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January 29, 2016

Parker Thaler
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812

RE: Karuk Tribe Scoping Comments on the California Water Resources Control Board's Notice of Preparation of an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing

Ayukii Mr. Thaler:

The Karuk Tribe appreciates the opportunity to comment on the scope of the Environmental Impact Report related to the Clean Water Act permitting of PacifiCorp's Klamath Hydroelectric Project.

The Karuk Tribe remains disappointed by Congress' failure to resolve the issues surrounding the Klamath Hydroelectric Project by enacting legislation that would implement a trio of settlement agreements negotiated by Klamath Basin stakeholders. Implementation of those agreements would have mooted out this proceeding entirely. Although we remain cautiously optimistic that an opportunity to resolve the fate of the Klamath dams through a negotiated settlement remains, we will now urge the Water Board to move forward with the Clean Water Action section 401 permitting process.

The State Water Resources Control Board (State Water Board) issued a Notice of Preparation of an Environmental Impact Report for the Klamath Hydroelectric Project Relicensing in November of 2015. Under the California Environmental Quality Act (CEQA) a Lead Agency is required to solicit comments on a Notice of Preparation (NOP) from interested parties. The Karuk Tribe is submitting comments as a long term participant in the Klamath Hydroelectric Project (KHP) relicensing process and a signatory to the Klamath Hydro Settlement Agreement (KHSA). Reduced fish populations and poor water quality resulting directly from the operation of the Klamath Hydroelectric Project (KHP) have had profound impacts on the traditional cultural practices and the health of Tribal member.

Clean Water Act

Before the Federal Energy Regulatory Commission can issue a new license for the KHP, PacifiCorp must obtain water quality certification under Section 401 of the Clean Water Act (33 U.S.C. § 1341) from the State Water Board. Under Section 401 conditions of a water quality certification become conditions of any federal license or permit for the project. The State Water Board is the agency authorized to issue

certification of any potential discharge from an activity that requires a FERC license or amendment. The State Water Board adopted the Water Quality Control Plan for the North Coast Region (Basin Plan). The Basin Plan includes the Beneficial Uses and Water Quality Objectives necessary to project the Beneficial Uses. Together these constitute the Water Quality Standards that must be met before the State Water Board can issue Water Quality Certification. Issuance of a water quality certification is a discretionary action subject to CEQA compliance. The State Water Board has correctly chosen to prepare an Environmental Impact Report (EIR) because there are potentially significant impacts associated with the KHP.

California Environmental Quality Act

CEQA requires a lead agency to analyze the impacts of a project as defined in the CEQA Guidelines. In the case of an existing hydroelectric project that has been in operation before the adoption of the Clean Water Act and Endangered Species Act the ongoing impacts of the project will not register as significant. While CEQA considers the existing conditions as the baseline for analysis of project impacts the State Water Board must analyze the existing operations to determine compliance with the Clean Water Act. The KHP has been operating in violation of the Clean Water Act, and potentially other State and Federal Laws, and this must be disclosed in a discussion of the baseline conditions. Mitigation measures necessary to bring the KHP into compliance with State and Federal Laws must also be evaluated in the EIR. Dam removal is an alternative that must be considered and may be the only alternative that can bring the KHP into compliance with the Clean Water Act. The process of removing dams may result in short term impacts which must be weighed against the long term benefits of improved water quality and increased fish populations resulting from the opening of between 300 and 700 miles of habitat. These short term impacts should be evaluated consistent with natural river processes, and the State Water Board should gather information from other dam removal projects to inform this EIR. In the EIR the State Water Board should provide a separate analysis of the impacts to, or compliance with, the Water Quality Standards. Baseline conditions, the proposed project, and project alternatives must all be evaluated for compliance with the Water Quality Standards.

Environmental Impact Statement

As you know the Federal Energy Regulatory Commission (FERC) prepared an Environmental Impact Statement (EIS) for the KHP in 2007. As required by CEQA the State Water Board will use this EIS as the basis for developing the EIR. There are several issues of concern using the EIS as the basis for the EIR. First, the EIS was developed nine years ago and new information is now available concerning the impacts of the project. Second, FERC staff concluded in the EIRS that "Based on our detailed analysis of the environmental benefits and costs associated with the four alternatives considered in detail in this EIS, we conclude that the best alternative for the Klamath Hydroelectric Project would be to issue a new license consistent with the environmental measures specified in the Staff Alternative." While continued operation may be best for the KHP and PacifiCorp, we disagree that the continued operation can comply with the Clean Water Act, the Endangered Species Act, restore tribal cultural practices, and restore fisheries to historic sustainable levels. We believe, based on years of study, that the best and only alternative that can restore water quality and fisheries, is the removal of the four lower dams.

The National Environmental Policy Act does not require that impacts be identified based on thresholds of significance as required by CEQA. In the EIS FERC staff describe the project and project effects, but only provide vague analysis of the impacts that are often not supported by evidence. State Water Board staff will need to establish thresholds of significance and make clear determinations when and if mitigation is required.

Impacts to Karuk Tribe

CalEPA has developed an Environmental Justice (EJ) Program that is designed to reduce the impacts to "individuals disproportionately impacted by pollution in decision making processes". Karuk Tribe members have been adversely impacted by the loss of salmon, poor water quality, and high levels of cyanotoxins resulting from operation of the KHP. Continued operation of the KHP combined with the impacts of climate change will likely worsen the impacts to Tribal members. The Karuk Tribe has been impacted more than any other group from the operation of the KHP. State Water Board staff should consider EJ and ensure consistency with State Law when developing the Draft EIR. Finally, please be aware the Karuk Tribe participated in the development of a CalEPA EJ pilot project for the Klamath River. State Water Board staff should review the results of the pilot project.

Following are comments submitted by the Karuk Tribe to the North Coast Regional Water Quality Control Board in 2007 addressing the Cultural (CUL) and Subsistence Fishing (FISH) Beneficial Uses. These comments provide detailed information about the ongoing impacts to the Karuk Tribe, and will help guide in the development of thresholds of significance in the EIR.

