PacifiCorp Positions on Important Topics

Klamath Hydroelectric Project No. 2082
PacifiCorp
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Introduction

The purpose of this submission is to summarize PacifiCorp's perspective and positions on important topics central to the relicensing of the Klamath Hydroelectric Project and associated NEPA analysis, and related to the federal agencies' preliminary prescriptions and conditions issued under sections 18 and 4(e) of the Federal Power Act ("FPA"). Pursuant to these sections, as amended recently by the Energy Policy Act of 2005 ("EPAct"), PacifiCorp has invoked its rights to request a trial-type hearing on disputed issues of material facts raised by these proposed mandatory conditions, and to offer alternatives to these proposed conditions for agency consideration. PacifiCorp submitted its requests on April 28, 2006, challenging:

- Preliminary fishway prescriptions from the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) pursuant to section 18 of the FPA.
- Preliminary conditions for protection and utilization of Bureau of Land Management (BLM) and Bureau of Reclamation (BOR) lands and facilities pursuant to section 4(e) of the FPA.

The summary provided below is organized into the following major topics:

- Fish passage and anadromous fish reintroduction
- Water quality
- Instream flows and ramping rates
- Proposed FERC boundary (including exclusion of Keno facilities)
- Dam removal

A detailed discussion of PacifiCorp's rationale for these positions is attached in Appendix A.

In addition to discussing these major topics, this submission presents PacifiCorp's responses with respect to:

- Recommendations to protect, mitigate, and enhance beneficial public uses and fish and wildlife resources pursuant to sections 10(a) and 10(j) of the FPA. A number of agencies filed letters to FERC providing section 10(a) and 10(j) recommendations. Additional stakeholders have filed comments under section 10(a).

For ease of reference, PacifiCorp has developed several matrices that provide PacifiCorp's responses to many of the comment letters from agencies, tribes, and other stakeholders that provide FERC with preliminary terms, conditions, prescriptions, and recommendations for the Project.

PacifiCorp's Positions

Fish Passage and Reintroduction

On March 29, 2006, NMFS and USFWS ("Services") issued preliminary fishway prescriptions for PacifiCorp's Klamath Project under section 18 of the FPA, essentially requiring the company to install fish ladders and screens at each of the Project's dams in efforts to facilitate the Services' objective of reintroducing anadromous fish to the Klamath River Basin above Iron Gate Dam. Not only will these measures cost the company more than $300 million to implement, they will not result in the Services' intended goal of restoring a self-sustaining fishery—a goal which PacifiCorp supports but which can only be achieved through implementation of a flexible and adaptive management plan, such as that proposed by the FPA section 18 Alternative PacifiCorp submitted to the Services on April 28, 2006.[1]

PacifiCorp's Alternative incorporates an adaptive, science-based approach to reintroducing anadromous fish to the Upper Klamath Basin, using a fish collection and transport program to test, verify, and adapt to the enormous uncertainties surrounding reintroduction, which have caused the federal and state fish and wildlife agencies in the recent past to conclude that reintroduction should not be attempted now, or in the near future. Those factors include:

> (1) the fact that anadromous fish do not exist in the Upper Klamath Basin. A reintroduction program would require transfer of lower Klamath River fish or out-of-basin fish stocks to the upper basin, yet these fish stocks would likely not have the genetic or behavioral traits needed to be successful in a stream environment considerably different than their natal stream. Fish transplanted above the project must adapt to the narrow biological requirements of the Upper Basin and not cause interbreeding, which could lower stock fitness;
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> (2) naturally warm water conditions, high pH, and low dissolved oxygen in Upper Klamath Lake, which are sub-optimal for salmonid migration and potentially lethal after June 1;
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> (3) long distances (hundreds of miles) required for juvenile migration, much of which is through Upper Klamath Lake and Lake Ewauna and other Project reservoirs to which Lower Klamath fish stocks have never been exposed; data demonstrates that only 4 to 38% of the population may successfully survive migration;
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> (4) predation that occurs in lakes and Project reservoirs;

[1] PacifiCorp submitted a series of Alternatives to the agencies that issued preliminary prescriptions and conditions pursuant to FPA sections 18 and 4(e) on April 28, 2006, as authorized by section 33 of the FPA, 16 U.S.C. §823d. In so doing, PacifiCorp demonstrated not only that its section 18 Fishway Alternative was equally protective, but that it was significantly less costly. PacifiCorp estimates that its adaptive collection and transport plan will cost approximately $50 million to implement, which is six times less costly than the Services'. Contemporaneous with its Alternatives filing, PacifiCorp filed a Request for Hearing on Disputed Issues of Material Fact challenging these same proposed mandatory conditions. These filings collectively demonstrate the impropriety of the Services' prescriptions and that PacifiCorp's Alternatives should be adopted as a matter of law. FPA section 33. PacifiCorp reserves its right to request FERC to invoke the Dispute Resolution Process in the event that its Alternative is not ultimately adopted by the Services. 70 Fed. Reg. 69805.

(5) competition for food and habitat with existing native fish fauna;

(6) mortality experienced by both adults and juveniles in attempting to navigate back and forth through a series of six dams and reservoirs; the significant height of several of the Project dams, which, when coupled with specific technical requirements for fish ladders, results in fishways approximating more than 3,000 feet in length, and thus long transit times and potential mortality;

(7) the small amount and marginal quality of fish habitat within the Project area as compared to above the Project area;

(8) the introduction and spreading of disease which could cause serious harm to native trout;

(9) adverse fishery impacts occasioned by ocean factors, current harvest rates, and other environmental factors. [2]

Significantly, a recognition of these same risks and uncertainties led the Klamath Tribe, in its recently filed Comments and Recommendations under FPA section 10(a), to include an adaptive management plan for reintroduction that cautioned against any precipitous action prior to a thorough scientific evaluation of the risks inherent in any reintroduction plan of the magnitude now contemplated for the Klamath River Basin. *See* Ex. A to Klamath Tribes' Comments, "Reintroduction of Anadromous Fish to the Upper Klamath Basin: An Evaluation and Conceptual Plan" (March 2006).

In light of these inherent risks and uncertainties, any reintroduction program in the Klamath River Basin must be both flexible and adaptive, allowing fishery managers to respond to the numerous fish management issues that will undoubtedly arise, and must be facilitated through use of a collection and transport plan such as that proposed by PacifiCorp's Alternative.

Indeed, this is the only way that reintroduction has been either attempted or accomplished by the very federal and state fish and wildlife agencies that have issued draft prescriptions or

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[2] These very risks were exhorted by federal, state, and tribal representatives to the Klamath River Basin Fisheries Task Force, which in 1992 concluded that

> [w]hile the dream of restoring salmon and steelhead remains alluring, consideration of re-introduction of these fish above Iron Gate Dam should be left to the future.

Upper Klamath River Basin Amendment to the Long Range Plan at 5-A-6. The risks inherent in a massive science experiment of this nature with serious potential repercussions were perhaps best explained by the Oregon Department of Fish and Wildlife ("ODFW"), which is on record cautioning against reintroduction due to just these factors:

> [B]ecause of existing habitat problems, loss of native stocks, risk of disease introduction and potential competition with remaining native redband trout, *it does not appear feasible, or prudent, to attempt re-establishment of anadromous salmon or steelhead to the Upper Klamath Basin in Oregon, now or in the near future.*

Klamath River Basin, Oregon Fish Management Plan (1997) at 66 (emphasis supplied).

recommendations in this relicensing proceeding. We know of no situation where NOAA Fisheries or USFWS, has ever attempted reintroduction in the inflexible manner prescribed in this relicensing proceeding.

While conceding all the risks stated above, the Services presume to know all there is to know about how, where, and when to safely reintroduce species that have not existed above Iron Gate Dam for more than a century, in a manner that will not only not compromise the health of native stocks, but will also ensure self-sustaining populations. Yet, as highlighted by the Klamath Tribe's adaptive management plan, it is simply impossible to know today how best to accomplish this goal, which these same agencies have recognized in all other relicensing proceedings will take years of rigorous scientific study and analysis to achieve.

In addition, by requiring the licensee to immediately build a series of costly ladders and screens at all Project dams, these proposed prescriptions will cause fish to unnecessarily encounter environmental perils. These perils should and could otherwise be avoided through implementation of a collection and transport program like that developed by PacifiCorp and adopted elsewhere by federal and state fishery managers. PacifiCorp's collection and transport plan will allow these fish (some of which are already listed as threatened or endangered under the Endangered Species Act) to bypass less viable habitat within the Project area, including Project reservoirs and ephemeral streams, and avoid the need to navigate over and through a series of dams and project facilities in order to reach higher-quality upstream habitat above the Upper Klamath Lake. Only through implementation of a collection and transport program that allows fish managers to scientifically evaluate information and data as it becomes known, and make the necessary adjustments responsive to that new information, can fish become self-sustaining against the odds posed by the Klamath River Basin.

Water Quality

The water quality of the Klamath River within the Project area is inherently influenced by the very poor quality of the waters flowing into the Project area from upstream, notably Upper Klamath Lake (UKL). Water quality in UKL is known as "hypereutrophic"—a condition which contributes large amounts of nutrients and organic material to the river, impairing water quality within Project reservoirs and causing seasonal algae blooms.

The Project not only does not substantially contribute to these impairments, it instead actually improves elements of water quality within the Project area and below. The Project reservoirs (particularly Copco and Iron Gate) act as a "sink" by slowing the time it takes water particles to travel, and thus causing unwanted and harmful organic matter and nutrients to sink toward the reservoir bottom. The "sink-like" effect of the reservoirs actually improves downstream water quality by mitigating the poor water quality dictated by hypereutrophic UKL discharges. The J.C. Boyle, Copco and Iron Gate reservoirs are more effective than the river in retaining organic matter and nutrients and thus removing them from passage downstream, where they would further adversely affect the river's water quality. During the summer, the more effective retention of organic matter and nutrients in these reservoirs results in episodes of low dissolved oxygen in deeper areas of the reservoirs and periodic blooms of algae near the surface of the reservoirs. To effectively address the low dissolved oxygen and periodic blooms of algae, PacifiCorp proposes to implement Reservoir Management Plans aimed at reducing algae concentrations, increasing dissolved oxygen, and improving pH.

Another way that the Project actually improves water quality is by diverting warm, nutrient-laden water from the 4-mile bypass reach downstream of J.C. Boyle dam, allowing cold, clear spring water to dominate this bypassed reach. The springs that enter this reach have a notable impact on conditions within the bypass reach down to the J.C. Boyle powerhouse, providing a cool water source to a river that may otherwise exceed 24°C. The absence of the warm, nutrient-laden water that would otherwise be present in this reach, which allows these cold spring waters to dominate, creates good fish spawning and rearing habitat that would otherwise not exist.

As a natural consequence of the reservoirs' presence, the Project can affect temperatures below the Project's dams during some periods of the year. Copco and Iron Gate reservoirs naturally cause a thermal "lag" as water passes through the reservoirs, which decreases water temperatures during spring and increases the temperature of water leaving the reservoir during fall. The water temperature increases do not detrimentally affect fish, however, because as the autumn progresses, water temperatures begin decreasing to levels that are suitable for anadromous fish. PacifiCorp is nevertheless committed to working with the water quality and fisheries agencies to explore opportunities for using the limited cool-water storage in Iron Gate reservoir to protect and enhance fish uses downstream of Iron Gate dam while also providing cool water to the Iron Gate fish hatchery.

Instream Flows and Ramping Rates

The Bureau of Land Management ("BLM") has issued a set of mandatory instream flow and ramping rate conditions under FPA section 4(e) that are beyond its powers to propose. First, as set forth in more detail in "PacifiCorp's Proposed Alternatives to the Department of the Interior's Preliminary Section 18 Prescriptions and Section 4(e) Conditions" (incorporated herein by reference), BLM has no authority to specify minimum instream or weekly peaking flows for the Klamath River in either the J.C. Boyle bypass or peaking reaches, because these reaches are owned exclusively by Oregon and California. *Federal Power Commission v Tuscarora Indian Nation,* 362 U.S. 99 (1960) (land not owned by the United States cannot be a "reservation" under section 3 of the FPA). Second, the J.C. Boyle bypassed river reach is not within the Project boundary, and as such is outside the scope of BLM's alleged authority. Third, the J.C. Boyle dam does not occupy any BLM reservation land; therefore BLM cannot dictate flows from or ramping restrictions related to the operation of that dam. Finally, the BLM lands adjacent to the J.C. Boyle river reaches are subject to power site reserves.[3] Thus, whatever authority BLM

[3] Some of the BLM lands adjacent to the Klamath River in these reaches are subject to Power Site Reserve No. 258, which requires BLM to manage lands subject to its terms for power site values exclusively. The remainder of the BLM lands adjacent to the Klamath River in the peaking and bypassed river reaches was subject to Power Site Reserve No. 582, which was revoked on August 10, 2000. The revocation of that Power Site Reserve divested BLM of all authority to issue FPA section 4(e) conditions for these former power-site classification lands, because the revocation eliminated the "reservation" status of such sites under BLM supervision for purposes of FPA section 3(2).

If, on the other hand, the revocation left any authority to BLM to issue conditions, that authority is limited to that necessary for the protection and utilization of the Oregon and California Act Revested Lands Act power site values, and does not allow BLM to impose stream flow-related conditions. *See* Senate Report No. 1231, 75th Congress, 1st Sess. at 5 (Aug. 16, 1937) (explicitly admonishing against agency attempt to allow direct regulation of stream flows); *see also* Section 1 of the 1937 O & C Act Amendments, emphasizing that nothing therein shall be construed to interfere with the use and development of power sites as may be authorized by law).

claims to have under FPA section 4(e) would require it to use that authority for the benefit of power production. PacifiCorp's April 28, 2006 DOI Alternatives at 52.

Moreover, even assuming, for the sake of argument only, that BLM possessed the requisite authority to issue mandatory license conditions under FPA section 4(e), it may exercise such authority only to support the "adequate protection and utilization" of its federal reservation. 16 U.S.C. §797(e) (emphasis supplied). Because the existing instream flow and ramping rate conditions within the J.C. Boyle peaking reach currently support a highly productive recreational trout fishery,[4] these conditions are clearly more than adequate for the protection and utilization of such reservation. In fact, the J.C. Boyle peaking reach was designated as an "Outstandingly Remarkable Value" ("ORV") under the Wild and Scenic Rivers Act, 16 U.S.C. § 1271(B), in recognition of the "exceptional trout fishery," with a catch rate among the highest in Oregon.

In addition to the outstanding fishery in the J.C. Boyle reaches, the National Park Service designated these waters as an ORV because they provide "a variety of year-round whitewater boating opportunities" as a result of the "year-round releases from the J.C. Boyle Dam/Powerhouse system." Klamath Wild & Scenic Eligibility Report and Environmental Assessment at 12, 18, 41-42 (1994); PacifiCorp's DOI Alternatives at 53-54. For these reasons, BLM is under a legal obligation to ensure that whatever authority it claims it possesses to dictate project flow conditions – and that authority is seriously in doubt – is exercised in a reasonable fashion that "protects and enhances" those legally protected values. 16 U.S.C. § 1283(a).

Notwithstanding the above, BLM has recently proposed a set of mandatory flow conditions and ramping restrictions for the J.C. Boyle bypass and peaking reaches based on flawed assumptions that do not apply to the Klamath River system, and a methodology that clearly departs from accepted science, at the expense of the other statutorily protected resource values that BLM is required to protect. First, BLM admits that its instream minimum flows, its weekly peak flow, and attendant ramp rate conditions will together cause a significant reduction in whitewater rafting opportunities – turning this from a year-round recreational industry into a sporadic, low-quality, intermittent one at best. Modeling conducted by PacifiCorp demonstrates that in below-average or dry water years, available rafting days would be few to none during the peak rafting months of June, July and August. BLM's proposed flows will also serve to diminish the fly fishing opportunities in this reach.

Second, again assuming for purposes of discussion that BLM has section 4(e) conditioning authority by dint of BLM reservation lands adjacent to the J.C. Boyle river reaches, these lands are power site reserves, which means that BLM is required to manage them to support power generation. Yet BLM acknowledges that its flows and ramping restrictions will cause more than a forty percent reduction in power during the summer months when consumer demand is at its highest. These concessions moreover underestimate the extent of the power losses that will result from BLM's proposed stream-flow and ramping restrictions. Modeling conducted by

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[4] Annual angler catch rates in the Oregon portion of the J.C. Boyle peaking reach support catch rates that are reported to be comparable to other high-quality trout streams in Oregon, including the Deschutes and Metolius Rivers (City of Klamath Falls 1986, National Park Service 1994). CDFG (2000) has reported that the California portion of the J.C. Boyle peaking reach had the highest overall catch rates among the wild trout rivers it monitors in California.

