Comments on the Public Review Draft of the Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) and Action Plan Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California

August 27, 2009

EXECUTIVE SUMMARY

PacifiCorp Energy herein provides detailed comments on the *Public Review Draft of the Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) and Action Plan Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California* (hereafter referred to as the "Draft TMDL").

Among the many comments in this document, PacifiCorp describes a number of major flaws and issues with the Draft TMDL. Some of these flaws and issues call into doubt the technical basis of the TMDL, and we encourage the Regional Board to resolve these flaws and issues promptly.

1. There are several substantial issues associated with the modeling done to support the Draft TMDL's analyses and recommended allocations. Undocumented, unjustified, and questionable source code modifications were made that render the technical basis of the TMDL flawed and unsuitable for use to set load allocations. Uncertainty analyses or even model performance metrics that allow model uncertainty to be quantified are absent. Without quantification and incorporation of model uncertainty, the adequacy and accuracy of the TMDL analyses are dubious, and the resulting TMDL load allocations questionable. The models are based on only a single model year. Additional model years are not included even though sufficient data were available to extend the models. This omission severely limits the TMDL analysis because of a complete lack of accounting for inter-annual variability. The Draft TMDL indicates that the models' upstream boundary conditions were based on a scenario that assumes complete compliance with Oregon's Upper Klamath Lake TMDL (ODEQ 2002). However, upon review, it appears that model upstream boundary values were set inconsistently below expected conditions presented in the UKL TMDL, and possibly even below expected natural conditions.

2. The Draft TMDL's water temperature allocations and targets are inconsistent with the Clean Water Act because they are not based on ensuring the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife (BIP). The Draft TMDL's temperature allocations and targets are based on "ideal" or near-ideal temperatures for salmonids in the generally colder waters of the Pacific Northwest, not the "thermal load which cannot be exceeded in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife" in the Klamath River per 40 C.F.R. § 130.7(c)(2). As discussed in detail in this document, there is extensive evidence (not considered in the Draft TMDL) demonstrating that the temperature effects of the Klamath

Hydroelectric Project (Project) are consistent with the protection and propagation of a BIP in the Klamath River.

3. Taken as a whole, the Draft TMDL's dissolved oxygen (DO) and nutrient-related allocations and targets are based on management decisions that would require shifting the upper Klamath River system to an unnaturally lower trophic state. However, the Klamath River is naturally eutrophic, primarily because of the large, natural nutrient loadings to the river from Upper Klamath Lake. Upper Klamath Lake is hypereutrophic now, and is considered to have been historically eutrophic (Bortleson and Fretwell 1993, Wee and Herrick 2005). Studies of sediment cores from Upper Klamath Lake have shown that the lake has been highly productive for at least the past 1000 years (Eilers et al. 2001, Sanville et al. 1974). The Regional Board must address in a realistic manner how the drastic reductions of nutrient loads proposed in the Draft TMDL would be achieved. To our knowledge, there have been no documented cases in which nutrient load reductions on such a large scale have been achieved elsewhere, or even concluded as feasible and achievable for planning and implementation purposes.

4. The Draft TMDL's nutrient allocations at Stateline (and other downstream locations by extension) are unachievable. There are no realistic methods for the reduction in total phosphorus (TP) of 90 to 98 percent and total nitrogen (TN) of 65 to 75 percent in the upper Klamath River as required in the Draft TMDL at Stateline. As a result, the Draft TMDL fails to provide proposed nutrient load allocations that are achievable, practicable, or enforceable.

5. The Draft TMDL's chlorophyll *a* targets of 10 µg/L for suspended algae chlorophyll *a* in the reservoirs, and 150 mg/m^2 for benthic algae chlorophyll *a* in the Klamath River downstream are unachievable. As with the unachievable nutrient allocations (as summarized above), the Draft TMDL errs with these chlorophyll *a* targets by not realistically accounting for the Klamath River system as naturally eutrophic, with hypereutrophic Upper Klamath Lake as its source.

6. The Draft TMDL assigns "zero nutrient loading from reservoir bottom" and also assigns nutrient allocations to Copco and Iron Gate reservoirs of 74,569 pounds TP annually and 1,091,654 pounds TN annually despite the fact that the reservoirs are not a source of nutrients. These TP and TN allocations are to be achieved at a location *upstream* of Copco reservoir (emphasis added). These allocations are inappropriate, particularly given that the reservoirs are a <u>net sink</u> of nutrients. The Draft TMDL fails to accurately and realistically portray and account for the nutrient sources and dynamics in the Klamath River system. Even the Draft TMDL's model outputs clearly show that the reservoirs substantially reduce large nutrient pulses emanating from the Klamath River upstream (in response to bloom conditions in Upper Klamath Lake).

7. The Draft TMDL assigns allocations to Copco and Iron Gate reservoirs in the form of a "temperature and dissolved oxygen compliance lens" for the period of May through October. The Draft TMDL further describes that "[t]he volume of each reservoir compliance lens is equal to the average hydraulic depth of the river in a free-flowing state for the width

and length of the reservoir". This compliance lens approach is unprecedented, and would be unrealistic to actually apply in an advection-dominated, stratified reservoir setting.

Despite these concerns, PacifiCorp remains firmly committed to working with the Regional Board and other stakeholders to enhance the water quality conditions in the Klamath River. As the Regional Board is aware, PacifiCorp has been active in supporting strong science and prudent actions related to water quality in the Klamath River. For example, the comprehensive water quality model of the Klamath River developed by PacifiCorp's water quality modeling consultant (Watercourse Engineering) was made available by PacifiCorp to serve as the foundation for the Regional Board's TMDL models. The empirical information on water quality conditions in the Klamath River includes data that PacifiCorp collected or funded for collection over several years. Moreover, even as the TMDL is still under development, PacifiCorp is already proactively implementing important water quality measures and activities designed to bring about substantial water quality improvements in the Klamath River basin. PacifiCorp has and will continue to implement these measures and activities under a number of separate but related commitments, including elements of the Agreement in Principle (AIP), the Interim Conservation Plan (ICP), Reservoir Management Plans (RMP), as well as other planned activities.

I. INTRODUCTION

PacifiCorp herein provides detailed comments on the *Public Review Draft of the Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) and Action Plan Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California* (hereafter referred to as the "Draft TMDL"). PacifiCorp's comments consist of this cover document, which discusses our overall responses, respectively, to (1) temperature-related TMDL allocations and targets, (2) DO and nutrient-related TMDL allocations and targets; (3) TMDL modeling and analysis issues; (4) peer review responses; (5) CEQA compliance; (6) and procedural and public participation issues. Following this cover document are two appendices. Appendix A supports the cover document with specific comments on the Draft TMDL by chapter and section, and for the various appendices to the Draft TMDL. Appendix B contains a list of key reports and documents that were not used or cited in the draft TMDL. Omission of these key reports and documents indicates that even a basic review of available reports and data was not completed, but rather a selective set of data were used in the TMDL analysis and development of load allocations.

The North Coast Regional Water Quality Control Board ("Regional Board") made the Draft TMDL publicly available in a piecemeal manner by posting chapters and appendices to the Regional Board's website over the course of a month, from June 15 to July 13, 2009. Given the piecemeal manner in which the Draft TMDL was issued by Regional Board, and the significant delays PacifiCorp faced in receiving other requested data and information underlying the Draft TMDL, PacifiCorp reserves the right to submit additional comments in the future.

Among the many comments in this document, PacifiCorp describes a number of major flaws and issues with the Draft TMDL. Some of these flaws and issues render the technical basis of the TMDL flawed and unsuitable for use in setting load allocations. PacifiCorp encourages the Regional Board to resolve these flaws and issues promptly. Despite these concerns, PacifiCorp remains firmly committed to working with the Regional Board and other stakeholders to enhance the water quality conditions in the Klamath River. As the Regional Board is aware, PacifiCorp has been active in supporting strong science and prudent actions related to water quality in the Klamath River. For example, the comprehensive water quality model of the Klamath River developed by PacifiCorp's water quality modeling consultant (Watercourse Engineering) was made available by PacifiCorp and served as the foundation for the Regional Board's TMDL models. The empirical information on water quality conditions in the Klamath River includes data that PacifiCorp collected or funded for collection over several years.

Even as the TMDL is still under development, PacifiCorp is already proactively implementing important water quality measures and activities designed to bring about substantial water quality improvements in the Klamath River basin. PacifiCorp has and will continue to implement these measures and activities under a number of separate but related commitments, including elements of the Agreement in Principle (AIP), the Interim Conservation Plan (ICP), Reservoir Management Plans (RMP), as well as other planned activities. PacifiCorp acknowledges that the measures proposed in the AIP and ICP are premised on a dam removal outcome as described in the AIP, and that a different Project outcome may require different Project-related measures under the TMDL and subsequent Implementation Plan. PacifiCorp intends to work with Regional Board staff to ensure that the final Implementation Plan adequately considers and accommodates different Project outcomes.

Based on our numerous conversations with Regional Board staff, we understand that nutrient and algae reduction measures are the primary focus of TMDL efforts. The measures that have been identified by PacifiCorp will directly address the water quality problems related to nutrients and organic matter that are discussed in the Draft Implementation Plan. These efforts also will address DO and water temperature conditions in the Klamath River basin below Iron Gate dam and within the Project area. Sample programs that PacifiCorp is pursuing or evaluating include wetlands treatment in the upper basin (a critical nexus of water quality for lower river conditions), in-reservoir treatments, and other management actions above, within and below the Project area.

In addition, comprehensive water quality monitoring will be continued and expanded to extend baseline monitoring at a basin scale and address public health monitoring needs. The baseline program will be valuable in assessing long-term trends, assessing the efficacy of actions associated with implementation of TMDL actions, and tracking progress toward TMDL targets. Special studies that may be implemented under this measure could provide other important information to fill data gaps, allowing the program to evolve and adapt to meet the highest priority needs through time. The public health monitoring elements of the plan utilize the latest information and approaches to blue-green algae ("BGA") monitoring and assessment through continued input from the Klamath BGA working group. The program will provide the necessary public health information to ensure timely postings, as well as identify inter-annual variability and long-term trends.

II. TEMPERATURE-RELATED NUMERIC TARGETS AND LOAD ALLOCATIONS

A. Description of the Thermal TMDL Targets and Allocations to Iron Gate and Copco Reservoirs and Iron Gate Hatchery

Regarding Iron Gate and Copco 1 and 2 reservoirs, the Draft TMDL states that "the temperature load allocation for these reservoirs equals zero temperature increase above natural temperatures" (page 5-16). The Draft TMDL interprets "natural temperatures" as "an allowance for natural temperature increases" that "was developed from model analysis for the year 2000 that predicts the natural temperature increases through the free flowing river reaches occupied by the reservoirs" (page 5-16). The thermal allocations in the Draft TMDL thus assume and in effect would require the absence of Iron Gate and Copco 1 and 2 dams.

The Draft TMDL states that no allowable temperature increase can be allocated to the reservoirs because "temperature alterations caused by the reservoirs adversely affect beneficial uses" (page 5-16). The Draft TMDL justifies the temperature load allocation for the reservoirs at least in part on the assumption that reservoir effects on temperatures in the Klamath River downstream "may have" or "could have" adverse effects on fish, which the Draft TMDL refers to as "biological implications" (page 2-41).

The Draft TMDL assigns numeric temperature targets to the Iron Gate and Copco 2 tailraces expressed as monthly average temperatures (in Table 5.6 on page 5-16) that "are calculated from the California compliance scenario" (page 5-16). The Draft TMDL explains that the "California compliance scenario" is the result of model analysis for the year 2000 that predicts temperature conditions required to achieve the California water quality objectives for temperature assuming "compliant conditions" (i.e., "achieving temperature compliance in Oregon") at Stateline (page 3-10). However, the Draft TMDL states that the achievement of Stateline and tributary nutrient and organic matter allocations will not result in compliance with DO, temperature, chlorophyll-a, *Microcystis aeruginosa* cell density, and microcystin targets in Copco 1 and 2 and Iron Gate reservoirs during summer months (page 5-5). In the case of temperature targets assigned to the Iron Gate and Copco 2 tailraces, the California compliance scenario developed in the Draft TMDL also assumes absence of Iron Gate and Copco 1 and 2 dams, equal to temperature conditions predicted by model analysis for the year 2000 for a hypothetical "Natural Conditions Baseline" that assumed river reaches without dams (pages 2-15 and 3-9).

The Draft TMDL admits that the "determination of compliance with water quality objectives for temperature is complicated" by the fact that under current conditions the temperature of water entering California upstream of the reservoirs "carries an anthropogenic heat load from upstream sources" that are "allocated temperature loads through the State of Oregon's Klamath River TMDL", and that "these allocations are expected to be achieved gradually over time" (page 5-16). As discussed in detail in section II.C below, there are three fundamental flaws with the Draft TMDL's numeric temperature targets to the Iron Gate and Copco 2 tailraces.

First, the targets are based solely on hypothetical without-dam modeled conditions. Yet, the Draft TMDL does not provide any analysis or quantification of modeling uncertainty, and the Draft TMDL allocations and targets include no consideration or allowance for this uncertainty.

Second, the targets are based on a single year (2000) of modeled conditions. Yet, the Draft TMDL does not provide any analysis or quantification of natural monthly, seasonal, and annual variability in temperatures, and the Draft TMDL allocations and targets include no consideration or allowance for this natural variability as a result of differing hydrology or meteorology. In addition, current flow conditions are higher than the 2000 flows modeled because of the updated Biological Opinion flow requirements at Iron Gate dam[1]. This change in conditions is not incorporated into the TMDL model.

Third, the numeric temperature targets are based on thermal loading allocations upstream of the reservoirs that the Draft TMDL admits would be achieved "gradually over time" (page 5-16). Thus, the targets applied to the reservoir tailraces are not realistic and achievable unless and until allocations upstream are achieved at a certain future time.

Regarding Iron Gate Hatchery, the Draft TMDL states that "there is no allowable temperature increase that can be allocated" and that "the temperature load allocation for the Hatchery equals zero temperature increase above natural temperatures" (page 5-18). The Draft TMDL does not interpret or provide an analysis of "natural temperatures" for the Hatchery temperature allocation. The Draft TMDL only states that "no temperature data are available to evaluate the effects of the hatchery effluent on the Klamath River" (page 4-21), but that "[r]egardless, because the discharge of elevated temperature waste is not allowed per the interstate water quality objective for temperature, any effluent discharged to the river at a higher temperature than the river exceeds the objective" (page 4-21 to 4-22).

B. The Thermal TMDLs Are Inconsistent with the Clean Water Act Because They Are Not Based on Ensuring the Protection and Propagation of a Balanced, Indigenous Population of Shellfish, Fish, and Wildlife

The Clean Water Act (CWA) requires a different TMDL analysis for heat than it does for all other pollutants. Whereas TMDLs for other pollutants must implement the water quality standards impaired by those pollutants, TMDLs for heat must ensure the "protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." The proposed Klamath River temperature TMDLs are inconsistent with the CWA because they do not determine, and would not establish, the thermal load limits necessary to ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife.

The CWA's thermal TMDL provisions are set forth in 33 U.S.C. § 1313(d)(1):

> (B) Each State shall identify those waters or parts thereof within its boundaries for which controls on thermal discharges under [33 U.S.C. § 1311] are not stringent enough to assure protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife.
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> . . . . . .

[1] U.S. Fish and Wildlife Service 2008-2018 Biological Opinion, dated April 2, 2008 and National Marine Fisheries Service Biological Opinions on Klamath Project Operations from June 1, 2002 through March 31, 2012, dated May 31, 2002.

> (D) Each State shall estimate for the waters identified in paragraph (1)(B) of this subsection the total maximum daily thermal load required to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife. Such estimates shall take into account the normal water temperatures, flow rates, seasonal variations, existing sources of heat input, and the dissipative capacity of the identified waters or parts thereof. Such estimates shall include a calculation of the maximum heat input that can be made into each such part and shall include a margin of safety which takes into account any lack of knowledge concerning the development of thermal water quality criteria for such protection and propagation in the identified waters or parts thereof.

EPA's TMDL regulations amplify and refine these statutory provisions:

> (1) . . . *For pollutants other than heat*, TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS [water quality standards] . . . .
>
> (2) [For waters impaired by heat,] [e]ach State shall estimate . . . the total maximum daily thermal load which cannot be exceeded in order to assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife.
>
> [40 C.F.R. § 130.7(c) (emphasis added)]

A State, then, does not have the option of basing a thermal TMDL on achieving numeric and narrative temperature standards and designated beneficial uses; a thermal TMDL must be based on "the total maximum daily thermal load which cannot be exceeded in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife."

The proposed thermal TMDLs for the Klamath River are based on the water quality objectives for temperature contained in the Water Quality Control Plan for the North Coast Region (the "Basin Plan"). See Draft TMDL at pages 5-3 to 5-4. These objectives prohibit any alterations in natural stream temperatures that "adversely affect beneficial uses" and any increase of more than 5°F in waterbodies designated for cold or warm freshwater habitat (Draft TMDL at page 2-5). Because the Draft TMDL concludes that natural water temperatures "already adversely affect the beneficial uses during critical time periods, the natural receiving water condition becomes the temperature objective" (page 5-4). Accordingly, the proposed TMDLs include a thermal load allocation of zero to all human sources (page 5-4).

