4.5 Two Dam Removal Alternative

4.5.1 Introduction

4.5.1.1 Alternative Description

In the Two Dam Removal Alternative, Copco No. 1 and Iron Gate dams and associated facilities would be fully removed, and J.C. Boyle and Copco No. 2 dams and associated facilities would remain. The J.C. Boyle facilities that would remain include (see also Figure 2.3-1):

1. A 2,629-acre-feet reservoir (J.C. Boyle Reservoir);
2. A 68-foot tall earthfill dam (J.C. Boyle Dam), concrete spillway, and three spill gates;
3. A concrete intake structure connecting to a 2.5-mile water conveyance system with an overflow forebay;
4. A 98-megawatt (MW) J.C. Boyle Powerhouse;
5. A switchyard with 2.8 miles of transmission lines; and
6. Ancillary buildings including an office building (known as the Red Barn), maintenance shop, fire protection building, communications building, two occupied residences, and a warehouse.

The Copco No. 2 facilities that would remain include (see also Figure 2.3-3):

1. A 70-acre-feet reservoir (Copco No. 2 Reservoir);
2. A 32-foot tall concrete diversion dam (Copco No. 2 Dam) including a gated spillway, basin apron, end sill, and a remnant cofferdam upstream of the concrete dam below the normal water surface elevation of the reservoir;
3. An approximately 15,000-square foot earthen embankment section with a gunite cutoff wall along the river right sidewall;
4. A diversion water conveyance system consisting of 3,610 feet of concrete-lined, 16-foot diameter conveyance tunnel, 1,330 feet of a 16-foot diameter wooden-stave penstock, an underground surge tank, a 405.5-foot long, 16-foot diameter steel penstock, and a 410.6-foot long, 16-foot diameter steel penstock;
5. A 7,000-square foot, 27-MW Copco No. 2 Powerhouse;
6. A 1,900-square foot control center building;
7. A 4,500-square foot maintenance building;
8. A 650-square foot oil and gas storage building; and
9. The nearby mostly vacant Copco Village, with a total structure area of 32,200 square feet, consisting of a cookhouse, bunkhouse, storage building, bungalow, three modular houses, four old style ranch houses, and a schoolhouse/community center.

This alternative assumes that the J.C. Boyle and Copco No. 2 dams and associated facilities would be relicensed by FERC for continued operations with changes to allow for upstream and downstream fish passage and updated flow requirements. More specifically, the Two Dam Removal Alternative assumes conditions described in the 2012 KHSA EIS/EIR *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and*

Iron Gate Alternative[204] for J.C. Boyle Dam and Copco No. 2 Dam. The primary conditions under the Two Dam Removal Alternative are the following:

- *Fishway Prescriptions* – upstream and downstream fish passage at J.C. Boyle Dam and Copco No. 2 Dam consistent with the prescriptions from the DOI and U.S. Department of Commerce imposed during the FERC relicensing process (FERC 2007) and upheld in a trial-type administrative hearing, and any specific fishway facility design and construction details included in the KHSA 2012 EIS/EIR *Fish Passage at Four Dams Alternative*[204], including fishway (i.e., fish passage structures installation for both upstream and downstream migrations and barriers to prevent entrainment into turbines);
- *Changes to J.C. Boyle Operations* – At least 40 percent of J.C. Boyle Reservoir inflow to be released downstream through the J.C. Boyle Bypass to increase minimum flows in the Bypass Reach (RM 225.2 to RM 229.8). J.C. Boyle hydroelectric peaking operations and/or recreation flows would not occur under the Two Dam Removal Alternative since Copco No. 1 and Iron Gate dams would not be present to reregulate flows downstream[205]. Power generation would be suspended and all inflow to J.C. Boyle Reservoir would be released down the Bypass Reach under a seasonal high flow event that would occur for seven full days in later winter/spring when inflows to J.C. Boyle first exceed 3,300 cfs (DOI 2007, NMFS 2007, FERC 2007); and
- *Changes to Copco No. 2 Operations* – Increase in minimum flows for the Copco No. 2 Bypass Reach (RM 200.0 to RM 201.5), with a release of 70 cfs or inflow, whichever is less, to the Bypass Reach. Inflow would be computed as a 3-day running average of flows at the J.C. Boyle Powerhouse gage added to the flow from Shovel Creek, as measured by a new gage (FERC 2007).

The following conditions under the Two Dam Removal Alternative are a modification to the 2012 KHSA EIS/EIR *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*:

- Flows specified in the NMFS and USFWS 2013 BiOp for the USBR Klamath Irrigation Project, which are currently being considered under reinitiated consultation (see also 3.1.6.1 *Klamath River Flows under the Klamath Irrigation Project's 2013 BiOp*).

As described in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project*, 2017 court-ordered flushing and emergency dilution flows are required to be released from Iron Gate Dam as part of re-initiation of consultation on the 2013 BiOp Flows, but they are not modeled as part of existing conditions hydrology. Potential new BiOp flow requirements under this alternative are speculative at this time, and it is not clear whether flushing and emergency dilution flow requirements would continue under the new BiOp during or after dam removal. However, the 2017 flow

[204] The KHSA 2012 EIS/EIR's *Section 2.4.5 Fish Passage at Four Dams Alternative* and *Section 2.4.6 Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative* (Appendix U) include fishway facility design and construction details beyond what are specifically required in the FERC prescriptions and that are based on designs of similar fishway facilities used at other hydroelectric facilities.

[205] Although it would remain in place under this alternative, Copco No. 2 Reservoir does not have adequate capacity to reregulate flows associated with J.C. Boyle Dam peaking operations so that they would be suitable for fish downstream.

requirements are considered to be the most reasonable assumption for conditions until agency formal consultation is completed and a new BiOp is issued. For analysis of potential impacts related to fish disease, the Two Dam Removal Alternative considers conditions with and without 2017 court-ordered flushing and emergency dilution flows.

Additionally, Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project* addresses the potential effects of using fishways other than the volitional ladders described in the 2012 KHSA EIS/EIR *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, and points out where such other fishways would result in different effects than fish ladders. Such fishway installation could include volitional facilities, or trap and haul facilities, or a combination of approaches. Regardless of how fish passage is provided, this alternative assumes fish passage consistent with the general prescriptions (DOI 2007) that cover anadromous (fall- and spring-run Chinook salmon, coho salmon, steelhead, and Pacific lamprey) and resident (rainbow and redband trout, shortnose and Lost River suckers) fish passage, and includes implementing operation and maintenance plans and prescribing attraction flows for upstream migrants (DOI 2007).

This alternative does not make any assumptions regarding conditions that could be imposed by the states of Oregon or California through water quality certification authority.

The aforementioned flow-related measures would reduce power generation at J.C. Boyle Dam. Power generation at Copco No. 2 Dam would decrease relative to existing conditions since Copco No. 1 would not be present upstream to regulate flows entering the Copco No. 2 Powerhouse. This alternative assumes that installation of fish passage facilities would follow the schedule described in *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*[206], which would install downstream passage facilities prior to upstream passage facilities and would take place over a 4-month period (June through September of dam removal year 2) for both J.C. Boyle Dam and Copco No. 2 Dam. The level of construction for J.C. Boyle and Copco No. 2 fish passage would be consistent with that estimated for development of the 2012 KHSA EIS/EIR *Fish Passage at Four Dams Alternative,* which includes removal of the existing J.C. Boyle fish ladder structure, construction of a new fishway at or near the same location as the existing fish ladder (Figure 2.3-1), and construction of downstream fish passage for J.C. Boyle Dam, as well as construction of upstream and downstream fish passage for Copco No. 2 Dam.

As neither the Fall Creek nor the Iron Gate hatchery facilities were built to address potential fisheries effects of J.C. Boyle Dam or Copco No. 2 Dam (Boyle 1976), this alternative assumes that hatchery operations would continue for eight years, with reduced production goals consistent with those described for the Proposed Project (see Section 2.7.6 *Hatchery Operations*).

[206] Fishway feature design was provided in the 2012 KHSA EIS/EIR *Section 2.4.5 Fish Passage at Four Dams Alternative* and *Section 2.4.6 Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative* (Appendix U) and is used for this EIR to support the construction-related effects analysis. The KRRC would be required to obtain concurrence from USFWS and NMFS regarding fishway design and construction plans for each Lower Klamath Project facility prior to advancing to feasibility-level of design.

Although leaving the J.C. Boyle Dam facilities in place, removing the existing fish ladder and installing a new fish ladder, would be less construction than removing the dam and associated facilities, this difference would not decrease the degree of construction activities or the associated impacts to resources in California since J.C. Boyle is located in Oregon. In California, removal of the Iron Gate and Copco No. 1 facilities would be the same as described for the Proposed Project. California materials import for Copco No. 1 and Iron Gate would be the same as that described in Section 2.7.1 *Dam and Powerhouse Deconstruction* and California waste disposal quantities, truck trips, and haul distances would be the same as presented in Table 2.7-3 (Copco No. 1 Dam) and Table 2.7-7 (Iron Gate Dam). None of the deconstruction activities described in Section 2.7.1.3 *Copco No. 2 Dam and Powerhouse* would occur under this alternative, eliminating the need for offsite transport and disposal of the waste materials and quantities listed in Table 2.7-5 such that overall haul distances for waste disposal would be lower than those described for the Proposed Project. Additional import of construction materials in California would be required for fishway construction at Copco No. 2, which could include approximately 1,000 cubic yards of reinforced concrete (2012 KHSA EIS/EIR, Table 2-26) depending on the type of fish passage facilities that would be constructed. This amount of import would be considerably less than the bulk quantity of concrete that would be removed from Copco No. 2 Dam and Powerhouse under the Proposed Project (Table 2.7-5). Leaving Copco No. 2 Powerhouse and the wooden-stave penstock in place under this alternative would avoid the need for replacing Daggett Road Bridge (Appendix B: *Definite Plan – Section 5.4 Copco No. 2 Dam and Powerhouse*) and any associated materials import and waste disposal, and it would avoid the need to dispose of 700 tons of treated wood (Table 2.7-5). Recreation facilities near J.C. Boyle Reservoir would remain intact, and the Copco No. 2 Reservoir does not have any developed recreation facilities. Recreation facilities at Iron Gate and Copco No. 1 reservoirs would be removed, as described under the Proposed Project (Section 2.7.8.3 *Recreation Facilities Management*).

Overall, under the Two Dam Removal Alternative the level of construction activities in California in the Hydroelectric Reach due to dam deconstruction at Copco No. 1 and Iron Gate facilities, and construction of upstream and downstream fish passage at Copco No. 2 Dam would be slightly less than those described under the Proposed Project, since full removal of the two largest dam facilities (Copco No. 1 and Iron Gate) would still occur. Workforce projections under the Two Dam Removal Alternative are presented in Table 4.5-1. Since construction activities for fish passage would occur at J.C. Boyle Dam and Copco No. 2 Dam concurrent with activities for removal of the Copco No. 1 and Iron Gate dams and associated facilities (i.e., for a 4-month period June through September of dam removal year 2), any construction-related impacts would also occur concurrently and some of these (e.g., water quality) that occur in Oregon could also result in downstream impacts in California.

Table 4.5-1. Estimated Construction Workforce for the Two Dam Removal Alternative.

Dam	Estimated Average Construction Workforce[a]	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle*	10 to 15 people[a]	4 to 6 months[a]	15-20 people[a]	Jun−Sep dam removal year 2[b]
Copco No. 1	35 people[b]	12 months[b]	55 people[b]	Apr–Nov dam removal year 2[b]
Copco No. 2	10 to 15 people[a]	4 to 6 months[a]	15-20 people[a]	Apr−Sept dam removal year 2[b]
Iron Gate	40 people[b]	10 months[b]	80 people[b]	Jun−Sep dam removal year 2[b]

* J.C. Boyle Dam is included in this table as some of the traffic flow may use roads in California (e.g., I-5 to OR 66)

[a] 2012 KHSA EIS/EIR

[b] Appendix B: *Definite Plan – Section 5*

If instead of fish ladders, trap and haul or some combination of fish passage methods were used, there would be the potential for reduced construction compared to the aforementioned activities for fish ladders. While trap and haul facilities differ by site, common features include a trap holding pool, diffusers or gates to guide fish into the trap, a channel or port for discharge of attraction flows, a lift mechanism for truck-loading fish, a truck loading station, and a discharge platform. Much of the trap and haul facility would be located in-stream, with only the truck loading station and discharge platform potentially requiring upland grading or other earthwork.

As described for the Proposed Project (Section 2.7.2 *Reservoir Drawdown*), power generation at Copco No. 2 Dam could continue to occur during removal of the other Lower Klamath Project dams and associated facilities if Copco No. 2 power generating equipment proves capable of operating under sediment-laden flow conditions. However, high suspended sediment concentrations (SSCs) that would occur during drawdown of the upstream J.C. Boyle and Copco No. 1 reservoirs could damage the turbines in Copco No. 2 Powerhouse such that they would require repair to support future operations. This EIR assumes continued powerhouse operations at Copco No. 2 during dam removal year 2 as described for the Proposed Project (see Section 2.7.2 *Reservoir Drawdown*) as the need to halt power generation is speculative. Water diversions for hydropower generation at Copco No. 2 would continue to affect flows in the 1.5-mile-long Bypass Reach in the Klamath River between the Copco No. 2 Dam and the Copco No. 2 Powerhouse (Figure 2.3-3) under this alternative.

Under the Two Dam Removal Alternative, the long-term use of the land currently underlying Iron Gate and Copco No. 1 reservoirs is more uncertain than under the Proposed Project, because the KHSA (including Section 7.6.4 that addresses land disposition) would not apply. It is possible that the hydroelectric license holder would reach an agreement to transfer the lands in and surrounding the Copco No. 1 and Iron Gate reservoirs for public interest purposes, in a manner similar to under the KHSA. If this were to happen, the potential impacts would be as analyzed under the Proposed Project, except that the land associated with Copco No. 2 facilities would not be made available.

It is also possible that the dams would remain undeveloped and under the Licensed hydroelectric facility operator, in light of continued operations in the area, or that they would be used for additional revenue generation, such as for lease or additional residential, commercial, or industrial development. It is also possible that a combination of these two scenarios would occur.

Because long-term land use under this alternative is currently unknown, this alternative does not assess the potential impacts of long-term use of the lands currently submerged under Iron Gate and Copco No. 1 reservoirs as that would require speculation.

4.5.1.2 Alternative Analysis Approach

The potential impacts of the Two Dam Removal Alternative are analyzed in comparison to existing conditions, with reference to impact analyses conducted for the No Project Alternative or Proposed Project, where appropriate. Unless otherwise indicated, the significance criteria, area of analysis, environmental setting, and impact analysis approach, including consideration of existing local policies, for all environmental resource areas under the Two Dam Removal Alternative are the same as those described for the Proposed Project (see Section 3.1 *Introduction* and individual resource area subsections in Section 3 *Environmental Setting, Potential Impacts, and Mitigation Measures*). The potential impacts for each environmental resource area are analyzed both in the short term and the long term, and unless otherwise indicated, use the same definitions of short term and long term as described for each resource area analyzed for the Proposed Project.

4.5.2 Water Quality

Water quality modeling specifically for the Two Dam Removal Alternative is limited compared to the available modeling for the Proposed Project or the No Project Alternative, but the influence of J.C. Boyle and Copco No. 2 dams and the effects of J.C. Boyle and Copco No. 2 dams remaining in place can be assessed through a combination of modeling scenarios equivalent to the Two Dam Removal Alternative or interpretation of the modeling done for the Proposed Project or other alternatives. Water quality models and modeling scenarios for evaluating the impacts of the Two Dam Removal Alternative are summarized in Appendix D. An analysis of model results from different reaches within the Klamath River highlights how J.C. Boyle and Copco No. 2 dams remaining in place would impact water quality. The influence of J.C. Boyle Dam on water quality can be assessed by the Klamath River Water Quality Model (KRWQM) and the River Basin Model 10 (RBM10), which both include modeling scenarios that have J.C. Boyle Dam remaining in place and Copco No. 1, Copco No. 2, and Iron Gate dams removed. The Klamath TMDL model includes a "TMDL dams-in" scenario (T4BSRN), which approximates the condition where the Lower Klamath Project dams remain in place, as well as the TOD2RN (Oregon reaches) and TCD2RN (California reaches) scenarios (together the "TMDL dams-out" scenario) that assume the removal of the Lower Klamath Project (see Appendix D for more detail). The Klamath TMDL model assumes full TMDL implementation for both "TMDL dams-in" and "TMDL dams-out" scenarios. While the mechanisms for implementation and the timing required to achieve future TMDL compliance are currently speculative, the Klamath TMDL model results are still informative with respect to the analysis of potential water quality impacts under this alternative for reasons described for the Proposed Project (see Section 3.2.4 *[Water Quality] Impact Analysis Approach*). Comparison of "TMDL dams-in" and "TMDL dams-

out" model results and comparisons of Proposed Project model results at different points in the Hydroelectric Reach (SRH-1D) also documents the influence of J.C. Boyle Dam. Models and modeling scenarios generally did not represent Copco No. 2 Dam due to its small size and short distance downstream of Copco No. 1 Dam. The influence of Copco No. 2 Dam and how its presence or absence would impact water quality in the Klamath River is determined by assessing the size, average water velocity, and hydraulic residence time of Copco No. 2 Reservoir compared to process(es) influencing the water quality parameters (e.g., settling velocity for suspended sediments). Overall, the available water quality modeling results provide sufficient information that the water quality impacts under the Two Dam Removal Alternative can be quantitatively or qualitatively assessed below.

4.5.2.1 Water Temperature

In general, the Two Dam Removal Alternative would have the same or similar potential impacts on water temperature in California as those identified under the Proposed Project. The presence of the J.C. Boyle Reservoir on the Klamath River does not alter water temperatures in downstream reaches because it has a shallow depth (8.3 feet average depth) and short hydraulic residence time (1.1 days) that does not support thermal stratification (FERC 2007). However, J.C. Boyle Dam operations do influence Klamath River water temperatures by releasing water for peaking power generation and whitewater recreation. These releases cause water temperature variations in the J.C. Boyle Bypass and Peaking reaches, from the Oregon-California state line to Copco No. 1 Reservoir, due to diversion of warmer reservoir discharges around the J.C. Boyle Bypass Reach, cold groundwater spring flows into the J.C. Boyle Bypass Reach, and the mixing of these flows when they rejoin in the J.C. Boyle Peaking Reach of the Klamath River. The combination of these flows produce an observed increase in daily water temperature range above the natural diel water temperature fluctuations in the J.C. Boyle Peaking Reach at the Oregon-California state line.

The Two Dam Removal Alternative would not include peaking power generation or whitewater recreation flows from J.C. Boyle Dam as the downstream dams would not be available to regulate the peaking flows. Elimination of the peaking and recreation flows from J.C. Boyle Dam would likely result in J.C. Boyle Reservoir operating in a run of the river manner and increases in the water temperature range associated with J.C. Boyle operations would no longer occur under both the Two Dam Removal Alternative and the Proposed Project (see also Section 3.2.2.2 *Water Temperature*).

Model results analyzed for the Proposed Project do not explicitly isolate the effects of the four individual Lower Klamath Project reservoirs on water temperature, but the KRWQM includes a scenario in which only Iron Gate and Copco No. 1[207] dams are removed with J.C. Boyle Dam and Copco No. 2 remaining in place ("WIGC" PacifiCorp 2004a; Dunsmoor and Huntington 2006; see also Appendix D). While the KRWQM WIGC scenario does not document the water temperature effect of Copco No. 2 Dam remaining in place, it does show the effect of J.C. Boyle Dam remaining in place. The KRWQM WIGC scenario results indicate that compared with removal of all four Lower Klamath Project reservoirs ("WIGCJCB"), the long-term effects of keeping J.C. Boyle

[207] Copco No. 2 dam was not explicitly included in the model due to its negligible size and hydraulic residence time.

Dam and Copco No. 2 in place under the Two Dam Removal Alternative would be similar to effects on water temperature under the Proposed Project (Figure 4.5-1).

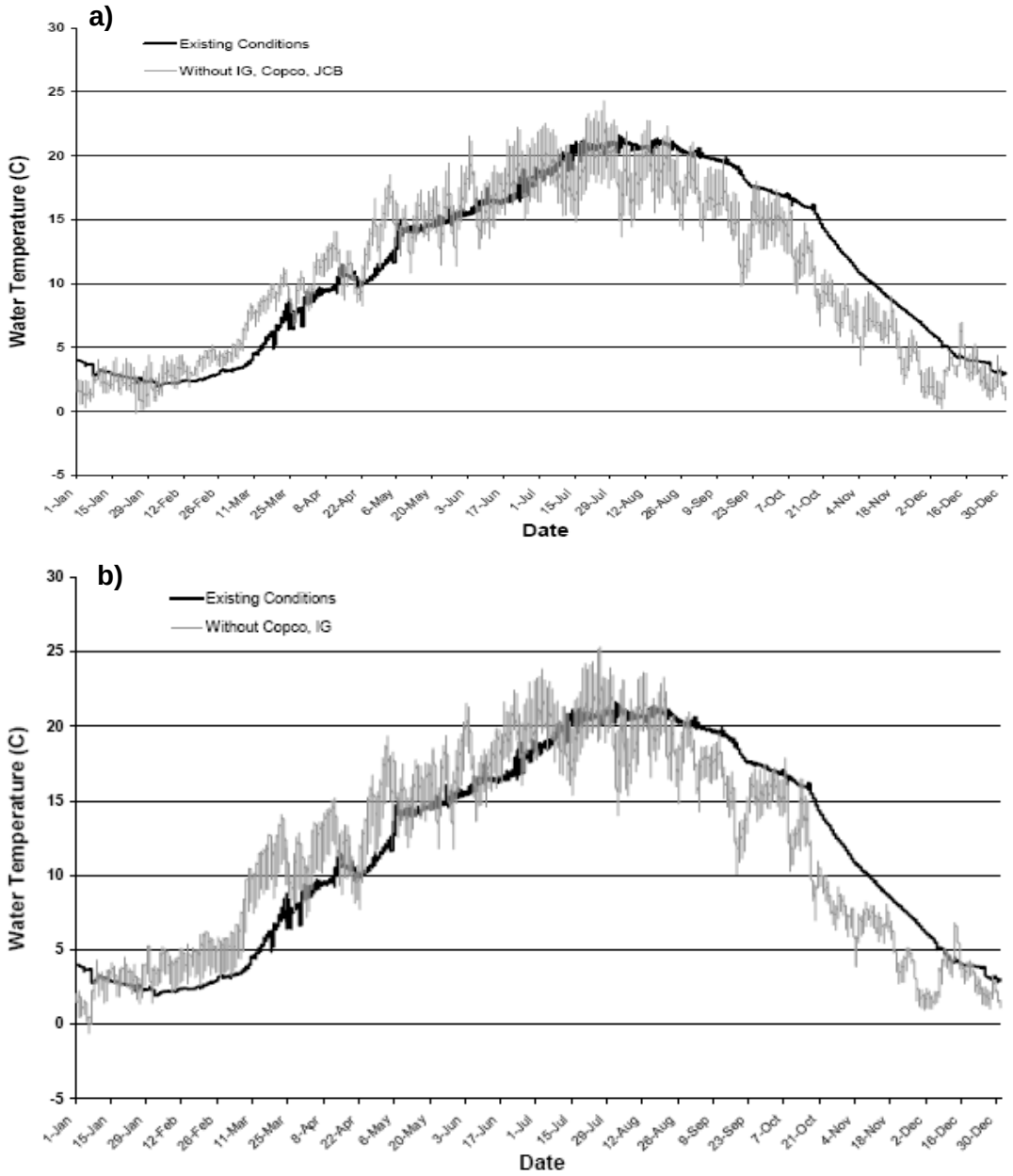

Figure 4.5-1. Simulated Hourly Water Temperature Downstream from Iron Gate Dam Based on Year 2004 for Current Conditions Compared to Hypothetical Conditions: (a) without Iron Gate (IG), Copco No. 1 and 2, and J.C. Boyle (JCB) Dams and (b) without Iron Gate (IG) and Copco No. 1 and 2 Dams. Source: PacifiCorp 2005.

