

COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE KLAMATH HYDROELECTRIC PROJECT

Docket No. P-2082-027

Section 4
Developmental Analysis
Pages 4-1 to 4-21
DEIS

4.0 DEVELOPMENTAL ANALYSIS

In this section, we analyze the project’s use of the water resources of the Klamath River to generate power, estimate the economic benefits of the Klamath Hydroelectric Project, and estimate the cost of various environmental protection and enhancement measures and the effects of these measures on project operations.

Under its approach to evaluating the economics of hydropower projects, as articulated in Mead Corporation, Publishing Paper Division (72 FERC ¶61,027, July 13, 1995), the Commission employs an analysis that uses current costs to compare the costs of the project and likely alternative power with no consideration for potential future inflation, escalation, or deflation beyond the license issuance date. The Commission’s economic analysis provides a general estimate of the potential power benefits and costs of a project and reasonable alternatives to project-generated power. The estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license.

For our economic analysis of alternatives, we used the assumptions, values, and sources shown in tables 4-1 and 4-2.

Table 4-1. Staff assumptions for economic analysis of the Klamath Hydroelectric Project.
(Source: Staff)

| Assumption | Value | Source |
|--|---|-------------------------|
| Energy rate (2006\$) | 43.62 mills/kWh (on-peak) 34.20 mills/kWh (off-peak) | PacifiCorp ^a |
| Capacity rate (2006\$) | Included in energy value | |
| Return on project equity | 10.8 percent | PacifiCorp ^b |
| Bond/debt ratio | 0.5 | PacifiCorp ^c |
| Overall cost of money | 8.057 percent | PacifiCorp ^d |
| Discount rate | 7.5 percent | PacifiCorp ^e |
| State and federal income tax rate | 35 percent | PacifiCorp ^f |
| Local tax rate | 3 percent | Staff |
| Insurance rate | 0.25 percent of initial net investment | Staff |
| Term of financing | 20 years | Staff |
| Period of analysis | 30 years | Staff |
| Escalation rate prior to 2006 | 2.4 percent | Staff |
| Escalation rate after 2006 | 0 percent | Staff |
| Relicensing costs | \$12,600,000 (as of 3/31/03) | PacifiCorp |
| No-action average annual generation (MWh) ^g | 716,820 | PacifiCorp |
| No-action dependable capacity (MW) | 42.7 | PacifiCorp |

^a Value provided by PacifiCorp for April 1, 2006, through March 31, 2007, in its AIR response dated April 1, 2005. The value was based on the average of Mid-Columbia and California-Oregon border estimates. Given the current estimate of on-peak and off-peak generation, the resulting composite energy rate was assumed to be about \$41.50/MWh.

^b Value provided by PacifiCorp in its 2004 U.S. Securities and Exchange Commission Form 10-K report, p. 13 (Oregon); p. 15 (California), not provided in 2005 10-K.

^c Value based on the ratio of long-term debt to total capitalization from PacifiCorp’s 2005 Form 10-K, p. 24.

^d Value from Order #05-1050 Oregon Public Utility Commission, September 28, 2005, p. 10.

^e Value provided by PacifiCorp in its July 21, 2004, deficiency response.

^f Value provided by PacifiCorp in its 2005 Form 10-K report, p. 105.

^g The no-action alternative does not include any incremental energy at the Fall Creek powerhouse associated with flows provided by the Spring Creek diversion. PacifiCorp provided the average annual generation based on a 30-year long-term average.

1 Table 4-2. Net investment value and operation and maintenance cost assumptions for the
 2 economic analysis of the Klamath Hydroelectric Project. (Source: PacifiCorp
 3 deficiency response dated July 21, 2004)

| Development | Net Investment^a (as of 3/31/03) | Operation and Maintenance^a (as of 3/31/03) |
|---------------------------|---|--|
| Upper Klamath Lake | \$4,237,220 | \$25,000 |
| East Side | \$691,500 | \$256,000 |
| West Side | \$28,410 | \$73,000 |
| Keno | \$4,810,350 | \$54,000 |
| J.C. Boyle | 12,571,160 | \$1,165,000 |
| Copco No. 1 | \$5,298,730 | \$772,000 |
| Copco No. 2 | \$4,897,600 | \$999,000 |
| Fall Creek | \$107,160 | \$134,000 |
| Fall Creek (Spring Creek) | \$64,308 | \$67,000 |
| Iron Gate | \$9,121,440 | \$666,000 |

4 ^a For the No-action Alternative, all of the net investment values and operation and maintenance values shown
 5 above would be included, except for the values associated with the Spring Creek facilities, which were not part
 6 of the current license. For PacifiCorp's Proposal, all of the values shown above would be used, except for the
 7 values for Upper Klamath Lake, East Side, West Side, and Keno developments, which would not be included in
 8 a new license. The net investment values do not include relicensing costs.

9 Table 4-3 compares the power value, annual costs, and net benefits for the No-action Alternative,
 10 Pacificorp's Proposal, the Staff Alternative, the Staff Alternative with Mandatory Conditions, and the
 11 Retirement of Copco No. 1 and Iron Gate Developments, which are discussed in details in sections 4.1,
 12 4.2, 4.3, 4.4, and 4.5, respectively. Appendix A, table A-1, shows the effect on costs and power values of
 13 individual measures proposed by PacifiCorp, recommended by others, and considered by staff for
 14 inclusion in the Staff Alternative. In section 5.2, *Discussion of Key Issues*, we discuss our reasons for
 15 including key measures in the Staff Alternative and why we consider the environmental benefits to be
 16 worth these costs.

17 Table 4-3. Summary of the annual net benefits in 2006 dollars for PacifiCorp's Proposal, the
 18 Staff Alternative, Staff Alternative with Mandatory Conditions, Retirement of
 19 Copco No. 1 and Iron Gate Developments, and the No-action Alternative for the
 20 Klamath Hydroelectric Project. (Source: Staff)

| | No Action | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|-----------------------------------|-----------------------|----------------------------------|------------------------------|--|---|
| Installed capacity (kW) | 161,338 | 157,550 | 157,550 | 157,550 | 119,550 |
| Annual generation (MWh) | 716,820 | 676,455 | 669,215 | 497,931 | 448,605 |
| Annual power value (mills/kWh) | \$29,748,030 41.50 | \$28,072,880 41.50 | \$27,772,420 41.50 | \$20,664,130 41.50 | \$18,617,110 41.50 |
| Annual cost (mills/kWh) | \$10,337,630 14.42 | \$15,319,450 22.65 | \$20,245,720 30.25 | \$49,413,530 99.24 | \$24,297,140 54.16 |
| Annual net benefit (mills/kWh) | \$19,410,400 27.08 | \$12,753,430 18.85 | \$7,325,700 11.25 | -\$28,749,400 -59.70 | -\$5,680,030 -12.66 |

1 **4.1 POWER AND ECONOMIC BENEFITS OF THE NO-ACTION ALTERNATIVE**

2 Under the No-action Alternative, the Klamath Hydroelectric Project would include all of the
3 facilities that are included under the current license, which includes East Side, West Side, and Keno
4 developments. The Spring Creek diversion was not included in the current license and is not included in
5 the No-action Alternative. The project would continue to operate as currently operated.

6 The project would continue to generate an average of 716,820 MWh of electricity annually, have
7 an annual power value of \$29,748,030 (41.50 mills/kWh), and total annual costs of \$10,337,630 (14.42
8 mills/kWh), resulting in a net annual benefit of \$19,410,400 (27.08 mills/kWh).

9 **4.2 POWER AND ECONOMIC BENEFITS OF PACIFICORP’S PROPOSAL**

10 As proposed by PacifiCorp, the Klamath Hydroelectric Project would include only J.C. Boyle,
11 Copco No. 1, Copco No. 2, Fall Creek (including the Spring Creek diversion), and Iron Gate
12 developments. East Side and West Side developments would be retired and decommissioned, and Keno
13 development would not be included in the new license.

14 The retirement and decommissioning of East Side and West Side developments would remove
15 3.8 MW from the available generating capacity of the region and would reduce the amount of generation
16 produced annually in the region by 18,800 MWh, based on the long-term average annual generation for
17 years 1973-2002 (30 years). The decommissioning of these facilities would slightly increase the need for
18 power in the region, as discussed in section 1.2, *Need for Power*.

19 Essentially all of the project facilities associated with these two developments would be removed,
20 and the sites would be re-graded to the natural contours and re-vegetated (section 2.2.1 provides a detailed
21 description of the decommissioning of these developments). PacifiCorp estimates that the
22 decommissioning of East Side and West Side developments would cost about \$844,000 in 2006 dollars
23 (letter from T. Olsen, PacifiCorp, to the Commission, dated July 21, 2004).

24 The removal of Keno development from the licensed project would not affect the annual
25 generation of the proposed project as there are no generating facilities at the site, and PacifiCorp states
26 that the operation of Keno development does not affect the generation of downstream hydroelectric
27 facilities. Costs associated with the continued operation of Keno would not be included as part of the
28 proposed project, but would continue to be borne by PacifiCorp, the owner of Keno dam.

29 The facilities and operation and maintenance costs associated with the Spring Creek diversion
30 would be included in the proposed project.

31 The proposed project would generate an average of 676,455 MWh of electricity annually, have an
32 annual power value of \$28,072,880 (41.50 mills/kWh) and total annual costs of \$15,319,450 (22.65
33 mills/kWh), resulting in a net annual benefit of \$12,753,430 (18.85 mills/kWh).

34 **4.3 POWER AND ECONOMIC BENEFITS OF THE STAFF ALTERNATIVE**

35 Resource agencies and non governmental organizations recommend implementing a variety of
36 measures at the project. We reviewed each recommendation and determined the measures that were most
37 appropriate for implementation. We also considered other recommendations that are warranted for
38 inclusion in a new license to protect and enhance project resources.

39 The Staff Alternative for the Klamath Hydroelectric Project would include J.C. Boyle, Copco No.
40 1, Copco No. 2, Fall Creek (including the Spring Creek diversion), and Iron Gate developments.

41 Under the Staff Alternative, the project would generate an average of 669,215 MWh of electricity
42 annually, have an annual power value of \$27,772,420 (41.50 mills/kWh) and total annual costs of
43 \$20,245,720 (30.25 mills/kWh), resulting in a net annual benefit of \$7,526,700 (11.25 mills/kWh).

1 **4.4 POWER AND ECONOMIC BENEFITS OF THE STAFF ALTERNATIVE WITH**
2 **MANDATORY CONDITIONS**

3 NMFS and Interior have made preliminary fishway prescriptions for this project pursuant to
4 section 18 of the FPA which, when finalized, the Commission would need to include in a new license for
5 this project (see section 2.3.1.2). Similarly, the Bureau of Land Management and Bureau of Reclamation
6 have specified in accordance with section 4(e) of the FPA, preliminary conditions which, when finalized,
7 would also need to be included in a new license for this project (see section 2.3.1.3). The Staff
8 Alternative with Mandatory Conditions includes those measures, and in some cases, the mandatory
9 conditions replace staff-recommended measures. We describe this alternative in section 2.3.3. Under this
10 alternative, the project would generate an average of 497,931 MWh of electricity annually, have an
11 annual power value of \$20,664,130 (41.50 mills/kWh) and total annual costs of \$49,413,530 (99.25
12 mills/kWh), resulting in a net annual benefit of -\$28,749,400 (-59.70 mills/kWh).

13 **4.5 POWER AND ECONOMIC BENEFITS OF RETIREMENT OF COPCO NO. 1**
14 **AND IRON GATE DEVELOPMENTS**

15 Staff also analyzed an alternative that would reduce the financial implications, while meeting
16 most of the environmental objectives, of the Staff Alternative with Mandatory Conditions. Under
17 Retirement of Copco No. 1 and Iron Gate Developments, the Copco No. 1 and Iron Gate dams would be
18 removed to facilitate anadromous fish passage to historical habitat and eliminate water quality problems
19 associated with Copco and Iron Gate reservoirs. We describe this alternative in section 2.3.4. Under this
20 alternative, the project would generate an average of 448,605 MWh of electricity annually, have an
21 annual power value of \$18,617,110 (41.50 mills/kWh) and total annual costs of \$24,297,140 (54.16
22 mills/kWh), resulting in a net annual benefit of -\$5,680,030 (-12.66 mills/kWh).

23 **4.6 CONCEPTUAL COSTS OF PROJECT DAM REMOVAL**

24 Various entities have advocated the removal of some or all project dams to facilitate restoration
25 of anadromous fish to historic habitat upstream of Iron Gate dam and as a potential means to enhance
26 water quality in the Klamath River downstream of Iron Gate dam. We prepared an independent
27 conceptual evaluation of the potential costs associated with removal of Keno, J.C. Boyle, Copco No. 1,
28 Copco No. 2, and Iron Gate dams with decommissioning of the hydroelectric facilities. In addition, we
29 evaluated the decommissioning of the Fall Creek hydroelectric facilities and removal of the diversion
30 structures to facilitate movement of resident fish. If any project dams are removed, more detailed on-site
31 evaluations would be necessary to develop detailed decommissioning and dam removal engineering and
32 environmental plans.

33 We have not estimated the potential salvage value of any materials removed from the
34 developments that would offset the decommissioning and removal costs. We assume for our base costs
35 that any sediment in the reservoirs would be re-distributed downstream naturally (similar to conditions
36 assessed by Stillwater Sciences, 2004) in a controlled manner at no additional cost (other than costs
37 associated with a staged, sequential dam removal process to avoid sediment release during a single event).
38 This assumption is predicated on the fact that sediment in each of the project reservoirs is uncontaminated
39 (similar to the assumption made by G&G Associates (2003) in its independent dam removal assessment).

40 If contaminated sediment is found, and is not suitable for downstream transport, the costs of dam
41 removal would be substantially higher. Actual costs for contaminated sediment removal and disposal
42 would depend on the nature of the contaminants. We use a range of \$162,500 to \$487,500 per acre-foot,
43 based on estimates developed for removal of contaminated sediment at other dam removal projects to
44 provide a general framework of what such costs could be at each mainstem development. The amount of
45 sediment to be removed would depend on site-specific conditions and the nature of contaminants. It
46 could be feasible to allow sediment not subject to scour following dam removal to remain in place with or

1 without capping. However, to provide a conservative estimate of costs, we assume all sediment
2 associated with reservoir lost storage (as shown in table 3-3) would need to be removed. Our base costs
3 also assume that the exposed bottoms of the reservoirs would naturally re-vegetate, except for the areas
4 disturbed by dam removal. We assume that no additional restoration costs for reservoir or downstream
5 riparian habitat that may be influenced by sediment releases during dam removal would be required
6 beyond the immediate dam site. In addition, we assume that all project-related roadways would remain in
7 place with no modifications.

8 **4.6.1 Keno Development**

9 The Taintor gates would be opened to drain the reservoir and then removed. The dam and
10 fishway concrete, earthen abutment, and control building with contents would be removed. The site
11 would be re-graded and re-vegetated along the shore of the river channel in proximity to the dam. We
12 estimate the decommissioning and removal of the Keno facilities would cost about \$2,680,000 (2006
13 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an additional \$14
14 to \$43 million. Substantial additional costs would be incurred by others if the water supply intakes at
15 Keno reservoir need to be redesigned to retain their current function.

16 **4.6.2 J.C. Boyle Development**

17 The reservoir would be drained in stages to allow much of the dam and associated structures to be
18 removed in the “dry.” This also would enable shoreline habitat to gradually acclimate as the reservoir
19 drains. This approach would be used, to the extent possible, for the removal of other project dams on the
20 mainstem. The Taintor gates could be opened to drain the reservoir to elevation 3,781.5 feet. The
21 reservoir could be further lowered to elevation 3,768 feet through the powerhouse conveyance pipeline,
22 canal, and tunnel. If operable, the dam bypass drains could be used to draw the reservoir down to
23 approximately elevation 3,750 feet. The base of the embankment dam is at about elevation 3,726 feet.
24 The remaining water in the reservoir would need to be removed prior to completion of dam removal.
25 This could be accomplished by creating a diversion channel through the dam using sheetpile driven to
26 bedrock. The entire embankment dam would be removed. Once this occurs, all concrete structures
27 associated with the power conveyance intake, Taintor gate structure, fishway, and other structural
28 components would be removed. The embankments at each end of the former dam would be re-graded
29 and re-vegetated.

30 The steel pipeline and supporting steel and concrete would be removed. The concrete structures
31 associated with the canal intake, canal flume, canal spillway, and tunnel entrance structure would be
32 removed. The lands under and adjacent to the canal flume would be backfilled and re-graded to stabilize
33 the slopes and the area would be re-vegetated. The downslope channel associated with the former canal
34 emergency spillway would be backfilled and stabilized to the edge of the Klamath River. The penstocks,
35 supports, and anchors would be removed, and the tunnel portals would be sealed.

36 The powerhouse crane would be dismantled and removed. The powerhouse substructure and
37 surface slab would remain intact. The powerhouse equipment would be removed. Any wooden materials
38 in the powerhouse would be removed. Any components from the powerhouse containing chemical or
39 other hazardous materials would be removed from the site, including transformers, bushings, batteries,
40 tanks, lead bearings, and asbestos-based insulating products. Windows and doors in the powerhouse and
41 the penstock entrance would be sealed to prevent public access. The turbine/generator openings in the
42 concrete powerhouse slab would be sealed with concrete, as would the draft tube openings. The walls of
43 the tailrace flume would remain. The tailrace area would be backfilled and re-graded to match the river
44 embankment upstream and downstream of the powerhouse area and stabilized as necessary.

1 The 0.24-mile-long, 69-kV, de-energized transmission line from the switchyard to Transmission
2 Line 18 would be removed, and the transmission right-of-way would be restored to natural conditions.
3 The switchyard serves non-project purposes and would be retained.

4 We assume that the support buildings located near the dam would be sold for other purposes. The
5 warehouse near the powerhouse would be removed.

6 We estimate the decommissioning and removal of the J.C. Boyle facilities would be \$13,951,000
7 (2006 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an
8 additional \$2 to \$7 million.

9 **4.6.3 Copco No. 1 Development**

10 We assume that it would be feasible to restore the existing dam drain gates and use them to drain
11 the reservoir. This would allow for removal of the dam by sawcutting or other methods without the need
12 to notch the dam to lower the reservoir. The dam would be removed to the natural river channel upstream
13 and downstream of the dam. No excess foundation material that was required to provide a solid
14 foundation for the dam would be removed. The penstocks would be removed entirely. The powerhouse
15 intake structure foundation and gatehouse would be sealed and the gatehouse secured. Once the dam is
16 removed, the dam drain structures would be removed and the tunnel sealed.

17 The powerhouse would remain. The penstock and tailrace openings would be sealed. The
18 powerhouse equipment and any wooden materials in the powerhouse would be removed. Any
19 components from the powerhouse containing chemicals or other hazardous materials would be removed
20 from the site. Windows and doors in the powerhouse would be sealed to prevent public access.

21 The two 0.7-mile-long, 69-kV lines from the Copco No. 1 powerhouse to the Copco No. 1
22 switchyard would be removed (the Copco No. 1 switchyard serves as a point of interconnection for the
23 Iron Gate and Copco No. 2 powerhouses). We assume for cost estimation purposes that Copco No. 1 dam
24 would only be removed if the Iron Gate and Copco No. 2 developments were decommissioned, and
25 therefore, the Copco No. 1 switchyard would no longer be needed as a point of interconnection. The
26 switchyard site and transmission line rights-of-way would be restored to natural conditions.

27 We estimate the decommissioning and removal of the Copco No. 1 facilities would cost
28 \$10,986,000 (2006 dollars). If contaminated sediment requires removal prior to dam removal, the costs
29 could increase an additional \$955 million to \$2.9 billion.

30 **4.6.4 Copco No. 2 Development**

31 The reservoir would be drained through the Taintor gates. Once drained, the gates and gate
32 structure would be removed. The power tunnel entrance would be sealed and the majority of the tunnel
33 intake structure removed. The river banks would be re-graded and re-vegetated, and the area where the
34 intake structure had been would be backfilled, re-graded, and re-vegetated.

35 The woodstave penstock, supports, and anchors would be removed, and the tunnel entrances
36 sealed. The tunnel exit portal and the tunnel spillway portal would be sealed. The powerhouse would
37 remain, and the penstock and tailrace openings would be sealed. The powerhouse equipment and any
38 wooden materials in the powerhouse would be removed. Any components from the powerhouse
39 containing chemicals or other hazardous materials would be removed from the site. Windows and doors
40 in the powerhouse would be sealed to prevent public access.

41 The Copco No. 2 powerhouse serves as the point of interconnection for the Iron Gate
42 development via the Copco No. 2 transmission connection to the Copco No. 1 switchyard. We assume
43 for cost estimation purposes that Copco No. 2 development would only be decommissioned if Iron Gate
44 development was decommissioned. Thus, the 1.23-mile-long, 69-kV transmission line from the Copco

1 No. 2 powerhouse to the Copco No. 1 switchyard would be removed. The transmission line right-of-way
2 would be restored to natural conditions. Since the Copco No. 2 switchyard serves non-project purposes, it
3 would be retained.

4 We estimate the decommissioning and removal of the Copco No. 2 facilities would cost
5 \$2,381,000 (2006 dollars). It is unlikely that there would be enough sediment in Copco No. 2 reservoir to
6 substantially influence this cost estimate.

7 **4.6.5 Fall Creek Development**

8 The Spring Creek diversion dam and diversion structures would be removed. The excavated
9 diversion ditch from the diversion dam to its end in the Fall Creek drainage basin would be backfilled and
10 graded. The diversion site would be restored to natural grades, if possible, and re-vegetated along the
11 creek banks.

12 The Fall Creek diversion dam and diversion structures also would be removed. The earth and
13 rock diversion ditch from the Fall Creek diversion dam to the penstock intake would be backfilled and
14 graded. The diversion site would be restored to natural grades, if possible, and re-vegetated along the
15 creek banks.

16 The penstock, supports, and anchors would be removed. The powerhouse would remain. The
17 penstock and tailrace openings would be sealed. The powerhouse equipment and any wooden materials
18 in the powerhouse would be removed. Any components from the powerhouse containing chemicals or
19 other hazardous materials would be removed from the site. Windows and doors in the powerhouse would
20 be sealed to prevent public access.

21 The short 69-kV tap line connection to Transmission Line 18 and the 1.65-mile-long, 69-kV
22 transmission line extending from the Fall Creek powerhouse to the Copco No. 1 switchyard would be
23 removed. The transmission line rights-of-way would be restored to natural conditions. There is no
24 switchyard at Fall Creek.

25 We estimate the decommissioning and removal of the Fall Creek facilities would cost \$1,183,000
26 (2006 dollars). It is unlikely that there would be enough sediment behind the Spring or Fall Creek
27 diversion dams to substantially influence this cost estimate.

28 **4.6.6 Iron Gate**

29 We assume that the dam diversion tunnel used during project construction could be used to
30 gradually drain the reservoir and control the release of sediment to the Klamath River downstream of the
31 dam. Once the reservoir has been drained, the dam would be removed. The drainage tunnel would be
32 used to maintain flow past the site during dam removal. The concrete penstock intake structure and
33 penstock would be removed as dam removal progresses, as would the water supply lines for the fish
34 facilities. The reservoir spillway would be abandoned in place.

35 The powerhouse crane would be dismantled and removed. The powerhouse equipment and any
36 wooden materials in the powerhouse would be removed. Any components from the powerhouse
37 containing chemicals or other hazardous materials would be removed from the site. The powerhouse
38 substructure and surface slab would be removed to the lowest slab, which would remain. The
39 powerhouse and tailrace area would be backfilled and re-graded to match the new river embankment
40 upstream and downstream of the powerhouse area. The fish facilities at the base of the dam would be
41 removed entirely. We assume that the Iron Gate Fish Hatchery located south of the dam would remain,
42 although its ability to function as a fish hatchery without its historic water supply would be questionable.

1 The switchyard and 6.55-mile-long, 69-kV transmission line from the Iron Gate switchyard to the
 2 Copco No. 2 powerhouse would be removed. The switchyard site and transmission line rights-of-way
 3 would be restored to natural conditions.

4 We estimate the decommissioning and removal of the Iron Gate facilities would cost \$49,863,000
 5 (2006 dollars). If contaminated sediment requires removal prior to dam removal, it could cost an
 6 additional \$485 million to \$1.5 billion.

7 Table 4-4 contains a summary of our recommendations and costs for dam removal at the Klamath
 8 Hydroelectric Project.

9 Table 4-4. Dam removal recommendations and costs. (Source: Staff)

| Dam/Environmental Measure | Capital Costs (2006\$) | Annual Costs (2006\$) | Annual Energy Costs (2006\$) | Total Annualized Cost (2006\$) |
|--|---|--|---------------------------------------|--|
| Keno | | | | |
| Remove Keno from the licensed project | -\$3,935,470 (remove net investment in project facilities from project – this represents the 2003 net investment value of the Keno facilities (\$4,810,350) depreciated to 2006) | -\$57,980 (remove 2003 O&M cost (\$54,000) from project expenses) | \$0 (no energy implications) | -\$589,210 (reduction in annual expenses) |
| Remove Keno dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible) | \$2,679,680 | \$0 | \$0 | \$361,710 |
| Decommissioning plan for Keno development | \$75,000 (staff) | \$0 | \$0 | \$10,120 |
| J.C. Boyle | | | | |
| Remove J.C. Boyle development from the licensed project | -\$10,284,780 (remove net investment in project facilities from project – this represents the 2003 net investment value of the JCB facilities (\$12,571,160) depreciated to 2006) | -\$1,250,910 (remove 2003 O&M cost (\$1,165,000) from project expenses) | \$13,653,500 (Loss of 329,000 MWh) | \$11,014,310 |
| Remove J.C. Boyle dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible) | \$13,950,560 | \$0 | \$0 | \$1,883,100 |

| Dam/Environmental Measure | Capital Costs (2006\$) | Annual Costs (2006\$) | Annual Energy Costs (2006\$) | Total Annualized Cost (2006\$) |
|---|---|--|---|---|
| Decommissioning plan for J.C. Boyle development | \$150,000 (staff) | \$0 | \$0 | \$20,250 |
| Copco No. 1 | | | | |
| Remove Copco No. 1 development from the licensed project | -\$4,335,030 (remove net investment in project facilities from project – this represents the 2003 net investment value of the Copco No. 1 facilities (\$5,298,730) depreciated to 2006) | -\$828,930 (remove 2003 O&M cost (\$772,000) from project expenses) | \$4,399,000 (Loss of 106,000 MWh) | \$2,984,910 |
| Remove Copco No. 1 dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible) | \$10,986,430 | \$0 | \$0 | \$1,482,990 |
| Decommissioning plan for Copco No. 1 development | \$250,000 (staff) | \$0 | \$0 | \$33,750 |
| Copco No. 2 | | | | |
| Remove Copco No. 2 development from the licensed project | -\$4,006,850 (remove net investment in project facilities from project – this represents the 2003 net investment value of the Copco No. 2 facilities (\$4,897,600) depreciated to 2006) | -\$1,072,670 (remove 2003 O&M cost (\$999,000) from project expenses) | \$5,602,500 (Loss of 135,000 MWh) | \$3,988,970 |
| Remove Copco No. 2 dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible) | \$2,381,280 | \$0 | \$0 | \$321,440 |
| Decommissioning plan for Copco No. 2 development | \$75,000 (staff) | \$0 | \$0 | \$10,120 |
| Fall Creek/Spring Creek | | | | |
| Remove Fall Creek development from the licensed project | -\$87,670 (remove net investment in project | -\$215,820 (remove 2003 O&M cost | \$654,540 (Loss of 15,772 MWh) | \$426,880 |

| Dam/Environmental Measure | Capital Costs (2006\$) | Annual Costs (2006\$) | Annual Energy Costs (2006\$) | Total Annualized Cost (2006\$) |
|---|--|---|---|---|
| | facilities from project – this represents the 2003 net investment value of the Fall Creek facilities (including Spring Creek diversion) (\$171,470) depreciated to 2006) | (\$201,000) from project expenses) | | |
| Remove Fall Creek and Spring Creek diversion dams (in some cases, if fish passage is not feasible) | \$1,183,400 | \$0 | \$0 | \$159,740 |
| Decommissioning plan for Fall Creek development, including Spring Creek diversion | \$50,000 (staff) | \$0 | \$0 | \$6,750 |
| Iron Gate | | | | |
| Remove Iron Gate development from the licensed project | -\$7,462,480 (remove net investment in project facilities from project – this represents the 2003 net investment value of the Iron Gate facilities (\$9,121,440) depreciated to 2006) | -\$715,110 (remove 2003 O&M cost (\$666,000) from project expenses) | \$4,814,000 (Loss of 116,000 MWh) | \$3,091,570 |
| Remove Iron Gate dam (in some cases, if meeting water quality standards and/or if fish passage is not feasible) | \$49,863,720 | \$0 | \$0 | \$6,730,810 |
| Decommissioning plan for Iron Gate development | \$250,000 (staff) | \$0 | \$0 | \$33,750 |

1 **4.7 KENO DEVELOPMENT ANALYSIS**

2 Keno development is a regulating facility that controls the water level of Keno reservoir by
3 releasing water downstream at a rate roughly equivalent to net inflow. This development, located about
4 21 miles downstream of Reclamation’s Link River dam, has no generation capability, and it regulates the
5 water level of, and controls releases from, Upper Klamath Lake. The Commission requires PacifiCorp, in
6 accordance with a 1965 license amendment, to operate Keno reservoir consistent with an agreement with
7 Reclamation that specifies a maximum water surface elevation of 4,086.5 feet and a minimum water

1 surface elevation of 4,085 feet. However, at the request of irrigators, PacifiCorp generally operates Keno
2 dam to maintain the reservoir at elevation 4,085.4 +/-0.1 foot from October 1 to May 15 and elevation
3 4,085.5 +/-0.1 foot from May 16 to September 30 (see figure 3-7). This allows reliable operation of
4 irrigation canals and pumps and results in an active storage volume of 495 acre-feet. Occasional 2-foot
5 drawdowns are implemented before the irrigation season to allow irrigators to clean out their water
6 withdrawal systems. J.C. Boyle reservoir, located about 4.7 miles downstream of Keno dam, has an
7 active storage volume of 1,724 acre-feet.

8 Keno reservoir receives most of its water from Upper Klamath Lake via Link River. Keno
9 reservoir also loses and receives a substantial amount of water from the Lost River diversion channel,
10 North canal, Klamath Straits drain, and the Ady canal associated with the Reclamation's Klamath
11 Irrigation Project (see figure 2-4). According to the Oregon Water Resources Department, in addition to
12 the larger Reclamation diversions, there are numerous much smaller water permits and claims along Keno
13 reservoir, mostly for irrigation on adjacent privately owned agricultural lands. Flows released from Keno
14 dam to the Keno reach are measured about 1 mile downstream at USGS gage no. 11509500.

15 PacifiCorp does not include Keno development as part of its proposed Klamath Hydroelectric
16 Project, stating that, because current operation of the development does not influence hydropower
17 production, it no longer serves any project purpose and is not under the Commission's jurisdiction.
18 Although it would continue to own the dam and appurtenant facilities, PacifiCorp proposes to relinquish
19 all hydropower responsibilities associated with the current license and operate the development according
20 to state of Oregon and Reclamation direction.

21 Keno dam would serve project purposes if it enhanced generation at PacifiCorp's downstream
22 developments. Downstream generation could be enhanced if the dam was able to store water for later
23 release that would otherwise spill (bypassing the turbines) at downstream developments, or by controlling
24 the magnitude and timing of releases to correspond to generation needs at the downstream developments.
25 No parties claim Keno dam is operated to prevent spillage at downstream developments, and we agree
26 that its limited active storage prevents it from serving that function. PacifiCorp's ability to alter the
27 timing and magnitude of flows is limited by its need to maintain the reservoir elevation within a narrow
28 range. Keno dam also would serve project purposes if it was operated to reregulate generation flows from
29 the upstream East Side and West Side powerhouses. Because PacifiCorp proposes to decommission those
30 two developments, we do not consider any reregulation function in our analysis.

31 In response to stakeholder comments, PacifiCorp conducted an analysis of Keno reservoir
32 operation to determine Keno's contribution, if any, to downstream power generation. PacifiCorp modeled
33 92 years (1905-1997) of inflow to Upper Klamath Lake, to which outflows through Link River dam
34 directly correlate. PacifiCorp based its modeling exercise on the following (letter to the Commission
35 dated May 12, 2006):

- 36 • The assumption that the majority of water reaching Keno reservoir is from Upper Klamath Lake.
- 37 • Separation of water years into five categories (wet to dry) based on their likelihood of occurrence.
- 38 • Use of the 1.5-foot operation range at Keno reservoir based on the current contract between
39 Reclamation and PacifiCorp.
- 40 • Use of a theoretical 9-foot operation range at Keno reservoir to examine model sensitivity.
- 41 • Simulation of Keno development operating in a run-of-river mode by assuming Keno dam and
42 reservoir are removed from the physical system and ignoring any irrigation withdrawals or return
43 flows from the Klamath Irrigation Project (outflow from Keno dam is equal to inflow from Link
44 River).
- 45 • Comparison of simulated run-of-river operation to Keno development's current operation, which
46 includes irrigation withdrawals and return flows to Keno reservoir from the Klamath Irrigation
47 Project.

48 Table 4-5 shows the results of PacifiCorp's modeling.

1 Table 4-5. Estimated annual generation (GWh) with and without operation of Keno facilities.
 2 (Source: PacifiCorp, 2006c)

| Inflow Exceedance Level with Current Upper Klamath Lake BiOp Restrictions | Without Keno (GWh/Year) | With Keno | | | |
|---|-------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| | | 1.5 foot Operational Range | | 9.0 foot Operational Range | |
| | | (GWh/Year) | (% Benefit) | (GWh/Year) | (% Benefit) |
| P5 | 964 | 1,000 | 3.80% | 1,001 | 3.80% |
| P25 | 948 | 948 | 0.00% | 951 | 0.40% |
| P50 | 804 | 803 | -0.10% | 802 | -0.20% |
| P75 | 685 | 645 | -6.00% | 643 | -6.20% |
| P95 | 428 | 322 | -24.70% | 321 | -24.80% |

3 Notes: P5: Annual inflow is equal to or greater than, in 5% of the record (Wet year).
 4 P25: Annual inflow is equal to or greater than, in 25% of the record (Upper Quartile year).
 5 P50: Annual inflow is equal to or greater than, in 50% of the record (Median year).
 6 P75: Annual inflow is equal to or greater than, in 75% of the record (Lower Quartile year).
 7 P95: Annual inflow is equal to or greater than, in 95% of the record (Dry year).
 8 Annual period is from May 1 through April 30.

9 According to PacifiCorp, these results show that the contribution of Keno dam to downstream
 10 generation varies depending on water year type. Keno dam benefited downstream generation only during
 11 the wettest 5 percent of years, and that benefit was at most a 3.80 percent increase in generation.
 12 PacifiCorp also states that its modeling demonstrates that, during the driest 5 percent of years, Keno dam
 13 resulted in a 24.7 percent loss of generation. During the middle 90 percent of the years, Keno resulted in
 14 no benefit to a 6.0 percent decrease in downstream generation.

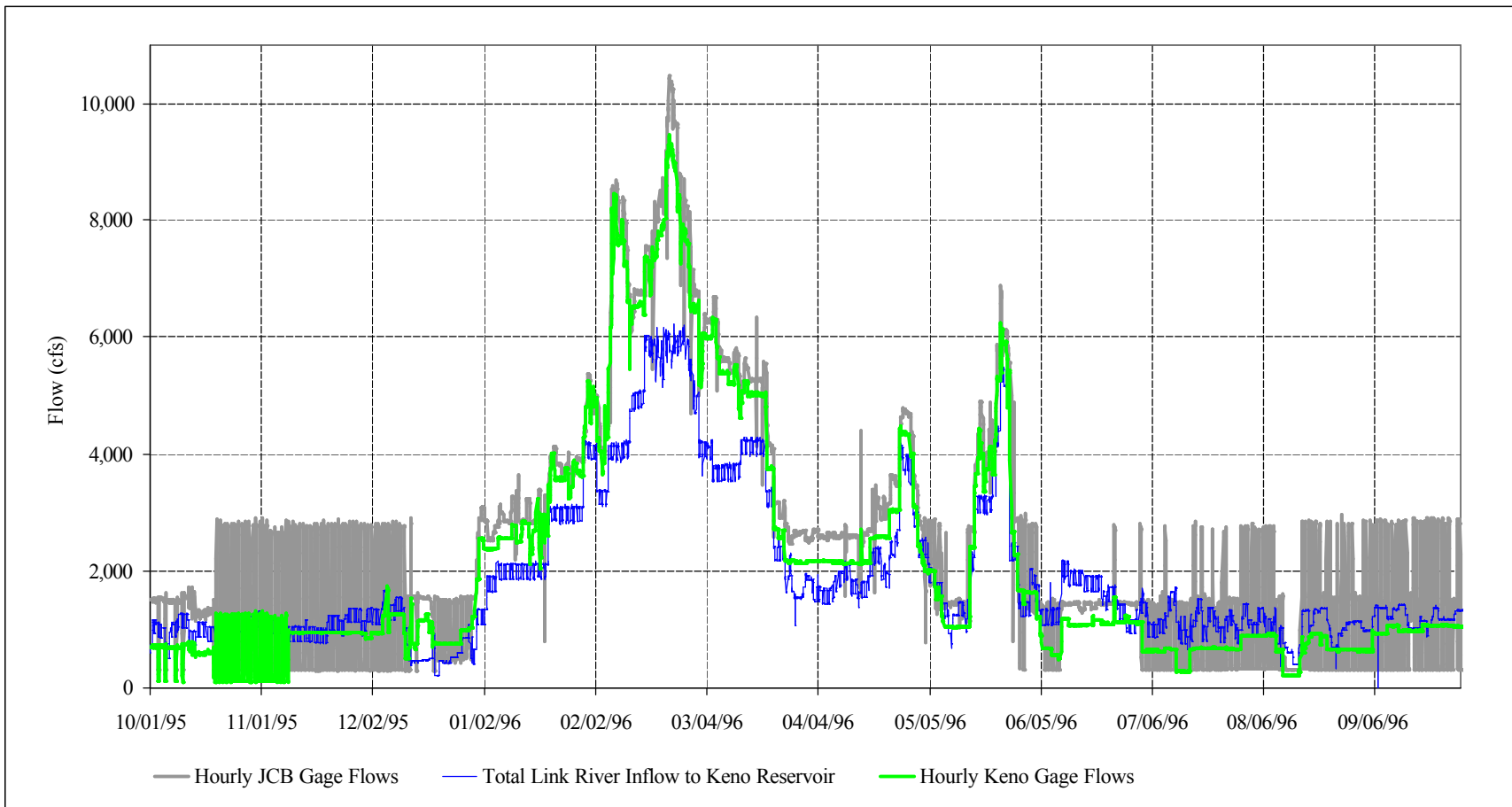
15 To assess the extent that recent operation of Keno development may have benefited PacifiCorp's
 16 downstream peaking operations, we analyzed flow and water level records for the locations shown in
 17 table 4-6 for water years 1991 to 2004. We based our analysis on hourly changes in inflow from all major
 18 sources to Keno reservoir, including back-calculated hourly flows from Klamath Irrigation Project
 19 channels that enter Keno reservoir (besides Link River), hourly reservoir elevation changes at Keno and
 20 J.C. Boyle reservoirs, and hourly (or smaller interval) gage data. Releases from Keno dam take about 2 to
 21 3 hours to reach J.C. Boyle reservoir.

