development of Horseback Riding Amenities

At the scoping meeting Crab Creek Riders, Backcountry Horsemen of Washington commented that development and maintenance of designated horseback riding areas would be beneficial, both financially and aesthetically, to Grant County.

According to WSPRC and Washington State Tourism, equestrian trails are established in 10 Washington State Parks. One of these trails, Steamboat Rock, offers 10 miles of equestrian trails in Central Washington and traverses sagebrush and basalt cliffs. Other designated equestrian trails are located in Ellensburg and Vantage. In particular, the John Wayne Pioneer Trail and Quilomene Creek offer equestrian trails.

The FWS (2002) notes unrestricted horseback riding occurs on the Wahluke Unit of the Monument. Equestrian use continues to be a popular activity. There are no designated horse trails or horse-specific developed facilities (*e.g.*, parking, water, portable toilets). The FWS identifies a need to assess the current supply and demand for horseback riding facilities on nearby and adjacent lands to the Monument. The FWS notes that there may be options and alternatives for use of trails by multiple users (*e.g.*, hikers, horseback riders) and for horseback riders only.

Our Analysis

We recognize the importance of the John Wayne Pioneer Trail and find Grant PUD's cooperation for rehabilitating the Beverly Bridge trestle, including safety improvements, would allow public use as a non-motorized trail bridge across the Columbia River. The proposed measure would significantly improve the John Wayne Pioneer Trail and enhance recreational use, including equestrian.

Grant PUD's proposal to improve the Beverly Bridge segment of the John Wayne Pioneer Trail should provide recreational use of a trail by multiple users. We find that if a license is issued for the Priest Rapids Project data collected and filed pursuant to the reporting requirements for FERC Form 80-Recreation Report may identify a need for project-related horseback riding amenities during the term of the license. Consequently, such a need could be re-assessed at that time.

Effects of Recreation Use Areas on Aesthetic Resources and Other Issues

As a component of its draft RRMP, Grant PUD proposes to provide periodic monitoring and site clean-up at six boat-in shoreline dispersed areas: (1) Goose Island; (2) Haystack Rocks; (3) McCumber Beach; (4) Quilomene Dune and Bay and West Bar; (5) Black Sand Beach; and (6) Quincy Wildlife Recreation Area. Other possible options that Grant PUD cites include site closure, new use restrictions, or new "hardened" recreation facilities (*e.g.*, tent pads, picnic tables, and designated hunting blinds).

The WDFW developed and implemented a State-wide aquatic nuisance species management plan. The plan identifies various objectives and tasks to control and/or eradicate aquatic invasive plant species. The plan notes WDOE is currently working with WDFW and the WSPRC to develop signs that would be placed at all boat launches in Washington State warning boaters of aquatic nuisance plant and animal species and encouraging boaters to clean their boats, trailers, and fishing gear.

Our Analysis

We identified the effects of recreation use areas and associated vegetation disturbance, soil erosion, and/or trash accumulation on aesthetic resources. Grant PUD proposes and the staff would recommend various management plans for the Priest Rapids Project that would protect and enhance environmental, recreation, and cultural resources at the project, thereby contributing toward a beneficial effect on aesthetic resources. One of these plans, an invasive species plan, could protect species of special concern, the biodiversity of the area, and enhance the aesthetic resources of the area. Some measures contained in the draft RRMP would retain the primitive character of the recreation site with minimal improvement.

Although providing periodic monitoring and site clean-up at recreation sites would address adverse effects on environmental resources and improve the aesthetic resources of the area, costs are incurred with recreation site clean-up. To minimize such costs- -in this instant, borne by Grant PUD, federal and state resource agencies, affected tribes, and counties- -Grant PUD should assess a "carry-in/carry-out" policy. The "carry-in/carry-out" policy would entail identifying and removing certain existing trash receptacles and installing containers with appropriately-sized plastic bags for people to carry out their trash. We are aware of similar efforts at national parks and other areas that encourage people to carry out their trash; the results are generally favorable. The identification and removal of certain trash receptacles and subsequent placement of containers at key public access and recreation sites could be coordinated with the agencies, affected tribes, and counties whose lands are located within or adjacent to the existing Priest Rapids Project boundary, as well as with other entities (*e.g.*, anglers, Crab Creek Riders, Back Country Horsemen of Washington) that utilize the facilities, including areas in the Hanford Reach. We envision this measure would compliment the Interpretation & Education Program as identified in the draft RRMP.

Land Use

Grant PUD proposes to develop public access and recreation facilities in areas that are compatible with its draft Shoreline Management Plan, Priest Rapids Hydroelectric Project, dated August 2003. The plan includes general land use practices, land use classification, and public access. The measures contained in the plan would also protect the scenic quality of the mid-Columbia River and its surrounding landscape. Grant PUD proposes to finalize the plan.

Pat Kelleher recommends that Grant PUD address its policy on land use permits. In its response filed July 8, 2005, Grant PUD notes that it currently manages 132 non-exclusive land use permits issued to adjoining landowners since the original license.

Since 1987 land use permits have been issued, by Grant PUD, in conformance with the Commission's standard land use article. The permits will expire with the current Commission license on October 31, 2005. Grant PUD states that in its draft shoreline management plan, Grant PUD proposes a shoreline permitting policy.

Pat Kelleher recommends that Grant PUD convert the existing feedlot at the Columbia River Siding Area (RM 460) to a public day use park and swimming area. In a response filed February 17, 2005, Grant PUD states that the feedlot is partially located on private property in Douglas County, Washington near RM 450.5 on the Wanapum Reservoir. Cattle are restricted to the feedlot area and can not access the shoreline. A portion of the feedlot was authorized by a Grant PUD permit that will expire coincident with the existing license. Grant PUD does not anticipate renewing the permit. Furthermore, Grant PUD states that the shoreline area adjacent to the feedlot is publicly accessible via Douglas County Road 195 and from the Wanapum Reservoir via boat.

Pat Kelleher recommends that Grant PUD develop the Auvil Area (RM 406) for boat-in camping in order to address recreation use at Goose Island. Pat Kelleher states the Auvil Area currently is used for commercial business, while excluding free public access. Pat Kelleher submits a similar comment for Sentinel Gap (RM 408).

By letter filed October 19, 2005, Mr. Ken Jacobson states that he recently entered into a purchase and sale agreement to purchase approximately 58 acres adjacent to the Priest Rapids Project boundary at the proposed Airstrip Site. Mr. Jacobson states that the current draft RRMP includes extensive encroachment on his intended purchase. He also states that there is a high existing need for an increase in public recreation opportunities at the Airstrip Site.