Copco No. 2 Reservoir has a small volume (approximately 70 acre-feet), a short hydraulic residence time (less than a day), no active storage, and it does not thermally

stratify, such that the reservoir has a negligible impact on water temperature, unlike the larger Copco No. 1 and Iron Gate reservoirs (see 3.2.2.1 *Overview of Water Quality Processes in the Klamath Basin*; FERC 2007; USBR 2012). Copco No. 2 Reservoir and Dam typically are not represented in modeling of the Klamath River as it is considered to have a negligible influence on water quality, including water temperature, in the Klamath River due to its small size, short hydraulic residence time, and lack of active storage. There is no data indicating Copco No. 2 Reservoir alters water temperatures in downstream reaches. As such, keeping Copco No. 2 Dam and Reservoir in place under the Two Dam Removal Alternative would not be anticipated to alter water temperature.

Relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on water temperature would be the same as or similar to those described for the Proposed Project, except as follows:

- J.C. Boyle Reservoir would not alter water temperature in the J.C. Boyle Peaking Reach from the Oregon-California state line to Copco No. 1 Reservoir and J.C. Boyle Dam operations for peaking and recreation releases that cause increases in the water temperature range would be eliminated under both the Two Dam Removal Alternative and the Proposed Project. Short-term and long-term alterations in water temperatures in the J.C. Boyle Peaking Reach from the Oregon-California state line to Copco No. 1 Reservoir under the Two Dam Removal Alternative would result in water temperature effects similar to those of the Proposed Project (i.e., slightly lower maximum water temperatures and less artificial diel temperature variation during summer and early fall, see also Potential Impact 3.2-1) and would be beneficial.
- Short-term and long-term alterations in water temperatures due to conversion of the Copco No. 1 and Iron Gate reservoir areas to a free-flowing river (Potential Impact 3.2-1) and keeping Copco No. 2 Reservoir in place would be the same as under the Proposed Project as retaining Copco No. 2 Reservoir would not alter water temperature in the Klamath River, and the alterations would be beneficial for the Hydroelectric Reach and the Middle Klamath River to the confluence with the Salmon River. As under the Proposed Project, there would be no significant impact for the Middle Klamath River downstream from the Salmon River, the Lower Klamath River, or the Klamath River Estuary.
- Sediment trapped by J.C. Boyle Dam would not be released under the Two Dam Removal Alternative, but the magnitude of the sediment releases from Copco No. 1 and Iron Gate reservoirs would still be over 90 percent of the sediment releases under the Proposed Project (Table 2.7-11). Copco No. 2 Reservoir would not retain the sediment released from Copco No. 1 due to its short residence time and the sediment characteristics (see Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown* and Section 4.5.2.2 *Suspended Sediments*). Thus, the overall short-term and long-term alterations in seasonal water temperatures in the Klamath River due to potential morphological changes induced by sediment release from Copco No. 1 and Iron Gate reservoirs and subsequent deposition would be similar under the Two Dam Removal Alternative and the Proposed Project (Potential Impact 3.2-2), and there would be no significant impact.

4.5.2.2 Suspended Sediments

As the Two Dam Removal Alternative does not include the removal of J.C. Boyle and Copco No. 2 dams, short-term mobilization of J.C. Boyle reservoir sediment deposits

would not occur under this alternative and the associated 1,190,000 cubic yards of deposits estimated to occur in the reservoir in 2020[208] (i.e., eight percent of total volume for the Lower Klamath Project reservoirs, see also Tables 2.7-10 and 2.7-11) would not be eroded or delivered to downstream reaches and the Pacific Ocean. The approximately 27 to 51 percent of the sediment trapped behind the J.C. Boyle Dam predicted to move downstream through the California reaches of the Klamath River and out into the Pacific Ocean under the Proposed Project (USBR 2012) would not be transported under the Two Dam Removal Alternative. Copco No. 2 Dam also does not retain appreciable amounts of sediment (USBR 2011b) since Copco No. 1 Dam is 0.25 miles upstream and intercepts and retains all upstream sediment. As such, the variation in the amount of sediment transported under the Two Dam Removal Alternative compared to under the Proposed Project would be due to only the decrease from J.C. Boyle reservoir sediment deposited being retained.

Copco No. 1 and Iron Gate reservoirs contain approximately 92 percent of the total estimated 2020 reservoir deposits (50 and 42 percent, respectively) and approximately 92 to 94 percent of the amount of sediment anticipated to erode from these reservoirs under the Proposed Project (Table 2.7-11) would occur under the Two Dam Removal Alternative. Increases in suspended sediment concentrations (SSCs) in the Hydroelectric Reach upstream of Copco No. 1 Reservoir from removal of J.C. Boyle Reservoir would be eliminated under this alternative as reservoir sediment would not be released from J.C. Boyle Reservoir. While there would be some reduction in SSCs downstream of Copco No. 1 due to no SSCs being released by J.C. Boyle Dam removal, Copco No. 2 Dam is unlikely to accumulate large sediment deposits during drawdown of the upstream Copco No. 1 Reservoir (see also Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown*), such that leaving it in place would not result in a difference in short-term mobilization of reservoir sediment deposits or SSCs under the Two Dam Removal Alternative compared to the Proposed Project.

Modeling of SSCs downstream of Copco No. 1 Reservoir from release of only Copco No. 1 Reservoir sediment deposits across the wet, average, and dry water year types indicate SSCs, within the general uncertainty of the model, would peak at approximately 7,000 to 8,000 mg/L between Copco No. 1 Dam and Iron Gate Reservoir within one to two months of reservoir drawdown, then SSCs would decrease to generally less than 1,000 mg/L within approximately one more month (Figure 3.2-15; see Section 3.2.5.2 *Suspended Sediments*). Thus, SSCs in the Hydroelectric Reach between Copco No. 1 and Iron Gate reservoirs would still exceed the significance criteria for suspended sediment (SSCs greater than 100 mg/L over a continuous two-week exposure period) under the Two Dam Removal Alternative due to the overall magnitude of reservoir deposits still anticipated to erode from Copco No. 1 and Iron Gate reservoirs. Downstream of the Hydroelectric Reach, SSCs would also exceed the significance criteria for suspended sediment under the Two Dam Removal Alternative since over 90 percent of the reservoir deposited sediments anticipated to be transported under the

[208] Between 2020 and 2021 (i.e., dam removal year 2 when drawdown would primarily occur), the sediment volume present behind the dams would increase by approximately 81,300 cubic yards in Copco No. 1 Reservoir and approximately 100,000 cubic yards in Iron Gate Reservoir based on estimates of annual sedimentation rates for each reservoir (USBR 2012). The increase in sediment volume between 2020 and 2021 would be an order of magnitude less than the uncertainty of the 2020 total sediment volume estimates, so model results using the 2020 sediment volumes would still be applicable.

Proposed Project would still occur. Thus, the overall short-term impact of decreases in SSCs in the Hydroelectric Reach from J.C. Boyle Dam to the upstream end of Copco No. 1 Reservoir due to J.C. Boyle Dam remaining in place, no change in SSCs from Copco No. 2 Dam remaining in place, and increases in SSCs due release of sediments currently trapped behind Copco No. 1 and Iron Gate dams under the Two Dam Removal Alternative would be similar to impacts under the Proposed Project in the Hydroelectric Reach downstream of Copco No. 1 Dam, the Middle and Lower Klamath River, the Klamath River Estuary, or the nearshore marine environment. (see Section 3.2.5.2 *Suspended Sediments* for additional details).

Sediments and suspended materials (inorganic and organic) would continue to be intercepted and retained behind J.C. Boyle Dam in the long term under the Two Dam Removal Alternative since that dam would remain in place. While the amount of sediment supplied to the Klamath River on an annual basis from the watershed upstream of J.C. Boyle Dam is a relatively small fraction of the total sediment (Stillwater Sciences 2010) (see also Section 3.11.2.4 *Sediment Load*), the long-term increase in mineral (inorganic) suspended material downstream of J.C. Boyle Dam under this alternative would be less than under the Proposed Project since J.C. Boyle Dam would continue to intercept upstream sediment. The majority of algal-derived (organic) suspended material from upstream sources (Upper Klamath Lake, Klamath Straights Drain, Lost River) is intercepted and retained by the Keno Impoundment/Lake Ewauna, but J.C. Boyle Dam does retain some algal-derived (organic) suspended material (see Appendix C, Section C.2.1 *Upper Klamath Basin* for more detail). Thus, the long-term increases in algal-derived (organic) suspended material downstream of J.C. Boyle Dam under this alternative would be less than under the Proposed Project since the dam would continue to intercept and retain upstream algal-derived suspended material.

Long-term interception and retention of sediments and suspended materials (inorganic and organic) would be minimal behind Copco No. 2 Dam[209] due to its small size and short residence time. Fine sediment and suspended material would be unlikely to accumulate behind Copco No. 2 Dam because the range of flow and water velocities along with the short residence time in Copco No. 2 Reservoir would inhibit appreciable amounts of fine sediment and suspended material from settling within the reservoir. However, some larger sediment (i.e., sand) that can settle out faster may accumulate over time behind Copco No. 2 Dam, but the overall interception and retention would be limited since J.C. Boyle Dam upstream would intercept and retain larger sediment from upstream of that dam. The sediment load in the Hydroelectric Reach from J.C. Boyle Dam to Copco No. 2 Dam is relatively small compared to upstream of J.C. Boyle Dam, and higher winter flows in Copco No. 2 Reservoir under the Two Dam Removal Alternative would be likely to mobilize desposited sand sediments. Thus, the long-term inteception and retention in sediments and suspended materials (inorganic and organic) behind Copco No. 2 Dam under this alternative would be minimal and the overall long-term inteception and retention in sediments and suspended materials would be similar to conditions under the Proposed Project.

Long-term interception and retention of sediments and suspended materials (inorganic and organic) would not occur behind Copco No. 1 and Iron Gate dams since they would be removed under the Two Dam Removal Alternative. Long-term increases in mineral

[209] Copco No. 2 Dam does not intercept or retain appreciable amounts of sediment (USBR 2011b).

(inorganic) and algal-derived (organic) suspended material under this alternative would be less than under the Proposed Project because J.C. Boyle Dam would continue to retain sediments and suspended materials from upstream of that dam. However, the overall long-term impact from changes in the interception of sediments due to retention of J.C. Boyle and Copco No. 2 dams and removal of Copco No. 1 and Iron Gate dams would be similar under both the Two Dam Removal Alternative and the Proposed Project. The long-term increases in mineral (inorganic) and algal-derived (organic) suspended material due to the lack of interception by the dams would be a less than significant impact under the Proposed Project as only a small amount of sediment and suspended material is delivered from upstream of J.C. Boyle Dam. Thus, a decrease in the amount of sediment transported downstream under the Two Dam Alternative due to the retention of J.C. Boyle and Copco No. 2 dams and removal of Copco No. 1 and Iron Gate dams would still be a less than significant impact.

Relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on suspended sediments would be the same as or similar to those described for the Proposed Project, except as follows:

- As discussed in the first two paragraphs of this section, there would be no change in SSCs from the existing conditions in the Hydroelectric Reach between the Oregon-California state line and the upstream end of Copco No. 1 Reservoir since sediment deposits in J.C. Boyle Dam would remain in place. While Copco No. 2 remaining in place would not retain appreciable amount of sediments or alter SSCs during drawdown, the increases in suspended sediment in the Hydroelectric Reach due to release of sediments currently trapped behind Copco No. 1 and Iron Gate Dams would remain a short-term significant and unavoidable impact for the Hydroelectric Reach, the Middle and Lower Klamath River, and the Klamath River Estuary (Potential Impact 3.2-3). The magnitude of suspended sediments increases in the Pacific Ocean nearshore environment due to release of sediments currently trapped behind Copco No. 1 and Iron Gate dams would be within the range of historical conditions, but the duration (i.e., weeks) of elevated suspended sediments would be greater than historical conditions, thus there would be a short-term significant and unavoidable impact on suspended sediments in the Pacific Ocean nearshore environment (Potential Impact 3.2-3). Suspended sediments would resume modeled background levels by the end of Post-Dam removal year 1, so there would be no significant impact in the long term for the Hydroelectric Reach, the Middle and Lower Klamath River, the Klamath River Estuary, and the Pacific Ocean nearshore environment (Potential Impact 3.2-3). The short-term significant impact of increased SSCs in the Hydroelectric Reach downstream of Copco No. 1 Dam, the Middle and Lower Klamath River, the Klamath River Estuary, and the Pacific Ocean nearshore environment due to removal of Copco No. 1 and Iron Gate dams cannot be avoided or substantially decreased through reasonably feasible mitigation.
- While there would not be potential construction-related short-term increases in suspended material from removal of J.C. Boyle Dam under the Two Dam Removal Alternative, there would be construction of new fish passage facilities at J.C. Boyle Dam that would potentially result short-term increases in suspended material downstream in California. Although short-term dam deconstruction activities would not occur at Copco No. 2 Dam under the Two Dam Removal Alternative, construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would occur. As such, the level of overall

construction activities in the Hydroelectric Reach in California would be slightly less than under the Proposed Project. Potential construction-related short-term increases in suspended material from pre-construction, dam removal, and restoration activities at Copco No. 1 and Iron Gate dams would be the same under this alternative as under the Proposed Project since these activities would occur in both scenarios. Under the Two Dam Removal Alternative, short-term increases in suspended material from stormwater runoff due construction activities associated with new fish passage facilities at J.C. Boyle and Copco No. 2 dams, a new day use area near Copco No. 2 Dam, and pre-construction, dam removal, and restoration activities at Copco No. 1 and Iron Gate dams would be potentially significant short-term impacts without mitigation in the Hydroelectric Reach between Copco No. 1 Reservoir and Iron Gate Dam and in the Middle Klamath River immediately downstream of Iron Gate Dam (Potential Impact 3.2-4). Implementation of mitigation measures WQ-1, TER-1, and HZ-1 would reduce this potential impact under the Two Dam Removal Alternative to no significant impact with mitigation, similar to the Proposed Project.

- As discussed earlier in this section, there would be no long-term change from existing conditions regarding the interception and retention of mineral (inorganic) (Potential Impact 3.2-5) or algal-derived (organic) (Potential Impact 3.2-6) suspended material by J.C. Boyle Dam in the Hydroelectric Reach between Oregon-California state line and the upstream end of Copco No. 1 Reservoir under the Two Dam Removal Alternative because J.C. Boyle Dam would remain in place and continue to intercept and retain mineral and algal-derived suspended material to the same extent that it currently does. Similar to under the Proposed Project, there would be potential long-term increases in suspended material in the Hydroelectric Reach downstream of Copco No. 1 Reservoir because Copco No. 1, and Iron Gate dams would be removed under this alternative and they would no longer intercept and retain suspended material. Copco No. 2 Dam remaining in place under this alternative would not alter the long-term change in sediments and suspended materials (inorganic and organic) compared to the Proposed Project because the small size and short residence time of Copco No. 2 Reservoir would limit the trapping of sediment and suspended material (inorganic and organic). Overall, keeping J.C. Boyle and Copco No. 2 dams in place and removing of Copco No. 1 and Iron Gate dams would result in a long-term increase in suspended material under the Two Dam Removal Alternative similar to the Proposed Project due to the lack of continued interception and retention of mineral (inorganic) and algal-derived (organic) downstream of Copco No. 1 Dam and there would be no significant impact for the Hydroelectric Reach between Copco No. 1 Reservoir and Iron Gate Dam, the Middle Klamath River, Lower Klamath River, Klamath River Estuary, and the Pacific Ocean nearshore environment (Potential Impacts 3.2-5 and 3.2-6).

4.5.2.3 Nutrients

Short-term or long-term increases in sediment-associated nutrients due to release of J.C. Boyle reservoir sediment deposits would not occur in the Hydroelectric Reach from the Oregon-California state line to the upstream end of Copco No. 1 Reservoir under the Two Dam Removal Alternative because none of the associated 1,190,000 cubic yards of

deposits estimated to occur in the reservoir in 2020[210] (i.e., eight percent of total volume for the Lower Klamath Project reservoirs, see also Tables 2.7-7 and 2.7-8) would be eroded or delivered to downstream reaches. As detailed in Section 4.5.2.2 *Suspended Sediments*, approximately 27 to 51 percent of the sediment trapped behind the J.C. Boyle Dam is predicted to be transported under the Proposed Project (USBR 2012), but this would not occur under the Two Dam Removal Alternative. Thus, nutrients associated with these sediments also would not be transported downstream and there would be no increase in sediment-associated nutrients from existing conditions in the Hydroelectric Reach between the Oregon-California state line and the upstream end of Copco No. 1 Reservoir.

Approximately 92 to 94 percent of the sediment anticipated to erode from Copco No. 1 and Iron Gate reservoirs under the Proposed Project (Table 2.7-11) would occur under the Two Dam Removal Alternative and mobilization of nutrients associated with these reservoir sediment deposits would occur. The majority of sediment-associated nutrients would be transported under both this alternative and the Proposed Project, but sediment-associated nutrients downstream of Copco No. 1 Dam would be slightly less under the Two Dam Removal Alternative than under the Proposed Project because nutrients associated with J.C. Boyle reservoir sediments would not contribute to nutrient concentrations. Copco No. 2 Dam does not retain appreciable amounts of sediment (USBR 2011b) under existing conditions and it is not expected to trap appreciable amounts of sediment during drawdown, so keeping Copco No. 2 in place under the Two Dam Removal Alternative would not alter the amount of sediment-associated nutrients transported downstream compared to under the Proposed Project. Thus, the overall pattern and duration of short-term and long-term increases in sediment-associated nutrients due to release of sediments from behind the Copco No. 1 and Iron Gate dams under the Two Dam Removal Alternative would be similar to the Proposed Project in the Hydroelectric Reach, the Middle and Lower Klamath River, the Klamath River Estuary, or the nearshore marine environment, but the magnitude of nutrient concentrations would be slightly less. See Section 3.2.5.3 *Nutrients* for further details.

Since J.C. Boyle Dam would remain in place, continuing interception and retention of sediment-associated nutrients and suspended materials would still occur behind J.C. Boyle Dam in the long term. However, Klamath TMDL modeling[211] and empirical data indicate that J.C. Boyle Dam does not retain high amounts of nutrients such that long-term effects of dam removal on nutrient levels in the Hydroelectric Reach under the Proposed Project would be primarily due to the removal of Copco No. 1 and Iron Gate dams (see generally Section 3.2.2.4 *Nutrients* and Section 3.2.5.3 *Nutrients* for information on the existing conditions for nutrients in the reservoirs). Under existing conditions, Klamath TMDL modeling[211] indicates interception results in Copco No. 1

[210] Between 2020 and 2021 (i.e., dam removal year 2 when drawdown would primarily occur), the sediment volume present behind the dams would increase by approximately 81,300 cubic yards in Copco No. 1 Reservoir and approximately 100,000 cubic yards in Iron Gate Reservoir based on estimates of annual sedimentation rates for each reservoir (USBR 2012). The increase in sediment volume between 2020 and 2021 would be an order of magnitude less than the uncertainty of the 2020 total sediment volume estimates, so model results using the 2020 sediment volumes would still be applicable.

[211] While the mechanisms for implementation and the timing required to achieve future TMDL compliance are currently speculative, the Klamath TMDL model results are still informative with respect to the analysis of potential water quality impacts under this alternative for reasons described for the Proposed Project (see Section 3.2.4 *[Water Quality] Impact Analysis Approach*).

retaining approximately 10.0 percent of the annual total nitrogen and approximately 5.1 percent of the annual total phosphorus; and Iron Gate retaining approximately 6.7 percent of the annual total nitrogen and approximately 3.3 percent of the annual total phosphorus (North Coast Regional Board 2010). The relative amounts of nutrient retention in each of the reservoirs without full TMDL implementation may be somewhat higher than the aforementioned estimates because the model mechanism increases the rate of retention as incoming nutrient concentrations increase; however, the model mechanism also indicates that the longer the retention time of water in the reservoir, the higher the nutrient retention. Copco No. 1 and Iron Gate reservoirs have average retention times of 11 days and 15 days, respectively, while J.C. Boyle Reservoir has a lower retention time of only approximately 1 day (Table 3.6-4) and thus allows most sediment-associated nutrients to pass through J.C. Boyle Reservoir and move downstream. Under the Two Dam Removal Alternative, long-term interception and retention of sediments and sediment-associated nutrients behind Copco No. 1 and Iron Gate dams would cease, similar to the Proposed Project, as the facilities would be removed. While Copco No. 2 Dam may retain some larger sediment (i.e., sand or larger), nutrients are not associated with such larger sediments and Copco No. 2 Dam is not anticipated to retain appreciable amount of fine sediment that have sediment-associated nutrients after removal of Copco No. 1 and Iron Gate dams. Thus, Copco No. 2 Dam staying in place under the Two Dam Removal Alternative would not alter long-term transport of sediment-associated nutrients compared to the Proposed Project.

Relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on nutrients would be the same as or similar to those described for the Proposed Project, except as follows:

- There would be no short-term or long-term change to the existing condition with regard to sediment-associated nutrients in the Hydroelectric Reach between Oregon-California state line and the upstream end of Copco No. 1 Reservoir, since sediment deposits in J.C. Boyle Dam would remain in place and no sediment-associated nutrients would be transported due to the release of sediments trapped behind J.C. Boyle Dam. Copco No. 2 Dam does not retain appreciable amounts of sediments or sediment-associated nutrients under existing conditions, so keeping Copco No. 2 in place under the Two Dam Removal Alternative would not alter the amount of sediment-associated nutrients transported downstream compared to under the Proposed Project. However, there would be short-term increases in sediment-associated nutrients due to release of sediments currently trapped behind Copco No. 1 and Iron Gate dams as in the Proposed Project (Potential Impact 3.2-7). Potential short-term increases in suspended material from construction of a new fish ladder at J.C. Boyle would be not result in short-term increases in sediment-associated nutrients since potential construction sediments would only have the nutrient content of the soils surrounding J.C. Boyle with substantially less nutrients than reservoir sediment deposits. As described in Section 3.2.5.3 *Nutrients*, this would result in no significant impact in the Hydroelectric Reach between Copco No. 1 Reservoir and Iron Gate Dam, the Middle Klamath River, the Lower Klamath River, the Klamath River Estuary, and the Pacific Ocean nearshore environment.
- Under the Two Dam Removal Alternative, there would be no long-term change from existing nutrient levels due to interception of nutrients by J.C. Boyle Dam in the Hydroelectric Reach between Oregon-California state line and the upstream end of Copco No. 1 Reservoir since J.C. Boyle Dam would remain in place.