PacifiCorp demonstrates that BLM's proposed prescriptions will result on average in a minimum loss of 96% of J.C. Boyle's total daily generating capacity in June, a 100% loss in July, and a 72% loss in August. By virtually eliminating the ability of PacifiCorp to conduct peaking operations, BLM would fail to protect the very resources it is by law required to protect.

In sum, the flow and ramping restrictions currently in place are more than adequate to support whatever section 4(e) authority BLM may claim to have, whereas BLM's proposed conditions are not only *ultra vires* but also arbitrary, capricious, and contrary to law, 5 U.S.C. § 706. PacifiCorp, on the other hand, has proposed Alternatives to BLM's allegedly authorized flow requirements that provide suitable and adequate habitat and water quality conditions for resident fish.

Proposed FERC Project Boundary (Including Exclusion of Keno Facilities)

The proposed Project boundary set forth by PacifiCorp in Exhibit A of the Final License Application (PacifiCorp, 2004) includes those lands necessary for operation and maintenance of Project facilities and for resource enhancement measures Because PacifiCorp intends to decommission and remove the East Side and West Side powerhouses associated with the Link dam, and because Keno Dam and Reservoir (Lake Ewauna) do not contribute to downstream Project generation, none of these facilities and works will be a part of the relicensed Klamath Project "unit of development," as defined by FPA section 3(12), and therefore FERC will not have jurisdiction over them. Accordingly, the proposed Project boundary excludes these facilities and works. The J.C. Boyle bypassed reach of the Klamath River is also excluded from the proposed Project boundary, because it is not necessary for Project purposes. ..

Dam Removal

On March 29, 2006, USFWS and NMFS issued preliminary fishway prescriptions for PacifiCorp's Klamath Project under section 18 of the FPA, requiring PacifiCorp to install fish ladders and screens at each of the Project's dams in efforts to reintroduce anadromous fish to the Klamath River Basin above Iron Gate Dam. At the same time, the agencies "continue to urge the Commission … to evaluate dam decommissioning and removal." Similarly, a number of tribal and environmental interest groups continue to express strong sentiment in favor of removal of the Project's existing facilities.

PacifiCorp is not persuaded that the Commission has authority to compel the removal of a project dam, if the licensee does not agree to such action; it therefore reserves its right to argue that the Commission lacks such authority. For purposes of current discussion, however, PacifiCorp notes that, as explained below, dam removal poses substantial environmental risks, entails great uncertainties, and offers limited benefits. The basis for these concerns includes the following:

> (1) The Project reservoirs created by the dams (Iron Gate, Copco, and J.C. Boyle) help protect water quality in the lower basin by processing the enormous loads of nutrients and organic matter from Upper Klamath Lake (UKL). Dam removal will result in a loss of this function, increasing the risk of long-term impairment of water quality and fisheries in the lower river and estuary.

(2) Approximately 15 million cubic yards of sediments have accumulated behind Iron Gate, Copco, and J.C. Boyle Dams. Dam removal is likely to cause:

- releases of nutrients and other contaminants currently bound in the sediments,
- increases in downstream turbidity and suspended sediment levels,
- downstream channel aggradation or sediment deposition, and
- channel incision and shifting in formerly impounded reaches of the river.

These effects are of particular concern in this system, as they would detrimentally impact sensitive fish below Iron Gate Dam, such as anadromous species, by further impairing water quality and habitat conditions.

(3) While dam removal will provide access to the Project area and the upper basin for anadromous fish, as desired by many stakeholders, uncertainty surrounding reintroduction and the resulting loss of Iron Gate Hatchery may significantly diminish total numbers of anadromous fish returning to the Klamath to potentially unsustainable levels.

(4) Dam removal increases the risks of detrimental impacts to native resident fishes from increases in disease, competition, and predation.

(5) Dam removal would eliminate whitewater rafting opportunities in the key summer months of July and August.

(6) The Project generates 737,000 MWh per year of clean, renewable energy. Replacement would require 360,000 tons per year of coal or 5 billion cubic feet of natural gas.

<u>Appendix A</u>

Rationale for PacifiCorp's Positions on Key Topics

Fish Passage and Anadromous Fish Reintroduction

Basis for Position

Anadromous Fish Reintroduction Efforts are Inherently Uncertain and Require a Flexible, Adaptive Approach

In general, the Services' prescriptions call for the installation or modification of facilities to provide "volitional" passage at all Project developments, including upstream fishways, downstream fishways, spillway modifications, and tailrace barriers to provide passage for fall and spring Chinook and coho salmon, steelhead trout, and Pacific lamprey. However, the Services have proposed a method of anadromous fish reintroduction that is incapable of responding to the many uncertainties and unknowns facing a reintroduction effort. The Services' goal is not only to provide access to upstream habitat to allow salmonids to complete their life cycles, but to ensure the long-term sustainability of restored anadromous fish. Unfortunately, the Services' "volitional" prescription is inherently inflexible, and requires that anadromous fish travel through unsuitable conditions in short time frames to have even the slimmest chance of survival. In fact, the Services have provided no evidence to support an optimistic conclusion that a series of ladders and juvenile bypass facilities requiring passage through the Project area will result in "substantial" and "sustainable" runs of restored anadromous fish.

While the goal of restoring anadromous fish runs in the upper Klamath basin is a worthy one, it is important to recognize the considerable uncertainty associated with reestablishing sustainable anadromous fish runs. The decision to attempt a reintroduction effort is not PacifiCorp's; however, PacifiCorp believes that the ultimate decision about whether and how to restore anadromous fish to the upper Klamath basin must be founded upon sound scientific evidence, which cannot be accomplished without data obtained by actually introducing anadromous fish in the upper Klamath basin. Moreover, any reintroduction program must be sufficiently flexible to allow fish managers to respond to the inherent uncertainties involved in such an effort.

The Uncertainty of Stock Genetics

Anadromous fish do not exist in the upper Klamath basin above Iron Gate dam. Therefore, a reintroduction program would require transfer of lower Klamath River fish or out-of-basin fish stocks to the upper basin to "seed" the restoration efforts. However, these fish stocks would likely not have the genetic or behavioral traits needed to be successful in an environment considerably different than their natal stream. While over many cycles the reintroduced stocks may adapt traits needed to complete their life-history successfully, until that occurs all adults and juveniles from lower river populations would need to be continually "mined" or reared in hatcheries to support the reintroduction program. To have any reasonable chance for genetic adaptation to succeed, harvest rates of commingled downriver fish would have to be significantly reduced or totally curtailed for many years.

The ecological and genetic diversity of fish stocks are reflective of distinctive adaptations. The concept of evolutionarily significant units ("ESUs"), NMFS's term used to describe "distinct population segments" under the ESA, is based on our current understanding of the importance of ecological and life history differences in defining fish populations that are genetically distinct (Waples 1991). The ESU concept assumes by definition that populations in different ESUs represent different evolutionary lineages. If all populations within the ESU are extirpated, then the species that was adapted to that geographically-defined area becomes extinct. The failure of nearly all attempts to successfully transplant salmonid stocks from one ESU to another attests to the importance of genetic adaptation to the different environmental regimes within each ESU.

The evolutionary significance related to population distinctness is a critical factor that must be considered when determining whether a particular population would be able to survive well enough to be sustainable if introduced into a new environment. Obviously, sustainability is a necessary criterion for successfully maintaining a population. The ESU concept is based on the assumption that subpopulations within the same ESU come from a common evolutionary lineage. It follows then that if a subpopulation is extirpated, another subpopulation within that ESU would have a fair likelihood of recolonizing and adapting to the ecological conditions in the area previously occupied by the extirpated subpopulation. Conversely, however, it follows that a subpopulation from one ESU would have little chance of being successfully introduced into the ecological region (typically geographic/climatic) associated with another ESU.

The Uncertainty of Water Temperature Regimes

Water quality conditions in the Klamath Basin raise uncertainties for the success of reintroducing anadromous fish to the upper basin. High stream temperatures in the Klamath River basin are the product of the natural climate, geology and anthropogenic factors. With the exception of some spring-water dominated streams (e.g., the Wood and Williamson rivers) and reaches, both upper Klamath River and Project area stream temperatures are of marginal suitability for anadromous fish production. Anadromous salmon prefer stream temperatures that are on average less than 16°C. Natural stream temperatures throughout the Project area and upper basin consistently exceed 22°C during the summer.

Additionally, if global climate change results in warmer air temperatures, stream temperatures in the lower Klamath River are likely to increase even more over the next fifty years. This would further reduce the probable success of any reintroduction program. Bartholow (2005) indicates that water temperatures in the basin have been increasing over time due to increases in measured basinwide air temperature that appear to be related to the cyclical Pacific Decadal Oscillation. Noting that the anadromous salmonid thermal resources are being "squeezed" in both space and time, Bartholow (2005) concluded that "[r]ivers as warm as the main-stem Klamath River might … be viewed as thermally adverse [for young salmon], essentially requiring out-migration to avoid early- or oversummer death …." Thus, while there may be "temperature windows of opportunity" in some locations and times to meet certain salmon life cycle requirements, the fact remains that these suitable temperature windows are much smaller today compared to what salmon had available to them historically.

The Uncertainty of Physical Habitat to Meet Spawning, Egg Incubation, Rearing, and Migration Needs

The results of habitat modeling show that there appears to be a very small amount of stream habitat in and just above the Project area (from Iron Gate dam to Keno dam) and a much larger amount in the upper Klamath basin above UKL that would support anadromous fish production, so long as fish are able to migrate successfully through lakes and Project reservoirs (PacifiCorp's Response to FERC AIR AR-2, Nov. 10, 2005). Of the total stream habitat above Iron Gate dam, only about 8.6 percent is located in the Project area and immediately above it to Keno dam. The vast majority of the habitat is located in the upper Klamath basin above Keno dam. It should be noted, however, that although upper basin stream habitat is plentiful, it has been degraded over time due to logging, agriculture, cattle grazing and other human developments.

The Uncertainty of Juvenile Survival

One of the key uncertainties identified through the modeling process are the survival rates for juvenile migrants through UKL, Lake Ewauna and Project area reservoirs (Oosterhout 2005). For anadromous fish populations to be sustainable, juveniles must be able to survive at high rates and migrate rapidly through lakes and reservoirs. Juvenile fish migrating from above UKL through the Project area would have to migrate approximately 280 miles to reach the ocean. On this journey, they would pass through approximately 46 miles of lakes and reservoirs, 6 dams, and 186 miles of mainstem Klamath River below Iron Gate Dam. As adults, these fish would then retrace their journey back to their natal spawning grounds. These are environments to which lower Klamath fish stocks have never been exposed.

The KlamRAS modeling effort assumed a cumulative juvenile survival rate from spawning grounds through the Project area of 52 to 81 percent (i.e., the range of low to high rates used in the model), and a cumulative juvenile survival rate from spawning grounds to the estuary of 14 to 50 percent (Oosterhout 2005). However, a pilot study conducted at Copco and Iron Gate reservoirs in 2004 provides evidence that fall Chinook migratory behavior would be slow through the reservoirs and survival would likely be lower than survival rates used in the models. Radio-tagged subyearling fall Chinook travel times were long, with medians of 11 days through Copco reservoir and 13 days though Iron Gate reservoir (Miller et al. 2004). Few fish migrating through the reservoirs were detected at the dams. Specifically, 65 percent of the fish released at the head of Copco reservoir were detected at Copco 1 dam and only 18 percent of the tagged fish released at the head of Iron Gate reservoir were subsequently detected at Iron Gate dam. This equates to nearly an 80 percent loss of juvenile fish in the two reservoirs.

For coho salmon, habitat between Iron Gate and J.C. Boyle dams is poorly suited for rearing; passage of coho salmon to the Project area is likely to result in significant mortality and an overall reduction in the size of the existing population. Tributaries within the Project are often ephemeral, and tributary temperatures are generally unsuitable for coho. Coho reared in these tributaries will be forced by these conditions to move into Project reservoirs, where they will be subject to predation and disease. This is likely to cause significant mortality and result in few juvenile coho arriving below Iron Gate dam.

Conversely, coho are known to successfully spawn and rear in tributaries to the lower Klamath River below Iron Gate dam. Because coho that move into the Project area are likely to produce few out-migrants due to lack of habitat, allowing them passage will effectively reduce this ESA-listed species' overall numbers. PacifiCorp's proposed adaptive collection and transport program could provide coho with immediate access to suitable habitat (Spencer Creek) above J.C. Boyle dam.

The Uncertainty of Smolt-to-Adult Survival Rates

Smolt-to-adult survival rates ("SARs") largely reflect ocean survival, over which there is little control. For fall Chinook salmon, empirical data collected on wild and hatchery fall Chinook from the lower Klamath River show that wild fish SARs are much less than 0.5 percent on average. Fish passage modeling using KlamRAS showed that unless SAR was significantly greater than 1 percent (KlamRAS model values averaged 2.8 percent), reintroduced fall Chinook production would not sustain itself over time for either the volitional or collection and transport fish passage alternatives.

For spring Chinook, EDT modeling (KlamRAS modeling was not done for spring Chinook) indicated that introduced populations would be sustainable in stream reaches upstream of Link River dam only if the highest SAR observed on the West Coast is assumed (~ 4 percent) as reported by Magnusson (2002) (PacifiCorp's Response to FERC AIR AR-2, Nov. 10, 2005). However, there is little empirical support for such a high SAR for Klamath River spring Chinook. Spring Chinook reared and released at the Iron Gate Hatchery in the 1960s using wild fish that arrived at the dam produced no adult returns. Survival data collected on Trinity River Hatchery spring Chinook indicate survival rates generally less than 0.5 percent (RMIS Coded-Wire-Tag Database Query, 2006). In addition, in reviewing spring Chinook survival data for streams located from Alaska to California, Magnusson (2002) found that wild spring Chinook SAR values were generally less than 1 percent, and only in good survival years might reach 4 percent.

Coho salmon are listed under the ESA as threatened in the Klamath River basin due to human activities including agriculture, logging, mining, water diversions, dams and harvest. Data on coho survival are limited, but given their current ESA status, survival is assumed to be insufficient to sustain healthy populations in key lower basin tributaries. Survival of coho smolts originating from above Iron Gate dam, if they were allowed to access that area, obviously would be even lower, given the additional mortality sources that these smolts would encounter in the reservoir(s).

Survival data on wild steelhead trout are also limited, thus EDT modeling relied on data collected in the Columbia River (PacifiCorp's Response to FERC AIR AR-2, Nov. 10, 2005). Given the complex life-history of this species, modeling was used to simply contrast fish passage options. However, the steelhead hatchery program at Iron Gate Dam has had minimal success because steelhead SAR values have generally been low, in the 1 to 2 percent range. The SAR survival data for Iron Gate Hatchery steelhead are complicated by the fact that a large number of fish (all tagged) returning to the Hatchery never actually leave the Klamath River, preferring instead to adopt a resident rather than anadromous life-history (CDFG and NMFS 2001).

The Uncertainty of Resistance to Pathogens and Disease

The question of whether stocks in the lower Klamath River have sufficient pathogen or disease resistance appears to be answered by the recent occurrence of reportedly severe disease outbreaks in lower river salmonids. Historically, the native anadromous fish stocks probably had sufficient disease resistance to basin-specific pathogens to maintain population viability over time. However, due to ambient air temperatures and anthropogenic changes in the basin, it appears that lower river pathogen(s) such as *Flavobacterium columnare*, and myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicornis* may be taking an unnatural toll on anadromous fish stocks.

Reintroduction of lower river fish into the upper Klamath basin is likely to increase disease load in this portion of the basin. The KFHAT (2005) report noted that 100 percent of juvenile fish collected in smolt traps below Iron Gate dam were infected with *C. shasta*. If adult anadromous salmonids are allowed access above Iron Gate dam, disease load – and thus severity – would likely increase as adult salmonids shed the spore life stage.