The Water Quality Control Plan for the North Coast Region (Basin Plan) includes two Native American Cultural Beneficial Uses; Native American Culture (CUL) and Subsistence Fishing (FISH). The CUL beneficial use covers "uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and regalia material collection, navigation to traditional ceremonial locations, and ceremonial uses"; FISH encompasses "uses of water that support subsistence fishing" (NCRWQCB 2007). CUL is designated as an "Existing" use in the Ukonom, Happy Camp, Seiad Valley, Klamath Glen, and Orleans Hydrologic Subareas of the Klamath River. Due to a lack of available information at the time of the last update of the Basin Plan, no waterbodies in the North Coast have been designated as "Existing" or "Potential" use for FISH. Based on the available information, however, Regional Water Board staff consider FISH an existing use within the same Hydrologic Subareas of the Klamath River as those designated CUL.

The CUL beneficial use in the Klamath River in California is currently impaired due to the decline of salmonid populations and degraded water quality resulting in changes to or the elimination of ceremonies and ceremonial practices and risk of exposure to degraded water quality conditions during ceremonial bathing and traditional daily activities. The FISH beneficial use is currently impaired in the Klamath River basin in California due to the decline of salmonid populations and other Tribal Trust fish populations resulting in decreased use, abundance, and value of subsistence fishing locations, altered diet and associated health issues, and increased poverty. Further, it is important to note that other beneficial uses, such as COLD and MUN, are linked to the support of the CUL and FISH beneficial uses throughout the year.

Decline in Salmonid and Other Fish Populations

Salmon are food, culture, and religion to the Klamath River tribes (Reed 2005). Religion, lore, law, and technology all evolved from the Tribal People's relationship with the salmon and other fish of the Klamath River basin (Pierce 2002, p.7-2). The Supreme Court has recognized the importance of salmon to Northwest tribes such as those in the Klamath River basin, concluding that access to the fisheries was "not much less necessary to the existence of the Indians than the air they breathed" (Pierce 2002, p.7-2).

The decline of salmon populations, as well as the decline of other Tribal Trust fish species of the Klamath River basin in California including sturgeon, eulachon (candlefish), and lamprey (eel), has impaired the CUL and FISH beneficial uses. Sufficient numbers of trust species must be maintained in the river to sustain the primary dietary needs of the Klamath River Basin Tribes. The federal government has allocated 50% of the total available harvest of salmonids in the Klamath River basin to the Tribes, as required by 50 CFR Part 661 (NOAA 1993). The elimination of the spring Chinook run above the Salmon River has resulted in the elimination of cultural ceremonies associated with the migration of this species through the length of the Klamath River. Declines in fish populations, especially salmonids, has also resulted in decreased use, abundance, and value of subsistence fishing locations, an altered daily diet that has been linked to health issues for Tribal Members, and increased poverty.

An elaborate ceremony called the First Salmon Ceremony, marks the passing of the first spring Chinook salmon up the Klamath River. This migrating salmon was allowed to pass all the way up the Klamath River to its spawning ground. It was believed that the first spring Chinook migrating upstream would leave its scales at each spawning location for the rest of the salmon run to follow (Roberts 1932 as cited by Sloan 2003, p. 25). This first migrating salmon of the year was considered taboo, and if eaten would cause convulsions and death. Thus, the First Salmon Ceremony allowed this fish to pass safely upstream, thereby lifting the taboo, and allowing the Native People to fish for salmon in the river (Waterman and Kroeber 1938 as cited by Sloan 2003, p.25). The dramatic decline in the spring Chinook run has made it impossible for the Klamath Tribes to conduct the First Salmon Ceremony. "And how do you perform the Spring Salmon Ceremony, how do you perform the First Salmon Ceremony, when the physical act of going out and harvesting that first fish won't happen?"(Leaf Hillman 2004 as cited by Norgaard 2005, p.35).

The Karuk Tribe historically depended on the abundant populations of fish found in the mainstem Klamath River for subsistence. However, as fish populations have declined the Karuk have shifted their reliance to other food source (Reed 2007). Ron Reed (2005), traditional fisherman and cultural biologist for the Karuk Tribe, states that there is only one remaining tribal fishery location that provides any level of subsistence fishing to the Karuk Tribe, Ishi Pishi Falls. According to Reed (2005), in 2002, about 1,500 fish were caught at Ishi Pishi Falls, in 2003 approximately 1,000 fish were caught, and in 2004 only 100 fish were harvested at this location. The limited harvest of fish at Ishi Pishi Falls has meant that even ceremonial salmon consumption is limited (Ron Reed Pers. Comm. as cited by Norgaard 2005, p.4). According to Norgaard (2006), in addition to declining salmonid numbers, the fishery at Ishi Pishi Falls is negatively affected by low flows. When flows are too low the ability to perform dip net fishing is limited and fewer fish are caught (Norgaard 2006).

The importance of fishing to Tribal Members is reflected by the fact that fishing locations are a form of real property (Pierce 2002, p.7-2; Sloan 2003, p.17). They can be owned by individuals, families, or a group of individuals, and can be borrowed, leased, inherited, and bought and sold (Sloan 2003, p.17, 18). The quality, use, and value of these fishing locations has been reduced as factors including increased siltation

and decreased salmonid abundance have occurred in the Klamath River and its tributaries (Sloan 2003, p.18, 28).

Historically, the Karuk Tribe had a platform fishery associated with each of their 100 Tribal village sites (Reed 2006). These fisheries were located near the tops of riffles, where eddies were created along the margins of the Klamath River. These areas of low velocity were where the salmon would hold. According to Reed (2006) these 100 platform fishery locations are no longer as productive as they once were, or are gone. Tribal elders convey that the riffles near these fishing areas have been filled in and flattened out by sediment, contributing to the decline in overall fish populations (Reed 2006), as well as contributing to the loss of a culturally significant way of life.