Copco No. 1 and Iron Gate dams would be removed and replaced by a free-flowing river under this alternative like in the Proposed Project, so these dams would no longer intercept and retain incoming nutrients. Copco No. 2 Dam would not retain appreciable amounts of sediments with sediment-associated nutrients, so keeping Copco No. 2 Dam in place would not alter the long-term nutrients levels compared to the Proposed Project. Long-term increases in nutrient levels from the lack of continued interception by the Copco No. 1 and Iron Gate dams and conversion of the reservoir areas to a free-flowing river (Potential Impact 3.2-8) would result in no significant impact under the Two Dam Removal Alternative for the Hydroelectric Reach, Middle and Lower Klamath River, Klamath River Estuary, and the Pacific Ocean nearshore environment, similar to the Proposed Project.

4.5.2.4 Dissolved Oxygen

J.C. Boyle reservoir sediment deposits (approximately 1,190,000 cubic yards in 2020 or approximately eight percent of total sediment volume trapped behind the Lower Klamath Project dams, see also Tables 2.7-7 and 2.7-8) would be not mobilized in the Hydroelectric Reach from the Oregon-California state line to the upstream end of Copco No. 1 Reservoir under the Two Dam Removal Alternative since J.C. Boyle Dam would remain in place (see Section 4.5.2.2 *Suspended Sediments*). Thus, the short-term mobilization associated effects of these sediments on sediment-associated oxygen demand and dissolved oxygen (i.e., high content of organic carbon present in the reservoir sediments allows for the possibility of microbial oxidation of organic matter exposed to the water column from deep within the sediment profile and mobilized during dam removal), would also not occur in the Hydroelectric Reach from the Oregon-California state line to the upstream end of Copco No. 1 Reservoir under the Two Dam Removal Alternative. However, approximately 92 to 94 percent the reservoir sediment deposits anticipated to erode under the Proposed Project would still occur in this alternative due to transport of reservoir sediments from Copco No. 1 and Iron Gate reservoirs (see Section 4.5.2.2 *Suspended Sediments*). Copco No. 2 Dam remaining in place under the Two Dam Removal Alternative would not alter the amount of sediment-associated oxygen demand compared to under the Proposed Project as the dam does not retain appreciable amounts of sediment under existing conditions (USBR 2011b) and it is not expected to trap appreciable amounts of sediment during drawdown. While there would be some reduction in SSCs downstream of Copco No. 1 due to no sediment being released by J.C. Boyle Dam removal, the overall short-term effects of sediment release and SSCs on sediment-associated oxygen demand and dissolved oxygen concentrations in the Hydroelectric Reach from downstream of Copco No. 1 Dam to Iron Gate Dam under the Two Dam Removal Alternative would still be similar to effects for the Hydroelectric Reach under the Proposed Project and impact significance associated with SSCs and SSC associated oxygen demand and dissolved oxygen concentration would be as described for the Proposed Project (see Potential Impact 3.2-9 for additional details for additional details).

Less sediment would be mobilized into the Middle Klamath River under the Two Dam Removal Alternative; therefore, the extent of downstream increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in this reach under the Two Dam Removal Alternative would be somewhat less than the following those of the Proposed Project. Since the range of SSCs under the Proposed Project would be greater than those expected under this alternative (see Section 4.5.2.2 *Suspended Sediments*), the range of dissolved

oxygen conditions modeled for the Proposed Project would generally bracket those anticipated under the Two Dam Removal Alternative. Minimum dissolved oxygen values likely would occur slightly upstream compared the Proposed Project, but they would still generally occur near RM 191 to 193.1 (approximately 0 to 2 miles downstream from Iron Gate Dam) since the location of minimum dissolved oxygen concentrations does not change much with variations in SSCs (see Table 3.2-13). Similarly, the farthest distance downstream with dissolved oxygen less than 5 mg/L likely would shift slightly upstream, but the distance would be similar to the Proposed Project (i.e., approximately RM 145 to RM 122 or within 48 to 71 miles downstream of Iron Gate Dam) since it does not change much with variations in SSCs. Minimum dissolved oxygen values would likely show a greater relative increase under the Two Dam Removal Alternative compared the Proposed Project, since the amount of IOD and BOD downstream of Iron Gate Dam is strongly influenced by variations in SSCs and there would be less sediment transported under this alternative.

Despite the potential for a slightly shorter distance of short-term impacts due to decreases in the sediment-associated oxygen demand and a reduction in the magnitude of the decrease in dissolved oxygen in the Middle Klamath River under the Two Dam Removal Alternative, the release of sediments trapped behind Copco No. 1 and Iron Gate Dam would decrease dissolved oxygen concentrations in the Klamath River below the Basin Plan water quality objective for dissolved oxygen (90 percent saturation) in the short term and constitute a significant impact. Additionally, since the location where the minimum and at least 5 mg/L dissolved oxygen concentrations occurred during modeling under the Proposed Project did not change much with variations in SSC, it is conservatively estimated that the distance the significant impact from the short-term increase in sediment-associated oxygen demand and reductions in dissolved oxygen under the Two Dam Removal Alternative occurs would be similar to that modeled under the Proposed Project (Potential Impact 3.2-9), so the short-term impact would remain significant in the Middle Klamath River from Iron Gate Dam to approximately the confluence with the Salmon River (RM 66).

Similarly, it is conservatively estimated that the distance where there would be no significant impact on dissolved oxygen from releases of reservoir deposited sediments under the Two Dam Removal Alternative would be similar to that modeled under the Proposed Project. Modeling under the Proposed Project indicates that downstream of the confluence with the Salmon River on the Middle Klamath River, as well as in the Lower Klamath River and the Klamath River Estuary, there would be no significant impact from the release of sediments trapped behind the Lower Klamath Project dams (see Section 3.2.5.4 *Dissolved Oxygen*). Thus, there also would be no significant impact under the Two Dam Removal Alternative in the Middle Klamath River from downstream of the confluence with the Salmon River, the Lower Klamath River, and the Klamath River Estuary.

In the long term, since J.C. Boyle Dam would remain in place, continuing summertime interception and retention of sediments and suspended materials from upstream sources containing high biological oxygen demand (see also 3.2.2.5 *Dissolved Oxygen*) would still occur in J.C. Boyle Reservoir under the Two Dam Removal Alternative. Accordingly, existing large summertime variations in dissolved oxygen in J.C. Boyle Reservoir, especially at depth, would still occur and could continue to influence dissolved oxygen concentrations in the California portion of the Hydroelectric Reach in the same manner as under existing conditions (see also 3.2.2.5 *Dissolved Oxygen*). Modeling of existing

conditions indicates these summertime dissolved oxygen variations in J.C. Boyle Reservoir increase the range of dissolved oxygen concentrations between the Oregon-California state line and the upstream end of Copco No. 1 Reservoir (North Coast Regional Board 2011), but aeration and fast water velocities within the free-flowing reach result in dissolved oxygen concentrations near or slightly greater than saturation upstream of Copco No. 1 Reservoir (FERC 2007; Raymond 2008). The Two Dam Removal Alternative would not include peaking power generation and release of flow for recreation within the J.C. Boyle Peaking Reach, but the dissolved oxygen at the Oregon-California state line would still likely have slightly greater daily variability than natural conditions (see also Potential Impact 3.2-10). While the degree of influence of peaking flows on daily variability in dissolved oxygen concentrations at the Oregon-California state line is not clearly defined by existing information, the daily variability is not currently adversely affecting beneficial uses. However, dissolved oxygen concentrations immediately downstream of J.C. Boyle would potentially fall below 85 percent saturation and 6.5 mg/L during summer similar to existing conditions. Thus, retaining J.C. Boyle Dam with no peaking or recreation flows under the Two Dam Removal Alternative would have only a small influence on dissolved oxygen concentrations downstream of the Oregon-California state line compared to existing conditions and there would be no significant impact.

Within the Hydroelectric Reach downstream of Copco No. 1 Reservoir, the long-term effects of the Two Dam Removal Alternative on dissolved oxygen concentrations would be the same as effects described for the Proposed Project (Potential Impact 3.2-10) as conversion of Copco No. 1 and Iron Gate reservoirs to free-flowing riverine reaches with higher velocities and more turbulent mixing would increase aeration of Klamath River. Additionally, keeping Copco No. 2 Dam and Reservoir in place would not alter dissolved oxygen concentrations in the Klamath River since Copco No. 2 Reservoir has a short residence time (less than a day) and it is not anticipated to retain appreciable amounts of fine sediment or suspended material that would alter dissolved oxygen conditions under the Two Dam Removal Alternative (see Section 4.5.2.2 *Suspended Sediments*). The extreme super-saturated surface water and oxygen-depleted hypolimnion conditions found in existing conditions in April/May to October/November would not occur under the Two Dam Removal Alternative as Copco No. 1 and Iron Gate reservoirs would be removed (see Section 3.2.5.4 *Dissolved Oxygen* for details). While Klamath TMDL modeling scenarios[212] included the removal of Copco No. 2 Dam, modeling results of the conversion of Copco No. 1, Copco No. 2, and Iron Gate reservoirs to free-flowing river reaches scenario are still likely representative of conditions under the Two Dam Removal Alternative because the small size and short residence time of Copco No. 2 Dam would be unlikely to influence dissolved oxygen conditions in the Klamath River. The Klamath TMDL modeling for this scenario indicates seasonal extremes in dissolved oxygen concentrations downstream of Iron Gate Dam would be eliminated (see Section 3.2.5.4 *Dissolved Oxygen* for details). Thus, the long-term effects of dam removal on concentrations of dissolved oxygen in the Middle and Lower Klamath, the Klamath River Estuary, and the Pacific Ocean nearshore environment under the Two Dam Removal Alternative would be the same as those described for the Proposed Project.

[212] While the mechanisms for implementation and the timing required to achieve future TMDL compliance are currently speculative, the Klamath TMDL model results are still informative with respect to the analysis of potential water quality impacts under this alternative for reasons described for the Proposed Project (see Section 3.2.4 *[Water Quality] Impact Analysis Approach*).

In summary, relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on increased IOD and BOD and dissolved oxygen would be the same as or similar to those described for the Proposed Project, except as follows:

- There would be no short-term increases in IOD and BOD or reductions in dissolved oxygen in the Hydroelectric Reach between Oregon-California state line and the upstream end of Copco No. 1 Reservoir since sediment deposits in J.C. Boyle Dam would remain in place (Potential Impact 3.2-9). Copco No. 2 Dam remaining in place would not accumulate appreciable sediments during drawdown, and therefore, would not alter short-term IOD, BOD, and dissolved oxygen compared to the Proposed Project, short-term increases in IOD and BOD along with reductions in dissolved oxygen due to release of sediments currently trapped behind Copco No. 1 and Iron Gate dams (Potential Impact 3.2-9) would result in a significant and unavoidable impact in the Hydroelectric Reach downstream of Copco No. 1 Dam, the Middle Klamath River from Iron Gate Dam to approximately the confluence with the Salmon River under the Two Dam Removal Alternative, similar to the Proposed Project. There would be no significant impact in the Middle Klamath River downstream of the confluence with the Salmon River, Lower Klamath River, and the Klamath River Estuary under the Two Dam Removal Alternative, similar to the Proposed Project. The short-term significant impact of increases in IOD and BOD and reductions in dissolved oxygen due to release of sediments in the Hydroelectric Reach downstream of Copco No. 1 Dam, the Middle and Lower Klamath River, and the Klamath River Estuary cannot be avoided or substantially decreased through reasonably feasible mitigation.
- Potential long-term alterations in daily variability of dissolved oxygen concentrations in the Hydroelectric Reach in California due to the elimination of hydropower peaking flows at J.C. Boyle Dam (Potential Impact 3.2-10) would result in no significant impact. However, long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, due to conversion of the Copco No. 1 and Iron Gate reservoirs to a free-flowing river (Potential Impact 3.2-10) would be the same under the Two Dam Removal Alternative as under the Proposed Project. Copco No. 2 Dam and Reservoir staying in place under the Two Dam Removal Alternative would not alter dissolved oxygen concentrations compared to the Proposed Project due to its short residence time (less than a day) and minimal long-term sediment retention. Thus, under the Two Dam Removal Alternative there would be no significant impact for daily fluctuations in the Hydroelectric Reach between Copco No. 1 and Iron Gate Dam and the Middle Klamath River immediately downstream of Iron Gate Dam, would be beneficial for elimination of summer and fall extremes in the Hydroelectric Reach and the Middle Klamath River immediately downstream of Iron Gate Dam, and would result in no significant impact in the Lower Klamath River and Klamath River Estuary.

4.5.2.5 pH

In general, the Two Dam Removal Alternative would have the same or similar potential impacts on pH as those identified under the Proposed Project. As J.C. Boyle Reservoir and peaking power generation and whitewater recreation flows downstream of J.C. Boyle Dam do not substantially alter pH in the downstream river under existing conditions, leaving this dam in place and ceasing peaking and recreation flows would be unlikely to impact pH relative to existing conditions in either the short-term or long-term. Under the existing conditions in Copco No. 1 and Iron Gate reservoirs, seasonal and

daily pH is characterized by high pH (greater than 9 s.u.) and large (0.5 to 1.5 s.u.) daily fluctuations occurring in reservoir surface waters during periods of intense phytoplankton blooms (see Section 3.2.2.6 *pH*). Klamath River TMDL modeling[213] for the Proposed Project indicates that removal of these two reservoirs, which would occur under the Two Dam Removal Alternative, would eliminate the occurrences of high pH and large daily fluctuations in pH in these reaches, because the free-flowing reaches of the river replacing these reservoirs would not support the intense phytoplankton blooms that are driving the existing pH conditions (see Section 3.2.5.5 *pH*). Due its small size and low retention time, Copco No. 2 Reservoir does not affect pH under existing conditions and keeping it in place under the Two Dam Removal Alternative also would not affect pH within the Hydroelectric Reach or downstream reaches. In the Klamath River downstream from Iron Gate Dam, pH conditions under the Two Dam Removal Alternative would be the same as under the Proposed Project (Potential Impact 3.2-11).

In summary, relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on pH would be the same as or similar to those as described for the Proposed Project (Potential Impact 3.2-11). Thus, there would be no significant impact in the short term or long-term to pH in the Hydroelectric Reach between J.C. Boyle Dam and the upstream end of Copco No. 1 Reservoir since J.C. Boyle Reservoir does not substantially alter pH in the river downstream from this dam under existing conditions (Potential Impact 3.2-11). While retaining Copco No. 2 Dam would not alter pH conditions in the Klamath River, short-term and long-term decreases in summertime pH and daily pH fluctuations due to a conversion of the Copco No. 1 and Iron Gate reservoir areas to a free-flowing river (Potential Impact 3.2-11) would be beneficial for the Hydroelectric Reach from Copco No. 1 Reservoir to Iron Gate Dam, and would have no significant impact for the Middle Klamath River, the Lower Klamath River, and the Klamath River Estuary.

4.5.2.6 Chlorophyll-a and Algal Toxins

In general, the Two Dam Removal Alternative would have the same or similar potential impacts on chlorophyll-*a* and algal toxins as those identified under the Proposed Project (see Section 3.2.5.6 *Chlorophyll-a and Algal Toxins*). The shallow depth (8.3 feet average depth) and short hydraulic residence time (1.1 days at average flows) of J.C. Boyle Reservoir does not promote the low mixing conditions or thermal stratification that create optimal habitat for phytoplankton growth, so the reservoir does not have large phytoplankton blooms (as measured by chlorophyll-a) under existing conditions (see Figure 3.2-5). Under existing conditions, peaking power generation flows occur in the late afternoons and early evenings to meet high power demand, and J.C. Boyle Reservoir refills during the night when power demand is minimal. Daily fluctuations in the reservoir water level under existing operations increases mixing in the reservoir, making the reservoir slightly less suitable habitat for phytoplankton during the season of maximum phytoplankton and cyanobacteria (blue-green-algae) growth in the system. Ceasing peaking power generation flows would reduce daily reservoir water level fluctuations in J.C. Boyle Reservoir because the facility would no longer be operated to draw on reservoir storage to support daily peaks in hydropower production when there is

[213] While the mechanisms for implementation and the timing required to achieve future TMDL compliance are currently speculative, the Klamath TMDL model results are still informative with respect to the analysis of potential water quality impacts under this alternative for reasons described for the Proposed Project (see Section 3.2.4 *[Water Quality] Impact Analysis Approach*).

not sufficient river flow for peak production (3,000 cfs), as occurs during the summer and fall low flow period under existing conditions. However, the residence time of J.C. Boyle Reservoir without peaking operations would still be short (i.e., on the order of one to three days), so leaving this dam in place and ceasing peaking flows would be unlikely to create conditions that would support large seasonal phytoplankton blooms or increase chlorophyll-*a* concentrations relative to existing conditions. Concentrations of the algal toxin microcystin are generally low in J.C. Boyle Reservoir (Section 3.2.2.7 *Chlorophyll-a and Algal Toxins*) and in the Hydroelectric Reach from J.C. Boyle Dam to the upstream end of Copco No. 1 Reservoir since the J.C. Boyle Reservoir does not support large blooms of toxigenic blue-green algae and springs downstream of J.C. Boyle Dam dilute any algal toxins that may be present within that reach. Thus, leaving J.C. Boyle Dam in place and ceasing peaking flows would not promote conditions that would support production of algal toxins.

In Copco No. 1 and Iron Gate reservoirs, existing conditions for chlorophyll-*a* levels in summer and early fall can be two to 10 times greater than those recorded in the mainstem river upstream of Copco No. 1 Reservoir near Shovel Creek. High chlorophyll-*a* readings in the reservoirs as compared to the Klamath River are in part due to the lower mixing conditions and longer residence times of these reservoirs (10.7 days for Copco No. 1 and 14.8 days for Iron Gate at average flows) that promote the growth of phytoplankton and the associated production of chlorophyll-*a* within the reservoirs. Additionally, measurements of microcystin in Copco No. 1 and Iron Gate reservoirs during summer months show high microcystin concentrations, especially during algal blooms when microcystin concentrations measured between 2006 and 2015 exceeded the State Water Board et al. (2010, updated 2016) threshold of 0.8 ug/L and peaked from 64 ug/L in Iron Gate Reservoir to 73,000 ug/L in Copco No. 1 Reservoir (Section 3.2.2.7 *Chlorophyll-a and Algal Toxins*). Under the Two Dam Removal Alternative, elimination of Copco No.1 and Iron Gate reservoirs, which currently support growth conditions for toxin-producing nuisance algal species such as *Microcystis aeruginosa,* would result in decreases in high seasonal concentrations of chlorophyll-*a* and periodically high levels of algal toxins generated by suspended blue-green algae, consistent with the Proposed Project (see Section 3.2.5.6 *Chlorophyll-a and Algal Toxins*). The removal of Copco No. 1 and Iron Gate reservoirs also would eliminate the primary habitat for blue-green algae in the Hydroelectric Reach, reducing both the amount of blue-green algae present that could contribute to chlorophyll-*a* and algal toxins within this reach and the amount of blue-green algae that may be exported into the Klamath River downstream of Iron Gate Dam. Due its small size and low residence time (less than a day), Copco No. 2 Reservoir does not have the habitat conditions (i.e., slow water velocity, low mixing conditions, or thermal stratification) that would promote phytoplankton growth and alter chlorophyll-*a* and algal toxins concentrations under existing conditions and keeping it in place under the Two Dam Removal Alternative also would not affect chlorophyll-*a* and algal toxins within the Hydroelectric Reach or downstream reaches.

As phytoplankton and the resulting chlorophyll-*a* and algal toxin levels (e.g., microcystin) are primarily internally generated in Copco No. 1 and Iron Gate reservoirs, removal of these reservoirs under the Two Dam Removal Alternative would also reduce the transport of chlorophyll-a and algal toxins to the Klamath River downstream of Iron Gate Dam in both the short-term and the long-term, consistent with the Proposed Project.

In summary, relative to existing conditions, the potential impacts and impacts of the Two Dam Removal Alternative on chlorophyll-*a* and algal toxins would be the same as or similar to those described for the Proposed Project, except as follows:

- There would be no short-term or long-term alterations in chlorophyll-a and algal toxins in the Hydroelectric Reach between J.C. Boyle Dam and the upstream end of Copco No. 1 Reservoir since J.C. Boyle Reservoir would remain in place, but it does not support conditions promoting large phytoplankton blooms and associated chlorophyll-a and algal toxins under existing conditions (Potential Impact 3.2-12). However, short-term and long-term reduction of chlorophyll-a and algal toxin levels due to a conversion of the reservoir areas to a free-flowing river (Potential Impact 3.2-12) under the Two Dam Removal Alternative would be beneficial for the Hydroelectric Reach from Copco No. 1 Reservoir to Iron Gate Dam, the Middle Klamath River, Lower Klamath River, and Klamath River Estuary, similar to the Proposed Project.

4.5.2.7 Inorganic and Organic Contaminants

Short-term mobilization of J.C. Boyle reservoir sediment deposits would not occur under the Two Dam Removal Alternative and none of the associated 1,190,000 cubic yards of deposits (i.e., eight percent of total volume for the Lower Klamath Project reservoirs, see also Tables 2.7-7 and 2.7-8) would be eroded or delivered to downstream reaches. While Copco No. 2 Dam would remain in place, it does not retain appreciable amounts of sediment (USBR 2011b) and it is unlikely to accumulate large sediment deposits during drawdown of the upstream Copco No. 1 Reservoir (see also Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown*), thus the short-term mobilization of reservoir sediment deposits and potential sediment-associated inorganic and organic contaminants in the Copco No. 2 section of the Hydroelectric Reach under the Two Dam Removal Alternative would be similar to under the Proposed Project. Mobilization of reservoir sediment deposits in the much larger Copco No. 1 and Iron Gate reservoirs would still occur such that the short-term potential for mobilization of inorganic and organic contaminants in the Hydroelectric Reach from downstream of Copco No. 1 Dam to Iron Gate Dam under the Two Dam Removal Alternative would be similar to impacts for the Hydroelectric Reach under the Proposed Project (Section 3.2.5.7 *Inorganic and Organic Contaminants*).

Mobilization of sediments from J.C. Boyle Reservoir are anticipated to not significantly impact freshwater benthic organism survival under the Proposed Project after consideration of dispersal and dilution, but testing of sediments from J.C. Boyle Reservoir without any dispersal or dilution suggests a higher potential for toxicity to freshwater benthic organisms compared to Copco No. 1 and Iron Gate reservoir sediments (Section 3.2.5.7 *Inorganic and Organic Contaminants*). Thus, the potential for toxicity to freshwater benthic organisms may be relatively slightly less under the Two Dam Removal Alternative than that of the Proposed Project due to no sediment from J.C. Boyle Reservoir being transported downstream. However, the overall impact of the release of sediments trapped behind Lower Klamath Project dams under both the Two Dam Removal Alternative and under the Proposed Project would be expected to be similar. The Proposed Project analysis assumes mixing of sediment deposits from all the reservoirs as they move downstream and exposure of downstream aquatic biota to an "average" sediment composition, rather than a reservoir-specific composition (Section 3.2.5.7 *Inorganic and Organic Contaminants*), so overall water column toxicity due to the

concentration of inorganic or organic substances under the Proposed Project is unlikely. As such, there would be a less than significant impact due to the release of sediments trapped behind Lower Klamath Project dams, including J.C. Boyle Dam, under the Proposed Project. While leaving J.C. Boyle Dam in place and not releasing J.C. Boyle reservoir deposited sediments under the Two Dam Removal Alternative would potentially slightly reduce toxicity to benthic freshwater organisms, the overall impact from the release of Copco No. 1 and Iron Gate reservoir deposited sediments and the sediment-associated inorganic and organic contaminants would be a less than significant impact in the short term under the Two Dam Removal Alternative, similar to the Proposed Project.