Although the Draft TMDL asserts that any temperature increase in excess of natural temperatures would adversely affect beneficial uses, the Draft TMDL does not identify the biological community or communities that would constitute the "balanced, indigenous population" (BIP) for the Klamath River or determine the maximum thermal load that would be consistent with the protection and propagation of this indigenous population. The Draft TMDL's recommended temperatures are based on "ideal" or near-ideal temperatures for salmonids in the generally colder waters of the Pacific Northwest, not the "total maximum daily thermal load *which cannot be exceeded* in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife" in the Klamath River. 40 C.F.R. § 130.7(c)(2) (emphasis added). The objective of a thermal TMDL is not to determine an ideal temperature for a generic salmonid but to determine the maximum thermal load that, with an appropriate margin of safety, is consistent with protecting the indigenous biological community of the Klamath River. As discussed in detail below, there is extensive evidence (not considered in the Draft TMDL) demonstrating that the temperature effects of the Project are consistent with the protection and propagation of a BIP in the Klamath River.

C. The Temperature Effects of the Klamath Hydroelectric Project and Iron Gate Hatchery Are Consistent with the Protection and Propagation of a Balanced, Indigenous Biological Community in the Klamath River

EPA defines a "balanced, indigenous population" as:

> a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the [CWA] [which imposes technology-based effluent limits on point sources subject to NPDES discharge permits]; and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to [CWA] section 316(a) [thermal variances for point sources subject to NPDES permits].
>
> 40 C.F.R. § 125.71(c).

Balanced, Indigenous Populations in the Klamath River

The Klamath River in the Project area and downstream of the Project supports a diverse freshwater fish community, including species assemblages with a mix of temperature preferences. Table 1 contains a list of the 31 native fish species that are known to occur in the Klamath River upstream and downstream of Iron Gate dam. Of these 31 native fish species, 16 are resident species in the Klamath River upstream of Iron Gate dam, and 24 are resident or anadromous species that occur in the Klamath River downstream of Iron Gate dam. Fish species are categorized in Table 1 as belonging to either cold-water or cool-water thermal preference guilds (Eaton et al. 1995, Zaroban et al. 1999). Cold-water species, such as trout and salmon, generally prefer water temperatures under 15.5°C (60°F) degrees. Cool-water species, such as suckers and sculpins, generally prefer water in the 15.5 to 24°C (60 to 75°F) range.

In the 6.2-mile reach of the Klamath River in California from the Stateline to the upper end of Copco reservoir, the fish community consists primarily of rainbow/redband trout (*Oncorhynchus mykiss newberrii*), speckled dace (*Rhinichthys osculus*), and marbled sculpin (*Cottus klamathensis*). Rainbow trout is classified as a cold-water species, and speckled dace and marbled sculpin are classified as cool-water species (Zaroban et al. 1999, FERC 2007). This reach of the Klamath River is noted for exceptional trout fishing and is designated by the California Department of Fish and Game (CDFG) as a Wild Trout Area. The rainbow/redband trout form in the Klamath River is reported to exhibit tolerance to higher and more variable ranges of water temperature than other forms of rainbow trout (e.g., coastal rainbow trout, steelhead) (Gamperl et al. 2002, Thurow et al. 2007).

In Copco and Iron Gate reservoirs, Desjardins and Markle (2000), PacifiCorp (2004), and FERC (2007) report a diverse assemblage of fish species, including 10 native species and 10 introduced species. The most prevalent native fishes in the reservoirs include tui chub (*Siphateless bicolor*), shortnose sucker (*Chasmistes brevirostris*), and other "unidentified" suckers (*Catostomidae*). These native fishes are each classified as cool-water species (Zaroban et al. 1999, FERC 2007). The most abundant fish species in Copco and Iron Gate reservoirs is yellow perch (*Perca flavescens*), which is an introduced (non-native) species. Yellow perch also is classified as a cool-water species (Zaroban et al. 1999, FERC 2007). Rainbow/redband trout also have been observed in Copco and Iron Gate reservoir, but are relatively uncommon (Desjardins and Markle 2000, PacifiCorp 2004, FERC 2007), due primarily to a preference for lotic habitats (i.e., river and stream habitats) in the river (PacifiCorp 2004, FERC 2007).

Table 1. Native fish species that occur in the Klamath River upstream and downstream of Iron Gate dam (Sources: FERC 2007; PacifiCorp 2004; NAS 2004; Moyle 2002).

Common Name	Scientific Name	Temperature Preference	Present above Iron Gate dam	Present below Iron Gate dam
Lampreys	**Petromyzontidae**			
Pit-Klamath brook lamprey	*Lampetra lethophaga*	Cool	Resident	--
Klamath River lamprey	*Lampetra similis*	Cool	Resident	Resident
Pacific lamprey	*Lampetra tridentata*	Cool	Resident	Anadromous
Miller Lake Lamprey	*Lampetra minima*	Cool	Resident	--
Sturgeons	**Acipenseridae**			
Green sturgeon	*Acipenser medirostris*	Cold	--	Anadromous
White sturgeon	*Acipenser transmontanus*	Cold	--	Anadromous
Carps and Minnows	**Cyprinidae**			
Klamath Tui chub	*Siphateless bicolor bicolor*	Cool	Resident	Resident
Blue chub	*Gila coerulea*	Cool	Resident	Resident
Klamath speckled dace	*Rhinichthys osculus*	Cool	Resident	Resident
Suckers	**Catostomidae**			
Klamath smallscale sucker	*Catostomus rimiculus*	Cool	Resident	Resident
Klamath largescale sucker	*Catostomus snyderi*	Cool	Resident	Resident
Shortnose sucker	*Chasmistes brevirostris*	Cool	Resident	Resident
Lost River sucker	*Deltistes luxatus*	Cool	Resident	--
Smelts	**Osmeridae**			
Longfin smelt	*Spirinchus thaleichtys*	Cool	--	Anadromous
Eulachon	*Thaleichthys pacificus*	Cool	--	Anadromous
Trout and Salmon	**Salmonidae**			

Table 1. Native fish species that occur in the Klamath River upstream and downstream of Iron Gate dam (Sources: FERC 2007; PacifiCorp 2004; NAS 2004; Moyle 2002).

Common Name	Scientific Name	Temperature Preference	Present above Iron Gate dam	Present below Iron Gate dam
Cutthroat trout	*Oncorhynchus clarki*	Cold	--	Resident, Anadromous
Chum salmon	*Oncorhynchus keta*	Cold	--	Anadromous
Coho salmon	*Oncorhynchus kisutch*	Cold	--	Anadromous
Coastal rainbow trout/ Steelhead	*Oncorhynchus mykiss irideus*	Cold	--	Resident, Anadromous
Rainbow/redband trout	*Oncorhynchus mykiss newberrii*	Cold	Resident	--
Sockeye salmon	*Oncorhynchus nerka*	Cold	--	Anadromous
Chinook salmon	*Oncorhynchus tshawytscha*	Cold	--	Anadromous
Bull trout	*Salvelinus confluentus*	Cold	Resident	--
Sticklebacks	**Gasterosteidae**			
Threespine stickleback	*Gasterosteus aculeatus*	Cool	--	Resident, Anadromous
Brook stickleback	*Culaea inconstans*	Cool	--	Resident
Sculpins	**Cottidae**			
Coastrange sculpin	*Cottus aleuticus*	Cool	--	Resident
Prickly sculpin	*Cottus asper*	Cool	--	Resident
Marbled sculpin	*Cottus klamathensis*	Cool	Resident	Resident
Klamath Lake sculpin	*Cottus princeps*	Cold	Resident	--
Slender sculpin	*Cottus tenuis*	Cool	Resident	--
Pacific staghorn sculpin	*Leptocottus armatus*	Cold	--	Resident

In the Energy Policy Act of 2005 (EPAct) trial-type proceeding on Project FERC relicensing requirements conducted in 2007, the presiding administrative law judge (ALJ) ruled, based on the testimony of fisheries experts from the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), that existing temperatures conditions will not preclude successful reintroduction of anadromous salmonids upstream of Iron Gate dam, including migration through the Project reservoirs. The ALJ concluded that anadromous fish stocks possess the biological and behavior traits needed to successfully spawn, rear and migrate in the Project reaches upstream of Iron Gate dam (assuming passage facilities at the dams). The ALJ concluded that the record clearly establishes that existing water temperatures will not preclude anadromous salmonid migration. The ALJ cited agency testimony that the temperature conditions are faced by anadromous fish to an equal degree both above and below Iron Gate dam. The ALJ cited agency testimony that coho salmon in other parts of the Klamath system occupy water with temperatures in excess of 26°C (the data relied upon by the draft TMDL cites 25°C as "lethal" for coho adults), and juvenile coho salmon observations in the main stem Klamath River where temperatures exceed 20°C (the data relied upon by the draft TMDL considers chronic effects to be observed in core juvenile rearing habitat at temperatures above 16°C). The ALJ also concluded that the evidence also demonstrates that juvenile fish most likely would not outmigrate during periods of sub-optimal water temperatures. See Findings of Fact on USFWS/NMFS Issue 2(A) in McKenna (2007).

Downstream of Iron Gate dam, the Klamath River supports a variety of freshwater fish species, including 24 native species and 18 introduced species (PacifiCorp 2004, FERC 2007). The Klamath River fish assemblage includes several species of anadromous fish, including Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), steelhead (*O. mykiss irideus*), green sturgeon (*Acipenser medirostris*), and Pacific lamprey (*Lampetra tridentata*). Chinook salmon, coho salmon, steelhead, and green sturgeon are classified as cold-water species, and Pacific lamprey is classified as a cool-water species (Zaroban et al. 1999, FERC 2007). Klamath fall Chinook salmon contribute to important commercial, recreational, and tribal fisheries; steelhead support a popular recreational fishery; and green sturgeon support a small tribal fishery.

The Klamath River mainstem downstream of Iron Gate dam supports the spawning and rearing life stages of fall Chinook salmon, and it serves as the migratory corridor for fall Chinook salmon and other anadromous fish that are produced in its tributaries. Coho salmon and steelhead spawn primarily in the tributaries, but they use the mainstem Klamath River as a migration corridor, and may rear for a period in the mainstem river or in the estuary on their way to the ocean.

Spawner surveys conducted by the USFWS indicate that approximately half of the fall Chinook salmon that spawn within the 82-mile survey reach construct their redds in the 13.5-mile section between Iron Gate dam and the Shasta River (FERC 2007). Between 1978 and 2002, the basin-wide escapement of adult fall Chinook salmon has ranged from a low of 19,121 fish in 1991 to a high of 208,380 fish in 1995 (FERC 2007). The number of fall Chinook salmon that spawn in the mainstem Klamath River is a relatively small proportion of the total basin-wide escapement, with estimates between 1978 and 2002 ranging from 580 fish in 1991 to 10,848 fish in 2002.

The Temperature Effects of the Klamath Hydroelectric Project and Iron Gate Hatchery Are Consistent with the Protection and Propagation of a Balanced, Indigenous Biological Community in the Klamath River

As mentioned in the Draft TMDL, Copco and Iron Gate reservoirs create a thermal phase shift ("thermal lag") that causes Iron Gate dam release temperatures to be cooler during spring and warmer during fall than would occur in the absence of the reservoirs. This thermal phase shift is a common and expected effect of reservoirs on river systems, due to the slower rate of heating or cooling in the larger water volume of a reservoir compared to a river over a given reach length. However, even accounting for the thermal phase shift created by the presence of the reservoirs, the current temperature conditions are supportive of a BIP.

Compared to a hypothetical without-Project scenario, the thermal phase shift created by the presence of the reservoirs has a cooling effect on Iron Gate and Copco tailrace water temperatures during spring and summer. As such, current temperature conditions are more frequently within (i.e., cooler than) chronic effects thresholds to salmonids (as used in the Draft

TMDL based on maximum weekly maximum water temperature [MWMT] values) than modeled without-Project or "natural" conditions during spring and summer. The Draft TMDL provides a definition of MWMT values as the daily maximum temperatures over running seven-day consecutive periods, and states that MWMT is also known as the seven-day average of the daily maximum temperature, or "7-DAD Max" (Appendix 4, page 2). The Draft TMDL states that MWMT thresholds for four life stages "are used for assessing the suitability of current Klamath River basin temperatures for fully supporting salmonids" (page 2-48). The four life stages include: (1) Adult Migration, (2) Adult Migration plus Non-Core Juvenile Rearing, (3) Core Juvenile Rearing, and (4) Spawning, Egg Incubation, and Fry Emergence, as defined in the Draft TMDL on page 2-48.

Compared to a hypothetical without-Project scenario, the thermal phase shift created by the presence of the reservoirs has a warming effect on Iron Gate and Copco tailrace water temperatures during fall. However, current temperature conditions with the reservoirs in place remain within (i.e., cooler than) MWMT chronic effects thresholds to salmonids during fall just as often, and in some cases more often, as modeled "natural" temperature conditions. To illustrate this point, PacifiCorp used the water temperature modeling results developed by Watercourse Engineering during the FERC relicensing study process (PacifiCorp 2004b, 2005, 2008b) for August through December 2000 to develop duration curves of MWMT values for the Iron Gate tailrace location under Current and Without-Project modeling scenarios. The FERC relicensing model results are used for this example rather than TMDL model results because of PacifiCorp's concerns over probable bias from inappropriate changes in the model source code dealing with solar radiation in the TMDL model (as discussed in section IV below). The duration curves are shown in Figure 1. The duration curves provide specific quantification of the percent of time during the August through December period that various MWMT values were equaled or exceeded.

The modeling results indicate that the maximum MWMT reached during the mid-August through December period is less under Current than Without-Project conditions (about 23 versus 25°C, respectively, in Figure 1). In addition, the MWMTs reached under Current conditions are within the temperature effects thresholds for Adult Migration the same percentage of time than under Without-Project conditions. The MWMTs reached under Current conditions are within the temperature effects thresholds for Core Juvenile Rearing and Spawning, Egg Incubation, and Fry Emergence a slightly lesser percentage of time than under Without-Project conditions. The MWMTs are within the temperature effects thresholds for Core Juvenile Rearing about 50 percent of the time under Current conditions and about 57 percent of time under Natural conditions, or a difference of about 7 days. The MWMTs are within the temperature effects thresholds for Spawning, Egg Incubation, and Fry Emergence about 43 percent of the time under Current conditions and about 53 percent of time than under Natural conditions, or a difference of about 10 days.

In addition, the Draft TMDL indicates that "the optimal temperature range for juvenile salmonids is 10-15°C, with a lower limit of 4°C" (page 2-51). Figure 1 indicates that MWMTs are within this optimal 10-15°C range for a longer duration (about 10 percent longer) under Current conditions than Natural conditions, and are less frequently below the 4°C "lower limit' than under Natural conditions. Collectively, these results indicate that MWMTs under Current conditions are as supportive, if not more so, for salmonids than under Without-Project conditions based on the thresholds, optimal ranges, and limits assumed in the Draft TMDL.

With regard to the temperature effects in the mainstem Klamath River, the Draft TMDL bases its case largely on a couple of simplistic graphical comparisons. The Draft TMDL presents a graph of "Current Conditions" and "Estimated Natural" temperatures (based on modeled results) downstream of Iron Gate dam (Figure 2.12 on page 2-50), and states that "the temperature alterations in Figure 2.12 results in adverse effects to salmonids" (page 2-51). However, the Draft TMDL provides little other model analysis, and no other specific direct analysis of biological effects. The Draft TMDL even fails to carefully evaluate existing and modeled "natural" temperature conditions against its own MWMT thresholds (page 2-48) that the Draft TMDL states "are used for assessing the suitability of current Klamath River basin temperatures for fully supporting salmonids" (page 2-48).