1 Table 4-6. Data description and sources. (Source: Reclamation, 2006a; PacifiCorp, 2005j;
 2 USGS, 2005)

| Gage No. | Description | Source | Time Interval |
|-----------------|--|---------------|----------------------|
| 11507001 | Upper Klamath Lake near Klamath Falls, OR | USGS | Daily |
| 11507500 | West Side powerhouse | PacifiCorp | Hourly |
| | Link River at Klamath Falls, OR | USGS | Quarter Hourly |
| | From Lost River canal | Reclamation | Daily |
| | To Lost River canal | Reclamation | Daily |
| | To North canal | Reclamation | Daily |
| | From Klamath Straits drain | Reclamation | Daily |
| | To Ady canal | Reclamation | Daily |
| 11509500 | Keno reservoir at Keno dam, OR | PacifiCorp | Hourly |
| | Klamath River at Keno, OR (below Keno dam) | USGS | Half Hourly |
| 11510700 | J.C. Boyle reservoir | PacifiCorp | Hourly |
| | J.C. Boyle powerhouse | PacifiCorp | Hourly |
| 11511400 | Gage below J.C. Boyle powerhouse | USGS | Half Hourly |
| 11511400 | Copco reservoir | PacifiCorp | Hourly |
| | Copco No. 1 powerhouse | PacifiCorp | Hourly |

3 Flow records show that water year 1996 best represents the variety of hydrologic conditions
 4 during the period from 1991 to 2004 (figure 4-1). Because releases in accordance with Reclamation’s
 5 BiOps and water bank provisions did not begin until 2003, there is a limited amount of information
 6 available that reflects operations under current flow conditions. However, the monthly flow targets
 7 specified in the BiOps would have little bearing on whether or not PacifiCorp operates Keno development
 8 to enhance downstream hydroelectric operations. Trends shown in flows measured at the Keno gage
 9 during 1996 are also representative of the trends that were evident during 2003 and 2004. The data that
 10 we used to develop figure 4-1 indicate several general relationships:

- 11 • Inflow to Keno reservoir, as measured at the USGS Link River gage and the West Side
 12 powerhouse, is normally lower than the flow measured at the USGS gage below Keno in the
 13 non-irrigation months of December through May, indicating that there is accretion from
 14 sources such as the Lost River diversion channel, Klamath Straits drain, and smaller natural
 15 sources not associated with the Klamath Irrigation Project.
- 16 • Inflow to Keno reservoir is higher than outflow during the irrigation months, indicating
 17 diversion of water to the Lost River diversion channel, North canal, Ady canal, and other
 18 withdrawals.
- 19 • The J.C. Boyle powerhouse generally operates in a peaking mode when the USGS gage
 20 below Keno is below 2,000 cfs, because there is not enough flow to sustain continuous
 21 operation and to take advantage of the cost difference between peak and off-peak generation.
- 22 • West Side powerhouse (with a maximum hydraulic capacity of 250 cfs) operates in a cyclical
 23 mode (i.e., it is either operating at full capacity or not operating at all).



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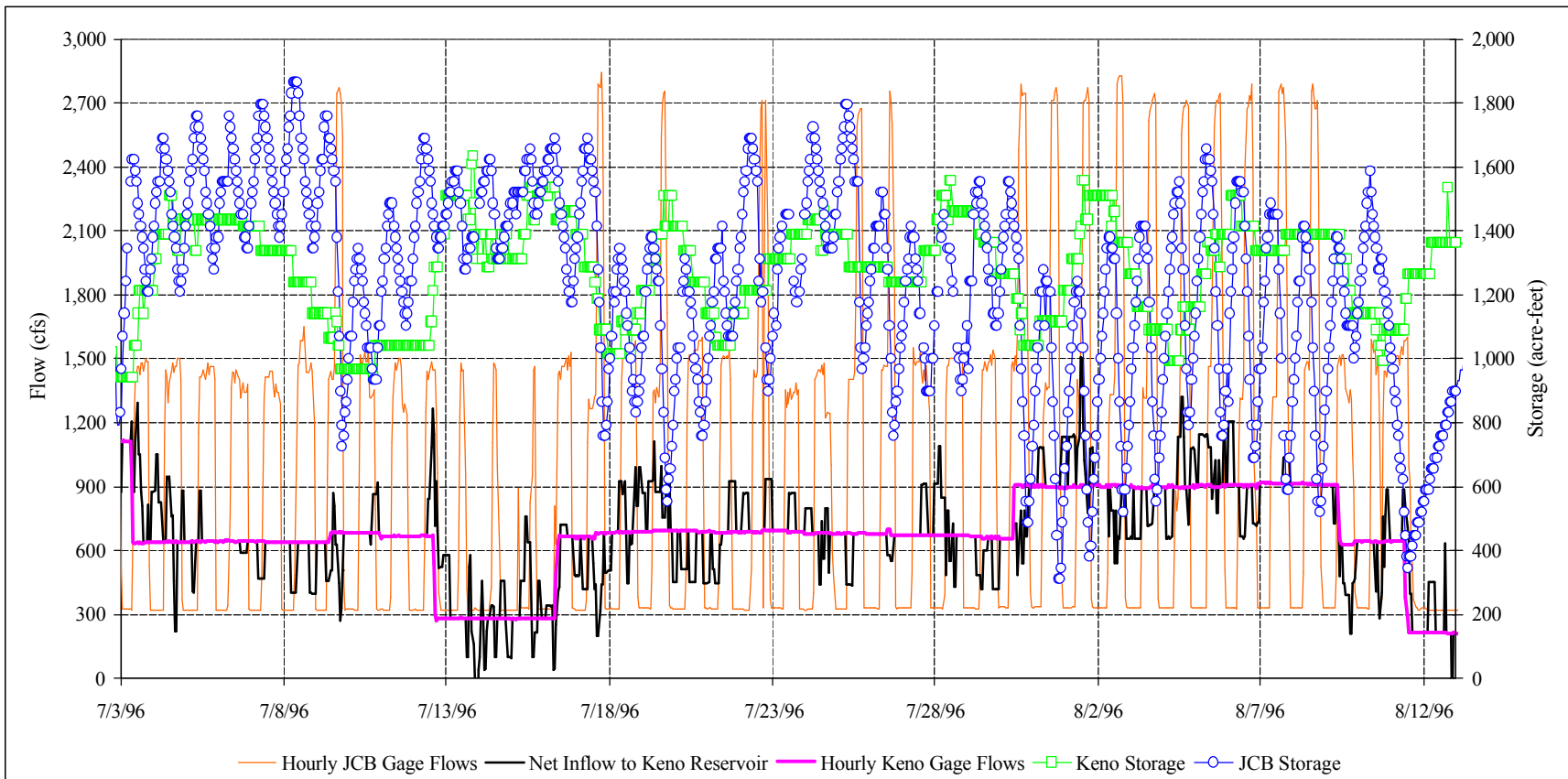
Figure 4-1. Flows entering Keno reservoir via Link River and in the Klamath River downstream of Keno development at USGS gage no. 11509500 and J.C. Boyle development at USGS gage no. 11510700 for water year 1996. (Source: USGS, 2005, as modified by staff)

1 During the irrigation months, most of the difference between the combined flow at the Link River
2 gage and West Side powerhouse and flows released at Keno dam is caused by withdrawals from Keno
3 reservoir by the Lost River diversion channel, North canal, Ady canal, and other withdrawals used largely
4 for irrigation. During the non-irrigation months, other than flows withdrawn from Keno to flood seasonal
5 wetland habitat in the Lower Klamath National Wildlife Refuge, flows enter Keno reservoir from the Lost
6 River diversion channel and the Klamath Straits drain, in addition to Link River. Based on flow data
7 from the gage below the J.C. Boyle powerhouse and accounting for the minimum flow releases from J.C.
8 Boyle dam (100 cfs) and spring accretion in the J.C. Boyle bypassed reach, the J.C. Boyle powerhouse
9 operates or had the ability to operate at full capacity all day about 12 percent of the days in water years
10 1991 to 2003. The generation from these days, when peaking operations would not have occurred,
11 produced about 33 percent of the total generation during that 13-year period.

12 The flow relationships shown in figure 4-2 are representative of the vast majority of the 1991 to
13 2004 water year period that we assessed. If PacifiCorp was manipulating flows from Keno dam to
14 enhance its peaking ability at the J.C. Boyle development and the other downstream powerhouses, we
15 would expect to see a spike in flows measured at the Keno gage about 2 hours before the beginning of
16 peaking operations at the J.C. Boyle powerhouse, which the spikes in flow at the USGS gage downstream
17 of the J.C. Boyle powerhouse, shown in figure 4-2, represent. No such spikes in flow are evident during
18 nearly all periods when J.C. Boyle is operating in a peaking mode, and figure 4-2 shows that water stored
19 in J.C. Boyle reservoir provides the necessary flows to support the peaking operations, not the limited
20 storage available in Keno reservoir.

21 Interior, in its March 27, 2006, letter to the Commission, disagreed with PacifiCorp's assertion
22 that Keno does not serve project purposes and provided three examples consisting of 2 days of flow data
23 each from the USGS gages at Link River, below Keno dam, and below J.C. Boyle powerhouse to show
24 that PacifiCorp has been operating Keno development to enhance hydroelectric power generation
25 downstream of Keno.

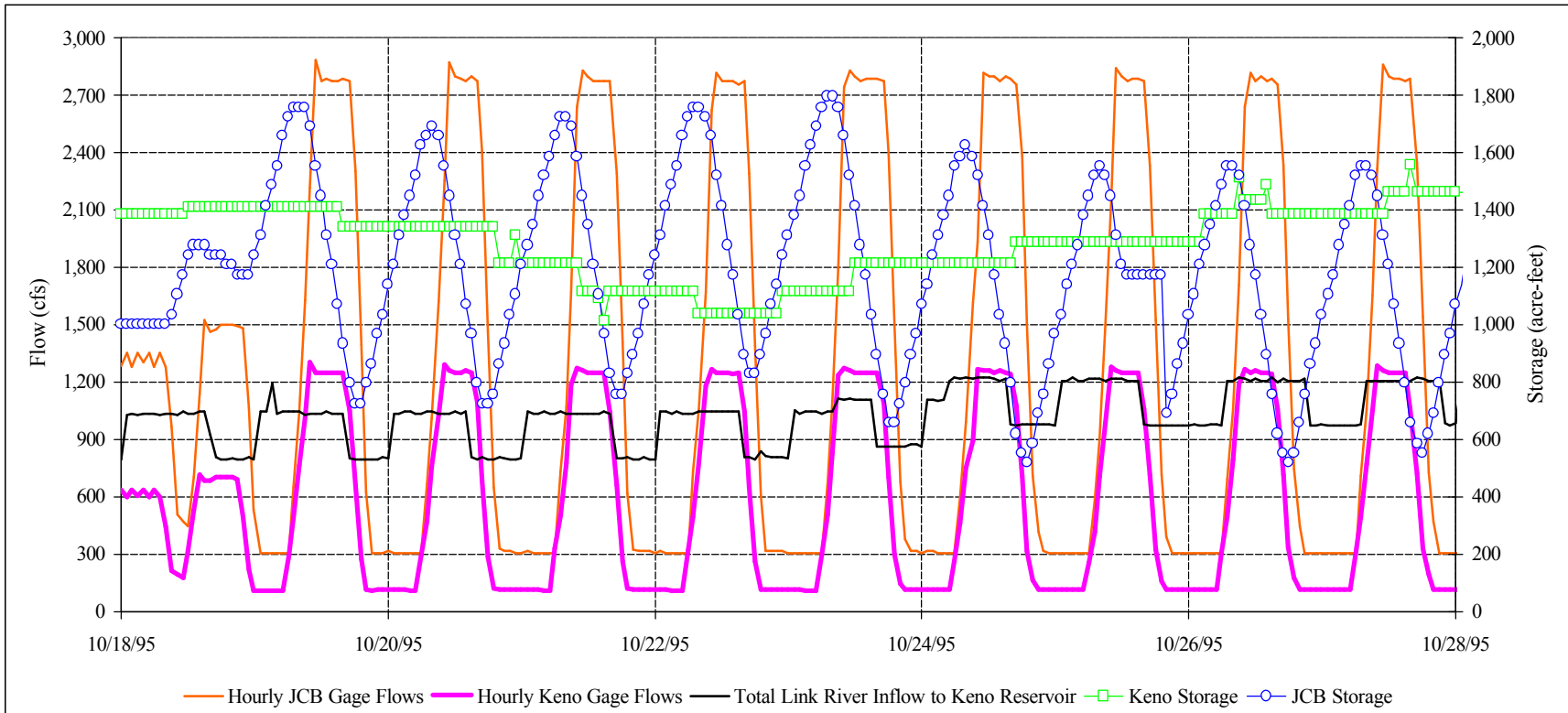
26 During late October and early November, outflow from Keno dam, as measured at the Keno gage,
27 spiked when the J.C. Boyle powerhouse was operating in a peaking mode (see figure 4-1). Figure 4-3
28 shows detailed flow characteristics during this period. Based on the spikes of flow measured at the Keno
29 gage that correspond to peaking releases from the powerhouse, one could conclude, as did Interior, that
30 operation of Keno development was enhancing peaking operations at J.C. Boyle development. This
31 relationship appears similar to the relationship portrayed in the three examples from Interior (March 27,
32 2006, letter).



1

2 Notes: Storage based on water volume between elevations 4,085.00 and 4,086.00 feet for Keno and 3,788.00 and 3,793.20 feet for J.C. Boyle.
 3 During the time period shown on this graph, the elevation at Keno reservoir varied between elevation 4,085.31 and 4,085.66 feet and 3,788.4 and
 4 3,793.4 feet for J.C. Boyle reservoir.

5 Figure 4-2. Relationship between inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse, and storage
 6 at J.C. Boyle and Keno reservoirs—June 1, 1996, until September 12, 1996. (Source: Reclamation, 2006a;
 7 PacifiCorp, 2005j; USGS, 2005; as modified by staff)



1
 2 Notes: Storage based on water volume between elevations 4,085.00 and 4,086.00 feet for Keno and 3,788.00 and 3,793.20 feet for J.C. Boyle.
 3 During the time period shown on this graph, the elevation at Keno reservoir varied between elevation 4,085.41 and 4,085.57 feet and 3,789.50 and
 4 3,793.20 feet for J.C. Boyle reservoir.

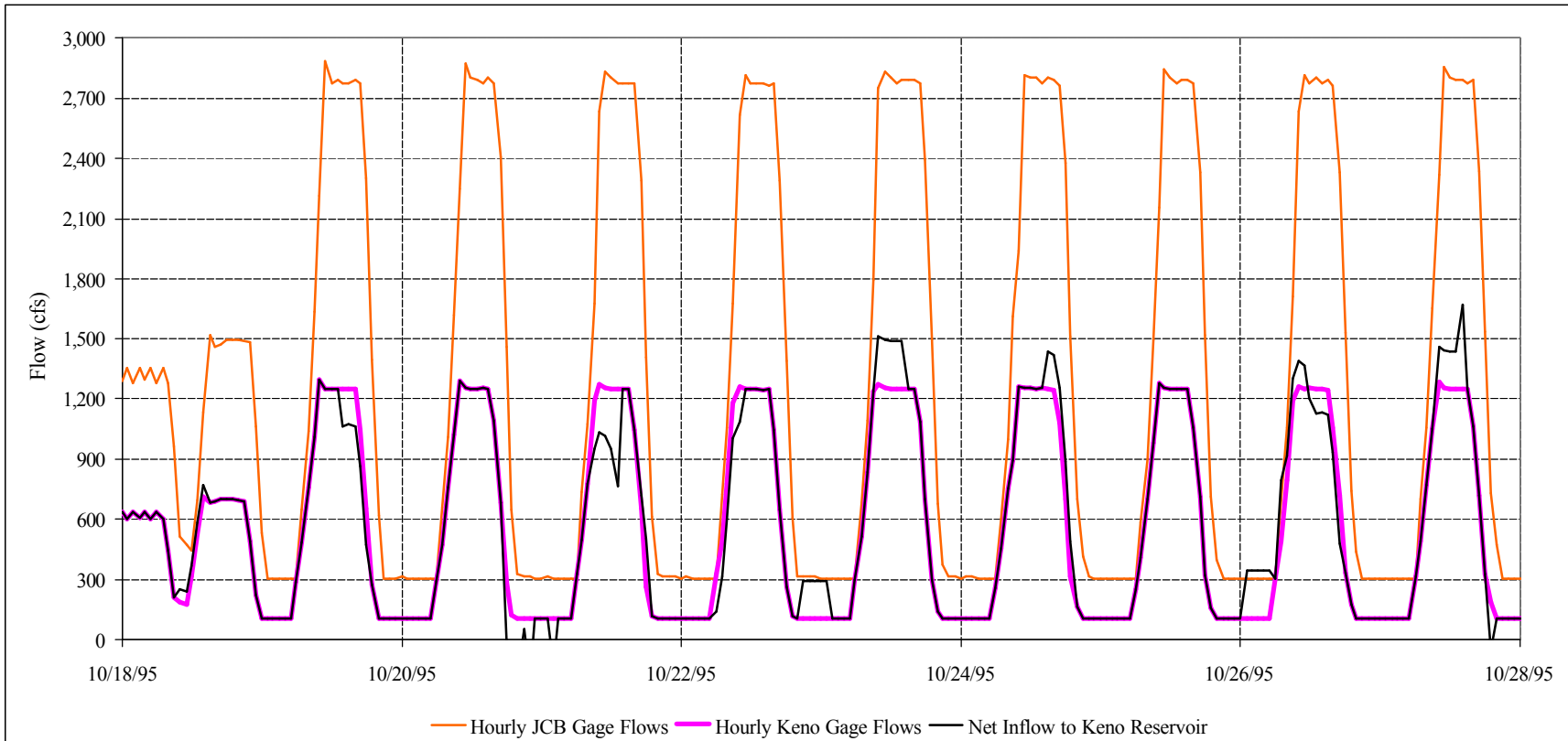
5 Figure 4-3. Relationship between inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse, and storage
 6 at J.C. Boyle and Keno reservoirs—October 18, 1995, until October 28, 1995. (Source: Reclamation, 2006a;
 7 PacifiCorp, 2005j; USGS, 2005; as modified by staff)

8

1 While we understand why, based on our figure 4-3, Interior would conclude that Keno dam
2 influences generation at J.C. Boyle, neither figure 4-3 or Interior's analysis considers water surface
3 elevation in Keno reservoir and likely changes in the Klamath Irrigation Project withdrawals and return
4 flows to Keno reservoir, other than flows that entered the reservoir via Link River. Figure 4-3 does not
5 show the relationship of flows measured at the Keno gage and the total inflow to Keno reservoir, which
6 includes flows from Link River in addition to flows from other Klamath Irrigation Project channels.
7 PacifiCorp states that water from Reclamation's Klamath Irrigation Project entering Keno reservoir via
8 the Klamath Straits drain and the Lost River diversion channel can be highly variable and problematic for
9 maintenance of a stable reservoir elevation. We reviewed inflow and outflow data records for the
10 Klamath Irrigation Project canals and channels at Keno reservoir (available on Reclamation's website),
11 including Klamath Straits drain, Ady and North canals, and the Lost River diversion channel, and these
12 records show a high degree of daily variance. PacifiCorp's maximum and average 24 hour change
13 analysis (PacifiCorp, 2004a) of the Klamath Straits drain for 1995 to 2001 showed an average 24 hour
14 change of 86 cfs. However, about 10 percent of the months during this time period had a maximum daily
15 change in excess of 1,000 cfs. To help maintain a relatively constant level in Keno reservoir, PacifiCorp
16 manages the releases from Keno reservoir as well as spill at Link River dam (on behalf of Reclamation)
17 and generation adjustments at the East Side and West Side powerhouses. If East Side and West Side
18 developments are decommissioned, as PacifiCorp proposes, all aspects of Link River flow that are within
19 the Commission's jurisdiction would be eliminated.

20 Based on the known hourly or shorter interval flow and water level (see table 4-6), mass balance
21 techniques, and assuming that the majority of the unknown inflow or outflow in the Keno reservoir area is
22 from the Klamath Irrigation Project, we estimated hourly inflows and outflows to Keno reservoir. Figure
23 4-4 shows our calculated hourly net inflows to Keno reservoir that can be attributed to operation of the
24 Klamath Irrigation Project, including Link River flows and flows through other irrigation project channels
25 and outflow from Keno dam and J.C. Boyle powerhouse. Releases from Keno dam during this period are
26 virtually identical to the net inflow to Keno reservoir. Without such closely coordinated releases at Keno
27 dam, the water level of Keno reservoir would quickly vary beyond the 0.2 foot operating band that
28 PacifiCorp seeks to maintain. PacifiCorp is successful in maintaining this narrow operating band under
29 most circumstances (see figure 3-7). Consequently, despite Interior's assertions otherwise, the
30 fluctuations in releases from Keno dam are a direct response to equivalent fluctuations in the net inflow to
31 Keno reservoir, rather than an attempt to enhance downstream peaking operations. We cannot determine
32 with certainty the reason for the fluctuations in the inflow to the reservoir shown in figure 4-4, but
33 diversions during the October and November time frame are likely associated with planned seasonal
34 flooding of wetland habitat at the Lower Klamath National Wildlife Refuge (Risley and Gannett, 2006).

35 Our analysis, conducted with a different method than PacifiCorp's analysis, shows that Keno dam
36 is clearly managed to maintain the water level within the restrictive 0.2-foot operational band. Inflow to
37 Keno reservoir tends to often vary on an hourly or daily basis, partly due to Klamath Irrigation Project
38 operations. Our results agree with the results of PacifiCorp's analyses. While in infrequent instances the
39 operation of Keno dam to maintain a steady reservoir elevation results in a very minor enhancement in
40 downstream generation; overall, Keno dam results in no benefit to, or a small net loss of, generation at the
41 downstream developments.



1
 2 Figure 4-4. Relationship between net inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse—
 3 October 18, 1995, until October 28, 1995. (Source: Reclamation, 2006a; PacifiCorp, 2005j; USGS, 2005; as
 4 modified by staff)

1 **4.8 GREENHOUSE GAS EMISSIONS**

2 The project provides low-cost energy that displaces non-renewable, fossil-fueled generation and
 3 contributes to a diversified generation mix. Displacing the operation of fossil-fueled facilities avoids
 4 some power plant emissions and creates an environmental benefit. Table 4-7 shows the amount of carbon
 5 emissions displaced by each development. If the electric output of the current project (716,820 MWh)
 6 was replaced with fossil-fueled generation, greenhouse gas emissions could potentially increase by
 7 110,787 metric tons of carbon per year (using a carbon intensity factor of 155 kgC/MWh). We consider
 8 the most likely fuel for generation in the project area to be natural gas.

9 Table 4-7. Klamath Project carbon emissions displacement. (Source: Staff)

| Development | Average Annual Generation (MWh) | Carbon Emissions (metric tons of carbon per year) |
|--------------------|--|--|
| East Side | 15,400 | 2,372 |
| West Side | 3,400 | 527 |
| J.C. Boyle | 329,000 | 50,666 |
| Copco No. 1 | 106,000 | 16,430 |
| Copco No. 2 | 135,000 | 20,952 |
| Fall Creek | 12,000 | 1,860 |
| Iron Gate | 116,000 | 17,980 |
| Total | 716,800 | 110,787 |

10 Both Oregon and California are working with the state of Washington to develop greenhouse gas
 11 reduction programs as part of the West Coast Governor’s Global Warming Initiative (Governor’s
 12 Advisory Group on Global Warming, 2004). The governors have approved recommendations for actions
 13 to reduce greenhouse gas emissions that are contributing to global warming. Among these initiatives are
 14 goals for greenhouse gas emission on both a short- and long-term basis. Table 4-8 shows those goals.

15 Table 4-8. Oregon and California greenhouse gas reduction goals. (Source: ODE, 2005;
 16 California Energy Commission, 2005; CPUC, 2006)

| Target deadline | Target goal | Target maximum emissions (million metric tons of CO₂) |
|------------------------|---------------------------------|---|
| Oregon | | |
| 2010 | Reduce to 1990 levels | 59 |
| 2020 | Reduce to 10% below 1990 levels | 53 |
| 2050 | Reduce to 75% below 1990 levels | 15 |
| California | | |
| 2010 | Reduce to 2000 levels | 473 |
| 2020 | Reduce to 1990 levels | 426 |
| 2050 | Reduce to 80% below 1990 levels | 85 |

17 Both Oregon and California are in the process of developing Renewable Energy Action plans that
 18 call for increases in the amount of renewable energy used in each state. Although these resources do not
 19 necessarily need to be located in the states, both states are implementing incentives to encourage

1 developers to construct the facilities in their respective states. Oregon has set a goal of supplying 10
2 percent of the power used in the state with renewable energy by 2015 and increased the goal to 25 percent
3 by 2025 (ODE, 2005). California has accelerated its Renewable Portfolio Standard to require 20 percent
4 of all power used in the state to be generated by renewable resources by 2010 and 33 percent by 2020
5 (CEPA, 2006).

6 Most of the planned or approved facilities in the northwest involve construction a considerable
7 distance from the Klamath Hydroelectric Project (NPCC, 2006). The majority of facilities proposed in
8 the state of Oregon would be located along the Oregon-Washington border. Those facilities would
9 primarily be fueled by natural gas, although a number of wind projects also are proposed. However, there
10 are some proposed and newly constructed generation facilities located within the local area (WECC,
11 2005a; 2005b; OEFSC, 2006). Among the larger local projects are the recently completed Klamath
12 Cogeneration Project (542.5 MW), which is fueled by natural gas and the proposed Klamath Generating
13 (500 MW) and COB Energy facilities (1,150 MW). The two proposed facilities also would be fueled by
14 natural gas. Although PacifiCorp owns both the Klamath Cogeneration Project and the Klamath
15 Hydroelectric Project, market rules prevent the power from the cogeneration facility from being sold to
16 Pacific Power (a PacifiCorp subsidiary) for local use. The Klamath Generating Facility is being proposed
17 by Pacific Power /PPM Energy (PacifiCorp subsidiaries). The COB Energy facility is being proposed by
18 People’s Energy. It is not known if the power from the facility could be sold to Pacific Power for local
19 use (PPM Energy, 2006). Smaller facilities planned in the area include the Dorena (8.3 MW) and
20 Applegate (12 MW) hydroelectric projects, several potential wind projects, and a geothermal project.

21 Although one new generation facility exists and two additional facilities are proposed in the
22 Klamath Falls area; the electricity generated at these three facilities may not be available to replace
23 generation from the Klamath Hydroelectric Project facilities if any of the dams are removed and the
24 hydroelectric facilities shut down, depending on applicable market rules for the two proposed new
25 facilities. Any facilities that may be available most likely would be fueled by natural gas. The loss of
26 hydroelectric facilities and replacement by energy facilities fueled by non-renewable natural gas would
27 hinder the efforts of the West Coast Governor’s Global Warming Initiative to reduce greenhouse gas
28 emissions and increase the percentage of energy consumed in the states produced by renewable resources.

29

COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE KLAMATH HYDROELECTRIC PROJECT

Docket No. P-2082-027

Section 5
Staff's Conclusions
Pages 5-1 to 5-90
DEIS

1 **5.0 STAFF'S CONCLUSIONS**

2 **5.1 SUMMARY COMPARISON OF APPLICANT'S PROPOSAL AND STAFF**
3 **ALTERNATIVE**

4 When the Commission considers license proposals, besides looking at power and other
5 developmental purposes, such as irrigation and water supply, it must also give equal consideration to the
6 purposes of energy conservation; the protection and enhancement of fish and wildlife habitat; the
7 protection of recreational opportunities; and the preservation of other aspects of environmental quality.
8 So far in this draft EIS, we have described the environmental effects and our estimated cost of proposed
9 and alternative environmental measures. In this section, we examine the environmental effects and
10 project costs and explain how we decided on the key environmental measures we include in a Staff
11 Alternative.

12 **5.1.1 Description of Alternatives**

13 **5.1.1.1 PacifiCorp's Proposal**

14 PacifiCorp's proposal consists of a proposed operating regime and 41 environmental measures
15 summarized previously in section 2.2, *PacifiCorp's Proposal*.

16 **5.1.1.2 Staff Alternative**

17 After evaluating PacifiCorp's proposal and recommendations from resource agencies, tribes and
18 other interested parties, we compiled a set of environmental measures that we consider appropriate for
19 addressing the resource issues raised in this proceeding. We call this the Staff Alternative. The Staff
20 Alternative includes some measures included in PacifiCorp's proposal as well as some of the section 18
21 and alternative section 18 fishway prescriptions, section 4(e) and alternative section 4(e) conditions,
22 section 10(j) recommendations, section 10(a) recommendations, and measures developed by the staff.

23 In the Staff Alternative, we also include the following environmental measures proposed by
24 PacifiCorp, based on our analyses included in sections 3 and 4. In some cases (*italicized*), we have
25 deleted, modified, or supplemented PacifiCorp's proposed measures.

26 **Water Resources**

- 27 1P. Implement instream flow and ramping rate measures in project reaches to protect and/or
28 enhance various flow-dependent resources, including water quality.
- 29 2P. Implement a low-level release of cooler hypolimnetic water from Iron Gate reservoir
30 during summer to provide some cooling of the Klamath River downstream of the project.
31 *PacifiCorp's proposed measure is modified to include development of a temperature*
32 *management plan that would include: (1) a feasibility study to assess modifications of*
33 *existing structures at Iron Gate dam to enable release of the maximum volume of cool,*
34 *hypolimnetic water during emergency circumstances; (2) an assessment of methods to*
35 *increase the dissolved oxygen of waters that may be released on an emergency basis; and*
36 *(3) development of protocols that would be implemented to trigger the release of*
37 *hypolimnetic water by using existing, unmodified structures at Iron Gate development or, if*
38 *determined to be feasible, modified structures, when conditions for downstream salmonid*
39 *survival approach critical levels.*
- 40 3P. Install a reservoir oxygenation diffuser system at the Iron Gate development as needed to
41 prevent adverse downstream effects caused by seasonally low levels of DO in hypolimnetic
42 generation flows. *PacifiCorp's proposed measure is modified to delay implementation of*

1 *reservoir oxygen diffuser until potential adverse effects are evaluated as part of 4 (below),*
2 *but implement turbine venting at Iron Gate development, as described in Mobley (2005),*
3 *and monitor and evaluate the response of the downstream DO regime.*

- 4 4P. Implement reservoir management plans for improving water quality in J.C. Boyle, Copco,
5 and Iron Gate reservoirs that include evaluating the effectiveness and feasibility of
6 hypolimnetic oxygenation, epilimnetic or surface aeration or circulation, and copper
7 algaecide treatment, for controlling water conditions.¹ *This proposed measure is modified*
8 *to include development of a single, comprehensive water quality management plan for all*
9 *project-affected waters, rather than three separate reservoir management plans, and*
10 *expanded to include: (1) consideration of spillage of warm water at Iron Gate dam during*
11 *late spring; (2) consideration of spillage at Copco No. 1, Copco No. 2, and Iron Gate dams*
12 *during the summer to enhance DO downstream of Iron Gate development; (3)*
13 *consideration of turbine venting at Copco No. 1 and No.2 powerhouses to increase DO in*
14 *the epilimnion of Iron Gate reservoir and, potentially, downstream of Iron Gate*
15 *development; (4) specification of water quality monitoring that would be used to evaluate*
16 *the effectiveness of any implemented water quality management measures; (5) specification*
17 *of long-term water quality monitoring programs (e.g., temperature and DO) that would*
18 *enable adaptive management decisions to occur; and (6) provisions for periodically*
19 *updating the water quality management plan.*
- 20 5P. Consult and coordinate with appropriate agencies on the annual scheduled outages for
21 project maintenance events where flows in project reaches are required to be outside the
22 normal operations.

23 **Aquatic Resources**

- 24 6P. Decommission the East Side and West Side facilities, to eliminate entrainment of ESA-
25 listed suckers from Upper Klamath Lake. *PacifiCorp's proposed measure is modified to*
26 *include consultation with NMFS, Interior, and Reclamation during development of the*
27 *decommissioning plan to ensure that PacifiCorp's actions to safely secure the*
28 *developments and restore the landscape in proximity to both developments would not*
29 *forestall the future installation of a smolt collection facility at this site.*
- 30 7P. Release a minimum flow of 100 cfs from J.C. Boyle dam at all times to enhance usable fish
31 habitat while maintaining high water quality in the J.C. Boyle bypassed reach and install a
32 gage to measure the flow.
- 33 8P. Release an additional minimum flow of 100 cfs at J.C. Boyle powerhouse or dam. *This*
34 *proposed measure is modified to specify that the extra 100 cfs, or 200 cfs in total, would be*
35 *released from J.C. Boyle dam.*
- 36 9P. Limit flow down-ramp rates to 150 cfs per hour in the J.C. Boyle bypassed reach, except
37 for flow conditions beyond the project's control.
- 38 10P. Limit flow up-ramp rates to 9 inches (in water level) per hour in the J.C Boyle peaking
39 reach (the reach of the Klamath River from the J.C. Boyle powerhouse to Copco reservoir).
40 Flow down-ramp rates would not exceed 9 inches per hour for flows exceeding 1,000 cfs,
41 and would not exceed 4 inches per hour for flows less than 1,000 cfs.

¹Not included in PacifiCorp's license application, but proposed in PacifiCorp's water quality certification application, submitted by letter dated March 29, 2006, and confirmed in PacifiCorp's responses to terms and conditions, dated May 12, 2006.

- 1 11P. Install synchronized bypass valves on each of the two J.C. Boyle powerhouse units to
2 ensure ramping rates could be met if a unit trips off-line and to reduce frequency of usage
3 of canal emergency spillway.
- 4 12P. Install a surface collection system (gulper) for the J.C. Boyle reservoir to exclude fish from
5 the power intake and to facilitate downstream fish passage. *PacifiCorp's proposed*
6 *measure is replaced by #10S and #11S.*
- 7 13P. Make minor improvements (i.e., increasing the existing bar spacing on the exit pool
8 trashrack and adding an additional weir) to the J.C. Boyle fish ladder to facilitate the
9 passage of adult fish.
- 10 14P. Eliminate the gravity-fed water diversions from Shovel Creek and its tributary, Negro
11 Creek (located adjacent to the Klamath River in the California segment of the J.C. Boyle
12 peaking reach), to prevent trout fry from being entrained and lost in the various ditches on
13 PacifiCorp's Copco Ranch (a non-hydro related property).
- 14 15P. Place approximately 100 to 200 cubic yards of spawning gravel in the upper end of the J.C.
15 Boyle bypassed reach. *This measure is replaced by #1S.*
- 16 16P. Maintain a minimum flow of 10 cfs in the Copco No. 2 bypassed reach and make
17 improvements to the gate and flow conduit to the bypassed reach. *This measure replaced*
18 *by #7S.*
- 19 17P. Limit flow down-ramp rates to 125 cfs per hour (equivalent to less than 2 inches per hour in
20 most of the expected flow ranges) in the Copco No. 2 bypassed reach, except for flow
21 conditions beyond the project's control.
- 22 18P. Release a minimum flow of 5 cfs into the Fall Creek bypassed reach, and release a
23 minimum flow of 15 cfs downstream of the bypass confluence.
- 24 19P. Divert no flow from Spring Creek during July and August and release 1 cfs, or inflow,
25 downstream of the Spring Creek diversion dam for the remainder of the year; install a
26 Parshall flume to measure the minimum flow. *PacifiCorp's proposed measure is modified*
27 *so that the period during which no flow would be diverted would extend from June 1 to*
28 *September 15.*
- 29 20P. Install canal screens and fish ladders for both the Fall Creek and Spring Creek diversions.
30 *PacifiCorp's proposed measure is not included in the Staff Alternative as the need for*
31 *upstream and downstream resident fish passage at Spring and Fall creek diversion dams is*
32 *not established.*
- 33 21P. Maintain the instream flow schedule and ramp rates downstream of Iron Gate dam
34 according to Reclamation's Klamath Project Operations Plans consistent with BiOps issued
35 by FWS and NMFS.
- 36 22P. Place approximately 1,800 to 3,500 cubic yards of spawning gravel downstream of Iron
37 Gate dam between the dam and the Shasta River confluence. *This measure is replaced by*
38 *#1S.*
- 39 23P. Maintain current obligation of funding for production and operation of Iron Gate fish
40 hatchery. *This measure is modified to increase PacifiCorp's obligation from 80 to 100*
41 *percent of the cost of operation of the Iron Gate fish hatchery.*
- 42 24P. Purchase, construct, and operate a mass-marking facility for use at the Iron Gate Hatchery
43 that provides for marking 25 percent of all Chinook salmon released. *PacifiCorp's*
44 *proposed measure is modified to provide for marking 100 percent of Chinook and coho*
45 *salmon released from the Iron Gate Hatchery.*

1 **Terrestrial Resources**

- 2 25P. Implement a vegetation resource management plan to include the following environmental
3 measures: (1) project facility (including roads and transmission line right-of-way)
4 vegetation management activities; (2) noxious weed control; (3) restoration of project-
5 disturbed sites; (4) protection of threatened, endangered, and sensitive plant populations;
6 (5) riparian habitat restoration; and (6) long term monitoring. *PacifiCorp's proposed*
7 *measure for a vegetation management plan is expanded to include consultation with*
8 *affected tribes regarding opportunities for re-establishment of plants of tribal significance*
9 *in project-affected areas, and include in the upland vegetation management program*
10 *measures to reduce fire fuels, such as controlled fires, to reduce the risk of wildfires and*
11 *enhance wildlife habitat.*
- 12 26P. Implement a wildlife resource management plan to include the following environmental
13 measures: (1) installation of wildlife crossing structures on the J.C. Boyle canal; (2) deer
14 winter range management; (3) monitoring powerlines and retrofitting poles to decrease
15 electrocution risk to raptors; (4) development of amphibian breeding habitat along Iron
16 Gate reservoir; (5) support of aerial bald eagle surveys and protection of bald eagle and
17 osprey habitat; (6) selective road closures; (7) installation of turtle basking structures; (8)
18 installation of bat roosting structures; (9) surveys for threatened, endangered, and sensitive
19 wildlife species in areas to be affected by new recreation development; and (10) long-term
20 monitoring of environmental measures. *This measure is modified to address deer winter*
21 *range management in the vegetation management plan, rather than the wildlife resource*
22 *management plan, because it would entail primarily vegetation management measures.*

23 **Recreational Resources**

- 24 27P. Work with the Bureau of Land Management and others to resolve current effects of
25 recreational use on sensitive resources and provide increased resource protection and
26 visitor management controls throughout the proposed project area.
- 27 28P. Increase the supply of camping and day use facilities to help meet current and future
28 demand, principally at Iron Gate reservoir, by adding approximately 85 new campsites and
29 30 day use picnic sites by 2040, or when needed on the basis of monitoring results. *The*
30 *schedule for construction of a potable water supply and restroom facilities at the proposed*
31 *J.C. Boyle Bluffs campground and day-use area is modified to correspond with the initial*
32 *construction phase at this site (rather than 20 years after license issuance).*
- 33 29P. Provide increased management presence at developed and undeveloped recreation sites.
34 *This proposed measure is modified to exclude provisions for funding law enforcement*
35 *agencies to patrol the project area as a condition of a new license.*
- 36 30P. Address Americans with Disabilities Act (ADA) compliance at all existing and new
37 recreational facilities, including providing ADA-accessible fishing access sites.
- 38 31P. Provide improved maintenance and repair or replace site-specific facilities at existing
39 developed recreation sites, including boat launches, picnic sites, and campsites.
40 *PacifiCorp's proposed measure is modified to address facility replacement, as needed, in*
41 *the final Recreation Resources Management Plan.*
- 42 32P. Finalize a recreational resource management plan including a multi-resource interpretation
43 and education program with new signs, kiosks, brochures, and/or services. *This proposed*
44 *measure is modified to expand the flow-related information available to the public on*
45 *PacifiCorp's website and addressed in the Whitewater Boating and River-based Fishing*

1 *Program component of PacifiCorp’s Recreation Resources Management Plan to include*
2 *real-time flow information at all telemetry-gaged project-reaches.*

3 33P. Provide new and/or enhanced multi-use, non-motorized trail opportunities. *PacifiCorp’s*
4 *proposed measure is modified to ensure acquisition of appropriate easements for the final*
5 *alignment of the proposed J.C. Boyle loop trail that avoids environmentally sensitive areas*
6 *and includes the final alignment in the project boundary. The proposed trail from the J.C.*
7 *Boyle powerhouse to the Spring Island boater access site is excluded because it would not*
8 *serve project purposes.*

9 34P. Provide designated wildlife viewing areas, such as watchable wildlife stations.

10 35P. Maintain current undeveloped open space lands on PacifiCorp-owned property for
11 activities such as wildlife viewing, sightseeing, nature appreciation, photography, and other
12 recreational activities that rely on adequate natural open space.

13 36P. Work with the Bureau of Land Management and Oregon Parks and Recreation Department
14 to implement portions of the Upper Klamath River Management Plan, when adopted, from
15 Stateline Take-Out on the Klamath River to Fishing Access Site No. 1 on Copco reservoir.
16 *This proposed measure is modified to expand the proposed project boundary at the State-*
17 *line Takeout Area to include the access road from Ager-Beswick Road to the existing site*
18 *on PacifiCorp land.*

19 37P. Provide whitewater boating and fishing opportunities in the upper Klamath River/Hell’s
20 Corner reach.

21 **Land Use and Aesthetic Resources**

22 38P. Reduce visibility and contrast of powerhouse facilities through vegetative screening or
23 painting at J.C. Boyle and Iron Gate developments. *PacifiCorp’s proposed measure is*
24 *modified to include vegetative screening or repainting measures for the Fall Creek and*
25 *Copco No. 2 powerhouses and the Copco No. 2 substation in the visual resources*
26 *management plan component of the final Recreation Resources Management Plan.*

27 39P. Finalize and implement the Study Area Roadway Inventory Analysis and Project Roadway
28 management Plan.