The decline of salmonids and other Tribal Trust fish populations in the Klamath River basin has altered the diet of each of the tribes along the river and its tributaries. Historically, traditional consumption of fish by the Karuk Tribe was estimated at 450 pounds per person per year, while in 2003 the Karuk People consumed less than 5 pounds of salmon per person, and in 2004 less than ½ pound per person was consumed (Norgaard 2005, p.13). In 2005 over 80% of Karuk households surveyed reported that they were unable to harvest adequate amounts of eel, salmon or sturgeon to fulfill their family needs (Norgaard 2005, p.4). Furthermore, 40% of Karuk households reported that there are fish species that their family historically caught, which are no longer harvested (Norgaard 2005, p.7).

The decrease in abundance and availability of traditional foods, including salmon, trout, eel, and sturgeon, is responsible for many diet related illnesses among Native Americans including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney troubles and strokes (Joe and Young 1993 as cited by Norgaard 2003, p.9, 39). These conditions result from the lack of nutrient content in foods consumed in place of the traditional foods such as salmon, as well as from the decrease in exercise associated with fishing and gathering food (Norgaard 2003, p.40). The estimated diabetes rate for the Karuk Tribe is 21%, nearly four times the U.S. average, and the estimated rate of heart disease for the Karuk Tribe is 39.6%, three times the U.S. average (Norgaard 2003, p.40).

In addition to altered diet and increased health issues, declines in fish populations have resulted in a documented increase in poverty rates for some Klamath tribes.

> The destruction of the Klamath River Fishery has led to both poverty and hunger. Prior to contact with Europeans and the destruction of the fisheries, the Karuk, Hupa and Yurok Tribes were the wealthiest people in what is now known as California. Today they are amongst the poorest. This dramatic reversal is directly linked to the destruction of the fisheries resource base.
>
> The devastation of the resource base, especially the fisheries, is also directly linked to the disproportionate unemployment and low socio-economic status of Karuk people today. Before the impacts of dams, mining and over fishing the Karuk People subsisted off salmon year round for tens of thousands of years. Now poverty and hunger rates for the Karuk Tribe are among the highest in the State and Nation. The poverty rate of the Karuk Tribe is between 80 and 85% (Norgaard 2005 Exec Summary).

Degraded Water Quality

Degraded water quality in the Klamath River basin in California, including the seasonal presence of algal toxins in the Klamath River and Reservoirs (see section 2.X), has impaired the CUL beneficial use. Known and/or perceived health risks associated with degraded water quality have resulted in the alteration of cultural ceremonies to exclude or limit ingestion of river water. Additionally, known or perceived risk of exposure to degraded water quality conditions during ceremonial bathing and traditional cultural activities such as bathing, gathering and preparing basket materials, and collecting and using plants has resulted in an impairment of CUL.

The Native American Tribes practice their culture through their ceremonies, such as the White Deer Skin Ceremony, the Brush Dance Ceremony, First Salmon Ceremony, Second Salmon Ceremony, and the World Renewal Ceremony (Reed 2005). All of these ceremonies require tribal members to be in close proximity to the Klamath River and the ceremonies are integrally linked to the river and its health (Sloan 2003 p.18).

According to Karuk Cultural Biologist Ron Reed (2006), the World Renewal Ceremony is held on the Klamath River at Clear Creek, Somes Bar, and Orleans during July, August, and September of each year. The Medicine Man, who leads the ceremony, walks 14 miles through the ridges and hills along the Klamath River and is joined halfway through his journey by children and adults of the Tribe who follow him the rest of the way for good luck. Upon reaching the Klamath River at the end of this walk, it was historically tradition to drink water from the river to complete the ceremony. This is no longer done due to health concerns about drinking water directly from the river, though children are still known to jump in and drink the water (Reed 2006).

Ceremonial bathing in the river is an important part of most ceremonies (Curtis 1924 as cited by Sloan 2003, p.28). For example, bathing in the Klamath River and its tributaries is a requirement for participants in the Brush Ceremony (Sloan 2003, P.16). "During the Fish Dam Ceremonies at *Kepel*, young girls were selected by the Medicine Man to participate in the ceremonies. Once selected, they were sent to the river to bathe and then were dressed in full regalia which they would wear during the ceremonies. Then they were sent home to their families, and were required to fast and bathe in the river every day" (Van Stranlen 1942 as cited by Sloan 2003, p. 28). During the World Renewal Ceremony, the Medicine Man and other participants bathe in the Klamath River for up to 10 days (Reed 2006).

Bathing is also associated with funeral services, subsistence practices, recreational swimming, courtship, and for individual hygiene (Reed 2007). Bathing associated with funeral rituals occurs year round and includes preparation for burial, and purification after burial (Curtis 1924 as cited by Sloan 2003, p.28). The Karuk Tribe historically bathed in the Klamath River, however in more recent years degraded water quality conditions during the summer have forced them to take precautionary steps and avoid contact with the water (Reed 2007). The Yurok Tribe has reported that detached algae have been present in the Klamath River in amounts high enough to prevent access and negatively affect the spirituality associated with bathing areas (McKernan 2006).

Willow roots, wild grape, Cottonwood, and Oregon Grape are collected by Tribal Members in the riparian zone of the Klamath River and used to make baskets (Reed 2007). Traditional collection of these basketry materials often involved wading in the water (Sloan 2007a), and further contact occurs when the material is washed and cleaned in the water (Reed 2007). Additionally, willow roots are peeled by mouth following cleaning with river water (Reed 2006). In addition, plants are collected for food, medicine, materials, and other cultural functions (Reed 2007). Gathering plants or plant materials involves wading and contact with

the Klamath River (Sloan 2007a; Reed 2007). Ingestion of water can occur because plants are often cleaned in the river water and water is consumed with medicinal plants (Sloan 2007a). Given degraded water quality conditions, ingestion of water may pose a potential health risk.

Table 1.a provides a summary of the activities that are encompassed by the CUL and FISH beneficial uses. Table 1.a also denotes when those activities occur during the year, and the footnotes identify the amount of physical contact with the water associated with each of these activities. This table is not comprehensive, but conveys the magnitude and diversity of activities that are covered under these uses. Based on the information presented, Regional Water Board staff find that the CUL and FISH beneficial uses of the Klamath River in California are not being fully supported.