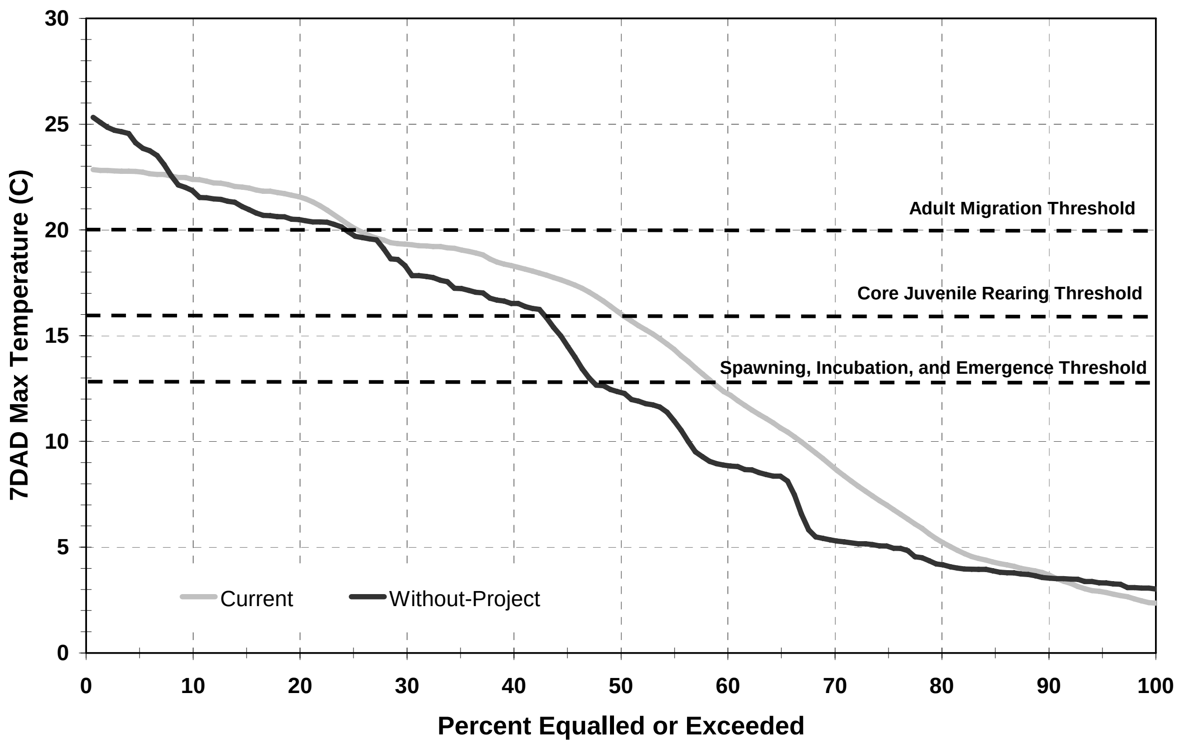

Figure 1. Comparison of duration of existing maximum weekly maximum water temperatures (7DAD Max) at Iron Gate tailrace under Current and Without-Project modeling scenarios during August through December (based on Watercourse modeling results performed during FERC relicensing studies).

Figure 2.11 (page 2-49) of the Draft TMDL shows "measured" values of maximum MWMT values at various locations in the Klamath River, displayed along with horizontal lines that depict the MWMT thresholds levels (from Table 2.8 on page 2-48) for the four life stages. Although the Draft TMDL is not clear on the source of the "measured" MWMT values plotted in Figure 2.11, the values are evidently the annual maximum (or warmest) MWMT values measured during mid-summer (the figure caption notes "MWMTs typically occur in late July") at various river locations. Because the plotted data are above (or warmer than) the threshold lines at all locations, the Draft TMDL concludes that "MWMT at all sites from the Oregon-California state line to the estuary are well above the suitable temperature range for full support of salmonids" and that "these data clearly demonstrate that the river has no capacity to assimilate increased heat loads during the hottest critical periods without adversely affecting the beneficial uses COLD, SPWN, RARE, and MIGR" (page 2-49).

The Draft TMDL discussion on Figure 2.11, and the MWMT thresholds for four life stages, lacks accuracy and balance by not providing important context and not extending the analysis to other periods of the year. For example, because the Draft TMDL focuses so much attention on Copco and Iron Gate reservoir temperature effects, it is a fundamental omission that the Draft TMDL's discussion on Figure 2.11 does not point out that the "measured" annual maximum MWMT are lower immediately downstream of Iron Gate dam than at any other location throughout the river system. Also, the Draft TMDL conclusions based on Figure 2.11 mislead the reader by failing to acknowledge that certain of the four life stages for key salmonid species are not present in the mainstem river downstream of Iron Gate dam when the annual maximum (or warmest) MWMT values occur in late July (e.g., spawning, incubation, and emergence). The Draft TMDL is deficient by not displaying and analyzing the modeled (or other "measured") data in comparison with the MWMT thresholds for other periods of the year when the life stages are present. In fact, as discussed above, the model results developed for the Draft TMDL indicate that MWMTs under Current conditions are as supportive, if not more so, for salmonids than under Natural conditions, including based on the MWMT thresholds assumed in the Draft TMDL.

The Draft TMDL erroneously implies that the cooler temperature releases at Iron Gate dam during late winter than modeled "natural" temperature conditions "may reduce the growth rates of salmonids rearing in the Klamath River, and may ultimately reduce the survival rate of salmonids in the ocean" (page 2-51). The Draft TMDL provides no substantive evidence for this assertion, but only implies that the cooler temperature releases at Iron Gate dam during late winter are adverse because "the optimal temperature range for juvenile salmonids is 10-15°C, with a lower limit of 4°C" (page 2-51). However, the Draft TMDL fails to provide the context that both current and "natural" temperature conditions are below the optimal range for juvenile salmonids during the winter, and modeled Without-Project temperature conditions are below 4°C (and therefore below the optimal range) more frequently than current conditions during the winter (see Figure 1 above).

Rather, exposure of juvenile salmonids to seasonally reduced water temperatures during spring and early summer under existing Project operations, primarily within the Iron Gate dam reach, would be expected to benefit the overall health and condition of juvenile rearing salmon. Exposure to reduced water temperatures within the Iron Gate dam reach during the spring and early summer juvenile rearing period would contribute to reduced vulnerability of juveniles to disease and infection. The Draft TMDL itself acknowledges this by stating that "juvenile fish migrating down the Klamath River in the spring suffer high mortality rates due to C. Shasta, which is more virulent at temperatures that typically occur that time of year" (page 2-50).

Although exposure of juvenile salmon to seasonally reduced water temperatures during the spring and early summer rearing period offers benefits in terms of a reduced risk of disease and infection, it also has been determined that exposure to lower water temperatures under current Iron Gate releases does not result in reduced juvenile growth rates (PacifiCorp 2008b). Results of studies by Marine and Cech (2004) show that juvenile Chinook salmon growth rates are virtually identical over a temperature range from 13-16°C and 17-20°C reflecting the general range of seasonal temperatures expected to occur during the juvenile rearing period under existing conditions in the reach downstream of Iron Gate dam. Results of these growth studies show no evidence that lower spring and early summer water temperatures under existing Project operations would adversely impact juvenile salmon growth rates.

PacifiCorp's conclusions with regard to beneficial Project-related water temperature effects on salmonids during spring and early summer are supported by other recent independent analyses. In an analysis of the effects on fall Chinook of hypothetical temperature conditions with and without Project dams and reservoirs, Bartholow et al. (2005) concluded that water temperature conditions for juvenile rearing life stages are better with Project dams and reservoirs than without, especially immediately below Iron Gate dam. In a subsequent analysis of factors limiting fall Chinook production potential, Bartholow and Henriksen (2006) concluded that water temperature during spawning and egg incubation is not a significant factor affecting fall Chinook production in the Klamath River.

The Draft TMDL further incorrectly concludes that the warmer temperatures in the releases at Iron Gate dam during fall (compared to modeled "natural" temperature conditions) adversely affect the reproductive success of adult salmonids because "the seasonal decline in temperatures during the fall months is delayed in comparison to estimated natural temperatures" (page 2-50). Within the Klamath River, adult fall-run Chinook salmon migrate upstream to spawn from approximately mid-August through October, and adult coho salmon migrate upstream to spawn from approximately mid-September through December. Water temperatures are undergoing a typical seasonal pattern of decline during mid-August through December. The seasonally declining temperature conditions are generally suitable for migration, spawning, and egg incubation throughout the river under both existing conditions and modeled "natural" temperature conditions. As the Draft TMDL itself points out, Strange (2006) found that fall Chinook salmon will migrate at temperatures as high as 23°C if temperatures are rapidly falling.

In the 2007 EPAct trial-type proceeding on Project FERC relicensing requirements, the presiding administrative law judge (ALJ) ruled, based on the testimony of fisheries experts from NMFS and USFWS, that existing temperatures conditions will not preclude successful fall Chinook spawning and egg incubation. The ALJ concluded that the fall Chinook spawning period (early September through late October) coincides with declining river temperatures in the suitable range, which by early November are within the optimal range for the developing embryos (i.e., 4-12˚C) (see Findings of Fact 2A-27 and 2A.6 in McKenna 2007).

In a similar situation to the Klamath River, Geist et al. (2006) conducted research on water temperature effects on fall Chinook salmon spawning in the Snake River downstream of Hells Canyon dam. The key objective of the research by Geist et al. (2006) was to determine whether various temperature exposures from 13˚C to 17˚C during the first 40 days of spawning egg incubation followed by declining temperature of approximately 0.28˚C per day (to mimic the thermal regime of the Snake River) affected survival, development, and growth of fall Chinook salmon embryos, alevins, and fry. Geist et al. (2006) determined that there were no significant differences in embryo survival at initial temperature exposures up to 16.5°C. Geist et al. (2006) further determined that there were no significant differences in alevin and fry size at hatch and emergence across the range of initial temperature exposures. On the basis of their research, Geist et al. (2006) concluded that an exemption to the state water quality standards for temperature was warranted for the portions of the Snake River where fall Chinook salmon spawning occurs.

Section 4.2.2.1 of the Draft TMDL discusses the effects of the Project reservoirs on water temperature based on calculated changes in modeled river temperatures upstream and downstream of the reservoirs for both current and modeled "natural" conditions (pages 4-13 to 4-15). The Draft TMDL concludes that these calculated changes demonstrate that the presence of the reservoirs "significantly influences temperature of the Klamath River" (page 4-14). However, this section does not provide any specific analysis of biological effects, except for the single sentence that "[t]he timing of the increases coincides with the time when Chinook salmon currently spawn in the Klamath River mainstem directly downstream of the reservoir" (page 4-14). However, again the Draft TMDL fails to provide accurate context that, irrespective of calculated changes in modeled temperature, the MWMT values under Current conditions are within (i.e., cooler than) the thresholds developed in the Draft TMDL for migration and spawning as often, if not more so, than under modeled "natural" conditions.

Temperature modeling also shows that differences in Iron Gate tailrace water temperatures between existing and without Project conditions diminish as a function of distance downstream from Iron Gate dam as water temperatures reach thermal equilibrium within the river. Temperature conditions may vary considerably due to local meteorological conditions and tributary contributions, but water releases from Iron Gate dam generally reduce mainstem average temperatures slightly in spring and summer, and increase mainstem average temperatures slightly in fall with diminishing effect down to the Scott River (Basdekas and Deas 2007). In general, there is very little difference in the suitability of river temperature conditions for salmonids under existing and modeled "natural" temperature conditions, and temperature conditions affecting attraction and entry of migratory salmonids into the river during upstream migration are independent of Project operations.

D. In the Alternative, the Thermal TMDLs and Load Allocations Are Unachievable and, as such, Are Inconsistent with EPA's TMDL Regulations; a Use Attainability Analysis is Required Before Undertaking the TMDL

Contrary to the comments above, if the TMDL may be based on achieving the water quality temperature objectives, or if any thermal loading to the Klamath River in excess of zero is inconsistent with the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, then the TMDL cannot be achieved. In particular, the proposed TMDL does not identify any practicable or legally enforceable means of achieving its thermal load allocations of zero to all sources. Further, no feasible technologies or best management practices exist that could be employed to reduce river temperatures to the extent necessary to meet the temperature load allocations assigned to the Project. Such unachievable load allocations are not permitted by EPA's TMDL regulations.

As discussed above, a TMDL must be established "at levels necessary to attain and maintain the applicable narrative and numerical WQS [water quality standards]" or, for heat, at levels "which cannot be exceeded in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife." 40 C.F.R. § 130.7(c)(1), (2). A TMDL, either for heat or other pollutants, is "[t]he sum of the individual WLAs [wasteload allocations] for point sources and LAs [load allocations] for nonpoint sources and natural background." Id., § 130.2(i). That is, WLAs + LAs = TMDL.

WLAs and LAs, however, are not simply different names for pollutant allocations to point sources, on the one hand, and to natural and nonpoint sources, on the other hand. WLAs and LAs are fundamentally different.

A WLA is "[t]he portion of a receiving water's loading capacity [i.e., the TMDL] that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation." Id., § 130.2(h) (emphasis added). A WLA to a point source is a true allocation. Because point sources must obtain NPDES discharge permits, the permitting agency can fully control the point source's discharge of the TMDL pollutant by establishing effluent limits for that pollutant in the permit. If need be, the permit can prohibit the discharge of the pollutant altogether. Moreover, EPA's regulations provide that NPDES permit effluent limits must be consistent with any WLA to the source. 40 C.F.R. § 122.44(d)(1)(vii)(B). Therefore, any WLA to the source must necessarily be implemented through the source's NPDES permit.

In contrast to a WLA, which is "allocated," an LA is "attributed." Unlike point sources, whose pollutant loadings can be fully controlled through NPDES permits, natural and nonpoint source pollutant loadings are not regulated by the CWA. Therefore, LAs cannot be allocated in the same manner as WLAs. EPA's regulations provide that an LA is:

> The portion of a receiving water's loading capacity that is *attributed* either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are *best estimates of the loading*, which may range from reasonably accurate estimates to gross allotments, depending on the *availability of data and appropriate techniques for predicting the loading*. Wherever possible, natural and nonpoint source loads should be distinguished.
>
> 40 C.F.R. § 130.2(g) (emphasis added).

As the emphasized language shows, LAs are an attribution of the actual or expected loadings from natural and nonpoint sources based on "best estimates," "data," and "appropriate techniques for predicting the loading." This is also reflected in EPA's definition of "TMDL": "If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs." Id., § 130.2(i) (emphasis added). An LA, then, may not simply be allocated to a natural or nonpoint source but must be a reasonable prediction of the actual loading from the source based on enforceable regulations, data, or other information.

In contrast, the Draft TMDL does not reasonably predict the actual loading from the source based on enforceable regulations, data, or other information because the actual loading depends on the attainment of the upstream temperature load allocations, which are not enforceable.

Because the temperature load allocations at Stateline are unachievable, the Draft TMDL is unachievable. That, in turn, means that the relevant water quality objectives cannot be achieved. In addition, the Regional Water Board has not shown that all beneficial uses can be attained even under "natural" conditions, nor why an increase in temperature above "natural" would adversely impact beneficial uses. Yet the Draft TMDL requires compliance with the modeled "natural" temperature conditions. Accordingly, the Draft TMDL is inconsistent with the Clean Water Act and EPA's implementing regulations because it is unachievable and not certain to protect beneficial uses even if compliance is attained. Therefore, the appropriate course before completing the TMDL would be to either revise the relevant water quality objectives (if the revisions would protect beneficial uses) or conduct a use attainability analysis to remove uses or subcategories of uses that cannot be attained, or to establish new, more refined and site-specific subcategories that are more reflective of this system.

E. Relevant Factors Are Not Addressed and Criteria Are Not Established to Support the Thermal Load Allocation Plan; Therefore, the Plan Is Inconsistent with State Law

The Regional Board did not consider relevant factors in determining the thermal load allocations nor establish the criteria used to make these determinations. The development of a load allocation plan "requires the consideration of numerous factors, including cost, technical achievability and equity." SWRCB "Impaired Waters Guidance," at p. 5-18. An allocation plan should achieve an acceptable balance between these factors. *Id.* Furthermore, "[l]oading scenarios may be adjusted… taking political, social, and economic factors into consideration," such as deciding to apply reductions only to a few targeted sources. *Id.* at p. 5-19. Most importantly, however, "[t]he criteria for making these decisions (e.g., magnitude of impact, degree of management controls in place, feasibility, probability of success, cost) must also be established." *Id.*

The technical analyses involved in TMDL development "can include applying models or other analytical tools to support an understanding of how pollutant loading affects instream conditions." *Id.* at p. 5-1. The allocation analysis actually determines the loading capacity, load allocations, waste load allocations and margin of safety. *Id.* The allocation analysis identifies the assimilative capacity of the receiving water and determines how the allowable loading capacity can be allocated among the various sources (i.e., the load allocation plan). *Id.* Developing the load allocation plan is where the Regional Board can consider the factors listed above and adjust the loading scenario, provided the criteria are established.

In the Draft TMDL, Chapter 3 describes the "technical analyses" used to develop the TMDLs. Chapter 4 describes how the technical analyses support the pollutant loading effects on instream conditions. Chapter 5 presents the loading capacity and load and waste load allocations. Therefore, Chapter 5 is the allocation analysis. Chapter 6, the Implementation Plan, implements the load allocations and allocates responsibility for corrective measures. Together, Chapters 5 and 6 are the load allocation plan. Neither chapter discusses how the relevant factors, including cost, technical achievability, and equity were used to determine the load allocation plan.

The temperature load allocations are simply stated as "all sources are allocated a temperature load of zero." p. 5-4. Yet, the Draft TMDL does not identify any practicable or legally enforceable means of achieving the zero allocation to all sources. Further, while the achievement of the temperature allocations at Stateline is expected to be achieved gradually over time, PacifiCorp is required to implement measures to comply with the allocations regardless of whether the Project continues to be operated or whether dams are removed, and also in the interim. P. 5-16, 6-13, 6-14. The load allocation plan is inequitable and inconsistent with State law for treating PacifiCorp's expected compliance differently than compliance by other sources, which is expected "gradually over time" without any justification or discussion of the relevant factors considered.