29 **Cultural Resources**

30 40P. Complete the project’s historic properties management plan providing direction and
31 guidelines for the management of historic properties within the new project boundary as
32 proposed by PacifiCorp. *This measure is modified to specify revision and finalization of*
33 *the project’s HPMP for management of historic properties within the geographic area of*
34 *historic property management for the project as determined by Commission staff and*
35 *reflected in a new license.*

36 41P. Through the final HPMP, implement measures to protect historic buildings and structures,
37 archaeological sites, and traditional cultural properties.

38 In addition, the Staff Alternative also includes the following additional measures identified by
39 staff based on agency, tribal, and non-governmental organization recommendations and our analysis.

40 **Geology and Soils**

41 1S. Develop and implement a sediment and gravel resource management plan that includes
42 mapping and evaluating gravel distribution in project reaches and the Klamath River from

1 Iron Gate dam to the confluence of the Shasta River, determining specific amounts and
2 locations for gravel augmentation based on the mapping; monitoring gravel and spawning
3 use after placement; and supplementing gravel placement based on monitoring results.

4 2S. Develop and implement a plan to restore slope failures and the affected channel, including
5 the slope below the emergency spillway and removal of sidecast material, along the J. C.
6 Boyle bypassed reach. Retain the right bank slope that is within the existing project
7 boundary in the project boundary of a new license to ensure Commission oversight of
8 restoration and protection measures and to ensure continued stability of the intake canal and
9 project access road.

10 3S. Develop protocols for contacting agencies that would be followed in the event of a water
11 conveyance system failure. In addition, promptly notify resource agencies in the event of
12 all unanticipated or emergency project-related situations that may result in harm to fish or
13 wildlife to obtain guidance on appropriate remedial measures that should be implemented.
14 Develop thresholds of harm that would trigger such notification, in consultation with the
15 resource agencies, and provide the thresholds to the Commission as well as reports
16 following each event that triggers agency notification, indicating the nature of the event, the
17 actions taken in response to the event, and any follow-up monitoring to ensure that the
18 response is effective.

19 4S. If a proposed project-related activity entails ground-disturbing activities, develop a site
20 specific erosion and sedimentation control plan to address erosion and dust control and
21 measures that would be taken to restore such areas following the activity. If the activity
22 would generate spoils, include in the plan measures to (1) characterize the spoils; (2)
23 identify where the spoil would be disposed in an environmentally responsible manner; and
24 (3) restore, stabilize, and monitor the spoil disposal site following its use. As appropriate,
25 include this plan in the broader plan for this activity (e.g., the final plan for development of
26 a specific recreational site, or in annual road maintenance plans developed pursuant to a
27 road management plan).

28 **Water Quantity and Quality**

29 5S. Develop and implement a project operation management plan that includes provisions for
30 installing gages to appropriately monitor the flow regime specified in a new license,
31 coordinating operation of the Klamath Hydroelectric Project with the Klamath Irrigation
32 Project, reporting project-related flows to appropriate entities, minimizing water level
33 fluctuations at Iron Gate reservoir from March through July to protect breeding wildlife,
34 and periodically updating the plan.

35 6S. Develop and implement a monitoring plan for *Microcystis aeruginosa* and its toxin in
36 project reservoirs and immediately downstream of Iron Gate dam.

37 **Aquatic Resources**

38 7S. Release 70 cfs or inflow, whichever is less, to the Copco No. 2 bypassed reach.

39 8S. Initiate an assessment of anadromous fish restoration potential to project reaches using
40 radio telemetry to determine the movements and spawning location of adult fall Chinook
41 salmon released upstream of Iron Gate, Copco No. 1, and J.C. Boyle dams. Release and
42 monitor 50 radio-tagged fish upstream of each dam in 3 consecutive years.

43 9S. Evaluate juvenile fall Chinook production in spawning and rearing areas used by fall
44 Chinook (as determined by the radio telemetry studies) using screw traps located at the
45 lower end of each reach or near the mouths of tributaries.

- 1 10S. Evaluate potential fish passage options at each reach where study results indicate that
2 anadromous fish restoration may be feasible and select the most promising and cost-
3 effective reach for initial anadromous fish restoration efforts.
- 4 11S. Develop and implement an anadromous fish restoration plan for the selected reach,
5 including any necessary fish passage facilities, habitat enhancement measures such as
6 spawning gravel augmentation, and any operational changes that are needed to support
7 restoration.
- 8 12S. Develop a fish passage resource management plan in consultation with resource agencies
9 that includes designs for any fishways included in a new license, provisions for developing
10 fishway operation and maintenance plans, provisions for evaluating and monitoring fish
11 passage at the fishways, and provisions for modifying the fishways in response to
12 evaluation and monitoring.
- 13 13S. Allow state and federal resource agency personnel access to project developments to
14 inspect fishways and records to monitor compliance with license conditions.
- 15 14S. Develop and implement a decommissioning plan for East Side and West Side
16 developments, that includes addressing public safety at the sites following
17 decommissioning,
- 18 15S. Rehabilitate the Fall Creek rearing facility, and fund 100 percent of the operation and
19 maintenance costs to resume the production of yearling fall Chinook salmon, as previously
20 funded by Cal Fish & Game.
- 21 16S. Sponsor a fishery technical advisory committee that would provide input to guide project-
22 related fish passage, hatchery, and anadromous fish restoration activities.
- 23 17S. Develop and implement a cooperative fish disease risk monitoring and management plan to
24 control disease risk in the Klamath River, including measures to reduce infection rates
25 between Iron Gate dam and the Shasta River.
- 26 18S. Develop and implement an aquatic resources monitoring and management plan that
27 includes provisions for recommending project operations and facility modifications in
28 response to monitoring results.

29 **Terrestrial and Threatened and Endangered Resources**

- 30 19S. Within 2 years of license issuance develop a bald eagle management plan for the project in
31 consultation with FWS, the Bureau of Land Management, Cal Fish & Game, and Oregon
32 Fish & Wildlife that includes provisions for (1) conducting annual aerial bald eagle surveys
33 to document new nests and productivity of territories, (2) monitoring and protecting bald
34 eagle nest sites, roost sites, and regular foraging areas from human disturbance within the
35 project boundary, including seasonal restrictions for active nest sites, and (3) evaluating
36 changes in prey base relationships. The bald eagle management plan should be prepared in
37 coordination with the wildlife habitat management plan, which includes provisions for
38 monitoring transmission lines and retrofitting poles on lines where birds have died to
39 improve avian protection.

40 **Recreational Resources**

- 41 20S. Coordinate with Oregon Department of Transportation regarding retaining the existing day-
42 use area at Pioneer Park East (adjacent to the Highway 66 bridge across J.C. Boyle
43 reservoir), and, if feasible, address this recreation site in the final Recreation Resources
44 Management Plan.

- 1 21S. Acquire necessary easements to include the access road to the upper J.C. Boyle reservoir
2 boating access site in the project boundary.
- 3 22S. Retain Topsy Campground in the project boundary, develop a potable water system for this
4 facility, address this facility in the Operations and Maintenance Program of PacifiCorp's
5 Recreation Resources Management Plan, and develop a Memorandum of Agreement with
6 the Bureau of Land Management that defines PacifiCorp's and the Bureau's responsibilities
7 at this site.
- 8 23S. Develop an off-highway vehicle management plan as a component of the final Recreation
9 Resources Management Plan.
- 10 24S. Conduct a feasibility study for enhancing communications between the J.C. Boyle
11 powerhouse and the Stateline Take-out and, if feasible, develop a plan and cooperative
12 agreement with appropriate entities to implement reasonable measures that may be
13 identified in the feasibility study.

14 **Land Use and Aesthetic Resources**

- 15 25S. Consult with the Bureau of Land Management, Oregon Fish & Wildlife, and Cal Fish &
16 Game in the finalization of the Recreation Resources Management Plan and Road
17 Management Plan, as appropriate.
- 18 26S. Include the portion of Topsy Grade from Highway 66 to the intersection of the road that
19 provides access to J.C. Boyle dam (designated 300000116 on PacifiCorp's road inventory
20 map) in the project boundary because this road provides, or would provide, access for the
21 public and PacifiCorp staff to Topsy Campground, the proposed Boyle Bluffs Campground
22 and day-use area, proposed recreational areas along the J.C. Boyle bypassed reach, and all
23 J.C. Boyle development features.

24 **Cultural Resources**

- 25 27S. Consult with state and federal law enforcement agencies and appropriate federal land
26 management agencies in addition to the local law enforcement agencies, Oregon SHPO,
27 California SHPO, and tribes specified in the revised HPMP in the finalization of the plan
28 and subsequent plans.
- 29 28S. Conduct archaeological identification surveys in Bureau of Land Management units L
30 through P on the J.C. Boyle peaking reach within the limits of project capacity, and in Units
31 B, D, F, and G on the inside of the J.C. Boyle bypass reach at Big Bend consistent with the
32 Area of Potential Effect for the project as ultimately licensed, and treat any sites determined
33 eligible or potentially eligible for the National Register in accordance with the provisions of
34 the HPMP.
- 35 29S. Include the Oregon State Commission on Indian Services in notifications of discoveries of
36 human remains in Oregon.
- 37 30S. Develop a plan for providing tribes with access to areas within the project boundary where
38 plants of traditional cultural importance occur, and permit use of such plants for traditional
39 practices.
- 40 31S. In the event that the Commission determines that Keno development is non-jurisdictional,
41 consult with the Oregon SHPO, resource and land management agencies, and tribes
42 regarding treatment of historic properties within the APE that we have established.

5.1.1.3 Staff Alternative with Mandatory Conditions

NMFS and Interior have made preliminary fishway prescriptions for the project (described in section 2.3.1.2, *Section 18 Fishway Prescriptions*) which, when finalized, the Commission would need to include in a new license for this project. Similarly, the Bureau of Land Management and Reclamation have specified preliminary 4(e) conditions (described in section 2.3.1.3, *Section 4(e) Federal Land Management Conditions*) which, when finalized, would also need to be included in a new license for this project. Incorporation of these mandatory conditions into a new license would cause us to modify or eliminate some of the environmental measures that we include in the Staff Alternative. When the Staff Alternative entails removing a development from the project, we do not include any mandatory conditions associated with that development in this alternative. PacifiCorp's proposed measures that we either accepted or modified for inclusion in the Staff Alternative that would be adjusted by mandatory conditions would include the following (see section 5.1.1.2 for the numerical designation and description of PacifiCorp's measures that would be adjusted):

- Measures 7P and 8P would be replaced by Bureau of Land Management's condition 4A1(a)(b), which pertains to the minimum flow in the J.C. Boyle bypassed reach.
- Measure 9P would be replaced by Bureau of Land Management's condition 4A2, which pertains to ramping rates in the J.C. Boyle bypassed reach.
- Measure 10P would be replaced by Bureau of Land Management's condition 4B2, which pertains to ramping rates in the J.C. Boyle peaking reach. In addition, J.C. Boyle powerhouse would only be able to operate in a peaking mode 1 day per week.
- Measures 12P and 13P would be replaced by NMFS and Interior's fishway prescription for J.C. Boyle development.
- Measure 15P would be replaced by Bureau of Land Management's conditions 4D1(a)(b)(c) and 4E, which pertain to gravel management in an adaptive manner.
- Measure 20P would remain as a license condition (we concluded the cost of upstream and downstream fish passage at Spring and Fall creeks was not worth the benefit), consistent with NMFS and Interior's fishway prescription for Fall Creek development.

Additional measures identified by staff based on our analysis that would be replaced by mandatory conditions include the following (see section 5.1.1.2 for the numerical designation and description of staff's additional measures):

- Measures 8S through 11S would be replaced by NMFS and Interior's fishway prescriptions.
- The portion of measure 1S that pertains to gravel augmentation in the J.C. Boyle bypassed reach would be replaced by Bureau of Land Management's conditions 4D1(a)(b)(c) and 4E, which pertain to gravel management in an adaptive manner. The portion of measure 1 that pertains to gravel augmentation downstream of Iron Gate dam would remain.

5.1.1.4 Retirement of Copco No. 1 and Iron Gate Developments with Staff Measures

We have analyzed a dam removal and development retirement alternative consisting of removal of Iron Gate and Copco No. 1 dams from the project. This alternative would address water quality issues that originate in the reservoirs associated with both developments, facilitate restoration of anadromous fish to habitat upstream of Iron Gate dam, and retain a substantial portion of the generation capability of the project. If removal of these two dams should be incorporated into a new license for this project, it would cause us to modify or eliminate some of the environmental measures that we include in the Staff Alternative. PacifiCorp's proposed measures that we either accept or modify for inclusion in the Staff

1 Alternative that would be adjusted under a two dam removal scenario would include the following (see
2 section 5.1.1.2 for the numerical designation and description of PacifiCorp’s measures that would be
3 adjusted):

- 4 • Measure 2P would be eliminated.
- 5 • Measure 3P would be eliminated.
- 6 • Measure 4P would be modified to reflect primarily a water quality monitoring plan that
7 would serve as a basis to verify the environmental response to the altered conditions and
8 serve as a basis for potential remedial actions.
- 9 • Measure 10P would be modified to include a provision for year-round project down-ramping
10 of 2 inches per hour as measured at the USGS gage downstream of Iron Gate dam of 2 inches
11 per hour, with a maximum daily limit of 12 inches during the Chinook salmon spawning and
12 incubation period.
- 13 • Measure 15P would be replaced with aspects of staff measure 1 that pertain to gravel
14 augmentation at the J.C. Boyle bypassed reach.
- 15 • Measure 21P would be modified to provide for flows released from Copco No. 2
16 development that are consistent with Reclamation’s Klamath Operations Plans and the BiOps
17 issued by FWS and NMFS for the Klamath Irrigation Project.
- 18 • Measure 22P would be eliminated.
- 19 • Measure 23P would be eliminated.
- 20 • Measure 24P would be eliminated.
- 21 • Measure 26P would be modified to eliminate proposed wildlife enhancement measures at
22 Copco reservoir.
- 23 • Measure 28P would be modified to eliminate proposed recreational facility enhancements at
24 Copco and Iron Gate developments.
- 25 • Measure 31P would be modified to eliminate proposed improved maintenance provisions at
26 recreational facilities at Copco and Iron Gate developments.
- 27 • Measure 32P would be modified to eliminate aspects of the interpretation and education
28 program that pertain to Copco and Iron Gate developments.
- 29 • Measure 38P would be modified to eliminate aspects of proposed vegetative screening or
30 painting at Iron Gate development.
- 31 • Measure 41P would be modified to replace proposed measures to protect historic buildings
32 and structures, archaeological sites, and traditional cultural properties associated with Copco
33 and Iron Gate developments, with measures that would be established during consultation
34 with California SHPO and tribes in a decommissioning plan for both developments.

35 Additional measures identified by staff based on our analysis that would be replaced or modified
36 under the two dam removal scenario would include the following (see section 5.1.1.2 for the numerical
37 designation and description of staff’s additional measures):

- 38 • Measure 1S would be modified to include only aspects of gravel augmentation that pertain to
39 the J.C. Boyle bypassed reach.
- 40 • Measure 6S would be eliminated.

- 1 • Measures 8S through 11S would be replaced with the fishway described in NMFS and
2 Interior’s prescription for the Copco No. 2 dam fish ladder, intake screening with fish bypass
3 system, and spillway modifications at Copco No. 2 dam and the natural bedrock sill removal
4 at the Copco No. 2 bypassed reach. Construction of a facility to provide downstream passage
5 of anadromous fish at J.C. Boyle dam may be considered in the future if it becomes evident
6 that passage is warranted based on consultations with the agencies and tribes.
- 7 • Measure 15S would be eliminated.
- 8 • Measure 16S would be modified to have the fishery technical advisory committee address the
9 disposition of the Iron Gate Hatchery once it is removed from the project.
- 10 • Measure 17S would be eliminated.

11 **5.1.2 Summary of Effects**

12 We summarize distinguishable differences between PacifiCorp’s Proposal, the Staff Alternative,
13 the Staff Alternative with mandatory conditions, and the two dam removal scenario in table 5-1.
14 PacifiCorp’s proposed operation is similar to current operations. Therefore, unless otherwise noted, the
15 ongoing effects of project operations under PacifiCorp’s Proposal are similar to current conditions.

16

1 Table 5-1. Summary of effects of PacifiCorp’s Proposal, the Staff Alternative, the Staff Alternative with Mandatory Conditions,
 2 and Retirement of Copco No. 1 and Iron Gate Developments. (Source: Staff)

| Resource | PacifiCorp’s Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|-------------------------------|---|--|--|---|
| Power Benefits | | | | |
| Annual generation (MWh) | 676,455 | 669,215 | 497,931 | 448,605 |
| Net annual power benefits | \$12,753,430 | \$7,325,700 | -\$28,749,400 | -\$5,680,030 |
| Geology and Soils | | | | |
| Sediment Supply and Transport | Minor enhancement of spawning gravel supply from one time placement in J.C. Boyle bypassed reach and downstream of Iron Gate dam. | Moderate enhancement of spawning gravel supply based on mapping and monitoring of distribution in J.C. Boyle bypassed reach and from Iron Gate to Shasta River; quantity and frequency based on habitat needs. | Deposition of from 1,226 to 6,134 tons of gravel a year downstream of J.C. Boyle dam would also provide a moderate enhancement of spawning gravel supply and could increase channel complexity in the peaking reach. Diverting all flow to the J.C. Boyle bypassed reach for 7 days during the spring could serve to transport deposited, and naturally occurring gravel from the bypassed reach into the peaking reach. | Similar to Staff Alternative for J.C. Boyle bypassed reach. Sediment stored in Iron Gate reservoir would likely be released to downstream reaches which would have short term adverse effects on aquatic habitat but eventually stabilize, and spawning gravel released from the reservoir could enhance salmon spawning habitat. Copco No. 2 dam may trap some sediments released from Copco reservoir, but would likely fill and require dredging to maintain powerhouse operations; dredged and natural sediment could be passed downstream to contribute to fluvial geomorphologic processes interrupted by the dams. |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|----------------------|--|---|---|--|
| Slope stabilization | Installation of bypass valve at J.C. Boyle powerhouse would reduce use of emergency spillway, the source of a major slope failure. | In addition to PacifiCorp's measure, would address stabilization and restoration of this and other slope failures along the J.C. Boyle bypassed reach; removal of sidecast material from bypassed reach channel would enhance access of salmonids to thermal refugium and recreational boating opportunities. | Similar to Staff Alternative, although channel restoration would extend downstream through the peaking reach. | Similar to Staff Alternative, provisions for stabilizing exposed banks following dam removal would be addressed in development decommissioning plan. |
| Water Quality | Hypolimnetic oxygenation at Iron Gate reservoir would enhance DO downstream of Iron Gate compared to No-action but would still likely not meet applicable standards for much of the summer. Implementation could have unintended adverse effects in the reservoir. Reservoir management plans could identify measures to further address DO, as well as temperature and nutrient-related problems. | Turbine venting at Iron Gate would offer immediate downstream DO enhancement, while other options would be evaluated in response to monitoring results. DO would meet applicable standards at a level comparable to PacifiCorp's Proposal, but without potential for water quality degradation that could occur with hypolimnetic oxygenation. <i>Microcystis</i> monitoring would enable public notification of potential health risks from contact recreation at project reservoirs. Other effects similar to PacifiCorp's. | Similar to Staff Alternative. | The major sources of project-related water quality problems would be eliminated. Temperature regime downstream of Iron Gate would be more suitable for salmon, DO would usually meet applicable objectives, nutrient load would be reduced downstream of Iron Gate, which may reduce abundance of algae that form habitat for the intermediate host for at least two salmon pathogens. |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|--------------------------|--|--|---|---|
| Aquatic Resources | | | | |
| Instream flows | Additional 100 cfs released from J.C. Boyle dam would enhance physical habitat and retain important thermal refugium in the bypassed reach; proposed peaking operation restriction and ramping rates in the peaking reach would reduce the potential for fish stranding. Minor enhancement of habitat in Fall and Spring creeks. | Similar to PacifiCorp's proposal, although increased minimum flow in Copco No. 2 bypassed reach would substantially increase physical habitat. Warm water would likely continue to limit the suitability of the reach for salmonids during the summer. | Release of at least 470 cfs to the bypassed reach would wash out thermal refugium in J.C. Boyle bypassed reach, but would provide additional physical habitat; limiting peaking operations to one day a week would reduce likelihood of stranding, and provide more stable aquatic environment but would conflict with Outstanding Remarkable Value for this Wild and Scenic River reach by eliminating most whitewater boating opportunities and reducing the availability of optimal flows for angling. | Limiting ramping rate to 2 inches per hour at the USGS gage at Iron Gate, with a 12 inch per day limitation during Chinook salmon spawning and rearing period would likely curtail the ability to operate J.C. Boyle in a peaking mode, which could result in less downstream fluctuation, reducing the stranding potential more than the Staff Alternative, but also curtailing whitewater boating opportunities in the J.C. Boyle peaking reach. Ramping rate downstream of Iron Gate would be faster than Staff Alternative, but effects of ramping would be monitored with provisions for adaptive management of ramping rates during critical spawning, rearing and fry rearing periods. Water temperature of minimum flow to Copco No. 2 bypassed reach likely to be cooler than other alternatives, and more suitable for salmonids. |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|--|---|--|--|---|
| Anadromous fish restoration and fish passage | Improvements to the existing fish ladder at J.C. Boyle dam, and use of a "fish gulper" to move downstream resident migrants past the dam, however, effectiveness of the proposed downstream passage system is uncertain. New fish ladders and screens at Spring and Fall creek diversion dams for resident fish. No specific provisions for restoration of anadromous fish. | Adaptive approach to restoring anadromous fish to most appropriate project reach using primarily trap and haul techniques, telemetry and smolt collection to assess use of habitat, and concentrated restoration effort to most promising reach. Provisions for expanding program to other project reaches based on monitoring results. No upstream or downstream resident fish passage provided at Fall or Spring Creek diversion dams. | Volitional upstream and downstream passage, with tailrace barriers and spillway modification at most project dams. Trap and haul element still included to transport adults and smolts around Keno reservoir during periods of poor water quality. Completion of fish passage facilities at all project developments would take up to 6 years. No provisions made for passing adults or smolts around Iron Gate and Copco reservoirs when water quality is poor or to minimize fish predation. Fish ladders and screens for resident fish prescribed for Fall and Spring creek diversion dams. | The two most problematic dams (based on height, reservoir size, and landscape constraints) for effective upstream and downstream passage would be removed. Upstream and downstream volitional fishways would be installed at Copco No. 2 dam and enhancements made to the existing fish ladder at J.C. Boyle dam. Water quality barrier to upstream and downstream passage of fish caused by both reservoirs would be eliminated. Migration corridor downstream of the project would be enhanced because conditions that foster disease outbreaks would be reduced. |
| Fish disease management | Reservoir management plan development could result in implementation of measures that would reduce nutrient load in project reservoirs, which could reduce downstream occurrence of algal populations that form habitat for fish pathogen host. | Implementation of a cooperative disease monitoring and management plan that integrates fish disease monitoring and management efforts by other entities with PacifiCorp's focused efforts between Iron Gate and Shasta River would address cumulative disease-related effects. | Similar to Staff Alternative. | Removal of the two dams would enhance downstream water quality and reduce cumulative effects that contribute to downstream fish kills caused by disease and poor water quality (low DO, high water temperature, variable pH and ammonia levels, crowding, nutrients and armored substrate favorable for algal populations that form habitat for fish pathogen host). |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|-------------------------------|--|--|--|--|
| Iron Gate Hatchery operations | Same level of funding (80%) for general operation and maintenance; unspecified minor improvements would be made to the hatchery; would purchase and operate facilities for tagging 25% of released Chinook salmon. | Increase level of hatchery funding to cover 100% of general operation and maintenance, purchase and operate facilities for tagging 100% of released Chinook and coho salmon. Refurbish and fund 100% of the operation of the Fall Creek rearing facility to enable shifting a greater portion of the released fish to yearlings rather than subyearlings, to reduce crowding effects with wild salmon. | Same as Staff Alternative. | Iron Gate Hatchery would either be dismantled or operated by others. Primary cold water supply, Iron Gate reservoir, would be eliminated. Fate of hatchery would be addressed in a decommissioning plan for the Iron Gate dam, in consultation with a fishery advisory committee that would include resource agency representatives. |
| Terrestrial Resources | | | | |
| | Development of vegetation and wildlife management plans would provide for protection of sensitive plants, control of noxious weeds, consideration of plant of importance to Native Americans for revegetation projects, and implementation of measures to protect and enhance wildlife and associated habitat. | Similar to PacifiCorp's proposed measures | Similar to PacifiCorp's proposed measures. | Similar to PacifiCorp's proposed measures at remaining developments; exposed reservoir substrate would likely offer ideal conditions for re-establishment of vegetation. Eventually would reach equilibrium, but successional plant communities would likely diversify wildlife habitat. |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|-------------------------------|---|--|--|--|
| Recreational Resources | <p>Propose to implement substantial recreational enhancements in accordance with its Recreation Resources Management Plan. Major new and modifications to existing facilities would be constructed at J.C. Boyle and Iron Gate developments, and moderate facilities at Copco and Fall Creek developments. Programmatic elements of the plan would also be implemented, including provisions for plan updates, coordination with agencies regarding shared operation and maintenance responsibilities, monitoring, project patrol, and an interpretation and education program.</p> | <p>Similar to PacifiCorp's proposal, although we would include Topsy Campground as a project facility for which PacifiCorp should have a share of the operation and maintenance costs and we provide for increased operation and maintenance at project recreational facilities during the term of a new license, if needed, to keep them current with applicable standards.</p> | <p>Similar to Staff Alternative, but would also include Spring Island Boater Access Site, Klamath Campground, dispersed day-use sites, and scouting trails at major rapids along the peaking reach among the facilities for which PacifiCorp was responsible. Provisions for peaking operations during only one day a week during the recreation season would substantially reduce whitewater boating opportunities in the peaking reach compared to PacifiCorp's proposal and the Staff Alternative. Because of this, commercial outfitters may attempt to crowd trips into the limited window that would be created, and create public safety hazards. Eventually, some commercial outfitters could go out of business because of lack of access to this Wild and Scenic River segment. Such diminishment of boating opportunities would be inconsistent with the Congressionally designated Outstanding Remarkable Value of whitewater boating.</p> | <p>The same as Staff Alternative for remaining developments. Existing recreational sites at Copco and Iron Gate developments would be either transferred to another entity or abandoned after appropriate decommissioning processes followed to secure the sites. Major new or enhanced facilities proposed at Iron Gate development would not be constructed. Some sites could serve as public access sites for the newly created riverine reaches. The length of the peaking reach would be increased by several miles, and additional riverine boating opportunities would be created at the Iron Gate reservoir site, potentially enhancing whitewater boating opportunities; however, restrictions to peaking operations to minimize stranding potential of salmon could reduce boatable days from the proposed project or the Staff Alternative.</p> |

| Resource | PacifiCorp's Proposal | Staff Alternative | Staff Alternative with Mandatory Conditions | Retirement of Copco No. 1 and Iron Gate Developments |
|---------------------------|---|---|---|--|
| Cultural Resources | Implementation of its revised HPMP would provide reasonable monitoring, inspection, and protective measures for cultural resources within PacifiCorp's defined APE. | We expand PacifiCorp's proposed APE, to include land within the existing and proposed project boundary, the area along the peaking reach influenced by the project, and downstream of Iron Gate dam to the confluence of the Scott River. The HPMP would be revised to address management of cultural resources in the APE. | Similar to Staff Alternative, although may provide for survey of areas outside our defined APE. | Similar to Staff Alternative for developments that remain in the project. However, major site monitoring, inspection, and treatments were proposed for areas at Copco and Iron Gate reservoirs. These sites would need to be addressed as part of a decommissioning plan that would include consultation with the CA SHPO and appropriate tribal and agency representatives. |

1 **5.2 DISCUSSION OF KEY ISSUES**

2 The measures proposed by PacifiCorp and those included in the Staff Alternative would help
3 protect and enhance water quality, fisheries, terrestrial, recreational, aesthetic, and cultural resources in
4 the project area, but would reduce the net power benefits of the project. In this section, we discuss our
5 rationale for including some measures in our Staff Alternative and not including others. We also
6 summarize the effects of an alternative that includes all mandatory conditions and selected measures from
7 the staff alternative and another that includes the removal of Iron Gate and Copco No. 1 dams and fish
8 passage at Copco No. 2 dam with other selected measures.

9 **5.2.1 Flushing Flows and Gravel Management**

10 **Flushing Flows**

11 FWS and Oregon Fish & Wildlife recommend that, at least once a year between February 1 and
12 April 15, no water be diverted to the J.C. Boyle or Copco No. 2 power canals when inflows exceed 3,300
13 cfs and that this diversion cessation be maintained for at least 7 full days. Oregon Fish & Wildlife
14 recommends the down-ramp rate for this seasonal high flow not exceed 2 inches per hour or 300 cfs per
15 24-hour period. FWS and Cal Fish & Game make the same recommendation, except they do not specify
16 an hourly ramp rate. NMFS recommends and the Bureau of Land Management specifies the same
17 flushing flow and ramping rate as Oregon Fish & Wildlife, but only for the J.C. Boyle bypassed reach.

18 Provision of annual flushing flows as recommended by the agencies could help to ensure that
19 spawning areas used by trout remain sufficiently free of silt to support egg incubation and trout
20 recruitment. However, our review of the average spill duration and quantity under existing conditions
21 indicates that spillage to the J.C. Boyle bypassed reach is sufficient to flush fine-grained sediment during
22 many years. The J.C. Boyle bypassed and peaking reaches currently support high densities of trout,
23 comparable to those in the lower Deschutes River, which is one of the most productive rivers in Oregon.
24 As we discuss in more detail later, we include in the Staff Alternative augmentation of spawning gravel in
25 the bypassed reach and elimination of agricultural diversions on Shovel and Negro creeks. Both measures
26 should improve the recruitment of trout fry from the primary locations where most of the spawning
27 between J.C. Boyle and Copco No. 1 dams are thought to occur. We are convinced that, with appropriate
28 monitoring and adaptive management provisions for gravel augmentation, both of these measures would
29 enhance the existing high quality trout fishery in the J.C. Boyle bypassed and peaking reaches. We
30 conclude that implementing flushing flows in the J.C. Boyle bypassed reach as recommended by FWS,
31 NMFS, Cal Fish & Game, and Oregon Fish & Wildlife, and as specified by the Bureau of Land
32 Management, would not be worth the estimated annualized cost of \$724,840, including 17,466 MWh of
33 lost generation, and we do not include this measure in the Staff Alternative.

34 For the Copco No. 2 bypassed reach, we conclude that this reach is unlikely to support a quality
35 trout fishery given the seasonal poor water quality conditions of flows that are released into the bypassed
36 reach from Copco reservoir and the lack of any tributaries that could provide suitable temperature refugia.
37 Furthermore, our review of the average spill duration and quantity indicates that spillage to the Copco No.
38 2 bypassed reach is sufficient to flush fine-grained sediment in many years. Because of the limited
39 capacity of the reach to support a trout fishery, we conclude that implementing flushing flows in the
40 Copco No. 2 bypassed reach as recommended by FWS, Cal Fish & Game, and Oregon Fish & Wildlife
41 would not be worth the estimated annualized cost of \$305,770, including 7,368 MWh of lost generation,
42 and we do not include this measure in the Staff Alternative.

43 Prior to the construction of Iron Gate dam, the Copco No. 2 bypassed reach supported spawning
44 of Chinook salmon. If access to any of the project reaches is restored for anadromous fish, we include in
45 the Staff Alternative a provision to develop an anadromous fish restoration plan for the reach, which
46 would include the consideration of measures to improve habitat conditions for anadromous fish. We

1 anticipate that, if passage is restored to the Copco No. 2 bypassed reach, the restoration plan for this reach
2 would include provisions for gravel augmentation to improve the condition of spawning habitat and
3 appropriate monitoring to determine the quality of spawning habitat. The restoration plan would include
4 provisions for adaptive management, which could include the provision of flushing flows if they are
5 needed to maintain the quality of spawning habitat.

6 **Gravel Management**

7 Several parties put forward gravel augmentation measures intended to increase spawning habitat
8 for resident trout or anadromous salmonids downstream of PacifiCorp's dams, which trap sediment and
9 cause a deficit of gravel and finer sediments in downstream reaches. PacifiCorp proposes to place about
10 100 to 200 cubic yards of spawning gravel in the upper end of the J.C. Boyle bypassed reach and 1,800 to
11 3,500 cubic yards between Iron Gate dam and the Shasta River confluence, and to monitor the gravel
12 augmentation efforts.

13 Oregon Fish & Wildlife, Cal Fish & Game, and the Hoopa Valley Tribe recommend that
14 PacifiCorp develop a sediment and gravel resource management plan, identify measures that would be
15 implemented to provide for the restoration of spawning habitat below each project dam, map the character
16 and distribution of gravels within project reaches, develop and implement recommendations for gravel
17 management for each project-affected reach, and develop and implement a monitoring program to assess
18 how introduced gravels are distributed and used under project operations. If monitoring indicates that the
19 plan does not achieve the plan objectives, PacifiCorp would revise the plan in consultation with the
20 resource agencies.

21 The Bureau of Land Management specifies that PacifiCorp develop a river gravel management
22 plan for the J.C. Boyle bypassed and peaking reaches designed to increase channel complexity and
23 availability of spawning habitat for resident and anadromous fish. The Bureau of Land Management's
24 plan would provide for the placement of a minimum of 1,226 tons of gravel per year, filing of a
25 comprehensive monitoring report in year 7, adaptive management in years 7 through 9, and revision of
26 the plan in year 10.

27 NMFS and FWS recommend that PacifiCorp develop a gravel augmentation plan for project
28 reaches and the Klamath River downstream of Iron Gate dam to include (1) identification of priority
29 spawning and holding reaches; (2) assessment of flows needed to transport gravels and maintain holding
30 habitat (pools); (3) identification of areas for removal of deposits of large debris; and (4) identification of
31 priority areas for gravel augmentation, volumes of gravel, and flows to implement deposition of gravel in
32 target areas and schedule for periodic replenishment of gravels. The plan would be implemented within 3
33 years of license issuance, results monitored in consultation with agencies, and reviewed at least every 5
34 years for the term of the license to facilitate adaptive management.

35 PacifiCorp's proposal to place up to 200 cubic yards of spawning gravel in the upper end of the
36 J.C. Boyle bypassed reach and up to 3,500 cubic yards between Iron Gate dam and the Shasta River
37 confluence, and to monitor these efforts, would enhance spawning habitat that has been adversely
38 influenced by the interruption of sediment transport by project dams, and enable evaluations of whether
39 gravel remains in place and available for salmonid spawning. Although PacifiCorp does not clearly
40 specify whether the quantity of gravel that it proposes represents a one-time placement, we consider it
41 likely that additional gravel would be required to replenish the supply of gravel after high flow events
42 occur. We also conclude that mapping of gravel before and after gravel placement would be useful to
43 help quantify the measure's benefits and to guide further gravel augmentation efforts. Accordingly, we
44 include in the Staff Alternative the approach to gravel augmentation recommended by Oregon Fish &
45 Wildlife, Cal Fish & Game, and the Hoopa Valley Tribe, which would begin with developing a gravel
46 augmentation plan, mapping existing spawning gravel deposits and alluvial surfaces suitable for riparian
47 recruitment and, based on the results of that mapping, developing sediment augmentation volumes,
48 locations, and sizes that meet plan goals. We expect that during some years it may not be necessary to

1 provide any augmentation if previous gravel has remained at locations that would provide appropriate
2 spawning habitat (e.g., during relatively dry years). During wet years, larger quantities of gravel may be
3 needed to augment gravel washed downstream from suitable spawning areas. The reporting aspects
4 specified by the resource and land management agencies and the Hoopa Valley Tribe for gravel
5 augmentation would provide for coordination and review of the program by the Commission and
6 stakeholders, and allow for consultation regarding any proposed changes to implementation and
7 monitoring. This approach would facilitate any future augmentation necessary to meet habitat objectives
8 in these reaches.

9 To estimate the cost of implementing the approach recommended by Oregon Fish & Wildlife, Cal
10 Fish & Game, and the Hoopa Valley Tribe, we have assumed 10 annual placements of the quantity of
11 gravel proposed by PacifiCorp in the J.C. Boyle bypassed and Iron Gate to Shasta reaches. We estimate
12 that this amount of gravel would provide sufficient spawning habitat to support about 6,200 rainbow trout
13 redds in the J.C. Boyle bypassed reach and about 4,300 fall Chinook redds downstream of Iron Gate dam.
14 We estimate that the annualized cost of this approach, including gravel mapping, monitoring, and
15 reporting, would be \$146,430. We conclude that the gravel augmentation program would provide
16 substantial benefits to populations of redband trout and fall Chinook salmon, and we include the measure
17 in the Staff Alternative.

18 The Bureau of Land Management gravel augmentation program is similar to the measure that we
19 include in the Staff Alternative. However, the Bureau's specified program would include placing a
20 minimum 1,226 to 6,134 tons (826 to 4,131 cubic yards) of gravel per year in the J.C. Boyle bypassed and
21 peaking reaches to increase channel complexity and availability of spawning habitat for resident and
22 anadromous fish. Although we acknowledge that placing a larger quantity of gravel into the reach would
23 likely increase channel complexity and habitat quality for redband trout, we conclude that the benefits of
24 this measure do not justify its additional cost, which we estimate would add at least \$33,640 to the
25 annualized cost of the gravel augmentation measure that we include in the Staff Alternative. As noted
26 previously, the J.C. Boyle peaking reach supports one of the best trout fisheries in the region based on the
27 trout population size and angler catch rates, and operational and habitat enhancement measures proposed
28 by PacifiCorp would substantially enhance the fishery, as would the expanded gravel augmentation
29 measure that we include in the Staff Alternative.

30 NMFS and FWS recommendations are also similar to the measure that we adopt, but they include
31 the assessment of flows for transporting gravels and depositing them in target areas and to maintain
32 holding habitat (pools), and the identification of areas for removal of deposits of large debris. However,
33 our review of the average spill duration and quantity indicates that spillage to the J.C. Boyle bypassed
34 reach is sufficient to flush fine-grained sediment during many years, and is sufficient to mobilize larger
35 spawning gravels in some years. Regarding flows necessary to redistribute gravel downstream in other
36 reaches such as the J.C. Boyle peaking reach and the Klamath River below Iron Gate dam, we conclude
37 that PacifiCorp does not have sufficient active storage within the project to provide or control flows of the
38 magnitude that is needed to initiate transport of spawning-sized gravel or the creation of holding pools.
39 Regarding the removal of large debris, it appears that this part of the NMFS and FWS recommendation is
40 related to sidecast material that was introduced into the J.C. Boyle bypassed reach when the road to the
41 powerhouse was constructed, and we address this issue in the next section.

42 **5.2.2 Restoration of Slopes and Channel at the J.C. Boyle Bypassed Reach**

43 Construction and maintenance of the canal and roadway along the J.C. Boyle bypassed reach has
44 resulted in the introduction of sidecast and eroded material to the river that has narrowed the channel
45 exacerbating erosion on the opposite bank and at one location completely filled the channel. At this latter
46 location, the sidecast material forms a barrier to fish migration, especially during summer low flow
47 conditions when only the minimum flow of 100 cfs is released into the bypassed reach. There is
48 substantial inflow from springs upstream of this sidecast blockage, and by preventing salmonid access to

1 this area during the warm months of the year, the full benefits of this thermal refugium are diminished.
2 The sidecast material also creates a barrier to recreational boaters that use the bypassed reach when flow
3 conditions are suitable. Also, use of the emergency spillway to pass flows in the canal to the bypassed
4 reach when the powerhouse units trip offline has created massive hillslope erosion of the adjacent slope,
5 contributing large amounts of sediment to the Klamath River. Left unchecked, the eroding hillslope could
6 threaten the integrity of the intake canal and adjacent road.

7 PacifiCorp proposes to install a synchronized bypass valve on each of the two powerhouse units
8 to minimize or eliminate the use of the emergency spillway. Oregon Fish & Wildlife, Interior, and the
9 Hoopa Valley Tribe recommend that PacifiCorp implement measures that would maintain flows at the
10 J.C. Boyle powerhouse during a powerhouse failure, which would be achieved with the installation of
11 PacifiCorp's proposed bypass valves. However, PacifiCorp proposes no measures to restore the eroding
12 slope downgradient of the emergency spillway or provisions to remove sidecast and eroded material from
13 the bypassed reach channel.