Table 1.a: Karuk, Yurok, and Quartz Valley Tribes Cultural Beneficial Uses (CUL and FISH) of the Klamath River and Tributaries[4]

RESOURCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CUL												
Plants[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Fish[1]	■	■	■	■	■	■	■	■	■	■	■	■
Fishing[1,2]	■	■	■	■	■	■	■	■	■	■	■	■
Water-drinking, steaming, cooking[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Rocks[1]	■	■	■	■	■	■	■	■	■	■	■	■
Bathing[2]	■	■	■	■	■	■	■	■	■	■	■	■
Boating[1,2]	■	■	■	■	■	■	■	■	■	■	■	■
Wildlife[1]	■	■	■	■	■	■	■	■	■	■	■	■
Hunting & Trapping[1]	■	■	■	■	■	■	■	■	■	■	■	■
River & Trail Access[1]	■	■	■	■	■	■	■	■	■	■	■	■
Training[2]	■	■	■	■	■	■	■	■	■	■	■	■
Swimming[2]				■	■	■	■	■	■	■		
Prayer & Meditation[1]	■	■	■	■	■	■	■	■	■	■	■	
Fish Dam[1,2]							■	■	■			
Washing[1]	■	■	■	■	■	■	■	■	■	■	■	■
Meditation[1]	■	■	■	■	■	■	■	■	■	■	■	■
Wood Gathering[1]	■	■	■	■	■	■	■	■	■	■	■	■
Tanning Hides[1]	■	■	■	■	■	■	■	■	■	■	■	■
Roots[1,3]	■	■	■	■	■	■	■	■	■	■	■	■
Sticks, Shoots & Bark[1]	■	■	■	■	■	■	■	■	■	■	■	■
Weaving[1]	■	■	■	■	■	■	■	■	■	■	■	■
Shells[1]	■	■	■	■	■	■	■	■	■	■	■	■
First Salmon Ceremony[2,3]				■	■							
World Renewal Ceremony[2,3]							■	■	■			

FISH												
Plants[1,3]												
Fishing[1,2]												
Eeling[1,2]												
Shellfish[1,2]												
Water-drinking, steaming, cooking[1,3]												
Rocks[1]												
Bathing[2]												
Boating[1,2]												
Wildlife[1]												
River & Trail Access[1]												

Sources: Bowman 2006; Norgaard 2006; Reed 2007; Sloan 2007a, Sloan 2007b

Indicates time of use.

1-Wading, 2-Full submersion, 3-Ingestion of water
4-Tributaries utilized by the tribes of the Klamath river for cultural purposes include many of those from the Scott River down to the mouth of the Klamath river. Additionally, the Quartz Valley tribe utilized all tributaries which flow into the Scott and Shasta Rivers.
Note: This table is not an exhaustive list of all activities covered under the CUL and FISH beneficial uses.

Geographic Scope/Cumulative Impacts

The State Water Board should ensure the geographic scope of the project is large enough to encompass the impacts of the KHP. The impacts of reduced salmon populations from the KHP extend well beyond the mouth of the Klamath River. West coast salmon fisheries are managed based on populations of Klamath River fish. Low escapement numbers have resulted in the curtailment of commercial salmon fishing. The Southern Resident Killer Whales, which predate on salmon, are listed as endangered under the Federal Endangered Species Act. Sturgeon tagged in the Klamath River have been located in the Frazier River in British Columbia. These examples show the geographic scope of the project, and the impacts of the KHP, extend well beyond the mouth of the river.

The NOP states the water quality impacts of the portions of the KHP in Oregon "...will be addressed only to the extent that discharges from Oregon KHP facilities adversely impact the California environment". This approach may not address the cumulative impacts of actions taken by the Oregon Department of Environmental Quality and the actions of the State Water Board in California. For example, if the lower three dams in California are removed, and if J.C. Boyle Dam is not altered to provide adequate fish passage, the full benefits of fish passage provided by California may be achieved. The actions of both water quality agencies are cumulative and must be addressed. The same concern applies to Keno Dam. PacifiCorp has proposed removing Keno Dam from the FERC license, and the KHSA proposed to transfer the dam to the Bureau of Reclamation (who would operate the dam for the benefit of irrigators). The impact of these actions in combination with the actions taken by the State Water Board must be evaluated.

Water Quality Impacts

The effects of PacifiCorp's Klamath Hydroelectric Project (KHP) on water quality have been assessed in several previous efforts including by the Federal Energy Regulatory Commission (FERC 2007) and the U.S. Department of the Interior and California Department of Fish and Game (US DOI and CDFG 2012). Overall, the water quality information presented in those two documents is of high quality and provides a solid foundation to inform SWRCB's development of an Environmental Impact Report (EIR) for a Clean Water Act section 401 water quality certification for the relicensing or decommissioning of the KHP. The US DOI and CDFG (2012) document was prepared more recently and is more comprehensive so we recommend that SWRCB reply on it more heavily than the FERC (2007) document in cases where different conclusions are reached (e.g., the effect of the reservoirs on nutrient dynamics).

The Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality, and is causing violations of California's water quality standards including the Klamath River TMDL (NCRWQCB 2010). SWRCB's obligation under section 401 of the Clean Water Act (CWA) is to determine how the operation of the KHP can be modified in order to comply with California's water quality standards. The menu of experiments and water quality improvement measures described in PacifiCorp's

(2014) Reservoir Management Plan fall far short of what would be needed to comply with California's water quality standards. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of techniques could be jointly implemented to actually meet water quality standards. The lack of such a plan is extremely revealing. There are no feasible means besides dam removal for mitigating the KHP's two most consequential water quality impacts: alteration of water temperature and promotion of toxic cyanobacterial blooms.