In addition, the Regional Board has not shown these allocations to be achievable. The characteristics of reservoirs make it impossible to meet the zero thermal load allocation; as discussed above, it is also uncertain whether dam removal would result in the elimination of all human-caused thermal loadings. Several peer review comments were made on the subject of achievability of temperature targets. *See* Appendix 7, at p. 13, 22, 26. In response, the Regional Board stated that allocations must be assigned to all sources to the levels needed to meet water quality standards and alternative strategies for achieving load reductions can be evaluated in the implementation phase. Appendix 7, at p. 2. As discussed above, the thermal load allocations assigned to the Project should have been attributed based on the actual or expected loadings. Because the loads are incorrect, the issue is not simply a matter of evaluating alternative strategies to meet the reductions. The issue is that the Regional Board did not identify scientifically feasible solutions in the first place. In addition, the SWRCB Impaired Waters Guidance specifically states that in setting load allocations, the relevant factors are cost, technical achievability and equity. Once scientifically feasible solutions are identified, loading scenarios can be adjusted taking political, social, and economic factors into account.

Finally, the cost of compliance methods was not considered for the Project, specifically the cost of dam removal, which the Draft TMDL indicates is the only means for compliance. This issue is further discussed below.

The Draft TMDL does not discuss how the relevant factors were considered in developing the thermal load allocation plan. If these factors were in fact considered, this fact should be explicitly stated and a discussion of factors considered and results reached should be included in the Draft TMDL.

F. The Temperature Targets and Wasteload and Load Allocations for the Project and Iron Gate Hatchery, Respectively, Are De Facto Water Quality Objectives that Do Not Meet the Substantive and Procedural Requirements for Establishing Such Objectives

The temperature targets, wasteload and load allocations for the Project and Iron Gate Hatchery are more stringent than necessary and result in *de facto* water quality objectives. As discussed above, the temperature effects of the Project and Iron Gate Hatchery are consistent with a BIP and the application of a zero thermal load as a year round margin of safety is inappropriate in this instance. In effectively establishing a new thermal water quality objective, the Regional Board should have complied with the procedure for adopting revised objectives and considered the relevant factors. Water Code Section 13241 provides that factors to be considered by a regional board in establishing water quality objectives include: past, present and probable future beneficial uses of water; environmental characteristics of the hydrographic unit under construction, including the quality of water available thereto; water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area; economic considerations; the need to develop housing in the region; and the need to develop and use recycled water. Because the Regional Board failed to follow the appropriate procedure and consider the relevant factors, the wasteload and load allocations are invalid.

III. DISSOLVED OXYGEN AND NUTRIENT-RELATED NUMERIC TARGETS AND ALLOCATIONS

A. Description of the Dissolved Oxygen and Nutrient-Related TMDLs and Load and Wasteload Allocations to the Project and IGH

The Draft TMDL proposes DO targets at Stateline and the Copco 2 and Iron Gate tailraces that are expressed as monthly mean and monthly minimum DO concentrations. According to the Draft TMDL, these DO targets are calculated to achieve compliance with the California DO objective (page 5-20). It is clear from the analysis in the Draft TMDL that achieving these DO targets is dependent on meeting the Draft TMDL's nutrient and organic matter allocations at Stateline. For example, the Draft TMDL states "[n]utrient and organic matter allocations at stateline are set to control their biostimulatory and oxygen consuming effect on DO and to achieve the DO objective/targets…" (page 5-20). The Draft TMDL's numeric DO target of 85 percent saturation (under natural temperatures) is implicit recognition of high natural organic loading effects at Stateline upstream of Copco reservoir.

The Draft TMDL proposes numeric targets for total phosphorus (TP), total nitrogen (TN), and organic matter (CBOD) for the tailraces below, and mid-point locations within Copco 1 and Iron Gate reservoirs (as listed in Tables 5.12 and 5.13 on page 5-21). The Draft TMDL states that "[t]hese nutrient and organic matter targets are established at the monthly mean concentrations that coincide with meeting the in-reservoir chlorophyll-*a* summer mean target of 10 µg/L, *Microcystis aeruginosa* cell density target of 20,000 cells/mL, and microcystin target of 4 µg/L" (page 5-20). However, the derivation of the specific monthly target values presented in the Draft TMDL (i.e., as listed in Tables 5.10, 5.12, and 5.13) cannot be determined from the materials provided in the Draft TMDL.

Despite the above statement from the Draft TMDL, it appears that the nutrient target values for the reservoirs are based entirely on meeting the 10 µg/L chlorophyll-*a* target, since none of the models supposedly used in the Draft TMDL to estimate nutrient target values incorporate *Microcystis aeruginosa* cell density or microcystin variables. Rather, these variables are assessed through correlation back to chlorophyll-*a* (note: problems with these correlations are discussed in Appendix A to this document). Therefore, it is evident that the TMDLs for nutrients and organic matter are fundamentally built on an assumed 10 µg/L chlorophyll *a* endpoint. However, for several reasons as discussed below, the 10 µg/L chlorophyll *a* target for the reservoirs is inappropriate for application to the Klamath River, particularly in light of the naturally eutrophic nature of the upper Klamath River system. The 10 µg/L target was not selected with the naturally eutrophic Klamath River system in mind. Instead, it was selected for the Draft TMDL as the most restrictive and stringent of several possible targets under the general, statewide Nutrient Numeric Endpoints (NNE) approach (Tetra Tech 2006).

The Draft TMDL also sets nutrient and organic matter targets for Copco and Iron Gate reservoirs and tailwaters at "natural conditions" values that assume full implementation and compliance with the Upper Klamath Lake TMDL (ODEQ 2002), plus the yet-to-be-issued TMDL for the upper Klamath River in Oregon (expected from ODEQ in fall 2009). The Draft TMDL states that "allocation and targets at stateline are presented in Sections 5.2.2 and 5.3.1, and reflect anticipated water quality at stateline once the Oregon TMDLs are fully implemented" (page 6-8). The Draft TMDL indicates that full implementation and compliance with both Oregon TMDLs "represent a critical part of the solution in meeting water quality objectives in California" (page 6-8).

Therefore, the TMDLs for nutrients and organic matter are built entirely on an assumed future state in which the upstream TMDLs are fully met. However, for reasons as discussed below, the very large reductions in nutrient loadings to Upper Klamath Lake necessary to achieve a compliant TMDL condition at Stateline cannot be feasibly attained. Yet, the Draft TMDL provides no discussion of any legal or practicable means of ensuring that the nutrient and organic matter loading reductions would occur at Stateline (and at other downstream locations by extension).

The Draft TMDL assigns nutrient allocations to Copco and Iron Gate reservoirs of 74,569 pounds TP annually and 1,091,654 pounds TN annually to be achieved at a location *upstream* of Copco reservoir (emphasis added) (page 5-22). The Draft TMDL provides limited explanation for the derivation of these additional nutrient allocations to Copco and Iron Gate reservoirs. The Draft TMDL suggests that the 10 µg/L chlorophyll *a* target for the reservoirs was not reached in model runs based on a scenario that assumes "natural conditions" or Oregon TMDL compliance conditions at Stateline upstream of the reservoirs. The Draft TMDL further suggests that additional nutrient allocations to Copco and Iron Gate reservoirs equal the additional reduction in loads under "natural conditions" or Oregon TMDL compliance conditions that the model predicts would be necessary at Stateline to meet the 10 µg/L chlorophyll *a* target in the reservoirs. The Draft TMDL also assigns "zero nutrient loading from reservoir bottom sediments … to account for the flux of nutrients (e.g., ammonia and orthophosphate) from reservoir bottom sediments under anoxic conditions during the critical period May through October" (page 5-22).

As discussed below, these nutrient load allocations to the reservoirs are inappropriate for several reasons, including requiring less-than-natural nutrient concentrations to be achieved in the river. Also as discussed below, the rationale for this allocation is flawed and counterintuitive, given that the reservoirs are not a source of nutrients, but a net sink of nutrients. Therefore, under "natural conditions" or Oregon TMDL compliance conditions, the net nutrient loading in the Klamath River from Stateline to downstream of Iron Gate would be less with the reservoirs in place.

The Draft TMDL also assigns allocations to Copco and Iron Gate reservoirs in the form of a "temperature and dissolved oxygen compliance lens" that the Draft TMDL claims is equivalent to DO instantaneous mass in Copco reservoir of 32,398 pounds annually and in Iron Gate reservoir of 47,624 pounds annually. The Draft TMDL describes this allocation as for the period of May through October and "requires that DO concentrations consistent with 85% saturation or better overlap temperatures consistent with natural water temperatures (natural baseline summer mean is ~18.7 °C) at the point of entry to the reservoirs within a lens throughout the reservoir" (page 5-25). The Draft TMDL further describes that "[t]he volume of each reservoir compliance lens is equal to the average hydraulic depth of the river in a free-flowing state for the width and length of the reservoir" (page 5-25). As discussed below, this compliance lens approach is unprecedented, and is unrealistic to actually apply in an advection-dominated reservoir setting.

With regard to the Iron Gate Hatchery, the Draft TMDL assigns DO targets for the Hatchery discharge based on monthly mean and monthly minimum DO concentrations that supposedly reflect compliance DO conditions in the Klamath River downstream of Iron Gate Dam (i.e., Table 5.14 on page 5-26). The Draft TMDL also assigns a "zero" nutrient and organic matter allocation to the Hatchery discharge; that is, that allocation is "zero net increase of nutrient and organic matter loads in the river above California dissolved oxygen compliance conditions", with an assigned target that consists of monthly mean concentrations that "reflect California compliance condition with no dams just downstream of where Iron Gate Reservoir is currently located" (page 5-26).

B. The Dissolved Oxygen, Benthic Algae, Chlorophyll-a, Microcystis, and Microcystin Targets Misapply the Applicable Water Quality Objectives

The DO, benthic algae, chlorophyll-a, *Microcystis*, and microcystin targets for the Project and Iron Gate Hatchery are more stringent than necessary and result in *de facto* water quality objectives. As discussed above, the modeling and technical analysis provide skewed information that results in nutrient-related targets that require much larger nutrient reductions than necessary to achieve water quality objectives. Even after accounting for a margin of safety, these targets are unnecessarily stringent or beyond what are necessary to protect the designated beneficial uses. In effectively establishing a new nutrient water quality objective, the Regional Board should have complied with the procedure for adopting revised objectives and considered the relevant factors. Water Code Section 13241 provides that factors to be considered by a Regional Board in establishing water quality objectives include: past, present and probable future beneficial uses of water; environmental characteristics of the hydrographic unit under construction, including the quality of water available thereto; water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area; economic considerations; the need to develop housing in the region; and the need to develop and use recycled water. Because the Regional Board failed to follow the appropriate procedure and consider the relevant factors, the nutrient-related targets are invalid.

C. The Proposed Numeric TMDL Targets and Load Allocations Are Unachievable; a Use Attainability Analysis Is Required Before Undertaking a TMDL

In addition to incorrectly applying the applicable water quality objectives, the numeric TMDL targets are unachievable. In particular, the load allocations to natural and nonpoint sources that are necessary to achieve the targets are unachievable. Unachievable load allocations to natural and nonpoint sources are inconsistent with EPA's TMDL regulations.

As discussed above in the comments on the proposed thermal TMDLs, a TMDL is "[t]he sum of the individual WLAs [wasteload allocations] for point sources and LAs [load allocations] for nonpoint sources and natural background." 40 C.F.R. § 130.2(i). That is, WLAs + LAs = TMDL. But whereas WLAs may be "allocated" (or not) to individual point sources, LAs must be "attributed" to natural and nonpoint sources based on a reasonable prediction of the actual pollutant loading from those sources. EPA's regulations provide:

> (g) *Load allocation (LA)*. The portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are *best estimates of the loading*, which may range from reasonably accurate estimates to gross allotments, depending on the availability of *data and appropriate techniques for predicting the loading*. Wherever possible, natural and nonpoint source loads should be distinguished.
>
> (h) *Wasteload allocation (WLA)*. The portion of a receiving water's loading capacity that is *allocated* to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.
>
> (i) . . . If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations *practicable, then* wasteload allocations can be made less stringent. Thus the TMDL process provides for nonpoint source control tradeoffs.
>
> 40 C.F.R. §130.2 (emphasis added)

As shown by the emphasized language, LAs are an attribution of the actual or expected loadings from natural and nonpoint sources based on "best estimates," "data," and "appropriate techniques for predicting the loading." An LA, then, may not simply be allocated to a natural or nonpoint source but must be a reasonable prediction of the actual loading from the source. For nonpoint sources in particular, any LA that would require a reduction in existing loadings must consider the enforceability and practicability of the reductions.

The Draft TMDL's Nutrient Allocations at Stateline (and Other Downstream Locations by Extension) Are Unachievable

The Klamath River is naturally enriched with nutrients. The primary source of water to the Klamath River is discharge from historically (and naturally) eutrophic, and currently hypereutrophic Upper Klamath Lake. The average TP concentration measured at the mouth of Link River near the outlet of Upper Klamath Lake is currently 0.147 mg/L, based on data collected from 2000 through 2008 (PacifiCorp website). The UKL TMDL mean concentration is 0.041 mg/L, and the Klamath River TMDL assumed natural conditions baseline concentration is 0.022 mg/L. Sources of phosphorus between Link dam and Stateline include municipal, industrial, and agricultural activities. Groundwater, in the form of large springs, enters the river with considerable flow and nutrient load below J.C. Boyle reservoir (TP concentration in these springs is approximately 0.080 mg/L).

The Draft TMDL asserts that TP concentration at Stateline below these springs will range from 0.030 to 0.039 mg/L when loads from Oregon are in compliance with the Oregon TMDLs, and the Draft TMDL assigns allocations to Copco and Iron Gate reservoirs in the same range (page 5-20).

Thus, the Draft TMDL requires TP concentrations at Stateline (and at other downstream locations by extension) that are lower than upstream concentrations from Upper Klamath Lake under future compliant TMDL conditions and naturally-occurring groundwater base flows.

Based on the above data, it is evident that the TP allocation for Stateline, as depicted in the Draft TMDL would require all four of the following conditions in order to be achieved:

- A 40 percent reduction in external phosphorus loading to Upper Klamath Lake, as estimated in the Upper Klamath Lake TMDL (ODEQ 2002) to achieve a compliant TMDL condition;
- Elimination of <u>all</u> (100 percent) of phosphorus loads (municipal, industrial, agricultural) between Link River and Keno dam to ensure that the Upper Klamath Lake compliant condition is maintained below Keno dam, i.e., no additional loads between Link Dam and Keno Dam;
- At a minimum, an additional 20 to 40 percent reduction in TP concentration between Keno dam and Stateline to reduce the Upper Klamath Lake compliant condition (0.041 mg/L) plus groundwater inflow loading (at a concentration of 0.080 mg/L) below J.C. Boyle to attain the range from 0.030 to 0.039 mg/L as required in the Draft TMDL at Stateline; and
- An additional 60 percent reduction in the total phosphorus concentration of base flow groundwater to the Klamath River above Stateline from 0.080 mg/L to 0.030 mg/L as required in the Draft TMDL at Stateline.

The first bullet alone – a 40 percent reduction in external phosphorus loading to Upper Klamath Lake to achieve a compliant TMDL condition – is itself likely unattainable. Because the anthropogenic load to Upper Klamath Lake is about 40 percent of the total load, the Upper Klamath Lake TMDL (ODEQ 2002) proposed to return the external phosphorus loading of the lake to background conditions. In addressing this aspect of the Upper Klamath Lake TMDL, the National Research Council (NRC 2004) concludes that "[e]ven a 20% reduction would be ambitious and potentially infeasible", and that "even a reduction of 40% in total external phosphorus loading would probably be ineffectual without suppression of internal phosphorus loading, given that internal phosphorus loading is very large for Upper Klamath Lake".

Aside from the likely unattainability of just the first condition above, the combination of all four conditions is clearly unachievable. There are no realistic methods for the desired future Upper Klamath Lake TMDL compliant condition to be reduced further and account for groundwater inputs to attain 0.03 mg/L as required in the Draft TMDL at Stateline. As a result, the Draft TMDL fails to provide proposed TP load allocations that are achievable, practicable, or enforceable.

The Draft TMDL provides no explanation, including in the Implementation Plan discussion, of any legal or practicable means of ensuring that the TP reductions would occur at Stateline (and at other downstream locations by extension). Also, the Draft TMDL provides no quantification of the reductions that are likely to be achieved. Because the TP allocations at Stateline (and at other downstream locations by extension) are unachievable, the Draft TMDL is unachievable. That, in turn, means that the relevant water quality objectives cannot be achieved. Accordingly, the Draft TMDL is inconsistent with the Clean Water Act and EPA's implementing regulations, and the appropriate course before completing the TMDL would be to either revise the relevant water quality objectives (if the revisions would protect beneficial uses) or conduct a use attainability analysis to remove uses or subcategories of uses that cannot be attained, or to establish new, more refined and site-specific subcategories that are more reflective of this system.