In a response to Mr. Jacobson, filed November 8, 2005, Grant PUD does not view the concepts proposed in its draft RRMP as encroachments. The draft RRMP and final license application for the Priest Rapids Project were available in October 2003, prior to Mr. Jacobson's purchase and sale agreement for the property adjacent to the Airstrip Site. Public meetings, beginning in 1999, provided opportunities for the stakeholders and public to comment. Grant PUD disagrees that there is a high existing need for development of the Airstrip Site; other recreation sites with expansion or infill potential have a higher priority over the generally undeveloped Airstrip Site. The draft RRMP provides for a phased approach to recreation facilities in order to address future recreation needs, with existing site expansion occurring first and new site development occurring as needed thereafter.

Our Analysis

We find Grant PUD's response to Pat Kelleher on its land use permit policy adequate. Grant PUD's referral to its permitting policy can be found in section 4.3 of its draft shoreline management plan, which generally outlines permitting and the conveyance of leases, easements, and fee title.

As stated in the draft shoreline management plan, the land use policies will not prohibit members of the Wanapum Indians from hunting and fishing within the Priest Rapids Project and maintaining the right at all times to gather wild roots, herbs, and berries. We also note that Grant PUD proposes to review the shoreline management plan's goals, policies, land use classifications, etc. every 6 years. This review could be coordinated with the recreation monitoring required by the filing of the FERC Form 80-Recreation Report. We find this timeframe appropriate because recreation data collected can be used to modify the shoreline management plan, accordingly.

No public recreation use occurs in the shoreline area adjacent to the feedlot (Duke Engineering & Services, Inc. 1997; EDAW, Inc., 2001). Project lands in the vicinity of the feedlot are designated "Public Recreation-Dispersed" in Grant PUD's draft shoreline management plan. This designation would provide opportunities for hiking, hunting, fishing, river access, and scenic viewing. We, therefore, find Grant PUD's response adequate.

Regarding public access, Grant PUD is not obligated to provide free public access to all project lands and waters especially in light of balancing public access with protection of sensitive resources. [82] Sentinel Gap was excluded from a recreation study because the majority of users are seasonal farm-workers who camp at the site; therefore, use of the site is not related to recreation as an activity (EDAW, Inc., 2000a). Sentinel Gap is permitted to WDFW to manage for wildlife, although Grant PUD retains ownership.

We acknowledge Mr. Jacobson's comments on the proposed Airstrip Site and discuss the site throughout this DEIS.

Other Measures

Grant PUD proposes to provide funding for 1.0 full-time employee (FTE) for the WDFW Enforcement Program in part to field additional WDFW Enforcement Officers in

[82] Order Dismissing Complaint. 99 FERC ¶ 61,363 (2002).

the project area during peak recreation use. Grant PUD also proposes funding be made available to the Kittitas County and Grant County Sheriff's Offices to fully fund 1.0 FTE (funding to be divided equally between the two county sheriff's offices).

Grant PUD currently provides a boat at Wanapum Dam for use by local law enforcement officers and proposes to continue this practice during the new license. Grant PUD notes the Wanapum River Patrol program is a field-based monitoring program in order to provide patrols of the Priest Rapids Project area on a daily basis by boat and/or vehicle. The program monitors and reports on the effects on historic properties and helps prevents looting and vandalism. The program also provides for visitor management.

Kittitas County recommends that Grant PUD fund 2.0 FTE Sheriff Deputy and vessel for approximately 6 months (May through October). Pat Kelleher recommends that Grant PUD fund 1.0 FTE and a vessel for Kittitas County Sheriff's Department (RM 421). WDFW, pursuant to section 10(j) of the FPA, recommends the licensee make available to the WDFW Enforcement Program funding appropriate to fully fund 2.0 FTE WDFW Enforcement Officers, including administrative costs, and additional funding to be made to Kittitas County and Grant County Sheriff's Offices to fund 1.0 FTE, including administrative costs.

CRITFC recommendation no. 19 stipulates that Grant PUD contract with local law enforcement personnel to enforce laws that protect cultural resources within the project area and Hanford Reach.

Our Analysis

We address the law enforcement officer and associated issues in Section 5.0, Staff Conclusions.

3.9.3 Cumulative Effects

We identified recreation as a resource that could be cumulatively affected by relicensing the Priest Rapids Project. The proposed public access sites, recreation facilities, and additional environmental measures would contribute to a cumulative beneficial effect on recreation resources at the project and within the mid-Columbia River Basin. A critical link (Beverly Bridge) would connect the John Wayne Pioneer Trail, a National Recreation Trail, and provide safe public access across the Columbia River. Barrier-free public access sites and recreation facilities would provide disabled persons with new recreational opportunities. Continued project operation would also benefit recreation by enhancing the aquatic resources (fisheries) of the mid-Columbia River, and providing continued opportunities for boating, fishing, and other "on-water" recreational

pursuits.

Under no-action the additional recreation enhancements would not be required at the Priest Rapids Project, resulting in no enhancement of opportunities for disabled persons. The no-action would forego maintenance and improvements of public access and recreational facilities at the project.

3.9.4 Unavoidable Adverse Impacts

Proposed recreation development at the Airstrip Site could result in an unavoidable adverse impact on wildlife because the area is a fall and winter waterfowl concentration area and riparian habitat occurs in the area. Environmental measures contained in a habitat management plan and other project-related plans, as well as a requirement for Grant PUD to coordinate its efforts to develop and implement the various plans with resource agencies, affected tribes, and applicable interested parties, could minimize adverse impacts on wildlife and associated habitat.

3.10 SOCIOECONOMICS

The EIS scoping process identified one issue related to project effects on socioeconomic resources: effects of the Priest Rapids Project on local, tribal and regional economies. In this section, we describe the affected environment with respect to socioeconomic resources and the effects, including cumulative effects, of the project as related to these issues.

3.10.1 Affected Environment

The Columbia River and its tributaries are susceptible of being developed into the greatest system for water power to be found anywhere in the United States (letter to the Speaker of the House of Representatives, from Mr. Elwood Mead, Commissioner, War Department, March 29, 1932). One of the 10 sites identified in 1932 as promising for development is described herein, the Priest Rapids Project.