14 NMFS and Interior, as part of the fishway prescription for the project, prescribe that PacifiCorp
15 remove the sidecast rock barrier within the bypassed reach to allow upstream passage for resident and
16 anadromous fish. Interior also recommends that PacifiCorp prepare site-specific remediation plans for the
17 J.C. Boyle emergency spillway and other canal and slope failures, including (1) a map depicting the
18 location of the proposed activity; (2) designs for site stabilization, channel restoration, location of disposal
19 sites, and erosion control plan; (3) implementation and effectiveness monitoring; (4) survey data,
20 biological evaluations, or results from consultation for ground- or habitat-disturbing activities; and (5) an
21 environmental analysis of the proposed action that meets NEPA requirements. Oregon Fish & Wildlife
22 makes a similar recommendation, and indicates that the plan should include provisions for revegetation of
23 affected hillslope and riparian areas and structural, vegetative, and flow strategy methods to halt erosion,
24 restore the damaged hillslope, and repair visual degradation. In addition, Oregon Fish & Wildlife
25 recommends that PacifiCorp restore the J.C. Boyle bypassed reach channel from damage caused by use of
26 the emergency spillway. In the event of future canal or spillway overflow events, both Oregon Fish &
27 Wildlife and the Bureau of Land Management recommend that PacifiCorp develop an action plan that
28 defines protocols for assessing and documenting environmental damage, notification of agencies,
29 developing restoration plans, securing appropriate permits to implement restoration measures, and
30 corrective actions taken in response to the emergency events.

31 Agency documentation and our observations of the severe erosion downslope of the emergency
32 spillway and resultant degradation of the bypassed reach channel are strong reasons to minimize the
33 future use of the emergency spillway, as we discuss in section 3.3.1.2.2, *Project Effects on Sediment*
34 *Supply*. PacifiCorp's proposed bypass valves at the J.C. Boyle powerhouse would achieve this objective.
35 The estimated annualized cost to install a valve at each of the two units is \$898,760. Although this is a
36 substantial cost, the resultant benefit of a substantial reduction in this source of erosion would be worth
37 the cost, and we include this measure in the Staff Alternative.

38 Although a major source of erosion would be eliminated with implementation of bypass valves at
39 the powerhouse, the existing substantial erosion downslope of the emergency spillway cannot be left in its
40 current unstable state without resulting in further damage to the bypassed reach channel, intake canal, and
41 adjacent access road. We consider restoration of this slope to be imperative. The steep slope associated
42 with the intake canal and access road is prone to damage by landslides, and during December 2005 a
43 landslide caused the intake canal to rupture, with the release of large quantities of water and rock to
44 downslope areas. Restoration of slopes and bypassed reach channel associated with this canal failure
45 would prevent continued erosion into the reach and reduce the potential for more severe slope failures.
46 When project-related erosion from slope failures and sidecast debris enters the bypassed reach, it can
47 adversely influence aquatic habitat.

1 As we discuss in section 3.3.3, *Aquatic Resources*, the J.C. Boyle bypassed reach is particularly
2 important to resident redband trout because it is one of two primary spawning areas between J.C. Boyle
3 dam and Copco reservoir (the other is Shovel Creek, about 18 miles downstream of the dam). The
4 bypassed reach is also the most substantial thermal refugium in the project area because of spring
5 accretion of more than 200 cfs which remains relatively undiluted during the summer because most of the
6 river flows are diverted through the powerhouse. Consequently, this reach has a disproportionately high
7 value in maintaining the existing quality redband trout fishery and could serve an equally important
8 function in the restoration of anadromous fish upstream of Iron Gate dam. We consider it appropriate for
9 PacifiCorp to be responsible for restoring the bypassed reach to natural conditions by removing sidecast
10 debris and eroded material that has originated from project-related slope failures. We recognize that the
11 steepness of the slope and difficult access would make restoring the eroded slope below the emergency
12 spillway and at other locations where slope stabilization is needed and removing sidecast and eroded
13 material from the bypassed reach channel a costly endeavor. We estimate that the annualized cost for
14 these remedial actions would be about \$695,930. However, considering the importance of the aquatic
15 habitat in the bypassed reach, we view the benefits of this measure to be worth the cost and include it in
16 the Staff Alternative.

17 It is evident that, because of the steepness of the slope above and below the J.C. Boyle intake
18 canal, it is vulnerable to unforeseen natural and project operational events that can cause sudden releases
19 of large quantities of water, resulting in erosion of material in the bypassed reach. This vulnerability is a
20 valid reason to establish protocols that would be followed by PacifiCorp as soon as a breach in the canal
21 or major uncontrolled spill event is discovered, as Oregon Fish & Wildlife and the Bureau of Land
22 management recommend. The protocols would not only define the procedures that would be followed
23 after such an event, but the threshold of flow conduit spill events that would trigger implementation of the
24 specific procedures. We estimate that the annualized cost to develop such protocols would be relatively
25 minor, about \$1,350. The establishment of proactive procedures that would be implemented following
26 future flow conduit failures or major spill events should expedite stabilization and follow-up restoration
27 work, and we include development of this plan in the Staff Alternative. We consider the cost of
28 implementing the actions defined in the protocols following any flow conduit failure or major spill event
29 to be a cost of operation and maintenance that would be necessary regardless of this relicensing
30 proceeding, and we therefore do not assign an incremental cost to such follow-up actions.

31 **5.2.3 Project Operation Management**

32 PacifiCorp proposes to install new flow gaging stations at two project reaches to provide a basis
33 for documenting that project operations are in compliance with the flow regime that may be specified in a
34 new license, specifically the J.C. Boyle bypassed reach and downstream of the Spring Creek diversion.
35 Existing USGS gaging stations downstream of the J.C. Boyle and Iron Gate powerhouses also provide a
36 basis for documenting project operations and compliance with applicable flow regimes.

37 PacifiCorp proposes minimum flows in project reaches that are based on a set flow release, often
38 during a specified period of the year. Consequently, documentation of such flow regimes focuses on
39 measuring the flow downstream of the project dam (e.g., J.C. Boyle), diversion point (e.g., Spring Creek),
40 or powerhouse (e.g., J.C. Boyle and Iron Gate). In some instances, we assume PacifiCorp intends to rely
41 on fixed weir or orifice devices to document compliance with the specified flow regime (e.g., below
42 Copco No. 2 dam and the Fall Creek diversion dam). The flow regimes specified by various entities (see
43 section 3.3.3.2.1, *Instream Flows*) entail the use of proportional flows, where the minimum flow would be
44 either a specified value or a proportion of inflow to the reservoir or diversion dam of each development,
45 whichever is the larger flow. Therefore, both establishing the minimum flow at any particular time, and
46 documentation of compliance with that minimum flow would require gages that accurately measure
47 inflow to each development on a real-time basis and outflow below each project dam or powerhouse
48 where a minimum flow specification has been established.

1 Another key aspect of Klamath Hydroelectric Project operation management pertains to
2 interactions with the Klamath Irrigation Project, operated by Reclamation. Reclamation is required, as a
3 condition of its BiOp for the protection of federally listed coho salmon, to release sufficient flows to the
4 Klamath Hydroelectric Project to enable specified minimum flow releases from the Iron Gate
5 development. In the past, this coordination was achieved through a contract between Reclamation and
6 PacifiCorp, but this contract expired in April 2006. Reclamation specifies that PacifiCorp develop
7 operational criteria to coordinate operation of Link River and Keno dams with operation of Iron Gate dam
8 to ensure that Reclamation can meet its obligations under the BiOp for the Klamath Irrigation Project.

9 Oregon Fish & Wildlife and the Hoopa Valley Tribe recommend that PacifiCorp develop a
10 project operations and resource management plan that would include provisions for documenting and
11 annual reporting of appropriate minimum flows and ramping rates as measured at project gaging stations,
12 non-compliance events pertaining to project operations, and an annual work plan for the upcoming year.
13 The plan also would include provisions for updating the plan at 5 year intervals to reflect new information
14 and management needs, and updated implementation strategies. Oregon Fish & Wildlife and the Hoopa
15 Valley Tribe also recommend that PacifiCorp develop a coordinated gage installation and reporting plan.
16 Because their flow recommendations are based on proportional inflow to each project reservoir or
17 diversion dam, they recommend installing gages, equipped with telemetry capabilities and hourly
18 recording intervals, above all project reservoirs and diversions and outflow from each project dam at the
19 head of the dewatered reach.

20 We agree with Oregon Fish & Wildlife and the Hoopa Valley Tribe that developing a project
21 operations and resource management plan would be an appropriate means to develop reporting formats in
22 consultation with appropriate resource agencies. However, much of the information contained in the
23 reports would be developed through flow and water level gages that would be necessary to ensure
24 documentation with the flow regimes that may be specified in a new license. We see no reason why
25 development of the project operations and resource management plan should not be consolidated with the
26 gage installation and reporting plan. Developing such a plan, in consultation with resource agencies
27 including USGS, would ensure that gages are installed and maintained in a manner that provides accurate
28 documentation of the project flow regime that may be required in a new license. This consolidated plan
29 would also be the ideal forum for establishing the mechanism for coordinating flows into the project with
30 Reclamation's BiOp responsibilities downstream of Iron Gate dam. Developing a separate agreement for
31 operating Link River and Keno dam, as Reclamation specifies, would be problematic if the Commission
32 removes East Side, West Side, and Keno developments from the project, as PacifiCorp proposes.
33 Including coordination provisions for the Klamath Irrigation Project and the Klamath Hydroelectric
34 Project in a project operations and resource management plan, which would be periodically updated,
35 would enable this important function to occur regardless of the disposition of East Side, West Side, and
36 Keno developments, as well as if any of the downstream developments should also be removed from the
37 project. We therefore include the development of a project operations and resources management plan
38 that includes provisions for gage installation appropriate to any flow regime specified in a new license in
39 the Staff Alternative. We estimate that the annualized cost for developing this plan and implementing the
40 reporting and plan update provisions would be about \$14,720.

41 As we discuss in more detail in section 5.2.5, *Instream Flows*, the Staff Alternative does not take
42 the approach that minimum flows should be a proportion of the inflow to the reservoir or diversion dam
43 of each development. As a result, the new gage placement that we include in the Staff Alternative is
44 considerably less than that recommended by other entities. Specifically, we include the following new
45 gages with hourly reporting intervals, equipped with telemetry to enable conveyance of real time
46 information at the following locations: J.C. Boyle bypassed reach (as proposed by PacifiCorp and
47 recommended by other entities) and Copco No. 2 bypassed reach (as recommended by other entities).
48 The flow regimes that we include in the Staff Alternative include set flows on a seasonal basis
49 downstream of Spring Creek diversion dam and a year-round basis downstream of Fall Creek diversion

1 dam. Consequently, a Parshall flume should be sufficient to measure compliance with the designated
2 flows in each reach, and we include such flow gages in our Staff Alternative. PacifiCorp currently
3 provides financial support for USGS to operate the gage downstream of the J.C. Boyle and Iron Gate
4 powerhouses, and there would be no incremental costs associated with this continued practice. We
5 estimate that the annualized cost for installation of the four new gages that we include in the Staff
6 Alternative would be about \$57,080.

7 In contrast, gages needed to measure inflow to each reservoir and outflow from each dam would
8 not only include the two new real-time gages that we recommend, but refurbishment or replacement of
9 the Spencer Creek gage, and new real-time gages at Shovel Creek and upstream and downstream of
10 Spring Creek and Fall Creek diversion dams. PacifiCorp currently provides financial support for USGS
11 to operate the gage in the Keno reach. We estimate that the annualized cost for installation of the gages
12 needed to establish and document project-related flows recommended by the agencies would be about
13 \$115,350. We do not view this additional cost to be warranted because the gaging recommended by the
14 agencies and others is unnecessary to document the flow regime that we include in the Staff Alternative.

15 **5.2.4 Water Quality Management**

16 Water quality within the Klamath River and throughout the mainstem portion of the project is
17 compromised for a number of parameters, including temperature, DO, and parameters related to nutrient
18 enrichment. PacifiCorp proposes to develop comprehensive reservoir management plans aimed at
19 improving DO, reducing algae blooms, and improving the pH in J.C. Boyle, Copco, and Iron Gate
20 reservoirs. In response to our AIR, PacifiCorp stated that it would install a hypolimnetic oxygenation
21 system at Iron Gate reservoir to enhance the DO level of water released from the Iron Gate development.
22 However, in response to agency concerns (expressed in comments, terms, and conditions) that
23 hypolimnetic oxygenation could result in resuspension of nutrients and other unwanted effects,
24 PacifiCorp indicated in its response to those comments that it would evaluate its proposed hypolimnetic
25 oxygenation system further, as well as other means to improve the DO regime within and downstream of
26 Iron Gate reservoir. PacifiCorp also stated that it would continue to evaluate potential means to provide
27 short-term temperature relief downstream of Iron Gate dam by releasing cool, hypolimnetic water from
28 Iron Gate reservoir.

29 Oregon Fish & Wildlife, the Forest Service, and the Hoopa Valley Tribe all recommend that
30 PacifiCorp develop a water quality management plan that includes assessments and implementation of
31 methods to improve water quality and water quality monitoring. NMFS, FWS, and the Klamath Tribes
32 recommend that PacifiCorp develop a plan to address Keno reservoir water quality problems and fund
33 implementation of remedial measures.

34 Water quality issues associated with the Klamath Hydroelectric Project are part of a systemic
35 problem whereby high levels of nutrients that originate from upstream sources enter project waters, and
36 processes associated with project reservoirs, primarily Copco and Iron Gate, exacerbate the problems
37 during the warmer months of the year. Consequently, we conclude that developing a single,
38 comprehensive water quality management plan for the project, in consultation with other resource
39 agencies including Reclamation, would be the most effective way to achieve positive results in a
40 cooperative manner that meshes with ongoing efforts by other entities to address water quality issues
41 unrelated to operation of the hydroelectric project. The plan would include provisions for (1) assessing
42 alternative techniques to address project-related water quality issues (temperature, DO, and nutrient
43 enrichment); (2) implementing feasible measures; (3) monitoring to determine the effectiveness of
44 measures that are implemented, or to determine when specific triggers are met that signal implementation
45 of seasonal or emergency measures (such as emergency cool water releases, spillage of warm water
46 during late spring to enhance juvenile salmon growth, or implementation of DO enhancement measures);
47 and (4) periodically updating the plan to be responsive to new scientific developments and evolving water
48 quality initiatives by other entities (e.g., TMDLs and implementation of the Klamath Irrigation Project's

1 CIP). We include development and implementation of a comprehensive water quality management plan
2 in the Staff Alternative.

3 We agree with the resource agencies that caution against implementing measures, such as
4 hypolimnetic oxygenation or chemical treatment of algal blooms, without fully evaluating the
5 ramifications on other water quality parameters. However, because water quality problems currently
6 exist, we conclude that waiting while PacifiCorp evaluates numerous alternative measures to address
7 these problems is not an acceptable response if methods to address these issues have already been
8 identified. For example, although we agree that as a component of a water quality management plan,
9 PacifiCorp should continue to evaluate the potential use of a hypolimnetic oxygenation system at Iron
10 Gate dam, PacifiCorp's response to our AIR regarding techniques to improve the DO of releases from
11 Iron Gate indicates that turbine venting could be implemented with relative minor modifications at the
12 powerhouse. PacifiCorp's modeling indicates that turbine venting would be effective in achieving almost
13 immediate increases in DO in the Klamath River downstream of Iron Gate dam. It is not clear whether
14 turbine venting at Iron Gate development would enable releases to meet applicable water quality
15 standards, but monitoring would enable documentation of the effect of this measure, and the level of
16 additional enhancement that should be targeted during future, supplemental efforts. Therefore, we
17 include turbine venting and follow-up DO monitoring in the Staff Alternative.

18 The cost of developing and implementing a water quality management plan would be high. We
19 estimate the identifiable annualized cost to be about \$185,940, and implementation of specific measures
20 not yet identified, but that may surface during the consultation and evaluation of measures to address
21 water quality issues, could increase this cost substantially (i.e., hypolimnetic oxygenation, if
22 implemented, could have an annualized cost of about \$563,030). However, project operations are causing
23 or exacerbating the following water quality effects: (1) currently-limited recreational use at project
24 reservoirs because of toxic algal blooms that occur during the latter half of the summer; (2) nutrient
25 enrichment caused, in part, by nitrogen-fixing algae in project reservoirs fosters downstream growth of
26 algae that creates habitat for the secondary host of at least two fish pathogens that have a major adverse
27 effect on Klamath River salmon stocks; (3) increased duration when the DO downstream of Iron Gate
28 dam does not meet applicable standards from less than 2 months (without the project) to most of the
29 summer and early fall; and (4) modification of the temperature regime downstream of Iron Gate dam in a
30 manner that adversely influences salmon. For these reasons, we consider the relatively high cost of the
31 water quality management plan to be warranted.

32 **5.2.5 Instream Flows**

33 **J.C. Boyle Bypassed Reach**

34 Minimum flow releases from J.C. Boyle dam affect habitat conditions in the 4.3-mile-long
35 bypassed reach, which supports a productive trout fishery and provides spawning habitat for trout in the
36 downstream peaking reach. PacifiCorp currently releases 100 cfs into the bypassed reach, and this flow is
37 augmented by the inflow of about 220 to 250 cfs from springs, most of which enters the reach about 1
38 mile below the dam. PacifiCorp proposes to release an additional 100 cfs either from the dam or from the
39 powerhouse to increase base flows in the peaking reach. If the additional 100 cfs was released at the
40 powerhouse, total flow in the lower portion of the bypassed reach would remain between 320 to 350 cfs,
41 including the existing 100 cfs release and 220 to 250 cfs of accretion flows. Flows in the lower portion of
42 the bypassed reach would increase to 420 to 450 cfs if the additional 100 cfs was released at the dam.

43 Oregon Fish & Wildlife, NMFS, and Cal Fish & Game recommend that PacifiCorp release a
44 minimum flow of 640 cfs or 40 percent of inflow, whichever is more, from the dam into the J.C. Boyle
45 bypassed reach. Bureau of Land Management specifies a similar flow, except that the minimum flow
46 threshold would be 470 cfs rather than 640 cfs. The Hoopa Valley Tribe recommends that PacifiCorp
47 discharge a continuous minimum flow of 500 cfs or 70 percent of inflow to the project, whichever is

1 greater. Each of these recommendations include a provision for minimum flows to be reduced to inflows
2 when inflows drop below the recommended minimum flow.

3 PacifiCorp conducted an instream flow study, which indicated that higher instream flow releases
4 would increase the amount of physical habitat that is available to rainbow trout in the bypassed reach.
5 However, these higher release flows would also increase water temperatures during the summer. To
6 evaluate the effect of increased dam releases on water temperatures, we calculated the water temperature
7 that would result from mixing different volumes of release flows at 22°C with an assumed accretion flow
8 of 235 cfs at 11°C, based on longitudinal water temperatures measured in the reach during an aerial
9 infrared imaging survey conducted in August. Using this method, we estimated that the temperature
10 below the primary area of groundwater accretion would be increased from 14.3°C at the 100 cfs release
11 flow to 16.1°C at a 200 cfs release flow, which is still very close to the optimal range of 13 to 16°C for
12 salmonid growth. Further increases in dam releases would raise water temperatures below the accretion
13 area to 18.3°C with the 470 cfs release specified by Bureau of Land Management to 19.0°C for the 640
14 cfs release recommended by Oregon Fish & Wildlife, NMFS, and Cal Fish & Game. We conclude that a
15 release of 200 cfs at the dam would strike a reasonable balance between temperature and physical habitat
16 needs for trout, because it would increase the amount of physical habitat for all three life stages of trout
17 without causing water temperatures to greatly exceed the optimal growth range for salmonids.
18 Accordingly, we include a minimum flow release of 200 cfs released from J.C. Boyle dam in the Staff
19 Alternative, which is consistent with the minimum flow release proposed by PacifiCorp, except that the
20 Staff Alternative would require that the entire minimum flow of 200 cfs be released at J.C. Boyle dam.

21 Down-ramping in the J.C. Boyle bypassed reach does not occur for power production purposes,
22 but occurs primarily when coming off of spill mode or during maintenance events, both of which are
23 infrequent. The existing license includes a ramp rate restriction of 9 inches per hour, which is equivalent
24 to about 700 cfs per hour when river flows are between 400 and 3,000 cfs. PacifiCorp proposes to limit
25 down-ramping in the bypassed reach to 150 cfs per hour, except for flow conditions beyond the project's
26 control.

27 Oregon Fish & Wildlife recommends that controllable up-ramp and down-ramp rates not exceed
28 1 inch per hour or 300 cfs per day. Bureau of Land Management specifies that up-ramp and down-ramp
29 rates not exceed 2 inches per hour during controlled flow events, except during implementation of the
30 seasonal flushing flow (see section 5.2.1, *Flushing Flows and Gravel Management*). The Hoopa Valley
31 Tribe recommends that when native salmonid fry and federally listed sucker juveniles are present (about
32 May 1- September 30), ramp rates not exceed 1.2 inches per hour, and ramp rates not exceed 2.4 inches
33 per hour for the rest of the year.

34 Flow down-ramping has the potential to strand fish in areas of the channel that are relatively low-
35 gradient, or where pockets or side channels exist in the river channel. PacifiCorp's proposed down ramp
36 rate of 150 cfs reflects a substantial reduction from the current licensed rate of 9 inches (about 700 cfs)
37 per hour. We estimate that the proposed rate of flow change would equate to a stage change of about 1.9
38 inches per hour, which is similar to the 2 inch per hour ramping rate specified by the Bureau of Land
39 Management. Compared to current operations, the proposed ramping rate would reduce the risk of
40 stranding fry and juvenile fish, and would provide a more gradual transition time for adult trout to
41 relocate as river levels change.

42 Oregon Fish & Wildlife and the Hoopa Valley Tribe's recommended ramping rate of 1 inch per
43 hour is more restrictive than PacifiCorp's proposed ramping rate of 1.9 inches per hour. However,
44 stranding has not been identified as a problem in this reach, ramping in this reach is an infrequent event,
45 and a down-ramp rate of 2 inches per hour is generally regarded as a conservative rate for the protection
46 of salmon and trout fry under most conditions. Accordingly, we include PacifiCorp's proposed down-
47 ramp rate of 150 cfs per hour in the Staff Alternative.

1 We estimate that PacifiCorp's proposed minimum flow release of 200 cfs with a 150 cfs per hour
2 ramp rate would reduce the annual generation from the project by 23,968 MWh and reduce the annualized
3 benefit of the project by \$1,032,860. We estimate that the Bureau of Land Management's specified
4 minimum flow of 470 cfs or 40 percent of inflow, combined with a 2 inch per hour ramping rate, would
5 reduce the annual generation from the project by 135,077 MWh and reduce the annualized benefit of the
6 project by \$5,679,190. We estimate that the Hoopa Valley Tribe's recommended minimum flow of 500
7 cfs or 70 percent of inflow, combined with 1.2 to 2.4 inch per hour ramp rate, would reduce the annual
8 generation from the project by 227,536 MWh and reduce the annualized benefit of the project by
9 \$9,516,240. Finally, we estimate that the Oregon Fish & Wildlife, NMFS, Cal Fish & Game, and
10 Conservation Group's recommended flow of 640 cfs or 40 percent of inflow combined with a 1 inch per
11 hour and 300 cfs per 24 hrs ramping rate would reduce the annual generation from the project by 151,062
12 MWh and reduce the annualized benefit of the project by \$6,342,570. We conclude that PacifiCorp's
13 proposed minimum flow and ramp rates would serve to enhance the existing high quality fishery in the
14 bypassed reach, that higher minimum flows could adversely affect water temperatures, and that more
15 restrictive ramp rates would provide minimal additional benefit. Accordingly, we conclude that the
16 environmental benefits of PacifiCorp's proposed minimum flows and ramp rates are worth the cost, and
17 we include them in the Staff Alternative.

18 **J.C. Boyle Peaking Reach**

19 Flows passing from the J.C. Boyle bypassed reach combine with those released from the J.C.
20 Boyle powerhouse to affect aquatic habitat in the 17.3-mile-long reach between the powerhouse and
21 Copco reservoir, referred to as the J.C. Boyle peaking reach. The upstream 11.1 miles of this reach are in
22 Oregon, and this segment has been federally designated as a Wild and Scenic River. The downstream 6.2
23 miles are in California, and this segment has been designated by Cal Fish & Game as a Wild Trout Area.
24 Both sections are managed for wild trout.

25 PacifiCorp proposes to increase its minimum flow release at the development from 100 to 200
26 cfs, which would provide a minimum flow of approximately 420 to 450 cfs in the peaking reach including
27 the 220 to 250 cfs of spring flow accretion that occurs in the bypassed reach. Furthermore, it proposes to
28 limit the maximum daily flow change to 1,400 cfs. This would eliminate full two-unit peaking (420 to
29 3,420 cfs at the gage), but one-unit peaking still would occur. PacifiCorp also proposes to limit flow up-
30 ramp rates to 9 inches per hour and down-ramp rates to 9 inches per hour for flows exceeding 1,000 cfs,
31 and 4 inches per hour for flows less than 1,000 cfs in the J.C. Boyle peaking reach.

32 NMFS and Cal Fish & Game recommend that PacifiCorp operate the J.C. Boyle development in
33 run-of-river mode, with no peaking operations. Cal Fish & Game, as well as Oregon Fish & Wildlife,
34 also recommends a minimum flow of 720 cfs, and the Hoopa Valley Tribe recommends a minimum flow
35 of 500 cfs or 70 percent of inflow to the project, whichever is greater. The Bureau of Land Management
36 states that the flows that it specifies for the bypassed reach (minimum flow of 470 cfs or 40 percent of
37 inflow, whichever is more), combined with accretion flows, would provide the minimum flow to the
38 peaking reach. Oregon Fish & Wildlife and Cal Fish & Game recommend ramp rates of 1 inch per hour,
39 Bureau of Land Management specifies a ramp rate of 2 inches per hour, and the Hoopa Valley Tribe
40 recommends a ramping rate that ranges from 1.2 when salmonid fry and sucker juveniles are present to
41 2.4 inches per hour for the rest of the year.

42 The J.C. Boyle powerhouse is typically operated as a peaking facility, with water stored at night
43 and then flows are ramped up during the day to either one unit operation (up to 1,500 cfs) or two unit
44 operation (typically 2,750 cfs). PacifiCorp conducted several different studies to evaluate the effect of
45 peaking operations on aquatic resources in the J.C. Boyle peaking reach, including an instream flow
46 analysis to evaluate effects on habitat for trout and suckers, a wetted perimeter analysis to evaluate
47 potential effects on invertebrate production, a bioenergetics study, and stranding surveys.

1 Results of the instream flow study indicate that the habitat versus flow relationship for trout adult
2 and juvenile habitat in the J.C. Boyle peaking reach follow the same general pattern – a gradual increase
3 before leveling off in the 400 to 600 cfs range then declining over the upper range of flows. The study
4 results indicate that the proposed base flow of 420 to 450 cfs would provide 64 percent, 100 percent, and
5 97 percent of the maximum modeled habitat for fry, juvenile, and adult trout, respectively, and that
6 increasing minimum flows up to 720 cfs would provide only minimal changes in habitat compared to the
7 proposed minimum flow. However, agency comments on the instream flow study indicate that there was
8 a considerable amount of disagreement on the approach that was used to model rainbow trout habitat, and
9 none of the stakeholders relied on the results of the instream flow study to support their flow
10 recommendations. Accordingly, we focused most of our analysis of the effects of flow fluctuations on
11 food (invertebrate) production and on stranding potential.

12 PacifiCorp used two modeling approaches to assess the effects of proposed operations on trout
13 growth. One approach used a model that examined food and water temperature effects of growth rates for
14 trout under different flow scenarios, while the second approach involved a detailed bioenergetics model
15 that evaluated growth rates based on food availability and ingestion rates, compared to energy losses from
16 basic and active metabolism and excretion. The results of both modeling approaches indicate that food
17 availability is more important than water temperature and physical habitat as a factor in trout growth in
18 the J.C. Boyle peaking reach. This suggests that current flow fluctuations may account for the smaller
19 size of trout in the peaking reach when compared with the Keno reach as a result of decreased benthic
20 macroinvertebrate production. However, trout sampled from this reach had above average condition
21 factors, indicating that they have an adequate supply of food to meet their metabolic needs. PacifiCorp's
22 proposed base flow would serve to enhance food production by increasing the permanently wetted area by
23 about 5 percent. Increasing the minimum flow to 500 cfs would provide a 6 percent increase compared to
24 the current base flow, and a flow of 720 cfs would provide an 11 percent increase over existing
25 conditions.

26 Although we would expect some improvement in the fishery under the higher minimum flows
27 recommended by the agencies and tribes and under run-of-river operations, available information
28 indicates that the redband/rainbow trout population in this river reach is highly productive, and we expect
29 that this fishery would be sustained and improved under PacifiCorp's proposed flow regime, which would
30 increase base flows and reduce the total flow change that would occur under peaking operations. In 1984,
31 there were estimated to be 890 trout per mile exceeding 7.8 inches in length in the upper 6 miles of the
32 peaking reach, and there were estimated to be 1,911 trout per mile of this size in the next 5 miles of the
33 river. This population estimate and angler catch rates in the Oregon section reported by PacifiCorp are
34 comparable to or exceed those reported for other high quality trout streams in Oregon including the lower
35 Deschutes and Metolius rivers. Cal Fish & Game (2000) reports that annual angler catch rates in the
36 California section of the peaking reach are among the highest of the wild trout rivers that they monitor.

37 Our analysis of the effect of alternative flow regimes on angling opportunities in section
38 3.3.6.2.2, *River Recreation*, shows that, under PacifiCorp's proposed flow regime, the total number of
39 days with flows that create acceptable angling opportunities would be comparable to those that would be
40 available under run-of-river operations, recommended by NMFS and Cal Fish & Game. However,
41 PacifiCorp's Proposal would provide from 20 to 31 days of optimal angling flows during nearly all
42 months from June through October for all water year types analyzed, and operating in a run-of-river mode
43 would not provide any days with optimal angling flows during the same time frame.

44 PacifiCorp's proposed flow regime would also provide appropriate flows for whitewater boaters
45 during the daytime over most of the summer season, while the higher minimum flows recommended by
46 others would substantially reduce opportunities for whitewater recreation by reducing the magnitude of
47 daytime peak flows. The cost of implementing PacifiCorp's proposed flow regime and of the agency
48 recommendations are included in the costs that we provided above for flows in the bypassed reach,
49 because minimum flow releases in the bypassed reach would generally meet the flows that would be

1 necessary in the peaking reach. Implementing run-of-river operations at J.C. Boyle development, as
2 recommended by some agencies, would provide some additional benefit to aquatic resources by
3 increasing habitat stability, but would substantially reduce whitewater boating opportunities and would
4 reduce project benefits by \$459,400 annually due to reduced generation during peak demand periods. We
5 conclude that PacifiCorp's proposed flow regime provides a suitable balance between providing improved
6 flows for aquatic resources while continuing to provide flows that are suitable for angling and whitewater
7 recreation, and we include their proposed flow regime in the Staff Alternative.

8 PacifiCorp's proposal to limit down-ramping to 4 inches per hour when flows are less than 1,000
9 cfs in the J.C. Boyle peaking reach also represents an improvement over the current rate of 9 inches per
10 hour. Stranding studies conducted by PacifiCorp indicate that few fish are stranded by current operations,
11 and implementing the reduced ramping rate at flows less than 1,000 cfs should reduce stranding by
12 slowing the rate of down-ramping after water levels drop below the toe-of-bank level. Although the more
13 restrictive rates recommended by other stakeholders would further reduce the risk of stranding, we see no
14 evidence that stranding is limiting fish populations, and stranding should be reduced under PacifiCorp's
15 proposal. Accordingly, we include PacifiCorp's proposed ramping rate in the Staff Alternative.

16 **Copco No. 1 and Copco No. 2 Developments**

17 Currently, PacifiCorp voluntarily releases about 10 cfs of flow into the Copco No. 2 bypassed
18 reach via leakage from the spill gates and from a small sluiceway. PacifiCorp proposes to maintain a
19 minimum flow of 10 cfs in the Copco No. 2 bypassed reach, and to limit flow down-ramp rates to 125 cfs
20 per hour (equivalent to less than 2 inches per hour) in the Copco No. 2 bypassed reach, except for flow
21 conditions that are beyond the project's control.

22 Oregon Fish & Wildlife, Cal Fish & Game, NMFS and FWS all recommend that PacifiCorp
23 release a minimum instantaneous minimum flow into the bypassed reach of 730 cfs or 40 percent of the
24 inflow, whichever is greater. The Hoopa Valley Tribe recommends that PacifiCorp release a continuous
25 minimum flow of 500 cfs or 70 percent of inflow to the project, whichever is greater, or total project
26 inflow when inflow is less than 500 cfs. However, in its alternative Section 18 prescription, the Hoopa
27 Valley Tribe recommends the same flow regime as Oregon Fish & Wildlife, Cal Fish & Game, NMFS,
28 and FWS.

29 Oregon Fish & Wildlife, Cal Fish & Game, and FWS recommend that ramp rates at Copco No. 2
30 dam not exceed 1 inch per hour at any time, and not exceed 300 cfs in any one 24 hour period. Cal Fish
31 & Game also recommends that PacifiCorp operate the J.C. Boyle, Copco No. 1 and Copco No. 2
32 developments as run-of-river facilities in conjunction with meeting minimum target flows. As previously
33 described, the Hoopa Valley Tribe recommends a ramping rate at all developments that ranges from 1.2 to
34 2.4 inches per hour.

35 An instream flow study conducted by PacifiCorp in the Copco No. 2 bypassed reach indicates
36 that there is little instream habitat for the adult and juvenile life stages of rainbow trout and suckers at the
37 current minimum flow of 10 cfs. Modeling results indicate that available habitat for juvenile and adult
38 trout increases rapidly at flows of up to 75 cfs. Habitat at 10 cfs is only 55 and 33 percent of maximum
39 WUA for juvenile and adult trout, but the available habitat increases to 80 and 63 percent of maximum
40 WUA for juvenile and adult trout, respectively, at a flow of 75 cfs. Habitat for trout fry increases
41 gradually from 46 percent of maximum at 10 cfs to 53 percent, 87 percent, and 95 percent of maximum
42 WUA at flows of 75, 500, and 730 cfs, respectively. Although flows in excess of 500 cfs increase the
43 available habitat for juvenile and adult trout, other physical constraints such as water quality conditions,
44 especially water temperature, would continue to be a limiting factor for trout productivity in the reach.
45 For example, the monthly average temperature of outflows from Copco reservoir exceeds 21°C in both
46 July and August, and because of the small size of Copco No. 2 reservoir, it is likely that the temperature
47 of water released into the bypassed reach would be similar, and would be too high to support a substantial
48 trout fishery at any minimum flow. We estimate that increasing the minimum flows to 70, 500 and 730

1 cfs would reduce the annual generation from the project by 4,280, 63,190, and 95,586 MWh, respectively,
2 and reduce the annualized benefit of the project by \$188,490, \$2,695,880, and \$4,040,310. Because of
3 the substantial gain in habitat area that would occur under a 70 cfs minimum flow and due to the high
4 costs and limited improvement in fish habitat at higher minimum flows, we include a minimum flow of
5 70 cfs in the Staff Alternative. We conclude that this flow would provide a substantial improvement in
6 the condition of aquatic habitat and fish populations, and could be made from existing release gates
7 without the need for extensive civil or structural modifications.

8 Down-ramping in this reach is rare and occurs primarily when Copco No.1 is coming off of a
9 spill event or during scheduled maintenance shutdown of the Copco No. 2 powerhouse. Such events may
10 strand some fish in the bypassed reach. PacifiCorp's proposed ramp rate of 125 cfs per hour is equivalent
11 to less than 2 inches per hour in most flow ranges. A ramp rate of 1 inch per hour as recommended by
12 Oregon Fish & Wildlife, Cal Fish & Game, and the Forest Service would also be protective of smaller
13 fish and reduce the incidence of stranding, but may be more restrictive than is needed to protect fish in the
14 reach given the limited nature of the fishery and the infrequent need for ramping. Because we consider
15 the ramp rate sufficient to minimize stranding potential and due to its lower cost, we include in the Staff
16 Alternative the 125 cfs per hour ramping rate.

17 Implementing run-of-river operations at Copco No. 1 and Copco No. 2 developments would
18 reduce project benefits by \$146,710 and \$165,750, respectively, due to reduced generation during peak
19 demand periods. Because both powerhouses discharge into reservoirs and outflows are reregulated in
20 Iron Gate reservoir, peaking operations at these developments do not affect flows in any riverine areas,
21 and no adverse effects from peaking operations in reservoirs have been reported. Accordingly, we do not
22 include run-of-river operation at these developments in the Staff Alternative.

23 **Fall Creek**

24 PacifiCorp proposes to increase the minimum flow that is released into the Fall Creek bypassed
25 reach from 0.5 cfs to 5 cfs. Cal Fish & Game, Oregon Fish & Wildlife, and FWS recommend that a
26 minimum of 40 percent of inflows be released into the Fall Creek bypassed reach, which would provide
27 minimum flows between 14 and 22 cfs under typical flow conditions. Oregon Fish & Wildlife, Cal Fish
28 & Game and FWS also recommend that ramp rates at Fall Creek diversion not exceed 1 inch per hour.

29 Fall Creek supports a population of rainbow trout, nearly all of which are smaller than 6 inches.
30 Fish sampling conducted by PacifiCorp in July 2005 resulted in the capture of 15 trout in the bypassed
31 reach, ranging in size from 2 to 8 inches, with an average size of 4 inches. Above the diversion, 9 trout
32 were sampled ranging in size from 2 to 6 inches, with an average size of 4.5 inches. PacifiCorp reported
33 that the catch per unit effort between the Fall Creek bypassed reach and above the Fall Creek diversion
34 exhibited a fairly wide range (81.8 to 187.5 fish per hour), however the catch per 100 feet of stream was
35 less variable, at 3.1 and 3.6, respectively. These results indicate that the trout populations in the two
36 reaches are similar, despite the reduced flows in the bypassed reach. Public access to Fall Creek in the
37 vicinity of the diversion dam is difficult, requiring four-wheel drive vehicles, and it is unlikely that this
38 stream supports much angler use, given the relatively nearby peaking reach, which in California, is much
39 more readily accessible.

40 PacifiCorp's instream flow analysis indicates that its proposed 5 cfs minimum flow would
41 increase the available habitat in the bypassed reach by about 16 percent for fry, by 32 percent for trout
42 juveniles (less than 6 inches), and by 28 percent for adult trout. Increasing minimum flows to 14 cfs as
43 recommended by the agencies would increase the available habitat over current conditions by 21 percent
44 for trout fry, by 52 percent for juveniles, and by 66 percent for adults. Increasing available habitat would
45 potentially result in an increase in populations in the bypassed reach. However, given the similarity of
46 trout populations upstream and downstream of the diversion, we expect that the higher flows
47 recommended by the agencies would provide only a limited benefit to the fishery compared to
48 PacifiCorp's proposed 5 cfs minimum flow. In addition, given the small size of the stream, the infrequent

1 nature of ramping events and the remoteness of the facility, we conclude that imposing a 1-inch per hour
2 ramping rate as recommended by the agencies would be a substantial burden to impose for a minimal
3 benefit. We estimate that the annualized cost of implementing PacifiCorp's proposed 5 cfs minimum
4 flow would reduce the annual generation from the project by 593 MWh, at an estimated annual cost of
5 \$24,610, and that the agency-recommended flow of 14 to 22 cfs would reduce the annual generation from
6 the project by 5,061 MWh, and reduce the annualized benefit of the project by \$223,530. We conclude
7 that PacifiCorp's proposed flow regime would improve fish habitat at a reasonable cost, and we include it
8 in the Staff Alternative. We do not include the agency-recommended flow due to its high cost, limited
9 additional benefit, and the limited nature of the fishery.

10 **Spring Creek**

11 The Spring Creek diversion is located 0.5 mile upstream from the stream's confluence with Jenny
12 Creek, and diverted flow is carried through a 1.7 mile-long canal before it enters Fall Creek about 1.7
13 miles upstream of the Fall Creek power canal diversion. In order to limit adverse effects on water
14 temperatures in Jenny Creek during the summer months, PacifiCorp proposes to shut the Spring Creek
15 diversion dam canal headgate so that no flow is diverted during July and August. For the remainder of
16 the year they propose to position the slide gate to release 1 cfs of flow into the bypassed reach, if
17 available. Oregon Fish & Wildlife, Cal Fish & Game, and FWS recommend that no flow diversion occur
18 from June 1 through September 15, that 50 percent of inflows be released to the reach downstream of the
19 diversion dam during the remainder of the year, and that ramp rates not exceed 1 inch per hour.