The Draft TMDL's Chlorophyll *a* Targets Are Unachievable

The Draft TMDL establishes numeric targets of 10 µg/L for suspended algae chlorophyll *a* in the reservoirs and 150 mg/m² for benthic algae chlorophyll *a* in the Klamath River downstream of the Salmon River. As with the unachievable TP allocations as discussed above, the Draft TMDL errs with these chlorophyll *a* targets by not realistically accounting for the Klamath River system as naturally eutrophic, with hypereutrophic Upper Klamath Lake as its source.

Along with the reality of the naturally-enriched conditions in the Klamath River system, the chlorophyll *a* targets proposed in the Draft TMDL would require enormous nutrient reductions that are unrealistic and unachievable (as described above for TP allocations). The Draft TMDL's analyses show that the TP loads in the river would need to be reduced 90 percent and TN loads by 65 percent to achieve the 10 µg/L chlorophyll *a* target (Appendix 2, page 11). The Draft TMDL's analyses show even larger reductions would be needed to achieve the 150 mg/m² target for benthic algae chlorophyll *a*; for that target, TP loads in the river would need to be reduced 98 percent and TN loads by 85 percent (Appendix 2, page 34). To our knowledge, there has been no documented case in which nutrient load reductions on such a large scale have been achieved elsewhere, or even concluded as feasible and achievable for planning and implementation purposes.

The Draft TMDL appears to acknowledge that the 150 mg/m² target for benthic algae chlorophyll *a* likely is not achievable. The Draft TMDL (in Appendix 2, page 37) states:

> "Table 19 shows that the 75th percentile summer TN concentrations under natural conditions appear to be greater than the concentrations estimated as needed to meet the 150 mg/m² maximum benthic chlorophyll *a* target in the analysis of existing conditions provided above in Table 15. This suggests that natural conditions may result in a tendency for elevated benthic algal densities in the Klamath River."

The Draft TMDL (in Appendix 2, page 37) states:

> "It is thus not clear from the benthic biomass spreadsheet analysis that the 150 mg/m² target could be met under natural conditions."

The Draft TMDL (in Appendix 2, page 38) states:

> "It is clear that significant reductions in summer nutrient concentrations would be needed to meet a target of 150 mg/m² maximum benthic chlorophyll a; however, the predicted magnitude of the needed reductions is highly uncertain."

The 10 µg/L target for suspended algae chlorophyll *a* in the reservoirs proposed in the Draft TMDL is inappropriate for application to the Klamath River, particularly in light of the naturally eutrophic nature of the upper Klamath River system, and the unrealistically large nutrient reductions that would be required for the target to be achieved. The 10 µg/L target was not selected with the naturally eutrophic Klamath River system in mind. Rather, it was selected for the Draft TMDL by the Regional Board staff as the most restrictive of several possible targets under the general, statewide Nutrient Numeric Endpoints (NNE) approach (Tetra Tech 2006).

As the Draft TMDL describes, the 10 µg/L target was chosen by Regional Board staff at a workshop, based on recommendations under the general NNE approach for the most restrictive of the 18 beneficial uses that have been designated for Copco and Iron Gate reservoirs – that is, Cold Freshwater Habitat (COLD) and Municipal Water Supply (MUN) beneficial uses. The Draft TMDL further acknowledges that the NNE-derived chlorophyll *a* target for the reservoirs is the most restrictive and is much lower than if based on other beneficial use categories, and states "10 µg/L summer average chlorophyll *a* provides one potential target for managing these reservoirs" (Appendix 2, page 6).

The 10 µg/L chlorophyll *a* target is not appropriate for the naturally eutrophic Klamath River system. Throughout the Draft TMDL, it is acknowledged that higher concentrations of nutrients result in higher levels of chlorophyll *a*, or that high levels of chlorophyll *a* are typical of nutrient-enriched water bodies (e.g., page 2-16). For example, as the Draft TMDL analyses show, achieving a chlorophyll *a* concentration of 10 µg/L would require TP load reduction to the reservoirs of 90 percent, resulting in an average growing-season phosphorus concentration of 0.03 mg/L (Appendix 2, page 17). As previously discussed above, such phosphorus loads reductions are infeasible and unachievable. That, in turn, means that 10 µg/L chlorophyll *a* is not a reasonable target in this naturally-enriched system.

As a key rationale for the 10 µg/L chlorophyll *a* target for the reservoirs, the Draft TMDL incorrectly states that the 10 µg/L chlorophyll *a* target is "achieved above the reservoirs but not within the reservoirs, thus the reservoirs themselves are the cause of these impairments" (page 4-20). But, in apparent contradiction, based on modeling analyses, the Draft TMDL concludes that the Klamath River entering Copco reservoir (at Shovel Creek) "exhibit high chlorophyll-a concentrations in the middle of the year"…"largely due to upstream conditions being carried downstream", and "in many of these situations, chlorophyll-a data are not available for comparison" The Draft TMDL makes an unsubstantiated assumption that "Nutrient impacts on phytoplankton are significant only in the reservoirs…[t]hus, the algae biomass in the riverine reaches is not related to the nutrient concentration"(Appendix 7, page 11).

The 10 µg/L chlorophyll *a* target for the reservoirs is inappropriate given that chlorophyll *a* levels in the river waters flowing into the reservoirs from upstream are frequently higher than 10 µg/L. Therefore, advected input of chlorophyll *a* alone could prevent achieving the target in the reservoirs. Data presented in the Draft TMDL clearly shows very high levels of chlorophyll *a* in the river from sampling sites above J.C. Boyle reservoir, at Keno dam, and at the Link River mouth (near the outlet of Upper Klamath Lake). The Draft TMDL states that "the high concentrations at these three stations are due in large part to residual algal biomass from Upper Klamath Lake" (page 2-60). Furthermore, the modeling analyses performed for the Draft TMDL to develop recommended TMDL allocations shows chlorophyll *a* levels in the river upstream of Copco reservoir ("Klamath River at Shovel Creek") that are much higher than 10 µg/L, particularly during summer, when the target is to be applied (as a "summer mean"). Figure 2 shows the Draft TMDL's model results for chlorophyll *a* levels in the river upstream of Copco reservoir (from Appendix 6, pages H-16 and H-19).

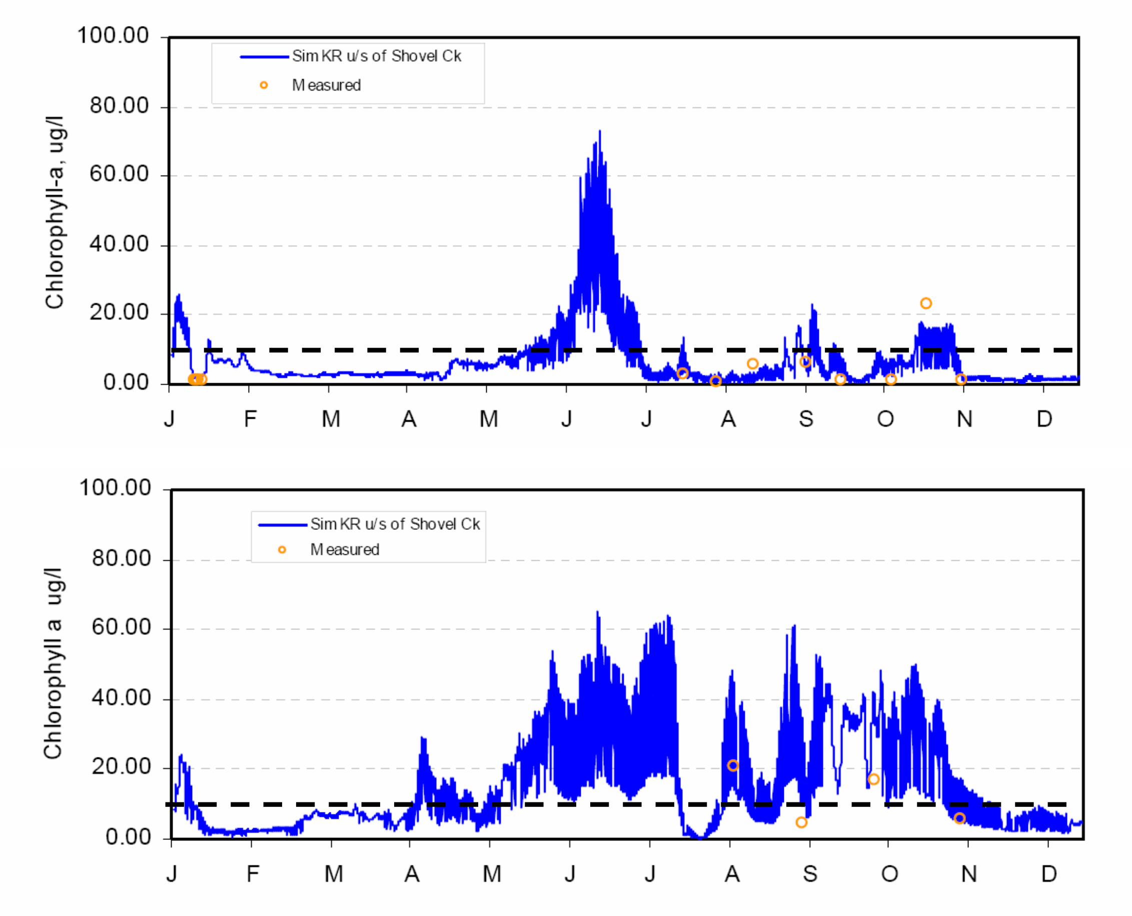

Figure 2. Draft TMDL's model results for chlorophyll a levels in the river upstream of Copco reservoir ("Klamath River at Shovel Creek") based on 2000 (upper plot) and 2002 (lower plot) simulation years (from Appendix 6, pages H-16 and H-19). For comparison purposes, a dark hatched line is added at the 10 µg/L chlorophyll *a* target level proposed in the Draft TMDL for the reservoirs just downstream of this location in the Klamath River.

The Draft TMDL's Dissolved Oxygen and Nutrient-Related Allocations and Targets Are Premised on an Unrealistic Shift in System Trophic State

Taken as a whole, the Draft TMDL's DO and nutrient-related allocations and targets are based on management decisions that would require shifting the upper Klamath River system to an unnaturally lower trophic state. The Draft TMDL indicates that algal conditions driving TMDL nutrient-related allocations require "a general reduction in eutrophication potential" Appendix 2, page 14). The Draft TMDL states the general NNE chlorophyll-*a* value of 10 µg/L was obtained from Walker (1985), a research paper that concluded that for mean chlorophyll-*a* values of 10 µg/L or less, "expected bloom frequencies" (of algae) "are minimal for a system with average variability" (Walker 1985, page 61). Walker (1985) also indicates that a chlorophyll-*a* value of 10 µg/L agrees with "definitions of the mesoeutrophic boundary", which implies that the Draft TMDL's chlorophyll-*a* target value of 10 µg/L, based on a minimal bloom frequency, would require a shift to an unnaturally lower (mesotrophic) trophic state. As with the chlorophyll *a* target, the Draft TMDL targets in the reservoirs for *Microcystis* cell density, and concentrations of TP, TN, organic matter (as CBOD), and microcystin all likewise would require a shift to an unnaturally lower (mesotrophic) trophic state.

However, as discussed above, the Klamath River is naturally eutrophic, primarily because of the large, natural nutrient loadings to the river from Upper Klamath Lake. Upper Klamath Lake is hypereutrophic now, and is considered to have been historically eutrophic since the earliest-known statements regarding the lake's water quality were made in 1855 (Bortleson and Fretwell 1993, Wee and Herrick 2005). Evidence for the long-term highly productive status of Upper Klamath Lake is not limited to the historical record. Studies of sediment cores from Upper Klamath Lake have shown that the lake has been highly productive for at least the past 1000 years (Eilers et al. 2001, Sanville et al. 1974).

The very large nutrient reductions sought in the Draft TMDL allocations (e.g., a 90 percent or more reduction in TP in the river above Copco reservoir) are unrealistic and unachievable, especially in light of naturally eutrophic conditions in the Klamath River system. The Draft TMDL's own analyses show that Klamath River would be eutrophic under "natural conditions" (e.g., page 3-8; Appendix 2 pages 20, 32, 36, and 37). Even the Draft TMDL's numeric DO target of 85 percent saturation (under natural temperatures) is implicit recognition of high natural organic loading effects at Stateline upstream of Copco reservoir. As such, the Regional Board should revise the TMDLs to provide allocations and targets that are realistic and achievable. Otherwise, if the Regional Board considers the Draft TMDL targets to be necessary to protect designated beneficial uses and meet water quality objectives, the targets are unachievable and the designated uses cannot be fully attained.

The TMDL must more realistically address the challenges posed by the hypereutrophic conditions in Upper Klamath Lake, and the resulting large loads of nutrients from the lake to the Klamath River. The Regional Board must address in a realistic manner how the drastic reductions of nutrient loads proposed in the Draft TMDL would be achieved.

D. The Proposed Load Allocations to the Project and Waste Load Allocations to Iron Gate Hatchery Are Inconsistent with the Clean Water Act

The Draft TMDL's Nutrient Allocations at Copco and Iron Gate Reservoirs Are Inappropriate and Unnecessary

The Draft TMDL assigns nutrient allocations to Copco and Iron Gate reservoirs of 74,569 pounds TP annually and 1,091,654 pounds TN annually to be achieved at a location *upstream* of Copco reservoir (emphasis added) (page 5-22). These load allocations are inappropriate, particularly given that the reservoirs are not a source of nutrients, but a net sink of nutrients. Even the Draft TMDL acknowledges that the reservoirs are a significant net sink of nutrients (see Table 4.5 on page 4-20). Because the reservoirs are a net sink of nutrients, the net nutrient loading in the Klamath River from Stateline to downstream of Iron Gate is significantly less with the reservoirs in place than it would otherwise be.

Assigning nutrient load allocations to Project facilities, which are not sources but rather net sinks of nutrients, is inappropriate. It points to the Draft TMDL's failure to accurately and realistically portray and account for the nutrient sources and dynamics in the Klamath River system. Even the Draft TMDL's model outputs clearly show that the reservoirs substantially reduce large nutrient pulses emanating from the Klamath River upstream (in response to bloom conditions in Upper Klamath Lake). Yet this information is not used in the TMDL to identify and account for the positive implications the reservoirs have on nutrient conditions in the system.

Using the Draft TMDL models recently obtained from Tetra Tech for review, PacifiCorp's water quality modeling consultant (Watercourse Engineering) performed model runs that clearly show that TP loads at Iron Gate dam are substantially lower under current conditions than under conditions assuming the dams are absent. This is due to the significant retention and loss of inflowing organic matter in the reservoirs that would not occur without the reservoirs.

To illustrate this point, Figure 3 shows bar charts of annual nutrient loads for the Klamath River below Iron Gate Dam for three modeled scenarios: (1) Existing Conditions (or current conditions); (2) Natural Baseline (as defined in the Draft TMDL); and Modified Natural Baseline. The Existing (S1) and Natural Baseline (T1BSR) scenarios are the same as used in Figures 5.9 to 5.11 in the Draft TMDL. The Modified Natural Baseline was developed by Watercourse Engineering (and is not in the Draft TMDL analysis) to represent the natural baseline scenario without Project dams (i.e., Keno, J.C Boyle, Copco 1, Copco 2, and Iron Gate dams are absent) if model boundary conditions assume existing conditions at Link River, rather than assuming unrealistic Upper Klamath Lake TMDL compliance conditions. When compared to Existing Conditions (or current conditions), the Modified Natural Baseline scenario allows for a direct and realistic assessment of the effects of Project reservoirs on nutrient loads. The difference between annual nutrient loads simulated for Existing Conditions (or current conditions) and the Modified Natural Baseline scenario gives the combined retention effects of J.C. Boyle, Copco, and Iron Gate reservoirs.