Before non-native settlement and development efforts along the Columbia River, several Indian tribes lived in the area. "The basis of these tribes' livelihoods and cultures was anadromous fish, particularly salmon. The spring, summer, and fall runs of salmon and steelhead trout from the Pacific Ocean to ancestral spawning grounds in the riverbeds were enormously productive" (Ortolano and Cushing, 1999: Section 3.1). The tribes' economy also consisted of intertribal trade, livestock, trade with fur companies, and hunting, fishing, and gathering. In 1805 Meriwether Lewis and William Clark (Lewis and Clark) traveled up the Columbia River from the mouth of the Snake River to the

mouth of the Yakima River, approximately 7 miles from the Hanford site. The Nez Perce Tribe provided Lewis and Clark with food, shelter, and sent guides along to assist them on part of their expedition to the Pacific Coast. Lewis and Clark's travels began the exploration and subsequent European settlement of the region, and ultimately, the Hanford Reach (U.S. Department of Energy, 2003).

During the late 19th century industries were developed on the Columbia River. In 1866, R.D. Hume established the first salmon cannery on the Columbia River. From 1880 to 1900, orchards were established at Hood River and Wenatchee on the Columbia River and along the Yakima and Okanogan Rivers. In the early 1880s the first commercial apple orchard in Chelan County is believed to have been planted. Orchardists dumped their blemished or deformed apples into the Columbia River. In 1916 a Chelan businessman purchased these apples from local orchardists and sold the apples to juice processing and fruit canning operations. Eventually, the Wenatchee Packing Corporation (now known as Wenatchee Canning Company) became the first fruit cannery established in Chelan County (Washington State Employment Security Department, 2002b).

From 1860 to 1882 the Oregon Steam Navigation Company dominated steamboat transportation on the lower and middle Columbia River. In 1877, a wagon road was constructed from Ellensburg to the foot of Priest Rapids, descending to the Columbia River down Haunsen Canyon. In 1882, an approximate 42-mile route between Yakima and Priest Rapids was constructed primarily for a freight terminal; however, both wagon roads were abandoned soon after a railroad was constructed (Public Utility District No. 2 of Grant County, Washington, 2001). Between the late 1800s and early 1900s, the railroad contributed to the growth and development of the region. For further discussion on the historical context see the Cultural Resources Section herein; Public Utility District No. 2 of Grant County, Washington (2003).

Regional Economy

The State of Washington's arable lands, mild climate, and unique growing season contribute to its recognition as a leading exporter of food and agricultural products. The Trade Development Alliance of Greater Seattle note the Columbia and Snake River systems provide a water route for agricultural products in the eastern portion of the State to be shipped to worldwide markets through ports in western Washington. Smaller ports in eastern Washington contribute to food processing and distribution facilities.

Although the region supports nonagricultural industries (mining, construction, manufacturing, transportation, retail, services, and government), agriculture is a major component in the State of Washington's economy. The primary commodities are apples

and potatoes; other commodities include corn, cherries, grapes, pears, asparagus, beets, spinach, and cantaloupes. Wheat, cattle, and dairy products also contribute to the economy.

In 2002, the estimated number of farms in Washington was 35,939 totaling 15,318,008 acres. Of that figure, the total cropland was 8,038,469 acres. Other farms were livestock and poultry (U.S. Department of Agriculture, 2004). As an example, cherries, grapes, and pears, combined, account for 34,443 acres (Schotzko, n.d.). As noted in the 2002 Census of Agriculture report, the number of farms in Washington decreased approximately 10 percent from 40,113 farms in 1997 to the current as stated. The market value of agricultural products sold [83] was estimated at $5.3 billion, of which $3.6 billion accounted for crop sales; livestock, poultry, and their products accounted for $1.7 billion (U.S. Department of Agriculture, 2004). Despite a decrease in the number of farms, the market value of agricultural products sold increased 8 percent.

The Bureau of Reclamation's (BOR) Columbia Basin Irrigation Project [84] land includes portions of Adams, Franklin, Grant, Lincoln, and Walla Walla Counties, with some northern facilities located in Douglas County, Washington. In January 1969, the BOR transferred the operations and maintenance for much of the project to three irrigation districts: East Columbia Basin Irrigation District; Quincy-Columbia Basin Irrigation District (Quincy District); and South Columbia Irrigation District (Northwest Power and Conservation Council, 2004).

Various agri-businesses spoke at the Commission staff scoping meetings conducted in April 2004 regarding the BOR's Columbia Basin Irrigation Project and how the businesses began as a result of the irrigation project. For example, Basic American Foods began operations in 1965. Further, the Quincy District delivers irrigation water to approximately 247,000 acres, of which 90,000 acres are return flows into lower Crab Creek.

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[83] Market value of agricultural products sold represents the gross market value before taxes and production expenses of all agricultural products sold or removed from the place regardless of who received the payment. Market value is equivalent to total sales (U.S. Department of Agriculture, 2004).

[84] The BOR's Columbia Basin Irrigation Project was authorized for construction by the Rivers and Harbors Act and approved August 30, 1935 (49 Stat. 1028, 1039-1040, Public Law 74-409). The authorized purposes are for flood control, navigation, regulation of stream flow, storage and delivery of stored water for reclamation of lands and other beneficial uses, and the generation of electric energy.

At the scoping meeting the Washington State Department of Fish and Wildlife stated that upper Columbia River steelhead (federally-listed endangered) and summer Chinook salmon utilize Crab Creek. By letter filed May 3, 2004, Washington State Potato Commission comments that the Grant County agricultural community is heavily reliant upon Crab Creek for irrigation. By letter filed January 20, 2005, NOAA-Fisheries state that upper Columbia River steelhead and summer/fall Chinook salmon occur in the Crab Creek watershed. For further discussion on Crab Creek and its aquatic resources see the Aquatic Resources Section.

Several companies in the region provide significant employment: Solar Grade Silicon, LLC; Chemi-Con Materials Corporation; Eka Chemicals; Moses Lake Industries; two potato processing facilities at Port of Warden; Basic American Foods; National Frozen Foods Corporation; and J.R. Simplot Company. The first four companies are foreign-owned that have production facilities in other countries (letter filed May 5, 2004, David K. Jones, President, Board of Commissioners, Port of Moses Lake, Moses Lake, Washington).

At the scoping meeting Washington State Potato Commission stated that potato growers in Washington State operate on an estimated 165,000 acres. In 2003 Washington State potatoes had a production (farm gate) value of approximately $500 million, ranking as the second largest crop in the State behind apples. In eastern Washington and northeastern Oregon, where much of the potato production occurs, the total regional employment related to potato production and processing is 28,000 jobs. The Washington State Potato Commission cited a 2001 report by Holland and Yeo in which potato farming and related processing contribute an estimated $3 billion annually to the Washington economy. Consequently, the employment provided by the potato industry is significant.