20 Closing off the Spring Creek diversion in the summer months, as proposed by PacifiCorp and
21 recommended by the agencies, would alleviate dewatering of the Spring Creek bypassed reach and
22 increase the volume of cool water that Spring Creek contributes into lower Jenny Creek. Temperature
23 monitoring conducted in three years when PacifiCorp was not operating the Spring Creek diversion
24 (1995, 1996, and 1997), which we present in section 3.3.3.2.1, *Instream Flows*, indicate that inflows from
25 Spring Creek reduce water temperatures in lower Jenny Creek during the summer months. In 1995 and
26 1996, the cooling effect was most pronounced during July and August, but in 1997 the cooling effect
27 extended from June through mid-September. Although temperatures in lower Jenny Creek would still be
28 above optimal during mid-summer in most years, closing off the diversion from Spring Creek during the
29 warm season would limit the duration of highly stressful temperatures, and would likely provide a
30 temperature refugium in Jenny Creek at its confluence with Spring Creek. We estimate that the
31 annualized cost of shutting down the Spring Creek diversion from July 1 through August 31, as proposed
32 by PacifiCorp, would reduce the annual generation from the project by 303 MWh, at an estimated annual
33 cost of \$12,570, and shutting down the diversion from June 1 to September 15, as recommended by the
34 agencies, would reduce the annual generation from the project by 1,599 MWh, at an estimated annual cost
35 of \$66,360. Both of these estimated costs include PacifiCorp's proposed minimum flow of 1 cfs for the
36 rest of the year. Because the agency recommendation to extend the shut down from June 1 to September
37 15 has a relatively low cost, and would improve trout rearing conditions in lower Jenny Creek during
38 adverse years, we include the agency recommended shutdown duration in the Staff Alternative.

39 PacifiCorp's proposal of releasing a 1 cfs minimum flow (or inflow, if inflow is less than 1 cfs) at
40 all other times would help to prevent dewatering in Spring Creek and help to maintain some aquatic
41 habitat downstream of the diversion, although there are other diversions on Spring Creek that are beyond
42 PacifiCorp's control. The Oregon Fish & Wildlife, Cal Fish & Game, and FWS recommendation that 50
43 percent of the flow above the diversion be released to the reach downstream of the diversion dam from
44 September 16 through May 31 regardless of flow volume would likely increase available habitat over
45 current conditions, however, releasing 50 percent of the inflow would require some type of monitoring
46 facility to determine the instantaneous release requirement as well as installation of facilities to
47 accommodate changing release flows. We estimate that PacifiCorp's proposed minimum flow, including
48 shutdown of the diversion from June 1 through September 15, would reduce the annual generation from
49 the project by 1,599 MWh, at an estimated annual cost of \$66,360, and we estimate that the minimum

1 flow recommended by the agencies would reduce the annual generation from the project by 2,020 MWh,
2 and reduce the annualized power benefit of the project by \$97,330. Given the limited amount of habitat
3 and small size of trout in Spring Creek upstream of the diversion, we expect that the benefit to the fishery
4 from the higher flows recommended by the agencies would be minimal. We conclude that the 1 cfs
5 minimum flow proposed by PacifiCorp would provide an appropriate level of protection for trout habitat
6 downstream of the diversion, and we include PacifiCorp's proposed minimum flow in the Staff
7 Alternative.

8 **Iron Gate**

9 The flow regime downstream of Iron Gate dam affects aquatic resources through its influence on
10 physical habitat (depth, velocity, substrate and cover), water quality (especially water temperature),
11 sediment transport processes (including effects on spawning habitat), and conditions that may influence
12 the prevalence of disease pathogens and the spread of fish diseases. Iron Gate development is operated as
13 a reregulating facility, and serves to eliminate daily flow fluctuations caused by peaking operation of the
14 upstream J.C. Boyle and Copco developments. Since 1997, PacifiCorp has operated the project to
15 provide instream flow releases that are established in Bureau of Reclamation's annual operating plans.
16 PacifiCorp proposes to maintain the instream flow schedule and ramp rates below Iron Gate dam
17 according to Reclamation's operating plans, which comply with Upper Klamath Lake water levels
18 specified in a 2002 FWS BiOp to protect listed suckers and monthly Klamath River flow levels below
19 Iron Gate dam specified in a 2002 NMFS BiOp to protect coho salmon. As described in section 3.3.2.1.1,
20 *Water Quantity*, flow releases at Iron Gate dam were recently increased based on a ruling by the U.S.
21 Ninth Circuit Court of Appeals that requires Reclamation to implement Phase III flows specified in the
22 2002 NMFS BiOp. These flows range between 1,000 and 1,300 cfs from July through February,
23 increasing up to a maximum of 1,500 cfs in April and May of dry years and up to 3,025 cfs in May of
24 above average and average water years. Ramp rates specified in the 2002 NMFS BiOp below Iron Gate
25 dam are 50 cfs per 2 hours not to exceed 150 cfs in 24 hours when flows are 1,750 cfs or less, and 125 cfs
26 per 4 hours or less, and 135 cfs per hour not to exceed 300 cfs in 24 hours when flows exceed 1,750 cfs.

27 The Hoopa Valley Tribe, Oregon Fish & Wildlife, Cal Fish & Game, and Forest Service
28 recommend monthly flows that are based on the Hardy Phase II flow study conducted by Interior (Hardy
29 and Addley, 2001). Monthly flows recommended by the Hoopa Valley Tribe match the Hardy Phase II
30 flow recommendations for each water year type, which are based on annual flow exceedance values of 10,
31 30, 50, 70, and 90 percent. To minimize disease risk associated with low flows, Cal Fish & Game
32 recommend that an absolute minimum flow of 1,200 cfs be released in all months and water year types.
33 Oregon Fish & Wildlife applies the same minimum flow of 1,200 cfs in dry years, but not in below
34 average water years. The Forest Service recommended that the 1,200 cfs minimum flow apply to all year
35 types, but only for the months of August and September.

36 Although Oregon Fish & Wildlife and Cal Fish & Game indicate that application of the 1,200 cfs
37 absolute minimum flow was their only change from the Hardy Phase II flows, the monthly flows that they
38 provided in tabular form deviate substantially from the Hardy Phase II flows in dry water years. This
39 may be a typographical error, however, because their dry year flow recommendations appear to
40 correspond with the Hardy Phase II flows, with the exception of the 1,200 cfs absolute minimum flow, if
41 they are shifted by 3 months.

42 Oregon Fish & Wildlife states that its flow recommendations are target flows, and that if the
43 target flows are not available, PacifiCorp should pass inflows to Iron Gate reservoir downstream of Iron
44 Gate dam. Cal Fish & Game recommends that, if inflows drop below the recommended minimum flows,
45 PacifiCorp should draft Iron Gate reservoir to elevation 2,322 feet, using the available active storage to
46 maintain the minimum flow. After the reservoir elevation drops to below 2,322 feet, Cal Fish & Game
47 recommends that operations at Iron Gate dam convert to run-of-river, with outflow equal to the 3 day
48 running average of inflow. The Forest Service recommends that, when the recommended flows are not

1 available, Iron Gate dam be operated as a run-of-river facility. NMFS and FWS recommend that, with the
2 exception of biologically based pulse releases, the project be operated as a run-of-river facility. Releases
3 from Iron Gate dam would equal the combined instantaneous inflow to the project including tributary
4 inflow, spring accretion flow, irrigation return flows, and releases made by Reclamation from its Klamath
5 Irrigation Project. Oregon Fish & Wildlife recommends that Iron Gate dam be generally operated as run-
6 of-river.

7 NMFS recommends the ramping rates specified in the 2002 NMFS BiOp, and Oregon Fish &
8 Wildlife and FWS recommends the same ramp rates, except that when flows are above 1,750 cfs, down-
9 ramping would be limited to 125 cfs per hour (this may be another typographical error) instead of 125 cfs
10 per 4 hours. Cal Fish & Game and Forest Service recommend that controllable ramp rates not exceed 1
11 inch per hour at any time.

12 Based on our estimate of the current storage capacity of the project reservoirs (see table 3-12),
13 PacifiCorp controls a total of 12,244 acre-feet of storage in the five mainstem reservoirs that are part of
14 the current project. This represents only 2.5 percent of the storage that is controlled by Reclamation in
15 Upper Klamath Lake, or enough water to augment river flows by about 2,000 cfs for 3 days. This volume
16 of water may be useful for contributing flow during short-term events, but is not sufficient to allow
17 substantial, long-term augmentation over inflows.

18 Based on our analysis in section 3.3.3.2.3, *Disease Management*, we conclude that development
19 of an effective disease management plan may be essential to prevent the further decline of populations of
20 fall Chinook salmon in the Klamath River Basin, and the potential spread of disease to other salmonid
21 species. Two components that could be included in such a plan would be evaluating the use of high flow
22 releases prior to the juvenile fall Chinook outmigration to reduce pathogen densities, and increasing flows
23 during the migration season to reduce the density of pathogens, expedite fish movement, and reduce water
24 temperatures during the juvenile fall Chinook outmigration season. In section 3.3.3.2.1, *Instream Flows*,
25 we compared flows that occurred during the 2006 outmigration, when few fish were infected (based on
26 currently available results from sampling conducted through June 7, 2006), with five recent years when
27 substantial mortalities were observed (1997, 2000, 2002, 2004, and 2005). We concluded from this
28 analysis that flows in the range of 3,000 cfs during the outmigration season (May through July) have the
29 potential to alleviate disease-related mortality and to protect the run of fall Chinook salmon from further
30 decline. We also conclude that maintaining flows on the order of 3,000 cfs for an extended period is
31 clearly beyond the range of flow volumes that can be provided using the active storage that is available in
32 the project reservoirs. Accordingly, in section 3.3.3.2.3, *Disease Management*, we discuss the potential
33 for PacifiCorp to develop a disease management plan in consultation with Reclamation and other
34 stakeholders to consider opportunities for coordinating the use of available storage in the most effective
35 manner possible.

36 Because of the limited storage capacity that is under PacifiCorp's control, we conclude that
37 PacifiCorp's proposal to maintain the instream flow schedule below Iron Gate dam according to
38 Reclamation's Klamath Irrigation Project Operations Plans is reasonable and appropriate. We see little
39 benefit in Cal Fish & Game's recommendation that PacifiCorp use the active storage in Iron Gate
40 reservoir to maintain target flows when inflows drop below their recommended monthly flow regime.
41 The limited storage that is available in PacifiCorp's reservoirs would be most valuable for use during
42 short-term emergencies when immediate flow increases are needed to avert impending fish losses based
43 on observed increases in fish losses or adverse water quality conditions. Because of Iron Gate reservoir's
44 proximity to the lower Klamath River, it could be used to augment flows more quickly in emergency
45 situations than flows released from Upper Klamath Lake. These could include releases of cool water
46 from the hypolimnion to provide some short-term cooling of flows below Iron Gate dam. The potential
47 for using releases from the hypolimnion, including potential adverse effects on the supply of cool water
48 for Iron Gate Hatchery, could be evaluated under the temperature management plan that we discuss in
49 section 3.3.2.1.2, *Water Quality*.

1 We also see little benefit in the Forest Service’s recommendation that Iron Gate dam be operated
2 as a run-of-river facility when inflows drop below their recommended flows or Oregon Fish & Wildlife’s
3 recommendation that Iron Gate dam should be generally operated as run-of-river. Iron Gate dam serves
4 an important re-regulating function to smooth out flow fluctuations from peaking operations at the
5 upstream J.C. Boyle and Copco developments. Implementing run-of-river operations at Iron Gate dam
6 while continuing peaking operations at the upstream developments would result in substantial flow
7 fluctuations downstream of Iron Gate dam, would violate ramping rates specified in the 2002 NMFS
8 BiOp, and could adversely affect aquatic resources through fish stranding, reduced invertebrate
9 production, disruption of spawning activity, and dewatering of salmon redds.

10 We also see little benefit in the recommendation made by NMFS and FWS that, with the
11 exception of biologically based pulse releases, the project should be operated run-of-river with releases
12 from Iron Gate dam equal to the combined instantaneous inflow to the project including tributary inflow,
13 spring accretion flow, irrigation return flows, and releases made from the Klamath Irrigation Project.
14 Because irrigation return flows to Keno reservoir can vary by up to 775 cfs over a 24 hour period, this
15 could result in substantial flow variations downstream of Iron Gate dam and violation of ramping rates
16 specified in the NMFS 2002 BiOp.

17 PacifiCorp reports that the ramp rates stipulated in the 2002 NMFS BiOp equate to about 0.4 inch
18 per hour 0.5 mile below the dam. Based on 10 available cross sections between Iron Gate dam and
19 Interstate 5 from Hardy and Addley (2001), PacifiCorp estimates that 0.4 inch per hour at the USGS gage
20 equates to about 0.25 inch per hour in wider areas of the river where stranding potential would be the
21 greatest, and that ramping rates become further attenuated downstream.

22 Because fish stranding is rarely observed at current ramping rates (PacifiCorp reports only one
23 incident, which occurred at a flow level higher than those that can be controlled by the project), we
24 conclude that the current rates specified in the 2002 NMFS BiOp appear to be protective of salmonids
25 rearing and emigrating through the lower Klamath River. PacifiCorp reports that the current ramp rates
26 equate to a stage change of less than 0.4 inch per hour 0.5 mile downstream of Iron Gate dam, which is
27 equal to or more conservative than the ramping rates recommended by the agencies for this development.
28 Although it is possible that less conservative ramping rates may be nearly as protective, given that
29 PacifiCorp has not reported any substantial operational difficulties or adverse economic effects related to
30 compliance with these ramping rates, we include them in the Staff Alternative because they would
31 minimize any potential for adverse effects on federally listed coho salmon and because of the importance
32 of the fall Chinook salmon fishery in the mainstem of the Klamath River.

33 If Copco No. 1 and Iron Gate dams were removed, imposing the BiOp ramp rates on flows
34 released from the project would essentially require run-of-river operation at the remaining developments,
35 since Copco No. 2 reservoir has very limited storage capacity that could be used to reregulate flows. This
36 would cause an annual reduction in benefits of \$459,400 at J.C. Boyle and \$165,760 at Copco No. 2, due
37 to reduced generation during peak demand periods. If Copco No. 1 and Iron Gate dams were removed,
38 we conclude that a year-round ramping rate of 2 inches per hour as measured at the Iron Gate gage with
39 an additional maximum daily limit of 12 inches during the Chinook spawning and incubation period
40 would likely be sufficiently protective, in conjunction with monitoring and provisions for adaptive
41 management. A ramping rate of 2 inches per hour is generally accepted as being sufficient to protect
42 rearing salmonids from stranding in most cases, and the 12 inch daily limit during the spawning and
43 incubation season should prevent redds from being dewatered.

44 **5.2.6 Anadromous Fish Restoration**

45 Measures to restore anadromous fish to areas upstream of Iron Gate dam as prescribed by
46 NMFS/Interior, as described in PacifiCorp’s alternative prescription, and as recommended by other
47 stakeholders include three distinct approaches. NMFS/Interior’s prescription involves the installation of

1 volitional passage facilities at all project dams but includes a trap and haul option to transport juvenile
2 and adult fish past Keno reservoir when water quality conditions are adverse. PacifiCorp’s alternative
3 prescription involves initiating feasibility studies to be followed by implementing trap and haul passage
4 from below Iron Gate dam to above J.C. Boyle reservoir if studies indicate that establishing self-
5 sustaining runs of anadromous fish is possible. Under PacifiCorp’s alternative, adult fish would be
6 trucked and released upstream of J.C. Boyle dam, but PacifiCorp indicates that fish could be released at
7 other locations in the upper basin such as in the Williamson River if the results of monitoring studies
8 suggest that this would be a better strategy. The third approach involves removal of most or all of the
9 mainstem dams. We evaluate each of these approaches, and an alternative approach to evaluate
10 restoration within the project reaches, in section 3.3.3.2.5, *Anadromous Fish Restoration*. We provide
11 additional analysis of the potential effects of dam removal on anadromous fish restoration in section
12 3.3.3.2.4, *Dam Removal or Decommissioning*, and we evaluate the potential benefits of installing fish
13 passage measures at each development individually in section 3.3.3.2.2, *Fish Passage*.

14 Restoration of anadromous fish passage to areas upstream of the project has the potential to
15 increase anadromous fish populations by restoring access to more than 350 miles of habitat that was
16 historically used by Chinook salmon, and possibly by other anadromous species including steelhead.
17 Although much of this habitat is currently in a degraded condition, habitat in the Williamson and Wood
18 rivers is reported to be in good condition, and substantial efforts are underway to restore habitat
19 throughout much of the upper basin. Restoration of passage to habitat upstream of Iron Gate dam would
20 be consistent with the California Recovery Strategy for California Coho (CDFG, 2004), which
21 recommends that a plan, including a feasibility analysis, be developed for coho salmon passage over and
22 above Iron Gate and Copco dams to restore access to historic habitats. In its report “*Endangered and*
23 *Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery*,” NAS
24 (2004) recommends serious evaluation of the benefits to coho salmon from elimination of Dwinnell dam
25 (on the Shasta River) and Iron Gate dam on grounds that these structures block access to substantial
26 amounts of coho habitat, as well as the cessation of diversion of flows from Jenny Creek to the Rogue
27 River Basin. NAS (2004), citing Snyder (1931), states that the flooded mainstem reach and its tributaries
28 apparently were excellent spawning habitat for Chinook salmon, coho, and steelhead, probably because of
29 cool water in the tributaries.

30 Although providing volitional passage at each dam is prescribed by NMFS and Interior would
31 provide access to more habitat than PacifiCorp’s alternative prescription (by providing access to each
32 interdam segment), PacifiCorp’s alternative trap and haul prescription would avoid mortality due to
33 predation or from poor water quality conditions in project reservoirs, because fish would be transported
34 by truck around project reservoirs. It would also limit mortality from the cumulative stress and injuries
35 that may be sustained during passage through multiple screening facilities. Mortality from these sources
36 could be substantial, especially late in the outmigration season when water quality conditions become
37 stressful (see section 3.3.3.2.5, *Anadromous Fish Restoration*). During truck transport, water quality
38 conditions can be controlled and maintained, typically with minimal mortality. In fact, adult returns
39 predicted based on PacifiCorp’s fish passage models were slightly lower for volitional passage than they
40 were for the trap and haul scenario, despite the fact that the latter scenario would not provide access to
41 habitat between Iron Gate and J.C. Boyle dams. Including measures that would be installed at East Side,
42 West Side, and Keno developments, we estimate that implementing volitional fish passage as prescribed
43 by NMFS and Interior would reduce the annual generation from the project by 2,021,019 MWh, and
44 reduce the annualized benefit of the project by \$36,296,910. Because of the lower predicted returns and
45 considerably higher costs, we do not include the provision of volitional fishways at PacifiCorp’s
46 mainstem dams (including fish ladders, fish screens, tailrace barriers, or spillway modifications) as
47 reflected in NMFS/Interior’s fishway prescription and recommendations from Oregon Fish & Wildlife
48 and Cal Fish & Game in the Staff Alternative.

1 Although we acknowledge that restoration of anadromous fish to habitat upstream of the project,
2 including areas upstream of Upper Klamath Lake, could provide substantial benefits to commercial,
3 recreational, and tribal fisheries, we conclude that PacifiCorp does not bear sole responsibility for the
4 obstacles that must be overcome, especially for water quality conditions in Upper Klamath Lake and
5 Keno reservoir. We are convinced that such a restoration effort would require a cooperative effort
6 involving PacifiCorp, Reclamation, and other stakeholders in the basin including the management
7 agencies and tribes. Accordingly, we do not include PacifiCorp's alternative prescription, which would
8 have an annualized cost of \$3,884,200, and would place the burden on PacifiCorp to conduct studies to
9 evaluate the productivity of habitat in tributaries to Upper Klamath Lake and to study the survival rates of
10 anadromous fish migrating through Upper Klamath Lake and Keno reservoir. We conclude that it is
11 incumbent on the upstream stakeholders, especially Reclamation, to address measures that relate to
12 upstream habitats including migration success through Upper Klamath Lake and Keno reservoir, where
13 the primary limitations are related to the water quality effects of diversions to support irrigated agriculture
14 and nutrients contributed from agricultural return flows.

15 One aspect of anadromous fish restoration that is largely within PacifiCorp's control is the
16 provision of access to habitat within the project area. In section 3.3.3.2.5, *Anadromous Fish Restoration*,
17 we evaluate an approach that would include development of an anadromous fish restoration assessment
18 plan within 1 year, followed by 3 years of radio telemetry studies to monitor the movement of adult fall
19 Chinook salmon placed upstream of Iron Gate, Copco No. 1, and J.C. Boyle dams to determine migration
20 behavior, survival until spawning, and the locations where spawning occurs. After the spawning and
21 incubation period, screw traps would be used to monitor the juvenile outmigration to assess the timing of
22 migration and juvenile production, with an evaluation of fish passage options for any reaches where
23 restoration of anadromous fish runs shows promise. An anadromous fish restoration plan would then be
24 developed, in consultation with the agencies and tribes, that would identify actions needed to restore
25 anadromous fish to the most promising reach, as determined from the 3 years of monitoring and
26 assessment. The plan would include the design of any needed fish passage facilities, an evaluation of any
27 additional measures that may be needed to improve habitat conditions in the selected reach, and an
28 implementation schedule. A draft of the plan would be provided to the agencies and tribes with a
29 minimum of 60 days to provide comments. The final plan would be filed for Commission approval
30 within 5 years after license issuance, including a description of how comments from the agencies and
31 tribes were addressed in the plan.

32 We estimate the annualized cost of the radio telemetry and juvenile production monitoring,
33 evaluation of fish passage options, and development and implementation of an anadromous fish
34 restoration plan would be \$107,530, \$10,110, and \$24,220, respectively. If the assessment indicates that
35 the installation of a smolt collection facility is needed to provide downstream passage, we estimate this
36 would reduce the annual generation from the project by 227,894 MWh, and reduce the annualized benefit
37 of the project by \$3,181,870. In section 3.3.3.2.5, *Anadromous Fish Restoration*, we estimate that
38 provision of passage over Iron Gate, Copco No. 1 and J.C. Boyle dams would provide access to
39 approximately 3.4, 25.6, and 19.4 miles of riverine habitat, respectively, and that this habitat could
40 support about 1,200, 4,600, and 4,200 adult fall Chinook spawners, respectively. Restoring passage to
41 one or more of these reaches would alleviate fish crowding downstream of Iron Gate dam and could
42 provide a substantial increase in anadromous fish production. This increase in fish production would
43 benefit commercial, recreational, and tribal fisheries, and these benefits could amount to tens of millions
44 of dollars annually if the harvest restrictions that have been imposed to protect the escapement of
45 naturally spawning fall Chinook salmon to the Klamath were relaxed or eliminated. Providing passage to
46 any of these three reaches would also provide access to substantial tributary habitat that is suitable for
47 spawning and rearing of steelhead and coho salmon. Providing passage upstream of Iron Gate dam would
48 allow access to Jenny and Fall creeks; passage over Copco No. 1 dam would provide access to Long Pine
49 and Shovel Creeks; and passage over J.C. Boyle would provide access to Spencer Creek. Based on the
50 potential substantial benefit to commercial, recreational and tribal fisheries, to the federally listed coho

1 salmon, and to the economy of coastal communities, we include these measures in the Staff Alternative
2 despite their substantial cost.

3 Removal of one or more of the project dams would likely assist with restoring anadromous fish to
4 habitat upstream of Iron Gate dam by restoring inundated habitat and facilitating fish passage, and it
5 could also play an important role in reducing the incidence of fish disease in the Klamath River
6 downstream of Iron Gate dam. Because of its potential to influence sediment transport, water quality, the
7 severity of fish diseases, and other resources, we discuss the effects of dam removal on all affected
8 resources in section 5.2.8, *Dam Removal*.

9 **5.2.7 Fish Disease Management**

10 In section 3.3.3.2.5, *Disease Management*, we conclude that high infection rates of *C. shasta* and
11 *P. minibicornis* observed in juvenile fall Chinook migrants in 2004 and 2005, and mortality rates
12 observed during juvenile migration monitoring, indicate that losses of juvenile migrants may be having a
13 substantial effect on fall Chinook salmon populations in the Klamath basin. Migrant sampling conducted
14 by FWS in 2004 indicated that high infection rates were associated with immediate mortality rates of
15 juvenile fall Chinook salmon that exceeded 70 percent during June and July, when the majority of fall
16 Chinook smolts outmigrate. Monitoring results from 2005 indicate that infection rates with *C. Shasta*
17 increased to levels of 70 percent or more by late April. Because most fish infected with *C. shasta* are
18 expected to die, it is likely that the percentage of the smolt population that is lost from disease may
19 exceed 70 percent in some years. Monitoring data from both years indicate that both infection and
20 mortality rates tend to increase rapidly with increasing water temperatures. Given the general trend of
21 increasing water temperatures in the basin over the last several decades reported by Bartholow (2005),
22 there is strong potential that disease-related mortality of both juvenile and adult migrants could increase
23 in the future and contribute to a continued decline in the fishery for fall Chinook salmon. In this section
24 we evaluate approaches for evaluating and implementing measures to control the incidence of fish disease
25 in the lower Klamath River.

26 In section 3.3.3.2.4, *Dam Removal or Decommissioning*, we conclude that the elimination of Iron
27 Gate and Copco reservoirs would be likely to reduce fish stress and disease susceptibility by moderating
28 fluctuations in DO and pH associated with algae blooms, increasing DO levels through natural aeration
29 from turbulent passage of water in areas of higher gradient that are inundated by the reservoirs, and
30 reducing levels of ammonia in downstream areas. In addition, expanding the length of river that is
31 accessible to anadromous fish would reduce the crowding of adult fall Chinook that currently occurs on
32 the spawning grounds downstream of Iron Gate dam, which would reduce pathogen density and the
33 transmission of disease. However, because of the substantial costs of dam removal, and due to the
34 urgency of the disease situation in the lower Klamath River, we also evaluate measures that would
35 involve developing and implementing approaches for reducing the incidence of fish diseases downstream
36 of Iron Gate dam through a disease monitoring and management plan. The plan would focus on
37 developing measures that could be implemented in the near term and potentially reduce disease losses in a
38 much shorter time frame and at a much lower cost than dam removal. If disease issues are not addressed
39 effectively within the next several years, there is a risk that the fall Chinook fishery could suffer a further,
40 dramatic decline, and that an increased prevalence of disease pathogens may affect other salmonid species
41 including the federally listed coho salmon ESU.

42 The approach for developing a disease monitoring and management plan that we describe in
43 section 3.3.3.2.5, *Disease Management*, may involve a collaborative effort between PacifiCorp,
44 Reclamation, and other stakeholders to identify and implement potentially effective measures and to
45 identify areas where additional studies are needed to develop or refine effective solutions. We
46 recommend that PacifiCorp develop measures that address project-related effects on disease incidence in
47 the reach between Iron Gate dam and the Shasta River, the area that is most directly affected by project
48 influences on water quality and sediment transport, which may influence the prevalence of fish pathogens

1 and the susceptibility of anadromous salmonids to infection. We also recommend that that PacifiCorp
2 consult with Reclamation and others (agencies and tribes) to coordinate and make the most effective use
3 possible of available storage for implementing flow-related measures, which may include flushing flows
4 to remove disease pathogens or substantial increases in flow during the fall Chinook juvenile
5 outmigration period.²

6 We estimate the annualized cost of PacifiCorp's participation in developing a disease monitoring
7 and management plan would be \$352,700. We conclude that the benefits of PacifiCorp's participation in
8 this effort would be substantial, and we include the development of a disease monitoring and management
9 plan in the Staff Alternative.

10 **5.2.8 Resident Fish Passage**

11 FWS, NMFS, Cal Fish & Game, Oregon Fish & Wildlife, and the Hoopa Valley Tribe
12 recommend installing upstream passage facilities designed to meet current agency criteria at all dams.
13 Although in most cases the primary intent of these facilities would be to provide passage for anadromous
14 fish, these ladders also would provide opportunities for resident fish passage. Oregon Fish & Wildlife
15 and the Hoopa Valley Tribe recommend constructing a ladder at Keno dam with a maximum gradient of 4
16 percent to accommodate passage of federally listed suckers. FWS specifies that PacifiCorp monitor usage
17 of their prescribed Keno fish ladder to determine whether a lower gradient ladder that meets sucker
18 criteria should also be constructed.

19 The existing ladders at Keno and J.C. Boyle dams were constructed to provide passage for
20 redband trout, but they do not meet current agency design criteria and were not designed to pass suckers.
21 We estimate that the annualized cost of constructing a low gradient ladder at Keno dam that is designed to
22 pass suckers would be approximately \$1,983,340. However, our review of the gradient profile of the
23 Klamath River indicates that suckers that pass over Keno dam and move downstream into the higher
24 gradient sections of the reach would probably be unable to move back upstream to access the fish ladder.
25 Furthermore, any suckers that were to ascend a ladder at Keno dam would be subject to sometimes lethal
26 DO conditions if they remained in the reservoir during the summer months, while downstream reservoirs
27 provide suitable rearing habitat for these species. Because they are a very long-lived species, adult fish
28 that take up residence in the project reservoirs could contribute to species conservation as a reserve
29 population of broodstock. This reserve population could be used to rebuild upstream populations if they
30 were to decline substantially, as they have in the past during water quality-related fish kills. We conclude
31 that construction of a fish ladder designed to meet sucker criteria at Keno dam would provide little, if any,
32 conservation benefit to the population of federally listed shortnose or Lost River suckers. We, therefore,
33 have not included this measure in the Staff Alternative due to its high cost and limited benefit.

34 Upgrading the ladders at Keno and J.C. Boyle dams to meet current agency criteria for passing
35 trout could increase their effectiveness, but these measures would have relatively high annualized costs of
36 \$1,113,220 and \$1,926,210, respectively. Monitoring conducted by Oregon Fish & Wildlife at the J.C.
37 Boyle ladder in the first few years after it was constructed indicated that several thousand trout migrated
38 through the ladder each year. PacifiCorp suggests that these initial high rates of ladder usage may have
39 been related to intensive hatchery stocking or due to fish attempting to return to historic spawning areas
40 near the mouth of Spencer Creek that were inundated by J.C. Boyle reservoir. Once the spawning area
41 was inundated, the advantage of moving upstream to spawn was lost, and monitoring studies conducted
42 from 1988 through 1991 indicated that the number of trout using the ladder decreased about 10-fold.

²Our analysis in section 3.3.3.2.1, *Instream Flows*, of flows that occurred in 2006 compared to years in which substantial disease losses have occurred indicates that flows on the order of 3,000 cfs may be effective in substantially reducing disease losses.

1 Another possible reason for the decline in ladder usage is an observed change in the river gradient
2 downstream of the ladder entrance, which may preclude trout from gaining access to the ladder entrance.
3 PacifiCorp is in the process of regrading the river channel in this section to provide a resting pool to
4 eliminate the potential migration barrier. PacifiCorp also has proposed to make several minor
5 modifications to improve passage conditions within the ladder. These modifications would have
6 annualized costs of \$261,680, and could improve the ability of trout to migrate past J.C. Boyle dam to
7 access spawning habitat in Spencer Creek. Because these measures have some potential to benefit trout
8 spawning, would facilitate the passage of anadromous fish if, in the future, they are restored to this
9 section of the river, and have a relatively low cost, we include them in the Staff Alternative. We do not
10 include the cost of rebuilding the Keno and J.C. Boyle ladders to meet current agency criteria. Oregon
11 Fish & Wildlife's initial monitoring studies conducted after the J.C. Boyle ladder was constructed
12 demonstrated that the ladder was successfully used by migrating trout, and PacifiCorp's plans to regrade
13 the channel downstream of the ladder should address the only passage condition that has changed since
14 the first several years when the ladder was heavily used. Furthermore, redband trout in the J.C. Boyle
15 reaches have access to suitable spawning habitat in the bypassed reach and in Shovel Creek, and trout in
16 the Keno reach have access to suitable spawning habitat in Spencer Creek. Improving the ladder at Keno
17 dam would not improve access to spawning habitat, as little or no spawning habitat is known to occur in
18 Keno reservoir or in the Link River.

19 Several agencies recommend or prescribe that PacifiCorp evaluate or implement spillway
20 modifications to improve downstream passage for resident and anadromous fish species at project dams.
21 At most of PacifiCorp's mainstem developments, spills are relatively infrequent, so the exposure of
22 downstream migrating fish to potential injuries during spillway passage is limited. At Keno dam,
23 however, there are no power generating facilities, so the spillway is the only available downstream
24 passage route, and there is the potential for fish to be injured or killed when they pass under spillway
25 gates, especially at narrow openings. PacifiCorp indicates that passage could be improved by adding a
26 top spill gate to the existing gate, at an annualized cost of \$71,990. This would eliminate the risk of fish
27 being injured passing under the gate through narrow gate openings, because low flow volumes could be
28 spilled over the top of this gated section, eliminating the need for operating the existing conventional
29 gates at narrow openings. Because this modification could improve the recruitment of federally listed
30 suckers to the project reservoirs, and the cost is reasonable, we would recommend it, if Keno remains
31 jurisdictional.

32 PacifiCorp proposes to construct fish ladders and fish screens at the Spring Creek and Fall Creek
33 diversions to provide passage for and to protect resident trout from turbine injuries. NMFS and FWS
34 prescribe, and Cal Fish & Game, Oregon Fish & Wildlife, and the Hoopa Valley Tribe all recommend the
35 installation of both upstream and downstream passage facilities. These measures would prevent trout
36 from being entrained into the diversion canals and would allow trout that pass over the diversion dams to
37 return upstream. At Spring Creek there are two non-project diversions located 0.1 mile above and 0.3
38 mile below the PacifiCorp diversion. These other diversions may limit upstream passage in this reach,
39 and there is a high gradient section near its confluence with Jenny Creek that PacifiCorp reports is likely a
40 migration barrier for suckers. Fish that migrate or are carried downstream past these potential obstacles
41 may not be able to return upstream, which would limit the benefit of installing a ladder at PacifiCorp's
42 diversion. We also find little indication that the diversion of some trout into the Spring Creek diversion
43 canal is adversely affecting populations, given the relatively high catch per unit effort that was observed
44 upstream of the diversion and the fact that any fish that are diverted into the diversion canal would have
45 access to suitable habitat both in the earthen canal and in Fall Creek.

46 Fish that are diverted into the Fall Creek power canal have the potential to be entrained into the
47 powerhouse and killed during passage through the turbines at the Fall Creek powerhouse. However, trout
48 populations upstream and downstream of the diversion appear healthy based on the relatively high catch
49 per unit effort that was observed during PacifiCorp's electrofishing survey, which produced a catch rate

1 of 82 fish per hour upstream of the diversion and 188 fish per hour in the bypassed reach downstream of
2 the diversion. Although the installation of effective upstream and downstream passage at the Fall Creek
3 diversion would improve connectivity between the populations upstream and downstream of the diversion
4 and protect some trout from being killed during turbine passage, we see little evidence that trout
5 populations in Spring or Fall creeks are being adversely affected.

6 We estimate the annual cost of constructing and operating upstream and downstream passage
7 facilities at Spring Creek would be \$50,750, and \$55,430, respectively, and the corresponding costs at
8 Fall Creek would be \$26,460 and \$111,000. Because of the high cost in relation to the limited benefit of
9 these measures, we do not include them in the Staff Alternative.

10 **5.2.9 Hatchery Management**

11 Iron Gate Hatchery was built in 1961 as mitigation for the loss of spawning areas in the Klamath
12 River and its tributaries between Iron Gate and Copco No. 2 dams. PacifiCorp proposes to continue to
13 fund 80 percent of the annual operation and maintenance costs for production and operation of Iron Gate
14 Hatchery, to fund unspecified minor upgrades at the hatchery, and to purchase and construct a mass-
15 marking facility at the hatchery to enable tagging 25 percent of released fall Chinook salmon. Agency
16 recommendations pertain to funding of existing operations for the hatchery, funding of yearling fall
17 Chinook production at the Fall Creek rearing facility, expanding fish marking, and development of a
18 hatchery and genetics management plan.

19 The Klamath Tribes recommend that PacifiCorp continue funding operation and maintenance of
20 Iron Gate Hatchery. NMFS, FWS and Cal Fish & Game recommend that PacifiCorp fund 100 percent of
21 hatchery annual operating costs, facility improvements, new construction, fish marking, monitoring and
22 recovery costs, and any permits and plans required by state or federal agencies. Cal Fish & Game
23 specifically recommends that PacifiCorp fully fund the production of yearling fall Chinook at the fall
24 Creek rearing facility. NMFS, FWS, and Cal Fish & Game recommend that hatchery production targets
25 be adjustable and developed in consultation with the agencies.

26 Our analysis in section 3.3.3.2.6, *Iron Gate Hatchery Operations*, indicates that adult return rates
27 of subyearling fall Chinook released from Iron Gate Hatchery were extremely low (0.05 percent or less,
28 compared to a long-term average of 1 percent) for 4 out of 9 brood years between 1990 and 2000 where
29 data was available. Although return rates of yearling releases are also variable, in some years they return
30 at rates that are an order of magnitude higher than subyearling releases. Preliminary data from more
31 recent years indicate an even larger differential: survival-data from the 2001 brood year indicate that 94
32 percent of adult fall Chinook that returned to the hatchery as age 3+ fish in 2004 were from yearling
33 releases.

34 The highly variable return rates observed for subyearling smolt releases indicate that pursuing a
35 more balanced strategy of releasing both subyearling smolts and yearling fall Chinook salmon may
36 provide more consistent adult returns, and help to prevent a severe decline if several consecutive years of
37 poor spring migration conditions were to occur. As discussed in section 3.3.3.2.5, *Disease Management*,
38 there appears to be a trend towards increased losses of subyearling juvenile fall Chinook from disease in
39 recent years, with mortality rates exceeding 70 percent during the last half of the outmigration in both
40 2004 and 2005. Releasing a substantial portion of hatchery-produced fall Chinook salmon as yearlings,
41 which are released in November when water quality conditions are more favorable, would reduce the
42 potential for hatchery fish to be exposed to disease, consequently reducing the potential for a severe
43 decline in adult returns.

44 We view resumption of the yearling release program to be a critical step towards ensuring that a
45 sufficient number of adult fall Chinook continue to return to meet egg take and production targets in
46 future years. Accordingly, we consider it appropriate for PacifiCorp to provide full funding for the
47 yearling portion of the hatchery program, including the refurbishment, operation, and maintenance of the

1 Fall Creek rearing facility. We estimate the annualized cost of this measure would be \$177,000, and we
2 conclude that the benefits to commercial, recreational, and tribal fisheries would be substantial.
3 Accordingly, we include this measure in the Staff Alternative.

4 Regarding the funding of existing hatchery operations, the Commission required the construction
5 and operation of Iron Gate Hatchery to compensate for anadromous fish production that was lost between
6 Copco No. 2 and Iron Gate dams due to the construction of Iron Gate dam. The hatchery was intended to
7 sustain the anadromous fishery resource of the upper Klamath River at a level approximately equal to that
8 which existed prior to construction of Iron Gate dam. Although a hatchery was built at Fall Creek to
9 mitigate for anadromous fish losses when Copco No. 1 dam was constructed, the hatchery ceased
10 operations in 1948 prior to the construction of Iron Gate dam. Furthermore, effects of the project on
11 water quality conditions and disease incidence, in combination with a basin-wide warming trend, are
12 causing substantial losses of smolts during outmigration, which limits the number of adults that the
13 hatchery contributes to commercial, recreational, and tribal fisheries. Accordingly, we conclude that full
14 funding of Iron Gate Hatchery operations by PacifiCorp is warranted. We estimate that the annualized
15 cost of increasing PacifiCorp's share of funding from 80 to 100 percent would add \$125,000 to their
16 current funding obligation of \$500,000 per year. Because of the benefits that hatchery production
17 provides to commercial, recreational, and tribal fisheries, we conclude that the benefits of continuing
18 existing hatchery production are worth the costs, and we include full funding of Iron Gate hatchery
19 operations in the Staff Alternative.

20 PacifiCorp also proposes to fund unspecified minor upgrades at Iron Gate Hatchery, which would
21 have an annualized cost of \$107,370. Periodic upgrades of hatchery facilities are often needed to
22 maintain production rates and to meet new hatchery standards. Although we cannot determine the
23 benefits of the specific upgrades that PacifiCorp anticipates, we expect that PacifiCorp would only
24 implement upgrades that are warranted to maintain and enhance hatchery operations, and we include
25 these costs in the Staff Alternative. Given the potential for adverse effects of increased hatchery
26 production on wild stocks, we do not include any provisions for expanding hatchery facilities to
27 accommodate any increases in production from current levels.