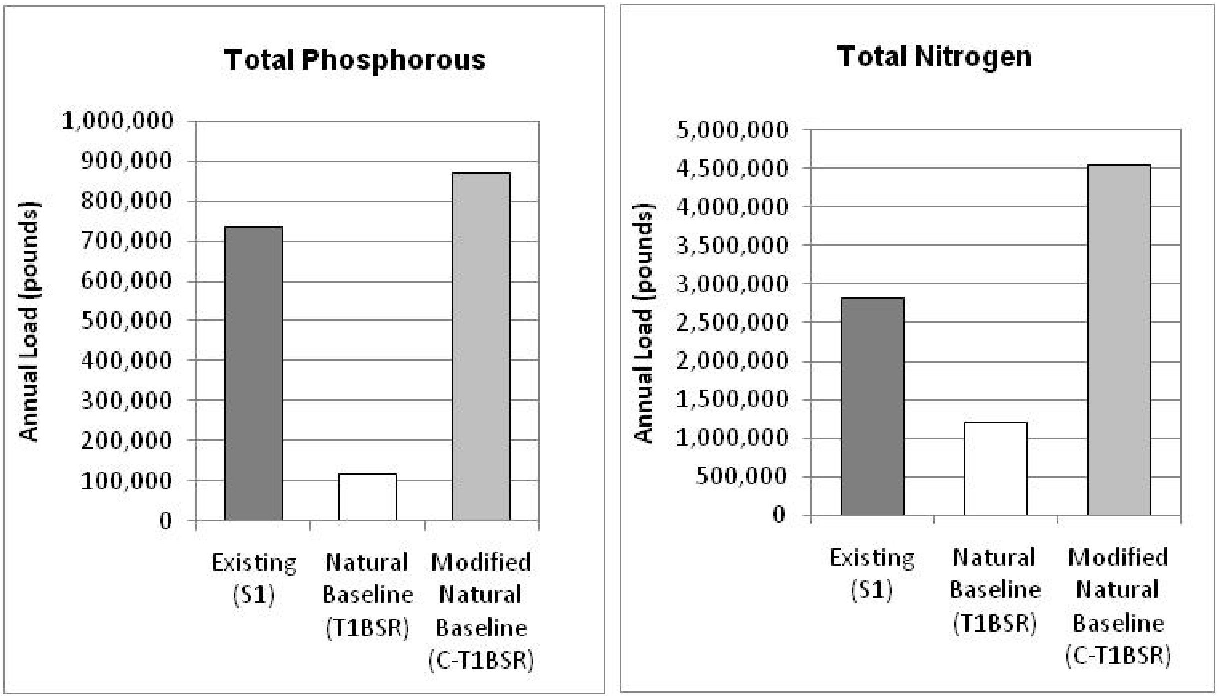

Figure 3. Comparison of current annual TP and TN loads below Iron Gate Dam to natural conditions baseline loads. C-T1BSR is a modification of T1BSR based on existing boundary conditions at Upper Klamath Lake.

Comparison of model results for Existing Conditions (or current conditions) and the Modified Natural Baseline scenarios demonstrates that the reservoirs provide significant nutrient retention. Figure 3 shows that the annual nutrient loads to the Klamath River at Iron Gate dam are less under current conditions than the no-dam natural baseline scenario by approximately 38 percent for TN and approximately 15 percent for TP.

Figure 4 shows that total nutrient loads from May to October – when the growth season occurs – also follow a similar pattern as the annual nutrient loads, i.e., there would be greater nutrient loads in the no-dam scenario. During May to October, nutrient loads to the Klamath River at Iron Gate dam are less under current conditions than the no-dam natural baseline scenario by approximately 55 percent for TN and approximately 20 percent for TP.

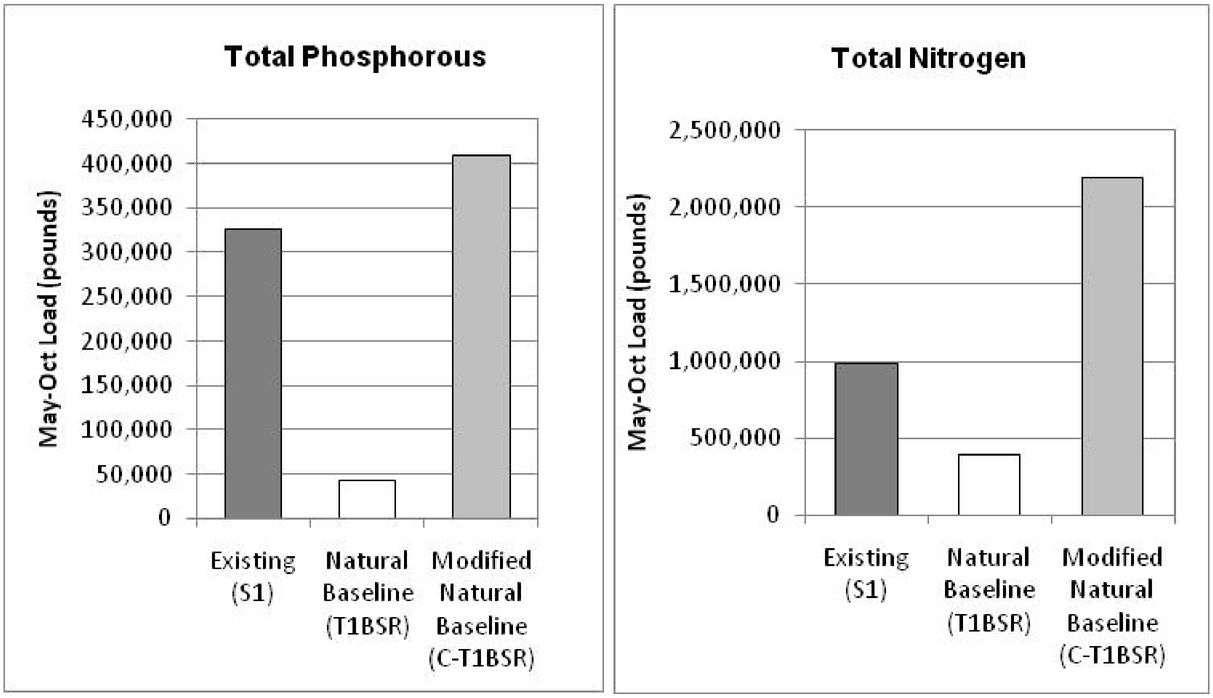

Figure 4. Comparison of current TP and TN loads below Iron Gate Dam to natural conditions baseline loads for the months of May to October. C-T1BSR is a modification of T1BSR based on existing boundary conditions at Upper Klamath Lake.

Figures 5 and 6 show the monthly distribution of nutrient loads from these model runs for the Klamath River at Iron Gate Dam. As seen from these graphs, the monthly nutrient loads under Existing Conditions (with reservoirs) are substantially lower than the Modified Natural Baseline scenario during the peak algal growth period in summer – on the order two to three times lower. This is due to the significant retention and loss of inflowing organic matter in the reservoirs that would not occur without the reservoirs.

Figures 5 and 6 also show that peak nutrient loads coming from upstream sources are significantly lower under Existing Conditions (with reservoirs) and also shifted later into the fall than under the Modified Natural Baseline scenario. This shift into the fall also is important because, with dams in place, nutrients tend to leave the reservoirs later in the season after benthic algae standing crop in the river has started to diminish.

The significant retention of inflowing nutrients and organic matter in the reservoirs, and the shift of peak concentrations into the fall, provide important water quality benefits. Without the reservoirs, the loading of nutrients and peak summer nutrient concentrations would be greater in the Klamath River below Iron Gate dam, and would cause more growth of benthic algae downriver. More growth of benthic algae would exacerbate the pathway described in the Draft TMDL (page 2-32) in which more benthic algae downriver would increase polychaete habitat and result in more fish disease.

Without the reservoirs, the greater loading of nutrients and peak summer nutrient concentrations would also cause more growth of suspended algae (phytoplankton) in slow-moving backwater areas of the river and in the estuary. More growth of suspended algae could result in a greater incidence of blue-green algae, including potentially-toxigenic species like Microcytis, in river backwater areas and the estuary. More growth of suspended or benthic algae also could cause other detrimental effects on water quality that often accompany increased algae growth, including significant diurnal reductions in DO and increases in pH. These potential water quality impairments that could occur without the nutrient retention provided by the reservoirs could impact aquatic species and identified beneficial uses in the lower river. These potential impacts should be thoroughly analyzed and understood to ensure TMDL implementation does not result in unanticipated or unintended adverse consequences.

These reservoir benefits are not discussed in the Draft TMDL. A more comprehensive and appropriate representation of actual reservoir dynamics in the TMDL is needed to allow better assessment of potential implementation actions and key intermediate milestones en route to TMDL compliance. Detailed discussion of travel time and nutrient dynamic through various river reaches from Link Dam to the Estuary is provided in PacifiCorp (2006) based on both model results and field data. PacifiCorp (2006) was not referenced in the draft TMDL.

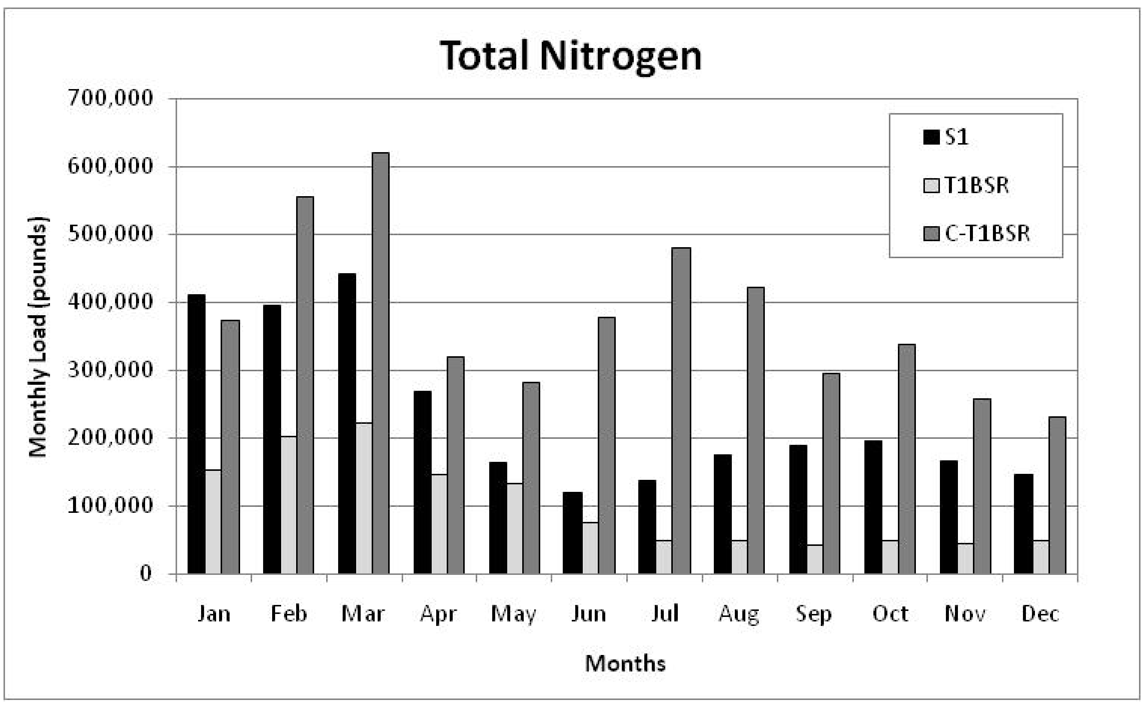

Figure 5. Comparison of monthly TN loads below Iron Gate Dam.

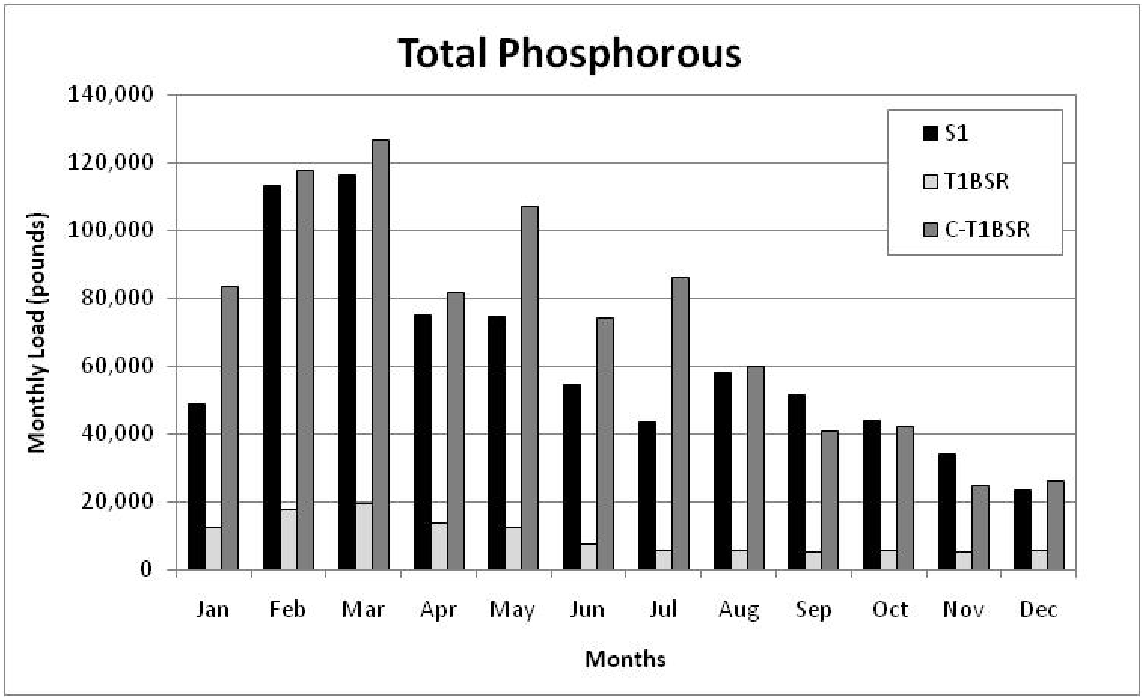

Figure 6. Comparison of monthly TP loads below Iron Gate Dam.

The Draft TMDL incorrectly describes the presence of the reservoirs as an impairment by making a misleading conclusion regarding the reservoirs as "a significant nutrient risk cofactor" (page 2-36) and by concluding that the additional nutrient allocations (as discussed above) "highlight the difficulty of having dams on a naturally productive river" (page 5-22). However, as discussed above, these conclusions are made despite the Draft TMDL disregarding important information on the effects of net nutrient reductions in the Klamath River as a result of the presence of the reservoirs.

The Draft TMDL makes misleading or one-sided data comparisons to support statements regarding reservoir effects. For example, in a section titled "2.5.3.4. Chlorophyll-a Reservoirs", the Draft TMDL displays chlorophyll *a* data for twenty sites along the Klamath River that are a mix of reservoir and river locations (Figure 2.22 on page 2-59 and Figure 2.23 on page 2-60). A horizontal bar is included on each figure demarking the 10 μg/L chlorophyll *a* target for the reservoirs, and the Draft TMDL then suggests the reservoirs are causing impairment because "chlorophyll *a* at all of the reporting stations for the reservoirs are at or above the summer mean numeric target of 10 μg/L" (page 2-61).

The Draft TMDL misleads by not pointing out that the 10 μg/L chlorophyll *a* target is specifically related to suspended algae (i.e., phytoplankton) and is a target that the Draft TMDL has clearly derived to apply only to the reservoirs. The Draft TMDL does not explain that many of the river sites are below the 10 μg/L chlorophyll *a* line on the figures because the river is a fundamentally different lotic habitat, which by its very nature has much less phytoplankton. The comparison and analysis in these figures is as misleading or one-sided as figures that might be made that show chlorophyll *a* values for attached or benthic algae (i.e., periphyton). On such graphs, the 150 mg/m² benthic chlorophyll a targets would be shown as exceeded at the river sites, but essentially zero at the reservoir sites. Does that suggest that the river channel is an impairment? Of course not. Chlorophyll *a* values for attached or benthic algae are not a concern, and are not even measured in the reservoirs, because it is a fundamentally different lentic habitat, which by its very nature has much less attached or benthic algae.

The Draft TMDL's "Zero" Nutrient Allocations for Copco and Iron Gate Reservoir Sediments Are Inappropriate and Unnecessary

The Draft TMDL assigns "zero nutrient loading from reservoir bottom sediments … to account for the flux of nutrients (e.g., ammonia and orthophosphate) from reservoir bottom sediments under anoxic conditions during the critical period May through October" (page 5-22). Yet, the Draft TMDL admits that nutrient flux from reservoir sediments is very small compared to loads entering the reservoirs (page 4-19). The TMDL may not arbitrarily assign a separate load allocation to reservoir sediments. The reservoir sediments must be considered in conjunction with the reservoirs as a whole. On this sediment-related allocation, one of the Peer Reviewers states that "the concept of a "zero" allocation target is a difficult one to conceive of in any natural context, and even if it were possible, the evidence presented does not provide a high level of confidence that the biological endpoints will be reached" (Appendix 7, page 12).

In addition, the allocation is inappropriate because the Draft TMDL makes several incorrect assumptions and conclusions in justifying and deriving this allocation. First and foremost, this allocation is inappropriate because it does not account for the fact that the reservoirs are not a source of nutrients, but a net sink of nutrients. Therefore, the net nutrient loading in the Klamath River from Stateline to downstream of Iron Gate is less with the reservoirs in place than would occur if they did not exist. Because the reservoirs also act as a trap for organic nutrients, a proper accounting of the net effect of the reservoirs must consider the accumulated flux of nutrients to the reservoir bed sediments. That is, the bed is also accumulating and storing nutrients. Correctly accounting for nutrient retention by the reservoirs will result in sediment loads identified in the TMDL being reduced and becoming negative, i.e., reservoirs as net sinks.