National Frozen Foods Corporation, by letter filed April 15, 2004, states that it farms over 25,000 acres in the Columbia River Basin and employs several hundred people. One of its plants, located in Moses Lake, Washington, produces approximately 300 million pounds of frozen vegetables annually.

Columbia Basin Vegetable Seed Association (CBVSA) represents 50 farms that raise seed crops, such as carrot, onion, radish, and parsley, on 5,000 acres. Of the seeds produced, approximately 50 percent is used domestically and 50 percent is exported. The CBVSA notes that these crops represent $5 million at the farm gate (letter filed May 7, 2004, from Pat Stevens, Columbia Basin Vegetable Seed Association, Quincy, Washington).

By letter filed May 26, 2004, Pacific Northwest Vegetable Association notes the region and favorable climate of the State of Washington contribute to quality crops grown, such as asparagus, onions, peas, and sweet corn, and the processing industry represents the purchaser of vegetables from Grant County and the state. Washington vegetable crops have a farm gate value of $343 million and Grant County produces about 20 percent of the total. The processing industry represents the largest purchaser of vegetables from Washington State and Grant County.

Between 1970 and 2004, the total civilian labor force [85] in Washington grew from 1.4 million to 3.2 million people. The State expects to gain an additional 1 million workers by the year 2030 (State of Washington, 2005). This report indicates that from 2005 to 2010 the State's workforce is expected to increase at a 1.6 percent annual rate; from 2010 to 2030 the growth rate will decrease to 0.9 percent annual rate due to the aging of the population.

As discussed below, the existing Priest Rapids Project is located in a portion of Benton County. Benton and Franklin Counties comprise the Tri-Cities (Richland, Kennewick, and Pasco) Metropolitan Statistical Area. The Tri-Cities area economy is supported by agriculture, food processing, and related industries. The Department of Energy's operations at Hanford, located in Benton County, provide for specialized professional and technical occupations. For example, the engineering and management services employ approximately 6,240 persons. Research indicates that these industries will continue to provide a substantial employment base (Washington State Employment Security Department, 2001).

The unemployment rate for Washington State in 2003 was 7.5 percent; an increase from 6.4 percent in 2001. Historically, the unemployment rate in Washington has been higher than the U.S. average due to a relatively high concentration of resource-based industries in the State (State of Washington, 2004). Columbia Basin Consultants (2000) reach similar conclusions regarding unemployment rates.

Economy of the Project Area

The region surrounding the existing Priest Rapids Project is lightly developed or undeveloped. The Priest Rapids Project is located in portions of Benton, Chelan,

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[85] Civilian labor force is defined as persons 16 years of age and older in a specified geographic area who are either employed (either part-time or full-time) or actively seeking employment. Individuals in nursing homes, prison, or the armed forces are not considered part of the labor force (State of Washington, 2005).

Douglas, Grant, Kittitas, and Yakima Counties, Washington. These counties define the environment for socioeconomic resources that may be affected by the Priest Rapids Project.

At the Commission staff scoping meetings the agri-businesses mentioned the irrigation system with its dams and canals - -an important infrastructure in the project area. See Table 35 for the acres of irrigated land for the counties.

Table 35. Acres of irrigated land for counties in the Priest Rapids Project area (Source: U.S. Department of Agriculture, 2004).

County	**Acres of Land Irrigated**
Benton	188,340
Chelan	34,705
Douglas	24,049
Grant	485,459
Kittitas	91,944
Yakima	269,127
Washington (State Total)	1,823,155

The primary counties for agricultural sales are Benton, Grant, and Yakima (Washington State Department of Agriculture, 2004). Crops grown in Benton County include wheat, potatoes, asparagus, grapes, and cherries. Data for Benton County indicate the 2002 market value of agricultural products was $400,571,000, an increase of 30 percent from 1997. Of this total, crop sales accounted for $366,342,000 (U.S. Department of Agriculture, 2004). Grant County produces potatoes, corn, green peas, and wheat. In 2002 the market value of agricultural products was $881,756,000, an increase of 6 percent from 1997. Of this total, crop sales accounted for $626,501,000 (U.S. Department of Agriculture, 2004). Yakima County produces cherries, asparagus, apples, and wheat. In 2002 the market value of agricultural products was $843,871,000, a decrease of 6 percent from 1997. Of this total, crop sales accounted for $508,254,000 (U.S. Department of Agriculture, 2004).

For Washington, the 2002 market value of livestock, poultry, and their products was approximately 1.7 billion; the project area counties' market value of said commodities ranged from $4,888,000 (Chelan County) to $355,617,000 (Yakima County).

By letter filed May 17, 2004, Alice Parker of P & P Farms comments that, as a farmer in Grant County, crop production from the area exceeds $600 million each year. With processing and packaging the economic value exceeds $6 billion annually.

Over a 31-year period (1970 to 2001) the civilian labor force for the project area fluctuated due to several factors, such as a slow regional economy, severe cold weather in 1985 adversely affected fruit and crop production, a shift in the population (*e.g.*, in-migration, residents leaving a county), and a shift in employment trends. For example, the increases in asparagus, apple, and cherry production in 1983 resulted in an increase in migrant workers to Yakima County (Washington State Employment Security Department, 2002c).

Recent information (Glenn, 2004) supports the data regarding a shift in employment trends. For example, while Yakima County lost agricultural employment in fruit trees, hay, and other miscellaneous farming, Benton and Grant Counties gained agricultural workers in fruit trees, as well as cattle ranching and crop production. In Grant County, employment in crop production accounted for 5,900 jobs and food processing-related employment accounted for 3,300 jobs (Public Utility District No. 2 of Grant County, Washington, 2003). The shift in employment trends is noted by Meseck (2005) - - between April 2004 and April 2005, nonagricultural employment in Yakima County grew by 1.3 percent (1,300 more jobs), primarily in the packing, sorting, and shipping-related processes for the 2004 apple crop.

For Kittitas County, the largest employing sector is in crop production, including tree fruits, oats, hay, and potatoes. Kittitas County is the largest producer of oats and hay in the State. Data for the county indicate the 2002 market value of agricultural products was $56,364,000, a decrease of 31 percent from 1997. Of this total, crop sales accounted for $38,432,000 (U.S. Department of Agriculture, 2004). The trade, services, and government sectors also contribute to the county's economy. In 2000, approximately 5,470 people were employed in the services and trade sector (*e.g.*, restaurants, tourist and recreation-related industries). The government sector employed approximately 3,700 people (Washington State Employment Security Department, 2002a).