The Klamath Hydroelectric Project (KHP) has an overall negative effect on Klamath River water quality. These effects include increased water temperatures in late summer/fall, cyanotoxins, substrate armoring, and release of water from Iron Gate reservoir with high ammonia, low dissolved oxygen, and high pH; however, the KHP also has some potentially positive effects including reduced nitrogen concentrations and cooling water temperatures in spring. These positive and negative effects generally diminish with increasing distance downstream of Iron Gate (although due to bioaccumulation of cyanotoxins transported from the reservoirs, effects on public health and biota continue to the river mouth and potentially to the costal margin). The river immediately below Iron Gate is very important due to high spawning use by chinook salmon, so effects in that reach are of particular concern.

All negative water quality effects of the reservoirs can be eliminated by dam removal. Nitrogen concentrations would likely increase long-term following dam removal (due to loss of nutrient retention within the reservoirs and more rapid downstream transit of water), but this is not likely to deleteriously affect D.O. and pH because downstream periphyton (algae attached the riverbed) communities are comprised of nitrogen-fixing species that can flourish even when nitrogen concentration is low. Thus, the effects of increased nitrogen are not likely to be outweighed by other effects of dam removal that would favor lower periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

In this section we present a brief summary, including references, of the impacts of the Klamath Hydroelectric Project (KHP) on Klamath River water quality. For additional details, we refer to the following documents that Tribes have previously placed into the FERC record (KTOC 2006a, 2006b; QVIR 2006; QVIC 2006; Yurok Tribe 2006a, 2006b; HVT 2006a, 2006b; Resighini Rancheria 2006a, 2006b), as well as the references cited herein.

KHP Effects on Specific Aspects of Water Quality

Cyanobacteria and cyanobacterial toxins

► Microcystin toxins produced by the toxic cyanobacteria (blue-green algae) *Microcystis aeruginosa* represent a substantial threat to human and animal health (OEHHA 2005; Kann 2006; Kann and Corum 2006, 2007; OEHHA 2012). The Klamath River is listed as impaired by microcystin toxins from Stateline to its confluence with the Trinity River[1]. Microcystin concentrations generally decline with distance downstream of

[1] Final 2012 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml

Iron Gate Dam (US DOI and CDFG 2012) but frequently exceed public health guidelines between Iron Gate and Orleans, and occasionally exceed public health and water quality criteria as far downstream as the Klamath Estuary (HVTEPA 2013, YTEP Annual Blue-Green Monitoring Reports[2]). More recent genetic fingerprinting research showed that Iron Gate Reservoir is the source of downriver *Microcystis* assemblages and that Iron Gate Reservoir was determined to be the principal source of *Microcystis* found throughout the lower 300 km of river separating the reservoir from the Pacific Ocean (Otten et al. 2015).

► In the presence of abundant nutrients, the transformation from river to reservoir environment leads to massive blooms (Kann 2006; Kann and Corum 2006, 2007). Although nutrients are necessary for bloom proliferation, such concentrations alone are not sufficient to cause the magnitude of blooms observed in Copco and Iron Gate reservoirs. As a consequence, despite similar nutrient loads, *Microcystis* is uncommon in the free-flowing river reach above Copco.

► There are higher levels of microcystin toxin and *Microcystis* cell density below the Copco-Iron Gate reservoir complex than above the reservoirs (Kann and Asarian 2007; Kann and Corum 2006, 2007; CH2MHill 2008; Asarian and Kann 2011).

► PacifiCorp's KHP provides ideal habitat for *Microcystis* by transforming turbulent free-flowing river reaches into stagnant thermally-stratified impoundments that favor cyanobacterial proliferation. For example, US DOI and CDFG (2012) concluded: "Removal of the dams would eliminate the lacustrine environment that currently supports ideal growth conditions for toxin-producing nuisance algal species such as M. aeruginosa." and "Under a dam removal with KBRA implementation scenario, the production of algal toxins in Copco 1 and Iron Gate reservoirs would be eliminated. The algae producing these toxins do not grow in a free flowing river." In addition, as concluded by Otten et al. (2015), there was no evidence of endemic *Microcystis* populations in the flowing regions of the Klamath River, both upstream and downstream of Copco and Iron Gate Reservoirs, indicating that the river itself does not represent good cyanobacterial habitat.

► Samples collected in 2007 indicate microcystin bioaccumulation in freshwater mussels from the Klamath River below Iron Gate, and in yellow perch from Iron Gate and Copco Reservoirs. Concentrations of microcystin in the organisms indicated that consumption of such organisms would exceed established public health advisory values (Kann 2008, OEHHA 2008). In 2009, freshwater mussels collected from the Klamath River between Iron Gate Dam and the Yurok Reservation also showed microcystin levels above public health advisory values (Kann et al. 2010). Such bioaccumulation in the lower river occurred despite very low ambient microcystin concentrations indicating that even when ambient concentrations do not exceed public health guidelines that shellfish may be unsafe for consumption. Furthermore, as demonstrated in Monterey Bay, microcystin exported from upstream lakes can be bioaccumulated in marine animals (e.g., sea otters) that consume shellfish containing algal toxins (Miller et al. 2010). Although yet to be monitored for in the Klamath system there is great potential for algal toxin bioaccumulation in sea mammals, sea birds, and other biota in the estuary and near-coastal environment.

► Although only limited data are available regarding the concentrations of microcystin toxins in tissues of Klamath Basin salmonids, data from 2007 indicate microcystin

[2] Yurok Tribe Environmental Program: http://www.yuroktribe.org/departments/ytep/water_reports.htm

bioaccumulation in juvenile salmonids reared in Iron Gate hatchery (Kann 2008). In addition, trace concentrations of microcystin were found in Klamath River steelhead livers in 2005 (Fetcho 2006). Analysis of salmonid tissue samples collected by the Karuk Tribe also showed that Klamath River salmonids (chinook salmon and steelhead) were exposed to microcystin and that bioaccumulation in liver tissue occurred with concentrations in several fish livers exceeding public health guideline values (Kann et al. 2013). Although histopathological results were inconclusive, the measured toxins in livers point to the potential for recurring microcystin exposure and subsequent bioaccumulation of microcystins in Klamath River Salmonids

► Laboratory and field studies from elsewhere have demonstrated toxic effects of microcystin on salmonids (Andersen et al. 1993, Bury et al. 1997, Landsberg 2002) and other fish (Smith et al. 2008). Based on these studies, and the documented prevalence of microcystin the Klamath River, the potential clearly exists for sublethal (e.g., stress and disease) effects on salmonids from exposure to algal toxins.