The Draft TMDL appears to justify the allocation of zero nutrient loading from reservoir bottom sediments in part on the assumption that anoxic conditions in the bottom layers of the reservoirs (hypolimnion) during summer stratification can transfer nutrients from the sediment to the water column. The Draft TMDL goes on to assume that the transfer of nutrients to the water column could stimulate algae growth or "exacerbate" DO conditions (pages 4-16 and 4-17). However, the processes and effects described in the Draft TMDL related to nutrient loading from reservoir bottom sediments are largely not applicable to Iron Gate and Copco reservoirs.

Nutrient loading from reservoir bottom sediments, if and when it occurs, emanates from the reservoir sediment under anoxic conditions. Therefore, internal nutrient loading in stratified reservoirs does little to exacerbate DO conditions because for internal loading to occur, anoxia already must be present. Anoxia occurs primarily because of seasonal stratification and is largely driven by the very large inflow loads of particulate organic matter that sink and accumulate in the hypolimnions of the reservoirs. Because it occurs during stratification, nutrients released from reservoir bottom sediments are generally confined to the hypolimnion and do not contribute to epilimnetic algae production.

When the reservoirs attain isothermal conditions in the fall, anoxia is gone and no nutrient release from sediments would occur. Any nutrients that were contained in the hypolimnetic volume during turnover are of minimal consequence to the algae production in the reservoirs and river downstream because the shorter days and cooler temperatures limit algal growth. Copco and Iron Gate Reservoirs have very short residence times, on the order of days, during elevated flow conditions in fall and winter, so carryover of hypolimnetic nutrients from one season to the next is likely insignificant.

Finally, the Draft TMDL's own analysis shows that the numerical estimate of potential loading from the sediments is only one percent of influent loads (as shown in Figures 4.1 to 4.3). Aside from the hypolimnetic confinement of nutrient loading from the sediments, if and when it occurs, such a small percent is unlikely to result in any additional measurable water quality impairment in the reservoirs or the river downstream.

The Draft TMDL's "Compliance Lens" Allocation is Unprecedented and Unrealistic

The Draft TMDL assigns allocations to Copco and Iron Gate reservoirs in the form of a "temperature and dissolved oxygen compliance lens" for the period of May through October. The Draft TMDL further describes that "[t]he volume of each reservoir compliance lens is equal to the average hydraulic depth of the river in a free-flowing state for the width and length of the reservoir". This compliance lens approach is unprecedented – PacifiCorp is unaware of any actual implementation of a similar "compliance lens" approach elsewhere. This compliance lens approach is unrealistic to actually apply in an advection-dominated reservoir setting.

The concept of applying a fixed volume where temperature and DO are both acceptable based on the reach average depth of a free-flowing river makes no physical sense: lentic and lotic systems are fundamentally different environments. The average reach depth (the Draft TMDL is unclear if this is average depth or average hydraulic depth) for a free-flowing river channel is not provided in the Draft TMDL, but based on modeling efforts is probably on the order of one meter. Even if the average depth were two meters, relying on this thickness of a compliance lens within the reservoir is tenuous given thermal stratification, wind mixing, and seasonal thermal loading. That is, such a thin lens would not actually persist in a biologically functional manner through the summer period.

Further, the definition states that the compliance lens applies to the width and length of the reservoir. This is an unattainable condition in reservoirs under stratified conditions. By definition, the thermocline within Copco and Iron Gate reservoirs does not extend the entire length of the reservoir. In shallower headwater areas, a hypolimnion is absent and there are no cold, deeper waters in the upper reaches of both reservoirs for considerable distances. Likewise, the thermocline also does not extend the full width of the reservoirs. Based on fundamental stratification dynamics and the morphology of reservoir systems, the compliance lens approach as defined in the draft TMDL cannot be realistically implemented.

The Draft TMDL's Nutrient Allocations at the Iron Gate Hatchery Are Inappropriate and Unnecessary

The waste load allocation for Iron Gate Hatchery is arbitrary, and cannot be met. The allocation for the Hatchery is for zero net increase above "California compliant conditions (i.e. with no dams)" (page 5-26). As discussed elsewhere, the California compliant conditions are inappropriate and unattainable. Therefore, because the intake water from the Klamath River of Iron Gate reservoir will be in excess of the target value given in Table 5.15, the objective of zero net increase over the "compliant" condition cannot be met. In addition, because the target values for TP and CBOD are less than laboratory analytical reporting limits, compliance could not be demonstrated, even if it could be achieved.

In the alternative, supposing that zero net discharge could be achieved, there would be only a negligible, probably undetectable, effect of the loading to the Klamath River. Even under "compliant conditions" the existing load from the hatchery (page 4-22) would constitute only 0.02 percent of the proposed compliant load for TN (Draft TMDL Table 5.3) and only 0.05 percent of the compliant load for TP (Draft TMDL Table 5.2). Any benefit from eliminating this miniscule load could not conceivably justify the expense involved.

E. Relevant Factors Are Not Addressed and Criteria Are Not Established to Support the Dissolved Oxygen and Nutrient Load Allocation Plan; Therefore, the Plan Is Inconsistent with State Law

The Regional Board did not consider relevant factors in determining the thermal load allocations nor establish the criteria used to make these determinations. The development of a load allocation plan "requires the consideration of numerous factors, including cost, technical achievability and equity." SWRCB, "Impaired Waters Guidance," at p. 5-18. An allocation plan should achieve an acceptable balance between these factors. *Id.* Furthermore, "[l]oading scenarios may be adjusted… taking political, social, and economic factors into consideration," such as deciding to apply reductions only to a few targeted sources. *Id.* at p. 5-19. Most importantly, however, "[t]he criteria for making these decisions (e.g., magnitude of impact, degree of management controls in place, feasibility, probability of success, cost) must also be established." *Id.*

Together, Chapters 5 and 6 are the load allocation plan. Neither chapter discusses how the relevant factors, including cost, technical achievability, and equity, were used to determine the load allocation plan. The Regional Board must address in a realistic manner the cost, technical achievability, and equity of the very large reductions of nutrient loads proposed in the Draft TMDL. The analysis of cost, technical achievability, and equity is particularly important in this case given that, to our knowledge, there have been no documented cases in which nutrient load reductions on such a large scale have been achieved elsewhere.

As discussed above, the nutrient-related targets represent a lowered trophic state that cannot be achieved under natural conditions. The nutrient allocations specified in the Draft TMDL for the Project and Iron Gate Hatchery would require huge reductions in nitrogen and phosphorus that are not related to the actual loadings from either source. A source is only responsible for the loadings it controls. It is inequitable to require a source to reduce its loadings by more than it contributes. Other TMDLs have recognized the difficulty of changing the trophic state of a naturally eutrophic system. For example, Crowley Lake in California was considered impaired by nutrients based on observations of blue-green algae blooms, but the TMDL resulted in the recognition that the reservoir was naturally eutrophic because even with maximum reductions of anthropogenic influent TN and TP, the trophic state index would remain essentially unchanged. Therefore, in the Crowley Lake case, rather than assigning unachievable negative load allocations, the Regional Board staff concluded that a site specific objective for DO should be prepared to account for naturally eutrophic conditions. Unlike the Crowley Lake TMDL, the nutrient allocations assigned in the Draft TMDL to the Project and Iron Gate Hatchery do not consider feasibility given similar circumstances or equity.

Moreover, the TMDL concludes that the water quality objectives are difficult to meet with the PacifiCorp facilities in place, yet it also states that with or without the dams, the nutrient loads would be in excess of acceptable loads (p. 4-21, 5-22). Other recent TMDLs involving hydropower projects, such as those for Hells Canyon and the Spokane River, for example, did not set the baseline to conditions that would exist without the dams in place. Here, the TMDL is inconsistent with State law for failing to consider the feasibility of the nutrient reductions assigned to the Project and the equity of assigning such reductions below the amount of loading the reservoirs actually contribute.

The Draft TMDL failed to show that the nutrient-related targets are achievable. As discussed above, with or without the dams, large nutrient reductions are required to achieve compliance. The feasibility of nutrient reductions assigned to Iron Gate Hatchery is also not addressed, but the reductions are similarly unachievable given that the intake water is from Iron Gate reservoir or downstream of the dam. *See* 4-21. The TMDL does not identify any practicable or legal means of ensuring that the reductions will occur. Although the TMDL states that off-site mitigation may be used to meet allocations for Iron Gate Hatchery and the Project in the interim, it fails to discuss any quantification of the expected reductions (p. 6-14, 6-15, 6-55-6-56). Several peer review comments questioned how the nutrient targets would be met. *See* Appendix 7, p. 1, 12, 26. As discussed above, the Regional Board staff's response that it need not consider feasibility is incorrect. *See* Appendix 7, p. 2. The load allocations were improperly set to require reductions below natural conditions. As such, it is not a matter of debating various implementation methods. Rather, it is a failure to accurately characterize natural conditions and identify feasible solutions.

Finally, despite highlighting the conclusion that the water quality objectives will be difficult to meet with the Project facilities in place, the Draft TMDL did not consider the cost of dam removal, which it indicates is the only viable means of compliance with TMDL load allocations (p. 5-22). This issue is discussed further below.

The Draft TMDL does not discuss how the relevant factors were considered in developing the DO and nutrient load allocation plan. If these factors were in fact considered, this fact should be explicitly stated and a discussion of factors considered and results reached should be included in the Draft TMDL. The criteria for determining that the Project and Iron Gate Hatchery should be required to achieve such large reductions should be established and included in the Draft TMDL.

IV. TMDL MODELING AND ANALYSIS ISSUES

There are several substantial issues associated with the modeling performed to support the Draft TMDL's analyses and recommended allocations. Undocumented, unjustified, and questionable source code modifications were made that render the technical basis of the TMDL flawed and unsuitable for use to set load allocations. Uncertainty analyses or even model performance metrics that allow model uncertainty to be quantified are absent. Without quantification and incorporation of model uncertainty, the adequacy and accuracy of the TMDL analyses remain dubious, and the resulting TMDL load allocations questionable. The models are based on only a single model year. Additional model years are not included even though sufficient data were available to extend the models. This omission severely limits the TMDL analysis because of a complete lack of accounting for inter-annual variability. The Draft TMDL indicates that the models' upstream boundary conditions were based on a scenario that assumes complete compliance with Oregon's Upper Klamath Lake TMDL (ODEQ 2002). However, upon review, it appears that model upstream boundary values were set inconsistently below expected conditions presented in the UKL TMDL, and possibly even below expected natural conditions.

A. Uncertainty Analyses or Model Performance Metrics are Absent

Numerical models can be extremely useful tools when applied properly. The strength of many water quality models, including the models that are the basis of the Klamath River TMDL, is that they are developed from physics of hydrodynamics and well-accepted representations of biological and chemical processes. Using acceptable numerical models, standard procedure is to calibrate model parameters to fit data from the river system being simulated. Often, calibration is followed by validation of the model. After calibration, the model may be considered representative of the river system and is applied to scenarios describing different boundary conditions for evaluation of management options. For obvious reasons, standard practice dictates that calibrated values not be changed from one scenario to another. In such case, scenario outcomes would not be comparable.

But the model calibration done to support the Draft TMDL deviated significantly from standard, acceptable practice. In the Draft TMDL simulations, calibrated values are changed during so-called validation. Changes appear in parameter values from one reach to the next with no apparent reason. Furthermore, calibrated parameter values are not always used throughout the simulation of management scenarios. Parameter values change, often slightly and sometimes significantly, throughout the simulations used in the TMDL. These changes are unacceptable in development and application of numerical models, particularly for assessing and determining regulatory actions, with costs and implications as significant as those required by the Draft TMDL.

B. Undocumented and Questionable Source Code Modifications Were Made that Render the Technical Basis and Validity of the Klamath River TMDL Flawed

Both models used as the basis for the Klamath River TMDL, the RMA models and CE-QUAL-W2, are well-established models that have been applied extensively worldwide. However, although the models are based on well-accepted numerical model programs, the model programs and source codes have been modified for use in the TMDL in significant ways and these modifications have not been documented nor have they been peer-reviewed. Models containing undocumented and questionable code changes raise serious concerns regarding the TMDL technical analyses and must be resolved promptly. In fairness, there appear to be some code changes that likely are valuable and useful in better representing some water quality processes. However, documentation of such changes is either absent or presented with inadequate detail.

One particular modification made to model source code is troubling. Specifically, the model codes used to develop the Draft TMDL have been modified with undocumented changes that reduce short-wave solar radiation by 20 percent in the water temperature logic. These modifications are applied to all reaches except for the hydropower project reservoirs where no reduction is applied. This undocumented, unjustified, and questionable source code modification results in "natural" baseline water temperatures that are colder by nearly 2°C in summer than would occur without the 20 percent reduction. Water temperatures modeled under "existing" conditions, with dams in place, have not been similarly manipulated, introducing bias of one scenario over another. The Regional Board staff should clarify their purpose for making this code modification and clearly document and justify all source code modifications, and promptly provide this information.

Code modifications to reduce solar radiation input values by 20 percent were made in both RMA11 and CE-QUAL-W2 models. In W2, code was added to ensure this reduction applied only to the Lake Ewauna-Keno reservoir. This arbitrary change to well-established source code is unexplained. The intention seems to have been to only affect changes to water temperatures because this code change only applied to the heat budget and was not applied to solar radiation inputs for either light extinction or photosynthetic light calculations.

Standard practice is for programmers to clearly identify changes made to model code, but the code change that reduces solar radiation is unmarked and undocumented in any way. The fact that this code is unmarked should be a "red flag" to anyone considering the credibility of this TMDL and the validity of its analyses. Until such information is provided, this matter casts significant doubt on the technical basis and validity of the Klamath River TMDL. PacifiCorp recommends removal of code that modifies the heat budget equations, followed by model reanalysis.

Another modification was made in the logic to calculate pH in river reaches based on alkalinity and total inorganic carbon. This code was added to the PacifiCorp version of the RMA11 model by Tetra Tech. After careful review the actual equation to solve for pH appears valid; however, the iterative technique used to find a solution is flawed. In the TMDL model, values for pH are iteratively tried until a solution criterion is attained. In assessing the implications of this technique, PacifiCorp's consultants found at least one instance in which the technique stepped over the correct solution. In such cases, solution criteria are never met and the module continues searching until it returns a numerical error in the model.

Another section of undocumented code results in a significant alteration of reaeration rates in short sections of the river. This logic caused serious problems in running the model. The

TMDL model contains new code in the RMA-11 program that resets reaeration rates in a short section at the beginning of each river reach. The code uses a so-called "turbulence factor" to presumably try to account for the higher concentrations of DO found in sections of river reaches just below dams. This addition is unstable and made simulation impossible under certain conditions. During review of TMDL simulations, this user-specified factor was set to unity, neutralizing its effect, in all reaches. It is unclear what purpose this code was intended to serve, but when the code was provided to PacifiCorp's modeling consultant, FTURB[2] was set to 100 in the input file of some reaches.

Other notable changes to model source code include (discussed further in Appendix A):

- Light extinction and organic matter representation in RMA11
- Benthic algae code modification in RMA11
- Addition of a new spillway formula (with no reference to its source) in W2
- Modifications to sedimentary organic matter computations in W2
- Modification to the phytoplankton and benthic algae in Keno reservoir, wherein "healthy" and "unhealthy" algae are modeled in response to DO conditions. This code (applied to W2) is not documented and parameter values to control the outcome of this logic are not supported in the literature

PacifiCorp requests that the Regional Board provide clear documentation on all model changes, such as identified above. Further, PacifiCorp's modeling consultant (Watercourse Engineering) received multiple versions of the code over several months – several of which were not the "latest" version, which resulted in considerable review effort spent on the incorrect model code and files. Version control is a crucial element in modeling, particularly in large scale applications such as the Klamath River basin. PacifiCorp has concerns about version control with the TMDL at this time, i.e., whether the May 2008 version of the code is the "current" version and whether that version has been used in all TMDL simulations.

PacifiCorp provided the Klamath water quality models developed by its consultant, Watercourse Engineering, to be used as the basis for the Klamath TMDL modeling effort in order to save the states of California and Oregon, and EPA significant time and money. The models were provided with the understanding that refinements to the models would be developed cooperatively between Tetra Tech and Watercourse Engineering in an open and transparent manner. This understanding was intended to assure that: (1) the TMDL model incorporated the latest water quality monitoring and data collection information; (2) modifications, additions, and recalibrations of the model were identified; and (3) model scenarios and assumptions necessary to enhance model calibration, identify data gaps, and provide model improvements were shared. The serious flaws with the modeling done for the Draft TMDL (as described above) could have been avoided had Regional Board staff more fully

[2] The user-specified factor, FTURB, modifies the reaeration rate in the first 2 elements of the grid defining the river reach. In the water quality parameter input file of the TMDL Model, the turbulence factor, FTURB, was set to 100.0 for some reaches. Application of this factor results in a reaeration rate as much as 100 times greater than would be calculated by standard reaeration formulas included in the code.

collaborated and shared modeling information with PacifiCorp throughout the TMDL development process as intended in the License Agreement.