28 Currently, about 5 percent of Chinook salmon produced at Iron Gate Hatchery are tagged with
29 coded wire tags and marked with an adipose fin clip. Cal Fish & Game funds the marking (fin or
30 maxillary clip) of all coho (75,000 released annually since 1996) and all steelhead (200,000 released
31 annually since 1998). PacifiCorp proposes to purchase and construct a mass-marking facility at Iron Gate
32 Hatchery to enable tagging 25 percent of released fall Chinook salmon. NMFS, FWS, and Cal Fish &
33 Game recommend that PacifiCorp fund all fish marking costs, and NMFS recommends that 100 percent
34 of hatchery-released Chinook salmon be marked, which we assume would include both coded wire tags
35 and an adipose fin clip.

36 PacifiCorp proposes, and FWS and Cal Fish & Game recommend, marking 25 percent of
37 hatchery-released Chinook salmon. Such marking can help reduce harvest mortality on wild Chinook
38 salmon through implementation of harvest restrictions on unmarked fish. Marking all hatchery fish,
39 including coho, would aid recovery and harvest management programs by enabling an assessment of the
40 relative contribution of hatchery and natural production of these fish in the ocean and inland harvests, in-
41 river spawning escapements, straying rates, and hatchery returns. Marking hatchery fish can also aid in
42 distinguishing the origin of fish that may be re-introduced to spawn in habitats upstream of Iron Gate
43 dam. Marking all steelhead released from the hatchery would help fishery management agencies to assess
44 whether the recent low returns of adult steelhead to the hatchery is the result of ocean mortality or
45 released fish remaining in the Klamath River throughout their lives. The outcome of such an assessment
46 could lead to altered hatchery management strategies to facilitate increased adult steelhead returns to the
47 hatchery. Cal Fish & Game manages the hatchery, and we consider it appropriate for this fisheries
48 management agency to fund any steelhead marking that may assist in updating their management
49 strategy.

1 Marking only a portion of the fish released does not allow anglers to distinguish non-clipped
2 hatchery fish from wild fish. Furthermore, when selective harvest restrictions are imposed to protect
3 natural spawners, this reduces the amount of catch that would otherwise be available for harvest. The
4 ability of commercial and sport anglers to distinguish coho salmon of hatchery origin, which are not
5 protected under the provisions of the ESA, from those of wild origin, which are protected under the ESA,
6 would avoid inadvertent takings of federally listed salmon.

7 We estimate that marking 25 and 100 percent of fall Chinook salmon and 100 percent of coho
8 salmon would have annualized costs of \$233,880, \$705,040, and \$4,750, respectively. Because 100
9 percent marking would allow the harvest rates of hatchery fish to be increased without adversely affecting
10 wild stocks including the federally listed SONCC coho salmon, we conclude that this measure would
11 provide substantial benefits to commercial, recreational, and tribal fisheries, and would assist with
12 conservation of the SONCC coho salmon. Accordingly, we include this measure in the Staff Alternative.

13 NMFS, FWS, Cal Fish & Game, and the Forest Service recommend that PacifiCorp consult with
14 the agencies to develop a hatchery and genetics management plan for Iron Gate Hatchery operations that
15 includes (1) an accurate adult census of natural salmonids; (2) determination of the rate and contribution
16 of hatchery strays to natural spawning stocks; (3) determination of the rate of competition between
17 hatchery and natural salmonids; (4) determination of genetic characteristics of natural and hatchery coho
18 and steelhead stocks; (5) determination of outmigration timing of hatchery and natural stocks; (6)
19 maintenance of tribal trust and resource trustee obligations to mitigate for lost habitat; (7) development of
20 conservation hatchery techniques; and (8) minimization of any negative effects from fish husbandry or
21 juvenile releases on native, naturally occurring populations of listed salmonids. NMFS further
22 recommends the hatchery facilitate implementation of fish passage measures to restore wild runs of
23 anadromous and resident fish above and below the project. The Klamath Tribes recommend that
24 PacifiCorp fund a group of state, federal, and tribal technical experts to provide recommendations and
25 guidance to fisheries' managers to maximize the use of Iron Gate Hatchery for anadromous salmonid
26 restoration and management efforts on portions of the Klamath River Basin affected by the project, and
27 that hatchery management be brought up to standards appropriate for a conservation hatchery.

28 Development of a hatchery genetics management plan in consultation with an agency and tribal
29 advisory committee would provide a structure for ongoing analysis of hatchery programs and
30 recommendations for future management of hatchery production. Development of a hatchery genetics
31 management plan would guide the evaluation of appropriate hatchery modifications, upgrades, and
32 operating procedures in consideration of potential effects of Iron Gate Hatchery production to federally
33 listed stocks in the basin and in the ocean. However, while we consider it PacifiCorp's responsibility to
34 maintain and fund the operation of the hatchery, we consider the management of fish after they are
35 released from the hatchery to be the responsibility of Cal Fish & Game (and others), since they operate
36 the facility and manage the fisheries associated with the stocks that are raised at the hatchery.
37 Accordingly, we do not include the cost of preparing a hatchery genetics management plan, which we
38 estimate would have an annualized cost of \$503,370 in the Staff Alternative.

39 We estimate that the annualized cost of supporting the administrative costs for a technical
40 oversight committee would be \$10,000. We consider it most efficient to form a single fisheries advisory
41 committee for the Klamath Hydroelectric Project because hatchery management issues are integrally tied
42 to other project-related fisheries issues, such as anadromous fish passage and restoration. Because the
43 cost of supporting the oversight committee is small and it would provide a valuable means for
44 coordinating hatchery operations with restoration efforts, we include this measure in the Staff Alternative.

45 **5.2.10 Aquatic Habitat Enhancement**

46 PacifiCorp proposes several measures to enhance aquatic habitat including gravel augmentation
47 (discussed in section 5.2.1, *Flushing Flows and Gravel Management*), replacing unscreened gravity-fed

1 irrigation diversions in the J.C. Boyle peaking reach with screened pump systems, and eliminating
2 existing irrigation diversions on Shovel Creek and its tributary, Negro Creek. Other stakeholders
3 recommend developing and implementing habitat enhancement plans designed to compensate for project
4 effects.

5 PacifiCorp's proposal to modify irrigation diversions associated with its Copco Ranch property
6 would reduce the entrainment of trout fry from mainstem diversions in the peaking reach and from Shovel
7 and Negro creeks, which provide an important spawning area for trout in the California section of the
8 peaking reach. Eliminating diversions on Shovel and Negro creeks would increase minimum flows in
9 Shovel Creek by about 15 cfs during the irrigation season, further increasing the production potential
10 from these tributaries. These tributaries and the J.C. Boyle bypassed reach provide the only substantial
11 spawning areas that are available to trout residing in the 17.3-mile-long peaking reach and 4.5-mile-long
12 bypassed reach. Access to spawning habitat for trout residing in the J.C. Boyle peaking reach has been
13 reduced by the interruption of sediment transport, inundation of spawning habitat by J.C. Boyle reservoir,
14 and potentially by poor performance of the fish ladder at J.C. Boyle dam. We conclude that PacifiCorp's
15 proposed measures, which would have an annualized cost of \$87,180, would provide a substantial benefit
16 to the high quality trout fishery in the J.C. Boyle bypassed and peaking reaches, and we include these
17 proposed measures in the Staff Alternative.

18 Siskiyou County recommends that PacifiCorp fund about \$26 million of programs to enhance
19 flows and reduce water temperatures in Klamath River tributaries. These measures have the potential to
20 benefit anadromous fish that spawn and rear in the tributaries, and also to improve water quality
21 conditions in the mainstem Klamath River, which may help to alleviate disease-related losses. In section
22 3.3.3.2.3, *Disease Management*, we include these types of enhancements in our listing of measures that
23 could be included in a disease monitoring and management plan. We conclude that the potential benefits
24 of all disease management approaches can be most effectively considered in a single coordinated plan that
25 would allow the most effective combination of approaches to be selected for implementation. Regarding
26 measures that would improve habitat within tributaries, we acknowledge their potential benefits to
27 anadromous fish, but we conclude that the condition of habitat within tributaries downstream of Iron Gate
28 dam is not affected by the project facilities or operations. Accordingly, because of this lack of project
29 nexus, we do not include Siskiyou County's recommendation in the Staff Alternative.

30 Several agencies including NMFS, FWS, Oregon Fish & Wildlife, Cal Fish & Game, and the
31 Hoopa Valley Tribe recommend that PacifiCorp develop and implement habitat enhancement plans to
32 compensate for fish losses associated with upstream and downstream passage and other continued,
33 ongoing, and cumulative project effects. Although these parties provide some idea of measures that
34 might be considered, they provide no specific details on how such measures would be implemented,
35 where they would occur, how closely associated they would be with project-related effects, or what
36 benefits they would provide. It is most appropriate to address identified project-specific effects with
37 specific protection and enhancement measures that address those effects, rather than considering general
38 types of protection or enhancement measures that may not clearly connect to project purposes.
39 Accordingly, we do not include the enhancement plans recommended by these entities in the Staff
40 Alternative.

41 In section 3.3.3.2.5, *Anadromous Fish Restoration*, we evaluate the development of a reach-
42 specific anadromous fish restoration plan, which would focus on initially restoring anadromous fish
43 passage and habitat conditions in a single reach upstream of Iron Gate, Copco No. 1, or J.C. Boyle dam
44 (with the potential for including additional project reaches in the restoration effort at a later time). The
45 reach would be selected based on the results of radio telemetry monitoring of adult fall Chinook salmon
46 and of juvenile production conducted over a 3-year evaluation period. The restoration plan would
47 evaluate potential methods for providing fish passage, and the need for habitat enhancement measures
48 such as spawning gravel augmentation or operational changes that are needed to support restoration
49 efforts. The plan would be developed in consultation with the management agencies and tribes, and filed

1 with the Commission for approval. We anticipate that the plan would be developed in the fourth year
2 after license issuance, and implemented over a 5-year period. We conclude that developing and
3 implementing appropriate habitat enhancement measures in the selected reach, which we estimate would
4 have an annualized cost of \$24,220, would improve the potential for the successful restoration of
5 anadromous fish to the reach, and we include this measure in the Staff Alternative.

6 **5.2.11 Aquatic Resources Monitoring**

7 Monitoring the effects of environmental measures that are included in a new license helps to
8 ensure that the measures are effective, and it affords the opportunity for measures to be modified, if
9 needed, to meet resource management goals. Numerous stakeholders provided recommendations related
10 to monitoring fisheries and aquatic habitat, reporting monitoring results to stakeholders, and
11 implementing adaptive management. PacifiCorp did not propose any specific measures for monitoring
12 aquatic resources.

13 We adopt many of the agency monitoring recommendations, although we reduce the frequency of
14 some measures and do not adopt several that we conclude are not needed. Because all available
15 information indicates that the trout fisheries in the Keno and J.C. Boyle peaking and bypassed reaches are
16 in good condition, and because we see no reason to expect that any of the proposed changes in operation
17 would adversely affect these fisheries, we conclude that monitoring riverine fish populations and
18 monitoring fish migration and movement, which we assume would involve telemetry studies, every 3
19 years as recommended by FWS and Oregon Fish & Wildlife is not justified. Monitoring riverine fish
20 populations in project-affected reaches at 5-year intervals should be sufficient to assess population
21 responses to changes in instream flow or passage-related measures, and this frequency could be reduced
22 to every 10 years after the second survey, by which time fish populations should have stabilized. For
23 reaches where gravel augmentation would occur, annual monitoring for the first 10 years would help to
24 determine whether the quantity and location of gravel placement requires any adjustment to assure that a
25 sufficient amount of habitat is available to support salmonid spawning. Telemetry studies conducted at 5-
26 year intervals over the first 15 years would assist with determining the spawning locations used by trout
27 residing in the J.C. Boyle peaking reach, and would facilitate adaptive management of the gravel
28 augmentation program. The frequency of spawning gravel monitoring could be reduced to every 5 years
29 after the first 10 years, and the frequency of telemetry studies could be reduced to every 10 years after the
30 first three surveys, which should provide a good understanding of the initial response of fish spawning
31 movements to the measures that have been implemented. Due to the long lifespan of the listed sucker
32 species, and because PacifiCorp is not proposing any operational changes that are expected to affect these
33 species, we conclude that monitoring sucker populations in the project reservoirs at 5 year intervals
34 should be sufficient for tracking population trends.

35 Some of the monitoring elements that Oregon Fish & Wildlife recommends appear to go beyond
36 what is needed to monitor the effectiveness of resource measures that would be implemented in a new
37 license. For example, the condition factor of trout collected during population assessments in the J.C.
38 Boyle peaking reach would provide a good indication of fish growth without the need for conducting
39 additional bioenergetics modeling or feeding behavior monitoring, and there is no reason to believe that
40 the project or any proposed measures would have any effect on the sex ratios of fish populations. We see
41 little benefit in monitoring the number, size, and sex of spawning redband trout in Scotch, Camp, Shovel,
42 Long Prairie, and Spencer creeks, as FWS recommends, because spawning habitat in these creeks is not
43 affected by project operations. However, periodic population sampling in Jenny and Fall creeks would
44 enable the effects of project operations on trout in these tributaries to be monitored.

45 We estimate that the aquatic resource monitoring plans recommended by Oregon Fish & Wildlife
46 and FWS, and specified by the Bureau of Land Management, would have annualized costs of \$124,050,
47 \$96,610, and \$104,050, respectively. Excluding the elements that we conclude are unnecessary and using
48 the monitoring frequencies we recommend, we estimate that the annualized cost of monitoring resident

1 fish populations would be \$54,840. We conclude that these monitoring efforts would assist with tracking
2 population responses to measures included in a new license and would facilitate adaptive management of
3 these measures, and we include them in the Staff Alternative.

4 NMFS and FWS recommend that PacifiCorp develop and implement an anadromous fish
5 monitoring plan that describes protocols for (1) estimating the number, size, sex, timing, survival, and
6 origin of anadromous fish returning to Iron Gate dam by using a combination of PIT tags and fish marked
7 in other ways; (2) estimating the spawning populations of each species of anadromous fish in key
8 tributaries within the project area; (3) estimating the numbers of juvenile outmigrant Chinook salmon
9 originating from the same key tributaries within the project area; and (4) implementing measures
10 recommended by the agencies to meet project passage goals. Both agencies recommend monitoring
11 juvenile outmigrants every third year. We agree that if a program to restore anadromous fish to habitat
12 upstream of Iron Gate dam is undertaken, it would be beneficial for PacifiCorp to include the monitoring
13 of anadromous fish populations as a component of the anadromous fish restoration plan that we discuss in
14 section 5.2.6, *Anadromous Fish Restoration*, which would include most of these elements. We conclude,
15 however, that information collected on the number and species of fish that are passed or transported via
16 any fish passage facilities that are constructed should provide sufficient information on the status and
17 trends of reintroduced populations. We do not agree that it is the responsibility of PacifiCorp to monitor
18 spawning populations or juvenile production within key tributary streams, which we estimate would have
19 an annualized cost of \$329,180, since habitat in these tributaries is not affected by project facilities or
20 operations.

21 In section 3.3.3.2.5, *Anadromous Fish Restoration*, we evaluate the development of a reach-
22 specific anadromous fish restoration plan, which would focus on restoring anadromous fish passage and
23 habitat conditions in a single reach upstream of Iron Gate, Copco No. 1, or J.C. Boyle dam, with a
24 provision to consider expanding the restoration effort to one or more additional reaches in the future. The
25 reach targeted for initial restoration efforts would be selected based on the results of radio telemetry
26 monitoring of adult fall Chinook salmon and of juvenile production conducted over a 3-year evaluation
27 period. Developing specific methodologies to be used for monitoring fish movement, spawning, and
28 juvenile production in consultation with the resource agencies, as part of the anadromous fish restoration
29 plan, would enable PacifiCorp to incorporate appropriate input into the anadromous fish monitoring
30 aspects of the plan. We estimate that the annualized costs of monitoring efforts during the 3-year
31 evaluation period would be \$107,530. The selection of the reach where initial restoration efforts would
32 focused would be based upon the results of these monitoring efforts. Although the costs of restoring fish
33 passage to any reach is high, there exists the potential for substantial benefits to commercial, recreational
34 and tribal fisheries if restoration is successful. Therefore, we conclude that the costs of the initial
35 monitoring program is warranted, and we include this measure in the Staff Alternative. Requirements for
36 reporting the numbers and species of fish that are moved upstream would be specified in an operations
37 plan developed for the trap and haul facility that would be constructed at Iron Gate dam.

38 The Bureau of Land Management specifies that PacifiCorp develop an adaptive management plan
39 in consultation with the Bureau that is designed to monitor how implementation of the Bureau's specified
40 "river corridor management condition" is effective in improving fish habitat quantity and quality for
41 resident, migratory, and anadromous fish. Monitoring results and an evaluation of the results would be
42 reported annually to the Bureau of Land Management, including PacifiCorp's conclusions about
43 spawning, holding, feeding, juvenile rearing, riparian, and migratory habitat; and the adequacy of flows
44 for providing migration, rearing, and spawning habitat for native aquatic species; moving spawning
45 gravel; achieving riparian habitat objectives; supporting power generation; and providing recreational
46 opportunities.

47 Some of the habitat-related measures that the Bureau of Land Management specifies would
48 constitute a substantial change from current operations, and would warrant monitoring to determine their
49 effects and evaluating whether additional alteration of project operations may be warranted. We evaluate

1 these measures in sections 5.2.1, *Flushing Flows and Gravel Management*, and 5.2.5, *Instream Flows*.
2 However, because we do not support adopting several of the measures specified by the Bureau, we do not
3 see a benefit in requiring PacifiCorp to monitor implementation of the Bureau's specified river corridor
4 management condition. It is reasonable to expect that in response to any type of environmental
5 monitoring, if the need for corrective actions or opportunities for environmental enhancements becomes
6 apparent, recommendations based on the monitoring results would be specified in any monitoring report
7 submitted to the Commission for approval. We conclude that the alternative monitoring approaches, that
8 we discuss above and include in the Staff Alternative, would be equally effective in providing a basis for
9 reaching adaptive management decisions.

10 **5.2.12 Vegetation Management**

11 Vegetation management at project facilities, along transmission line rights-of-way, along project
12 roads, and at recreational sites has the potential to both directly and indirectly affect native plant
13 communities, rare plants, and wildlife habitat either beneficially or adversely. Furthermore, fluctuating
14 reservoir levels, water releases, and altered hydrology in the project reaches may favor noxious and
15 invasive plant species.

16 PacifiCorp proposes to develop and implement a vegetation resources management plan in
17 consultation with the resource agencies within 2 years of license issuance to guide land management
18 practices on PacifiCorp-owned non-aquatic land within the project boundary. PacifiCorp would address
19 (1) project facility vegetation management; (2) noxious weed control; (3) vegetative restoration of sites
20 that have been disturbed by project activities; (4) threatened, endangered, and sensitive plant protection;
21 and (5) long-term monitoring in its proposed vegetation resources management plan. PacifiCorp also
22 proposes to enhance upland habitat for deer by managing about 1,031 acres of PacifiCorp-owned land
23 within the project boundary to increase forage and cover habitat for deer. PacifiCorp proposes working
24 with resource agencies to investigate and implement habitat enhancements within the project boundary
25 aimed at improving shrub forage in oak woodlands and chaparral habitats, and to reduce or eliminate
26 livestock grazing effects. PacifiCorp also proposes to protect and restore riparian habitat along the
27 margins of three of the project reservoirs and along about 13 miles of tributary and river reaches.
28 PacifiCorp also proposes to protect wetlands near recreational areas. PacifiCorp proposes including these
29 riparian enhancement measures in its proposed wildlife habitat management plan.

30 The Bureau of Land Management's preliminary 4(e) condition specifies that PacifiCorp develop a
31 vegetation resources management plan within 1 year of license issuance that includes provisions for
32 managing noxious and invasive plants and threatened, endangered, and sensitive plants on Bureau-
33 administered lands that are affected by the Klamath Hydroelectric Project. Oregon Fish & Wildlife and
34 the Hoopa Valley Tribe recommend that PacifiCorp prepare a vegetation and noxious weed resource
35 management plan within 1 year of license issuance and a vegetation management plan within 2 years of
36 license issuance.

37 Interior recommends that PacifiCorp consult with the Bureau of Land Management to develop a
38 plan for managing upland vegetation to improve forest health (by reducing risk of insect infestation) and
39 reduce potential fire hazard (by reducing wildfire risk) adjacent to project facilities. Interior also
40 recommends that PacifiCorp consult with affected tribes to develop and implement a vegetation
41 management plan within 1 year of license issuance to reestablish native vegetation and plants that are
42 suitable to tribal members for food, medicine, basket material, cradles, art, and other cultural products.
43 FWS recommends that PacifiCorp develop a riparian habitat management plan to conserve, develop, and
44 enhance fish and wildlife resources.

45 The description of the vegetation and noxious weed plans recommended by Oregon Fish &
46 Wildlife and the Hoopa Valley Tribe is so similar that we do not see a need for separating them into two
47 plans. Also, including the various vegetation management specifications and recommendations in one

1 comprehensive vegetation resources management plan would allow the measures to be addressed in an
2 efficient manner without the need to develop separate plans. We consider the differences between
3 PacifiCorp’s proposed vegetation management plan content and the content offered by various
4 stakeholders to be relatively minor, and development of a unified approach to vegetation management
5 should be possible during the consultation that would occur during plan development. However, the
6 vegetation resources management plan would only address aspects of vegetation management that have a
7 nexus to the project, which would generally include lands within the project boundary and access roads
8 for which PacifiCorp has shared or sole responsibility for maintaining because they are needed for project
9 purposes. PacifiCorp proposes to develop the vegetation management plan within 2 years of license
10 issuance and the stakeholder indicate that most aspects of a vegetation management plan should be
11 developed within 1 year of license issuance. Providing PacifiCorp 2 years to consult with the agencies
12 and develop the plan would ensure that all of the elements of the plan are adequately addressed and that
13 any disagreements could be resolved prior to filing the plan with the Commission for approval. It would
14 also allow PacifiCorp to develop the vegetation resources management plan in the same time frame that it
15 develops the wildlife management plan, to ensure that the appropriate aspects of the vegetation
16 management plan are integrated with the appropriate aspects of the wildlife management plan.

17 We estimate that consultation and development of a single, comprehensive vegetation
18 management plan for the entire project, incorporating the elements of vegetation management at all
19 project facilities, noxious and invasive plant control, threatened, endangered, and sensitive plant
20 protection, upland vegetation management, riparian and wetland habitat management, implementation of
21 measures that pertain to vegetation management, and long term monitoring would reduce the annual net
22 benefit of the project by about \$93,400. Although this amount is substantial, we consider the protection
23 that would be afforded to sensitive plant species, potential enhancements to wildlife habitat and
24 ethnobotanical resources, and control of noxious and invasive plant populations within project-influenced
25 areas to be worth the cost and we include development and implementation of a vegetation management
26 plan in the Staff Alternative.

27 **5.2.13 Wildlife Management**

28 PacifiCorp proposes to develop and implement a wildlife habitat management plan that would
29 describe all wildlife enhancement measures and provide a mechanism for coordinating with the
30 PacifiCorp environmental management system and best management practices and for protecting and
31 monitoring threatened, endangered, and sensitive species. PacifiCorp’s proposed plan would include: (1)
32 restoring riparian habitat along river and reservoir shorelines to improve habitat structure and
33 connectivity; (2) installing wildlife crossing structures on the J.C. Boyle canal to enhance connectivity;
34 (3) managing habitats within the project boundary to meet deer winter range objectives; (4) monitoring
35 transmission lines and retrofitting poles on lines where birds have died to improve avian protection; (5)
36 developing amphibian breeding habitat along Iron Gate reservoir; (6) funding annual aerial bald eagle
37 surveys to document new nests and productivity of territories, and protect bald eagle and osprey habitat
38 within the project boundary; (7) selectively closing roads that are unnecessary for project operation or
39 other management activities; (8) installing turtle basking structures in selected sites; (9) installing bat
40 roosting structures near project sites known to support roosting bats; (10) conducting surveys for
41 threatened, endangered, and sensitive species in areas to be affected by new recreation development; and,
42 (11) monitoring the effectiveness of enhancement measures over the course of the new license.

43 The Bureau of Land Management’s preliminary 4(e) condition specifies that PacifiCorp develop a
44 wildlife habitat management plan within 2 years of license issuance for Bureau-administered land
45 affected by project operations and maintenance by PacifiCorp. Oregon Fish & Wildlife, Cal Fish &
46 Game, and the Hoopa Valley Tribe recommend that PacifiCorp prepare a wildlife mitigation resource
47 management plan within 1 year of license issuance; Oregon Fish and Wildlife and Cal Fish & Game also

1 recommend that PacifiCorp prepare a comprehensive wildlife mitigation plan within 2 years of license
2 issuance.

3 FWS recommends that PacifiCorp complete an avian collision and electrocution hazard
4 avoidance plan within 1 year of license issuance to ensure that adverse interactions between project
5 transmission and distribution lines and birds are minimized. Oregon Fish & Wildlife also recommends
6 that PacifiCorp develop a wildlife crossing monitoring plan to evaluate the efficacy of wildlife crossings
7 along project canals and waterways within 1 year of license issuance.

8 In its proposed wildlife habitat management plan, PacifiCorp proposes installing and maintaining
9 eight wildlife crossings on the J.C. Boyle canal and developing a monitoring program to document the
10 use of the wildlife bridges. The Bureau of Land Management specified and Oregon Fish & Wildlife
11 recommended wildlife crossings and escape ramps for the J.C. Boyle canal and effectiveness monitoring.
12 PacifiCorp disagrees with the need for additional wildlife escape ramps and effectiveness monitoring of
13 the wildlife crossings and believes that monitoring use of the structures would be more appropriate. We
14 agree that wildlife crossings are appropriate for the J.C. Boyle canal and expect that the need for
15 additional crossings and the monitoring of those crossings would be worked out in consultation and
16 included in a wildlife management plan.

17 The description of the wildlife mitigation and comprehensive wildlife plans recommended by
18 Oregon Fish & Wildlife, the Hoopa Valley Tribe, and Cal Fish & Game is so similar that we do not see a
19 need for separating them into two plans. We have also concluded that measures related to restoring
20 riparian habitat along river and reservoir shorelines and managing upland habitats within the project
21 boundary are more appropriately addressed in a vegetation resources management plan, even though
22 those measures would benefit various species of wildlife. Likewise, we recognize that closing and
23 restoring roads would enhance wildlife habitat connectivity, but conclude that it would be best to handle
24 road closures in a road management plan. We also conclude that annual aerial bald eagle surveys as
25 proposed by PacifiCorp and other specifications and recommendations related to bald eagle management
26 are more appropriately addressed in a separate bald eagle management plan.

27 Including the remaining wildlife management specifications and recommendations in one
28 comprehensive wildlife management plan would allow the measures to be addressed in an efficient
29 manner without the need to develop separate plans. We consider the minor differences between
30 PacifiCorp's proposed wildlife management plan content and the content offered by various stakeholders
31 to be relatively inconsequential, and a unified approach to wildlife management should be able to be
32 achieved during the consultation that would occur during plan development. The Bureau of Land
33 Management specifies and Oregon Fish & Wildlife recommends that PacifiCorp develop the wildlife
34 management plan within 2 years of license issuance. We agree that providing PacifiCorp 2 years to
35 consult with the agencies and develop the plan would ensure that all of the elements of the plan are
36 adequately addressed and that any disagreements could be resolved prior to filing the plan with the
37 Commission for approval. It would also allow PacifiCorp to develop the wildlife management plan in the
38 same time frame that it develops the vegetation resources management plan, to ensure that the appropriate
39 aspects of the wildlife management plan are integrated with the appropriate aspects of the vegetation
40 resources management plan.

41 We estimate that consultation and development of a single, comprehensive wildlife management
42 plan for the entire project, incorporating wildlife management elements such as installing wildlife
43 crossing structures on the J.C. Boyle canal; developing amphibian breeding habitat; installing turtle
44 basking structures; installing bat roosting structures; conducting surveys for threatened, endangered, and
45 sensitive species in areas to be affected by new recreation development; monitoring transmission lines
46 and retrofitting poles on lines where birds have died to improve avian protection; implementing measures
47 pertaining to wildlife management; and long term monitoring would reduce the annual net benefit of the
48 project by about \$83,370. Although this amount is substantial, we consider the protection that would be

1 afforded various wildlife species and potential enhancements to wildlife habitat within project-influenced
2 areas to be worth the cost, and we include development and implementation of a wildlife management
3 plan in the Staff Alternative.

4 **5.2.14 Recreational Resource Management**

5 PacifiCorp proposes to finalize the draft Recreation Resources Management Plan that it provided
6 to the Commission in September 2004. This plan specifies extensive recreational facility enhancements
7 that would be implemented at existing and new sites at J.C. Boyle reservoir and bypassed reach, the
8 California portion of the J.C. Boyle peaking reach, Copco and Iron Gate reservoirs, Fall Creek
9 development, and the Iron Gate Hatchery. In addition, the plan identifies programmatic elements that
10 also would be implemented, including an operation and maintenance program, a recreational monitoring
11 program (which not only would include recreational use monitoring, but project patrols by PacifiCorp
12 personnel and support for law enforcement agencies to provide additional project patrols), a resource
13 integration and coordination program (that would coordinate overlapping recreational resource
14 responsibilities with other agencies such as the Bureau of Land Management and Cal Fish & Game, and
15 establish agreements that define the responsibilities of each), provisions for periodically updating the plan
16 in consultation with agencies, and an interpretation and education program.

17 In general, agencies and other entities do not object to implementation of PacifiCorp's proposed
18 recreational enhancements, but include additional measures that should be included in the plan, such as
19 including operation and maintenance provisions for Topsy Campground, the Spring Island Boater Access
20 site, Klamath River Campground, dispersed recreational sites along the peaking reach (Bureau of Land
21 Management and Interior), and downstream of the Iron Gate Hatchery (Forest Service and Interior).
22 Oregon Parks & Rec and Interior recommend that PacifiCorp provide funding for law enforcement at
23 project reservoirs, roads, and dispersed recreation sites along the Oregon portion of the peaking reach, and
24 that PacifiCorp conduct a feasibility study regarding methods to establish communications for
25 recreational boaters along the peaking reach, for emergency purposes. Interior and the Forest Service
26 recommend that PacifiCorp provide for additional Klamath River patrols downstream of the Iron Gate
27 Hatchery.

28 As we discuss in section 3.3.6.2, *Recreation Resources*, we consider most of the proposed
29 measures in PacifiCorp's draft plan to be appropriate to address identified recreational needs in the
30 project area, and we include these measures in the Staff Alternative. The annualized costs of PacifiCorp's
31 proposed recreational enhancements that we include in the Staff Alternative would be about \$1,539,880.
32 PacifiCorp proposes to be responsible for nearly all proposed new or enhanced recreational facilities.
33 Operation and maintenance of several project recreational sites is either assigned to another entity, as in
34 the case of the proposed "old foundations day use area" near J.C. Boyle powerhouse (assigned to the
35 Bureau of Land Management) or the Iron Gate Hatchery day-use area (assigned to Cal Fish & Game), or
36 is unclear, as in the case of proposed trail enhancements at the Fall Creek development (either PacifiCorp
37 or Cal Fish & Game). All three of these sites are project-related recreational areas and, as such,
38 PacifiCorp would ultimately be responsible for their operation and maintenance. In addition, the term of
39 any new license for the project would be from 30 to 50 years. Even with PacifiCorp's proposed operation
40 and maintenance of project recreation facilities, it is probable that the useful life of major facility features
41 would end prior to the expiration of the term of the license and may need to be replaced. Therefore, we
42 have assessed PacifiCorp's proposed operating and maintenance costs, and increased them to account for
43 replacement of facilities, as needed. The final plan should reflect this aspect of operation and
44 maintenance. We estimate that the annualized cost for this increased operation and maintenance, as well
45 as operation and maintenance at the "old foundations," Fall Creek, and Iron Gate Hatchery day-use areas,
46 would be about \$154,180.

47 Although PacifiCorp should coordinate its proposed project patrol activities with those of local
48 law enforcement agencies, we do not consider it appropriate for PacifiCorp to be directly responsible for

1 funding any public law enforcement patrols of project lands and waters. We also conclude that
2 PacifiCorp should only be responsible for operation and maintenance (either directly or through
3 cooperative maintenance agreements with the Bureau of Land Management) for facilities that provide
4 public access to project lands and waters. Topsy Campground currently serves such a project function
5 and is located within the existing project boundary. Consequently, we include provisions for PacifiCorp
6 to contribute to the long-term operation and maintenance of Topsy Campground, including the provision
7 of an updated potable water system, in the Staff Alternative. We estimate that the annualized cost of this
8 measure would be about \$34,060. We have not been able to establish a similar project purpose for the
9 Spring Island Boater Access Site, Klamath Campground, dispersed recreation sites between the Spring
10 Island Boater Access Site and the California border, or recommended facilities or patrols downstream of
11 Iron Gate Hatchery. Consequently we do not include such measures in the Staff Alternative.

12 We conclude that, because much of the whitewater rafting recreational use along the peaking
13 reach is supported by PacifiCorp's peaking operations at the J.C. Boyle development, an unscheduled
14 powerhouse outage could place such recreationists at risk if flows in the peaking reach decrease prior to
15 the completion of the complete run. Radio and cell phone reception along the peaking reach is either non-
16 existent or marginal. Given that it is about 11 miles from the Spring Island Boater Access site, where
17 boaters put-in, to the State-line Take-out site, boaters that become stranded in this reach would at best
18 suffer inconveniences but also could suffer from exposure if outfitters cannot reach their home bases to
19 arrange for a pick-up at an alternative site. Consequently, we agree that PacifiCorp should conduct a
20 feasibility study that assesses potential means to enhance communications along the peaking reach and
21 include it in the Staff Alternative. Such enhancements could include installation of a repeater station,
22 cellular tower, or radio tower at a location that maximized coverage along the peaking reach. We
23 estimate that the annualized cost of such a feasibility study would be about \$2,700.

24 However, if implementation of any such measure is found to be feasible, we do not consider it
25 appropriate for PacifiCorp to be responsible for funding the entire cost of implementation. We consider
26 implementation to be appropriately shared among the parties that would benefit from any such enhanced
27 communications, which could include whitewater boating outfitters, local law enforcement and public
28 safety agencies, and the Bureau of Land Management, in addition to PacifiCorp. A cooperative funding
29 agreement for any planned enhancements to peaking reach communications could be included in
30 PacifiCorp's proposed periodic updates to the plan, and implementation of any such measures would
31 require the Commission's approval, in addition to other appropriate communication agency and
32 governmental approvals.

33 **5.2.15 Aesthetic Resource Management**

34 Project facilities and operations can directly affect the aesthetic character of the project area in
35 both positive and negative ways. Power generation and transmission facilities and the physical elements
36 of recreational facilities often create contrasts with the natural landscape; operations that affect the flow in
37 downstream river reaches can either enhance or detract from the attractiveness of the river; and reservoirs
38 can either add to or detract from the aesthetic appeal of an area, with high pool conditions generally more
39 appealing than low pool conditions.

40 PacifiCorp proposes to use vegetative screening and repainting or recoating to reduce the
41 visibility of several project facilities, including the Red Barn at J.C. Boyle dam; the powerhouse,
42 penstocks, surge tank, and switching station at the J.C. Boyle powerhouse; and the penstock at Iron Gate
43 dam. PacifiCorp proposes to implement these measures within the first 15 years of a new license, and
44 proposes to consult with the Bureau of Land Management on the color choices that would minimize the
45 visual contrast of project facilities with the natural landscape. PacifiCorp's proposal to improve the
46 appearance of several project features and to reduce their contrast with the surrounding area would clearly
47 improve the aesthetic environment in the vicinity of J.C. Boyle dam, the J.C. Boyle bypassed reach, and
48 Iron Gate dam. We include these measures in the Staff Alternative at an annualized cost of 51,060. We

1 also considered vegetative screening and repainting or recoating the Fall Creek powerhouse and Copco
2 No. 2 powerhouse and substation, because these structures also create a high degree of visual contrast
3 with the surrounding environment as seen by visitors. At an estimated annualized cost of \$6,750 over
4 PacifiCorp's proposed measure, we include those aesthetic improvements in the Staff Alternative,
5 because the benefits associated with these measures are worth the additional cost.

6 **5.2.16 Road Management**

7 PacifiCorp-owned or -maintained roads within the project area provide both public access to
8 project lands and waters and PacifiCorp access to project developments. Appropriate project road
9 management provides for safety and protection of environmental resources while continuing to provide
10 reasonable public access to the project.

11 PacifiCorp proposes to use its proposed project roadway management plan (PacifiCorp, 2004d),
12 filed with the Commission on November 2, 2004, to guide its management of project-related
13 transportation facilities within the proposed project boundary during the term of a new license.
14 PacifiCorp proposes to facilitate long-term coordination and budgeting among PacifiCorp and other
15 transportation-related management entities by annually preparing a rolling 5-year transportation action
16 plan to help guide anticipated activities for normal or recurrent general maintenance, as well as major
17 maintenance. As proposed by PacifiCorp, the transportation action plan would summarize the project-
18 related road, bridge, and major culvert maintenance and capital improvements performed during the
19 previous year and planned for the current year and subsequent 3 years. The plan also would document
20 incurred and planned costs, including the allocation of joint costs, such as between PacifiCorp and the
21 Bureau of Land Management. We conclude that implementing the road management plan as proposed by
22 PacifiCorp would improve access management and road maintenance, as well as coordination with the
23 Bureau of Land Management, and we include this measure in the Staff Alternative. However, we
24 consider it most appropriate to address all aspect of project-related roads in the road management plan,
25 such as road closures to improve wildlife habitat connectivity and to protect sensitive environmental
26 resources. We estimate the annualized cost would be \$21,350.

27 The Bureau of Land Management's preliminary 4(e) condition specifies that, within 6 months of
28 license issuance, PacifiCorp should file a project roads inventory analysis and roads management plan for
29 project-related roads that cross Bureau of Land Management land. PacifiCorp's alternative condition
30 would modify the Bureau of Land Management's condition to conform to the content of PacifiCorp's
31 application and its proposed road inventory analysis and project roadway management plan (PacifiCorp,
32 2004d). PacifiCorp would also limit the scope of this condition to Bureau of Land Management lands
33 within the project boundary. In our view, all elements of PacifiCorp's proposed plan and the Bureau of
34 Land Management's preliminary condition would be appropriate for inclusion in the final plan, within the
35 limits of each party's authority. We note that PacifiCorp offered no explanation or reasoning behind its
36 proposal to exclude from the project boundary several roads that are within the existing project boundary.
37 We conclude that the plan would be much more useful in defining PacifiCorp's road management
38 responsibilities if it defined the miles, levels of use, and projected future use of roads necessary to operate
39 and maintain the project, and offered a rationale as to why other roads should not be PacifiCorp's
40 responsibility, and we include that provision in the Staff Alternative. The cost of this provision is
41 reflected in the \$21,350 annualized cost of the road management plan discussed above.

42 In our review of proposed and recommended project boundary changes, we conclude that there is
43 a segment of Topsy Grade Road that serves project purposes. It includes the section that accesses Topsy
44 Campground and the proposed Boyle Bluff recreation area, and serves as an alternative access to the Red
45 Barn and J.C. Boyle dam and powerhouse. The Staff Alternative includes a provision to include within
46 the project boundary the section of Topsy Grade Road from the junction with Route 66 near Pioneer Park
47 to the intersection of the road that accesses the Red Barn and J.C. Boyle dam. The cost of including this

1 area in the project boundary is reflected in the \$21,350 annualized cost of the road management plan
2 discussed above.

3 **5.2.17 Cultural Resources Management**

4 PacifiCorp proposes to manage project-affected cultural resources using a variety of measures
5 presented in its revised (March 2006) HPMP. The HPMP for the project would provide direction and
6 guidelines for management of historic properties within the new project boundary as proposed by
7 PacifiCorp (its APE). Mitigation measures for protection of historic properties defined in the revised
8 HPMP include monitoring, detailed inspections, stabilization, site concealment, site isolation, removing
9 incompatible uses, coordination with law enforcement agencies, erosion control, and, if necessary,
10 archaeological data recovery.

11 Various entities make recommendations regarding cultural resource management issues that are
12 generally consistent with the content of PacifiCorp's revised HPMP. The Bureau of Land Management
13 specifies that PacifiCorp conduct archaeological surveys on about 77 acres of Bureau-managed land in the
14 vicinity of Big Bend and along the peaking reach. In addition, Interior recommends that PacifiCorp
15 develop a program to provide tribal members with access to traditional gathering places, while limiting
16 access by others, and that PacifiCorp implement a sophisticated surveillance program that includes
17 cameras in addition to patrols by tribal staff. The Oregon SHPO recommends that PacifiCorp consult
18 with the tribes, SHPO, and appropriate land managers and sign a Memorandum of Agreement prior to
19 capping any archaeological sites. The consultation portion of this agreement is consistent with
20 PacifiCorp's revised HPMP, but the Memorandum of Agreement aspect is not addressed in the revised
21 HPMP.