► Other than dam removal, PacifiCorp has yet to demonstrate mitigations likely to effectively remedy the *Microcystis* problem. For example, Solar Bee circulators deployed in Copco Reservoir by PacifiCorp in 2008 did not appear to be effective at reducing microcystin concentrations (CH2MHill 2008), and a plastic curtain installed at the Iron Gate log boom did not prevent a pulse of *Microcystis* cells from moving downstream in September of 2008.

Temperature

Primarily due to the thermal mass of Iron Gate and Copco reservoirs, the KHP significantly alters water temperatures in the Klamath River (FERC 2007, PacifiCorp 2004, PacifiCorp 2005c) in ways that are detrimental to the various runs of anadromous fish in the Klamath River.

► The KHP causes warm temperatures in the fall, negatively impacting fall Chinook salmon spawning success and egg survival, and resulting in a delay in spawning run-timing of several weeks.

► The KHP cools the river in early spring, which depresses the growth and survival of juvenile salmonid during this critical life history stage because it keeps water temperature below the optimum growth temperatures for juvenile salmonids. The resulting smaller-sized Chinook salmon juveniles migrate downstream more slowly than would larger individuals (PFMC 1994) and are less likely to survive to maturity and to spawn (Nicholas and Hankin 1988). This increased transit time exposes them to prolonged stress, increasing their likelihood of becoming infected with parasites.

► PacifiCorp has acknowledged that adjustment in operation (e.g. using selective withdrawals, curtains, or flow augmentation) cannot effectively mitigate for these temperature impacts (PacifiCorp 2005a, 2005b; Scott 2005).

► The Klamath River TMDL requires that water released from Iron Gate and Copco Reservoirs cause "Zero temperature increase above natural temperatures"(NCRWQCB 2010). Dam removal is the only method that is likely to reverse these KHP impacts to water temperatures.

Nutrients

► By replacing a formerly free-flowing river with a series of reservoirs, peaking reaches, and bypass reaches, the KHP has greatly altered the hydrologic, physical, chemical, and biological processes of the Klamath River.
► To provide a range of estimates for how total phosphorus (TP) and total nitrogen (TN) concentrations at Iron Gate Dam might change under a dam removal scenario for the months of June through October, Asarian et al. (2010) compared relative retention rates in river reaches with results from a study of the Copco-Iron Gate Reservoir complex by Asarian et al. (2009). The results indicated that dam removal will result in only a very small increase in TP concentration in the Klamath River between Iron Gate and Turwar. TN concentrations will increase 37-42% at Iron Gate, with the magnitude of the increase diminishing with increasing distance downstream. The effect on TN is substantially diminished by Orleans and quite small at Turwar. The implications of this increase is discussed in the "Dissolved oxygen and pH" sub-section below.
► As PacifiCorp itself (2005d) has acknowledged, peaking and bypass operations inhibit the river's capacity to assimilate nutrients within the KHP area. Bypass operations also inhibit the decomposition of organic matter, passing on a greater oxygen demand to downstream river reaches. Due to insufficient data, such effects were not included in predictions of nutrient concentration by Asarian et al. (2010) cited above.

Dissolved oxygen and pH

► Photosynthesis and respiration by periphyton (algae attached the riverbed) and aquatic plants in the Klamath River can degrade dissolved oxygen and pH conditions, resulting water quality that is chronically stressful to fish (HVTEPA 2008, NCRWCB 2010, Asarian and Kann 2013).
► The KHP has a direct effect on D.O. and pH levels in the Klamath River immediately below Iron Gate Dam (FERC 2007). During the summer season the reservoir often releases water with high pH and low D.O. (Asarian and Kann 2013), which could harm salmonids in the vicinity of the dam. Phytoplankton blooms from KHP reservoirs tend to decrease daily minimum dissolved oxygen concentrations in the Klamath River, presumably by reducing light availability and rates of production from periphyton (Genzoli 2013, Genzoli and Hall, in review, Genzoli et al. 2015).
► The KHP dams interrupt the downstream transport of gravel, resulting in more coarse stream substrates (Biggs 2000). The Klamath Hydroelectric Project has had this effect on the Klamath River below Iron Gate Dam (FERC 2007). Larger substrate materials like cobble and boulder require higher flows to scour them than smaller substrates like gravel and sand. These coarse substrates are more stable, increasing the amount of periphyton and aquatic macrophytes than can grow (Biggs 2000, Anderson and Carpenter 1998), which in turn increases diel fluctuations in pH and D.O.
► Although nitrogen concentrations are predicted to increase in the mainstem Klamath River downstream of the dams following dam removal (Asarian et al. 2010), this is not likely to deleteriously affect D.O. and pH because periphyton communities are comprised of nitrogen-fixing species that can convert abundant atmospheric nitrogen into biologically available forms and flourish even when nitrogen concentrations are low (Asarian et al. 2014, Asarian et al. 2015, Gillett et al. 2016). Thus, increased nitrogen is not likely to increase periphyton biomass and would actually likely be outweighed by other effects of dam removal that would likely reduce periphyton biomass, such as a more dynamic flow regime and restored sediment transport.

Ammonia toxicity

► Data clearly show that ammonia concentrations are often substantially higher below Iron Gate Dam than above Copco Reservoir (Asarian et al. 2009, Kann and Asarian 2007, FERC 2007, Asarian and Kann 2011). These higher concentrations represent a localized toxicity risk to fish in the river below Iron Gate.