The Chelan-Douglas Counties is part of the north central area, which also includes Kittitas and Okanogan Counties. Research indicates that this area is a top producer of apples, cherries, and pears. For example, the 2001 cherry crop was valued at over $150 million (Washington State Employment Security Department, 2002b). Data for Chelan and Douglas Counties indicate the 2002 market values of agricultural products were $169,406,000 and 124,348,000, respectively, (U.S. Department of Agriculture, 2004), which showed an increase from 1997. Of these totals, crop sales accounted for $164,518,000 for Chelan County and $118,186,000 for Douglas County. The agricultural

sector employed an estimated 11,440 persons in 2000 (Washington State Employment Security, 2002b).

At the scoping meeting, representatives from the Port of Warden and Port of Mattawa, located in Grant County, noted that based on 2002 data the average annual income for their communities is $22,077 and $15,137, respectively, which is below both Grant County and Washington State. Further, they commented on the unemployment rate for Port of Warden is 18.1 percent (year 2000) and for Port of Mattawa, 16.2 percent (year 2001). In Mattawa approximately 86 percent of public school students are eligible for the free lunch program.

Also at the scoping meeting, healthcare representatives commented that healthcare is an important employer in Grant County with an estimated total 730 people. They also stated that the agricultural business that supports the community also employs the uninsured and underinsured workers. Approximately 65 to 70 percent of the people receiving health care at the hospitals qualify for low income support.

Some of the other employers in the project area include Moses Lake School District, Grant County PUD, Samaritan Hospital, Quincy School District, Sunfresh (vegetable packer), Allen Produce (vegetable/fruit packer), and Lamb Weston (food processing) (Public Utility District No. 2 of Grant County, Washington, 2003).

Regarding the Port of Warden and Port of Mattawa scoping comments our analysis takes into account the various cities, towns, and communities within the Priest Rapids Project area. Nearby population centers include: (1) East Wenatchee; (2) Ellensburg; (3) Ephrata; (4) Kittitas; (5) Mattawa; (6) Moses Lake; (7) Moxee; (8) Prosser; (9) Quincy; (10) Richland; (11) Yakima; and (12) Wenatchee. See Table 36 for a comparison in resident civilian labor force and employment by county. The unemployment rate is also shown. Although not reflected in the annual employment numbers, the unemployment rate among the counties can vary according to the predominance of agriculture and seasonality of its employment. For example, we looked at Chelan County's 2001 unemployment rate by month. As noted by Washington State Employment Security Department (2002b) the county's unemployment rate in January 2001 was 11.9 percent, rose slightly in February, and decreased to 6.0 percent in July during the peak cherry harvest and remained at 6.0 percent through October due to the apple harvest. The Yakima County employment rate showed a similar trend, with the highest unemployment rates in January or February, then decreasing in June or July with the asparagus and cherry harvests and increasing again at the end of the harvests.

Table 36. Employment statistics for 1990 and 2001 for the counties in the Priest Rapids Project area (Source: Washington Employment Security Department, April 2002).

	Benton	Chelan	Douglas	Grant	Kittitas	Yakima	Washington (State Total)
1990							
Civilian Labor Force	60,600	30,980	16,350	27,070	12,590	102,300	2,538,000
Total Employment	57,000	28,360	15,150	24,760	11,630	91,400	2,412,800
Total Unemployment	3,700	2,630	1,200	2,310	960	10,900	125,100
Percent Unemployment	6.1	8.5	7.3	8.5	7.7	10.7	4.9
2001							
Civilian Labor Force	71,800	33,850	18,830	36,340	14,920	108,000	2,995,700
Total Employment	67,100	30,630	17,410	32,610	13,940	95,800	2,804,100
Total Unemployment	4,700	3,220	1,430	3,730	970	12,200	191,600
Percent Unemployment	6.5	9.5	7.6	10.3	6.5	11.3	6.4

For year 2000, Table 37 shows three economic parameters: median household income, per capita income, and the percent of families below the poverty level. Of the six counties within the project area, Benton and Kittitas Counties are not classified as economically distressed counties. The four other counties are classified as economically distressed counties, which make them eligible for some preference in bidding for government contracts and distressed area tax incentives for manufacturing (Washington State Employment Security, 2002). By letter dated May 26, 2005, Yakima County comments that because of its poverty the county received a federal designation as a rural enterprise community.

Table 37. Household and per capita income for counties in the Priest Rapids Project area (Source: U.S. Census Bureau, 2000).

County	Median Household Income	Per Capita Income	Families Below Poverty Level (%)
Benton	$47,044	$21,301	7.8
Chelan	$37,316	$19,273	8.8
Douglas	$38,464	$17,148	11.2
Grant	$35,276	$15,037	13.1
Kittitas	$32,546	$18,928	10.5
Yakima	$34,828	$15,606	14.8

Regional Population

The State of Washington (2004) estimates Washington's population for 2004 is 6,167,800, an increase of 4.64 percent from the year 2000 (5,894,143 people). Various reports indicate that migration is a major component of the State's growth. From 2000 to 2004, Benton and Kittitas Counties exhibited a population increase of 8.86 percent and 7.31 percent, respectively, which is higher than other counties for the project area: Douglas County at 4.90 percent; Grant County at 4.82 percent; Chelan and Yakima Counties are 2.68 percent and 2.21 percent, respectively. We assume population increases will continue. In Grant County, population is estimated to increase from 78,300 in 2004 to a population of 95,715 in 2020 (Grant County Economic Development Council, 2005).

Table 38 shows the population and population change (2000-2004) for the cities, towns, and communities within the Priest Rapids Project area. East Wenatchee is located in Douglas County; Ellensburg and Kittitas are in Kittitas County; Ephrata, Mattawa, Moses Lake, and Quincy are in Grant County; Moxee and Yakima are in Yakima County; Prosser and Richland are in Benton County; and Wenatchee is located in Chelan County.

Table 38. Recent population changes (2000-2004) for cities, towns, and communities in the Priest Rapids Project area (Source: State of Washington State, 2004).

Population Area	2000 Population	2004 Population	Population change (Percent) 2000-2004
Washington State	5,894,143	6,167,800	4.64
East Wenatchee	5,757	8,255	43.4
Ellensburg	15,414	16,390	6.3
Ephrata	6,808	6,890	1.2
Kittitas	1,105	1,130	2.3
Mattawa	2,609	3,265	25.1
Moses Lake	14,953	16,110	7.7
Moxee	821	895	9.0
Prosser	4,838	4,985	3.0
Quincy	5,044	5,255	4.2
Richland	38,708	42,660	10.21
Yakima	71,845	79,480	10.6
Wenatchee	27,856	28,760	3.2

In Washington State, persons age 65 and over will represent 19.7 percent of the population in 2030, an increase from 11.2 percent in 2000. With the exception of Benton County, persons age 65 or over represented an estimated 12.0 percent of the population in the other counties. For Benton County the elderly population was 10.3 percent (State of Washington, 2004).