Currently, no viral diseases are known to infect native fish of the upper Klamath basin. If salmonids were brought in from other basins, or even allowed to pass upstream from Iron Gate dam, there is a strong possibility of introducing Infectious Hematopoietic Necrosis ("IHN") to the upper Klamath basin. IHN has been detected in both juvenile and adult salmon in the lower Klamath and Trinity rivers. The loss of approximately 20 percent of the spring Chinook juveniles reared at the Trinity River Hatchery has been attributed to IHN infection (PFMC 1994). Because native fish populations in the upper basin, including redband trout, have no natural resistance to IHN, an inadvertent introduction of this disease could result in catastrophic losses of native fish in UKL.

The Services' Prescriptions Are Flawed

In addition to the uncertainties associated with reintroducing fish to the upper Klamath basin as summarized above, there are several additional flaws in the Services' prescriptions.

Water Temperature Differences Would Cause Stress and Delay

Fall Chinook begin arriving at Iron Gate dam in early September, and their numbers peak around the first of October (Fish Pro 1992). The daily average surface water temperatures in Iron Gate reservoir during mid-September are approximately 20°C (Figure 1). In contrast, water temperatures in the existing Iron Gate fish ladder at this time of year are typically 9°C to 12°C because water is drawn from the reservoir's cooler hypoliminion (Figure 1). Similar conditions exist in Copco reservoir.

With a volitional system designed to pass fish from below Iron Gate and Copco 1 dams to the reservoirs above, adult fall Chinook would be required to pass the ladders into waters approximately 10°C warmer, causing considerable temperature shock. Conceivably, fish could be exited to cooler water at depth; however, the availability of cooler water would disappear rapidly as fish move upstream. Any passage program that requires adult fall Chinook to experience this degree of temperature shock is likely to cause significant stress and migration delays, thus jeopardizing an already uncertain reintroduction program.

In contrast, surface water temperatures behind J.C. Boyle dam are approximately 2°C cooler than those in Iron Gate reservoir in September and about 3°C cooler in October (Figure 1). Transporting adult Chinook directly to or above J.C. Boyle reservoir as PacifiCorp proposes would avoid both the stress and delay of fish passing through the reservoirs below.

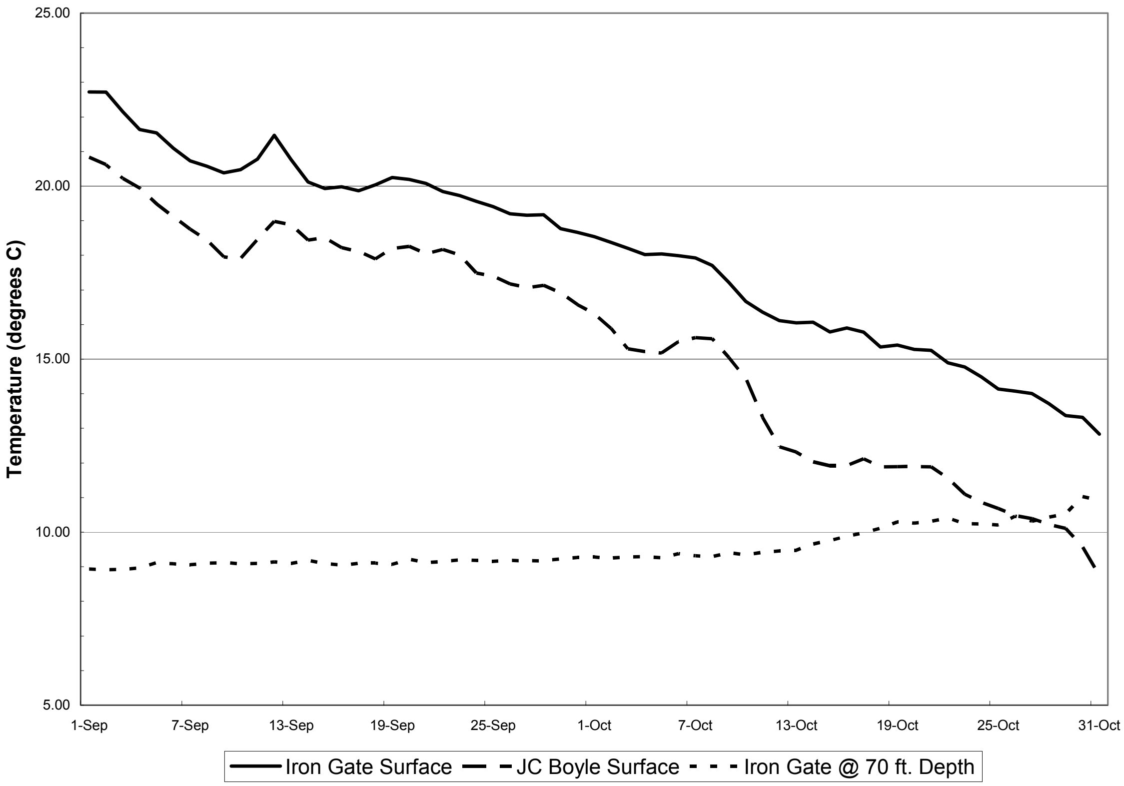

Figure 1. Water temperatures during September and October at Iron Gate and J.C. Boyle reservoirs. Values represent daily averages for years 2000, 2002, and 2003 combined. Iron Gate reservoir water temperatures at a 70 foot depth represents the water used for the existing Iron Gate fish ladder and hatchery.

Summer Operation of the Ladder Would Deplete Cool Water and Cause Fish Losses in the Ladder and Hatchery

The Services' prescriptions would require year-round operation of a ladder at Iron Gate dam. Year-round operation of the ladder would require drawing cool water from below the reservoir's thermocline, which sets up in the reservoir during the April through October period of temperature stratification. The Iron Gate Hatchery uses this same source for cool water during the summer and fall for fish rearing at the main hatchery. With a ladder design flow requirement of approximately 20 cubic feet per second ("cfs"), the Services' prescribed operation of the ladder during summer would deplete the limited source of cool water in the reservoir in most years by late summer or early fall. Without this source of cool water in late summer and fall, the Services' prescriptions would likely result in substantial losses of juvenile fall and spring Chinook salmon and steelhead trout at the hatchery, as well as both wild and hatchery adult fall Chinook in the ladder, due to thermal stress.[5]

[5] The Iron Gate ladder is currently operated from mid-September to late-March – it uses no cool water during the summer. Even without operating the ladder through the summer, however, existing hatchery operations

Requiring Migration through All Project Reservoirs Would Delay Arrival at Spawning Grounds

According to Lane & Lane Associates (1981) and Fortune et al. (1966), adult fall Chinook salmon used to arrive in fishing areas above UKL from late August through October, with their numbers peaking in September. The lower-river fall Chinook stock, which is proposed for reintroduction to the upper basin, currently begins arriving at Iron Gate Dam in early- to mid-September, peaking about October 1 (Fish Pro 1992). Peak spawning occurs about two weeks after arrival at the Iron Gate Hatchery. Peak arrival of fall Chinook to Bogus Creek, which enters the Klamath River just downstream from Iron Gate Hatchery, occurs in the second or third week of October (Richey and Hampton 2003, Hampton 2004). This information suggests that the current lower river stock of fall Chinook has a later migration time – and perhaps spawning time – compared to fish that may have occurred in the upper Klamath basin. Therefore, to give lower river fall Chinook stocks the best chance of successful reintroduction in the upper basin, those fish should spend as little time as possible migrating through the Project area.

Given the obstacles posed by existing dams and their reservoirs, as well as 25 miles of high-gradient river above Iron Gate dam, it is clear that an all-ladder "volitional" fish passage program would expose adult fish to considerable delay (1 to 2 weeks) in reaching spawning areas in the upper basin, possibly leading to high pre-spawning mortality or poor spawning success. It has been suggested that, even historically, adult fall Chinook passage through the high-gradient and turbulent Caldera reach (in the J.C. Boyle peaking reach above the California-Oregon border) may have been problematic during certain years (Hamilton et al. 2005). PacifiCorp's collection and transport program, described below, would circumvent such delay by allowing adult fish to reach J.C. Boyle reservoir within a day or two of their arrival at Iron Gate dam.

Volitional Upstream Fishways at Iron Gate and Copco 1 Dams May be Biologically Ineffective

The Services' prescriptions require that volitional upstream passage be provided at all developments on the Klamath River, including the high Iron Gate and Copco No. 1 dams. While such facilities are feasible from an engineering perspective, they may not provide the biological effectiveness that the Services desire. The Iron Gate dam has a gross head of approximately 157 feet and the Copco 1 dam has a gross head of approximately 124.5 feet. The significant height of these dams, coupled with the 0.5-foot vertical drop pool criteria and the salmon pool size required by the Services, would result in fishways of approximately 3,140 feet in length at Iron Gate dam and 2,490 feet in length at Copco 1 dam. Long fishways result in long transit times for fish and, in some cases, fish may become discouraged and stop ascending the fishway. For these reasons, there have been few effective fishways of this magnitude constructed in the Pacific Northwest. A fishway rising approximately 200 feet was built at Pelton Dam on the Deschutes River in Oregon, but its operation was eventually discontinued because of the difficulties fish had in completing their ascent. The fishway was converted to a rearing facility after ten years of operation. On the Clackamas River in Oregon, the North Fork dam fishway rises 196 feet. While it generally provided good passage, sometimes it experienced problems attracting fish because of the warming of the transport water. Since Chinook salmon became listed in the

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alone can periodically deplete the cool water source as early as late summer. The resulting warmer water temperatures have caused stress and mortality in adult fall Chinook entering fish ladders (Kim Rushton, CDFG, Iron Gate Hatchery Manager, pers. comm.). In addition, these warmer temperatures have caused stress in rearing hatchery fish.

Clackamas River, all fish are now trapped at the fishway entrance and selectively transported and released to predetermined locations.

Due to the height of the dams and the length of the required fishways, a fish collection and transportation facility at Iron Gate dam is a more reasonable alternative with fewer uncertainties regarding effectiveness. In nearly every situation with high dams analogous to those on the Klamath River, upstream fish passage has been accomplished with collection and transport facilities.

Passage Through the Projects Jeopardizes Establishment of Viable Population above Upper Klamath Lake

Stakeholder comments throughout the collaborative process and in their terms, conditions and recommendations indicated a desire to see reintroduction to the upper Klamath basin succeed. The Services' prescriptions aspire to achieve production in both the Project area and in the upper Klamath basin. However, more and better quality habitat for anadromous fish production occurs in the basin above UKL than in the Project area. Moreover, mortality sources differ greatly between the two areas, with more risks facing those fish migrating through the Project area to and from the upper basin.

A strategy to establish production in the Project area (with passage over all Project dams and through all Project reservoirs) would, in fact, jeopardize the success of the upper basin reintroduction program by forcing upper basin fish, both as adult and juvenile migrants, to encounter significant sources of mortality within the Project area (such as delayed travel time, predators, disease, impaired water quality resulting from the enormous loads of organic matter and nutrients from UKL, and juvenile screening and bypass systems). Already there is considerable uncertainty associated with the proposal to establish anadromous fish populations in the upper basin. Clearly, forcing these fish to move through areas where they will suffer significant mortalities would further reduce the potential for successful reintroduction. PacifiCorp's proposed adaptive collection and transport program is designed to provide the greatest possible opportunity for successful reintroduction in the upper basin.

Access to Project-Area Habitat May Further Impede Recovery of ESA-Listed Coho Salmon

The Services hope that allowing ESA-listed coho salmon access to tributary habitat above Iron Gate and Copco 1 and 2 dams will aid coho recovery. However, while some of these tributaries may have once supported coho, the vast majority of that habitat is no longer suitable for juvenile rearing, and would require juveniles to move into reservoirs where they would face significant hazards, such as predation, disease, impaired water quality resulting from the enormous loads of organic matter and nutrients from UKL, and juvenile screening and bypass facilities.

The listed population of coho salmon in the Klamath basin includes wild fish that spawn primarily in tributaries as well as hatchery fish returning to the Trinity and Iron Gate hatcheries. The Iron Gate Hatchery releases approximately 75,000 coho smolts each year. Of the adult coho returning to Iron Gate dam, about 20 percent are wild fish (Kim Rushton, CDFG, Iron Gate Hatchery Manager, pers. comm., March 2006). In past years these wild fish were artificially spawned and mixed in with hatchery stock. This procedure raised concerns that wild coho were not being given the opportunity to spawn naturally in their stream of origin. In response to this concern, most wild coho adults returning to Iron Gate dam are now returned to the lower

Klamath River. Marking and radio telemetry studies have shown that these fish successfully spawn naturally in tributaries downstream of Iron Gate dam (Hampton 2004).

The importance of this background information about coho salmon at Iron Gate dam is the fact that many of the wild coho originating from below Iron Gate dam tend to overshoot their destination and enter the Iron Gate fish ladders. Therefore, if a volitional fish passage facility were to be installed at Iron Gate, many of the wild listed coho originating from below the dam would ascend the dam and not be able to successfully return downstream to their intended stream of origin. In contrast, PacifiCorp's Alternative would allow managers the ability to sort lower river basin wild fish from upper basin origin supplemented fish, and return these fish unharmed to the lower river.

Because habitat conditions for coho salmon in tributaries to and between Iron Gate and Copco reservoirs are marginal, a volitional fish passage facility would afford them access to relatively unproductive habitat, and would expose them to significant sources of mortality in the reservoir primarily due to predation, disease, impaired water quality resulting from the enormous loads of organic matter and nutrients from UKL, and juvenile screening and bypass facilities. Most importantly, however, volitional passage would shift coho distribution away from more productive streams below Iron Gate Dam where coho currently spawn to the less productive habitat above Iron Gate dam. The Klamath River coho salmon population below Iron Gate dam is barely sustaining itself at this time. To allow any number of these ESA-listed fish to move into areas where their spawning is unlikely to result in any appreciable number of progeny would impede the species' ability to recover – and may further push the species toward extinction.

PacifiCorp's Alternative would facilitate the transport of coho salmon to and from Spencer Creek which, unlike tributaries to and between Iron Gate and Copco reservoirs, contains more suitable spawning and rearing habitat for coho.

PacifiCorp's Alternative for Anadromous Fish Passage

The discussions above demonstrate that anadromous fish reintroduction efforts are inherently uncertain. For that reason, any reintroduction program must be flexible and adaptive to respond to the numerous fish management issues that may arise as we learn more over time. The Services' prescriptions are neither flexible nor adaptive. They require construction of ladders and installation of screens and bypass systems to facilitate passage over each Project dam and through each Project reservoir, without adaptively managing to ensure that reintroduced fish are afforded the best possible opportunity to build self-sustaining populations and maximize production potential. Because the Services' prescriptions place reintroduced fish in harm's way, have the potential to jeopardize existing native resident fish populations, and offer no tools for addressing new information as it is learned, and because they assume that volitional passage through the Project area is the best way to accomplish the goals of reintroduction without first conducting the necessary studies that are a scientific condition precedent, it is critically flawed and should not be imposed.

As an alternative to the Services' prescriptions for anadromous fish at the Project's dams, PacifiCorp proposes to collect upstream migrating adults at Iron Gate dam and transport them via truck to a release site at or upstream of J.C. Boyle reservoir. These fish would then be allowed to continue migrating to upstream spawning areas. Through implementation of an Adaptive

Management Program[6], fish managers would obtain, analyze and make decisions regarding the appropriate location to collect and sort downstream migrating juvenile fish for transport to specific locations below Iron Gate dam.

Iron Gate Dam Collection Facilities and Upstream Transport

Under PacifiCorp's Alternative, the existing Iron Gate Hatchery fish ladder's existing collection, sorting, and holding facilities would be modified as necessary to facilitate upstream collection and transport of Chinook, coho, steelhead, and Pacific lamprey. PacifiCorp would operate the collection and transport facilities year-round.

PacifiCorp would construct a hopper system to transfer fish from holding ponds to a transport truck. PacifiCorp would augment the existing sorting facility to enable detection and recording of PIT/tag data and other identifiers. The facility would accommodate all holding, counting, marking and sorting requirements contained in the Services' prescription for the Iron Gate fishway.

The existing auxiliary water system (AWS) would continue to be used to augment ladder flow from the forebay. PacifiCorp would not modify the Iron Gate spillway; there is no evidence that the existing spillway causes false attraction to non-passable areas, and downstream migrating anadromous fish would be transported to below the Iron Gate dam and therefore not be required to migrate through the spillway.

At least initially, it is proposed that adult fish be released in J.C. Boyle reservoir. From there they would be free to migrate volitionally and ultimately spawn in areas of their liking, possibly including Spencer Creek, which enters J.C. Boyle reservoir. While the ultimate destination of these fish would be uncertain, it is expected that most would enter UKL and its tributaries. Once the program becomes established, adult fish released into J.C. Boyle reservoir would be expected to return to their natal stream. However, since the program is adaptive, some adult fish could be released either above Link dam or directly into the tributaries of UKL to facilitate access to potential spawning habitat.