While the overall extent of fish passage construction activities at J.C. Boyle and Copco No. 2 dams and dam deconstruction activities at Copco No. 1 and Iron Gate dams in the Hydroelectric Reach under the Two Dam Removal Alternative would be slightly less than the extent of dam deconstruction activities for all four dams in the Hydroelectric Reach under the Proposed Project (see also 4.5.1 *[Two Dam Removal Alternative] Introduction – Alternative Analysis Approach*), short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and restoration activities under the Two Dam Removal Alternative would be similar to those described for the Proposed Project and they would be potentially significant impacts without mitigation in the Hydroelectric Reach and the Middle Klamath River immediately downstream of Iron Gate Dam. Implementation of mitigation measures WQ-1, TER-1, and HZ-1 would reduce impacts to less than significant.

In the long term, existing inorganic and organic contaminant data characterizing J.C. Boyle Reservoir sediment deposits indicate that a relatively small number of chemicals (i.e., mercury, DDTs, and possibly dioxin-like chemicals) are present at levels that have the potential to cause minor or limited adverse effects (i.e., toxicity or bioaccumulation) to freshwater aquatic species remaining in this reservoir under the Two Dam Removal Alternative. Elutriate sediment sample bioassay results from J.C. Boyle Reservoir indicate that no further dilution would be required to prevent water column toxicity to freshwater fish. Relative to existing condition, there would be no change. Copco No. 2 Reservoir remaining in place would also be similar to existing conditions since it neither contains appreciable sediment deposits nor is it expected to accumulate appreciable amounts of sediment with associated inorganic or organic contaminants (i.e., fine sediments) in the long term (see Section 4.5.2.2 *Suspended Sediment*). However, long-term retention of inorganic and organic contaminants contained within existing sediment deposits behind Copco No. 1 and Iron Gate dams and their potential to cause minor or limited adverse effects (i.e., toxicity or bioaccumulation) would not occur since they would be removed under the Two Dam Removal Alternative, which would be beneficial.

In summary, relative to existing conditions the potential impacts and impacts of the Two Dam Removal Alternative on inorganic and organic contaminants would be the same as or similar to those described for the Proposed Project, except as noted below:

- J.C. Boyle Reservoir sediment deposits and its sediment-associated inorganic and organic contaminants would not be released downstream, but the short-term and long-term human exposure to inorganic and organic contaminants due to release of sediments currently trapped behind Copco No. 1 and Iron Gate dams (Potential Impact 3.2-13) would result in a potentially significant impact for the Hydroelectric Reach, Middle Klamath River, Lower Klamath River, and Klamath River Estuary.

Implementation of, mitigation measures WQ-2 and WQ-3 would result in no significant impact.

- While J.C. Boyle Reservoir sediment deposits and its sediment-associated inorganic and organic contaminants would not be released downstream and Copco No. 2 would remain in place, the short-term and long-term freshwater aquatic species' exposure to inorganic and organic contaminants due to release of sediments currently trapped behind the Copco No. 1 and Iron Gate dams (Potential Impact 3.2-14) would result in no significant impact for the Hydroelectric Reach, Middle Klamath River, Lower Klamath River, Klamath River Estuary, and Pacific Ocean nearshore environment based on sediment screening and/or laboratory toxicity results after consideration of dilution conditions during drawdown.
- Short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and restoration activities (Potential Impact 3.2-15) in the Hydroelectric Reach and the Middle Klamath River immediately downstream of Iron Gate Dam would be potentially significant without mitigation. Implementation of Mitigation Measure WQ-1 would result in no significant impact.
- Short-term impacts to aquatic biota from herbicide application during restoration of the reservoir footprint area (Potential Impact 3.2-16) would be potentially significant without mitigation. Implementation of Mitigation Measure WQ-4 would result in no significant impact.
- Long-term freshwater aquatic species' exposure to inorganic and organic contaminants contained within J.C. Boyle Reservoir sediment deposits would continue to have the potential to cause minor or limited adverse effects (i.e., toxicity or bioaccumulation) to some freshwater aquatic species in the reservoir (Potential Impact 4.2.2-8), which would be no impact (no change from existing adverse conditions).

4.5.2.8 General Water Quality

Iron Gate Hatchery operations would continue, and Fall Creek Hatchery would reopen, for eight years under the Two Dam Removal Alternative. The potential short-term and long-term impacts of these operations on the Klamath River, Bogus Creek, and Fall Creek water quality would be the same as described for the Proposed Project (Potential Impact 3.2-17).

4.5.3 Aquatic Resources

4.5.3.1 Suspended Sediment

As discussed in Section 4.5.2.2 *Suspended Sediments*, while there would be some reduction in SSCs downstream of Copco No. 1 due to no SSCs being released by Copco No. 2 and J.C. Boyle Dam removal, the reduction of SSCs under the Two Dam Removal Alternative would not alter the overall impact of dam removal on SSCs compared to the Proposed Project in the Hydroelectric Reach, the Middle and Lower Klamath River, the Klamath River Estuary, or the nearshore marine environment. Thus, the potential impacts of suspended sediment on aquatic resources in California would be the same under the Two Dam Removal Alternative as those described under the Proposed Project (see also Section 3.3.5.1 *Suspended Sediment*).

4.5.3.2 Bed Elevation and Grain Size Distribution

Because the volume of stored sediment in Copco No. 2 and J.C. Boyle reservoirs is relatively small compared with the volume of stored sediment in Copco No. 1 and Iron Gate reservoirs, the potential for alterations in bed elevation and grain size distribution and the associated effects on aquatic resources in California would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (see also Section 3.3.5.2 *Bed Elevation and Grain Size Distribution*). Thus, downstream impacts to aquatic species due to bed elevation and grain size distribution would be very similar to those described for the Proposed Project.

4.5.3.3 Water Quality

For the reasons discussed below, potential impacts of water quality on aquatic resources in California would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (see also Section 3.3.5.3 *Water Quality*). As Copco No. 1 and Iron Gate reservoirs are the largest of the four Lower Klamath Project reservoirs, they have the greatest impact on water quality (FERC 2007), and their removal would result in water quality conditions similar to those of the Proposed Project. Because of their relatively small size and short residence time, continuing to store water within Copco No. 2 and J.C. Boyle reservoirs would generally not result in the same poor water temperature conditions that occur downstream of the larger Lower Klamath Project reservoirs (Iron Gate and Copco No. 1 reservoirs) under existing conditions. Section 4.5.2 discusses the impacts of the Two Dam Removal Alternative with an emphasis on similarities and differences with the potential impacts of the Proposed Project.

The Two Dam Removal Alternative includes no peaking power generation or release of flow for recreation at J.C. Boyle Dam. As described in Section 3.2.2.2 *Water Temperature*, daily peaking operations at J.C. Boyle Powerhouse (RM 225.2) result in an increase in the daily water temperature range in the Bypass Reach because warmer reservoir discharges are diverted around this reach and cold groundwater springs enter the river and dominate remaining flows. The temperature effects of altering the flow regime under the Two Dam Removal Alternative (while keeping J.C. Boyle Dam in place) would be a reduction in diel (24-hour) temperature variation and overall warmer water temperatures in the Bypass Reach during summer and early fall compared with existing conditions. In the Peaking Reach, water temperature effects would be the same as under the Proposed Project (i.e., slightly lower maximum water temperatures and less artificial diel [24-hour] temperature variation during summer and early fall) since no peaking flows would occur and the effect of J.C. Boyle thermal mass on water temperatures does not extend this far downstream (see also Section 4.5.2.1 *Water Temperature*).

In the Hydroelectric Reach from the upstream end of Copco No. 1 Reservoir to Iron Gate Dam, removing Iron Gate, Copco No. 1, and Copco No. 2 reservoirs and converting the reservoir areas to a free-flowing river under this alternative would result in the same effects on water temperatures in the Middle Klamath River immediately downstream from Iron Gate Dam as described for the Proposed Project (i.e., long-term increases in spring water temperatures and decreases in late summer/fall water temperatures) (see Section 3.3.5.3 *Water Quality*).

4.5.3.4 Fish Disease and Parasites

For the reasons discussed below, potential impacts of fish disease and parasites on aquatic resources in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.5 *Fish Disease and Parasites*). The main factors contributing to risk of juvenile salmonid infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) for the polychaete intermediate host; microhabitat characteristics (static flows and low velocities); congregations of spawned adult salmon with high spore; polychaete proximity to spawning areas; planktonic food sources from Lower Klamath Project reservoirs; and water temperatures greater than 59°F (Bartholomew and Foott 2010). The current reach with highest infectivity (nidus) for *C. shasta* and *P. minibicornis* is located in the Klamath River downstream of Iron Gate Dam, where returning adult spawners congregate. For adult salmon, *Ichthyophthirius multifis* (Ich) and *Flavobacterium columnare* (columnaris) have occasionally resulted in substantial mortality, particularly when habitat conditions include exceptionally low flows, high water temperatures, and high densities of fish (such as adult Chinook salmon migrating upstream in the fall and holding at high densities in pools). This section addresses differences between these disease factors anticipated under the Two Dam Removal Alternative in comparison with the Proposed Project, and implications for effects on juvenile and adult salmonid life stages.

The availability of habitat for the polychaete worm intermediate host is driven by sediment transport and hydrologic dynamics that as described in sections above would be nearly the same as the Proposed Project. The relatively low volume of sediment in Copco No. 2 and J.C. Boyle reservoirs would not appreciably affect habitat for the polychaete host relative to existing conditions, and the hydrology affecting microhabitat characteristics would be the same as that described for the Proposed Project. The reduction in congregations of spawned adults with proximity to polychaetes would be similar to the Proposed Project, since anadromous salmonids would have upstream migratory access past Iron Gate Dam, including provision of fish passage at Copco No. 2 and J.B. Boyle Dam, and would be as widely distributed. As described in Section 3.1.6 *Summary of Available Hydrology Information for the Proposed Project*, 2017 court-ordered flushing and emergency dilution flows are required to be released from Iron Gate Dam as part of re-initiation of consultation on the 2013 BiOp Flows, but they are not modeled as part of existing conditions hydrology. Under the Two Dam Removal Alternative, it is anticipated that the nidus would no longer form downstream of Iron Gate Dam, and the risk of a new nidus forming upstream is low, even in the absence of the 2017 flow requirements (see also Section 3.3.5.5 *Fish Disease and Parasites*). Although the conditions leading to a reach that would exhibit the highest infectivity (nidus) for *C. shasta* and *P. minibicornis* downstream of Iron Gate Dam would be ameliorated once Copco No. 1 and Iron Gate dams are removed, some disease factors would continue under the Two Dam Removal Alternative, including eight years of additional Iron Gate Hatchery operations potentially resulting in continued (through post-dam removal year 10) congregations of mostly adult fall-run Chinook salmon in the reach from Iron Gate Dam to Seiad Valley (see also Section 3.3.5.6 *Fish Hatcheries*). Under the Two Dam Removal Alternative, if a nidus were to remain in the vicinity of Iron Gate Hatchery, or theoretically were to form within newly accessible upstream habitat such as the reach immediately downstream of Copco No. 2 or J.C. Boyle dam where future fish passage facility entrances would be located, flushing and emergency dilution flows as required by

the 2017 court order may be required from a new upstream location to achieve the same ecological benefits (i.e., disruption of nidus).

Under the Two Dam Removal Alternative, planktonic (e.g., floating organisms such as algae) food sources would be reduced relative to existing conditions with elimination of reservoir habitats, similar to conditions under the Proposed Project. However, because Copco No. 2 and J.C. Boyle reservoirs would remain it would continue to provide a source of planktonic food for the polychaete host of *C. shasta* and *P. minibicornis*. Therefore, while planktonic food sources would be reduced under the Two Dam Removal Alternative relative to existing conditions, slightly more reservoir (and thus planktonic food source) would be removed under the Proposed Project.

Conditions resulting in water temperatures greater than 59°F downstream of Iron Gate Dam under the Two Dam Removal Alternative would be the same as those identified under the Proposed Project. As described in Section 4.5.2.1 *Water Temperature*, the presence of the Copco No. 2 and J.C. Boyle reservoirs on the Klamath River do not alter water temperatures in further downstream reaches J.C. Boyle Reservoir has a shallow depth (8.3 feet average depth) and short hydraulic residence time (1.1 days) that does not support thermal stratification (FERC 2007), and Copco No. 2 Reservoir has a small volume (approximately 70 acre-feet originally), a short hydraulic residence time (less than a day), no active storage, and it does not thermally stratify, such that the reservoir has a negligible impact on water temperature.

Under the Two Dam Removal Alternative, the conditions that can support Ich and columnaris outbreaks among adult salmonids (i.e., exceptionally low flows, high water temperatures, and high densities of fish), would be similar to those identified under the Proposed Project, especially within the Lower Klamath River where Ich and columnaris have caused substantial mortality under existing conditions. Downstream of the confluence with the Salmon River neither the Proposed Project or the Two Dam Removal Alternative would have a pronounced effect on instream flows, water temperatures, or congregations of fish, due to the contributions of several large tributaries (notably the Trinity River). Overall, impacts to aquatic species due to fish disease and parasites would improve relative to existing conditions under the Two Dam Removal Alternative and they would be very similar to those described for the Proposed Project.

4.5.3.5 Fish Hatcheries

The potential impacts of fish hatcheries on aquatic resources in the California portions of the Klamath River would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.6 *Fish Hatcheries*). As this alternative includes volitional fish passage at Copco No. 2 and J.C. Boyle dams consistent with mandatory conditions issued for relicensing of the Klamath Hydroelectric Project, thereby eliminating Copco No. 2 and J.C. Boyle dams as fish barriers, this alternative assumes that hatchery operations would continue for eight years under the Two Dam Removal Alternative and then the hatcheries would be removed. During the eight years following removal of Copco No. 1 and Iron Gate dams, the hatcheries would operate with reduced production goals consistent with those described for the Proposed Project (see Section 2.7.6 *Hatchery Operations*).

4.5.3.6 Algal Toxins

Potential impacts of algal toxins on aquatic resources in the California portions of the Klamath River would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.7 *Algal Toxins*). Removal of the larger Copco No. 1 and Iron Gate reservoirs would decrease or eliminate support for excessive growth of phytoplankton, including seasonal blue-green algae blooms and associated algal toxins (e.g., microcystin), by eliminating large areas of quiescent habitat where these phytoplankton species currently thrive. While Copco No. 2 and J.C. Boyle reservoirs would remain, because of their small sizes (Table 2.3-1) and short hydraulic residence times (Table 3.6-4), they would not support substantial blooms and thus the expected decrease in algal toxins anticipated under the Two Dam Removal Alternative would be the same as described for the Proposed Project. Additionally, potential for bioaccumulation of algal toxins in freshwater mollusk and fish tissue under the Two Dam Removal Alternative would be expected to decrease in the mainstem Klamath River from the Hydroelectric Reach to the Klamath River Estuary, as described for the Proposed Project.

4.5.3.7 Aquatic Habitat

For the reasons discussed below, potential impacts of aquatic habitat on aquatic resources in California portions of the Klamath River would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.8 *Aquatic Habitat*). Improvements in aquatic habitat conditions resulting from increased minimum flows and eliminated peaking operations in the Bypass Reach downstream of J.C. Boyle Dam based on federal mandatory conditions in the PacifiCorp hydroelectric relicensing process would occur under the Two Dam Removal Alternative as described for the Proposed Project. As described in sections above, changes in sediment dynamics would also be similar to those described under the Proposed Project. Access to additional aquatic habitat upstream of Iron Gate Dam would be the same under the Two Dam Removal Alternative as described for the Proposed Project, since fish passage would be provided at Copco No. 2 and J.C. Boyle dams (see also Section 4.5.3.8 *Fish Passage*). The primary difference under the Two Dam Removal Alternative is that aquatic habitat within Copco No. 2 and J.C. Boyle reservoirs would remain lentic rather than reverting to the riverine conditions described for the Proposed Project. Based on the estimate by Cunanan (2009) of 3.5 miles of riverine habitat currently inundated by J.C. Boyle Reservoir, and an estimated 0.3 miles inundated by Copco No. 2, there would be approximately 3.8 fewer miles of additional riverine habitat that would become available under this alternative compared to the Proposed Project. However, Copco No. 2 and J.C. Boyle reservoir inundation is a small proportion (approximately 16 percent) of the 22 miles of Lower Klamath Project reservoir habitat that would be restored to riverine habitat under the Proposed Project (the original estimate of 22 miles did not take into account the relatively minor inundation at Copco No. 2 Reservoir). In addition, J.C. Boyle Dam would continue to provide reservoir habitat to support aquatic resources (including shortnose and Lost River suckers). Under the Two Dam Removal Alternative, the two larger lower reservoirs would be removed as described for the Proposed Project, restoring approximately 18.5 miles of mainstem river that previously exhibited high sinuosity and complex channels that historically provided excellent salmonid spawning and rearing habitats (Hetrick et al. 2009).

4.5.3.8 Fish Passage

Copco No. 2 Dam is not currently equipped with fish passage facilities (DOI 2007). The current upstream fishway at J.C. Boyle Dam is obsolete and does not meet NMFS (2011) design criteria (U.S. Department of Interior, DOI 2007). Under the Two Dam Removal Alternative, fish would have access beyond the location of Copco No. 1 and Iron Gate dams, as described for the Proposed Project (Section 3.3.5.8 *Aquatic Habitat*). However, whereas under the Proposed Project fish would have volitional unimpeded access past Copco No. 2 and J.C. Boyle dams, under the Two Dam Removal Alternative fish migrating upstream and downstream past Copco No. 2 and J.C. Boyle dams would access upstream habitat via fishways. DOI (2007) included a prescription for a NMFS-criteria volitional year-round fish ladder at Copco No. 2 and J.C. Boyle dams to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. In addition, DOI (2007) prescribed a new year-round NMFS criteria fish screen and a bypass facility at Copco No. 2 and J.C. Boyle dams (and modifications to spillways) to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, redband trout, and listed sucker species. Under the Two Dam Removal Alternative, fishways would be consistent with the prescriptions from the DOI and U.S. Department of Commerce imposed during the FERC relicensing process (FERC 2007), and specific fishway facility design and construction details included in the KHSA 2012 EIS/EIR *Fish Passage at Four Dams Alternative*[215], including fishway (i.e., fish ladder and screens) installation for both upstream and downstream migrations and barriers to prevent juvenile salmonid entrainment into turbines. Use of trap and haul would involve design assumptions described in the Section 4.4 *Continued Operations with Fish Passage Alternative,* but the assumptions would only be applied to Copco No. 2 and J.C. Boyle dams. In this EIR, it is assumed that for application at these two dams (Copco No. 2 and J.C. Boyle dams), if alternative passage facilities were designed and constructed, they would necessarily meet agency criteria and thus would have an equivalent level of mortality as volitional fishways.

In their preliminary fishway prescriptions for the Lower Klamath Project dams, NMFS (2006) recommended dam removal to FERC under FPA S10(a) and (j) as the environmentally preferred alternative to provide the least mortality and injury to migrating fish. The associated NMFS fishway prescription (DOI 2007) is a mandatory conditioning authority that was submitted during the hydropower relicensing process at the time, in case FERC chose to reject NMFS' strong recommendation to removal all of the Lower Klamath Project mainstem dams. While unimpeded volitional fish passage is assumed to have higher survival and lower injury than fishways, no data or analyses are available to accurately compare the effectiveness of unimpeded fish passage under the Proposed Project with volitional fishways under the Two Dam Removal Alternative. NMFS does not provide an expected level of mortality or injury in association with fishways constructed to their criteria, and performance would depend on many site-specific factors that would be considered in the design phase of new fishways. Based on the measured effectiveness of fishways constructed to NMFS criteria at other dams (DWR 2013), this EIR assumes at least 98 percent survival (or less than 2 percent mortality) of upstream and downstream migrating aquatic species at each facility in recognition that while survival could be high at properly constructed facilities, it is unlikely to be as high as survival would be with dams removed (i.e., 100 percent). Therefore, the assumed cumulative upstream mortality for fish migrating past both Copco No. 2 Dam and J.C. Boyle Dam would be around 4 percent, and the same for downstream mortality.

Regardless of how fish passage is provided, this alternative assumes fish passage consistent with the general prescriptions (DOI 2007) that cover anadromous (fall- and spring-run Chinook salmon, coho salmon, steelhead, and Pacific lamprey) and resident (rainbow and redband trout, shortnose and Lost River suckers) fish passage, and includes implementing operation and maintenance plans and prescribing attraction flows for upstream migrants (DOI 2007). This EIR also assumes that effects of passage through volitional fishways would be equivalent for other migratory species, which appears to be a reasonable assumption based on available data (DWR 2013) for fishways designed and constructed to modern agency criteria as required by DOI (2007).

Based on the similarities between the Two Dam Removal Alternative and the Proposed Project for several of the key ecological attributes discussed above, the potential impacts of the Two Dam Removal Alternative would be the same as those described under the Proposed Project for several potential impacts (Potential Impact 3.3-2, 3.3-3, 3.3-5, 3.3-6, 3.3-12, 3.3-15, 3.3-16, 3.3-18, 3.3-20, 3.3-21, 3.3-22, 3.3-23, and 3.3-24). The potential impacts of the Two Dam Removal Alternative that could result in different effects than those already discussed under the Proposed Project are discussed below.

Potential Impact 3.3-1 Effects on coho salmon critical habitat quality and quantity due to short-term sediment releases and long-term changes in habitat quality and quantity due to dam removal.

Potential impacts on coho salmon critical habitat in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-1), with a few subtle differences. For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins* impacts on critical habitat from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion expected under the Proposed Project would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities. Habitat in the J.C. Boyle Bypass and Peaking Reaches would be improved through elimination of peaking operations and higher baseflows. Therefore, although upstream of current designated critical habitat, the Two Dam Removal Alternative would expand the geographic extent of habitat available to coho salmon in a similar manner to the Proposed Project.

The short-term impacts on coho salmon critical habitat from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-1), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. Based on the substantial short-term decrease in quality of the features of critical habitat and PCEs supporting SONCC coho salmon, there would be a significant impact to coho salmon critical habitat under the Two Dam Removal Alternative in the short term.

However, as described for the Proposed Project, the Two Dam Removal Alternative includes aquatic resource measures AR-1 (Mainstem Spawning) and AR-2 (Juvenile Outmigration) to reduce the short-term effects of SSCs on coho salmon PCEs of critical habitat. In addition, mitigation measures AQR-1 and AQR-2 (described in Section 3.3.5.9), would be implemented to increase certainty of the effectiveness of the aquatic resource measures AR-1 and AR-2 and reduce the short-term significant adverse impacts of the Two Dam Removal Alternative on coho salmon critical habitat. Consistent with the Proposed Project, based on the wide distribution of coho salmon critical habitat within tributaries, aquatic resource measures, and mitigation measures designed to offset short-term impacts to PCEs of critical habitat, there would not be a substantial decrease in the quality of a substantial proportion of habitat for coho salmon critical habitat in the short term. Therefore, the Two Dam Removal Alternative would have no significant impact on coho salmon critical habitat in the short term.

For the reasons described in Section 4.5.3.7 *Aquatic Habitat*, in the long term the Two Dam Removal Alternative would increase the amount of habitat available to coho salmon upstream of currently designated critical habitat and improve water quality and bedload characteristics in the mainstem Klamath River within current critical habitat in the same manner as the Proposed Project. Overall, these changes would be a substantial increase in the quality and quantity of coho salmon critical habitat in the long term as compared to existing conditions. Therefore, the Two Dam Removal Alternative would be beneficial for coho salmon critical habitat in the long term.