22 We have reviewed and analyzed available information and conclude that the APE for relicensing
23 this project appropriately encompasses (1) the entirety of the APE as delineated by PacifiCorp in its
24 October 2004 draft HPMP and (2) that portion of the Klamath River from the Iron Gate dam to the
25 confluence of the Scott River. We describe the reasoning for our defined APE and the geographic extent
26 of cultural resources management under the HPMP in section 3.3.9.2.2, *Management of Cultural*
27 *Resources*. Our APE would include the area within the existing and proposed project boundary, including
28 East Side, West Side, and Keno developments, because the Commission's determination regarding
29 whether or not to exclude these three developments from the project would not be final until a license is
30 issued for this project. At that time, assessments would be made regarding whether or not the undertaking
31 would affect historic properties within the APE. The downstream limit of the APE (the Klamath River at
32 the confluence of the Scott River) represents what we consider to be the geographic extent of project
33 alterations to geomorphic processes, water quality and quantity, riparian vegetation, and aquatic
34 resources, which, in turn affect cultural resources in this area. We also include the Bureau of Land
35 Management's measure to conduct archaeological surveys in areas that had not yet been surveyed as long
36 as those areas are within our defined APE. In addition, although we conclude that the costs of using
37 surveillance cameras to monitor sensitive cultural sites is not warranted (we estimate the annualized cost
38 would be about \$113,500 for such a program), we expect PacifiCorp to use appropriate equipment as
39 determined in its consultations with relevant law enforcement organizations, to conduct its proposed
40 monitoring program. PacifiCorp may choose to provide tribal members with opportunities to be part of
41 the trained patrol staff it proposes to use for monitoring historic sites or to provide funding to facilitate
42 tribal staff participation in cultural resource-related programs. However, we do not intend to recommend
43 inclusion of either of these recommendations as a condition of a new license.

44 PacifiCorp should revise its HPMP to reflect the geographic area of historic property
45 management for the project as determined by Commission staff and reflected in a new license and the
46 additional measures that we recommend be addressed during project-related management of cultural
47 resources, and we include this in the Staff Alternative. The Commission intends to execute a
48 Programmatic Agreement with the Oregon and California SHPOs, thus there would be no need for a

1 Memorandum of Agreement with either SHPO prior to capping any archaeological sites, and we do not
2 recommend this measure for inclusion in a new license. We estimate that implementation of the
3 protective measures proposed in PacifiCorp's HPMP would reduce the annual benefits of the project by
4 about \$1,052,080. We estimate that additional measures that we include in the Staff Alternative would
5 reduce the annual benefit of the project by an additional \$19,820. Considering the rich cultural heritage
6 that is present in the project area, we consider these costs to be worth the benefits to cultural resources.

7 **5.2.18 East Side and West Side Development Decommissioning**

8 PacifiCorp proposes to decommission both East and West Side developments because the cost of
9 installing fish screens that would be protective of all life stages of federally listed suckers would be
10 prohibitive relative to the revenue associated with the estimated annual generation of 18,800 MWh, which
11 has a value of about \$780,200. PacifiCorp describes its proposed decommissioning procedures in its
12 license application, and we consider PacifiCorp's approach to be reasonable. If anadromous fish are
13 restored to historical habitat upstream of Upper Klamath Lake, one logical location for a smolt collection
14 facility would be at or near Link River dam, possibly using portions of the intake canal of East Side
15 development. NMFS and Interior include such a collection facility in their fishway prescriptions because,
16 when water quality conditions in Keno reservoir become particularly degraded during the summer,
17 outmigrating smolts could be trapped and transported to a point downstream of Keno dam. We therefore
18 consider it appropriate for the decommissioning plan to specify measures that would not forestall the
19 future construction of a smolt collection facility by other entities at this location. NMFS, Interior, and
20 Reclamation (owner of Link River dam) should therefore be included among the consulted entities in
21 developing the decommissioning plan. In addition, PacifiCorp proposes to address the disposition of the
22 Link River Trail, the only recreational facility associated with these two developments, in a
23 decommissioning plan for these developments. We consider addressing whether operation and
24 maintenance of this trail should be turned over to another interested entity, or whether the trail should be
25 dismantled and returned to a natural state, to be appropriately dealt with in a decommissioning plan. Both
26 developments are eligible for listing in the National Register of Historic Places. Therefore, the
27 decommissioning plan would need to address how any adverse effects on these facilities would be
28 resolved, in consultation with the Oregon SHPO.

29 We estimate that the total annualized cost associated with developing a decommissioning plan
30 and decommissioning both developments, including lost revenue from generation would be \$469,770. If
31 the developments are not decommissioned, the fish screens specified in the 2002 FWS BiOp would be
32 required, which we estimate would have an annualized cost of more than \$4 million. However, given the
33 small size and weak swimming ability of larval suckers, we consider it likely that even a large facility
34 designed to operate at low velocities would cause more sucker mortality than passing the larvae over the
35 Link River dam spillways, as would occur if East Side and West Side developments were
36 decommissioned. In addition to the fish screens required in the 2002 BiOp, if both developments are not
37 decommissioned, the fishways prescribed for these developments may need to be included in a new
38 license (which would entail facilities to collect outmigrating salmon smolts and truck them downstream of
39 Keno dam when water quality in Keno reservoir is impaired, and tailrace barriers at each of the
40 powerhouses). The estimated annualized cost for the prescribed fishways would be about \$5,259,000.
41 Because of the high cost of fish screens and the greater level of protection afforded by decommissioning,
42 we conclude that decommissioning these two developments would be a reasonable undertaking.

43 **5.2.19 Keno Development**

44 PacifiCorp proposes to remove Keno development from its proposed project because it states that
45 it no longer serves any project purposes. If operation of Keno development enhances generation at
46 PacifiCorp's downstream developments, it would serve project purposes. As discussed in section 4.5,
47 *Keno Development Analysis*, we reviewed documentation that PacifiCorp provided to support its position

1 that the project is no longer operated in a manner that enhances downstream project generation. We also
2 conducted our own independent analysis of whether releases from Keno dam were occurring in a manner
3 that could enhance the downstream peaking operations of the hydroelectric developments. Our analysis
4 showed that pulsed releases at Keno dam, as observed by Interior, were adjustments in responses to
5 pulsed inflows to Keno reservoir from the Link River and Klamath Irrigation Project, and are necessary to
6 maintain the Keno reservoir water level within a 0.2 foot range, as requested by irrigators. Our review of
7 historical Keno reservoir fluctuations shows that PacifiCorp has, for the most part, maintained this
8 restrictive water level regime from 1990 to 2004. Consequently, our results agree with the results of
9 PacifiCorp's analysis. We conclude that, although in infrequent instances the operation of Keno dam to
10 maintain a steady reservoir elevation results in a very minor enhancement in downstream generation,
11 overall, operation of Keno development results in no benefit to, or a small net loss of, generation at
12 PacifiCorp's downstream developments.

13 In the event that the Commission should include Keno development in a new license that may be
14 issued for this project, we would recommend that the following environmental measures that pertain to
15 Keno development be included in the new license:

- 16 • Operate the Keno development in a run-of-river mode, with hourly outflows to be held
17 within 10 percent of a 3-day running average of inflows. Maintain a minimum Keno
18 reservoir water surface elevation of 4,085.0 feet from May 1 through October 15 (the
19 irrigation season). Specify in the project operations management plan (#5S), provisions
20 for refilling Keno reservoir when it is drawn down that ensure maintenance of Keno
21 reach flows.
- 22 • Evaluate the Keno dam spillway for fish passage survival, and, if appropriate, modify
23 the spillway to accommodate safe downstream passage of smolts and suckers.
- 24 • Address enhancements at the Keno Recreational Area in the final Recreation Resources
25 Management Plan.

26 **5.2.20 Project Boundary Changes**

27 Project boundaries must enclose only those lands necessary for operation and maintenance of the
28 project and for other project purposes such as recreation, shoreline control, or protection of environmental
29 resources. The Staff Alternative generally includes the project boundary proposed by PacifiCorp, but
30 with the following modifications:

- 31 • PacifiCorp proposes a new car-top boat access and day-use area at J.C. Boyle reservoir,
32 but does not propose to include the access road to this site, which passes through
33 Sportsman's Park) in the proposed project boundary. We conclude that without this
34 road, the recreation site would be of little value, and recommend that the access road be
35 included in the project boundary of a new license. The portion of this road not within
36 the existing and proposed project boundary is about 0.8 mile long on land owned by
37 PacifiCorp and a small portion by a private landowner.
- 38 • PacifiCorp proposes to adjust the existing project boundary at the J.C. Boyle
39 development to exclude Topsy Campground. We conclude that Topsy Campground
40 serves project related recreation purposes, and recommend that it be retained in the
41 project boundary of a new license.
- 42 • PacifiCorp proposes to develop a loop trail around the lower portion of J.C. Boyle
43 reservoir. Although the exact alignment of the trail is not yet known, because of
44 ongoing assessments of cultural resources and negotiations with private landowners
45 regarding easements, the trail would be about 5 miles long, and portions are likely to be
46 outside of the proposed project boundary. We conclude that the entire trail and

1 associated trailheads, once the final alignment is set, should be within the project
2 boundary of a new license for this project because it would provide access to project
3 lands and waters.

- 4 • PacifiCorp does not propose to include any of Topsy Grade Road in the project
5 boundary. We conclude that Topsy Grade Road from its junction with Route 66 near
6 Pioneer Park to the intersection of the road that accesses PacifiCorp's support building
7 (the Red Barn) and J.C. Boyle dam (designated 300000116 in PacifiCorp's Road
8 Inventory mapping) provides access to the Topsy Campground and serves as alternative
9 access to the Red Barn and J.C. Boyle dam, and would also provide access to
10 PacifiCorp's proposed Boyle Bluffs recreation area. We therefore recommend that this
11 road be included in the project boundary of a new license. The portion of the road not
12 within the existing project boundary is about 0.9 mile long and on land owned by
13 private entities.
- 14 • PacifiCorp proposes to adjust the existing project boundary along the right bank of the
15 J.C. Boyle bypassed reach from the river channel upslope to include only the land
16 associated with and immediately adjacent to the intake canal and associated access road.
17 The area upslope of the J.C. Boyle bypassed reach between the power canal, the
18 emergency spillway channel, and the river have been and are likely to continue to be
19 affected by the project and are likely to require a long term commitment by PacifiCorp
20 to repair project-related environmental damage and prevent their recurrence. We
21 therefore recommend that the existing project boundary not be reduced along the
22 bypassed reach.
- 23 • PacifiCorp proposed to include the State-line Takeout area, often used as the end point
24 by recreational boaters on the peaking reach, within the proposed project boundary.
25 However, PacifiCorp does not propose to include the access road from Ager-Beswick
26 Road to the State-line Takeout area in the project boundary. We conclude that, without
27 this road, this existing recreational site would have minimal value, and recommend that
28 this access road be included in the project boundary of a new license. The portion of
29 this road outside the proposed project boundary is about 0.3 mile long and on Bureau of
30 Land Management lands.

31 **5.2.21 Dam Removal**

32 Removal of one or more of the mainstem dams could enhance the prospects for restoring
33 anadromous fish to areas within and upstream of the project and improve conditions within the
34 downstream migration corridor. We evaluate the potential benefits to anadromous fish of removing one
35 or more mainstem dams in section 3.3.3.2.4, *Dam Removal or Decommissioning*. Because of their greater
36 effect on downstream water quality, and because of the quality and quantity of habitat that they inundate,
37 we conclude that the removal of Iron Gate and Copco No. 1 dams would provide a much greater benefit
38 than removing the Copco No. 2 and J.C. Boyle dams. Removal of Iron Gate dam would provide access to
39 two tributaries that are capable of supporting Chinook and possibly coho salmon (Fall and Jenny creeks),
40 would provide access to important Chinook salmon spawning habitat in the Copco No. 2 bypassed reach,
41 and would restore Chinook salmon spawning habitat currently inundated by Iron Gate reservoir. It also
42 would restore access to these same areas for steelhead and Pacific lamprey.³ If fish passage was provided

³As we discuss in section 3.3.3.2.5, *Anadromous Fish Restoration*, we do not endorse the installation of fish passage facilities intended to pass Pacific lamprey, because we consider it unlikely that this species would be able to migrate through the project reservoirs and effective screening technology for this species has not been developed.

1 at Copco No. 2 dam, removal of Copco No. 1 dam would restore Chinook salmon spawning habitat
2 inundated by Copco reservoir, provide coho salmon with access to potential habitat in Long Pine Creek,
3 and provide anadromous fish with access to spawning and rearing habitat and temperature refugia in the
4 J.C. Boyle peaking and bypassed reaches. Based on the similarity of stream gradient in the river sections
5 impounded by Iron Gate and Copco No. 1 dams to the primary fall Chinook spawning areas downstream
6 of Iron Gate dam, we conclude that the habitat inundated by these reservoirs would likely provide a
7 substantial amount of spawning habitat for fall Chinook salmon. In section 3.3.3.2.4, *Dam Removal or*
8 *Decommissioning*, we used spawner densities calculated for tributary and mainstem habitats from historic
9 redd counts in Jenny and Fall creeks and in the Copco No. 2 bypassed reach to estimate the number of
10 spawners that could be accommodated with these two dams removed. We estimated that about 12,000
11 spawners could potentially be accommodated if both Iron Gate and Copco No. 1 dams were removed and
12 fish passage was provided at Copco No. 2 dam. Providing access to this habitat could substantially
13 reduce crowding of adult fall Chinook in the spawning areas downstream of Iron Gate dam, which should
14 reduce pathogen densities and the transmission of disease among adult and juvenile anadromous fish.

15 Removal of Iron Gate and Copco No. 1 dams could also have a substantial influence on water
16 quality conditions and disease prevalence in the Klamath River downstream of Iron Gate dam. In section
17 3.3.3.2.4, *Dam Removal or Decommissioning*, we conclude that the elimination of Iron Gate and Copco
18 reservoirs would be likely to reduce fish stress and disease susceptibility by moderating fluctuations in
19 DO and pH associated with algae blooms, increasing DO levels through natural aeration from turbulent
20 passage of water in areas of higher gradient that are inundated by the reservoirs, and reducing levels of
21 ammonia in downstream areas. Restoring access to these reaches for anadromous fish would allow
22 spawning fall Chinook salmon to distribute over a greater length of the river, reducing crowding and the
23 concentration of disease pathogens that currently occurs in the reach between Iron Gate dam and the
24 Shasta River. Restoring natural sediment transport processes would contribute to the scour of attached
25 algae downstream of the current site of Iron Gate dam, and deposited sediments would provide a less
26 favorable substrate for attached algae due to its greater mobility during high flow events. The reduction
27 in attached algae would reduce habitat for the polychaete intermediate host of the myxosporidian parasites
28 *C. shasta* and *P. minibicornis*, which should reduce the infection rate of juvenile salmonids downstream
29 of Iron Gate dam.

30 Removal of these two dams would eliminate flatwater recreation and warmwater fisheries at these
31 reservoirs. In addition, removal of Copco No. 1 dams would eliminate the two formal recreation sites on
32 Copco reservoir, Mallard Cove and Copco Cove, from the project, and they would likely no longer serve
33 as recreational resources, unless another entity offered to assume operation and maintenance of these
34 facilities. Likewise, removal of Iron Gate dam would eliminate nine existing recreational facilities at the
35 reservoir and Iron Gate Hatchery, and two new recreational facilities proposed by PacifiCorp at this
36 development would not be constructed. Recreational opportunities accommodated by these existing and
37 proposed facilities include car-top and trailered boat access to the reservoir, picnicking, hiking, tent and
38 recreational vehicle camping, and educational programs at Iron Gate Hatchery. Another entity may offer
39 to continue operation of one or more of these facilities during the decommissioning process for these two
40 developments because they would still provide public access to the newly unimpounded portions of the
41 Klamath River. Salmonid angling opportunities and whitewater boating opportunities would be created
42 by removal of both dams. Removal of Copco No. 1 and Iron Gate dams could also reduce land values
43 adjacent to the reservoirs, although this is by no means a definite outcome, especially given the recent
44 occurrence of toxic algal blooms that would limit the ability of property owners along the reservoirs to
45 enjoy typical activities that may have been enjoyed previously.

46 Although the potential benefits to commercial, recreational, and tribal fisheries of removing Iron
47 Gate and Copco No. 1 dams are substantial, so are the costs. In section 4.4., *Conceptual Costs of Project*
48 *Dam Removal*, we estimate that the annualized cost of removing Iron Gate dam, including 116,000 MWh
49 of lost generation, would likely be about \$9,856,130, assuming that the sediments in the reservoir are not

1 contaminated. The corresponding lost generation and reduction in project benefits from removing Copco
2 No. 1 dam would be about 106,000 MWh and \$4,501,650, assuming the sediments in the reservoir are not
3 contaminated. We note that the annualized cost of installing upstream and downstream fish passage
4 facilities at Copco No. 2 dam, which would be needed to provide access to restored habitat currently
5 inundated by Copco reservoir, would be \$4,121,630.

6 Removal of Copco No. 1 and Iron Gate dams would cause the release of sediments to the
7 Klamath River downstream of Iron Gate dam. If dam removal is conducted in a carefully planned
8 manner, perhaps using a staged approach to removal of Iron Gate dam, the release of sediments could be
9 minimized and timed to avoid critical spawning and rearing periods for salmon in the downstream
10 reaches. However, if sediments in Copco or Iron Gate reservoirs are found to be contaminated to the
11 extent that release of the sediments to downstream areas could not reasonably occur, the costs for
12 dredging and upland disposal of contaminated sediments could be exorbitant, as we discuss in section 4.4,
13 *Conceptual Costs of Project Dam Removal*. Although characterization and quantification of sediments in
14 each reservoir would be necessary prior to any detailed planning of dam removal, based on available
15 estimates of sediment in each reservoir, the dredging and disposal of sediments at a secure landfill site
16 could range from about \$1 to 3 billion for Copco reservoir, and \$0.5 to 1.5 billion for Iron Gate reservoir.
17 Funds needed for such a major undertaking may be sufficient to dissuade pursuit of the removal of both
18 dams. We currently have no information that would indicate whether or not the sediments in either
19 reservoir would be contaminated to the extent of requiring dredging and upland disposal, but sampling
20 being conducted by the California State Coastal Conservancy should provide information on contaminant
21 levels prior to issuance of the final EIS.

22 **5.3 PREFERRED ALTERNATIVE**

23 Based on our analysis of the environmental benefits and project costs associated with the four
24 alternatives considered in this document, we select the Staff Alternative as the preferred alternative. We
25 recommend this alternative because (1) issuance of a new license would allow PacifiCorp to continue to
26 operate the project as a dependable source of electric energy for its customers; (2) the 161 MW project
27 would avoid the need for an equivalent amount of fossil-fuel fired electric generation and capacity,
28 continuing to help conserve these nonrenewable energy resources while reducing atmospheric pollution;
29 and (3) the recommended environmental measures would enhance water quality, help restore anadromous
30 fish to historical habitat, protect fish and terrestrial resources, improve public use of recreational facilities
31 and resources, and maintain and protect historic and archaeological resources within the area affected by
32 project operations.

33 Although we acknowledge that the removal of Iron Gate and Copco No. 1 dams would provide
34 greater benefits to anadromous fish, it would result in a substantial reduction in generation benefits and
35 very high costs for decommissioning, especially if sediment contamination levels are high enough to
36 warrant dredging and off-site disposal. In addition, while the Staff Alternative does not include all of the
37 4(e) conditions filed by Interior or the Forest Service, we recognize that the Commission may include them
38 in a license due to their mandatory nature. The 4(e) conditions not included in the Staff Alternative are
39 outlined in table 5-3 along with reasons for exclusion.

40 **5.4 SUMMARY OF SECTION 10(j) RECOMMENDATIONS AND 4(e) CONDITIONS**

41 **5.4.1 Fish and Wildlife Agency Recommendations**

42 Under the provisions of the FPA, each hydroelectric license issued by the Commission shall
43 include conditions based on the recommendations provided by federal and state fish and wildlife agencies
44 for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. In
45 response to our REA notice, the following fish and wildlife agencies submitted recommendation for the

1 project: Oregon Fish & Wildlife (letter filed March 28, 2006), Cal Fish & Game (letter filed March 29,
2 2006), FWS (letter filed March 29, 2006), and NMFS (letter filed March 29, 2006).

3 Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife
4 agency recommendation is inconsistent with the purposes and requirements of the FPA or other
5 applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving
6 due weight to the recommendations, expertise, and statutory responsibilities of the agency. Table 5-2 lists
7 the federal and state recommendations filed pursuant to section 10(j) and indicates whether the
8 recommendations are included under the Staff Alternative. Environmental recommendations that we
9 consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are
10 addressed in the specific resource sections of this document.

11 Of the 77 recommendations that we consider to be within the scope of section 10(j), we include
12 42 in and exclude 35 from the Staff Alternative. We discuss the reasons for not including those
13 recommendations in the following table or in section 5.2, *Discussion of Key Issues*. Table 5-2 shows the
14 basis for our preliminary determinations concerning measures that we consider inconsistent with section
15 10(j) of the FPA.

1 Table 5-2. Analysis of fish and wildlife agency recommendations for the Klamath Hydroelectric Project. (Source: Staff)

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|---|---------------------------------|------------------------|--|
| 1. Develop a sediment and gravel resource management plan within 1 year of license issuance, provide annual monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. | Oregon Fish & Wildlife (1A4, 1B, 1C, 1D4) Cal Fish & Game (IV) | No ^b | \$17,020 | Yes |
| 2. Develop a gravel mapping and augmentation plan within 1 year of license issuance (NMFS & FWS) or 2 years of license issuance (Oregon Fish & Wildlife & Cal Fish & Game) that includes provisions for mapping gravel and specific measures that would be implemented to restore spawning habitat downstream of project dams. | Oregon Fish & Wildlife (9A), Cal Fish & Game (II), NMFS (8), FWS (8) | Yes | \$10,670 | Yes |
| 3. Develop and implement specific recommendations for gravel augmentation within 3 years of license issuance. | Oregon Fish & Wildlife (9B), Cal Fish & Game (II), NMFS (8), FWS (8) | Yes | \$118,740 | Yes |
| 4. Monitor gravel following augmentation for distribution and spawning use and adaptively manage. | Oregon Fish & Wildlife (9C), Cal Fish & Game (II), NMFS (8), FWS (8) | Yes | \$9,560 | Yes |
| 5. Implement flow continuation provisions at J.C. Boyle powerhouse within 1 year of license issuance. | Oregon Fish & Wildlife (7C) | Yes | \$898,760 | Yes |
| 6. Develop a plan for restoration of slope failures along J.C. Boyle bypassed reach within 1 year of license issuance. | Oregon Fish & Wildlife (9D) | Yes | \$409,000 | Yes |
| 7. Develop a monitoring and maintenance plan to reduce chances of water conveyance system failure and excess use of emergency overflow spillway. | Oregon Fish & Wildlife (9D) | No ^b | \$1,350 | No, the need for such a plan would be addressed under Part 12 of the Commission's regulations. |
| 8. Notify and report to agencies in the event of an accidental spill or discharge from project waterway system or other events. | Oregon Fish & Wildlife (9E) | No ^b | \$0 | Yes, but phrase "or other events" would need clarification. |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|---|---------------------------------|--|-----------------------|
| 9. Coordinate on a timely basis with resource agencies regarding remedial measures following waterway failures. | Oregon Fish & Wildlife (9F) | Yes | \$0 | Yes |
| 10. Develop an action plan that establishes protocols to be followed following a failure of project water conveyance systems within 1 year of license issuance. | Oregon Fish & Wildlife (9G) | Yes | \$1,350 | Yes |
| 11. Consult with agencies to develop a site specific erosion control plan prior to ground-disturbing activities. | Oregon Fish & Wildlife (9H) | No ^b | Costs included in plans for specific actions | Yes |
| 12. Develop a project operations resource management plan within 1 year of license issuance, provide annual water quantity monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. | Oregon Fish & Wildlife (1A1, 1B, 1C, 1D1, 10A, 10B) Cal Fish & Game (IV) | No ^b | \$11,350 | Yes |
| 13. Develop a coordinated gage installation plan. Within 6 months of license issuance install gages with telemetry systems above all project reservoirs or diversions and at outflows from each project dam at the head of the dewatered reach to measure inflow to the reservoir and outflow below each project dam, including ramping rates | Oregon Fish & Wildlife (6A, 6B) | Yes | \$138,160 | No (see section 5.2). |
| 14. Install gages where needed to appropriately monitor inflow, outflow, and reservoir elevations at each project facility. | NMFS (6) | Yes | \$60,450 | Yes |
| 15. Install gages that allow measurement of inflow above all project reservoirs and outflow from each project dam. Flow records should be made available to resource agencies upon request. | Cal Fish & Game (I) | Yes | \$118,720 | No (see section 5.2). |
| 16. Develop a water quality resource management plan within 1 year of license issuance, provide annual water quality monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. Monitoring should include temperature, DO, TDG, pH, chlorophyll <i>a</i> , nutrients, and toxic algae. | Oregon Fish & Wildlife (1A2, 1B, 1C, 1D2, 8A, 8B) Cal Fish & Game (IV) | Yes | \$2 | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|-----------------------------|--|------------------------|---|
| 17. Develop decommissioning plans for project developments where meeting water quality standards is not feasible. | Oregon Fish & Wildlife (8C) | No ^b | Development dependent | No, developing any decommissioning plans would be addressed in a decommissioning proceeding for any such development. |
| 18. Develop a Keno reservoir water quality plan within 1 year of license issuance (NMFS) or 2 years of license issuance (FWS) and implement appropriate measures to address water quality problems. | NMFS (11), FWS (11) | Yes, but timing is not. | \$22,700 | Yes, if Keno is included in project license. |
| 19. Develop a temperature control device feasibility and implementation plan conducted by an independent third party and approved by the agencies for Copco No. 1 and Iron Gate dams within 1 year of license issuance. | NMFS (9), FWS (9) | Yes, although who conducts the studies is not. | \$10,120 | Yes, although not provisions for an independent third party. |
| 20. Develop a DO enhancement plan that provides for study and implementation of measures to increase DO downstream of Iron Gate dam for the geographic extent of project effects within 1 year of license issuance. | NMFS (10), FWS (10) | Yes | Included in 16, above | Yes |
| 21. Develop a plan to monitor for <i>Microcystis</i> and reduce the risk of toxic algal blooms on fish in Copco and Iron Gate reservoirs. | FWS (12A) | Yes | \$68,700 | Yes, although we limit the scope of monitoring to immediately downstream of Iron Gate reservoir. |
| 22. Do not operate East Side and West Side developments when flows are 500 cfs or less below Link River dam (if not decommissioned). | Oregon Fish & Wildlife (6A) | Yes | \$2,660 | Yes, if East Side and West Side included in project license. |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|--|---------------------------------|------------------------|--|
| 23. Install a gage in the bypassed reach below Link River dam to ensure East Side and West Side developments operate only when flows exceed 500 cfs. | Oregon Fish & Wildlife (6A) | Yes | \$19,440 | No, nearly all flow released at Link River dam is under the control of Reclamation. |
| 24. If East Side and West Side developments are decommissioned, operate controlling structures in a manner that avoids fluctuations in river flow. | NMFS (6) | Yes | Cannot be quantified | No, controlling structures at Link River dam are not within the existing project and would not be after decommissioning. Not within the Commission's jurisdiction. |
| 25. Consult with NMFS regarding flow and facility operation schedule that minimizes effects on anadromous fish, if East Side and West Side developments are not decommissioned. | NMFS (6) | No ^b | \$1,350 | Yes, if East Side and West Side included in project license. |
| 26. Release a minimum flow of 625 cfs or inflow to the Keno reach (NMFS & FWS do not specify a minimum flow). When flows are above 625 cfs on a 24-hour basis, flows released from Keno dam should be within 10% of the measured inflow. Keno dam should not to be used to regulate flow for downstream peaking operations. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I), | Yes | \$0 | No, because releasing inflow would result in passing daily fluctuations from Klamath Irrigation Project operations to downstream reaches (see section 4.5). |
| 27. Provide minimum flows in the Keno reach within 10% of inflow (NMFS defines inflow as daily inflow, FWS defines inflow as the sum of the 3-day average inflow). Keno dam should not be used to regulate flow for downstream peaking operations. | NMFS (6), FWS (6.2) | Yes | \$0 | Yes, if inflow is 3-day average and Keno included in project license. |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|---|---------------------------------|------------------------|---|
| 28. Release a minimum flow of 640 cfs or 40% proportional inflow, whichever is greater, to the J.C. Boyle bypassed reach. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I), NMFS (6) | Yes | \$6,342,570 | No (see section 5.2). |
| 29. Release a minimum flow of 720 cfs to the J.C. Boyle peaking reach (Cal Fish & Game adds “or inflow”). | Oregon Fish & Wildlife (6A), Cal Fish & Game (I) | Yes | \$0 | No (see section 5.2). |
| 30. Release a minimum flow of 730 cfs or 40% proportional inflow, whichever is greater, to the Copco No. 2 bypassed reach. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I), NMFS (6), FWS (6.4) | Yes | \$4,040,310 | No (see section 5.2). |
| 31. Release 40% of the instantaneous flow measured above the Fall Creek diversion into the bypassed reach. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I), FWS (6.5) | Yes | \$210,030 | No (see section 5.2). |
| 32. Release all inflow to the Spring Creek diversion dam from June 1 through Sept. 15, and 50% inflow for the remainder of the year. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I), FWS (6.6) | Yes | \$83,830 | No (see section 5.2). However, we adopt the recommendation that no flow be diverted from June 1 through September 15. |
| 33. Release minimum flows from Iron Gate dam in accordance with a specific schedule that specifies monthly flows by water year type. Oregon Fish & Wildlife’s monthly flows are identical to Cal Fish & Game except for August and September of a below average water year; Oregon Fish & Wildlife specifies 1,000 and 1,100 cfs, respectively, and Cal Fish & Game specifies 1,200 cfs for both months. | Oregon Fish & Wildlife (6A), Cal Fish & Game (I) | Yes | \$0 | No (see section 5.2). |
| 34. Operate Iron Gate development in a run-of-river mode when inflow drops below the specified minimum release and normal active storage above elevation 2,322 feet is depleted. | Cal Fish & Game (I) | Yes | \$0 | No (see section 5.2). |
| 35. Ensure releases from Iron Gate dam are equivalent to the combined instantaneous inflow to the project, including tributary inflow, spring accretion, irrigation return flows, and releases from the Klamath Irrigation Project. | NMFS (6), FWS (6.7) | Yes | \$0 | No (see section 5.2). |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|---|---------------------------------|--|--|
| 36. Annually release flushing flows to the J.C. Boyle and Copco No. 2 (Copco No. 2 included in NMFS rationale only) bypassed reaches by diverting all flows from the powerhouses for 7 days between February 1 and April 15, when inflow to J.C. Boyle reservoir exceeds 3,300 cfs, (FWS specifies this as the inflow to Copco reservoir), with a down-ramp rate of 2 inches an hour (only specified by Oregon Fish & Wildlife) and 300 cfs per 24 hours. | Oregon Fish & Wildlife (6C), NMFS (7), FWS (7; FWS only specifies the Copco No. 2 bypassed reach, since J.C. Boyle is covered by the Bureau of Land Management's 4(e) condition), Cal Fish & Game (I) | Yes | \$1,030,610 | No (see section 5.2). |
| 37. Consult with resource agencies regarding timing of scheduled maintenance that entails diversion of flow to project bypassed reaches. | Oregon Fish & Wildlife (6D) | Yes | None | Yes |
| 38. Operate all project developments except Iron Gate in a run-of-river mode. | Oregon Fish & Wildlife (7A), Cal Fish & Game (I), NMFS (5, 6) | Yes | \$771,870 | No (see section 5.2). |
| 39. Provide controllable ramp rates of 1-inch per hour and 300 cfs per day maximum. (Oregon Fish & Wildlife excludes Iron Gate from this ramp rate, Cal Fish & Game does not.) | Oregon Fish & Wildlife (7A), Cal Fish & Game (I), FWS (6.1, 6.4, 6.5; FWS excludes J.C. Boyle because it is covered by the Bureau of Land Management's 4(e) condition | Yes | Included in corresponding flow recommendations | No (see section 5.2). |
| 40. Provide controllable ramp rates downstream of Iron Gate dam of 125 cfs per hour and 300 cfs per 24-hours when flows are greater than 1,750 cfs; when flow are at or below 1,750 cfs, ramp rates would be 50 cfs per 2 hours and 150 cfs per 24-hours | Oregon Fish & Wildlife (7B), FWS (6.7) | Yes | Included in flow recommendations | Yes, the ramping rates in the Staff Alternative would be more restrictive. |
| 41. Provide controllable ramp rates downstream of Iron Gate dam of 125 cfs per 4 hours and 300 cfs per 24-hours when flows are greater than 1,750 cfs; when flow are at or below 1,750 cfs, ramp rates would be 50 cfs per 2 hours and 150 cfs per 24-hours | NMFS (6) | Yes | Included in flow recommendations | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|---|---------------------------------|--|-----------------------|
| 42. Re-regulate flows in the development immediately downstream, if peaking should be allowed at any development. | Cal Fish & Game (I) | Yes | Cost would depend on which developments are operated in a peaking mode | No (see section 5.2). |
| 43. Develop a fish passage resource management plan within 1 year of license issuance, provide annual monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. | Oregon Fish & Wildlife (1A3, 1B, 1C, 1D3) Cal Fish & Game (IV) | No ^b | \$14,050 | Yes |
| 44. Establish a fish passage implementation committee. | Oregon Fish & Wildlife (5A, 5B, 5C) | No ^b | \$10,000 | Yes |
| 45. Construct fish ladders at J.C. Boyle (10% slope, within 4 years), Keno (4% slope, within 3 years), Copco Nos. 1 & 2 (10% slope, within 6 years), Iron Gate (10% slope, within 6 years), and Spring & Fall creek diversion dams (10% slope, within 3 years). Include fish trap and counting system at Keno and J.C. Boyle and monitoring plans to ensure that passage survival meets Oregon standards of 95% in first 5 years and 98% thereafter. | Oregon Fish & Wildlife (3A, 3B, 3C, 3D, 3E, 3I) | Yes | \$12,244,990 | No (see section 5.2). |
| 46. Construct fish ladders at all project dams within 6 years to include monitoring plans that enable effectiveness to be evaluated. | Cal Fish & Game (II) | Yes | \$11,374,370 | No (see section 5.2). |
| 47. Construct tailrace barriers at all powerhouse outlets within 8 years. | Oregon Fish & Wildlife (3D), Cal Fish & Game (II) | Yes | \$3,998,890 | No (see section 5.2). |
| 48. Develop standard operating procedures for O&M of all upstream and downstream fish passage facilities. | Oregon Fish & Wildlife (3H, 3J, 4H, 4J) | Yes | \$1,350 | Yes |
| 49. Notify agencies prior to scheduled upstream or downstream fish passage maintenance that dewater fishways and conduct fish salvaging during maintenance. | Oregon Fish & Wildlife (3K, 4K) | Yes | \$0 (fish salvaging currently occurs) | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|---|---------------------------------|-------------------------------------|---|
| 50. Develop a plan to evaluate whether Keno dam spillway currently is effective in passing fish safely downstream within 1 year, implement the plan within 2 years, and implement any spillway modification within 4 years, as appropriate. | Oregon Fish & Wildlife (4B) | Yes | \$71,990 | Yes, if Keno included in project license. |
| 51. Modify all project dam spillways to current criteria for downstream fish passage within 6 years of license issuance and monitor after modifications to assess effectiveness. | Cal Fish & Game (II) | Yes | \$1,161,630 | No (see section 5.2) |
| 52. Within 4 years, construct, operate year-round, maintain, and evaluate a fish screen at Boyle dam. Include a trap to evaluate screen performance and long-term monitoring of the downstream migrant population, including holding and sorting of fish by age and species. Detailed designs should be developed within 2 years of license issuance for agency review and comment. | Oregon Fish & Wildlife (4A, 4E, 4F, 4I) | Yes | \$5,008,850 | No (see section 5.2). |
| 53. Construct downstream fish passage facilities within 3 years at Spring and Fall creeks, within 5 years at Iron Gate and within 6 years at Copco 1 and 2. Monitor and evaluate effectiveness. | Oregon Fish & Wildlife (4C, 4E, 4F, 4I) | Yes | \$9,996,230 | No (see section 5.2). |
| 54. Construct downstream fish passage facilities at all project dams within 6 years of license issuance. Monitor and evaluate effectiveness. | Cal Fish & Game (II) | Yes | \$15,005,080 | No (see section 5.2). |
| 55. Prepare a decommissioning plan for East Side and West Side developments that protects downstream migrating fish within 1 year of license issuance, implement within 1 year of Commission approval (Oregon Fish & Wildlife) or within 3 from license issuance (NMFS, FWS). NMFS and FWS also call for post decommissioning monitoring. | Oregon Fish & Wildlife (4D), NMFS (4) | No ^b | \$122,330 | Yes, any post-decommissioning monitoring would be brief. |
| 56. Prepare a decommissioning plan for developments where effective upstream or downstream fish passage is not feasible. | Oregon Fish & Wildlife (3L, 4L), Cal Fish & Game (II) | No ^b | Depends on the specific development | No, developing any decommissioning plans would be addressed in a decommissioning proceeding for any such development. |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|--|---------------------------------|------------------------|-----------------------|
| 57. Allow state and federal agencies access to project to inspect fishways and records to monitor compliance with license conditions. | Oregon Fish & Wildlife (14D) | No ^b | None | Yes |
| 58. Develop a plan to provide temporary enhanced flows from Iron Gate dam on emergency basis to protect downstream anadromous fish. | Oregon Fish & Wildlife (14C), Cal Fish & Game (I), NMFS (12A), FWS (12A) | Yes | \$6,040 | Yes |
| 59. Develop an upstream and downstream anadromous fish passage habitat protection and enhancement plan that includes provisions for evaluating the survival of upstream and downstream migrating juveniles and adults. Develop project operation and structure modifications that could enhance upstream and downstream passage success including predator and predation control. FWS includes listed suckers in its recommendation. | NMFS (1, 2), FWS (1, 2) | Yes | \$34,830 | No (see section 5.2). |
| 60. Develop a Pacific lamprey management plan within 2 years of license issuance that includes provisions for telemetry studies to evaluate upstream and downstream passage success through project fishways and reservoirs. Modify project fishways, structures, and operations to enhance lamprey populations based on study results. | FWS (4) | Yes | \$111,930 | No (see section 5.2). |
| 61. Fully fund and continue Iron Gate Hatchery operations. | NMFS (13a), FWS (15), Cal Fish & Game (II) | Yes | \$125,000 | Yes |
| 62. Fully fund and implement a fall Chinook yearling program, including refurbishment and operation of the Fall Creek juvenile rearing facility | Cal Fish & Game (II) | Yes | \$177,000 | Yes |
| 63. Mark 100% of Chinook salmon released from the hatchery | NMFS (13b, 13d) | Yes | \$705,040 | Yes |
| 64. Mark 100% of coho salmon released from the hatchery | FWS (15) | Yes | \$4,750 | Yes |
| 65. Mark 25% of the Chinook salmon released from the hatchery | FWS (15), Cal Fish & Game (II) | Yes | \$233,880 | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|---|---------------------------------|------------------------|--|
| 66. Develop a hatchery and genetics management plan for Iron Gate Hatchery including an adult census of natural salmonids, hatchery straying, competition, genetic characteristics of natural coho and steelhead stocks, and determination of outmigration timing. | Cal Fish & Game (II, IV), NMFS (13c) | Yes | \$503,370 | No (see section 5.2). |
| 67. Develop juvenile and adult fish disease risk monitoring and management plan that include studies, recommendations based on the studies, and implementation plans. | Oregon Fish & Wildlife (14A, 14B, 14D), Cal Fish & Game (I, IV) NMFS (12A), FWS (12A) | Yes | \$352,700 | Yes |
| 68. Develop a plan for restoration of fish habitat upstream and downstream of the project and key tributaries such as Jenny, Fall, Spencer, and Shovel creeks. Fund the implementation and maintenance of projects identified in consultation with resource agencies. | NMFS (3), FWS (3) | Yes | \$52,700 | No (see section 5.2). |
| 69. Develop an aquatic monitoring resource management plan within 1 year of license issuance that includes the following at the J.C. Boyle bypassed and peaking reaches: fish health, fish habitat conditions, reach productivity or bioenergetics, population structure, spawning populations, and fish migration. The plan should include provisions for annual monitoring and compliance reporting to the Commission and resource agencies, and reports every 3 years that summarize the previous 3 years of monitoring results. The plan should be updated the plan every 5 years. | Oregon Fish & Wildlife (1A5, 1B, 1C, 1D5, 11A, 11C) | Yes | \$124,050 | No (see section 5.2, we adopt some of the recommended elements). |
| 70. Include in the Oregon Fish & Wildlife aquatic monitoring resource management plan an adaptive management strategy that provides for changes and proposed actions that enable resource goals for restoration of fish and aquatic life in the J.C. Boyle bypassed and peaking reaches to be met. | Oregon Fish & Wildlife (11B) | Yes | \$54,840 | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|--|---------------------------------|--|---|
| 71. Develop an anadromous fish monitoring plan that describes protocols for estimating: the number, size, sex, timing, survival, and origin of fish returning to Iron Gate dam; the size of spawning populations in key tributaries in the project area; number of outmigrating juvenile Chinook from these key tributaries; and implementing measures recommended by the agencies to meet project passage goals. | NMFS (12B), FWS (12B2) | Yes | \$329,180 | No (see section 5.2, we adopt some of the recommended elements). |
| 72. Develop a resident fish monitoring plan that describes protocols for monitoring: the distribution, population structure, and abundance of resident fish populations in all project reservoirs and reaches below Keno dam;, and the number, size, and sex of spawning redband trout in key project tributaries. Monitoring should be at 3 year intervals for the term of the license. | FWS (12B1) | Yes | \$96,610 | No (see section 5.2, we adopt some of the recommended elements). |
| 73. Develop an aquatic habitat monitoring plan that monitors the effectiveness of license conditions designed to enhance the quality and quantity of aquatic habitat for resident, migratory, and anadromous fish within project reaches and apply adaptive management as needed. Submit annual reports that document the state of spawning, holding, feeding, juvenile rearing, riparian, and migratory fish habitat and the adequacy of flows to meet these habitat needs and habitat connectivity; movement of spawning gravel; achievement of riparian habitat objectives; power generation; and recreational opportunities. | FWS (13) | Yes | Included in the previous two measures (71 and 72) | No (see section 5.2, we adopt some of the recommended elements). |
| 74. Develop a fish and wildlife habitat restoration resource management plan within 1 year of license issuance, provide annual monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. | Oregon Fish & Wildlife (1A7, 1B, 1C, 1D7) | No ^b | \$22,020 | No, because this plan would be redundant with other, more specific plans. |
| 75. Identify, in consultation with agencies, and fund instream flow and habitat enhancements in mainstem reaches and tributaries with native fish and wildlife, within and upstream of the project. | Oregon Fish & Wildlife (6E), Cal Fish & Game (I, II) | No ^b | Included in the previous measure (74) | No |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|--|---------------------------------|--|-----------------|
| 76. Develop a fish and wildlife habitat enhancement plan designed to increase the success of anadromous fish reintroduction and potamodrous restoration and to support resource protection measures for project-related effects not otherwise covered by specific license conditions. Measures could include those that enhance wetlands, riparian habitats, and aquatic, riparian, and terrestrial species habitat connectivity affected by project operation. Funding of enhancement measures could include mainstem and tributaries with native fish and wildlife species, including those upstream and downstream of the project. PacifiCorp would cooperate with landowners to acquire property for enhancement projects. | Oregon Fish & Wildlife (13A), Cal Fish & Game (II) | No ^b | Included in measure 74 | No |
| 77. Establish a habitat fund to accomplish habitat enhancement measures developed in the Oregon Fish & Wildlife habitat enhancement plan. The amount to be deposited into this fund annually would be developed in consultation with resource agencies. | Oregon Fish & Wildlife (13B) | No ^b | Dependent on post-licensing consultation | No |
| 78. Notify resource agencies within 48 hours of un-anticipated harm to non-federally listed fish and wildlife, take immediate actions to prevent further losses, comply with restorative measures specified by the resource agencies, and notify the Commission within 10 days of the event and report on actions taken. | Oregon Fish & Wildlife (15B) | No ^b | \$5,000 | Yes |
| 79. Notify resource agencies within 6 hours of un-anticipated harm to state or federally listed fish and wildlife, take immediate actions to prevent further losses, comply with restorative measures specified by the resource agencies, and notify the Commission within 10 days of the event and report on actions taken. | Oregon Fish & Wildlife (15A) | No ^b | \$670 | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|---|--|--|--|
| 80. Consult with appropriate agencies prior to repairing or modifying project operations or facilities and obtain required permits. | Oregon Fish & Wildlife (15C) | No ^b | None | Yes, although limits on what types of repairs require consultation would need to be established. |
| 81. Develop a vegetation and noxious weed resource management plan that includes provisions for managing native vegetation to optimize habitat for wildlife and controlling invasive weed species, within 1 year of license issuance. Provide annual monitoring and compliance reports to the Commission and resource agencies and update the plan every 5 years. | Oregon Fish & Wildlife (1A8, 1B, 1C, 1D8) | Yes, although timing of plan development is not. | \$52,190 | Yes, although we plan to recommend consolidation of vegetation-related plans. |
| 82. Develop a vegetation management plan within 2 years of license issuance that guides land management practices on company-owned lands to control exotic and invasive weeds so that they do not infest downstream or adjacent property or compromise the integrity of native fish and wildlife habitat. | Oregon Fish & Wildlife (13C) | Yes | Included in the cost of the previous measures (81) | Yes, we assume Oregon Fish & Wildlife meant company-owned land within project boundary or influenced by the project. |
| 83. Develop a riparian habitat management and monitoring plan within 1 year of license issuance that addresses project effects on fish and wildlife riparian habitat. The plan would provide a basis to adaptively manage license conditions designed to restore riparian habitats within the project area. The plan would also identify actions to minimize project effects on riparian habitat and identify site-specific restoration measures for project-related effects based on an inventory of riparian areas, as needed. Actions would be designed to restore hydrologic connectivity in the varial zone and diversity of riparian species. | FWS (14) | Yes | \$37,440 Monitoring and management included in the cost of measure 81 | Yes, although we plan to recommend consolidation of vegetation-related plans. |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|---|---------------------------------|---|--|
| 84. Develop a wildlife “mitigation” resource management plan that includes provisions for monitoring raptor injury and mortality at project transmission poles, installation of protective devices, and monitoring wildlife entrapment and mortality at project canals, within 1 year of license issuance. Provide annual monitoring and compliance reports to the Commission and resource agencies and update the plan every 5 years. | Oregon Fish & Wildlife (1A6, 1B, 1C, 1D6) | Yes, although timing is not. | \$28,730 | Yes, although we plan to recommend consolidation of wildlife management plans. |
| 85. Develop an aquatic and riparian habitat and a wildlife resource management plan within 1 year of license issuance, provide annual monitoring and compliance reports to the Commission and resource agencies, and update the plan every 5 years. | Cal Fish & Game (IV) | No ^b | Not specific enough to estimate, but could be similar to the sum of measures 74, 83, and 84 | No |
| 86. Develop a wildlife “mitigation” plan for the project area and related company-owned lands within 2 years of license issuance. The plan would include provisions for monitoring and evaluating wildlife and their habitats and measures to address project effects (river and reservoir fluctuations, habitat degradation or loss, and hazards from power canals and transmission lines). Any new project development or effects authorized during relicensing should be consistent with Oregon Fish & Wildlife’s Mitigation Policy, Wildlife Diversity Plan, and Comprehensive Wildlife Conservation Strategy. | Oregon Fish & Wildlife (12A), Cal Fish & Game (III) | Yes, although timing is not. | Included in the cost of measures 83 and 84 | Yes, although we plan to recommend consolidation of wildlife management plans. |
| 87. Install additional large wildlife crossings and escape ramps at the J.C. Boyle intake canal within 2 years of license issuance. | Oregon Fish & Wildlife (12B) | Yes, although timing is not. | \$45,410 | Yes (if determined during consultation to be needed). |
| 88. Install additional small animal crossings at project canals within 2 years of license issuance. | Oregon Fish & Wildlife (12C) | Yes, although timing is not. | Included in the previous measure (87) | Yes |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|--|------------------------------|---------------------------------|--|--|
| 89. Develop a wildlife crossing monitoring plan for project canals and waterways within 1 year of license issuance to enable assessment of effectiveness. | Oregon Fish & Wildlife (12D) | Yes, although timing is not. | \$1,350 | Yes, although we plan to recommend that this be consolidated with other wildlife plans. |
| 90. Develop a wildlife crossing and escape ramp inspection plan within 2 years of license issuance that provides for maintenance, annual inspections, and reporting to agencies by March 1. | Oregon Fish & Wildlife (12E) | Yes, although timing is not. | Included in measures 87 and 89 | Yes, although we plan to recommend that this be consolidated with other wildlife plans. |
| 91. Implement protective measures for birds at project transmission lines where bird mortalities have been documented. | Oregon Fish & Wildlife (12F) | Yes | Monitoring costs included in measure 84; protective measures in O&M. | Yes |
| 92. Conduct O&M activities in the project area in accordance with the most current spatial and temporal guidelines for avian protection. (Oregon Fish & Wildlife cites these as APLIC, 1996 and 2005.) | Oregon Fish & Wildlife (12G) | Yes | No incremental costs | Yes |
| 93. Follow existing agreement with Oregon Fish & Wildlife and FWS, dated February 18, 1988, regarding procedures for addressing bird mortalities and nests. This agreement establishes a database that documents bird mortalities near project facilities and annual reports of such to the resource agencies. | Oregon Fish & Wildlife (12H) | Yes | No incremental costs | Yes, we assume the salient elements of the 1988 agreement would be incorporated into a current avian protection plan (an element of PacifiCorp's proposed wildlife resources management plan). |