However, adult fish easily could be released at other locations in the upper basin if, consistent with PacifiCorp's proposed adaptive approach, results of monitoring studies suggest that doing so would be a better strategy. Estimates used in the KlamRAS model, for example, assumed an adult cumulative survival rate of 68 percent for fish volitionally traveling from J.C. Boyle dam to their spawning grounds in tributaries to UKL. By contrast, adult fish transported directly to the Williamson River were assumed to survive at a rate of 79 percent. Thus, releasing adults above UKL rather than in J.C. Boyle reservoir could increase the number of adults reaching their spawning grounds by 16 percent.

Juvenile Collection Facilities and Downstream Transport

Under PacifiCorp's Alternative, a juvenile collection and transport facility would be located at or above J.C. Boyle dam to maximize outmigrant survival by avoiding Copco and Iron Gate dams

[6] PacifiCorp submitted the Adaptive Management Program as Attachment A to the "Alternative" to the joint preliminary fishway prescriptions submitted by the Services pursuant to section 33 of the Federal Power Act (FPA).

and reservoirs. However, consistent with an adaptive management approach, the precise timing, location and type of juvenile collection facilities is not specified at this time. Under PacifiCorp's Alternative, these details would be based on a phased analysis of downstream migrating juvenile behavior early in the program to determine what facilities are appropriate. At a minimum, however, such facilities would meet agency criteria for screening, collecting, sorting and transporting juvenile fish.

Should fish managers decide as a result of implementing an adaptive management approach that a juvenile collection and transport facility is appropriate, one location that should be considered when determining the location for a collection facility is J.C. Boyle Dam. J.C. Boyle is the most upstream facility within the jurisdictional boundary of the Project. PacifiCorp has developed a description of a collection, sorting and transport facility that could be placed at J.C. Boyle Dam and that would accommodate the type of downstream juvenile migration that could occur in upper Klamath basin if reintroduction is successful. The ODFW-criteria V-screen and juvenile bypass system would include sorting, collection, and transfer facilities.

It is expected that any out-migrating juvenile fall and spring Chinook, coho, and steelhead migrants would enter the facilities primarily in March, April and May. During this period, anadromous migrants would be collected and sorted from other species, such as redband trout, which would need to be bypassed to below the collection location. Collected anadromous fish would be transferred to a tanker truck and transported to a release location downstream from Iron Gate Dam.

Under PacifiCorp's Alternative, the marking and/or tagging of downstream migrating juveniles would be included for special studies and program monitoring. As appropriate, any sorting and collection facilities could be constructed to be compatible with juvenile marking and tagging activities. Also, the proposed sorting facilities would be configured to allow any marked or tagged fish arriving at the collection facility to be detected and recorded. Any decision to tag upper basin migrants at or upstream of the collection facility would require policy-level decisions from ODFW and CDFG to address potential conflicts with tagging programs in the lower basin.

Juvenile collection efficiency at the proposed V-screen is expected to be very high given the screen's state-of-the-art design criteria. The primary rationale for selecting a juvenile collection and transport option is that it would route as many migrants as possible around the downstream dams and reservoirs in recognition of the high fish losses that would occur there. Based on experience elsewhere, PacifiCorp expects a juvenile trucking survival rate of 98 percent (California Department of Water Resources 2004). Juvenile migrants could be released directly into the Klamath River below Iron Gate Dam at one or more locations.

Benefits of PacifiCorp's Alternative

Collection and Transport is the Only Method Used for Reintroduction in the Western United States

PacifiCorp recently commissioned a review of collection and transport programs in the western United States involving anadromous fish reintroduction efforts. All of these large-scale reintroduction programs rely or would rely on collection and transport to pass both juvenile and adult life stages. In fact, to PacifiCorp's knowledge, no other passage option has been approved for any large-scale reintroduction effort. These programs are relevant to reintroduction in the upper Klamath basin because their passage components span large geographic scales similar to that of the Project, and because most require that fish pass more than one dam and reservoir, as is the case on the Klamath River. These programs have been recommended, developed or approved by many of the same federal and state fishery agencies involved in the Klamath Project relicensing proceedings, and there is no legitimate reason for those agencies to propose a different passage scheme for the Klamath River. On the contrary, the unique environmental challenges in the upper Klamath basin make collection and transport the only appropriate approach to reintroduction.

Collection and Transport Focuses on Best Habitat and Least-Risk Areas

A clear benefit of a collection and transport operation over volitional passage is the ability to bypass less viable areas in favor of higher-quality upstream habitat. In this way, habitats that have been altered by developments such as reservoirs, unscreened diversions, and marginal water quality can be avoided. Results of the EDT modeling clearly demonstrate the lesser amount of suitable habitat between Iron Gate and J.C. Boyle dams compared to what occurs in the upper basin above UKL. In terms of total stream miles, the area above J.C. Boyle Reservoir contains 352 stream miles compared to only 29.3 stream miles in the Project area.

Another clear benefit of bypassing fish around reservoirs and dams is the estimated cumulative survival for adult fish as they make their way upstream to their spawning destination and for juveniles as they make their way downstream to the ocean. Estimates of survival at various river locations for adult and juvenile fall Chinook were included in the KlamRAS model methods report (Oosterhout 2005). Average cumulative survival values for the all-volitional and collection and transport scenarios are summarized in Table 1. These data clearly show that the collection and transport alternative for fall Chinook salmon outperforms the all-volitional alternative. For juvenile Chinook salmon, collection and transport out performs volitional by 24 percent (0.42 versus 0.34 survival). For adult fish destined to the upper basin, the collection and transport alternative (to above UKL) provides a 32 percent improvement in survival over the all-volitional alternative (0.79 versus 0.60 survival).

Table 1. Cumulative Average Survival Estimates for All-Volitional and Collection and Transport Alternatives Used in KlamRAS for Fall Chinook Salmon Originating Above Upper Klamath Lake (Data Source: Oosterhout, October 10, 2005)

		Average Cumulative Survival	
Life Stage	**Destination Node**	**All-Volitional**	**Collection and Transport**
Juveniles	Above UKL to below Link dam	0.78	0.78
	Below Link dam to below Keno dam	0.63	0.63
	Above JCB to below JCB	0.54	0.54
	Above Copco to below Copco	0.46	Transport
	Above IGD to below IGD	0.42	↓
	Below IGD to ocean	0.34	0.42
Adults	Ocean to IGD	0.98	0.98
	Below IGD to above IGD	0.90	Transport
	Below Copco to above Copco	0.77	↓
	Below JCB to above JCB	0.70	↓
	Below Keno to below Link	0.65	↓
	Below Link to above UKL	0.60	0.68 (0.79)*

* For adults transported from IGD to above UKL.

Collection and Transport is Well Suited for Testing and Monitoring Reintroduction Success

As discussed above, considerable uncertainties exist as to whether self sustaining runs of anadromous fish to the upper Klamath basin can be achieved with reintroduction. Monitoring of adult returns and smolt production would be critical in determining the program's success. Monitoring of fish numbers would be especially important to test modifications to the reintroduction program that might be needed to enhance the program's probability of success. PacifiCorp's proposed collection and transport facilities, which would include collection, sorting, inspection for tags, and provisions for fish marking, would help meet the monitoring and assessment needs associated with the reintroduction program.

The Collection and Transport Alternative Compares Favorably to Volitional Passage Options for Enhancing Total Numbers of Fall Chinook in Klamath Basin

Based on the KlamRAS modeling results, the estimated number of adult fall Chinook salmon spawners under PacifiCorp's Alternative is slightly less (-4 percent) under existing conditions and slightly more (+2 percent) under restored conditions compared to the all-volitional option (Table 2). For existing habitat conditions, EDT estimated that a collection and transport program to and from Iron Gate dam to J.C. Boyle dam would produce approximately 97 percent and 3 percent more spring Chinook and steelhead adults, respectively, than the volitional system (PacifiCorp's Response FERC AIR AR-2, Nov. 10, 2005).

PacifiCorp notes that the all-volitional option in KlamRAS includes what are likely very unrealistic assumptions for production from the small tributaries (e.g., Jenny, Snackenburg and Beaver creeks) in the Project area. The EDT model ranks a collection and transport alternative higher, with 14 percent more adults and 23 percent more juveniles than the all-volitional alternative under existing conditions. For restored conditions, the collection and transport alternative produces 27 percent more adults and 2 percent more juveniles than the all-volitional alternative.

Table 2. Comparison of EDT and KlamRAS Adult and Juvenile Fall Chinook Salmon Production for Scenarios Similar to Services' Fishway Prescription and PacifiCorp's Alternative

	Adult Abundance (number of adults)		Juvenile Abundance (number of juveniles)		Percent in Area from Iron Gate Dam to Keno Dam (%)	
Alternative/Description	**EDT**	**KlamRAS**	**EDT**	**KlamRAS**	**EDT**	**KlamRAS**
Existing Conditions						
PacifiCorp Collection and Transport from Iron Gate to J.C. Boyle, with screens	3,619	28,539	345,091	1,331,132	11	24
Services' All-Volitional Passage, with screens	3,169	29,754	280,132	1,396,052	51	46

PacifiCorp's Alternative Contains Opportunities to Adaptively Manage Reintroduction Efforts Over Time

PacifiCorp's Alternative would allow adult salmon to be transported for release to a location or locations above J.C. Boyle dam based on an adaptive approach to reintroduction. Modeling of a collection and transport alternative using KlamRAS and EDT assumed that adult salmon would be released in J.C. Boyle reservoir. However, the lowering of pre-spawn mortality of adults by transporting them around Keno and Link dams (and thus Lake Ewauna and UKL) could substantially increase the number of adults reaching the spawning grounds. The increased adult spawning escapement would subsequently increase total production over time. Results of KlamRAS and EDT ranked an alternative that transported fish to above UKL higher by 20 percent than an all-volitional ladder alternative.

One example of where the flexibility of PacifiCorp's Alternative would particularly benefit adult fish survival is during those times when water quality conditions in Lake Ewauna are stressful or even lethal to migrating fish. If water quality monitoring (temperature and dissolved oxygen) indicate a potential problem in this reach, adult fish can easily be directed to sites upstream of the problem area. PacifiCorp Alternative recommends that the location of adult releases be subject to specific future studies to determine the best long term approach.

PacifiCorp's Alternative Would Avoid Jeopardizing ESA-Listed Coho Salmon

As described earlier, PacifiCorp believes that an all-volitional passage facility at Iron Gate dam would cause harm to the listed coho salmon population in the Klamath basin. Specifically, volitional passage at Iron Gate dam would allow these fish to access poorer habitat than they now have available to them below the Iron Gate dam, and expose them to additional mortality sources above the dam(s). PacifiCorp's Alternative would allow adult coho salmon to be sorted and distributed to desired locations (e.g., Spencer Creek above J.C. Boyle dam or habitat below Iron Gate dam, as appropriate). Recent experience at the existing Iron Gate dam ladder indicates that wild coho that enter the ladder and then are returned to the river below the dam do, in fact, spawn successfully in tributaries downstream of the dam.

Upstream Migration Timing for Fall Chinook is Better Served With Collection and Transport

As noted previously, the peak arrival of fall Chinook at Iron Gate dam is approximately October 1 and peak spawning occurs about two weeks later. According to Fortune et al. (1966), peak fall Chinook arrival to the upper basin probably occurred in September. Given these circumstances, it is clear that adult fall Chinook would need to pass quickly through the Project area to reach their spawning destinations above UKL. Volitional passage through a series of ladders, reservoirs, and high-gradient stream reaches would delay migration and cause late arrival at spawning grounds, which in turn could result in high rates of pre-spawn mortality or latent egg mortality. PacifiCorp's Alternative would allow adult fish to move to above the Project area within days of their arrival at Iron Gate dam.

PacifiCorp's Alternative is Significantly Less Costly to Implement or Will Result in Improved Operation for Electricity Production

The Services' prescriptions for anadromous fish at and between Iron Gate, Copco 1, Copco 2, and J.C. Boyle (including a tailrace barrier at Fall Creek) would cost approximately $300 million. In general, the Services' preliminarily prescribed facilities are typical in nature and reflect published criteria and guidelines. However, some requirements are very unusual and have never been implemented on any known project. As such, the cost estimates provided herein consider facilities that generally meet the Klamath prescriptions while observing normal design criteria.

PacifiCorp's Alternative for anadromous fish would require (1) minor modifications to the existing ladder and holding facility at the Iron Gate Dam to facilitate the upstream adult collection and transport program; and (2) a single intake screen at J.C. Boyle Dam or another location in the upper Klamath basin based on adaptive management. The Alternative, including initial studies pursuant to the adaptive reintroduction program, would cost approximately $50 million. The cost estimates below assume construction of a screen and a sorting, holding and loading facility at J.C. Boyle Dam to provide for a downstream collection and transport program for juveniles. If, pursuant to an adaptive management approach, a similar juvenile collection and transport facility is located elsewhere above J.C. Boyle Dam, the costs would likely be equivalent or greater.

Water Quality

Basis for Position

Overview of Historical Water Quality Conditions in the Basin

Upper Klamath Lake (UKL) has been the subject of intensive scientific investigation dating back to the 1950s. Despite these investigations, no viable solutions have been identified to remedy the lake's hypereutrophic condition. Unless and until these problems are resolved, the impaired quality of the water flowing from UKL will remain a background condition for the Klamath River, constraining efforts to improve water quality.

Concerns over the quality of water in the UKL date back to the earliest known contacts with that body of water. Bortleson and Fretwell (1993) suggest that the lake has probably been naturally eutrophic since before settlement of the basin by non-Native Americans. During the 20th Century, UKL has become hypereutrophic.

In 1953, a study was conducted by the state of Oregon et al. (1955) to explain the problems associated with the *Aphanizomenon* algae at UKL. The study concluded that the shallow configuration of UKL provides for rapid decomposition of dead organic material and maintains the lake in almost constant nutrient circulation. Recirculation of the nutrients released through decomposition occurs rapidly, and this constant release means the nutrients are regularly available to organisms at both the surface and bottom of the lake.

In August 1957, Oregon and California entered into the Klamath River Basin Compact. The Klamath River Basin Commission funded several water quality studies over the following decades. In 1962, the Commission convened a panel of experts to review the Klamath Basin problems and identify possible solutions. According to the experts' findings, chemical treatment of algae, control of algae through biological means or harvesting, control of the algae through the elimination of the nutrients, or control of algal populations through artificial reduction of light penetration in the lake were all infeasible.

In 1964, the Oregon State Sanitary Authority (OSSA), after gathering baseline data in efforts to control basin pollution, issued a report stating, "all of the man-made BOD [biochemical oxygen demand] loadings in the [Klamath] Basin are quite insignificant when compared to the BOD of naturally occurring organic materials emitting from the upper Klamath Lake." After studying the UKL algal blooms around 1967, Dr. A.F. Bartsch, the director of the Federal Water Pollution Control Administration's Eutrophication Research Branch, concluded (Klamath County Historical Society, 1967):

> "It is possible that bottom sediments could supply nutrients in such quantity that the nuisance algal growths would continue as a major problem in the lake even if all other nutrient sources were controlled to the maximum practicable degree."

The U.S. Environmental Protection Agency also conducted studies regarding UKL. In the early 1970s, the agency announced that UKL would be one of seven Oregon lakes studied as part of a national survey in regard to eutrophication. The EPA planned to include approximately 1,200 lakes across the continental United States in this survey, which sought to "identify and evaluate water bodies … which have actual or potential eutrophication problems….” The survey emphasized the role of phosphates in algal growth, and aimed at assisting state and local governments in determining whether the reduction of excess phosphates through additional municipal waste treatment facilities was a viable option in attempting to reduce algal populations. This “National Eutrophication Survey” sampled 49 lakes in July 1971. Upper Klamath Lake was “ranked third in algal productivity and was one of the six lakes characterized as highly productive.”[7]

Congress authorized the Army Corps of Engineers (Corps) to investigate potential methods of revitalizing the UKL area in 1977. Two years later, the Corps recommended more research be conducted (Corps, 1979). While the Corps considered various alternatives, the lake’s characteristics made it unclear whether any alternative could be implemented without adverse consequences:

> “The lake is hyper-eutrophic…High nutrient loadings and associated sedimentation of organic matter have produced an ideal habitat for the abundant growth of algae, benthic animals, and macrophytes.”