Significance
No significant impact with mitigation to coho salmon critical habitat in the short term

Beneficial for coho salmon critical habitat in the long term

Potential Impact 3.3-4 Effects on Chinook and coho salmon Essential Fish Habitat (EFH) quality and quantity due to short-term sediment releases and long-term changes in habitat quality and quantity due to dam removal.
Potential impacts on Chinook and coho salmon EFH in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-4), with a few subtle differences. For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on EFH from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion expected under the Proposed Project would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

The short-term impacts on Chinook and coho salmon EFH from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-4), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed*

Elevation and Grain Size Distribution. Based on the substantial short-term decrease in quality of EFH for Chinook and coho salmon, there would be a significant impact to Chinook and coho salmon EFH under the Two Dam Removal Alternative in the short term.

However, as described for the Proposed Project, the Two Dam Removal Alternative includes aquatic resource measures AR-1 (Mainstem Spawning) and AR-2 (Juvenile Outmigration) to reduce the short-term effects of SSCs on Chinook and coho salmon EFH. In addition, mitigation measures AQR-1 and AQR-2 (described in Section 3.3.5.9), would be implemented to increase certainty of the effectiveness of the aquatic resource measures AR-1 and AR-2 and reduce the short-term significant adverse impacts of the Two Dam Removal Alternative on Chinook and coho salmon EFH. Consistent with the Proposed Project, based on the wide distribution and use of tributaries by both juvenile and adult Chinook and coho salmon, aquatic resource measures (AR-1 and AR-2), and mitigation measures (AQR-1 and AQR-2), designed to offset short-term impacts to Chinook and coho salmon EFH, there would not be a substantial decrease in the quality of a large proportion of Chinook and coho salmon EFH in the short term. Therefore, the Two Dam Removal Alternative would have no significant impact, with mitigation, on Chinook and coho salmon EFH in the short term.

For the reasons described above in Section 4.5.3.7 *Aquatic Habitat*, in the long term the Two Dam Removal Alternative would increase habitat for Chinook and coho salmon (upstream of currently designated EFH) by providing access to habitats upstream of Iron Gate Dam in the same manner as the Proposed Project. Overall, these changes would be a substantial increase in the quality and quantity of Chinook and coho salmon EFH in the long term. Therefore, the Two Dam Removal Alternative would be beneficial for Chinook and coho salmon EFH in the long term.

Significance

No significant impact with mitigation to Chinook and coho salmon EFH in the short term

Beneficial for Chinook and coho salmon EFH in the long term

Potential Impact 3.3-7 Effects on the fall-run Chinook salmon population due to short-term sediment releases and long-term changes in habitat quality, habitat quantity, and hatchery operations due to dam removal.

Potential impacts on fall-run Chinook salmon in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-7), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on fall-run Chinook salmon from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion expected under the Proposed Project would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. Based on the 440 miles of fall-run Chinook salmon habitat estimated upstream of Iron Gate Dam (Section 3.3.5.8 *Aquatic Habitat*), the 3.8 miles that would remain inundated by Copco No. 2 and J.C. Boyle reservoirs rather than reverting to riverine habitat under the Two Dam Removal Alternative is not substantial (< 1 percent of newly accessible habitat). Juvenile Chinook salmon would be subject to

some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018).

As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities. Therefore, the estimated increases in fall-run Chinook salmon abundance predicted to occur under the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-7), would be less under the Two Dam Removal Alternative due to mortality in fish passage facilities and migration through reservoir habitat.

The short-term impacts on fall-run Chinook salmon from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-7), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. As described for the Proposed Project (Potential Impact 3.3-7), because there would be no substantial short-term decrease in fall-run Chinook salmon abundance of a year class, and no substantial decrease in habitat quality or quantity, there would not be a significant impact to fall-run Chinook salmon under the Two Dam Removal Alternative in the short term.

In addition, and as described for the Proposed Project, although this EIR finds no significant impact on fall-run Chinook salmon In the short term, aquatic resource measures AR-1 (Mainstem Spawning) and AR-2 (Juvenile Outmigration) would occur under the Two Dam Removal Alternative, which would further reduce the potential for short-term effects of SSCs on salmonid juveniles, smolts, and eggs, including fall-run Chinook salmon. In addition, although CEQA Guidelines Section 15126.4(a)(3) states that mitigation measures are not required for effects which are not found to be significant, mitigation measures AQR-1 and AQR-2, which would be implemented as a result of significant adverse impacts described for Potential Impact 3.3-1 and Potential Impact 3.3-4, would even further reduce the potential for short-term effects of the Two Dam Removal Alternative on fall-run Chinook salmon by increasing certainty regarding the effectiveness of the proposed aquatic resource measures.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, in the long term the Two Dam Removal Alternative would increase habitat availability, restore a more natural flow regime and seasonal water temperature variation, improve water quality, and reduce the likelihood of fish disease and algal toxins, all of which would be beneficial for fall-run Chinook salmon in the same manner as the Proposed Project. Overall, the multiple benefits of the Two Dam Removal Alternative would be beneficial for fall-run Chinook salmon in the long term.

Significance

No significant impact for fall-run Chinook salmon populations in the short term

Beneficial for fall-run Chinook salmon populations in the long term

Potential Impact 3.3-8 Effects on the spring-run Chinook salmon population due to short-term sediment releases and long-term changes in habitat quality, habitat quantity, and hatchery operations due to dam removal.

Potential impacts on spring-run Chinook salmon in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-8), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on spring-run Chinook salmon from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion expected under the Proposed Project would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. Based on the 440 miles of spring-run Chinook salmon habitat estimated upstream of Iron Gate Dam (Section 3.3.5.8 *Aquatic Habitat*), the 3.8 miles that would remain inundated by Copco No. 2 and J.C. Boyle reservoirs rather than revert to riverine habitat under the Two Dam Removal Alternative is unsubstantial (< 1 percent of newly accessible habitat). Juvenile Chinook salmon would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018).

As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

The short-term impacts on spring-run Chinook salmon from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-8), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. As described for the Proposed Project (Potential Impact 3.3-8), because there would not be a substantial short-term decrease in spring-run Chinook salmon abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to spring-run Chinook salmon under the Two Dam Removal Alternative in the short term.

In addition, and as described for the Proposed Project, although this EIR finds no significant impact on fall-run Chinook salmon In the short term, aquatic resource measure AR-2 (Juvenile Outmigration) would occur under the Two Dam Removal Alternative, which would further reduce the potential for short-term effects of SSCs on salmonid juveniles, smolts, and eggs, including spring-run Chinook salmon. In addition, although CEQA Guidelines Section 15126.4(a)(3) states that mitigation measures are not required for effects which are not found to be significant, mitigation measure AQR-2, which would be implemented as a result of significant adverse impacts described for Potential Impact 3.3-1 and Potential Impact 3.3-4, would even further reduce the potential for short-term effects of the Two Dam Removal Alternative on spring-run Chinook salmon by increasing certainty regarding the effectiveness of the proposed aquatic resource measures.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3 *Algal Toxins*, in the long term the Two Dam Removal Alternative would increase habitat availability, restore a more natural flow regime and seasonal water temperature variation, improve water quality, and reduce the likelihood of fish disease and algal toxins, all of which would be beneficial for spring-run Chinook salmon in the same manner as the Proposed Project. Overall, the multiple benefits of the Two Dam Removal Alternative would be beneficial for spring-run Chinook salmon in the long term.

Significance

No significant impact for spring-run Chinook salmon populations in the short term

Beneficial for spring-run Chinook salmon populations in the long term

Potential Impact 3.3-9 Effects on coho salmon populations due to short-term sediment releases and long-term changes in habitat quality, habitat quantity, and hatchery operations due to dam removal.

Potential impacts on coho salmon in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-9), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on coho salmon from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion (approximately 80 miles) expected under the Proposed Project (as described in Section 3.3.5.8 *Aquatic Habitat*) would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. Juvenile coho salmon would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018).

As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

The short-term impacts on coho salmon from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-9), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. Because there would not be a substantial short-term decrease in coho salmon abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to coho salmon under the Two Dam Removal Alternative in the short term.

In addition, and as described for the Proposed Project, although this EIR finds no significant impact on coho salmon In the short term, aquatic resource measures AR-1 (Mainstem Spawning) and AR-2 (Juvenile Outmigration) would occur under the Two

Dam Removal Alternative, which would further reduce the potential for short-term effects of SSCs on salmonid juveniles, smolts, and eggs, including coho salmon. In addition, although CEQA Guidelines Section 15126.4(a)(3) states that mitigation measures are not required for effects which are not found to be significant, mitigation measures AQR-1 and AQR-2, which would be implemented as a result of significant adverse impacts described for Potential Impact 3.3-1 and Potential Impact 3.3-4, would even further reduce the potential for short-term effects of the Two Dam Removal Alternative on coho salmon by increasing certainty regarding the effectiveness of the proposed aquatic resource measures.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, in the long term the Two Dam Removal Alternative would increase the amount of habitat available to coho salmon and improve water quality and bedload characteristics in the mainstem Klamath River in the same manner as the Proposed Project. Overall, these changes could result in a substantial increase the abundance of coho salmon populations in the long term. Therefore, the Two Dam Removal Alternative would be beneficial for coho salmon in the long term.

Significance
No significant impact for coho salmon populations in the short term

Beneficial for coho salmon populations in the long term

Potential Impact 3.3-10 Effects on the steelhead population due to short-term sediment releases and long-term changes in habitat quality, habitat quantity, and hatchery operations due to dam removal.
Potential impacts on steelhead in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-10), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on steelhead from sediment releases would be similar to the Proposed Project, as well as water quality, fish disease and parasites, fish hatcheries, and algal toxins. The same habitat expansion (approximately 440 miles) expected under the Proposed Project (as described in Section 3.3.5.8 *Aquatic Habitat*) would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir. Juvenile steelhead would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018).

As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

The short-term impacts on steelhead from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-10), for the reasons described in

Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. Because there would not be a substantial short-term decrease in steelhead abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to steelhead under the Two Dam Removal Alternative in the short term.

In addition, and as described for the Proposed Project, although this EIR finds no significant impact on steelhead In the short term, aquatic resource measures AR-1 (Mainstem Spawning) and AR-2 (Juvenile Outmigration) would occur under the Two Dam Removal Alternative, which would further reduce the potential for short-term effects of SSCs on salmonid juveniles, smolts, and eggs, including steelhead. In addition, although CEQA Guidelines Section 15126.4(a)(3) states that mitigation measures are not required for effects which are not found to be significant, mitigation measures AQR-1 and AQR-2, which would be implemented as a result of significant adverse impacts described for Potential Impact 3.3-1 and Potential Impact 3.3-4, would even further reduce the potential for short-term effects of the Two Dam Removal Alternative on steelhead by increasing certainty regarding the effectiveness of the proposed aquatic resource measures.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6. *Algal Toxins*, in the long term the Two Dam Removal Alternative would increase the amount of habitat available to steelhead and improve water quality and bedload characteristics in the mainstem Klamath River in the same manner as the Proposed Project. Overall, these changes could result in a substantial increase the abundance of steelhead populations in the long term. Therefore, the Two Dam Removal Alternative would be beneficial for steelhead in the long term.

Significance

No significant impact for steelhead populations in the short term

Beneficial for steelhead populations in the long term

Potential Impact 3.3-11 Effects on the Pacific lamprey population due to short-term sediment releases and long-term changes in habitat quality and quantity due to dam removal.

Potential impacts on Pacific lamprey in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-11), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on Pacific lamprey from sediment releases would be similar to the Proposed Project, as well as water quality, and algal toxins. The same habitat expansion (approximately 80 miles) expected under the Proposed Project (as described in Section 3.3.5.8 *Aquatic Habitat*) would occur, with the exception of habitat under Copco No. 2 Reservoir (0.3 miles) and J.C. Boyle Reservoir (approximately 3.3 miles; Cunanan 2009) and the downstream portion of Spencer Creek (approximately 0.2 miles; Cunanan 2009), which would be accessible but would continue to be inundated by J.C. Boyle Reservoir and unlikely to be used by Pacific Lamprey. Based on the 80 miles of Pacific lamprey habitat estimated upstream of Iron Gate Dam (Section 3.3.5.8 *Aquatic Habitat*), the 3.8 miles that would remain inundated by Copco No. 2 and J.C. Boyle reservoirs rather than revert to riverine habitat under the Two Dam Removal Alternative is unsubstantial (< 5 percent of newly accessible habitat). Juvenile lamprey would be subject to some level of predation by introduced resident species

including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018).

As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

The short-term impacts on Pacific lamprey from sediment releases would be the same under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-11), for the reasons described in Section 4.5.3.1 *Suspended Sediment* and Section 4.5.3.2 *Bed Elevation and Grain Size Distribution*. Because there would not be a substantial short-term decrease in Pacific lamprey abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to Pacific lamprey under the Two Dam Removal Alternative in the short term.

In addition, and as described for the Proposed Project, although this EIR finds no significant impact on Pacific lamprey In the short term, aquatic resource measure AR-1 (Mainstem Spawning) would occur under the Two Dam Removal Alternative, which would further reduce the potential for short-term effects of SSCs on Pacific lamprey. In addition, although CEQA Guidelines Section 15126.4(a)(3) states that mitigation measures are not required for effects which are not found to be significant, mitigation measure AQR-1, which would be implemented as a result of significant adverse impacts described for Potential Impact 3.3-1 and Potential Impact 3.3-4, would even further reduce the potential for short-term effects of the Two Dam Removal Alternative on Pacific lamprey by increasing certainty regarding the effectiveness of the proposed aquatic resource measures.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6. *Algal Toxins*, in the long term the Two Dam Removal Alternative would increase the amount of habitat available to Pacific lamprey and improve water quality and bedload characteristics in the mainstem Klamath River in the same manner as the Proposed Project. Overall, these changes could result in a substantial increase the abundance of Pacific lamprey populations in the long term. Therefore, the Two Dam Removal Alternative would be beneficial for Pacific lamprey in the long term.

Significance

No significant impact for Pacific lamprey in the short term

Beneficial for Pacific lamprey in the long term

Potential Impact 3.3-12 Effects on the green sturgeon population due to short-term sediment releases and long-term changes in habitat quality due to dam removal.

Southern DPS Green Sturgeon may enter the Klamath River Estuary to forage during the summer months. They would not be present when the most severe effects of dam removal are occurring and are not expected to be affected by the Two Dam Removal Alternative. The remainder of this section focuses on the effects of the Two Dam Removal Alternative on the Northern Green Sturgeon DPS. Northern Green Sturgeon

do not occur upstream of Ishi Pishi Falls and would not be affected by Two Dam Removal Alternative impacts that do not extend downstream past these falls. Potential impacts on green sturgeon in California would be the same under the Two Dam Removal Alternative as those described for the Proposed Project in the short- and long-term (Potential Impact 3.3-12). Because there would not be a substantial short-term decrease in green sturgeon abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to the green sturgeon population under the Two Dam Removal Alternative in the short term.

For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6. *Algal Toxins*, in the long term the Two Dam Removal Alternative would result in improvements in flow regime, water quality, temperature variation, and algal toxins which could affect Northern Green Sturgeon in the same manner as the Proposed Project. Because there would not be a substantial long-term decrease in green sturgeon abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to the green sturgeon population under the Two Dam Removal Alternative in the long term.

Significance
No significant impact for green sturgeon in the short or long term

Potential Impact 3.3-13 Effects on Lost River and shortnose sucker populations due to short- and long-term changes in habitat quality and quantity due to dam removal.
Potential impacts on Lost River and shortnose suckers in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-13), with a few notable differences. For reasons described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on Lost River and shortnose suckers in Upper Klamath Lake, interactions with anadromous fish, and from conversion of Lower Klamath Project reservoir habitat to riverine habitat would be similar to the Proposed Project. Lost River and shortnose suckers currently occur within all Lower Klamath Project reservoirs, except Copco No. 2 due to its small size (Desjardins and Markle 1999). Therefore, while under the Proposed Project all Lower Klamath Project reservoir habitat currently supporting Lost River and shortnose suckers would be removed (2,347 acres), under the Two Dam Removal Alternative habitat would remain in J.C. Boyle Reservoir (420 acres). Most of the reservoir habitat (82 percent), and the preponderance of the Lost River and shortnose sucker populations in the Hydroelectric Reach is within Iron Gate and Copco No. 1 reservoirs.

Overall, the short-term impact of the Two Dam Removal Alternative would be very similar to the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-13), with the exception of those Lost River and shortnose sucker individuals that are able to remain within J.C. Boyle Reservoir habitat. All individual suckers occurring within Iron Gate and Copco No. 1 reservoirs would likely be lost within dam removal year 2; however, these individuals are not considered to substantially contribute to the achievement of conservation goals or recovery, since little or no reproduction occurs downstream from Keno Dam (Buettner et al. 2006), and there is no potential for interaction with upstream populations (Hamilton et al. 2011). Based on the best available estimates of Lost River and shortnose sucker abundance in the Lower Klamath Project excluding J.C. Boyle and Copco No. 2 reservoirs, there are likely fewer than 1,000 adult suckers of both species (USFWS 2012, Desjardins and Markle 1999), with a

combined suitable sucker area of less than 2,500 acres. The populations in Upper Klamath Lake are estimated at 50,000 to 100,000 Lost River sucker (USFWS 2013b), and up to 25,000 shortnose suckers (USFWS 2013c), within around 79,000 acres of suitable habitat in Upper Klamath Lake and connected water bodies. Therefore, a loss of the suckers in Lower Klamath Project reservoirs (excluding J.C. Boyle and Copco No. 2 reservoirs) represents around less than 1.5 percent of the total sucker population, and a loss of less than 3.5 percent of the total suitable sucker habitat. Based on no predicted substantial (< 1.5 percent) short-term decrease in Lost River and shortnose suckers' abundance of a year class, or substantial decrease in habitat quality or quantity (<1.5 percent), the Two Dam Removal Alternative would not cause a significant impact to the Lost River and shortnose sucker populations in the short term.

For the reasons described above in Section 4.5.3.7 *Aquatic Habitat*, in the long term reservoir removal associated with dam removal under the Two Dam Removal Alternative would eliminate habitat availability and affect Lost River and shortnose suckers in Iron Gate and Copco No. 1 reservoirs. All individual suckers occurring within these reservoirs would likely be lost within the short term and would not be replaced in the long term. However, as described above, these individuals are not considered to substantially contribute to the achievement of conservation goals or recovery of the populations (Hamilton et al. 2011). Because there would not be a substantial long-term decrease in Lost River and shortnose suckers abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to the Lost River and shortnose sucker populations under the Two Dam Removal Alternative in the long term.

In addition, and as described for the Proposed Project (Section 3.3.5.9 *Aquatic Resource Impacts*, Potential Impact 3.3-13), although this EIR finds no significant impact on Lost River and shortnose suckers in the short term or long term, aquatic resource measure AR-6 (Suckers) would occur under the Two Dam Removal Alternative, which would further reduce the potential for effects of reservoir removal.

Significance

No significant impact for Lost River and shortnose sucker populations in the short term

No significant impact for Lost River and shortnose sucker populations in the long term

Potential Impact 3.3-14 Effects on the redband trout population due to short-term sediment releases and long-term changes in habitat quality and quantity due to dam removal.

Potential impacts on redband trout in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Potential Impact 3.3-14), with a few notable differences. As described in Section 4.5.3.1 *Suspended Sediment* through Section 4.5.3.6 *Algal Toxins*, impacts on redband trout from water quality would be similar to the Proposed Project, as well as algal toxins. Redband trout would also be affected by the reintroduction of anadromous fish, including the potential for competition, predation, and exposure to disease in the same manner as described for the Proposed Project (Potential Impact 3.3-14), since these result from restored habitat access of anadromous salmonids that would not differ between the Proposed Project and the Two Dam Removal Alternative.

Suspended and bedload sediment effects would differ from those described for the Proposed Project. Redband trout are distributed upstream of Iron Gate Dam, and therefore under the Proposed Project the only impacts these individuals would experience from sediment releases would be downstream of J.C. Boyle or downstream of Copco No.2). Therefore, despite the relatively small volume of sediment stored in J.C. Boyle Reservoir (and even less in Copco No. 2), impacts of sediment release on redband trout that would occur under the Proposed Project would be substantially less under the Two Dam Removal Alternative.

As described in Section 4.5.3.7 *Aquatic Habitat*, conversion of Lower Klamath Project reservoir habitat to riverine habitat would be similar to the Proposed Project, with the exception of Copco No. 2 and J.C. Boyle reservoirs. Under the Two Dam Removal Alternative redband trout would benefit from changes in hydropower operations, and from the conversation of 17.7 miles of reservoir habitat to riverine habitat, in the same manner as for the Proposed Project. However, 3.8 miles of mainstem and tributary habitat would continue to be inundated by Copco No. 2 and J.C. Boyle reservoirs. It is anticipated that under the Two Dam Removal Alternative this habitat would continue to support an adfluvial redband trout population. As described in Section 4.5.3.8 *Fish Passage*, mortality within fishways (i.e., volitional facilities, trap and haul) at Copco No. 2 and J.C. Boyle dams is predicted to be less than 2 percent for upstream and downstream migrating adults and juveniles at each facility, or 4 percent cumulative mortality for migrants that use both facilities.

Because there would not be a substantial short-term decrease in redband trout abundance of a year class or a substantial decrease in habitat quality or quantity, there would not be a significant impact to the redband trout population under the Two Dam Removal Alternative in the short term. Based on a long-term substantial increase in redband trout habitat quality and quantity, the Two Dam Removal Alternative would be beneficial for redband trout in the long term.

Significance

No significant impact for redband trout in the short term

Beneficial for redband trout in the long term

Potential Impact 3.3-17 Effects on species interactions between introduced resident fish species and native aquatic species due to short- and long-term changes in habitat quality and quantity due to dam removal.

Introduced fish species threaten the diversity and abundance of native fish species through competition for resources, predation, interbreeding with native populations, and causing potential physical changes to the invaded habitat (Moyle 2002). Potential impacts on species interactions between introduced resident fish species and native aquatic species ("species interactions") in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9, Potential Impact 3.3-14), with a few notable differences. As described for the Proposed Project, implementation of the Two Dam Removal Alternative would eliminate reservoir habitat associated with Iron Gate and Copco No. 1 reservoirs, and thus the abundance of introduced resident species would decline substantially (Buchanan et al. 2011a), providing a benefit to native aquatic species. However, the Two Dam Removal Alternative would retain the habitat supporting non-native fish species associated primarily with J.C. Boyle Reservoir. As described in Section 3.3.2.1 *Aquatic Species*

[non-native fish species], non-native fish species would continue to occur in J.C. Boyle Reservoir, including yellow perch and bass species (Copco No. 2 is too small to provide substantial habitat for non-native species). Juvenile salmonids and lamprey would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (NMFS 2006a). Mortality rates in reservoirs can be substantial (>50 percent; Stillwater Sciences 2018). However, in restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (NMFS 2006a). In addition, the majority of the non-native species are within Iron Gate and Copco No. 1 reservoirs, which support popular recreational fisheries for yellow perch and bass. Therefore, species interactions under the Two Dam Removal Alternative would be substantially improved relative to existing conditions, albeit to a lesser degree than under the Proposed Project. This effect would be beneficial for native aquatic species in the short and long term.

Significance

Beneficial for the effects of introduced resident fish species on aquatic species in the short term and long term

Potential Impact 3.3-19 Effects on freshwater mollusks populations due to short-term sediment releases and long-term changes in habitat quality due to dam removal.