Indian Tribes

From a 1997 initiative through the Washington Governor's Office of Indian Affairs, Tiller and Chase (n.d.) find that federally-recognized Indian tribes contributed an estimated $1 billion annually to the Washington State economy. Tribal enterprises employ approximately 14,375 people full-time, including non-tribal persons. The authors note that among Indian tribes in Washington State, fishing, hunting, and gathering of natural resources have been central activities for thousands of years and remain important to the tribes for subsistence, economic, and ceremonial purposes.

Salmon was the principal source of food, primarily taken during the annual spring run. "Dried on open air racks, the fish would be stored for winter food or used for trading with other tribes" (Washington State Employment Security Department, 2001, p.4). The Nez Perce, *et al*. (1995) state that salmon fishing maintained over 60,000 jobs and the net value of the northwest's salmon fishing in 1990 was estimated at $279 million. The Columbia River Inter-Tribal Fish Commission (CRITFC), by letter filed May 27, 2004, state that "anadromous fish, including Pacific lamprey, have significant cultural and religious significance to tribal members, provide members with subsistence for health and well-being, and contribute to a critical share of tribal commerce in an area of limited economic opportunity" (p. 3).

Currently, the Confederated Tribes of the Yakama Nation (Yakama), Confederated Tribes of the Umatilla Indian Reservation (Umatilla), Confederated Tribes of the Warm Springs Reservation of Oregon (Warm Springs), and the Nez Perce Tribe co-manage along with various resource agencies the fishery resource to protect and restore anadromous fish throughout their lands.[86]

Tribal governments have initiated other activities that provide employment, thereby contributing to both the tribes' and state economy.[87] The State of Washington's Office of Indian Affairs and Office of Trade and Economic Development note that tribes are utilizing tourism as a source of economic development.

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[86] See Joint Response of the Yakama Nation, The Confederated Tribes of the Umatilla Indian Reservation and the Columbia River Inter-Tribal Fish Commission Contesting the Offer of Settlement, dated May 10, 2004, for the Priest Rapids Hydroelectric Project No. 2114.

[87] Selected information available at: www.umatilla.nsn.us; www.ohwy.com/wa/y/yakamana.htm; www.inlandnwregion.org; www.ihs.gov; www.edforco.org; and www.critfc.org.

For the Priest Rapids Project we identified six Indian tribes that have an interest in the project relicensing: (1) Confederated Tribes of the Colville Reservation (Colville); (2) Yakama; (3) Wanapum Indians (Wanapum); (4) Umatilla; (5) Warm Springs; and (6) Nez Perce. See the Cultural Resources section herein and Smithsonian Institution (1988) for further information on the tribes.

The Coleville reservation, located in north-central Washington, is approximately 1.4 million acres and its estimated enrollment in 2000 was 8,398. Persons age 65 and over represent 6.2 percent of the tribal community. The economy of the Colville consists of agriculture, forestry, construction, manufacturing, recreation/tourism, such as the Rainbow Beach Resort (with vacation cabins, RV spaces, and boat rentals), and casinos. The Confederated Tribal Services Corporation, a general contracting/construction firm, has projects throughout Washington State that earned revenues of $1.6 million in 2000 (Barney & Worth, 2001). The tribe also operates health clinics. Based on U.S. Census Bureau data, the Colville Tribe has an estimated employment of 5,878. Table 5 shows several economic characteristics of the Indian Tribes. Please note the data reflects the year 1999.

Data indicates an unemployment rate for the Colville Tribe at 11.9 percent, which is 6.7 percent higher than Washington State (5.2 percent in 2000).

Table 5. Median household and per capita income of the Indian Tribes (Source: U.S. Census Bureau, 2000a).

Tribe	Median Household Income	Per Capita Income	Families Below Poverty Level (%)
Colville Tribe	$29,830	$11,805	19.9
Yakama Tribe	$30,714	$9,564	28.7
Wanapum Indians	unavailable	Unavailable	Unavailable
Umatilla Tribe	$37,827	$15,158	12.0
Warm Springs Tribe	$28,203	$7,467	26.8
Nez Perce Tribe	$27,696	$12,817	17.5

The Yakama reservation, located in south-central Washington, is approximately 1.1 million acre and its estimated enrollment in 2000 was 8,337. Persons age 65 and over

represent 4.7 percent of the tribal community. The economy of the Yakama consists of agriculture, forestry (such as, Yakama Forest Product), manufacturing, and recreation/tourism (such as, the Yakama Nation Museum of the Cultural Heritage Center). Other tribal income is derived from leasing tribally-owned farming and grazing lands. In addition, the tribe operates health facilities and clinics. Based on U.S. Census Bureau data, the Yakama Tribe has an estimated employment of 5,548. Data indicates an unemployment rate of 12.3 percent, which is 7.1 percent higher than Washington State.

The Wanapum [88] once occupied villages from near Vantage, southward, 80 miles to Pasco, including portions of the Hanford site. The Wanapum subsisted on local game and salmon migrating up the Columbia River, and gathered roots, berries, and wild carrots. The Crab Creek drainage is an important part of the Wanapum past, and continues to serve the tribe's subsistence and ceremonial needs (Northwest Power and Conservation Council, 2004). In its filing of May 27, 2005, the Wanapum comment that their homes, ceremonial longhouse and village site were relocated onto land adjoining the Priest Rapids Dam. The Wanapum and Grant PUD have continued their cooperative efforts in monitoring and protecting cultural resources (letter filed May 7, 2004, Laurel Heacock, Public Utility District No. 2 of Grant Count County, Washington, Ephrata, Washington). This effort is evident in the Wanapum Traditional Cultural Program and Wanapum River Patrol established in order to continue the tribal traditions and protect tribal lands, respectively.

The Umatilla reservation, located in northeastern Oregon, is approximately 172,000 acres and its estimated enrollment in 2000 was 2,927. Persons age 65 and over represent 11.1 percent of the tribal community. The economy of the Umatilla consists of agriculture, forestry, retail, and recreation/tourism, such as the Wildhorse Casino and Resort (with a hotel, RV spaces, and 18-hole golf course). The tribe operates a health clinic. The Umatilla Tribe, along with the State of Oregon, operates fish propagation facilities to restore salmon runs. In the Grande Ronde watershed, the Umatilla and Nez Perce Tribes, along with resource agencies, developed a salmon restoration plan for the U.S. Forest Service (Nez Perce, *et al*., 1995). Based on U.S. Census Bureau data, the Umatilla Tribe has an estimated employment of 2,139 people. Data indicates an unemployment rate of 4.7 percent.