In 1982, the Corps issued a second report (Corps, 1982), which concluded:

> “…a full scale reversal of the lake’s long-term natural, natural, and ultimately irresistible eutrophication is simply not feasible given the present limits of applied limnology, economic means and project priority.”

In 1993, U.S. Geological Survey scientists produced a report suggesting several explanations for UKL’s excessive nutrient enrichment (Bortleson and Fretwell, 1993). Among the more likely explanations, the report suggested, were human activities such as agricultural activities. Natural causes were deemed less likely to be the source of the trouble, for two reasons: (1) the lake’s water levels had remained stable over the last 70 years; and, (2) the evidence that human activities produced the excessive nutrient enrichment was more compelling. Whether natural or human in origin, the impacts to UKL have been studied for decades without leading to a viable solution to the problem.

In May of 2002, ODEQ established total maximum daily loads (TMDLs) for the UKL drainage. The UKL TMDL for nutrient-related pollution identified controlling total phosphorous loading as the “primary and most practical mechanism to reduce algal biomass and attain water quality standards for pH and dissolved oxygen.” To alleviate the lake’s pollution, a reduction by 40 percent of total phosphorous loading was called for, and the UKL TMDL stated that this reduction could be achieved by restoring wetlands, changing hydrology along the watercourses flowing into the lake, and reducing phosphorous discharge levels.

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[7] “Three Local Lakes Included in EPA Study,” *Herald and News*, June 4, 1972; J. W. Mullins, R. N. Snelling, D. D. Moden, and R. G. Seals, “National Eutrophication Survey: Data Acquisition and Laboratory Analysis System for Lake Samples,” EPA-600/4-75-015, U.S. EPA, Office of Research and Development, Environmental Monitoring and Support Laboratory, November 1975, 1; Peter D. Dileanis, Steven E. Schwarzbach, Jewel Bennett and others, *Detailed Study of Water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in the Klamath Basin, California and Oregon, 1990-92*, U. S. Geological Survey Water-Resources Investigations Report 95-4232 (Sacramento, CA, 1996), 7.

Current Conditions and Processes Affecting Water Quality

Flow and water quality conditions in the Klamath River basin vary dramatically along the approximately 250 river miles from UKL to the estuary at the Pacific Ocean. A wide range of natural and anthropogenic influences affect water quality throughout the system. Inflows to the system at Link dam originate in hypereutrophic UKL. Diversions and return flows for agriculture, as well as municipal and industrial use, occur in the reach between Link dam and Keno dam. The river receives considerable inflow from major and minor tributaries between Iron Gate dam and the estuary.

Not only is the Klamath River system complex, it is also unique because water quality generally improves as water flows from headwaters towards the estuary. In most river systems, water quality is highest at the source and degrades as water flows downstream. The water quality of hypereutrophic UKL often is profoundly impaired and has deteriorated at an accelerated rate over the last century as a result of anthropogenic activities. A critical feature of hypereutrophic systems is that the eutrophication processes are typically irreversible. The result is that the quality of the water flowing from UKL is the "driver" that dictates water quality throughout the system. The influence of UKL's highly variable and seasonal discharges of large quantities of algae, nutrients, and organic matter on downstream river reaches can be dramatic. The characteristics of the various downstream river reaches affect the fate and transport of these materials.

Five dams on the upper Klamath River – Link, Keno, J.C. Boyle, Copco No. 1, and Iron Gate – directly affect how long it takes for water to travel from UKL to the estuary. The transit time of waters released from UKL to the estuary (as well as water released from the BOR's Klamath Irrigation Project to the river between UKL and Keno dam) is about 1 to 2 months or more, except during high winter flow conditions when the transit time may be reduced to as little as 2 weeks. If no dams were in place, transit time from UKL (Link dam) to the estuary would be about a week during summer periods and less during winter high flow events. The dams basically slow the travel time in the upper 65 miles, which allows settlement and processing of the enormous loads of organic matter and nutrients from UKL.

Upper Klamath Lake

Although UKL is upstream of the Project and is not affected by the Project's operations, the lake's water quality is discussed here because of its importance as inflow or "boundary" conditions to water quality within and downstream of the Project.

UKL is a large (121 mi^2), shallow (mean depth about 7.8 feet) lake that is geologically old and classified as hypereutrophic (highly enriched with nutrients and supporting high abundance of suspended algae) (Johnson et al. 1985). A paleolimnological study by Eilers et al. (2001) revealed that UKL has been a very productive lake, with high nutrient concentrations and blue-green algae, for at least the period of record represented by the study (about 1,000 years). However, recent lake sediments showed that the water quality of UKL has apparently changed substantially over the past several decades. Mobilization of phosphorus from agriculture and other nonpoint sources (Walker, 2001) appears to have pushed the lake into its current hypereutrophic state, which includes algal blooms reaching or approaching theoretical maximum abundance. In addition, algal populations now are strongly dominated by the single blue-green algal species *Aphanizomenon flos-aquae* (cyanobacteria) rather than taxa that apparently dominated blooms before increased nutrient enrichment (Kann, 1998; Eilers et al. 2001).

Low dissolved oxygen and high pH values have been linked to high algal productivity in UKL (Kann and Walker, 2001; Walker, 2001). Chlorophyll *a* concentrations exceeding 200 µL are frequently observed in the summer months (Kann and Smith, 1993). Algal blooms are accompanied by violations of Oregon's water quality standards for dissolved oxygen, pH, and free ammonia. Such water quality violations led to 303(d) listing of UKL in 1998 by ODEQ. ODEQ subsequently established TMDLs for UKL in May 2002 (ODEQ, 2002).

Keno Reservoir

Keno reservoir is also upstream of the proposed Project, and is generally a broad, shallow body of water that extends from the headwaters of Lake Ewauna (RM 253.4) to Keno dam (RM 233.3). Municipal, industrial, and agricultural activities are located along this reach (ODEQ, 1995; USBR, 1992). Currently, Keno reservoir experiences severe water quality impairment. Although the impacts of anthropogenic inputs are notable, and legacy impacts are present, the primary source of loadings to this system is UKL.

Keno reservoir does not experience seasonal thermal stratification, but exhibits weak, intermittent temperature gradients during summer periods. Annual water temperatures range from near zero degrees Celsius to over 25°C and are at or near equilibrium temperatures,[8] reflecting local meteorological conditions and the fact that UKL is generally at or near equilibrium.

Nutrient conditions in Keno reservoir vary throughout the year, mainly in response to inputs from UKL. Organic matter is a primary product from UKL to the downstream river reaches. This material may exist as living material (algae) or dead and decomposing material. Owing to the hypereutrophic nature of the lake, large quantities of material can be passed downstream – the highest BOD_5 value recorded at Link Dam is over 50 mg/L. This problem is not recent, as noted by the State of Oregon et al. (1955), where it is stated that the large nutrient load and oxygen demand cause severe downstream impacts that are "equivalent to the raw sewage from a population of more than 240,000 persons" but that "94 percent of BOD is derived from natural causes."

During winter, primary production in Keno reservoir is limited. During spring, when water temperatures are still cool, diatoms are present. As waters warm and day length increases, Keno reservoir often experiences an extensive algal standing crop. This standing crop is apparently the result of in-reservoir primary production, as well as wash-in of algae from UKL. Maximum concentrations of chlorophyll *a* at Link River are in excess of 250 µg/L, while concentrations in the Klamath River below Keno dam are generally well under 100 µg/L. However, at times of severe anoxia the reservoir has limited primary production, apparently due to the lack of available oxygen to meet algal respiratory demands.

[8] Equilibrium water temperature is the water temperature for a given set of meteorological conditions (Martin and McCutcheon, 1999). It is somewhat of a theoretical concept due to constantly changing meteorological conditions, but is nonetheless useful when considering water temperature conditions on a conceptual basis.

Keno Reach from Keno Dam to J.C. Boyle Reservoir

The Keno reach of the Klamath River, just upstream of the proposed Project, extends from Keno dam (RM 233.3) to the headwaters of J.C. Boyle reservoir (RM 228.2). There are no facilities in this reach and there are no appreciable tributaries, diversions, returns, or springs in this reach. A steep bedrock channel dominates the reach as the Klamath River traverses the Cascade Range.

The available data for the Keno dam to J.C. Boyle reach suggests that temperature, dissolved oxygen, total nitrogen, total phosphorus, total organic carbon, alkalinity, pH, and specific conductance characteristics do not change appreciably between inflows to and outflows from the reach. The data suggest that a portion of available ammonia converts to nitrate in route to J.C. Boyle reservoir, and that total inorganic nitrogen increases. This increase may be the result of organic matter from Keno reservoir converting to inorganic nitrogen in this reach. However, overall total nitrogen is almost unchanged in the reach. As with total inorganic nitrogen, total inorganic phosphorous, as represented by orthophosphate, is slightly higher at the downstream end of the reach. Total phosphorous is similar at the top and bottom of this reach. Overall, these findings suggest that this reach is doing little to reduce total nutrient levels in the river.

J.C. Boyle Reservoir

J.C. Boyle reservoir, the most upstream reservoir of the proposed Project, extends from the end of the Keno reach at (RM 228.2) to J.C. Boyle dam (RM 224.6). This reservoir has a total storage capacity of approximately 3,500 acre-feet and a maximum depth of about 40 feet (Eilers, 2005). Spencer Creek is a minor tributary in this reach, entering near the headwaters of the reservoir. Reservoir residence time ranges from less than half a day to over 2 days, depending on flows through the reservoir.

Due to a short hydraulic residence time and modest depth (maximum depth is approximately 40 feet), J.C. Boyle reservoir does not thermally stratify, but is subject to weak, intermittent vertical temperature gradients during summer. Average inflow temperatures to the reservoir are similar to average outflow temperatures because the inflow temperatures are at or near equilibrium temperature. The outflow temperatures exhibit a reduced diurnal variation compared to the reservoir's inflow due to the deep profile of the reservoir compared to shallow depths in typical river reaches. This reduced diurnal variation results in a maximum daily temperature that is lower in the reservoir's outflow than inflow.

J.C. Boyle reservoir is eutrophic due to the large nutrient load from upstream sources, notably UKL. Due to the short residence time, lack of stratification, and limited photic zone, the total nutrient concentrations in the reservoir's outflowing waters are often similar to those in inflowing waters. Inflow and outflow concentrations for total inorganic nitrogen, total nitrogen, orthophosphate, and total phosphorous are generally similar. Total organic carbon observations, although limited to 2004, suggest that values are equal to or lower in reservoir releases than in inflows.

The short residence time produces a noticeable current in the reservoir, which is not generally conducive to phytoplankton populations. However, the reservoir morphology and setting allows primary production to generally persist from spring through fall. Generally, algal concentrations are similar to or lower below J.C. Boyle reservoir than upstream of the reservoir, suggesting that although primary production is present, it is not of the same magnitude as in upstream areas such as UKL and Keno reservoir.

J.C. Boyle Bypass Reach from J.C. Boyle Dam to J.C. Boyle Reservoir

The J.C. Boyle bypass reach extends from J.C. Boyle dam (RM 224.6) to J.C. Boyle powerhouse (RM 220.4)—a distance of approximately 4 miles. Starting approximately a half-mile downstream of the dam, the river gains some 220 to 250 cfs of spring input—resulting in a reach base flow of approximately 320 to 350 cfs. The residence time of this steep reach under nonspill conditions at J.C. Boyle reservoir is on the order of hours but can be considerably less under spill events.

The river immediately downstream of J.C. Boyle dam is similar in quality to the waters of J.C. Boyle reservoir. However, the springs that enter in this reach have a notable impact on conditions within this reach down to the J.C. Boyle powerhouse. The springs in the bypass reach discharge at a water temperature of approximately constant 11°C year round. As a result of the spring inflows, the river temperature deviates substantially from the river's equilibrium temperature in summer and winter. During the summer, the springs provide a cool water source to a river that may otherwise exceed 25°C.

The total nitrogen, phosphorous, and organic carbon data suggests that the principal "process" in this reach is dilution. Nutrient concentrations are generally reduced within this reach due to dilution from spring inflows. The ratio of release from J.C. Boyle dam to spring inflows is approximately 1:2. Comparisons of total nitrogen, total phosphorous, and total organic carbon concentrations at the top and bottom of the reach indicate that in almost all instances concentrations are reduced consistently with this ratio, i.e., they are reduced by approximately two-thirds.

J.C. Boyle Peaking Reach from J.C. Boyle Powerhouse to Copco Reservoir

The J.C. Boyle peaking reach extends from J.C. Boyle powerhouse (RM 220.4) to the Oregon-California border at RM 209 and beyond to the headwaters of Copco reservoir (RM 203.1). Noteworthy features of the reach include the powerhouse penstock return and the influence of the bypass reach flows. Water quality conditions vary considerably from low flow conditions that are dominated by spring accretions flowing out of the bypass reach, to high flow conditions where powerhouse releases (equivalent to J.C. Boyle reservoir release water quality) dominate the downstream water quality.

Nutrient conditions also respond to variations due to peaking operations. Nitrate concentrations in the Klamath River above Copco reservoir can increase 30 percent between nonpeak and peaking periods. Ammonia and phosphate also respond to the flow regime, but not as dramatically. Total nitrogen, phosphorous, and organic carbon are generally lower at the bottom of the J.C. Boyle peaking reach than at the top. It appears that only modest changes in nutrients occur within the relatively short residence time, with the exception of reduction via dilution. Phytoplankton generally perform poorly in river conditions, and increased depths, high velocities, significant light extinction, and boulder/bedrock substrate limit benthic algae, thus limiting the ability of nutrients to be acquired by aquatic plants.

Conditions within the peaking reach probably lead to only a limited capacity for any attached periphytic algae to utilize available nutrients due to scour, light limitations due to colored water and suspended matter, the inability of phytoplankton to persist in the riverine environment, and short residence time (Reynolds, 1994; Stevenson, 1996). Field observations indicate that the standing crop of attached algae is modest, with some filamentous algae on the channel margins and among partially submerged boulders, and limited periphyton growth.

Copco Reservoir

Copco reservoir extends 4.6 miles from Copco dam at RM 198.6 to the reservoir headwaters at RM 203.2. There are no major tributaries to Copco reservoir. The reservoir has a storage capacity of approximately 40,000 acre-feet and is its maximum depth is approximately 115 feet (Eilers, 2005). Copco reservoir's hydraulic residence times range from a few days under winter high flow events to approximately 2 to 3 weeks under typical summer conditions.

Copco reservoir stratifies during the warmer periods of the year. The onset of seasonal stratification typically occurs in mid to late March, and the breakdown of stratification in October. The minimum temperatures at the bottom of this reservoir during mid-summer and early fall are typically in the range of 12°C to 14°C. This cool pool of water at the reservoir bottom that occurs during stratification is relatively small (approximate annual minimum is less than 2,000 AF).

Throughout the year, the diurnal range of release temperatures is moderated by the volume of the reservoir. During the spring months, the reservoir tends to minimize deviations from seasonal mean temperatures, i.e., the relatively deep water release moderates short term response in water temperature to deviations in meteorological conditions ("hot" or "cold" spells). During late spring and mid-summer, the reservoir releases are generally below equilibrium. In the fall, reservoir release temperatures tend to be above equilibrium temperatures of the Klamath River upstream and downstream due to the storage and later release of inflowing heat ("thermal lag").

Copco reservoir acts as a significant annual net sink for both total nitrogen and total phosphorous (Kann and Asarian, 2005). Reservoirs generally act as traps, reducing organic matter, nutrient, and particulate matter (Thornton, 1990; Ward and Stanford, 1983). Copco reservoir receives enormous hydraulic and nutrient loads from the inflowing Klamath River. Analysis of 2002 nutrient loading data reported by Kann and Asarian (2005) indicates that Copco reservoir provided a net retention of 48 metric tons of total nitrogen, equivalent to 8 percent of the inflow load, and 36 metric tons of total phosphorus, equivalent to 26 percent of the inflow load. These findings indicate that Copco reservoir removes and retains significant quantities of nutrients flowing from upstream.

Under certain conditions, the loads of nutrients and/or organic matter entering the reservoir from these upstream sources is so high that Copco reservoir can be overwhelmed—somewhat similar to how UKL discharge conditions overwhelm Keno reservoir during summer periods. Under such conditions, Copco reservoir can assume characteristics more consistent with a hypereutrophic system, including large algae blooms. *Aphanizomenon* is usually the dominant bloom-forming species during summer, although large blooms of *Microcystis* have been observed recently, particularly in late summer.