Potential impacts on freshwater mollusks in California would be similar under the Two Dam Removal Alternative as those described for the Proposed Project (Section 3.3.5.9, Potential Impact 3.3-19), with a few subtle differences. As described in Section 4.5.3.1 *Suspended Sediment*, impacts on freshwater mollusks from sediment releases would be similar to the Proposed Project. Based on the distribution of freshwater mollusks primarily downstream of Iron Gate dam (summarized in Section 3.3.5.9, Potential Impact 3.3-14), the impacts of the Two Dam Removal Alternative would be the same as those described for the Proposed Project (Section 3.3.5.9, Potential Impact 3.3-14) with one exception. The Proposed Project would have the most substantial impact on the floater mussels (*Anodonta spp*.) which occur in the mainstem Klamath River in the Hydroelectric Reach, within Lower Klamath Project reservoirs, in a reach (<15 miles) directly downstream of Iron Gate Dam, and within the Upper Shasta River. *Anodonta spp*. have been found in high abundance within J.C. Boyle Reservoir as recently as summer 2018 (Troy Brandt, River Design Group, pers. comm., November 2018). Therefore, under the Two Dam Removal Alternative the *Anodonta spp.* would remain unaffected within a portion of their range in J.C. Boyle Reservoir and Upper Shasta River. Therefore, while the impacts to other species of freshwater mollusks would be the same under the Proposed Project (not significant), impacts to the *Anodonta spp*. would be less substantial under the Two Dam Removal Alternative than under the Proposed Project. However, impacts the *Anodonta spp.* would still occur under the Two Dam Removal Alternative in the mainstem Klamath River (primarily downstream of Iron Gate Dam) as described for the Proposed Project (Section 3.3.5.9, Potential Impact 3.3-14), and based on predicted substantial short-term decrease in *Anodonta spp.* abundance of a year class, there would be a significant impact to the *Anodonta spp.* population under the Two Dam Removal Alternative in the short term.

However, the Two Dam Removal Alternative includes aquatic resource measure AR-7 (Freshwater Mussels) to reduce the short-term effects of sediment transport during dam

removal on *Anodonta spp.*, as described for the Proposed Project (Section 3.3.5.9, Potential Impact 3.3-14). Under the Proposed Project this salvage and relocation plan would consider sites for translocation downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco No. 1 Reservoir (RM 209.0). These areas would have less impact from increased SSCs but would not be completely protected from short-term effects. The areas downstream of the Trinity River confluence do not currently support *Anodonta spp*. and are unlikely to in the future (Davis et al. 2013). However, under the Two Dam Removal Alternative *Anodonta spp*. could be salvaged from the reach downstream of Iron Gate Dam and relocated to J.C. Boyle Reservoir, which does support suitable *Anodonta spp*. habitat. Therefore, with aquatic resource measure AR-7, there would likely not be a substantial reduction in the abundance of *Anodonta spp.* species in the short term, and impacts would be not significant with for *Anodonta spp.* in the short term.

Significance

No significant impact for *M. falcata, G. angulate, or Anodonta spp.* in the short or long term

No significant impact for freshwater clams in the short or long term

4.5.4 Phytoplankton and Periphyton

4.5.4.1 Phytoplankton

Short-term mobilization of J.C. Boyle Reservoir sediment deposits would not occur under the Two Dam Removal Alternative (see Section 4.5.2.2 *Suspended Sediments*), thus there would be no short-term increase in sediment-associated nutrients downstream of J.C Boyle Dam (see Section 4.5.2.3 *Nutrients*). There would be no change in the short term sediment-associated nutrients in the Hydroelectric Reach or downstream under the Two Dam Removal Alternative compared to under the Proposed Project due to keeping Copco No. 2 Dam in place, since that dam with its small size and short residence time is not expected to intercept or retain appreciable amounts of sediment or the associated nutrients during drawdown. While there would be a short-term increase in sediment-associated nutrients from release of Copco No. 1 and Iron Gate reservoir deposited sediments and associated nutrients in the Hydroelectric Reach, as well as in the Middle Klamath River, Lower Klamath River, and Klamath River Estuary during reservoir drawdown (see Section 4.5.2.3 *Nutrients*), minimal deposition of fine suspended sediments, including the associated nutrients, would occur in the river channel and the estuary (Stillwater Sciences 2008; USBR 2012). Thus, the short-term increase in nutrients would be limited to the time period when sediment deposits are being transported through the Klamath River. The drawdown of Copco No. 1 and Iron Gate reservoirs and release of these nutrients also would occur during winter months when the rates of phytoplankton growth and reproduction along with the rates of nutrient transformations by microbes (e.g., nitrification and denitrification) are relatively low, so the ability of phytoplankton to use sediment-associated nutrients mobilized during reservoir drawdown would be low (see Potential Impact 3.4-1). Sediment released during reservoir drawdown under the Two Dam Removal Alternative also would increase suspended sediment concentrations and water turbidity (see also Potential Impact 3.2-3), limiting light availability for phytoplankton photosynthesis and further reducing the potential for additional phytoplankton growth and reproduction. Under the Two Dam Removal Alternative, the sediment-associated nutrients would be less than under the

Proposed Project since no J.C. Boyle sediment-associated nutrients would be released, but the overall impact would be the same in both the Two Dam Removal Alternative and the Proposed Project. The sediment-associated nutrients would not be likely to stimulate phytoplankton growth or reproduction that would lead to an increase spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton, so there would be no significant impact.

With respect to potential long-term impacts, J.C. Boyle Reservoir does not support low mixing conditions or thermal stratification that create optimal habitat for phytoplankton growth or reproduction under existing conditions due to its shallow depth (8.3 feet average depth) and short hydraulic residence time (1.1 days at average flows) and it would not do so under the Two Dam Removal Alternative. Peaking power generation flows are released in the late afternoons and early evenings to meet high power demand, and J.C. Boyle Reservoir refills during the night when power demand is minimal. Daily fluctuations in the reservoir water level under existing operations increases mixing in the reservoir, making the reservoir slightly less suitable habitat for phytoplankton during the season of maximum phytoplankton and cyanobacteria (blue-green-algae) growth in the system. Ceasing peaking power generation flows would reduce daily reservoir water level fluctuations in J.C. Boyle Reservoir because the facility would no longer be operated to draw on reservoir storage to support daily peaks in hydropower production when there is not sufficient river flow for peak production (3,000 cfs), as occurs during the summer and fall low flow period under existing conditions. However, the residence time of J.C. Boyle Reservoir without peaking operations would still be short (i.e., on the order of one to three days), so leaving this dam in place and ceasing peaking flows would not change long-term phytoplankton growth or reproduction and thus it would not change the spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms, including blue-green algae, to the degree that new or further impairment of designated beneficial uses would occur.

Similarly, Copco No. 2 Reservoir has no active storage, a negligible hydraulic residence time (i.e., less than one day) (USBR 2012), and does not thermally stratify, such that the reservoir under existing conditions does not support conditions for the growth of phytoplankton in the epilimnion, unlike the larger Copco No. 1 and Iron Gate reservoirs (see 3.2.2.1 *Overview of Water Quality Processes in the Klamath Basin*). Under the Two Dam Removal Alternative, Copco No. 2 Reservoir remaining in place would not affect the spatial extent, temporal duration, and concentration of nuisance and/or noxious phytoplankton species within the Hydroelectric Reach or downstream reaches since it would continue to not support suitable habitat for phytoplankton growth, reproduction, or blooms.

Copco No. 1 and Iron Gate reservoirs currently support growth conditions for toxin-producing nuisance phytoplankton species such as *Microcystis aeruginosa*, with these two reservoirs serving as the primary habitat for blue-green algae in the Hydroelectric Reach. Thus, the removal of Copco No. 1 and Iron Gate reservoirs under the Two Dam Removal Alternative would eliminate the main habitat for toxin-producing nuisance phytoplankton and reduce the long-term spatial extent, temporal duration, and concentration of nuisance and/or noxious phytoplankton species relative to existing conditions, consistent with the Proposed Project. The elimination of Copco No. 1 and Iron Gate reservoirs would be beneficial in the Hydroelectric Reach downstream of Copco No. 1 Reservoir.

Because seasonal phytoplankton blooms are primarily internally generated in Copco No. 1 and Iron Gate reservoirs, removal of these reservoirs under the Two Dam Removal Alternative would also decrease or eliminate the long-term downstream transport of nuisance and/or noxious phytoplankton species and their associated toxins from Copco No. 1 and Iron Gate reservoirs into the Middle and Lower Klamath River, the Klamath River Estuary, and the Pacific Ocean nearshore environment.

In summary, relative to existing conditions, the potential impacts and impacts of the Two Dam Removal Alternative on phytoplankton would be the same as or similar to those described for the Proposed Project, as follows:

- There would be no short-term change in phytoplankton growth and reproduction from existing conditions in the Hydroelectric Reach from J.C. Boyle Dam to the upstream end of Copco No. 1 Reservoir due to mobilization of sediment-associated nutrients from J.C. Boyle Reservoir because this reservoir and its sediment deposits would remain in place (Potential Impact 3.4-1).
- While there would be short-term increases in sediment-associated nutrients downstream of Copco No. 1 Dam due to the release of sediments currently trapped behind the Copco No. 1 and Iron Gate dams, Copco No. 2 remaining in place would not alter the short-term sediment-associated nutrients conditions compared to the Proposed Project and the short-term increases in sediment-associated nutrients would not increase the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton species, including blue-green algae, in the Hydroelectric Reach downstream of Copco No. 1 Dam, the Middle and Lower Klamath River, and the Klamath River Estuary such that there would be new or further impairment of designated beneficial uses; thus there would be no significant impact in the short term (Potential Impact 3.4-1).
- There would be no significant impact in the long term from J.C. Boyle Dam remaining in place and ceasing peaking power generation flows on the spatial extent, temporal duration, transport, and/or concentration of nuisance and/or noxious phytoplankton species and concentrations of algal toxins because J.C. Boyle Reservoir would not support habitat that would promote phytoplankton blooms under the Two Dam Removal Alternative similar to under existing conditions (Potential Impact 3.4-2).
- Copco No. 2 remaining in place would not alter the phytoplankton conditions in the Hydroelectric Reach since it does not support habitat conditions for the growth or reproduction of phytoplankton, including blue-green algae. However, the long-term reduction in the spatial extent, temporal duration, transport, and/or concentration of nuisance and/or noxious phytoplankton species and concentrations of algal toxins due to elimination of Copco No. 1 and Iron Gate reservoir habitats would be beneficial for the Hydroelectric Reach, Middle and Lower Klamath River, and Klamath River Estuary (Potential Impact 3.4-2). There would be no significant impact for the Pacific Ocean nearshore environment (Potential Impact 3.4-2).

4.5.4.2 Periphyton

Short-term mobilization of J.C. Boyle Reservoir sediment deposits would not occur under the Two Dam Removal Alternative, thus there would be no short-term increase in sediment-associated nutrients downstream of J.C Boyle Dam. There would be no change in the short term sediment-associated nutrients in the Hydroelectric Reach or

downstream under the Two Dam Removal Alternative compared to under the Proposed Project due to keeping Copco No. 2 Dam in place, since it is not expected to intercept or retain appreciable amounts of sediment or the associated nutrients during drawdown (see Section 4.5.2.2 *Suspended Sediments* and Section 4.5.2.3 *Nutrients*). While there would be a short-term increase in sediment-associated nutrients between Copco No. 1 Reservoir and Iron Gate Dam in the Hydroelectric Reach, as well as in the Middle Klamath River, Lower Klamath River, and Klamath River Estuary during reservoir drawdown, minimal deposition of fine suspended sediments, including the associated nutrients, would occur in the river channel and the estuary (Stillwater Sciences 2008; USBR 2012). Thus, the short-term increase in nutrients would be limited to the time period when sediment deposits are being transported through the Klamath River. The drawdown of Copco No. 1 and Iron Gate reservoirs and release of these nutrients would occur during winter months when the rates of periphyton growth and reproduction along with the rates of nutrient transformations by microbes (e.g., nitrification and denitrification) are relatively low due to less light availability for photosynthesis and lower water temperatures. As a result, the ability of periphyton to use sediment-associated nutrients would be limited and there would not be an increase in periphyton growth or reproduction during this period, even though additional nutrients would be available due to the release of sediments trapped behind the Lower Klamath Project dams. Light limitation from high concentrations of suspended sediments in the water (Potential Impact 3.2-3) would also reduce any potential for nuisance levels of periphyton growth during reservoir drawdown. Additionally, high river flows during the winter drawdown period and late spring storm events would result in greater sediment movement and scouring, which would greatly limit, if not eliminate, the area of the streambed that periphyton can establish to grow during this period. Thus, the Two Dam Removal Alternative would not be likely to stimulate an increase in periphyton growth or reproduction and result in an increase in the spatial extent, temporal duration, or biomass of nuisance periphyton species that causes a new or further impairment of designated beneficial uses, similar to the Proposed Project.

Under the Two Dam Removal Alternative, J.C. Boyle Reservoir would remain in place and peaking power generation and release of recreation flows would cease from J.C. Boyle Dam, so there would be less artificial diel temperature variation during summer and early fall in the J.C. Boyle Peaking Reach from the Oregon-California state line to Copco No. 1 Reservoir, similar to the Proposed Project (see also Potential Impact 3.2-1). While J.C. Boyle retains relatively little nutrients under existing conditions (see Appendix C, Section C.3.1.1 *Hydroelectric Reach*), nutrient conditions in this reach would be the same under the Two Dam Removal Alternative as under existing conditions since there would be no change in nutrient interception or retention with J.C. Boyle Dam remaining in place. The less diel temperature variations and slight decrease in the maximum water temperature in this reach is not anticipated to affect periphyton colonization. Additionally, the generally high gradient and velocity in the J.C. Boyle Peaking Reach does not currently support excessive periphyton mats and it is not anticipated this reach would support excessive periphyton mats under lower flows once peaking and recreation flows cease. In the short term and long term, increases in periphyton biomass from elimination of peaking and recreation flows along with the change in water temperature in this reach are expected to be limited under the Two Dam Removal Alternative and any potential increase in periphyton would not result in new or further impairment of designated beneficial uses. Nutrient reduction measures in California's Lower Lost River TMDLs and Klamath River TMDLs could, in the long term, further minimize colonization of periphyton mats in the J.C. Boyle Peaking Reach from the Oregon-California state line

to Copco No. 1 Reservoir. However, the measures necessary to achieve significant reductions are, at this point, unknown.

Further downstream in the Hydroelectric Reach, periphyton growth in low-gradient channel margin areas in the footprints of Copco No. 1 and Iron Gate reservoirs could increase on a seasonal basis following dam removal because removal of those two reservoirs would provide additional low-gradient habitat suitable for periphyton assemblages. Periphyton growth would not be likely to be supported in the approximately 0.3 miles of Copco No. 2 Reservoir due to relatively deep water (i.e., up to 28 feet [USBR 2012]), so retaining Copco No. 2 Dam under the Two Dam Removal Alternative and the reduction in suitable periphyton habitat would slightly reduce the extent of periphyton growth compared to the Proposed Project. Dam removal construction and restoration activities in dam removal year 2 and additional sediment transport and scour during winter post-dam removal year 1 may inhibit some periphyton growth in the Hydroelectric Reach in the Copco No. 1 and Iron Gate reservoir footprints, but, overall, periphyton would be expected to begin colonizing the newly created suitable habitat within the short term and would continue in the long term. While retaining Copco No. 2 Reservoir would reduce the available periphyton habitat compared to the Proposed Project, the growth of periphyton within the newly created low-gradient channel margin areas in the Copco No. 1 and Iron Gate reservoirs' footprint conservatively would be a significant impact similar to the Proposed Project (Potential Impact 3.4-4) due to potential increases in nuisance periphyton within the footprints of those two reservoirs. The response of periphyton in the river is subject to many competing processes that could either accelerate or hinder periphyton growth and potential increases in nuisance periphyton (i.e., *Cladophora* sp.) extent, duration, and biomass. In the long term, improvements (i.e., reductions in biomass) are expected from several processes such as scour, long term nutrient reductions stemming from TMDL actions, and in-stream retention processes, whereas improvements could be diminished by processes such as reduced nutrient retention from the reservoirs or climate change. While the growth of nuisance periphyton along channel margin areas is not expected to contribute algal toxins that would impair water quality, the degree to which designated beneficial uses would be impaired due to an increase in nuisance periphyton species (i.e., *Cladophora* sp.) in the newly formed low-gradient channel margin areas of the Hydroelectric Reach is not fully understood. The implications of potential changes in periphyton biomass and community composition on dissolved oxygen and the spread of fish disease are described in Section 3.2.5.4 *Dissolved Oxygen* and Section 3.3.5.5 *Fish Disease and Parasites*, respectively.

Periphyton are a natural component of river ecology and they are an important element of aquatic food webs. The establishment and growth of periphyton, including nuisance periphyton species, along the margins of the newly created low gradient river channel is a natural process. While processes that influence periphyton establishment and growth have been identified (e.g., light availability, nutrient availability, water temperature, seasonal flow variations, sediment transport), variations in these processes within the Hydroelectric Reach of the Klamath River after dam removal would not completely prevent the potential for growth of nuisance periphyton species along the margins of the newly created low gradient river channels. In the reservoir areas of the Hydroelectric Reach that would become the newly created low gradient habitat, there is no periphyton since it is not suitable habitat. No mitigation measure would completely eliminate the potential for establishment and growth of periphyton or specifically nuisance periphyton

within these areas. As such, there are no mitigation measures that can be proposed to significantly avoid or minimize this impact and reduce the impact to less than significant.

In summary, relative to existing conditions, the potential impacts of the Two Dam Removal Alternative on periphyton would be the same as or similar to those described for the Proposed Project, as follows:

- There would be no significant impact in the short term from changes in periphyton growth compared to existing conditions due to mobilization of sediment-associated nutrients from J.C. Boyle Reservoir (Potential Impact 3.4-3) because this reservoir and its sediment deposits would remain in place.
- Copco No. 2 Dam remaining in place would not alter the short-term sediment-associated nutrients during drawdown and periphyton usage of sediment-associated nutrients mobilized from Copco No. 1 and Iron Gate reservoirs would be limited due to lower light levels reducing photosynthesis for periphyton growth and higher flows scouring periphyton from the streambed during winter and early spring. Thus, there would not be an increase in the spatial extent, temporal duration, or biomass of nuisance periphyton species in the Hydroelectric Reach downstream of Copco No. 1, the Middle and Lower Klamath River, or the Klamath River Estuary that would result in a new or further impairment of designated beneficial uses (Potential Impact 3.4-3), and there would be no significant impact.
- There would be no short-term or long-term increase in nuisance periphyton growth that results in new or further impairment of designated beneficial uses in the Hydroelectric Reach from J.C. Boyle Dam to Copco No. 1 Reservoir, including the Oregon-California state line, due to increased nutrients or ceasing of peaking flows at J.C. Boyle (Potential Impact 3.4-4), so there would be no significant impact.
- While Copco No. 2 Dam remaining in place would reduce the available periphyton habitat compared to the Proposed Project, there could be a short-term and/or long-term increase in nuisance periphyton growth that would result in new or further impairment of designated beneficial uses in the Hydroelectric Reach from Copco No. 1 Reservoir to Iron Gate Dam due to an increase in nutrients and available low-gradient channel margin habitat from conversion of the Copco No. 1 and Iron Gate reservoir areas to a free-flowing river (Potential Impact 3.4-4) and if this increase were to occur, it would be a significant and unavoidable impact.
- There would be no long-term increase in biomass of nuisance periphyton that would result in new or further impairment of designated beneficial uses in the Middle Klamath River, Lower Klamath River, and Klamath River Estuary due to increased nutrient availability from upstream dam removal under the Two Dam Removal Alternative similar to the Proposed Project (Potential Impact 3.4-5), so there would be no significant impact.

4.5.5 Terrestrial Resources

Although short-term dam deconstruction activities would not occur for Copco No. 2 Dam under the Two Dam Removal Alternative, deconstruction of Copco No. 1 and Iron Gate dams and associated facilities, and construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would occur, and thus the level of overall construction activities in the Hydroelectric Reach in California would be only slightly less than those described under the Proposed Project. Therefore, in general the Two Dam Removal Alternative would have slightly less short-term potential

impacts on vegetation communities, culturally significant species, special status species, wildlife corridors and habitat connectivity, as those described for the Proposed Project (see Section 3.5.5 *[Terrestrial Resources] Potential Impacts and Mitigation]*. The mitigation measures and recommended terrestrial measures would be the same as those identified for the Proposed Project. Long-term potential impacts and any short-term potential impacts that would be different under the Two Dam Removal Alternative than the Proposed Project are discussed below.

In the long term, since Copco No. 2 Dam and Reservoir would remain under the Two Dam Removal Alternative, the reduction of existing wet habitat that currently supports the following wetland vegetation communities would not occur and there would be no significant impact compared with existing conditions:

- Palustrine Scrub-shrub Wetland and Palustrine Forested Wetland on the southern slope of Copco No. 2 Dam.
- Small, local patches of Palustrine Emergent Wetland supported by water leaks from the Copco No. 2 penstock.

While retaining the existing wet habitat at Copco No. 2 Reservoir would reduce potential long-term impacts to these wetland and riparian vegetation communities described under the Proposed Project and thus may be relatively beneficial, the proposed acreage (150 acres) for restored riparian and wetland vegetation under the Proposed Project is well above the total acreage that would potentially be impacted (68 acres), such that the policy of no net loss compared with existing conditions would be achieved regardless of whether the Copco No. 2 Dam remains under the Two Dam Removal Alternative.

Leaving Copco No. 2 Dam in place under the Two Dam Removal Alternative would avoid potential long-term impacts to the rock talus habitat present just downstream of the dam, and there would be no significant impact on Forest Service or BLM special-status terrestrial invertebrates Oregon shoulderband, Trinity shoulderband, Siskiyou shoulderband, and Tehama chaparral compared with existing conditions. However, since suitable habitat is present in numerous locations throughout the Primary Area of Analysis for terrestrial resources (Appendix G), any impact on this specific area would not be expected to affect any federal species of special concern at a population level, if present (Potential Impact 3.5-10), regardless of whether the Copco No. 2 Reservoir remains under the Two Dam Removal Alternative.

While Copco No. 1 and Iron Gate dams and facilities would be fully removed under this alternative, the Copco No. 2 Dam and facilities and the J.C. Boyle Dam and facilities would remain in place, which would slightly reduce construction activities relative to the Proposed Project. Short-term construction-related noise would still be generated in California due to removal of the Copco No. 1 and Iron Gate dams and associated facilities and installation of fish passage at the Copco No. 2 Dam. Retaining Copco No. 2 structures under this alternative would not reduce noise-related impacts on special-status bats or birds to a less than significant level. Although this alternative would remove structures that also support known bat roosts, including maternity roosts (e.g., Copco No. 1 Dam – C-12 Gatehouse, Copco No. 1 Powerhouse, and Copco No 1. Diversion Tunnel), some of the structures that would be retained (i.e., Copco No. 2 Powerhouse and vacant house #21601) are known to support maternity colonies (see Section 3.5.5.3 *Special-status Species and Rare Natural Communities*). Thus, relative to the Proposed Project, the Two Dam Removal Alternative would reduce the potential

for long-term population-level impacts due to the removal of large maternity colonies day roosts and large maternity colonies that may be present (Potential Impact 3.5-15). While there would be no significant impact to maternity roosts associated with the Copco No. 2 structures compared with existing conditions, there would still be a significant impact compared to existing conditions for this alternative due to the removal of maternity roosts associated with the Copco No. 1 structures.