V. PEER REVIEW RESPONSES

The Regional Board Staff is required to submit the "scientific portions of a rule" to external scientific peer review, including supporting data, studies, and other appropriate materials on which the scientific portions are based. Health & Safety Code § 57004(d). The Regional Board Staff must respond to peer review comments, in particular where the peer reviewer concludes that the scientific portion of the proposed rule is not based upon sound scientific knowledge, methods, and practices. If Staff disagrees with the peer reviewer, the response must explain why the challenged portion is in fact based on sound science.

The Regional Board Staff failed to include Chapter 6, the Implementation Plan, and Chapter 7, the Monitoring Program, in the package of materials submitted to the peer reviewers. These two chapters should have been included in the peer review package because they included scientific portions of the proposed rule as well as supporting information for the other chapters submitted. Indeed, one reviewer stated that it is "difficult" to evaluate the proposed TMDL, "impossible" to understand the impacts of the targets, and "impossible" to consider whether this TMDL is achievable without these chapters. Appendix 7, p. 21-22, 26. In response, the Regional Board staff stated that the Chapters were not completed when materials were sent to peer reviewers. The response also stated that the Regional Board did not include these chapters in the scope of technical peer review. Regardless of whether the chapters were completed at the time materials were sent to peer reviewers, the chapters contained scientific portions of the rule or supported or explained the scientific portions and they should have been submitted to peer review.

In several areas, the peer review comments identified serious scientific shortcomings in the proposed TMDL, particularly regarding lack of calibration of the model and analysis of model uncertainty, and Staff failed to provide an adequate explanation in response. For example, Dr. Characklis emphasized the need to evaluate and more clearly describe the degree of uncertainty in model estimates of "natural" background levels and of current conditions. Dr. Characklis also found his concerns over lack of uncertainty analyses heightened by the lack of validation and corroboration of the model for California river segments, nutrient inputs, and tributary temperatures. Appendix 7, p. 6-7, 10, 16.

The Regional Board Staff responded with a list of reasons why formal quantitative uncertainty analyses were not feasible including the size and complexity of the system, limited resources, schedules, computational complexity, and data limitations. Appendix 7, p. 8-10. However, these factors do not show that uncertainty was adequately addressed based on sound science. Conclusive statements that the model performs reasonably well are not responsive to the comments that levels of uncertainty must be identified. Appendix 7, p. 8-10, 11, 15-16. Regional Board Staff did not respond to the main point that uncertainty must be addressed explicitly even given these practical constraints.

In another example, Dr. Tullos also commented that analysis of uncertainty in the bathymetry model is necessary and that the calibration scheme of the model to estimate "natural" conditions is particularly dubious. Appendix 7, p. 22, 24-25. The Regional Board's response again only provided the conclusive statement that the model was deemed sufficient for the purpose of this study and that the model performed reasonably well. Appendix 7, p. 22, 25. Staff also referenced the practical reasons identified in response to Dr. Characklis. Id. Similarly, Dr. Kondolf requested an indication of the uncertainty in the nutrient inputs. Appendix 7, p. 35. In response, Staff conclusively stated that the "Regional Water Board is confident that the model estimates provide an adequate basis for assigning initial allocations." Id. Again, these responses do not address the need for an explicit identification and discussion of the levels of uncertainty involved in model estimates.

VI. CALIFORNIA ENVIRONMENTAL QUALITY ACT COMPLIANCE

The Regional Board's basin planning process is a certified regulatory program, or certified as functionally equivalent to the California Environmental Quality Act (CEQA). 14 C.C.R. § 15251(g). Although certified regulatory programs are exempt from some provisions of CEQA (including Chapter 3, at Public Resources Code Section 21100, Chapter 4, at Section 21150, and Section 21167), CEQA's broad policy goals and substantive standards apply. *California Sportfishing Protection Alliance v. State Water Res. Control Bd.* (2008) 160 Cal.App.4th 1625, 1643. The State Board and Regional Board regulations provide that a proposed Basin Plan amendment must be accompanied by a completed environmental checklist and written report containing a description of the activity, a discussion of reasonable alternatives to the proposed activity, and analysis of mitigation measures needed to minimize any significant adverse environmental impacts of the proposed activity. 23 C.C.R. § 3777(a).

CEQA requires an agency to perform, at the time of the adoption of a rule or regulation requiring a performance standard, an environmental analysis of the reasonably foreseeable methods of compliance. Pub. Res. Code § 21159(a). This environmental analysis must include: (1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance; (2) an analysis of reasonably foreseeable feasible mitigation measures; and (3) an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation. *Id.* "The environmental analysis shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites." Pub. Res. Code § 21159(c). The agency may use numerical ranges or averages where specific data are not available. Pub. Res. Code § 21159(a). Although the agency is not required to engage in speculation or conjecture in the preparation of this analysis or to engage in project level analysis, it must consider reasonably foreseeable impacts. Pub. Res. Code § 21159(a), (d). Even where project level environmental impact reports (EIRs) will be more detailed, an agency may not avoid this analysis. The Regional Board's CEQA document is inadequate where it "sets forth various compliance methods, the general impacts of which are reasonably foreseeable but not discussed." *City of Arcadia v. State Water Res. Control Bd.* (2006) 135 Cal.App.4th 1392, 1425-1426.

A significant effect on the environment is "a substantial, or potentially substantial, adverse change in the environment." Pub. Res. Code § 21068. In evaluating the significance of an environmental effect, an agency shall consider direct physical changes and reasonably foreseeable indirect physical changes. 14 C.C.R. § 15064(d). Economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. 14 C.C.R. § 15064(e). "The board shall not approve a proposed activity if there are feasible alternatives or feasible mitigation measures available which would substantially lessen any significant adverse impact which the proposed activity may have on the environment." 23 C.C.R. § 3780. Most importantly, the written report must identify all possible environmental impacts that the agency considered in concluding that the project would not have any significant effects on the environment. If the agency fails to consider a reasonably foreseeable environmental impact, it subverts the purposes of CEQA by omitting "material necessary to informed decision-making and informed public participation." *Sportfishing Protection Alliance v. State Water Res. Control Bd.*, 160 Cal.App.4th at 1644.

A. The Written Report Failed to Analyze the Environmental Impacts, Including Cost, of Reasonably Foreseeable Compliance Methods for the Klamath Hydroelectric Project

Although the written report identified and evaluated environmental impacts of various implementation measures identified in the AIP to achieve the DO objectives and load allocations assigned to the Project, it failed to evaluate any environmental impacts of dam removal, which the Draft TMDL indicates is the only feasible means of compliance with the otherwise unachievable load allocations. Despite the fact that the written report identifies dam removal as "the measure by which final compliance with the TMDL waste load allocations will be accomplished," it does not identify any environmental impacts or potential mitigation measures for this reasonable foreseeable compliance method (p. 9-17). Rather, the report declares the "details associated with dam removal" to be "too speculative to consider at this time." *Id.* Dam removal, as conceived by most studies performed to date, would require the discharge of the estimated 20 million cubic yards of sediment that have accumulated in the Project reservoirs since their construction. The discharge of this sediment could have severe environmental effects on the river, resident and anadromous fish, and existing beneficial uses. In addition, the discharge of this sediment would not comply with the existing Basin Plan. Thus, the TMDL fails to identify environmental impacts or potential mitigation measures that may be necessary to implement the reasonably foreseeable compliance method, nor does it identify a regulatory path to achieve that outcome that does not conflict with existing water quality requirements.

In addition, the report makes no attempt to consider the economic costs for dam removal, again stating that they are "too speculative." (p. 10-3). However, information on the cost of dam removal is available. The existing FERC FEIS on Project relicensing includes a list of available studies on dam removal costs that could have been evaluated by the Regional Board staff to analyze the potential costs of dam removal (FERC 2007, p. 4-5). FERC itself developed costs of between $61 million and $4.4 billion in 2006 dollars for physical removal of the Iron Gate, Copco 1, and Copco 2 facilities, which do not include the costs of lost power generation or restoration of inundated reservoir lands (FERC 2007). Subsequent work has estimated the cost of restoration of Project lands following dam removal at $65 million (Philip Williams Associates 2009).

Although it is correctly stated that the "details associated with dam removal are the subject of extensive investigations and confidential negotiations," it is not the details that need to be exhaustively included in this CEQA analysis. What is required is some discussion of reasonably foreseeable impacts of dam removal in order to provide this valuable material for informed decision-making and informed public participation. This discussion would not require the Regional Board to engage in speculation as numerous potential environmental impacts of dam removal are known. Allowing the Board to avoid any analysis of impacts because not all of the details are known would undermine the very purpose of CEQA which is to require public agency decision-makers to document and consider the environmental implications of their actions. Pub. Res. Code § 21001(g).

B. The Written Report Failed to Analyze Alternative Means of Compliance

The report's analysis of reasonably foreseeable alternative means of compliance with the regulation is a single paragraph that identifies alternative means of compliance "to consist of the different combinations of structural and non-structural BMPs [best management practices] that responsible parties might use" (p. 9-55). The analysis continues: "Because there are innumerable ways to combine compliance measures, all of the possible arrangements of alternative means of compliance cannot be discussed here." *Id.* The report recommends that compliance alternatives minimize structural BMPs and maximize non-structural BMPs. *Id.* This is not an analysis of alternative means of compliance. While it is true that there may be innumerable ways to combine compliance measures and therefore analysis of all of the possible arrangements of alternatives is not feasible, the failure to analyze any of the alternatives is not an option. There are numerous ways in which the Board could have met its obligation, including an analysis of example alternatives or a range of alternatives. The Board chose none of them. The analysis of alternative means of compliance is insufficient to provide particularized information about alternative means of compliance for each responsible party. Specifically, no alternative means of compliance is identified for the Project.

VII. PROCEDURAL AND PUBLIC PARTICIPATION ISSUES

A. The Public Comment Period Was Inadequate and the Piecemeal Release of the Public Review Draft TMDL and Supporting Information Hindered Public Participation

The Regional Board made the Draft TMDL publicly available in a piecemeal manner by posting chapters and appendices to the Regional Board's website over the course of a month, from June 15 to July 13, 2009. The Regional Board stated in its June 10 notification that chapters 1-5 would be available for review on June 15, 2009, that the remaining six chapters and eight appendices would be available by June 29, and that the public comment period would close August 17. Instead, the complete document was not posted to the website until July 13, more than a month after the initial notice and more than two weeks late, with no intervening notice that the entire draft TMDL was now publicly available. In a public notice dated July 30, 2009, the Regional Board issued a subsequent public notice without taking the time to accurately update the notice, indicating that "Chapters 1 through 5 of the Public Review Draft will be available for review on June 15, 2009" and that the remaining chapters "will be available for review on or before July 9, 2009." All of the remaining chapters were not actually available until July 13 due to failure of the Regional Board's website.

The Public Review Draft TMDL must be available for public comment for at least 45 days in accordance with the procedural mandates of CEQA. 23 C.C.R. § 3777; SWRCB Impaired Waters Guidance at A-5. Federal regulations also require at least 45 days of public comment prior to agency action on a proposed regulation under the Clean Water Act. 40 C.F.R. § 25.5(b). The earlier availability of some of the chapters and appendices of the Public Review Draft TMDL is not relevant when determining compliance with the full public review period required by law. *See Ultramar, Inc. v. South Coast Air Quality Management Dist.* (1993) 17 Cal.App.4th 689, 698-701. The July 30 notice incorrectly states that the public comment period started June 15. The beginning of the public comment period cannot be considered to start until the complete document is actually available in the manner noticed. Therefore, the earliest the public comment period could be considered to have begun was July 30, 2009, when the Regional Board issued its notice that the last remaining chapters of the Public Review Draft TMDL were posted to the website.

The public comment period was initially scheduled to close August 17, and while the Regional Board subsequently extended the public comment period to August 27, 2009, this extension was not granted until the Regional Board received a letter from PacifiCorp informing the Board of its inadequate public comment period. Starting July 30, with comments "due *no later than* **5:00 PM on Thursday, August 27, 2009**," the public comment period is in fact only 28 days. Regional Board "Notice of Availability of Draft Document, Public Comment Period, and Public Workshops" (July 30, 3009). This is a legally inadequate public comment period.

In the alternative, if the public comment period is deemed to start on July 13, then the public comment period is now exactly 45 days, the procedural minimum. Compliance with procedural minima is not adequate in the present circumstance. The 45-day period is inadequate in this case given the complexity of the TMDL and of the underlying technical information and especially given the piecemeal release of the Draft TMDL and supporting documents. The Regional Board rejected several requests by PacifiCorp, made July 2 and July 20, and by the United States Bureau of Reclamation, made July 23, for extensions of the public comment period to allow adequate time for a comprehensive review and accurate, constructive comments.

In addition, the Regional Board provided supporting technical information and modeling files in a piecemeal fashion in response to repeated requests. PacifiCorp requested that all Draft TMDL model files used in the analytical assessment of load allocations developed as part of the Draft TMDL be released prior to or coincident with the scheduled June 15 release of the Public Review Draft TMDL. Some of this information was provided starting June 22 though it was available for release much earlier than this date. Additional requests were later made for essential data and information underlying the TMDL analyses. While requested information was provided throughout July and August, much of the requested information was not available until well into the public comment period. The most recent information request was submitted August 7. While the requested information and documentation was finally available on August 14, the continued delay in obtaining the supporting technical information and modeling files impeded PacifiCorp's review of the TMDL within the public comment period.

Public consultation must be preceded by timely distribution of information, sufficiently in advance of agency decision making to allow the agency to assimilate public views into agency action. 40 C.F.R. § 25.4(d). Federal regulations recognize that providing information to the public at the earliest practicable time is a necessary prerequisite to meaningful, active public involvement. 40 C.F.R. § 25.4(b). Objectives for public participation in regulations enacted to implement the Clean Water Act include assuring that the public has the opportunity to understand official programs and proposed actions, encouraging public involvement, fostering a spirit of openness and mutual trust among EPA, States, substate agencies and the public, and using all feasible means to create opportunities for public participation. 40 C.F.R. § 25.3(c). Related to these objectives, President Barack Obama recently emphasized the need for trust and transparency in policymaking:

> The public must be able to trust the science and scientific process informing public policy decision. Political officials should not suppress or alter scientific or technological findings and conclusions. If scientific and technological information is developed and used by the Federal Government, it should ordinarily be made available to the public. To the extent permitted by law, there should be transparency in the preparation, identification, and use of scientific and technological information in policymaking.
>
> President Barack Obama, "Statement on Scientific Integrity" (March 9, 2009).

Public participation in the Draft TMDL was hindered by the significant delays in the release of documents and information as outlined above. Given these delays in addition to the heavy reliance on modeling in developing the TMDL, the regulatory and technical complexity of the Public Review Draft, and the sheer volume of information, the public comment period was inadequate. Despite the demonstrated need for additional time to allow full public participation, the Regional Board chose to limit the time for meaningful public comment and involvement.

B. The Regional Board Used Unfair Procedures By Relying on Private Information or Biased Sources Without Disclosing the Criteria Used in Decision-making

In several instances, the Regional Board used information from interested parties to support its decisions without making that information publicly available or without disclosing the criteria used for such decision-making. Principles of fairness require that an agency make information available that served as the basis for its decisions. An agency may not use the public proceeding as a façade for a private decision resting upon privately acquired data. *California Optometric Ass'n v. Lackner* (1976) 60 Cal.App.3d 500, 510-511.

In evaluating solutions to achieve water quality objectives, the Regional Board can take several factors into account, including political, social, and economic factors, provided that the criteria for making decisions regarding these solutions are established. SWRCB Impaired Waters Guidance at p. 5-19. The Regional Water Boards have broad discretion in determining how to address water quality impairments. Nonetheless, public agencies must comply with fair procedures.

The modeling and technical analysis supporting load allocations assigned to the Project are designed so that compliance is not expected without dam removal. The Regional Board staff's response to one peer reviewer's comment suggesting "a discussion on how this TMDL might restrict or otherwise effect plans for removal of the 4 dams" is simply that "based on the TMDL modeling analysis, the TMDL allocations and targets would be achieved should the dams be decommissioned." Appendix 7, p. 25-26. The Public Review Draft TMDL compares the nutrient loadings for dams-out and dams-in scenarios and states that "[t]his comparison highlights the difficulty of meeting water quality objectives and supporting beneficial uses throughout the Klamath River in California with the PacifiCorp facilities in place." p. 5-22. As described in Appendix A, the modeling supporting these assumptions is inaccurate. In addition to these technical flaws, the process of developing the modeling supporting this conclusion was fundamentally unfair.

IX. REFERENCES

All of the reports and documents cited below are publicly available, and therefore should be easily accessible by Regional Board staff. If Regional Board staff have difficulty in obtaining any of these reports or documents, PacifiCorp can provide copies upon request. Otherwise, PacifiCorp assumes that the listed documents are hereby incorporated into the record.

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