Iron Gate Reservoir

Iron Gate reservoir reach extends from Iron Gate dam at RM 190.5 to the reservoir's headwaters at RM 196.7. The reservoir has a storage capacity of approximately 50,000 acre-feet, and a maximum depth of 162 feet (Eilers, 2005). Iron Gate reservoir's hydraulic residence times range from a few days under winter high flow events to approximately 3 to 4 weeks under typical summer conditions. Iron Gate reservoir is located only 1.5 miles below Copco reservoir, and as such the two reservoirs essentially act in series.

Iron Gate reservoir stratifies during the warmer periods of the year. The onset of seasonal stratification typically occurs in mid to late March, and the breakdown of stratification in November. The minimum temperatures at the bottom of Iron Gate reservoir during mid-summer and early fall are typically in the range of 7°C to 8°C. The bottom waters of Iron Gate reservoir are appreciably cooler than Copco reservoir owing to the larger size of Iron Gate and the generally stable (short-term) inflow temperatures from Copco No. 2 powerhouse releases to Iron Gate reservoir. These conditions create a fairly isolated cold water hypolimnion (approximate annual minimum 5,000 AF). Iron Gate reservoir's cold water volume is a crucial source of cold water for the Iron Gate fish Hatchery.

Throughout the year, the diurnal range of release temperatures is moderated by the volume of the reservoir. During the spring months, the reservoir tends to minimize deviations from seasonal mean temperatures, i.e., the relatively deep water release moderates short term response in water temperature to deviations in meteorological conditions ("hot" or "cold" spells). During late spring and mid-summer, the reservoir releases are generally below equilibrium. In the fall, reservoir release temperatures tend to be above equilibrium temperatures of the Klamath River upstream and downstream due to a similar thermal lag condition as occurs in Copco reservoir.

Like Copco reservoir, Iron Gate reservoir acts as a significant annual net sink for both total nitrogen and total phosphorous (Kann and Asarian, 2005). Analysis of 2002 nutrient loading data reported by Kann and Asarian (2005) indicates that Iron Gate reservoir provided a net retention of 66 metric tons of total nitrogen, equivalent to 12 percent of the inflow load, and 32 metric tons of total phosphorus, equivalent to 25 percent of the inflow load. These findings indicate that Iron Gate reservoir, like Copco reservoir, removes and retains significant quantities of nutrients flowing from upstream. In tandem, Copco and Iron Gate reservoir provided a net retention of 124 metric tons of total nitrogen, equivalent to 20 percent of the inflow load from upstream sources, and 51 metric tons of total phosphorus, equivalent to 35 percent of the inflow load. These findings indicate that the reservoirs, in tandem, remove and retain substantial quantities of nutrients flowing from upstream, and prevent their passage downstream where they might further adversely affect water quality.

As with Copco reservoir, under certain conditions, the loads of nutrients and/or organic matter entering the reservoir from these upstream sources is so high that Iron Gate reservoir can be overwhelmed – somewhat similar to how UKL discharge conditions overwhelm Keno reservoir during summer periods. Under such conditions, Iron Gate reservoir can assume characteristics more consistent with a hypereutrophic system, including large algae blooms.

Klamath River from Iron Gate Dam to Turwar

The Iron Gate dam to Turwar reach extends from Iron Gate dam (RM 190.5) to the USGS gauge at Turwar (RM 5.3) near the mouth of the Klamath River. There are several major tributaries flowing into the reach—Shasta River (RM 177.3), Scott River (RM 143.6), Salmon River (RM 66.4), and Trinity River (RM 43.3)—as well as many minor tributaries. The flow in the river increases significantly in the downstream direction due to major and minor tributary contributions. Travel time through the reach under typical summer flows is on the order of 4 days. Under extreme low flow conditions (e.g., drought) this may be slightly longer, and under winter flood conditions travel time would be somewhat less.

Water temperatures in this reach are generally at or near equilibrium with the exception of immediately below Iron Gate dam and in the vicinity of certain tributaries. As previously described, Iron Gate reservoir releases are generally moderated owing to the relatively large reservoir volume and a penstock release elevation that is about 30 feet deep. These attributes lead to water temperatures that may be at or slightly below equilibrium temperature of the river downstream of the dam in the spring and summer, and higher than equilibrium temperature of the river in fall. These effects diminish relatively quickly in the downstream direction as the river comes into equilibrium with the local meteorological conditions. Water temperatures are generally at or near equilibrium once below about the Shasta River.

The concentrations of nitrate and phosphorous are steadily reduced with distance from Iron Gate dam. This condition is partly due to dilution, but also in response to uptake from seasonal periphyton growth in the river. The rate of nutrient reduction in the downstream direction tends to diminish in the vicinity of Salmon and Trinity Rivers. The reduction in rate may be due to the large alluvial channel and the inability of attached periphytic algae to effectively uptake nutrients due to an ever deepening water column, some light limitation with increasing river depth, and dilution. Nutrient concentrations also indicate seasonal variations, with lower concentrations in early spring, increasing through summer and fall. This condition is probably due mostly to dilution from tributaries during the wetter months.

During summer and fall periods there is a considerable amount of particulate matter readily observable in the lower Klamath River. The proportion of this particulate matter that is derived from Iron Gate reservoir and upstream sources compared to that generated within the river downstream of Iron Gate dam is unknown at this time. Regardless, the eutrophic nature of the Klamath River downstream of Iron Gate dam is largely due to upstream sources of nutrients, notably UKL.

Project Contributions to Water Quality

PacifiCorp proposes to include in the new FERC license only Project facilities from the J.C. Boyle Development downstream to Iron Gate dam. The East Side and West Side developments at Link River will be decommissioned, and Keno dam, which does not generate hydroelectric power, is not included as part of the proposed Project. Operations will continue at the J.C. Boyle Development, including load following (peaking) operations. Diversion of flows up to approximately 3,000 cfs from the J.C. Boyle bypass reach (except for a minimum instream flow release of 100 cfs from J.C. Boyle dam) will continue to allow approximately 225 cfs of high-quality spring inflow to dominate and enhance water quality conditions in the reach.

The existing Project reservoirs contained in this new Project license application—including J.C. Boyle, Copco, and Iron Gate reservoirs —will have continuing effects on water quality. J.C. Boyle reservoir is a relatively small, fast-flushing impoundment with a short residence time and limited, weak thermal stratification. In many respects, J.C. Boyle is river-like in water quality character, especially compared to Copco and Iron Gate reservoirs, which are much larger reservoirs, and more lacustrine (lake-like) in character. However, J.C. Boyle reservoir is somewhat more effective than the river in retaining organic matter, especially particulate forms, and nutrients delivered from UKL and the KIP. During summer, the more effective retention of organic matter and nutrients in the reservoir results in periodic blooms of planktonic algae and may contribute to lower dissolved oxygen in the reservoir.

Copco and Iron Gate reservoirs differ from the river reaches in their water quality character, mainly because of the longer hydraulic residence time in the reservoirs. These reservoirs are more effective than the river in retaining organic matter, especially particulate forms, and nutrients delivered from UKL. Retention of organic matter and nutrients in the reservoirs results in periodic seasonal blooms of planktonic algae and can contribute to low dissolved oxygen below the thermocline. This results in a net decrease in organic matter and nutrients that would otherwise continue downstream and contribute to increased algae growth in the Lower Klamath River. PacifiCorp proposes to implement Reservoir Management Plans[9] (RMP) for improving water quality in J.C. Boyle, Copco, and Iron Gate reservoirs. Actions implemented through the RMPs are aimed at improving reservoir water quality conditions (such as algae, dissolved oxygen, and pH) related to primary production from organic and nutrient loads contributed from sources upstream of the Project.

As a natural consequence of the reservoirs' presence, the Project can affect temperatures below the Project's dams during some periods of the year. The water mass present in Copco and Iron Gate reservoirs naturally causes a thermal "lag" as water passes through the reservoirs. This decreases the temperature of reservoir releases as compared to hypothetical without-Project conditions during spring, and increases the temperature of reservoir releases during fall. The increases during fall do not appear to detrimentally affect fish, however, as water temperatures tend to be decreasing during the fall period to levels that are suitable for anadromous fish. PacifiCorp is nevertheless committed to working with the water quality and fisheries agencies to explore opportunities for using the limited cool water storage in Iron Gate reservoir to protect and enhance fish uses downstream of Iron Gate dam. Of course, such uses must be balanced against, and reconciled with, existing cool water needs at the Iron Gate fish hatchery.

[9] Reservoir Management Plans were included in PacifiCorp's applications for Water Quality Certification pursuant to Section 401 of the Clean Water Act submitted to the Oregon Department of Environmental Quality and the California State Water Resources Control Board on March 29, 2006.

Instream Flows and Ramping Rates

Basis for Position

PacifiCorp's Proposed Instream Flow Conditions Provide for Integration and Balance of Resources, Including Fish and Aquatic Habitat Conditions

J.C. Boyle Bypass Reach

In the J.C Boyle bypass reach, PacifiCorp proposes to release a minimum flow of 100 cfs from J.C. Boyle dam at all times. The minimum flow release of 100 cfs from J.C. Boyle dam, combined with the approximately 220–250 cfs accretion of spring water that occurs throughout this reach, provides near maximum habitat conditions for adult trout and suckers based on PacifiCorp's instream flow study results (PacifiCorp 2004, 2005). The 100 cfs, when added to the accretion flow, provides slightly less habitat (compared to a no-diversion scenario) for juvenile trout and fry. However, the habitat-versus-flow relationships for these life stages are relatively flat over a wide range of flows, indicating that the margin habitats where small fish generally reside would be maintained, and further demonstrating that the quality and quantity of habitat does not change appreciably with the change in flow. Since fry are known to occur in this reach, maintenance of margin habitat is important. The 100 cfs release would also maintain the excellent water quality that occurs in most of this reach as a result of spring water accretion.

J.C. Boyle Peaking Reach

As previously explained, the J.C. Boyle peaking reach supports one of the most highly productive recreational trout fisheries in Oregon or California. The flows present in this reach – notwithstanding PacifiCorp's peaking operations at J.C. Boyle – are thus more than adequate to support the existing fishery. Despite the productivity and quality of the existing fishery, PacifiCorp, has proposed a series of additional instream flows and flow fluctuation/ramping rate restrictions in the spirit of further enhancing this fishery.

In the J.C. Boyle peaking reach, an increased minimum flow level and adjustments in peaking operations are proposed in the J.C. Boyle peaking reach to enhance usable fish habitat, while preserving water quality, and recreational boating and angling. A minimum release of 200 cfs plus J.C. Boyle bypass accretion will be provided at the USGS gauge downstream of the J.C. Boyle powerhouse (USGS gauge No. 11510700). This flow release will provide approximately 425 cfs into the J.C. Boyle peaking reach. The minimum flow will be met through a release of 100 cfs (200 cfs total) from J.C. Boyle dam and an additional release of 100 cfs at the powerhouse. This will result in an increase of about 100 cfs compared to current minimum flow conditions. The new base flow of 425 cfs would nearly maximize the instream habitat (Weighted Usable Area – WUA), while providing about the same WUA for rainbow trout juveniles and fry. The proposed increase in the minimum flow would also increase the wetted perimeter of the river in the peaking reach, on average, by 6.5 feet or about 5.3 percent. In riffle areas, the average increase in wetted perimeter would be about 11.3 feet (8.0 percent). This increase in wetted perimeter is expected to increase the biomass of aquatic macroinvertebrates. An increase in macroinvertebrate biomass is expected to further enhance the growth and general condition of fish in this reach.

Peaking operations will continue at the powerhouse. However, the daily Project-controlled flow change (or flow magnitude change, that is, the difference between lowest and highest flow in a 24-hour period) during peaking operations will not exceed 1,400 cfs (as measured at USGS gauge No. 11510700 downstream of the J.C. Boyle powerhouse). This limit of flow change to 1,400 cfs per 24-period will preclude no load to full two-unit peaking events (420 cfs to 3,420 cfs at gauge). Two-unit operation will occur if inflows are high enough to run both units, or run one unit in continuous operation and the second one operated in peaking fashion. Peaking of the second unit will only occur while the first unit is in operation.

This limit on powerhouse operations will provide greater flow stability for aquatic resources but continue to provide a balance of whitewater boating and angling opportunities (periods of optimal wading-based fishing and standard whitewater boating flows), as one unit can provide raftable flows. Low flow periods (that is, flows of 700 cfs or lower at Iron Gate dam) will have limited one-unit peaking time "windows" for standard whitewater boating (which relies on flows of 1,500 to 1,800 cfs). Anglers will conversely have larger time "windows" for angling opportunities.

Contrary to agency assertions, there is no site-specific evidence that flow fluctuations in the J.C. Boyle peaking reach have caused severe impacts to fish, notably redband/rainbow trout. To the contrary, trout populations in the reach are healthy and self-sustaining. Agencies have designated this fishery as an outstanding resource value, with relatively high recreational fishing catch rates. Comparison of growth of trout in the J.C. Boyle peaking reach to the upstream Keno reach is not necessarily an indicator of flow fluctuation effects. Younger trout (ages 1, 2, and 3) in the J.C. Boyle peaking reach are actually larger than in the Keno reach. The observation that older trout (3+) are smaller in the J.C. Boyle peaking reach could be indicative of a shift in diet by the Keno fish to larger prey items, such as fish, or a shift to a more energetically favorable habitat, such as a lake. Notwithstanding the smaller size of older trout (3+) in the J.C. Boyle peaking reach, the condition factors of the trout in the peaking reach are well within the normal, healthy range.

PacifiCorp's Proposed Instream Flow Conditions Also Support Recreation and Power Generation Uses that Agency Recommendations Would Not Support

The Importance of Whitewater Boating

Whitewater boating is an important activity within the Project area and is discussed in further detail in the Recreation Flow Analysis (Section 2.0 of the Recreation Resources Final Technical Report). The Upper Klamath River draws visitors from a very broad area for whitewater boating recreation, extending from central California to Washington and beyond. Daily peaking flows in the J.C. Boyle peaking reach largely determine the frequency and quality of whitewater boating and fishing. In general, existing peaking flows (1,500 to 1,700 cfs) provide high-quality whitewater boating on nearly 90% of all peak season days (Table 3).

An 11-mile segment of the J.C. Boyle peaking reach from the J.C. Boyle powerhouse to the California/Oregon state line was designated a Wild and Scenic River reach in 1994. The river was designated for several of its "outstandingly remarkable values" (ORVs), including whitewater boating recreation. According to the National Park Service, this stretch was so designated because it "[o]ffers a variety of year-round whitewater boating opportunities," due to "year-round releases from the J.C. Boyle Dam/Powerhouse system" (Klamath Wild & Scenic Eligibility Report and Environmental Assessment [1994]). The designated segment includes the Hell's Corner portion of the J.C. Boyle peaking reach, which provides challenging Class IV and V whitewater boating runs. Downstream of the state line, the river reach is considered eligible for W&SR designation, but it has not been designated to date.

Regional demand for recreation popular in the Project area is anticipated to continue to increase in the future. The population of the counties of origin of visitors to the Project area also is expected to increase. As a result, it is estimated that, if Project operations continue in accordance with the proposed license, annual recreational use of the Project area may increase by up to 44 percent by 2040 (from approximately 96,000 to about 138,000 recreation days – see Recreation Resources Final Technical Report).

Table 3. Actual Number and Percent of Days with Raftable Flows below the J.C. Boyle Powerhouse, 2000-2005.

Number of Days with Raftable Flows						
Year	**May**	**June**	**July**	**Aug**	**Sept**	**Total**
2000	30	30	30	28	25	143
2001	29	30	24	29	30	142
2002	29	30	30	27	13**	129
2003	31	18**	31	31	27	138
2004	30	30	27	20	29	136
2005	30	24	29	25	29	137
Percent of Days with Raftable Flows						
Year	**May**	**June**	**July**	**Aug**	**Sept**	**Total**
2000	97%	100%	97%	90%	83%	93%
2001	94%	100%	77%	94%	100%	93%
2002	94%	100%	97%	87%	43%	84%
2003	100%	60%	100%	100%	90%	90%
2004	97%	100%	87%	65%	97%	89%
2005	97%	80%	94%	81%	97%	90%

** Two week outages for plant maintenance (headgate and controls) occurred during this month. Otherwise, number of days with raftable flows would have been consistent with other months.