Retaining Copco No. 2 facilities (reservoir, dam, penstocks, buildings) under the Two Dam Removal Alternative would result in no change from existing conditions with respect to wildlife corridors and habitat connectivity associated with these structures. Effects on wildlife corridors and habitat connectivity would be marginally less beneficial in terms of providing enhanced migration opportunities as those described for the Proposed Project because Copco No. 2 facilities would remain and may continue to impede wildlife migration. The greatest length of parallel steel penstocks that would remain at Copco No. 2 Dam under this alternative is approximately 410 feet and the length of wooden-stave penstock that would remain is approximately 1,330 feet. The Copco No. 2 powerhouse and intake structure do not present a migration barrier under existing conditions such that retaining these features would not represent a change from existing conditions. While retaining Copco No. 2 Dam and Reservoir under the Two Dam Removal Alternative would continue to impede upstream movement of amphibians and reptiles, as described for the Proposed Project, removing Copco No. 1 and Iron Gate dams and reservoirs would benefit some terrestrial species by eliminating barriers to migration (Potential Impacts 3.5-24, 3.5-30, 3.5-31) and overall the effect of the Two Dam Removal Alternative on wildlife corridors and habitat connectivity would be beneficial.

In summary, relative to existing conditions, the potential long-term impacts of the Two Dam Removal Alternative on terrestrial resources would be different from those described for the Proposed Project, as follows:

- Long-term reduction of existing wet habitat that supports the aforementioned wetland vegetation communities on the southern slope of Copco No. 2 Dam and associated with the Copco No. 2 penstock (Potential Impact 3.5-2) would not occur and there would be no significant impact.
- Long-term disturbance of potentially suitable rock talus habitat for the terrestrial invertebrates Oregon shoulderband, Trinity shoulderband, Siskiyou shoulderband, and Tehama chaparral located just downstream of Copco No. 2 Dam (Potential Impact 3.5-9) would not occur and there would be no significant impact.
- Long-term impacts to small day roosts and large maternity colonies in or near the Copco No. 2 Powerhouse and other Copco No. 2 facility structures (Potential Impact 3.5-15) would not occur and there would be no significant impact.

4.5.6 Flood Hydrology

The Two Dam Removal Alternative would have the same potential impacts on flood hydrology as those described for the Proposed Project (Potential Impacts 3.6-1 through 3.6-6). This is because Copco No. 2 Reservoir has no active storage, J.C. Boyle Reservoir has a relatively small storage capacity (2,267 acre-feet total storage; 1,724 acre-feet active storage; see Table 3.6-4) and does not attenuate flood flows in the Area of Analysis, and PacifiCorp does not operate either reservoir for flood control. Therefore, leaving Copco No. 2 and J.C. Boyle reservoirs in place would not affect flood

hydrology compared to the Proposed Project and there would be no significant impacts for Potential Impacts 3.6-1, 3.6-2, and 3.6-4 through 3.6-6. There would be significant and unavoidable impacts related to exposing structures to a substantial risk of damage due to flooding downstream of the location of Iron Gate Dam (Potential Impact 3.6-3).

4.5.7 Groundwater

The Two Dam Removal Alternative would have the same potential impacts on groundwater as those identified under the Proposed Project (Potential Impacts 3.7-1 and 3.7-2). This is because Copco No. 2 Reservoir has no active storage and J.C. Boyle is more than 20 river miles upstream of the Area of Analysis, such that leaving these reservoirs in place would not affect groundwater levels or wells immediately adjacent (potentially extending up to a mile from the reservoirs under certain conditions) to Copco No. 1 and Iron Gate reservoirs compared to the Proposed Project. Removal of Copco No. 1 and Iron Gate reservoirs under the Two Dam Removal Alternative would result in the same effects on groundwater as described for the Proposed Project (Section 3.7.5 *[Groundwater] Potential Impacts and Mitigation*) for the reasons described in Potential Impacts 3.7-1 and 3.7-2, and there would be no significant impacts.

4.5.8 Water Supply/Water Rights

The Two Dam Removal Alternative would have the same potential impacts on water supply/water rights as those identified under the Proposed Project (Potential Impacts 3.8-1 through 3.8-5). This is because Copco No. 2 Reservoir has no active storage, J.C. Boyle Reservoir has a relatively small storage capacity (2,267 acre-feet total storage; 1,724 acre-feet active storage; see Table 3.6-4), and neither reservoir is operated by PacifiCorp as a water supply source, such that leaving these reservoirs in place would not affect water supply/water rights compared to the Proposed Project. Thus, Potential Impacts 3.8-1, 3.8-2, and 3.8-5 under the Proposed Project would be the same under the Two Dam Removal Alternative, and there would be no significant impacts.

Short-term mobilization of J.C. Boyle Reservoir sediment deposits would not occur under the Two Dam Removal Alternative and none of the associated 1,190,000 cubic yards of deposits (i.e., eight percent of total volume for the Lower Klamath Project reservoirs, see also Tables 2.7-7 and 2.7-8) would be eroded or delivered to downstream reaches, although little to no sediment deposition would be expected in the reach between J.C. Boyle Dam and Copco No. 1 Reservoir (USBR 2012). Copco No. 2 Dam does not retain appreciable amounts of sediment (USBR 2011b), nor is it likely to accumulate large sediment deposits during drawdown of the upstream Copco No. 1 Reservoir that would subsequently be released downstream once drawdown begins (see also Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown*). However, mobilization of reservoir sediment deposits in the much larger Copco No. 1 and Iron Gate reservoirs would still occur under this alternative such that release of stored sediment during reservoir drawdown could still impact water intake pumps downstream from Iron Gate Dam (Potential Impact 3.8-3). This would be a significant impact. Implementation of Mitigation Measure WSWR-1 would be required to result in no significant impact.

The City of Yreka's municipal water supply pipeline would still need to be relocated following drawdown of Iron Gate Reservoir, and there would still be potential for disruption to the City's water supply, as described under the Proposed Project. This

would be a significant impact. Implementation of Mitigation Measure WSWR-2 would reduce this potential impact to less than significant.

4.5.9 Air Quality

For the reasons discussed below, potential air quality impacts due to construction activities under the Two Dam Removal Alternative would be the same as those described for the Proposed Project (Potential Impacts 3.9-1 through 3.9-5). Construction activities at J.C. Boyle Dam, regardless of whether these would be for dam removal or fish ladder construction, would occur in Oregon. However, as with the Proposed Project, due to the potential for the emissions generated from construction activity in Oregon to have air quality impacts in Siskiyou County, California, the emissions from construction activity in Oregon are conservatively included in the estimate of total emissions due to construction activity under this alternative.

In California, while short-term dam deconstruction activities would not occur at Copco No. 2 Dam under the Two Dam Removal Alternative, construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would occur, and thus the level of overall construction activities and thus daily emissions of air pollutants (i.e., VOCs, CO, NOx, SOs, PM_{10}, $PM_{2.5}$) in the Hydroelectric Reach in California would be slightly less than those described under the Proposed Project. However, this alternative would still result in air quality levels that exceed the Siskiyou County Air Pollution Control District emissions thresholds for NOx and PM_{10} (Table 4.5-2). If instead of fish ladders, trap and haul or some combination of fish passage methods were used, the level of construction activities at J.C. Boyle and Copco No. 2 dams would be further reduced, however this degree of difference would not be sufficient to result in emissions below the Siskiyou County Air Pollution Control District emissions thresholds for NOx and PM_{10} (Table 4.5-2) and this alternative would result in a significant and unavoidable impact.

Table 4.5-2. Total Uncontrolled Daily Emissions from the Two Dam Removal Alternative.[1]

Project Activity	Daily Emissions (pounds per day)[2]					
	VOC	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
Dam and Powerhouse Deconstruction	117	552	620	7	399	225
Restoration Activities	18	60	165	20	3	3
Recreation Facilities	8	45	54	0	13	6
Yreka Water Supply Pipeline Relocation	3	16	18	0	10	3
Total	146	673	**857**	27	**425**	237
Significance Criterion[2]	250	2,500	250	250	250	250

[1] Data from 2012 KHSA EIS/EIR.

[2] Values shown in grey highlight exceed the Siskiyou County Air Pollution Control District's (SCAPCD) thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants).

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM_{10} = inhalable particulate matter

$PM_{2.5}$ = fine particulate matter

This alternative would not include operational changes that would affect air emissions in the long term for implementation of fish ladders and there would be no significant impact (Potential Impact 3.9-1).

If trap and haul facilities were to be constructed instead of fish ladders, peak daily emissions due to construction activities would be less than those described above. Long term trap and haul operations would consist of trapping adult upstream migrants downstream of Copco No. 2 Dam and releasing them in J.C. Boyle Reservoir as an ongoing activity. Similarly, downstream migrating smolts would be trapped at J.C. Boyle Reservoir, and released downstream of Copco No. 2 Dam. Although the exact extent and timing of these ongoing hauling activities is not known, peak daily air quality emissions would be considerably less than those estimated above because it is unlikely that more than ten truck trips per day would be necessary, including a conservative assumption of round trip (i.e., upstream and downstream) hauling for 30 for 40 miles each way between Copco No. 2 Dam and J.C. Boyle Reservoir. Therefore, the long-term potential impact on air quality emissions due to trap and haul operations would be less than significant.

4.5.10 Greenhouse Gas Emissions

For the reasons described below, greenhouse gas (GHG) impacts under the Two Dam Removal Alternative would be the slightly less than those described for the Proposed Project (Section 3.10.5 *[Greenhouse Gas Emissions] Potential Impacts and Mitigation*). Construction activities at J.C. Boyle Dam, regardless of whether these would be for dam removal or fish ladder construction (or trap and haul or some combination of fish passage methods) would occur in Oregon. However, as with the Proposed Project, due to the cumulative nature of GHG emissions, the emissions from construction activity in Oregon are conservatively included in the estimate of total emissions due to construction activity under this alternative. In California, construction activities at Copco No. 1 and Iron Gate dams would still occur and this, combined with construction activities at Copco No. 2 Dam (including fishway construction) and at J.C. Boyle Dam in Oregon, means that the detailed discussion of impacts to GHGs provided in the Proposed Project (Potential Impact 3.10-1) also applies to this alternative. Leaving Copco No. 2 and J.C. Boyle dams in place would not change the potential for a conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs (Potential Impact 3.10-2). Overall, the Two Dam Removal Alternative would result in no significant impacts due to GHG emissions.

If trap and haul facilities were to be constructed instead of fish ladders, greenhouse gas emissions due to construction activities would be less than those described above. Long term trap and haul operations would consist of trapping adult upstream migrants downstream of Copco No. 2 Dam and releasing them in J.C. Boyle Reservoir as an ongoing activity. Similarly, downstream migrating smolts would be trapped at J.C. Boyle Reservoir, and released downstream of Copco No. 2 Dam. Although the exact extent and timing of these ongoing hauling activities is not known, greenhouse gas emissions would be considerably less than those estimated above because it is unlikely that more than ten truck trips per day would be necessary, including a conservative assumption of round trip (i.e., upstream and downstream) hauling for 30 to 40 miles each way between Copco No. 2 Dam and J.C. Boyle Reservoir. Therefore, the long-term potential impact on greenhouse gas emissions due to trap and haul operations would be less than significant.

4.5.11 Geology, Soils, and Mineral Resources

For the reasons discussed below, the Two Dam Removal Alternative would have similar effects on geology, soils, and mineral resources in California as would the Proposed Project (Section 3.11 *Geology, Soils, and Mineral Resources*), with minor differences discussed at the end of this section. Relative to the Proposed Project, leaving J.C. Boyle and Copco No. 2 dams and associated facilities in place would reduce overall construction activities related to dam removal. However, as discussed in Section 4.6.1.1 *Alternative Description*, the Two Dam Removal Alternative also includes construction of a new fish ladder at J.C. Boyle Dam (and removal of the existing one within a similar footprint to the existing ladder) and construction of a fish ladder at Copco No. 2 Dam. If instead of fish ladders, trap and haul or some combination of fish passage methods were used, the level of construction activities at J.C. Boyle and Copco No. 2 dams would be further reduced relative to the Proposed Project. While there would potentially be less construction activities resulting in short-term soil disturbance under this alternative than under the Proposed Project, the relative decrease in construction activities under the Two Dam Removal Alternative would not change the potential for impacts compared to existing conditions due to geologic hazards, short-term soil disturbance, hillslope instability, earthen dam embankment instability, or loss of mineral resources and impacts would be the same as those described for the Proposed Project.

In California, any of these potential impacts, under either the Proposed Project or the Two Dam Removal Alternative, would be due to removal and reservoir drawdown activities at Copco No. 1 and Iron Gate dams and associated facilities in California. Thus, there would be no significant impacts due to potential for changes to geologic hazards, short-term soil disturbance, earthen dam embankment instability, and mineral resource availability under the Three Dam Removal Alternative for the reasons described for the Proposed Project (Potential Impacts 3.11-1, 3.11-2, 3.11-4 and 3.11-8).

As with the Proposed Project, implementation of Mitigation Measure GEO-1 would be necessary to reduce the potential impacts resulting from slope failure in reservoir rim areas at Copco No. 1 Reservoir (see Potential Impact 3.11-3). With implementation of Mitigation Measure GEO-1, there would be no significant impacts due to the potential for hillslope instability at Copco No. 1 Reservoir during drawdown and the year following drawdown.

Under the Two Dam Removal Alternative, J.C. Boyle Dam would remain in place and the associated 1,190,000 cubic yards of reservoir sediment deposits (eight percent of total volume for the Lower Klamath Project reservoirs, see also Tables 2.7-7 and 2.7-8) would not be eroded or delivered to downstream reaches. The latter would reduce associated short-term erosion and sediment delivery impacts (i.e., sedimentation and bank erosion downstream of Iron Gate Reservoir) that would occur under the Proposed Project, given the relatively smaller volume of sediments in J.C. Boyle Reservoir compared with Copco No. 1 and Iron Gate reservoirs. However, the effect would be relatively small since mobilization of reservoir sediment deposits in the much larger Copco No. 1 and Iron Gate reservoirs would still occur. Further, Copco No. 2 Dam does not retain appreciable amounts of sediment (USBR 2011b), nor is it likely to accumulate large sediment deposits during drawdown of the upstream Copco No. 1 Reservoir that would subsequently be released downstream once drawdown begins (see also Section 2.7.3 *Reservoir Sediment Deposits and Erosion During Drawdown*). Therefore, potential

short-term erosion and sediment delivery impacts under the Two Dam Removal Alternative would be the same as those described for the Proposed Project (Potential Impacts 3.11-5 through 3.11-7) and there would be no significant impacts, with the exception of the Middle Klamath River between Iron Gate Dam and Cottonwood Creek where there would be a significant and unavoidable impact (see Potential Impact 3.11-5). In the long term, J.C. Boyle Reservoir would continue accumulating sediment at approximately the rate that it does under existing conditions, which is generally low (see Table 3.11-6).

4.5.12 Historical Resources and Tribal Cultural Resources

Under the Two Dam Removal Alternative, leaving the J.C. Boyle Dam and associated facilities in place would reduce construction activities related to dam removal relative to the Proposed Project; however, it would not decrease the degree of construction activities or the associated impacts to historical and tribal cultural resources in California since J.C. Boyle is located in Oregon. Unlike under the Proposed Project, reservoir drawdown associated with the removal of J.C. Boyle Dam would not occur under the Two Dam Removal Alternative. However, as discussed in Potential Impact 3.12-3, drawdown releases from J.C. Boyle Dam under the Proposed Project would not cause flooding of the river between the dam and Copco No. 1 Reservoir and would not result in short-term erosion or flood disturbance to the numerous prehistoric archaeological riverside sites with habitation debris, house pits and rock features and cemeteries; as well as ethnographic places and other features of the cultural landscape that have been identified as TCRs along this reach of the Klamath River (PacifiCorp 2004, Daniels 2006). Therefore, leaving J.C. Boyle Dam in place under the Two Dam Removal Alternative would have no bearing on the potential for impacts to known or unknown historical and/or tribal cultural resources within this reach and, like the Proposed Project, there would be no significant impact. The potential for flood disturbance further downstream along the Klamath River would not be different under this alternative from that described for the Proposed Project (Potential Impact 3.12-3) since the two largest reservoirs, Copco No. 1 and Iron Gate would still be removed.

Copco No. 1 and Iron Gate dams would be removed under this alternative and potential impacts to the built environment and historic-period archaeological resources (Potential Impacts 3.12-11 through 3.12-16) and tribal cultural resources (Potential Impacts 3.12-1 through 3.12-8) would be the same as those described for the Proposed Project and would be significant and unavoidable. However, under the Two Dam Removal Alternative, the Copco No. 2 facility, which contributes to the Klamath Hydroelectric Historic District [214], would not be removed and direct impacts to the historical significance of its structures and hydroelectric facilities (e.g., wooden-stave penstock) would not occur (Potential Impact 3.12-11). Installation of upstream and downstream fish passage at Copco No. 2 dam, including all associated construction activities, may impact Copco No. 2 Dam and its associated facilities, and combined with the removal of Copco No. 1 and Iron Gate facilities, the Two Dam Alternative could possibly affect the overall integrity of the Klamath Hydroelectric Historic District. This would be a significant

[214] The Klamath Hydroelectric Historic District is presumed eligible for inclusion on the National Register and the California Register due to its role in early development of electricity and economy of the southern Oregon and northern California regions (see also Section 3.12.2.3 *Known Tribal and Historical Resources in the Vicinity of the Proposed Project*).

and unavoidable impact for the reasons described under the Proposed Project (Potential Impact 3.12-11).

Leaving Copco No. 2 Dam in place under the Two Dam Removal would reduce impacts to known, or as yet unknown, tribal cultural resources located within the footprint of Copco No. 2 reservoir and its associated hydroelectric facilities. However, installation of upstream and downstream fish passage at Copco No. 2 dam and a new day use area near Copco No. 2 Dam, including all associated construction activities, may impact known, or as yet unknown, tribal cultural resources to a similar degree as that described for the Proposed Project. For this reason, and because Copco No. 1 and Iron Gate dams would be removed under this alternative as described for the Proposed Project, potential impacts to tribal cultural resources (Potential Impacts 3.12-1 through 3.12-8) would be the same as those described for the Proposed Project. Implementation of Mitigation Measures TCR-1 through TCR-8 would reduce impacts to tribal cultural resources, but for the reasons described under the Proposed Project, the impacts would remain significant and unavoidable.

There would be approximately 18.2 miles of additional riverine habitat that would become available for salmonids under this alternative (not including 3.5 miles of riverine habitat that would remain inundated by J.C. Boyle Reservoir, and an estimated 0.3 miles of riverine habitat that would remain inundated by Copco No. 2). The additional habitat, combined with a reduced incidence of fish disease and parasites in the Klamath River under this alternative (see Section 4.5.3.4 *Fish Disease and Parasites*), would improve conditions for the Klamath Cultural Riverscape related to fisheries (Potential Impact 3.12-9) relative to existing conditions. This would be a beneficial effect. Reductions in blue-green algae concentrations under this alternative (see Section 4.5.2.6 *Chlorophyll-a and Algal Toxins*) would support Cultural Use of Klamath River waters without risk of adverse health effects, which would improve tribal members' access to the river above levels occurring under existing conditions (Potential Impact 3.12-10) and would be a beneficial effect.

4.5.13 Paleontologic Resources

For the reasons described under the Proposed Project (Section 3.13.5 *[Paleontologic Resources] Potential Impacts and Mitigation*), there could be instances of bank erosion and slope failures in the Middle Klamath River due to changes in river discharge should Copco No. 1 and Iron Date dams be removed (Potential Impact 3.13-1). However, the magnitude of this bank erosion would not be substantial compared to the existing condition and there would be a low likelihood that downcutting or erosion of the Hornbrook Formation located downstream of Iron Gate Dam would occur to a greater degree than existing conditions. Because of their small size (2,267 acre-feet total storage for J.C. Boyle and 70 acre-feet total storage for Copco No. 2; see Table 3.6-4) and because they are not operated by PacifiCorp as a flood control reservoir, retaining J.C. Boyle and Copco No. 2 reservoirs under this alternative would not affect the likelihood of downcutting or erosion relative to existing conditions or the Proposed Project, and given the formation's Low Paleontologic Potential (Potential Impact 3.13-1), there would be no significant impact to paleontologic resources under the Two Dam Removal Alternative.

4.5.14 Land Use and Planning

Under the Two Dam Removal Alternative, the short-term impacts on land use and planning in California would be the same as those described for the Proposed Project in Section 3.14.5 *[Land use and Planning] Potential Impacts and Mitigation*, with the exception of the transfer of Parcel B lands. Because long-term land use under this alternative is currently unknown, this alternative does not assess the potential impacts of long-term use of the lands currently submerged under Iron Gate and Copco No. 1 reservoirs as that would require speculation. The dam removal actions at Copco No. 1 and Iron Gate dams would occur in the same manner under both the Two Dam Removal Alternative and the Proposed Project. Maintaining J.C. Boyle Dam 20 miles upstream in Oregon would not have an impact on California land use or planning. Additionally, the relatively small footprint of the Copco No. 2 Dam and associated facilities would not have a significant impact on land use and planning compared to the Proposed Project.

4.5.15 Agriculture and Forestry Resources

For the reasons discussed below, the potential for impacts on agriculture and forestry resources in California under the Two Dam Removal Alternative would be the same as that for the Proposed Project. Retaining J.C. Boyle Dam would not change or result in the conversion of any California land use relating to agriculture or forestry. In addition, the issues relating to agricultural water in the Lower Klamath Project area would be the same regardless of whether J.C. Boyle Dam remains in place or is removed. The relatively small footprint of the Copco No. 2 Dam and associated facilities does not affect agriculture and forestry resources, such that leaving this reservoir in place would not affect agriculture and forestry resources compared to the Proposed Project. Therefore, under the Two Dam Removal Alternative, potential impacts on agriculture and forestry resources would be the same as those of the Proposed Project and there would be no significant impacts (Potential Impacts 3.15-1 through 3.15-3).

4.5.16 Population and Housing

In California, although short-term dam deconstruction activities would not occur at Copco No. 2 Dam under the Two Dam Removal Alternative, construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would occur and thus the level of overall construction activities and associated population and housing impacts would be slightly less than those described under the Proposed Project (Potential Impacts 3.16-1 and 3.16-2). If instead of fish ladders, trap and haul or some combination of fish passage methods were used, the level of construction activities at J.C. Boyle and Copco No. 2 dams would be further reduced relative to the Proposed Project. For reasons described for the Proposed Project, the Two Dam Removal Alternative would not result in a substantial influx of population (Potential Impact 3.16-1), nor would there be a need to displace existing residents or build replacement housing elsewhere (Potential Impact 3.16-2), and there would be no significant population and housing impacts.

4.5.17 Public Services

In California, although short-term dam deconstruction activities would not occur at Copco No. 2 Dam under the Two Dam Removal Alternative, construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam

would occur and thus the level of overall construction activities and associated impacts to utilities and service systems would be slightly less than those analyzed under the Proposed Project. If instead of fish ladders, trap and haul or some combination of fish passage methods were used, the level of construction activities at J.C. Boyle and Copco No. 2 dams would be further reduced relative to the Proposed Project. For reasons described for the Proposed Project, removal of the two largest California dams under this alternative would still result in significant impacts due to short-term increased response times for emergency fire, police, and medical services (Potential Impact 3.17-1). Mitigation Measure HZ-1 would reduce impacts. In addition, the KRRC is developing a Traffic Management Plan to identify mitigation and other protective measures that would be implemented to reduce impacts to public services. It would also be appropriate for the final Traffic Management Plan to include Recommended Measure TR-1. Overseeing development and implementation of the Traffic Management Plan does not fall within the scope of the State Water Board's water quality certification authority. While the State Water Board expects that this plan will be finalized and implemented, at this time the plan is not finalized, and the State Water Board cannot require its implementation. Accordingly, while the State Water Board anticipates that implementation of Mitigation Measure HZ-1 would reduce impacts to public services, because it cannot require implementation of Recommended Measure TR-1, it is analyzing the impacts under this alternative as significant and unavoidable.