Fish parasites

The KHP promotes infection of salmonids by the myxosporean parasites *Ceratonova shasta* and *Parvicapsula minibicornis* in the Klamath River through:

► Providing habitat for the polychaete *M. speciosa* by:

- Increasing substrate stability below Iron Gate Dam (see "Dissolved oxygen and pH" sub-section above)(FERC 2007)
- Increasing the stability of the hydrograph below Iron Gate Dam by regulating flow of tributaries from Keno to Iron Gate Dam.

► Increasing salmon spawning density below Iron Gate Dam by blocking fish passage, delivering massive loads of myxospores in an area with high polychaete populations, which results in high infection prevalence of polychaetes in an area of salmon crowding (FERC 2007, Stocking 2006, Stocking and Bartholomew 2007).

► Deteriorating pH and D.O. conditions and increasing ammonia, which are conditions created by the KHP cause stress and immunosuppression in salmonids, increasing the likelihood that they will become infected and diseased (FERC 2007).

Evaluation of Pacificorp's Interim Measure 11 Studies and Reservoir Management Plan

With the stated goal to improving water quality within Copco and Iron Gate Reservoirs and the Klamath River downstream, PacifiCorp has conducted a series of activities under the Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measures 10 and 11 and developed a Reservoir Management Plan (RMP) and (PacifiCorp 2014). Although PacifiCorp correctly states that the source of nutrient enrichment for the reservoirs is the result of upstream nutrient and organic matter loads, they do not directly acknowledge that the dams create the lacustrine habit required for the large and toxic cyanobacteria blooms that currently dominate (see above discussion). The RMP then proposes to implement management techniques that are aimed at improving reservoir water quality conditions related to nutrients, algae, dissolved oxygen and pH[3].

However, despite the aim of the RMP and the statement that the RMP "will also help to improve water quality in the Klamath River below the Project reservoirs" and "The implemented techniques, particularly when combined with implementation of appropriate TMDLs to control and reduce nutrient loads upstream of the Project, are expected to provide appreciable and sustained water quality enhancements in and below Copco and Iron Gate reservoirs" (PacifiCorp 2015a), no data or evidence are provided for how the proposed techniques will reduce toxic cyanobacteria blooms to meet Clean Water Act and public health thresholds. Rather, for those techniques that relate to cyanobacteria reduction, the RMP references ongoing evaluation of the

[3] (1) constructed treatment wetlands; (2) reservoir and tailrace aeration and oxygenation systems; (3) epilimnion (surface water) mixing and circulation; (4) selective withdrawal and intake control; (5) reservoir drawdown and fluctuation; and (6) algaecide treatment.

techniques, many of which have not moved past the modelling phase (e.g., surface mixing and circulation and reservoir drawdown), and for those that have, some have been discounted (e.g., destratification, solar powered circulators, phosphorus inactivation), and others have only undergone small scale testing. Those in the latter category (chiefly application of algaecide and implementation of an intake barrier to reduce algal entrapment downriver), have either been shown to be completely ineffective (algaecide) or existing studies have yet to show improvement in downstream conditions (intake barrier). Moreover, PacifiCorp has not provided information on how any of the proposed projects would be scaled to the size necessary to improve water quality on a reservoir-wide basis (even assuming water quality could be improved on a small scale basis such as in an isolated cove), let alone what the cost of such full-scale implementation would be.

The water quality improvement measures described in the RMP fall far short of what would be needed to comply with California's water quality standards. The current RMP is really more a menu of options or a study plan than it is a management plan. The RMP described various techniques, including conceptual ideas for how the techniques could be applied in Iron Gate and Copco Reservoirs, but there are no details provided regarding at what scale the techniques would be applied, what capital and maintenance costs would be, and what expected water quality outcomes would be. Despite a decade of experimentation and study, PacifiCorp has yet to offer a specific plan for how a combination of the techniques could be jointly implemented to meet water quality standards. There are no feasible means besides dam removal for mitigating the KHP's two most consequential impacts to water quality: alteration of water temperature and promotion of toxic cyanobacterial blooms.

The various Klamath River Tribes (as well as other federal and state agencies) have been evaluating and commenting on the management techniques proposed in the RMP as part of PacifiCorp's Interim Measure 11 studies (which consist of testing, design, or modelling) to address water quality conditions (Table 1)[4]. Those comments support our statement above that none of the proposed RMP projects have been demonstrated to improve cyanobacterial related water quality violations or public health. In the following sub-sections, we provide an overview of the major components of PacifiCorp's Interim Measure 11 studies and the Reservoir Management Plan.

[4] The list in Table 1 may not be exhaustive and therefore we request that SWRCB contact the Klamath Basin Tribes and other members of the Interim Measures Implementation Committee to obtain other relevant documents.

Table 1. List of 1) PacifiCorp IM11 study plans, 2) Tribal comments on PacifiCorp's IM11 study plans and draft reports, and 3) PacifiCorp responses to Tribal comments. Check boxes on left side of table indicate which topics/approaches are addressed in each document. Documents are sorted by date. Some of the dates are approximate (i.e., within a month). All documents listed were organized into folders according to Document Type and uploaded to an online archive accessible at: https://www.dropbox.com/s/exc6fkhmaiz7sw3/IM11_docs.zip

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x	x	x	x	x		x	8/10/10	PacifiCorp IM11 study plan	PC Interim Measure 11 Plan - Draft.doc	Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11), preliminary draft
x	x	x	x	x			8/23/10	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plan_comments_2010 08 24.doc	Asarian, Eli. 2012. Comments regarding Klamath Hydroelectric Settlement Agreement Implementation: Proposed Activities Related to Interim Water Quality Improvements (Interim Measure 11). From: Eli Asarian, Kier Associates. Date: August 23, 2010.
x	x	x	x	x		x	10/18/10	PacifiCorp IM11 study plan	IM 11 Studies Cost Summary _Oct 18 2010_.pdf, IM 11 Study Plan Copco Algaecide _Oct 18 2010_.pdf, IM 11 Study Plan Iron Gate Intake _Oct 18 2010_.pdf, IM 11 Study Plan JC Boyle DO _Oct 18 2010_.pdf, IM 11 Study Plan Keno OM Removal _Oct 18 2010_.pdf, IM 11 Study Plan Treatment Wetlands _Oct 18 2010_.pdf, IM 11 Study Plan WQ Accounting _Oct 18 2010_.pdf	[final IM11 study plans for 2010, separate document for each study plan]
x			x	x			11/16/10	Tribal comment on PacifiCorp IM11 study plan	Yurok Comments on IM 11 Final Plans 111610.docx	Fetcho, Ken. Yurok Tribe Comments prepared with assistance from Eli Asarian on 3 Final Study Plans. Yurok Tribe, November 16, 2010.