The Importance of Power Generation

The J.C. Boyle powerhouse generally operates as a peaking facility when flow is not adequate to allow continuous operations; i.e., when river flows are less than maximum turbine hydraulic capacity of 3,000 cfs. Power generation (and hence flow through the powerhouse) is shaped to coincide with peak customer electricity demand. During the summer months, peak demand typically occurs on weekdays in the afternoons and early evenings. In general, on a daily basis, water storage occurs in the J.C. Boyle reservoir at night when generation is not occurring. Such operating conditions can result in a fluctuation of approximately 3.5 feet maximum between minimum and full pool elevations in the J.C. Boyle reservoir, but the average daily fluctuation is approximately 1–2 feet to provide a practical operating margin to allow for unexpected changes to inflow, system load requirements, customer demand, or mechanical failure.

Operating in a peaking mode allows commercial and recreational rafting opportunities from the powerhouse to Copco reservoir (approximately 15 miles) from May to mid-October. During that period and dependent on power demand conditions, PacifiCorp may consider the timing needs of commercial rafters when it is scheduling flow releases.

The annual average value of power for the 30-year license period (starting in 2006) is estimated in PacifiCorp's Final License Application, Exhibit D. The average value of on-peak generation, assuming a 30-year average value of California-Oregon-Border (COB) and Mid-Columbia values ($74 per MWh) and a future on-peak generation of about 450,000 MWh (proposed Project), is $32.9 million per year. The average value of off-peak generation, assuming a 30-year average value of COB and Mid-Columbia values ($62 per MWh) and a future off-peak generation of about 250,000 MWh (proposed Project), is $15.6 million per year.

The Adverse and Substantive Impacts of Agency-Recommended Flows on Recreation and Power Generation Resources

The agency-recommended flow requirements would adversely and substantively impact whitewater boating and power production. The recommendation of many agencies to eliminate peaking operations would essentially eliminate whitewater boating, particularly during the June-August period of peak whitewater boating activity when over 80 percent of the rafting trips normally occur. Even the weekly peak flow condition recommended by BLM would adversely and substantively impact whitewater boating opportunities in the J.C. Boyle peaking reach. In fact, PacifiCorp concludes that BLM's weekly peak flow condition would not support whitewater boating in a reliable and consistent manner.

PacifiCorp calculates that the weekly peak flow condition required by BLM would reduce total available rafting days by about 65 to 95 percent depending on water year. In fact, in below-average or dry water years, available rafting days would be few or none during the peak rafting months of June, July, and August. As mentioned above, only 2 days were estimated as available based on 1994 conditions. A similar review by PacifiCorp of other below-average or dry water years (i.e., 1990, 1991, and 2002) confirm that available rafting days would be few or none during the peak rafting months.

Another detrimental effect of the weekly peak flow condition required by BLM is the short duration of flow at 1,500 cfs that would often be available after flow up-ramping was completed. In many cases, particularly during the peak rafting months, only 2 to 5 hours of a flow at 1,500 cfs would be available. This would significantly constrain the logistics and windows of raft put-in, run timing, and take-out, and thereby detrimentally affect the quality of the whitewater boating experience.

As with whitewater boating opportunities, the recommendation of many agencies to eliminate peaking operations would severely impact the Project's generating capacity. BLM's own assessment of power production under the weekly peak flow condition indicates that power production would be reduced by over 40 percent in the long-term average at the J.C. Boyle development. However, these estimates do not accurately represent the level of reduction that would likely occur under the weekly peak flow condition, particularly during the peak summer months. PacifiCorp calculations indicate that total daily generation for an average day in an average water year in June, assuming a median flow of 494 cfs, would drop from 294 MWh to 12 MWh, a loss of 96 percent of total daily generating capacity. Total daily generation for an average day in July, assuming a median flow of 391 cfs, would drop from 210 MWh per day, to zero MWh per day – a loss of 100 percent. Total daily generation for an average day in August, assuming a median flow of 676 cfs, would drop from 436 MWh per day to 122 MWh per day. That represents a loss of 72 percent.

Proposed FERC Boundary (Including Exclusion of Keno Facilities)

Basis for Position

BOR Lacks FPA Section 4(e) Authority Over Link and Keno Facilities

PacifiCorp's application for new license does not include Keno reservoir and Keno dam (Keno), because FERC lacks authority to relicense Keno. As demonstrated below, although Keno re-regulates the irrigation-dominated releases from the BOR's Klamath Irrigation Project and Link River dam, and although PacifiCorp's contract with BOR governing Keno operations gives PacifiCorp limited flexibility to shape releases on behalf of downstream generation, in fact Keno's contribution to generation is at best insubstantial. This means that Keno does not qualify as a part of the Klamath Hydroelectric Project unit of development, a concept that defines the works FERC has jurisdiction to license (for example, see FPA Section 3(11), 16 U.S.C. § 796(11) definition of "project", and *Chippewa and Flambeau Improvement Co. v. FERC,* 325 F.3d 353 (D.C. Cir. 2003)).

Contrary to DOI's implication, the test of whether a facility is part of a unit of development depends <u>only</u> on whether the facility contributes to hydroelectric generation. The facility's impacts, adverse or beneficial, on other public interest considerations (including BOR projects) are irrelevant (for example, see *PacifiCorp*, 98 FERC 61,117 at 61,346 (2002), *aff'd*, *Bear Lake Watch v. FERC,* 324 F.3d 1071 (9th Cir. 2003)).

FERC's basic test for whether a reservoir that is not connected directly to a generating unit is nevertheless part of a hydroelectric unit of development is whether the reservoir contributes more than a *de minimis* amount to annual generation at downstream generating units. In this case, the downstream generating units are at J.C. Boyle, Copco 1, Copco 2, and Iron Gate. In order to isolate the effect of the reservoir at issue –Lake Ewauna and Keno Dam, which impounds it ("Keno") – PacifiCorp used a computer model to simulate annual downstream generation with and without Keno. Pursuant to FERC methodology, PacifiCorp used annual generation numbers to ensure a complete picture, because while certain months of the year may register positive contributions to generation, they may be subsequently counterbalanced and even outweighed by negative contributions in other months of the year.

The predominant source of water reaching Keno is the upstream Upper Klamath Lake. This large reservoir has about 240 days' worth of storage capacity. Keno, which has less than one day of storage, receives flows from Upper Klamath Lake through releases at Link River dam. To determine Keno's contribution, if any, to downstream power generations, PacifiCorp modeled approximately 92 years (1905-1997) of gauging data on inflow to Upper Klamath Lake, to which outflows through Link River Dam directly correlate.[10]

[10] PacifiCorp developed a set of synthetic flow records designed for prompt analyses with results that cover the full range of flow possibilities. The synthetic inflows used for Klamath River analyses are based on the actual historical inflow volumes for Upper Klamath Lake (1905-1997) as provided by the California Nevada River Forecast Center. The historical record is used to approximate the 5%, 25%, 50%, 75% and 95% probability levels for annual inflow volume. The annual exceedance levels are used to determine the total volume for each probability

As depicted in Table 4, PacifiCorp used the historical data to approximate five water-year levels, from wet to dry, based on their likelihood of occurrence. These levels are set forth in the first column -- P5, P25, P50, P75, and P95 -- under the caption "Inflow Exceedance Level." P5 means that inflow to Upper Klamath Lake, and therefore releases from Link River Dam to Keno ("inflow to Keno") was exceeded only 5% of the time over the 40 years of data; in other words, unusually large volumes of water arrived at Keno; *i.e.*, it was a very wet year. P50 means that inflow to Keno was exceeded 50% of the time; in other words, there was more water half the time and less water the other half of the time; accordingly, this is the 92 years' median flow. Finally, P95 indicates that inflow to Keno was exceeded 95% of the time; in other words, it was a very dry year.

The second column on the chart shows the number of Gigawatt-hours per year generated in each of the five representative water years, assuming Keno does not exist. For purposes of illuminating the "no Keno" results, the model removed from the equation water storage in Lake Ewauna, and irrigation withdrawals from and return flows (contributions) to Lake Ewauna. As proxy for "no Keno," the model assumed Keno in run-of-river operation, *i.e.*, input exactly equals output (no store-and-release operations). Because Keno can release without delay any amount of water Link River Dam can send it, the model's use of the run-of-river proxy does not materially skew the results.

The third column shows the number of Gigawatt-hours per year generated in each of the five representative water years, assuming Keno exists and is being operated pursuant to the terms of the current contract between PacifiCorp and BOR. That contract allows a reservoir operating range of 1.5 vertical feet (elevation 4084.50 to 4086.00); *i.e.*, PacifiCorp may store 1.5 feet of water in Lake Ewauna for its own purposes and release it when it wishes, *e.g.*, to maximize downstream generation. Due to its other storage obligations, PacifiCorp can store this surplus water for no more than a day; *i.e.,* it has the flexibility to achieve only daily peaking for power generation and water management purposes (per BOR contract). The calculations in this column include irrigation withdrawals from and contributions to Lake Ewauna.

The fourth column compares annual generation in each of the five representative water years without Keno, versus with Keno at 1.5 feet operating range, to derive the percentage gain with Keno at 1.5 feet operating range.

The fifth column shows the number of Gigawatt-hours per year generated in each of the five representative water years, assuming Keno exists and is being operated at its theoretical physical maximum operating range of 9.0 feet. The model assumes a reservoir operating range of 9.0 vertical feet (elevation 4080.50 to 4089.50) and includes irrigation withdrawals from and contributions to Lake Ewauna. All voluntary and contractual operating considerations are removed, in order to measure an estimated theoretical maximum operating range.

The sixth column compares annual generation in each of the five representative water years without Keno, versus with Keno at 9.0 feet operating range, to derive the maximum percentage gain that Keno contributes for these periods. Column 6 at P50 depicts Keno's median annual

factor, and monthly increments are used to establish the shape of the monthly distribution. The monthly volumes for each probability factor are converted to daily values for use by the model.

generation contribution based on over nine decades of Upper Klamath Lake inflow data. In other words, a median expectation of the maximum theoretical benefit that Keno contributes downstream is -20%.

Table 4. Estimated annual generation totals (in Gigawatt-hours [GWh] for the period of May 1 through April 30) assuming conditions with and without the operation of Keno facilities.

(1) Inflow Exceedance Level (w/UKL BO)*	(2) Without Keno	(3) With Keno at 1.5 Ft. Ops. Range	(4) With Keno at 1.5 Ft Ops. Range: Benefit	(5) With Keno at 9.0 Ft Operating Range	(6) With Keno at 9.0 Ft Ops Range: Benefit
	GWh/Year	**GWh/Year**	**%**	**GWh/Year**	**%**
P5	964	1,000	3.80%	1,001	3.80%
P25	948	948	0.00%	951	0.40%
P50	804	803	-0.10%	802	**-0.20%**
P75	685	645	-6.00%	643	-6.20%
P95	428	322	-24.70%	321	-24.80%

* Biological Opinions' Restrictions on Upper Klamath Lake level are in place.

P5: Inflow is equal to or greater than, in 5% of the record (Wet)

P25: Inflow is equal to or greater than, in 25% of the record (Upper Quartile)

P50: Inflow is equal to or greater than, in 50% of the record (Median)

P75: Inflow is equal to or greater than, in 75% of the record (Lower Quartile)

P95: Inflow is equal to or greater than, in 95% of the record (Dry)

When viewed in its totality, Table 4 demonstrates that Keno contributed at most 3.8% to downstream generation in only the wettest 5% of the inflow record. Table 4 also shows that there was an equal probability of a 24.7% loss of generation in the driest 5% of the inflow record. In short, the table demonstrates that there is at most a 25% probability that the existence of Keno provides any benefit (and that benefit ranges between 0 and 3.8%) while there is a corresponding 75% probability that the existence of Keno results in a loss of generation (ranging from 0 to 24.7%).

PacifiCorp's analysis is consistent with that used by FERC, which has been affirmed on judicial review. In 2003, three appellate court opinions reviewed and affirmed FERC determinations on the issue of whether reservoirs without powerhouses are part of a downstream unit of hydroelectric development. In *Bear Lake Watch v. FERC*, 324 F.3d 1071, 1075 (9th Cir. 2003), the court affirmed FERC's ruling that "when a reservoir . . . does not have a significant beneficial impact on power generation but, rather, has the opposite effect, it is not a necessary or appropriate part of the generation project." The court noted that FERC had conducted an analysis of records over a very long period and had determined that the reservoir in that case (Bear Lake) reduced the output of hydroelectric power from downstream plants below the output they would have generated if the river had been allowed to run free. Although at times the reservoir was beneficial to downstream generation, its overall operation was detrimental to power generation.

The petitioner in *Bear Lake Watch* complained that FERC should have "sliced time into smaller segments and considered daily or even hourly flow data" (FERC considered monthly data). The court quoted FERC's response approvingly (324 F.3d at 1077):

> "[T]he losses in potential generation caused by Bear Lake operation are so consistent across such a broad range of conditions that any interstitial daily or hourly increases would clearly be dwarfed by corresponding decreases during other daily or hourly periods."

In *Chippewa and Flambeau Improvement Co. v. FERC*, 325 F.3d 353, 358-59 (D.C. Cir. 2003), the court stated:

> "In a series of cases involving the licensure of upstream reservoirs, the Commission has based its jurisdictional determinations upon the extent to which operation of the reservoir benefits downstream generation. In two . . . recent decisions, the Commission held that adding 2.4 to 5 percent to the total power output of plants downstream was a sufficient effect to give it jurisdiction over a reservoir."

> "The Commission has reasonably interpreted the Act to require licensure of a reservoir that provides to a licensed power plant downstream benefits substantial enough to be deemed "necessary or appropriate" to the operation and maintenance of that plant. And the Commission has found an increase in total generation of 2.4 percent or more "substantial," while considering an impact of .06 percent insufficient. . . . We conclude that the Commission's case-by-case approach to determining whether a reservoir is "necessary or appropriate" to a licensed project, with the emphasis upon the effect of the reservoir upon the generation of power, is reasonable and consistent with the purpose of the Act."

Finally, in *Domtar Maine Corp. v. FERC*, 347 F.3d (D.C. Cir. 2003), the court affirmed FERC's estimates, based on data submitted by the licensee, that two upstream reservoirs increased the project's total annual generation by an average annual 3.4 percent, an amount above *de minimis* which required the reservoirs to be licensed.

Accordingly, PacifiCorp has demonstrated that Keno not only doesn't contribute to downstream generation, it, in fact, **reduces** such generation. As a result, Keno is not within FERC's jurisdiction, which, therefore, prohibits FWS, NMFS, BOR, or BLM from imposing FPA section 4(e) conditions on it.[11]

Perhaps anticipating the weakness of their position, DOI attempts to argue that the mere existence of the Keno contract makes Keno a necessary part of the licensed project, asserting:

> "Even if PacifiCorp "excludes" Keno Dam from its Project, PacifiCorp is still required to operate Keno Dam under its contract with Reclamation. Thus, PacifiCorp is contractually required to operate and maintain Keno Dam as long as

> PacifiCorp operates the Project. Thus, Keno Dam must remain a part of the project." (DOI letter of March 27, 2006 at P. 17).

However, it is Keno's value to hydroelectric generation – not the contract – that defines Keno for FERC jurisdictional purposes. Interior's bootstrap argument cannot create FERC jurisdiction where there is none, or require FERC to keep a non-jurisdictional work in the license. Because Keno at best provides insubstantial benefits to generation and therefore will not be in the new license, neither PacifiCorp nor FERC has a stake in the continuation of the Keno contract.

DOI further misinterprets FERC's regulatory authority when it asserts that if FERC concludes it lacks jurisdiction over Keno, PacifiCorp must apply for permission to "decommission" the project (BOR at 18). Because Keno is not required to be licensed, it can exit the project at the end of the license term and is not subject to any further FERC proceedings or requirements. *Cf. Pennsylvania Electric Co.,* 56 FERC 61,435 (1991) (at end of license term of project not required to be licensed, no further actions are taken by FERC).

As explained above, BOR has no section 4(e) conditioning authority in this proceeding with respect to the Keno facilities. BOR similarly lacks authority to issue FPA section 4(e) conditions governing the Link facilities, because BOR owns the Link River Dam, and PacifiCorp has proposed to de-commission the East Side and West Side power facilities. Nor, in any event, would a new license for the Klamath Project require an extension of the 1956 Link River Dam contract between PacifiCorp and Reclamation, whereby PacifiCorp operated the federal dam primarily for Reclamation purposes, and had the use of any water surplus thereto. The 1956 contract expired by its terms on April 16, 2006, and FERC has ruled that the current Klamath Project license does not require PacifiCorp to continue to perform under that contract after its expiration. *See PacifiCorp*, 114 FERC 61,051, *reh'g denied,* 115 FERC 61,075 (2006). Indeed, FERC has stated that PacifiCorp need not, for purposes of any new license for the Klamath Project, hold the rights it held under the 1956 Link River Dam contract. 114 FERC 61,051 at P 27.