The Warm Springs reservation, located in north-central Oregon, is approximately 600,000 acres and its estimated enrollment in 2000 was 3,190. Persons age 65 and over represent 2.5 percent of the tribal community. The Warm Springs Tribe's economic development includes continued co-operation of the Pelton-Round Butte Hydroelectric

[88] "History and Cultural Programs" pamphlet. Wanapum Dam Cultural Center.

Project No. 2030 and other industries such as agriculture, forestry, manufacturing, retail (*e.g.*, Warm Springs Clothing Company), and recreation/tourism (such as, Kah-Nee-Ta Resort). The tribe operates the Warm Springs Health & Wellness Center. In 1992, the Warm Springs Tribe established a Small Business Development Center that offers a grant program for tribal members (Barney & Worth Inc., 2001). Based on U.S. Census Bureau data, the Warm Springs Tribe has an estimated employment of 1,848 people. Data indicates an unemployment rate of 14.7 percent.

The Nez Perce reservation, located in northern Idaho, is approximately 750,000 acres. The tribe's estimated enrollment in 2000 was 4,082. Persons age 65 and over represent 6.8 percent of the tribal community. The economy of the Nez Perce Tribe consists of agriculture, forestry, construction (Nez Perce Limestone Enterprise), manufacturing, and retail. In addition, the tribe employs approximately 50 staff in their fish program (Nez Perce, *et al.,* 1995). Based on U.S. Census Bureau data, the Nez Perce Tribe has an estimated employment of 2,998. Data indicates an unemployment rate of 7.5 percent.

3.10.2 Environmental Effects and Recommendations

Grant PUD proposes environmental protection measures that would indirectly affect socioeconomic conditions in the vicinity of the Priest Rapids Project. Measures that are proposed for the protection and enhancement of fish, wildlife, recreation and cultural resources would have a positive effect on socioeconomic conditions by providing jobs and increasing tourism. The cost of implementing such measures would increase the cost of Project power, which would have a negative effect on socioeconomic conditions by decreasing the production cost advantage of the food growing and processing industries that are an important part of the regional economy. In its license application, Grant PUD states that it proposes a comprehensive environmental protection, mitigation and enhancement package that also preserves its ability to provide low-cost, reliable power for the benefit of Grant County customers and the millions of electric customers outside the County that are served through long-term power sales contracts (Public Utility District No. 2 of Grant County, Washington, 2003, Exhibit E1, Volume 2).

During the relicensing process, many commentors expressed the concern that costly protection, mitigation, and enhancement measures at the Priest Rapids Project would impact the project's ability to continue to provide low-cost, reliable power. To sustain the agri-business economy of the mid-Columbia River Basin the commentors stated that electric power rates in Grant County must be kept significantly below market rates, which are largely driven by the cost of non-renewable fossil fuels. They say that low-cost electricity is critical to the local economy and the social welfare of the

community. Among the commentors at the scoping meetings, the Port of Mattawa stated that long-term stable electric rates are essential in attracting new industry to the area.

In its motion for intervention, Yakima County stated that Grant County has not shared the many economic benefits related to its ownership of the Priest Rapids Project with Yakima County. In response, Grant County Economic Development Council noted that a privilege tax paid by Grant PUD into the State General Fund is distributed back into all 39 Washington State counties, including Yakima County (July 11, 2005, letter from Grant County Economic Development Council). Information filed by Grant PUD shows that Yakima County has received over $900,000 from Grant PUD's privilege tax payments since 2000. In addition, Grant PUD pointed out that Pacificorp, the major electricity supplier to Yakima County, purchases a share of Priest Rapids Project power at a cost-based rate of less than one cent per KWh and sells electricity to its Yakima County residential customers at about the same rate as Grant PUD charges Grant County residential customers. Hence, the Council and Grant PUD believe that Yakima County does receive significant benefit from the Priest Rapids Project.

CRITFC (undated) notes the cumulative effects of dam construction to produce electricity, irrigation for agriculture, and navigation have transferred potential wealth in the river basin from salmon on which the tribes depend to non-Indians. The tribal traditional subsistence economy is broad-based, which includes fishing, hunting, gathering of berries and medicinal plants, and livestock grazing (U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management, 1996).

The Yakama Nation has commented on numerous occasions to the effect that Grant PUD should make available to its on-Reservation utility, Yakama Power, a "fair share" of project power at, or below the cost of production.[89] This recommendation would represent a direct economic benefit to the Yakama Nation, both by providing an economical source of power for use by the Yakama people and, potentially, a source of income through the sale of a portion of that power at market rates to other customers of Yakama Power.

In its comments on scoping[90], the Yakama Nation recommends further that any license issued to Grant require the economic benefits of the project to be redistributed by

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[89] Yakama Nation's Motion to Intervene and Supporting Memorandum in Grant PUD's Application for New License, Project No. 2114-116, January 5, 2005.

[90] Letter filed May 7, 2004, from Tim Weaver, Attorney, Yakama Nation to Commission Secretary.

means of a "public benefits charge," pursuant to which:

> (1) Ten percent of the project's gross revenues would be "taken off the top" as a "public benefits charge" and paid in various portions to Yakama and to Grant, Yakima, Kittitas, and Benton Counties. The payments would be made with the understanding that they would be used for energy and water conservation, and renewable resources purposes, preferably related to project effects.
>
> (2) From any remaining economic benefits after the "public benefits" charge is deducted, Grant would receive ten percent "off the top," and the remaining 90 percent would be distributed to Yakama and the four abovementioned counties in the same proportions as the public benefits charge.

Yakama characterizes the public benefits charge as satisfaction of a debt owed by Grant for project impacts during the initial license term. The recommended allocation of remaining economic benefits appears to be based on Yakama's belief that the FPA was intended to ensure that the economic benefits of licensed projects are broadly shared and because Yakama and the neighboring counties have experienced losses of fish, wildlife, and cultural resources as a result. Although this recommendation raises legal questions more appropriately addressed in the Commission's license order, we acknowledge the recommendation in this EIS and briefly discuss the merits for such a proposal as mitigation for past and future environmental effects in our analysis.

Our Analysis

Although Grant PUD made no proposals that pertain directly to socioeconomic resources within the project boundary, many of Grant PUD's proposed measures would have a positive effect on the socioeconomic resources of the counties, communities and tribes in the region or receiving power (either directly from Grant PUD, or indirectly from the purchasers) from the Priest Rapids Project. Those proposals include capital investment in facility improvements totaling about $113 million for anadromous fish and $20 million for recreation.