With respect to the elimination of a long-term water source for wildfire services (Potential Impact 3.17-2), under this alternative J.C. Boyle Reservoir and Copco No. 2 Reservoir would remain in place and would serve as relatively accessible sources of water for helicopter fire suppression crews compared to the mainstem Klamath River. However, because J.C. Boyle Reservoir is approximately 20 river miles upstream of Copco No. 1 Reservoir and has a relatively small surface area (approximately 350 acres versus 942 acres [Iron Gate Reservoir] and 972 acres [Copco No. 1 Reservoir], see also Table 2.3-1), response and travel times between water fills related to this reservoir would still be increased over existing conditions. Within the California portion of the Hydroelectric Reach, Copco No. 2 Reservoir would remain as a local source of water for fire suppression relative to existing conditions. Copco No. 2 Reservoir has not been identified by CalFire as a water source for wildfire suppression during the past three years (2015−2018), although this may be because the much larger Copco No. 1 and Iron Gate reservoirs are directly adjacent and presently serve as adequate sources. Under the Two Dam Removal Alternative, Copco No. 2 Reservoir would provide a small surface area, potentially less than 10 acres depending on its upstream extent once Copco No. 1 Dam is removed. The considerably smaller surface area means that Copco No. 2 Reservoir could accommodate fewer helicopters at one time as compared with Copco No. 1 and Iron Gate reservoirs under existing conditions, which would increase response times. The State Water Board anticipates that implementation of alternative water sources for both ground and helicopter crews that are developed through the FERC process would provide a level of protection for reducing the public's risk of loss from wildfires, thereby reducing impacts to less than significant. The KRRC is developing a Fire Management Plan to identify mitigation and other protective measures that would be implemented to reduce impacts to public services. It would be appropriate for the final Fire Management Plan to include Recommended Measure PS-1. Overseeing development and implementation of the final Fire Management Plan does not fall within the scope of the State Water Board's water quality certification authority. While the State Water Board expects that this plan will be finalized and implemented, at this time the plan is not finalized, and the State Water Board cannot require its

implementation. Accordingly, while the State Water Board anticipates that implementation of Recommended Measure PS-1 would reduce impacts to public services, because it cannot require implementation of Recommended Measure PS-1, it is analyzing the impacts under this alternative as significant and unavoidable.

Because removal of Copco No.1, Copco No. 2, and Iron Gate dams and associated facilities would occur under the Two Dam Removal Alternative in the same manner and to the same extent as under the Proposed Project, potential impacts on school services and facilities (Potential Impact 3.17-3) under this alternative would be the same as described for the Proposed Project and would be less than significant.

4.5.18 Utilities and Service Systems

Construction-related activity in California under the Two Dam Removal Alternative would require the need for onsite wastewater disposal, stormwater drainage, and/or solid waste disposal facilities at levels similar to that described for the Proposed Project (Potential Impacts 3.18-1 through 3.18-4) and would result in no significant impacts. Although short-term dam deconstruction activities would not occur at Copco No. 2 Dam and the need for offsite transport and disposal of the waste materials and quantities listed in Table 2.7-5 would be eliminated, there is sufficient permitted capacity to accommodate the solid waste disposal needs of the Lower Klamath Project regardless of whether the Copco No. 2 Dam and associated facilities are removed (Potential Impact 3.18-4). Under this alternative, construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would be likely to require additional materials import, depending on the type of fish passage facilities and day use area that are constructed. However, the overall level of construction-related activity in California would be only slightly less than that described under the Proposed Project, regardless of the type of fishway used, such that the degree of difference would not be sufficient to significantly change the assessment of dam removal activities on the potential for impacts to utilities and service systems. There would be no significant impacts on utilities and service systems related to this degree of construction for the Two Dam Removal Alternative, and construction is the only part of the proposed activities that merits analysis for potential impacts on utilities and service systems.

4.5.19 Aesthetics

For the reasons described in Section 3.19.5 *[Aesthetics] Potential Impacts and Mitigation*, under the Two Dam Removal Alternative, short-term and long-term impacts on aesthetic resources in California, including a loss of open water and lake vistas in favor of more natural river, canyon, and valley vistas (Potential Impact 3.19-1) and changes in river flows, channel morphology, and visual water quality (Potential Impacts 3.19-2 and 3.19-3) would be the same as those of the Proposed Project, since the two largest Lower Klamath Project reservoirs (Copco No. 1 and Iron Gate) would be removed. Although Copco No. 2 Reservoir would not be removed, its small size (70 acre-feet) and lack of access does not provide a substantial open water vista under existing conditions and thus leaving it in place would not materially affect the value of scenic vistas as described under the Proposed Project (Potential Impact 3.19-1) and there would be no significant impacts. In addition, for the reasons described under the Proposed Project, visual changes resulting from drawdown of Copco No. 1 and Iron Gate reservoirs would still be significant and unavoidable in the short term and would

have no significant impact in the long term (Potential Impact 3.19-4) under the Two Dam Removal Alternative.

Under the Two Dam Removal Alternative, the Copco No. 2 facilities would not be removed and installation of new upstream and downstream fish passage at Copco No. 2 Dam, including all associated construction activities, would occur. However, due to the small size of the Copco No. 2 facilities, their inaccessibility to the public, and the fact that they are already inconsistent with the area VRM classification, this would not change the significance determination.

Visual changes due to removal of Copco No. 1 and Iron Gate dams and facilities (Potential Impact 3.19-5), construction activities (Potential Impact 3.19-6) including fishway construction at Copco No. 2 Dam, would be the same as those of the Proposed Project since the manner of dam deconstruction for these two relatively large facilities would be the same under the Two Dam Removal Alternative; impacts would be less than significant. Similarly, impacts to nighttime views from construction lighting would be significant and unavoidable as under the Proposed Project (Potential Impact 3.19-7).

4.5.20 Recreation

Under the Two Dam Removal Alternative, short-term dam deconstruction activities would not occur at Copco No. 2 Dam, and construction of upstream and downstream fish passage facilities and a new day use area near Copco No. 2 Dam would occur, such that the level of overall construction activities and short-term impacts to recreational opportunities in California would be slightly less than those described under the Proposed Project (Potential Impact 3.20-1). For the reasons described in Potential Impact 3.20-1, there would be no significant impact on recreation from implementation of the Two Dam Removal Alternative.

Recreational facilities associated with Copco No. 1 and Iron Gate reservoirs would still be subject to closure and reservoir-related recreation use would still transfer to other regional recreational facilities and/or would be replaced with river-related recreation under this alternative. All portions of the existing recreational facilities at J.C. Boyle Reservoir (Pioneer Park, Topsy Campground, Spring Island River Access) would remain in place under this alternative, offering more regional boating and fishing recreational opportunities relative to the Proposed Project. Elimination of peaking operations under this alternative may increase the appeal of J.C. Boyle Reservoir recreational sites due to elimination of regular reservoir water level fluctuations, but otherwise there would be no change from existing conditions for J.C. Boyle Reservoir recreational opportunities. Although Copco No. 2 Reservoir would not be removed, its small size (70 acre-feet) does not support reservoir-based recreation under existing conditions and thus leaving it in place would not affect reservoir-based recreation opportunities compared to existing conditions and there would be no significant impacts (Potential Impacts 3.20-2 and 3.20-3).

Because long-term land use under this alternative is currently unknown, this alternative does not assess the potential impacts of long-term use of the lands currently submerged under Iron Gate and Copco No. 1 reservoirs as that would require speculation. Therefore, any adverse effects from the construction of new or expansion of existing recreational facilities (Potential Impact 3.20-4) is unknown and not analyzed for this alternative.

While the Two Dam Removal Alternative would not remove J.C. Boyle Reservoir, it also would increase minimum flows in the Bypass Reach, and would not include peaking power generation or release of flows for recreation at J.C. Boyle Dam. Since there would be no recreational flows in the Hydroelectric Reach under this alternative, and flows in the Hydroelectric Reach would be similar to those under the Proposed Project, the loss of whitewater boating opportunities in the Hell's Corner Reach (within the upper portion of the Hydroelectric Reach) would be the same as the Proposed Project (Potential Impact 3.20-5) and would be significant and unavoidable. Farther downstream in the Hydroelectric Reach, Copco No. 2 Dam would remain in place under this alternative, and a new day use area would be constructed near Copco No. 2 Dam that would serve as a whitewater boater take-out point for boaters putting in downstream of J.C. Boyle Dam (FERC 2007). Thus, the Two Dam Removal Alternative would not adversely impact potential new whitewater boating opportunities in the Copco No. 1 and Iron Gate reservoir footprints described for the Proposed Project.

Just downstream of Copco No. 2 Dam in the Copco No. 2 Bypass Reach, effects of the Two Dam Removal Alternative would be different than those described for the Proposed Project. Model results analyzed for the Proposed Project (Potential Impact 3.20-5) indicate that there would be a substantial increase in whitewater boating opportunities during the July through September time period under the 2013 BiOp Flows, which would be a long-term beneficial effect under the Proposed Project. Under the Two Dam Removal Alternative, water diversions for hydropower generation at Copco No. 2 Dam would continue to affect flows in the a 1.5-mile-long Bypass Reach in the Klamath River between the Copco No. 2 Dam and the Copco No. 2 Powerhouse (Figure 2.3-3), such that the long-term benefit to whitewater boating opportunities that would occur under the Proposed Project would not occur under this alternative. Relative to existing conditions, there would be a significant and unavoidable impact to whitewater boating opportunities in the Hell's Corner reach (within the upper portion of the Hydroelectric Reach), a less than significant impact in the Hydroelectric Reach in the Copco No. 1 and Iron Gate reservoir footprints, and no impact in the Copco No. 2 Bypass Reach (where conditions currently do not support whitewater boating), under the Two Dam Removal Alternative. For the reasons described for the Proposed Project (Potential Impact 3.20-5), there would be no significant impact to whitewater boating opportunities in the Middle and Lower Klamath River under this alternative.

Under the Two Dam Removal Alternative, removal of Copco No. 1 and Iron Gate dams and construction of upstream and downstream fish passage at Copco No. 2 and J.C. Boyle dams would beneficially affect recreational fishing of anadromous fish (Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout) throughout the Hydroelectric Reach in California, as described for the Proposed Project (Potential Impact 3.20-6). The primary difference under the Two Dam Removal Alternative is that approximately 3.5 miles of aquatic habitat within J.C. Boyle Reservoir and 0.3 miles of aquatic habitat within Copco No. 2 Reservoir would remain lentic rather than reverting to the riverine conditions described for the Proposed Project. However, the combined inundation length for Copco No. 2 and J.C. Boyle reservoirs is a small proportion (approximately 16 percent) of the 22 miles of Lower Klamath Project reservoir habitat that would be restored to riverine habitat under the Proposed Project (see also Section 4.5.3.7 *[Two Dam Removal Alternative] Aquatic Habitat*) and so the effect of the Two Dam Removal Alternative on California recreational fishing would remain beneficial compared with existing conditions.

The Two Dam Removal Alternative would result in the same impacts to other (non-whitewater boating) river-based recreational facilities in the Middle Klamath River and Lower Klamath River as the Proposed Project (Potential Impact 3.20-6). Water quality improvements would be beneficial for the Hydroelectric Reach, the Middle Klamath River downstream of Humbug Creek (RM 174.3), and the Lower Klamath River. With respect to potential flooding impacts to existing river-based recreational facilities, maintaining J.C. Boyle Reservoir and Copco No. 2 Reservoir would not affect flood hydrology, relative to Proposed Project or to existing conditions, in the Hydroelectric Reach or farther downstream Middle Klamath River and Lower Klamath River (see also Section 4.6.6 *Flood Hydrology*). As under the Proposed Project, there would be little to no change to the 100-year floodplain extent in the Klamath River and Lower Klamath River, with the exception of the reach along the Middle Klamath River from Iron Gate Dam (RM 193.1) to the confluence with Humbug Creek (RM 174.0), where the 100-year floodplain extent would change slightly due to removal of the California Lower Klamath Project dams. However, the slightly increased potential for flooding in this reach would not represent a change or loss of a rare or unique river-based recreational facility affecting a large area or substantial number of people and therefore impacts to recreation under the Two Dam Removal Alternative would be the same as those described for the Proposed Project (Potential Impact 3.20-6) and would be less than significant.

As under the Proposed Project, there would be long-term beneficial effects on the scenic quality, recreation, fisheries and wildlife of the California Klamath River wild and scenic river segment and to the resource values of the eligible and suitable wild and scenic river segment (Potential Impact 3.20-7), though some of the impacts (such as to scenic resources) would be less beneficial under the Two Dam Removal Alternative. However, beneficial effects on water quality, natural flow regimes and anadromous fisheries would still occur.

4.5.21 Hazards and Hazardous Materials

The Two Dam Removal Alternative would have similar potential impacts on hazards and hazardous materials as those described for the Proposed Project (see Section 3.22.5 *[Hazards and Hazardous Materials] Potential Impacts and Mitigation*). Short-term dam deconstruction activities would not occur at Copco No. 2 Dam under the Two Dam Removal Alternative, eliminating the need for offsite transport and disposal of potentially hazardous materials at Copco No. 2 Dam and Powerhouse, including the creosote-treated wooden-stave (redwood) penstock, coatings containing heavy metals in the powerhouse, on the exterior surfaces of the steel penstocks, air vents, and other painted materials, a fueling facility containing above-ground gasoline (1,000 gallon) and diesel (500 gallon) tanks, and underground septic systems used for seven residences near the powerhouse (see also Section 2.7.1.3 *Copco No. 2 Dam and Powerhouse).* While this alternative would reduce potential impacts in California due to reduced offsite transport and disposal of these hazardous materials relative to the Proposed Project, the aforementioned Copco No. 2 features that have coatings containing heavy metals, gasoline and diesel tanks, and underground septic systems could be damaged or exposed during or following construction activities and would require preservation to reduce the risk of environmental contamination. Further, construction of upstream and downstream fish passage facilities at Copco No. 2 Dam would result in an overall level of construction-related activity in California that would be only slightly less than that described under the Proposed Project, where the degree of difference would not be

sufficient to significantly change the assessment of dam removal activities on the potential for hazard-related impacts due to transport or use of hazardous materials during construction activities as compared with those discussed under the Proposed Project. Lastly, maintaining J.C. Boyle Dam in Oregon would not change the hazards and hazardous materials analysis for California because the transport, use, and disposal of general construction waste materials (e.g., concrete, rebar, building waste, power lines) associated with J.C. Boyle Dam removal, as well as construction-related activities that could result in the accidental release of hazardous materials to the environment, would occur in Oregon. Overall, potential construction-related impacts under the Two Dam Removal Alternative would be slightly less than or the same as those of the Proposed Project (Potential Impacts 3.21-1, 3.21-2, and 3.21-4) and would be significant. Implementation of Mitigation Measure HZ-1 would be required to result in no significant impacts. For the reasons described for the Proposed Project, the potential short-term impact of this alternative on the implementation of adopted emergency response plans would be significant and unavoidable (Potential Impact 3.21-7).

With respect to removal of the Lower Klamath Project reservoirs as a readily available source of water for helicopter fire suppression crews fighting local fires, Copco No. 2 Reservoir has not been identified by CalFire as a water source for wildfires during the past three years (2015−2018), while Copco No. 1 and Iron Gate reservoirs have served in this capacity (see also Potential Impact 3.21-8). The two largest Lower Klamath Project reservoirs (Copco No. 1 and Iron Gate) would still be removed under this alternative, which would substantially increase the public's risk of loss, injury or death associated with wildfires as described for the Proposed Project (Potential Impact 3.21-8). J.C. Boyle Reservoir and Copco No. 2 Reservoir would remain in place and would continue to serve as accessible water surfaces for helicopter fire suppression crews compared to the mainstem Klamath River. However, because J.C. Boyle Reservoir is approximately 20 river miles upstream of Copco No. 1 Reservoir and has a relatively small surface area (approximately 350 acres versus 942 acres [Iron Gate Reservoir] and 972 acres [Copco No. 1 Reservoir], see also Table 2.3-1), response and travel times between water fills would still be increased over existing conditions and the Proposed Project for helicopter crews to fly to J.C. Boyle Reservoir for water pick up. Within the California portion of the Hydroelectric Reach, Copco No. 2 Reservoir would remain as a local source of water for fire suppression relative to existing conditions. However, this reservoir would have an even smaller surface area, potentially less than 10 acres (depending on its upstream extent) once Copco No. 1 Dam is removed. A smaller surface area means that it could theoretically accommodate fewer helicopters at one time, as compared with Copco No. 1 and Iron Gate reservoirs under existing conditions, which would increase response times. Overall, relative to existing conditions, removal of the two largest reservoirs (Copco No. 1 and Iron Gate) under the Two Dam Removal Alternative would result in a substantial increased public risk of loss, injury, or death involving wildland fires due to increased response and travel times relative to existing conditions and would be a significant impact.

4.5.22 Transportation and Traffic

For the reasons described in Section 3.22.5 *[Transportation and Traffic] Potential Impacts and Mitigation Measures*, removal of the two largest of the Lower Klamath Project dams and associated facilities (Copco No. 1 and Iron Gate) would still occur under the Two Dam Removal Alternative and would result in short-term potential impacts on transportation and traffic. In California, short-term dam deconstruction activities

would not occur at Copco No. 2 Dam under this alternative, reducing the need for offsite waste transport and the number of associated truck trips relative to the Proposed Project. However, construction of upstream and downstream fish passage facilities at Copco No. 2 Dam would occur, potentially increasing the need for material import and associated California truck trips for this facility such that overall construction levels under this alternative would be slightly less than those described for the Proposed Project. In Oregon, construction of upstream and downstream fish passage at J.C. Boyle Dam would generate a short-term increase in construction-related vehicle trips, which would be similar to, albeit likely somewhat less than, transportation and traffic impacts described for dam deconstruction under the Proposed Project. Note that J.C. Boyle Dam-associated vehicle trips are included in the analysis of the Proposed Project as some of the construction-related traffic flow may use roads in California (e.g., I-5 to OR 66) and this also would be likely to occur under the Two Dam Removal Alternative.

As described in Section 3.22.5 *[Transportation and Traffic] Potential Impacts and Mitigation*, the Proposed Project would result in significant and unavoidable short-term impacts to traffic flow, road safety, road conditions, emergency access, public transit, and non-motorized transportation, unless and until KRRC reaches enforceable 'good citizen' agreements that are finalized and implemented through the FERC process and that include proposed items for the final Traffic Management Plan and Emergency Response Plan (Appendix B: *Definite Plan − Appendices O1 through O4*), as well as the additional components included in Recommended Measure TR-1 (Potential Impacts 3.22-1 through 3.22-5). Because the level of overall construction activities and impacts to transportation and traffic in California would be only slightly less than those described under the Proposed Project, the Two Dam Removal would also result in significant and unavoidable short-term impacts to the aforementioned traffic- and transportation-related activities and would require similarly enforceable 'good citizen' agreements to reduce impacts to less than significant, as described for the Proposed Project.

As described for the Proposed Project, the Lower Klamath Project dams are not located within two miles of an airport nor would their removal result in a change in air traffic patterns that would result in a substantial safety risks, regardless of whether J.C. Boyle Dam and Copco No. 2 Dam remain place, and there would be no significant impact (Potential Impact 3.22-6).

As described previously, fish passage under the Two Dam Removal Alternative would either be provided by volitional fishways, or trap and haul, or some combination. Facility construction, and thus any related potential transportation and traffic impacts, for trap and haul would be less than that described for fish ladders. Long term trap and haul operations would consist of trapping adult upstream migrants downstream of Copco No. 2 Dam and releasing them in J.C. Boyle Reservoir as an ongoing activity. Similarly, downstream migrating smolts would be trapped at J.C. Boyle Reservoir, and released downstream of Copco No. 2 Dam. Roads within the traffic and transportation Area of Analysis currently carry substantially fewer vehicles than the planning capacity (Table 3.22-2 and Section 3.22.2.1*Traffic Flow*), such that additional truck trips, assuming both upstream and downstream trap and haul operations, would not substantially change traffic conditions. Although the exact extent and timing of these ongoing hauling activities is not known, it is unlikely that more than ten truck trips per day would be necessary, including a conservative assumption of round trip (i.e., upstream and downstream) hauling for 30 to 40 miles each way between Copco No. 2 Dam and J.C. Boyle Reservoir. Therefore, trap and haul traffic would be a less than significant impact.

Significance
No significant impact

4.5.23 Noise

For the reasons described in Section 3.23.5 *[Noise] Potential Impacts and Mitigation Measures*, removal of Copco No. 1 and Iron Gate dams would result in noise and vibration that would affect sensitive receptors and exceed Siskiyou County General Plan standards under this alternative. The Two Dam Removal Alternative would have slightly less short-term potential impacts on noise than those described for the Proposed Project since short-term dam deconstruction activities would not occur at Copco No. 2 Dam. However, construction of upstream and downstream fish passage facilities would occur and would likely generate short-term increases in daytime and nighttime noise levels affecting nearby residents such that overall there would be significant and unavoidable adverse environmental impacts resulting from: construction equipment exceeding maximum allowable noise levels (Potential Impact 3.23-1); noise disturbance to residents from construction-generated noise at Copco No. 1 and Iron Gate dams (Potential Impacts 3.23-2 and 3.23-4), reservoir restoration at Copco No.1 and Iron Gate dams (Potential Impact 3.23-5); and vibration disturbance from blasting activities at Copco No. 1 and Iron Gate dams (Potential Impact 3.23-6). Other noise and vibration generation from the Two Dam Removal Alternative would not have a significant adverse impact (Section 3.23-5 *[Noise] Potential Impacts and Mitigation*).

As described previously, fish passage under the Two Dam Removal Alternative would either be provided by volitional fishways, or trap and haul, or some combination. If trap and haul were to be used there could be potential long-term noise-related impacts due to regular truck traffic during seasonal trap and haul operations, as described below.

Potential Impact 4.5-1 Trap and haul-related noise.
Activities associated with the implementation of seasonal trap and haul operation prescriptions for Copco No. 2 Dam and associated facilities could result in daytime and nighttime noise levels affecting nearby residents. Trap and haul operations for J.C. Boyle would occur in Oregon and thus would not result in noise-related impacts in California. As described under the analysis of traffic flow effects for the Continued Operations with Fish Passage Alternative (Section 4.4), vehicle trips associated with trap and haul operations would take place following dam deconstruction and fishway construction. There would be no overlap between these trips and peak construction-related traffic. The closest noise-sensitive receptor to Copco No. 2 Dam is the Janice Avenue rural residential area, located approximately 3,700 feet to the east of the dam (Figure 3.23-4). The line of sight from the receptor to Copco No. 2 Dam is blocked by a hill. Due to the natural topography surrounding the dam and the distance between the dam and the receptor, noise from ongoing, seasonal trap and haul activities at the Copco No. 2 Dam would be reduced to less than significant levels at sensitive receptors**.**

Significance
No significant impact

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