BLM's Project Boundary Assertions Are Invalid

PacifiCorp owns and manages approximately 91.2 percent of the lands within the proposed Project boundary, including the land occupied by most of the Project powerhouses; portions of the Project transmission lines, conduits, canals, and dam facilities; and the Project reservoirs, [I thought we say the State owns the river beds] and tributary streams. Approximately 4.2 percent of the Project boundary area is federally owned, 3.6 percent is state owned, and 0.6 percent is privately owned. Portions of the J.C. Boyle canal and the entire powerhouse are located on BLM land. The Spring Creek diversion dam and ditch also are located on BLM land.

In efforts to support its overreaching attempt to control Project effects, BLM objects to PacifiCorp's exclusion from the proposed Project boundary of the J.C. Boyle bypassed river reach, where BLM wishes to require measures. First, the FPA vests FERC, not BLM, with exclusive jurisdiction to determine what lands and works belong in a project and its associated boundary. BLM cannot preempt FERC's jurisdiction by proposing mandatory section 4(e) conditions that require actions within, or activities specific to, the J.C. Boyle bypassed reach. Second, FERC has made it clear that its decision whether to include a bypassed reach in a project boundary is not determined by a project's <u>effects</u> on the reach. The Commission stated:

> We do not base our decision as to whether a reach is part of a project purely on whether the reach is <u>affected</u> (positively or negatively) by the project. Were we to do so, we would have to include within the boundaries of some of the larger projects we regulate river reaches tens, or even hundreds, of miles downstream from those projects. We do not believe that the FPA requires such an expansive view of our jurisdiction. [*Duke Power*, 100 FERC ¶ 61,294 at P 35 (2002); emphasis added.]

Rather, FERC looks to whether the license requires ongoing programs in the bypassed reach necessitating continued FERC oversight to meet those requirements. Evaluation and monitoring are not measures necessitating continued FERC oversight of the subject sites; further, one-time or intermittent activities, such as placing gravel in a stream, have not by themselves caused the Commission to expand the boundary to ensure permanent oversight (*See Duke Power*, *supra*, at P 34-35).

In support of its assertion that the J.C. Boyle bypassed reach should be included in the Project boundary, BLM refers to the impact to water quality in the reach from repeated overflow at the J.C. Boyle canal emergency spillway. However, PacifiCorp plans to install bypass valves that will address the causes of such overflows. In addition, Interior cites to a December 2005 rockslide that created a hole in the J.C. Boyle Canal, causing canal water and sediment to enter the J.C. Boyle bypass reach. However, such failure, even if repeated, does not occasion boundary alterations. Rather, such events are addressed by FPA section 10(c), which requires the licensee to make the necessary repairs and leaves the pursuit of damages awards to the appropriate state or federal forum.[12]

BLM also argues that Topsy Campground should remain in the Project boundary. However, since Topsy Campground is owned and operated by BLM, and PacifiCorp has no role in its maintenance and operation, it is unclear why the Campground was placed in the Project boundary as part of the prior license. In any event, since PacifiCorp has no responsibilities with respect to Topsy Campground, the relicense application properly excludes it from the Project boundary.

[12] BLM's real motivation in challenging PacifiCorp's removal of the bypass reach from the Project boundary may be to bootstrap its attempt to impose mandatory flow conditions in the J.C. Boyle reaches. However, BLM can in any event not impose minimum or other flow-related conditions on these reaches of the Klamath River, because the reaches are owned exclusively by the States of Oregon and California.

Dam Removal

Basis for Position

Project Reservoirs Provide Beneficial Processing of Nutrients and Organic Matter

As previously described in the Water Quality section of this paper, the Project reservoirs, particularly Copco and Iron Gate reservoirs, play an important role in processing the enormous loads of organic matter and nutrients from upstream sources, notably Upper Klamath Lake (UKL). Both Copco and Iron Gate reservoirs act as significant annual net sinks for both total nitrogen and total phosphorous. Reservoirs generally act as traps, reducing organic matter, nutrient, and particulate matter (Thornton, 1990; Ward and Stanford, 1983).

Analysis of 2002 nutrient loading data reported by Kann and Asarian (2005) indicates that Copco reservoir receives loads of almost 600 metric tons of total nitrogen and 135 metric tons of total phosphorus from the inflowing Klamath River. Kann and Asarian's (2005) analysis of the 2002 nutrient loading data further indicates that Copco reservoir provided a net retention of 48 metric tons of total nitrogen, equivalent to 8 percent of the inflow load, and 36 metric tons of total phosphorus, equivalent to 26 percent of the inflow load. Iron Gate reservoir provided a net retention of 66 metric tons of total nitrogen, equivalent to 12 percent of the inflow load, and 32 metric tons of total phosphorus, equivalent to 25 percent of the inflow load. In tandem, Copco and Iron Gate reservoir provided a net retention of 124 metric tons of total nitrogen, equivalent to 20 percent of the inflow load from upstream sources, and 51 metric tons of total phosphorus, equivalent to 35 percent of the inflow load.

These findings indicate that the reservoirs remove and retain substantial quantities of nutrients flowing from upstream, and prevent their passage downstream where they would otherwise further adversely affect water quality. As such, the reservoirs created by the Project's dams help protect water quality in the lower basin by processing the enormous loads of nutrients and organic matter from Upper Klamath Lake (UKL). Dam removal will result in a loss of this processing of nutrients and organic matter, increasing the risk of further impairment of water quality and fisheries downstream in the lower river and estuary.

In addition, PacifiCorp proposes to implement Reservoir Management Plans for improving water quality in J.C. Boyle, Copco, and Iron Gate reservoirs. The Reservoir Management Plans will evaluate the effectiveness and feasibility of several technologies and measures[13] for more effectively controlling water quality conditions in the reservoirs that result from significant loads of organic and nutrient matter originating upstream of the Project, notably UKL. Through actions identified in the plans, several beneficial water quality responses are expected. These responses include: reduced hypolimnetic biochemical oxygen demand (BOD) and ammonia (through oxidation of these compounds), reduced orthophosphate and ammonia (through retention in sediments), and a decrease in algae populations in surface waters that would lead to decreased deviations in pH. Implementation of these Reservoir Management Plans and the beneficial water quality responses would obviously not occur with dam removal.

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[13] The specific technologies and measures to be further evaluated for the reservoirs include hypolimnetic oxygenation, epilimnetic or surface aeration/circulation, and copper algaecide treatment.

The Reservoir Management Plans do not (and cannot) directly address the large inflowing loads of nutrients and organic matter from sources upstream of the Project, particularly Upper Klamath Lake. Control of the large inflow loads from upstream sources is most appropriately addressed through implementation of Total Maximum Daily Loads (TMDLs) that are currently being developed by the State of California's North Coast Regional Water Quality Control Board (NCRWQCB) and the Oregon Department of Environmental Quality (ODEQ). However, PacifiCorp concludes that the Reservoir Management Plans will be an important adjunct to the system-wide TMDLs, and provide a proactive response by PacifiCorp to implementation of the anticipated TMDLs, particularly as they may pertain to the Project reservoirs.

Potential Impacts from Sediment Accumulated Behind the Dams

Bathymetric surveys were conducted on J.C. Boyle, Copco, and Iron Gate reservoirs in Fall 2001 (PacifiCorp 2004). Accumulated sediment in the reservoirs was subsequently estimated by comparing the current bathymetry with available information on pre-impoundment topography. Estimated sediment accrual in Copco and Iron Gate reservoirs is summarized in Table 5 (estimated accrual in J.C. Boyle reservoir is minor by comparison – only about 0.02 million yd^3 – and so is not included in Table 5).

Table 5. Estimated Sediment Accrual in Copco and Iron Gate Reservoirs

	Copco	Iron Gate
Sediment Deposited (million yd^3)	10.4	4.8
Total Reservoir Capacity (million yd^3)	75.6	94.9
Capacity Reduction (%)	14	5

From this analysis, PacifiCorp estimates that approximately 15 million yd^3 of sediments have accumulated behind Iron Gate and Copco dams (Table 5). The accumulated sediments in the reservoirs are almost entirely comprised of fine to very fine sediments (i.e., sand, silt, and clay). The sediments are known to contain nutrients, particularly phosphorus and nitrogen (PacifiCorp 2004). Little is known about the content of potential contaminants from upstream sources that may have become bound to the sediments. New information on potential sediment contamination in Iron Gate and Copco reservoirs is expected from a study this summer that is being conducted under the sponsorship of the California Coastal Conservancy.

Given the appreciable volume of fine sediments accumulated behind Iron Gate and Copco dams, dam removal could cause significant detrimental impacts. These impacts could include downstream releases of nutrients and other contaminants currently bound in the sediments, increases in downstream turbidity and suspended sediment levels, downstream channel aggradation or sediment deposition, and channel incision and shifting in formerly impounded reaches of the river.

The uncertainty resulting from potential detrimental effects of dam removal is now well recognized. For example, the technical paper by Doyle et al. (2003) titled *Dam Removal in the United States: Emerging Needs for Science and Policy* concluded:

> "Appropriate policy must be driven in part by an understanding of the geomorphic, ecological, economic, and social impacts of dam removal. This is a rapidly emerging area of science, yet there are few well-documented scientific studies of dam removal, and the limited data that do exist are primarily for small dams."

> "Because dams and their reservoirs persist for decades, river channels typically adjust to the altered hydrologic and sediment transport regimes that dams impose. Dam removal itself therefore represents a geomorphic disturbance to a quasi-adjusted riverine system. The removal of a dam unleashes cascades of erosional and depositional processes that propagate both upstream and downstream, with the upstream response driving the downstream response."

> "Dam removal may also wreak havoc on already highly-disturbed ecosystems. In the midwestern United States, reservoirs often provide a valuable, albeit unintentional, service as sinks for nutrients …. Further, the sediment released following a dam removal will inevitably be harmful to some downstream biota, which may include taxa of special interest…."

> "An additional wild card is the possibility that reservoirs may store high levels of contaminants, including heavy metals and other organic and inorganic compounds. Release of such materials following dam removal can create contaminant plumes with wide-ranging environmental consequences…."

Similarly, other studies have noted that:

> "Dam removal should therefore be considered a disturbance in the strict ecological sense of a "discrete event in time that disrupts ecosystem, community, or population structure, and changes resources, substrate availability, or the physical environment" (White and Pickett 1985). Also, because it is a disturbance, we should expect substantial changes in many ecological variables, including the loss of resident flora and fauna and the disruption of ecosystem processes, at least in the short term. Ecologists face key questions regarding the mechanisms and rates of change after the removal, and the longer-term trajectories of these changes."

> "In many Midwestern states, reservoir sediments frequently contain a similar chemical legacy in the form of nutrient-rich particles derived from past and present agricultural activity (Stanley and Doyle 2002). Removal may then reintroduce nutrients that had been stored for decades, causing enrichment of downstream rivers, lakes, and even coastal areas. In support of this prediction, Gray and Ward (1982) found that the flushing of sediments from the Guernsey Reservoir on the North Platte River caused a sixfold increase in downstream phosphorus concentrations and stimulated the growth of large filamentous green algal mats. Similarly, when the Capilano Reservoir in British Columbia was drawn down for structural improvements to the dam, ammonium in the sediments was released into the water column, increasing concentrations by two orders of magnitude over the 4-month period when the water level was being lowered (Perrin et al. 2000). Thus, there is the very real possibility that by adding to already elevated nutrient

concentrations in rivers, dam removal will be at odds with nutrient management strategies in some parts of the US (Stanley and Doyle 2002)."

Stanley and Doyle (2003); *Trading Off: The Ecological Effects of Dam Removal*.

Risks Associated with Reintroducing Anadromous Fish

Dam removal would provide anadromous fish access to the upper basin. However, as previously discussed in the Fish Passage and Reintroduction section of this document, such access would not be without some major impacts and risks to the existing fish populations as well as to the commercial and sport fisheries. These include:

1. Disease. Reintroduction of anadromous fish via dam removal would increase the risks of introducing diseases to native resident fishes, especially redband trout, in the upper basin. For example, there are no known viral diseases presently infecting native fish in the upper Klamath basin. If anadromous salmonids were allowed to pass upstream from Iron Gate dam, there is a strong possibility of introducing Infectious Hematopoietic Necrosis ("IHN") to the upper Klamath basin. IHN has been detected in both juvenile and adult salmon in the lower Klamath and Trinity rivers. Because native fish populations in the upper basin, including redband trout, have no natural resistance to IHN, an inadvertent introduction of this disease could result in catastrophic losses of native fish in UKL. The spread of IHN to the upper basin could also filter back downstream to further impact all salmonids in the lower Klamath River upstream of the Trinity River where the disease is now uncommon.

2. Mainstem Chinook salmon spawning. Removal of dams would result in highly degraded water quality and a significant increase in fine sediments in the mainstem Klamath River for decades. The most pronounced impacts would occur in the area closest to Iron Gate. Based on spawning surveys conducted between 1993 and 2001, the 22 km reach from Iron Gate dam to the Shasta River consistently has had the highest density of naturally spawning Chinook salmon in the entire mainstem Klamath River (USFWS 2001). The reach represents only 7% of the mainstem but typically supports more than 50% of the natural spawning of Chinook salmon. Returns of coded wire tag data have shown that the high spawner density in this reach is not due to contribution from hatchery strays (CDFG and NMFS 2001). Thus, the area having the highest density of mainstem Chinook spawning would be most severely impacted if Iron Gate dam was removed.

3. Coho salmon. The risk of IHN disease, degradation of water quality, and increase in fine sediments, noted above, also would adversely affect coho salmon if mainstem dams were removed. Unlike Chinook salmon, the coho salmon in the Klamath River are at risk of extinction under current conditions and are an ESA-listed species. Adding more risks to this species could certainly jeopardize the population. Removal of dams may avail more tributary habitat to coho salmon, but these small streams above Iron Gate contain only a limited amount of suitable habitat, much of which is highly degraded. It is doubtful that any increased coho salmon production from these tributaries would be enough to offset the adverse impacts to the population below Iron Gate, at least for the several decades that it would require for habitat conditions to stabilize.

4. Hatchery contribution. The Iron Gate Hatchery is one of the most successful hatcheries on the West Coast. The broodstocks have consisted almost entirely of native stocks returning to the immediate area. There has been no intentional or unintentional manipulation of run timing. The facility has had an excellent history of fish health, with few disease problems. The hatchery is entirely dependant on the availability of cold water withdrawn from below the thermocline in Iron Gate reservoir. Removal of Iron Gate dam would eliminate the hatchery and its contribution of Chinook and coho salmon and steelhead trout.

5. Commercial and Sport Fisheries. The Upper Klamath Basin above Iron Gate dam supports an acclaimed sport fishery for redband trout. As noted above, the introduction of anadromous fish to this area could devastate the redband trout population via introduction of IHN and perhaps other diseases. This was a major concern of Oregon fish managers when anadromous fish reintroduction was reviewed in 1997. The Klamath River supports a valuable tribal and nontribal commercial and sport fishery for Chinook salmon and steelhead trout. Much of the Chinook salmon catch in the ocean troll and sport fisheries off northern California and southern Oregon originates from Klamath River fish. Habitat modeling of reintroduction provided a strong indication that anadromous fish reintroduction to the upper basin could not be successful unless current harvest rates were significantly reduced or perhaps curtailed totally for several decades. This would create a major economic impact to the region. Decision-makers for anadromous fish reintroduction would need to acknowledge this major impact to the commercial and sport community, and those communities would need to be willing to sacrifice much of their livelihood for the sake of seeing the reintroduction experiment go forward.

Lost Recreation and Generation Resources

Dam removal would essentially eliminate whitewater boating in the Project area, particularly during the June-August period of peak whitewater boating activity when over 80 percent of the boating trips normally occur. This would severely diminish the value of this unique, high-quality regional recreation resource.

Dam removal would obviously result in loss of the 737,000 MWh per year of clean renewable power generated by the Project. Replacement of this power would require the equivalent of 360,000 tons per year of coal or 5 billion cubic feet of natural gas.

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