| Recommendation | Agency^a | Subject to Section 10(j) | Annualized Cost | Adopted? |
|---|-----------------------------|---------------------------------|--|---|
| 94. Develop an avian collision and electrocution hazard avoidance plan within 1 year of license issuance. The plan should include monitoring strategies sufficiently repetitive to detect sites causing mortalities. | FWS (17) | Yes | Any incremental costs would be included in measure 84. | Yes, although we plan to recommend consolidation of wildlife plans. |
| 95. Develop an adaptive management plan within 1 year of license issuance to evaluate the need for a fish ladder built to federally listed sucker criteria at Keno dam. Data would be collected at the anadromous fish trap prescribed by Interior and NMFS at Keno dam and supplemented by regular visual examination of the existing ladder to evaluate current use by suckers. | FWS (16) | Yes | \$1,350 for plan development; implementation costs \$1,983,340 | No (see section 5.2). |
| 96. Monitor project waters for federally listed suckers every 3 years | FWS (12B1) | Yes | \$23,220 | Yes, although we recommend fish monitoring at 5-year intervals. |
| 97. Develop a bald eagle management plan for the project area within 2 years of license issuance. | FWS (18) | Yes | \$17,390 | Yes |
| 98. Provide a minimum of 60 days for Oregon Fish & Wildlife and other stakeholders to provide comments on all plans and actions required in a new license. Consultation should be documented in each plan or report submitted to the Commission. | Oregon Fish & Wildlife (2A) | No ^b | \$0 | Yes, although the term “all actions” should be clarified. |

1 ^a Numbers and letters in parentheses are the designations for the specific measures in the source letter from the fish and wildlife agency.

2 ^b Not a specific measure to protect fish and wildlife resources.

5.4.2 U.S. Bureau of Land Management and U.S Bureau of Reclamation Section 4(e) Conditions

In section 2.3.1.3, *Section 4(e) Federal Land Management Conditions*, we list the preliminary 4(e) conditions submitted by the Bureau of Land Management and by Reclamation, and note that section 4(e) of the FPA, 16 U.S.C. § 797(e), provides that any license issued by the Commission “for a project within a federal reservation shall be subject to and contain such conditions as the Secretary of the responsible federal land management agency deems necessary for the adequate protection and use of the reservation.” Thus, any 4(e) condition that meets the requirements of the law must be included in a license issued by the Commission, regardless of whether we include the condition in our Staff Alternative. In section 2.3.1.3 we identified eight Bureau of Land Management and six Reclamation preliminary 4(e) conditions that we consider to be administrative or legal in nature and not specific environmental measures. We therefore do not analyze these 14 conditions in our EIS. Table 5-3 summarizes our staff conclusions with respect to the preliminary 4(e) conditions that we consider to be environmental measures. More detailed descriptions of the conditions are presented in table 2-3, in section 2.3.1.3, and in Interior’s letter to the Commission dated March 27, 2006. Of the 39 preliminary 4(e) conditions submitted by the Bureau of Land Management and Reclamation, we include in the Staff Alternative 14 conditions, for reasons summarized in table 5-3 and, in some cases, discussed in more detail in section 5.2, *Discussion of Key Issues*.

Table 5-3. Bureau of Land Management and Reclamation preliminary 4(e) conditions for the Klamath Hydroelectric Project. (Source: Staff)

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|---|---------------------------|------------------------|--|
| 1. Consult with the Bureau of Land Management prior to taking actions beyond the scope of the license or not previously approved, to resolve conflicts with Bureau policy and direction (1A). | Bureau of Land Management | Unknown | Actions not addressed in this EIS would generally be addressed during a license amendment proceeding, which would include agency consultation. |
| 2. Obtain written approval from the Bureau of Land Management prior to changing location of any project facility on Bureau-administered land (1C). | Bureau of Land Management | \$0 | Yes, except we modify to provide for definition of the threshold for approval during consultation. |
| 3. Prepare plans for Bureau of Land Management approval and conduct analysis sufficient to meet NEPA standards for PacifiCorp activities that could affect Bureau-administered lands, if not previously analyzed on a site-specific basis (1D). | Bureau of Land Management | Unknown | Actions not addressed in this EIS would generally be addressed during a license amendment proceeding. The Commission would conduct a NEPA analysis if action is project-related. |
| 4. Conduct environmental analysis sufficient for formal consultation pursuant to NEPA regulations upon approval from the Bureau of Land Management of plans specified in number 3, above (1E). | Bureau of Land Management | Unknown | Actions not addressed in this EIS would generally be addressed during a license amendment proceeding, which would include agency consultation. |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|---|---------------------------|---|---|
| 5. Develop a safety during construction plan 60 days prior to ground disturbing activities on Bureau of Land Management administered land (1F). | Bureau of Land Management | Costs included in plans for specific actions. | No, the need for such a plan would be addressed under Part 12 of the Commission's regulations |
| 6. Perform daily inspections during construction on Bureau of Land Management administered land and adjoining fee title property. Develop and implement an integrated Comprehensive Recreation Management Plan (1G). | Bureau of Land Management | Costs included in plans for specific actions. | Yes, but inspection frequency should be established during consultation regarding specific plans commensurate with the nature of the proposed action. |
| 7. Prepare a spoils disposal plan prior to ground disturbing activity on Bureau of Land Management administered land (1H). | Bureau of Land Management | Costs included in plans for specific actions. | Yes |
| 8. Provide the Bureau of Land Management a copy of a hazardous substances plan for oil and hazardous substance storage, spill prevention, and clean up for planning, construction, or maintenance that may affect Bureau of Land Management administered lands 90 days prior to filing the plan with the Commission (1I). | Bureau of Land Management | \$0 | Yes, PacifiCorp indicates in its alternative to this 4(e) condition that it is required by 40 CFR part 112 to maintain a spill prevention countermeasure control plan at all project facilities, and would provide this plan to the Bureau of Land Management and the Commission upon request. |
| 9. Provide semi-annually to the Bureau of Land Management information on the location of spill cleanup equipment and the location, type, and quantity of hazardous substances on Bureau-administered lands. Notify the Bureau immediately as to the nature, time, date, location, and action taken for any spill affecting Bureau-administered land (1J). | Bureau of Land Management | \$5,000 | No, instead we adopt PacifiCorp's alternative condition that states that it would maintain spill clean-up equipment in accordance with the required spill prevention countermeasure control plan. PacifiCorp would continue to annually submit its hazardous chemical inventory to appropriate state agencies as required by federal regulations. PacifiCorp would notify the Bureau of any spills on reservation land. |
| 10. Restore Bureau of Land Management administered land to a satisfactory condition prior to any surrender of the project license or surrender of project facilities (1M). | Bureau of Land Management | Unknown | No, appropriate restoration measures for facility or project decommissioning would be addressed in a separate proceeding. |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|--|---------------------------|---|--|
| 11. Develop a standard operating procedure for emergencies that would address permitting and implementation of subsequent measures for any project-related effects to Bureau of Land Management administered lands, including emergency spillway and slope failures along the canal (10). | Bureau of Land Management | \$1,350 | Yes, except we modify to enable definition of threshold for effect that would trigger implementation of the standard operating procedure. |
| 12. Consult with the Bureau of Land Management between September 1 and the end of November and prepare a report that summarizes the results of monitoring conducted during the past year, foreseeable changes to project operations, upcoming scheduled maintenance, and suggested changes to any environmental programs included in the project license (2A). | Bureau of Land Management | \$2,000 (assumes a meeting is necessary beyond other consultation requirements) | No, however we expect there to be sufficient flexibility to enable consultation and reporting that would be required for other programs to be consolidated with this consultation. |
| 13. File record of consultation and any Bureau of Land Management comments and recommendations with the Commission within 60 days of issuance of the report detailed in 12, above. The Bureau reserves the right to require changes to project operation through revisions of 4(d) conditions (2D). | Bureau of Land Management | Costs included in 12 and other annual filings | Yes regarding documentation of consultation. Modification of project operations specified in a license would require a license amendment, which would be a separate proceeding. |
| 14. File a project roads inventory analysis and roads management plan for project-related roads that cross Bureau-administered land within 6 months of license issuance (3). | Bureau of Land Management | \$21,350 | Yes |
| 15. Maintain minimum streamflows in the J.C. Boyle bypassed reach of 470 cfs or 40% of the combined inflow from Keno reach and Spencer Creek, whichever is the greater of the two flows. When the proportional flow of 40% is greater than 470 cfs, the required proportional flows are the average of the previous 3 days of the combined daily flow (4A1[a][b]). | Bureau of Land Management | \$5,679,190 | No, flows of at least 470 cfs (or 640 cfs as specified in Oregon Fish & Wildlife's and Cal Fish & Games alternative 4(e) conditions) would wash out thermal refugia and diminish salmonid habitat. We adopt PacifiCorp's second alternative 4(e) condition, with a total of 200 cfs released at the dam (see section 5.2). |
| 16. At least once per year between February 1, and April 15, suspend diversion of water to the J.C. Boyle power canal when inflow to the J.C. Boyle reservoir exceeds 3,300. Cessation of diversion should be maintained for at least 7 full days (4A1[c]). | Bureau of Land Management | \$724,840 | No, flows sufficient to flush fine-grained sediment from spawning gravel and transport gravel in the bypassed reach occur under existing conditions (see section 5.2). |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|--|---------------------------|---|--|
| 17. Not exceed an up or down ramp rate of 2 inches per hour as measured at a new gage downstream of J.C. Boyle dam when conducting controlled flow events, except during implementation of seasonal high flow (4A2). | Bureau of Land Management | Energy cost included in item 15 (4A1[a][b]); new gage cost \$19,440 | Yes |
| 18. Operate the J.C. Boyle development to provide streamflows of 1,500 to 3,000 cfs a maximum of once a week between May 1, to October 31, with a priority set for Saturday, Sunday, and then Friday (4B1). | Bureau of Land Management | \$ 393,400 | No, would not support the Outstanding Remarkable Value of this Wild and Scenic River segment. We do not adopt Oregon Fish & Wildlife's or Cal Fish & Game's alternative 4(e) condition (which would have J.C. Boyle operate in a run-of-river mode) for the same reason (see section 5.2). |
| 19. Not exceed an up or down ramp rate of 2 inches per hour as measured at the USGS gage downstream of the J.C. Boyle powerhouse when conducting controlled flow events, except during the implementation of seasonal high flow (4B2). | Bureau of Land Management | Included in corresponding flow measures | No, we see no evidence that such a restrictive ramping rate is needed (see section 5.2). We do not adopt Oregon Fish & Wildlife's or Cal Fish & Game's alternative 4(e) condition (a ramping rate of 1 inch per hour) for the same reason (see section 5.2). |
| 20. Continuously measure the stage of water at a minimum of four gage sites (Keno, Spencer Creek, downstream of J.C. Boyle powerhouse, and a new bypassed reach gage) using the most current USGS protocols. PacifiCorp should operate and maintain the gages if they are no longer served by the current operators (4C1). | Bureau of Land Management | \$19,440 (cost for refurbishing Spencer Creek gage; J.C. Boyle bypassed reach gage included in 17, above) | No, gages for which PacifiCorp should be responsible should be determined once the project flow regime is set in a new license (see section 5.2). |
| 21. Provide instantaneous real time data that is readily available and accessible to the public, and design a database for reporting on surface water (4C2). | Bureau of Land Management | \$0 (already available) | Yes |
| 22. Develop a gravel management plan that provides for deposition of from 1,226 tons to 6,134 tons of gravel per year, monitoring and evaluation, and adaptation (4D1[a][b]). | Bureau of Land Management | \$43,930 | No, but we recommend mapping existing gravels, placement of gravel for 10 years and annual monitoring in the J.C. Boyle bypassed reach, with the need for additional gravel to be determined based on monitoring results (see section 5.2). |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|--|---------------------------|---|---|
| 23. Provide an annual report to the Bureau of Land Management and the Commission that summarizes gravel augmentation activities, consult with the Bureau about any proposed changes to the gravel augmentation program, provide a comprehensive monitoring report after 6 years on augmentation, with recommendations for adaptive management (4D1[c]). | Bureau of Land Management | \$17,020 | Yes |
| 24. Develop an adaptive management plan that is designed to monitor the effectiveness of flow and gravel augmentation in enhancing fish habitat. Provide annual reports summarizing monitoring results and assessments of spawning, holding, feeding, rearing, riparian, and migratory habitat and the adequacy of flows for providing migration, rearing, and spawning habitat for native aquatic species, moving spawning gravel, achieving riparian habitat objectives, supporting power generation, and providing recreational opportunities (4E). | Bureau of Land Management | \$104,050 (reporting costs included in 23, above) | Yes, although we do not include all the specified parameters to be monitored. |
| 25. Complete a cultural resources inventory on 77.2 acres of unsurveyed Bureau of Land Management administered land. Develop a protocol for conducting cultural resource surveys on Bureau-administered land prior to future project-related activities within the APE and for processing cultural resources exposed by un-anticipated project-related effects (5A). | Bureau of Land Management | \$2,020 | Yes, although we would limit the extent of the surveys to the limits of project capacity along the peaking reach and areas in the vicinity of Big Bend that may be subject to disturbance by proposed recreational facilities. Protocols for addressing cultural resources would be specified in the final HPMP for the entire APE, which would include Bureau-administered land, as appropriate. |
| 26. Amend the HPMP to include measures to monitor, protect, and restore known damage to cultural sites within the APE on Bureau of Land Management administered land, including 18 known sites and additional sites identified under the previous condition (25). Submit annual reports and consult with the Bureau and affected tribes every 5 years regarding the need to revise the HPMP (5B). | Bureau of Land Management | \$1,350 | Yes, although we would restrict PacifiCorp's responsibilities to sites within the APE that are influenced by project operations, which may not include all 18 sites specified by the Bureau of Land Management. |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|---|---------------------------|------------------------|---|
| 27. Include in a recreation resources management plan descriptions of existing and potential recreation sites on Bureau of Land Management administered lands and affected by the project, schedules of implementation, maintenance, monitoring, costs, and identification of instruments for shared administration (6A). | Bureau of Land Management | \$226,090 | Yes, except we limit the content of the plan to measures that have a clear nexus to project purposes and adjust recreation monitoring schedule to be consistent with Commission requirements. |
| 28. Develop a recreation resources plan in consultation with the Bureau of Land Management and provide a copy of the plan to the Bureau at the same time that it is filed with the Commission. Upon Commission approval, implement the plan including any changes required by the Bureau (6B, 6C). | Bureau of Land Management | Included in 27, above | Yes |
| 29. Include in the recreation resources management plan a visual resources management plan that addresses provisions for managing visual resources on Bureau of Land management administered land (6A). | Bureau of Land Management | \$51,060 | Yes |
| 30. Develop a vegetation management plan for Bureau of Land Management administered land affected by the project. Upon Commission approval, implement the plan including any changes required by the Bureau (7). | Bureau of Land Management | \$52,190 | Yes |
| 31. Develop a wildlife habitat management plan for Bureau of Land Management administered lands affected by the project. Upon Commission approval, implement the plan including any changes required by the Bureau (8). | Bureau of Land Management | \$76,630 | Yes |
| 32. Continue to operate and maintain Link River dam consistent with the Klamath Irrigation Project annual project operations plans (1A). | Reclamation | \$0 | No, Link River dam is not in the existing or proposed project boundary and its operation is not under the Commission's jurisdiction. |
| 33. Maintain the approach channel to the A Canal of the Klamath Irrigation Project as may be necessary to ensure a flow of at least 1,200 cfs into the canal (1C). | Reclamation | \$10,000 | No, ensuring flow to the A Canal has no nexus to project purposes. |
| 34. No rights to water or land along the margin of Upper Klamath Lake. No water used for hydroelectric purposes when needed for irrigation or other purposes by entities serviced by the Klamath Irrigation Project (1E). | Reclamation | \$0 | No, water and land rights issues are not within the jurisdiction of the Commission. |

| Recommendation^a | Agency | Annualized Cost | Adopted? |
|--|---------------|--|--|
| 35. Operate Keno dam so that the water level of the reservoir would not be below elevation 4,085 feet (Reclamation datum)(1F). | Reclamation | \$0 | Yes, except we modify water level management to accommodate occasional drawdowns for water users to service their pump intakes, as is the current practice (if Keno included in project license). |
| 36. Operate Keno dam to accommodate a discharge of 3,000 cfs from Lost River diversion channel and 600 cfs from Klamath Straits drain (1G). | Reclamation | \$0 | Yes, except we modify to account for events beyond PacifiCorp's control (if Keno included in project license). |
| 37. Develop operating criteria in consultation with Reclamation that provide for coordination of Link River and Iron Gate dam (or the most downstream of the project), consistent with Reclamation's responsibilities (2). | Reclamation | \$0 | No, Link River is not a project feature and its operation is not within the Commission's jurisdiction. Coordination with Reclamation regarding flows would be defined in a project operations management plan. |
| 38. Develop operating criteria in consultation with Reclamation, that provide for coordination of Keno and Iron Gate dam (or the most downstream of the project), consistent with Reclamation's responsibilities (3). | Reclamation | Costs included in other project operations plans | Yes (if Keno included in project license; if not, operating criteria for the most upstream development and Iron Gate development would be defined in a project operations management plan). |
| 39. Provide Reclamation with area capacity curves for all project facilities and real time access to reservoir elevations and releases from project facilities (4). | Reclamation | \$0 | Yes, to the extent that such information is available and pertinent to Reclamation's management needs. Area capacity curves are included in exhibit B of the license application and available to the public. |

1 ^a Numbers and letters in parentheses are the designations for the specific measures in the source letter from
2 Interior.

3 **5.5 CONSISTENCY WITH COMPREHENSIVE AND OTHER RESOURCE PLANS**

4 Section 10(a)(2) of the FPA requires the Commission to consider the extent to which a project is
5 consistent with federal or state comprehensive plans for improving, developing, or conserving waterways
6 affected by the project. Under section 10(a)(2), federal, state and local agencies filed comprehensive
7 plans that address various resources in California and Oregon. The 68 plans listed below address
8 resources applicable to the project. Based on our review and analysis, we concluded that the project as
9 described in the Staff Alternative would be consistent with the plans.

10 **California**

11 Bureau of Land Management. June 1993. Redding Resource Management Plan and Record of
12 Decision. Department of the Interior. Redding, CA. 55 pp.

- 1 California Advisory Committee on Salmon and Steelhead Trout. 1988. Restoring the balance:
2 1988 annual report. Sausalito, CA. 84 pp.
- 3 California Department of Fish and Game. 1996. Steelhead restoration and management plan for
4 California. February 1996. 234 pp.
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32 **5.6 RELATIONSHIP OF LICENSE PROCESS TO LAWS AND POLICIES**

33 **5.6.1 Section 401 of the Clean Water Act—Water Quality Certification**

34 The status of the water quality certifications for the project is discussed in section 2.3.1.1.

35 **5.6.2 Coastal Zone Management Act—Consistency Certification**

36 Section 307(c) of the Coastal Zone Management Act requires that all federally licensed and
 37 permitted activities be consistent with approved state Coastal Zone Management Programs. If the project
 38 is located within a coastal zone boundary or if a project could affect resources located in the boundaries of
 39 the designated coastal zone, the applicant must certify that the project is consistent with the state Coastal

1 Zone Management Program. The Klamath Hydroelectric Project is not located within the coastal zone
 2 boundary and would not affect resources located within the coastal zone boundary.

3 **5.6.3 Section 18 of the Federal Power Act—Authority to Prescribe Fishways**

4 Fishway prescriptions and recommendations for reservation of authority to prescribe fishways are
 5 discussed in section 2.3.1.2.

6 **5.6.4 Endangered Species Act**

7 Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to
 8 jeopardize the continued existence of endangered and threatened species or cause the destruction or
 9 adverse modification of critical habitats of such species. Three federally listed fish species (Klamath
 10 River coho salmon, Lost River sucker, and shortnose sucker), three federally listed plant species (slender
 11 Orcutt grass, Applegate’s milk-vetch, and Gentner’s fritillaria), and six federally listed wildlife species
 12 (California red-legged frog, bald eagle, northern spotted owl, western snowy plover, Canada lynx, and
 13 gray wolf) could occur in the project area or in downstream areas potentially affected by project
 14 operations. Species were identified as being likely to occur in the project area by the Interior in a letter
 15 dated July 21, 2006, and by NMFS in a letter dated July 6, 2006.

16 Table 5-4 shows our determinations regarding the effect of relicensing the Klamath Hydroelectric
 17 on federally listed species that are likely to occur in the project area. Table 5-4 also summarizes the basis
 18 for our effect determinations. We will request formal consultation with FWS on the Lost River sucker
 19 and shortnose sucker and NMFS on Klamath River coho salmon. We will also request concurrence from
 20 FWS on our determinations that relicensing would “not likely to adversely affect” other listed species or
 21 critical habitat. This draft EIS will serve as our biological assessment.

22 Table 5-4. Summary of effect determinations for fish, plants, and wildlife. (Source: Staff)

| Species | Species Status | Species Finding | Critical Habitat Finding | Basis for Determination |
|--|-----------------------|--------------------------------|---------------------------------|--|
| Lost River sucker (<i>Delistes luxatus</i>) | Endangered | Likely to adversely affect | None designated | Continued potential for entrainment or impingement of young at project powerhouse intakes. |
| Shortnose sucker (<i>Chasmistes brevirostris</i>) | Endangered | Likely to adversely affect | None designated | Continued potential for entrainment or impingement of young at project powerhouse intakes. |
| Coho salmon (<i>Oncorhynchus kisutch</i>) | Threatened | Likely to adversely affect | Likely to adversely affect | Continued potential for adverse effects of low DO and project-related disease. |
| Bull trout (<i>Salvelinus confluentus</i>) | Threatened | No effect | No effect | No populations found during surveys in project area. |
| Slender Orcutt grass (<i>Orcuttia tenuis</i>) | Threatened | No effect | No effect | No populations or potential habitat found during surveys in project area. |
| Applegate’s milk-vetch (<i>Astragalus applegatei</i>) | Endangered | Not likely to adversely affect | None designated | Effects are discountable or insignificant |
| Gentner’s fritillaria (<i>Fritillaria gentneri</i>) | Endangered | No effect | None designated | No populations found during surveys in project area |

| Species | Species Status | Species Finding | Critical Habitat Finding | Basis for Determination |
|---|-----------------------|--------------------------------|---------------------------------|--|
| California red-legged frog (<i>Rana aurora draytoni</i>) | Threatened | No effect | No effect | No individuals found during surveys in project area, no critical habitat near project |
| Bald eagle (<i>Haliaeetus leucocephalus</i>) | Threatened | Likely to adversely affect | None designated | Continued potential for disturbance from project-related recreation and construction. Potential for electrocution and collision at project transmission lines cannot be ruled out. |
| Northern spotted owl (<i>Strix occidentalis caurina</i>) | Threatened | Not likely to adversely affect | Not likely to adversely affect | Effects are discountable or insignificant. |
| Western snowy plover (<i>Charadrius alexandrinus nivosus</i>) | Threatened | No effect | None designated | No individuals or suitable breeding habitat found during surveys in project area. |
| Canada lynx (<i>Lynx canadensis</i>) | Threatened | No effect | None designated | No individuals or preferred prey (snowshoe hare) found during surveys in project area. |
| Gray wolf (<i>Canis lupus</i>) | Threatened | No effect | None designated | No individuals and little suitable habitat found during surveys in project area. |

1 **5.6.5 Essential Fish Habitat**

2 Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act requires
3 federal agencies to consult with the Secretary of Commerce regarding all actions or proposed actions that
4 are authorized, funded, or undertaken by the agency that may adversely affect EFH. The Klamath River
5 downstream of the project comprises EFH for Chinook and coho salmon.

6 PacifiCorp proposes the following measures that should benefit Chinook and coho EFH in the
7 Klamath River: (1) continue releases from Iron Gate dam consistent with Reclamation’s operating plans
8 for the Klamath Irrigation Project, which are developed in accordance with the 2002 NMFS and FWS
9 BiOps; (2) evaluate low level releases of cooler hypolimnetic Iron Gate reservoir water during the
10 summer to provide cooler water to downstream reaches; (3) install a hypolimnetic oxygenation system at
11 Iron Gate reservoir to increase downstream DO (if studies show that this would not adversely affect other
12 water quality analyses); (4) place 1,800 to 3,500 cubic yards of spawning gravel downstream of Iron Gate
13 dam and monitor the gravel afterwards; (5) mark 25 percent of the fall Chinook salmon released from
14 Iron Gate Hatchery to assist with harvest management efforts by resource agencies; and (6) develop and
15 implement reservoir management plans for J.C. Boyle, Copco, and Iron Gate reservoirs which could
16 result in improved water quality downstream of Iron Gate dam and a reduction in conditions that foster
17 salmon diseases.

18 In section 5.2, *Discussion of Key Issues*, we discuss five additional measures that we include in
19 the Staff Alternative that would benefit EFH: (1) mapping of spawning gravel deposits downstream of
20 Iron Gate dam, and gravel augmentation and monitoring as needed to enhance salmon spawning habitat;
21 (2) implementation of turbine venting at Iron Gate dam to enhance the DO regime downstream of the
22 dam; (3) development of a temperature management plan to include protocols that would be implemented
23 to trigger the release and possible oxygenation of cool hypolimnetic water from Iron Gate reservoir for
24 short-term relief when downstream conditions on the Klamath River approach maximum stress levels for
25 salmon; (4) development of a disease monitoring and management plan to evaluate and implement

1 measures to control fish diseases in the Klamath River between Iron Gate dam and the Shasta River; and
2 (5) development of a single, comprehensive water quality management plan for all project-affected
3 waters, to include consideration of spilling warm water at Iron Gate dam during late spring, of spilling at
4 Copco No. 1, Copco No. 2, and Iron Gate dams during the summer to enhance dissolved oxygen released
5 at Iron Gate development, and of turbine venting at Copco No. 1 and No. 2 powerhouses to increase
6 dissolved oxygen in the epilimnion of Iron Gate reservoir and, potentially, downstream of Iron Gate
7 development. We conclude that the measures that we include in the Staff Alternative would not adversely
8 affect EFH.

9 **5.6.6 National Historic Preservation Act**

10 The NHPA (16 U.S.C 470 et seq.) (as amended) requires federal agencies to manage cultural
11 resources under their jurisdiction and authorizes the Secretary of the Interior to maintain a National
12 Register. The law also provides for the creation of SHPOs to facilitate the implementation of federal
13 cultural resource policy at the state level, and for the responsible federal agency (i.e., agency official) to
14 consult with Native American tribes who attach religious or cultural importance to cultural resources
15 under their jurisdiction. Section 106 of the Act requires federal agencies to take into account the effect of
16 any proposed undertaking on properties listed in, or eligible for listing in the National Register. If the
17 agency official determines that the undertaking may have adverse effects on properties listed in or eligible
18 for listing in the National Register, the agency official must afford an opportunity for the Advisory
19 Council to comment on the undertaking. The relicensing of the Klamath Hydroelectric Project is
20 considered an undertaking, and the Commission acts as the agency official.

21 To meet the requirements of section 106, the Commission would execute a Programmatic
22 Agreement to take into account the effects on historic properties from the operation of the Klamath
23 Hydroelectric Project. The terms of the Programmatic Agreement would ensure that PacifiCorp would
24 address and treat all historic properties identified within the areas of potential effect through the HPMP.
25 The HPMP entails ongoing consultation involving historic properties for the term of any new license.

26 **5.6.7 Wild and Scenic Rivers Act**

27 The Wild and Scenic River Act (P.L. 90-542) and its amendments protect in their free-flowing
28 conditions designated rivers and their immediate environments that possess ORVs. ORVs may include
29 scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Section 7 (a) of
30 the act states that the Commission shall not license the construction of any dam, water conduit, reservoir,
31 powerhouse, transmission line, or other project works under the FPA on or directly affecting any river
32 designated as a Wild and Scenic River. The Wild and Scenic Rivers Act specifically does not preclude
33 licensing of developments upstream or downstream of designated wild, scenic, or recreational rivers if the
34 development does not invade the area or unreasonably diminish the scenic, recreational, and fish and
35 wildlife values present in the designated reach.

36 Congress added about 189 miles of the mainstem of the Klamath River to the Wild and Scenic
37 Rivers system in 1981 as part of a total 286 mile designation of river segments in the Klamath River
38 Basin. The upstream end of this designated river segment begins about 3,600 feet downstream of Iron
39 Gate dam in the vicinity of the Iron Gate Hatchery. Portions of the Salmon and Scott rivers and Wooley
40 Creek make up the balance of the designated river segments (97 miles). Most (250 miles) of the total of
41 286 miles was designated by Congress as recreational; 24 miles was designated as scenic; and 12 miles
42 was designated as wild. The ORV for this 286 mile portion of the Wild and Scenic Rivers system is
43 anadromous fisheries (steelhead and salmon).

44 The measures to enhance anadromous fish habitat included in the Staff Alternative and
45 summarized in section 5.6.5, *Essential Fish Habitat*, would support the ORV of anadromous fisheries for
46 the Wild and Scenic River segment downstream of Iron Gate dam. In addition, recreational

1 enhancements at the Iron Gate Hatchery day use area that we include in the Staff Alternative would serve
2 to facilitate public education regarding the importance of anadromous fish restoration to the Klamath
3 River Basin. Enhancements at a nearby boater access location at the upstream end of the designated Wild
4 and Scenic River segment would facilitate recreational use of this river reach. Together, these measures
5 would help enhance the environmental attributes of this Wild and Scenic reach.

6 In 1994, Congress added an 11 mile segment of Klamath River from downstream of the J.C.
7 Boyle powerhouse to the Oregon and California state line (much of the peaking reach) to the Wild and
8 Scenic Rivers system. This segment was designated by Congress as scenic, with ORVs of quality
9 whitewater boating, diverse wildlife, prehistoric sites, quality rainbow trout fishery, habitat for
10 endangered species, historic places, scenery, and evidence of Native American traditional uses.

11 A primary reason for the ORV of quality whitewater boating is the peaking operation at the J.C.
12 Boyle powerhouse. This operation provides quality boating opportunities throughout the summer when
13 low flow conditions curtail whitewater boating opportunities at other regional unregulated river systems.
14 The Staff Alternative retains daily peaking operations which would maintain whitewater boating
15 opportunities for most of the time that existed when this was designated by Congress as a Wild and
16 Scenic River reach in 1994. It would also, during wet water years, enhance whitewater boating
17 opportunities from July through October because of limitations in the change in generation flows that are
18 also included in the Staff Alternative (see section 3.3.6.2.2, *River Recreation*, for more details). Angling
19 opportunities would be similar under the Staff Alternative to those that existed in 1994. Habitat
20 protection and enhancement measures included in the Staff Alternative for the J.C. Boyle bypassed and
21 peaking reaches, including spawning gravel augmentation, protection of the thermal refugia, increased
22 minimum flow in the peaking reach, and limitations on the rate of flow change in the peaking reach
23 should maintain and result in minor improvements to the existing quality rainbow trout fishery in the
24 peaking reach. Protection of sites of prehistoric, historic, and of importance to Native Americans would
25 be provided for by the HPMP that is included in the Staff Alternative.

COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE KLAMATH HYDROELECTRIC PROJECT

Docket No. P-2082-027

Section 6
Literature Cited
Pages 6-1 to 6-16
DEIS

6.0 LITERATURE CITED

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