In addition, the project is a source of low-cost power, which provides an economic benefit to residents and businesses located in Grant County, as well as, the other jurisdictions served by purchasers of project power. This low-cost power has had a positive socioeconomic effect on the region's agricultural, food processing, basic metals (aluminum) manufacturing, tourism, and recreation industries. Grant PUD's proposal to replace the existing turbines over the term of a new license with more efficient units at a cost of about $280 million would increase the generating capacity by about 12 percent and is expected to result in lower mortality for downstream fish passage and improved

water quality with respect to total dissolved gas downstream from the project dams. The cost for Grant PUD's proposed enhancements would increase the cost of generation, but still provide a relatively low cost source of power compared to the fossil fueled generating resources, which hydropower replaces in the region.

Our baseline for considering socioeconomic effects is the existing conditions of the project, rather than pre-project conditions. There is no indication on the record that a new license would contribute to any wealth transfer from area tribes by further reducing the quality of the salmon fishery in the project. In contrast, many of the proposed measures would improve future conditions for anadromous fish within the project and downstream in the Hanford Reach. Insofar as proposed environmental measures protect and enhance anadromous fish, Grant PUD's proposal would have some positive effect on tribal socioeconomic conditions.

With respect to the Yakama Nation's recommendation for Grant PUD to allocate a portion of the project output to the Yakama Nation and neighboring counties, the Commission's policy is not to require compensation on relicensing for alleged impacts experienced during the term of the original license as a result of construction and operation of the project consistent with the terms of its license. In any event, there is no evidence that neighboring counties have been negatively affected by the project. Yakima County asserts generally that the project detrimentally impacts fish and wildlife resources and shorelines within its boundaries, and adversely affects recreational opportunities for its citizens (Yakima County's Motion to Intervene, filed May 7, 2005). It also states that the project should benefit the public on a regional basis, and asserts that it has not received any such benefits (Yakima County's May 27, 2005 response to the Commission's Notice of Application ready for Environmental Analysis). Yakima County does not, however, make any specific allegations of harm.

The project's effects on fish and wildlife are discussed elsewhere in this document in great detail, and appropriate mitigation measures are recommended. As to recreation, the project area includes many recreation sites to which citizens of the Yakima County have easy access via Interstate 90 and connecting roads. There are no project-related facilities in Yakima County, but this is most likely because the U.S. Army's Yakima Training Center, which is used for military training, restricts access to the eastern portion of Yakima County bordering the Priest Rapids reservoir.

Kittitas County receives economic benefits from the project because Public Utility District No. 1 of Kittitas County receives low-cost project power as a preference party pursuant to Public Law No. 83-544. There are also several developed and undeveloped recreation facilities wholly or partially within the project boundary in Kittitas County operated by Grant or others. *See* Application, Volume 5, Exhibit E7 at Section 7.3.1-2

and Figure E7-3. The great majority of Kittitas County residents also have easy access to project area facilities via I-90. The Kittitas County Department of Public Works recommends various recreational improvements, several of which Grant has agreed to undertake and which we are recommending be included in any new license issued.

As to Yakama itself, its allegations of past and continuing harm from the project related to fish and wildlife and cultural resources are discussed elsewhere in this document, which makes many recommendations for mitigation and enhancement measures.

Benton Rural Electric Association filed comments asserting merely that its consumer-owners have an interest in environmental issues related to the project because of their proximity to it, and states its desire for a short-term arrangement under which it purchases project power to be converted to a long-term arrangement (Benton Rural Electric Association's Motion to Intervene, filed January 6, 2004). Grant County's power sales agreements are not a matter for consideration in the license except to the extent that its obligations under Public Law 83-544 are implicated. Grant PUD's compliance with that statute, as discussed below, will be considered in the Commission's order dealing with the merits of Grant PUD's applications.

Finally, Pat Kelleher states that because Grant receives most of the economic benefits of the project, its retail rates are dramatically lower than those of some other neighboring counties. He contends that the public interest requires the project to be treated as a regional resource, with the economic benefits shared by all of the counties in the project area. To this end, he recommends a license article requiring Grant to sell most or all of the project power pursuant to a nondiscriminatory market-based mechanism (Comments filed February 17, 2004, May 3, 2004, and May 17, 2005).

It is the Commission's long-standing and consistently applied policy not to require a licensee to allocate project power in the absence of a legislative directive to the contrary. *Power Authority of the State of New York*, 109 FERC ¶ 61,092 (2004) The only expression of legislative intent with respect to this project is the Congressional determination in P.L. 83-544 that economic benefits should be shared through the Reasonable Portion allocation. As required by prior orders of the Commission, Grant PUD has submitted with its application a marketing plan for making a portion of the Project power available to the region (Grant PUD, 2003). Whether the marketing plan is in compliance with P.L. 83-544 and the Commission's prior orders is a matter for consideration in the merits order on Grant PUD's application.

3.10.3 Unavoidable Adverse Impacts

None

3.11 EFFECTS OF NO-ACTION ALTERNATIVE

Under the No-Action Alternative as defined by the staff, the project would continue to operate as it is currently. There would be no significant change to the existing environmental setting or project operation. No new environmental measures would be implemented.

3.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Our recommended action alternative to relicense this existing project would not irreversibly or irretrievably commit any significant developmental or nondevelopmental resources in the basin. At any point in the future, project facilities and operations could be modified or removed and any future or ongoing effects altered. There is no new capacity or construction proposed or recommended that would commit lands or resources in an irreversible manner.

3.13 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Our recommended operating alternative for the project is expected to provide an average of 9,754,000 kWh of energy each year to the region. This long-term energy productivity would extend for at least as long as the duration of the new license. Our recommendations are designed to minimize or avoid long-term decreases in biological productivity of the system, as well as enhance aquatic habitat and local and regional recreational opportunities.

If the project were operated solely to maximize hydroelectric generation, there could be a loss of long-term productivity of the river fisheries due to decreases in fish passage and adverse effects on downstream fish habitat in the Hanford Reach. By constraining power operations to protect and enhance fish habitat, the Priest Rapids Project sacrifices short term energy benefits to mitigate the cumulative effects of all the Mid-Columbia Projects on fish. Moreover, many efforts to enhance recreational opportunities at the project would be foregone.

With the proposed operating mode, as well as with proposed and recommended enhancement and protection measures, the project would continue to provide a low-cost,

environmentally sound source of power. The project, with our recommended measures, would further many of the goals and objectives identified by agencies, tribes, and other interested parties.

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