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x			x	x		x	5/13/11	PacifiCorp's response to comments on IM11 study plan	IMIC_IM11 Comment_Table_5-13-2011.pdf	PacifiCorp. 2011. PacifiCorp Responses to IMIC Comments on Interim Measure 11 Study Plans.
							4/27/12	Tribal comment on PacifiCorp IM11 report	2012.04.27 Yurok_PC Comments Draft Wetland Rpt.pdf	Fetcho, Ken. 2012. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments on the draft document "Approaches to Water Quality Treatment by Wetlands in the Upper Klamath Basin". From: Ken Fetcho, Yurok Tribe. Date: April 27, 2012.
x	x	x	x	x		x	6/25/12	PacifiCorp IM11 study plan	IM11-WQStudyProgressRpts_June 2012.pdf	PacifiCorp. 2012. Klamath Hydroelectric Settlement Agreement Interim Water Quality Improvements (Interim Measure 11) Water Quality Study Progress Reports June 25, 2012
x		x		x			10/31/12	Tribal comment on PacifiCorp IM11 study plan	kier_imic_wq_study_plans_comments_20121031.doc	Asarian, Eli. 2012. Memo to Klamath Basin Tribal Water Quality Work Group. RE: Comments regarding Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies for 2012-2013. From: Eli Asarian, Kier Associates. Date: October 31, 2012. [note: header has incorrect date 9/31/2012]
x		x		x			12/31/12	PacifiCorp's response to comments on IM11 study plan	IM 11 Study Comment Response (Dec 31 2012) F.pdf	PacifiCorp. 2012. PacifiCorp Responses to Comments from IMIC Members on Interim Measure 11 Studies (Received October 29 to November 9, 2012).
x		x	x	x			2/28/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013 IM 11 022813.pdf	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe Comments and Recommendations for 2013 IM 11 Water Quality Studies. From: Ken Fetcho, Yurok Tribe. Date: February 28, 2013.
x		x	x	x			3/4/13	Tribal comment on PacifiCorp IM11 study plan and reports	Karuk IM 11 Comments_3.04.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies. From: Crystal Bowman, Karuk Tribe. Date: March 4, 2013.
x		x	x	x	x	x	5/9/13	Tribal comment on PacifiCorp IM11 study plan and reports	IMIC IM 11 2013 Project Comments Karuk Tribe 05.09.13.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Review and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Crystal Bowman, Karuk Tribe. Date: May 9, 2013.

In-reservoir		Nutrient Reduction				Other				
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x		x	x	x	x	x	5/10/13	Tribal comment on PacifiCorp IM11 study plan	Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf (and identical MS Word version: Yurok comments 2013-2014 IM 11 Study Plan 051013.pdf)	Fetcho, Ken. 2013. Comments letter to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014 . From: Ken Fetcho, Yurok Tribe. Date: May 10, 2013.
x		x		x			5/16/13	Tribal comment on PacifiCorp IM11 report	Karuk Comments_ IM 11 Project Reports 2012.pdf	Bowman, Crystal. 2013. Memo to Tim Hemstreet, PacifiCorp. RE: Comments of PacifiCorp 2012 Draft Reports. From: Crystal Bowman, Karuk Tribe. Date: May 16, 2013.
x		x		x			5/17/13	Tribal comment on PacifiCorp IM11 report	Yurok comments 2012 IM 11 Draft Reports 051713.pdf	Fetcho, Ken. 2013. Memo to Tim Hemstreet, PacifiCorp. Subject: Yurok Tribe comments and recommendations for Klamath Hydroelectric Settlement Agreement (KHSA) Interim Measure 11 water quality studies 2013-2014. From: Ken Fetcho, Yurok Tribe. Date: May 17, 2013.
x							9/6/13	PacifiCorp's response to comments on IM11 study plan	Activity 5 Karuk Comment Response (Sep 6 2013).pdf	PacifiCorp. 2013. Responses to Comments of the Karuk Tribe on the Implementation and Monitoring Plan for the 2013 Environmentally-Safe Algaecide Application in Long Gulch Cove, Iron Gate Reservoir September 6, 2013
					x		1/30/14	Tribal comment on PacifiCorp IM11 study plan	IMIC Karuk Comments_Activity 7 Bench Testing IM 11 Draft Study Plan 02.03.14.pdf	Bowman, Crystal. 2014. Memo to PacifiCorp and Interim Measures and Interim Conditions Committee. RE: Review and comment on Interim Measure 11 Study Activities for 2013-2014, Activity : Pilot Study of Nutrient Reduction Methods in Klamath Basin Waterbodies, Initial Testing Approach and Prodeedures (Review Draft). From: Crystal Bowman, Karuk Tribe. Date: January 30, 2014.
					x		3/12/14	PacifiCorp's response to comments on IM11 study plan	IM Activity 7 Comments Responses f _Mar 12 2014_.pdf	PacifiCorp. 2014. Table B-1. Responses to Comments on the Activity 7 Draft Study Plan. March 12, 2014.
		x					3/24/14	Tribal comment on PacifiCorp IM11 report	KHSA IM 11 Iron Gate Intake Comments_Karuk Tribe 3.24.14.pdf	Bowman, Crystal. 2014. Memo to Tim Hemstreet and Linda Prendergast, PacifiCorp. RE: Review and comment on Assessment of an Intake Barrier for Water Quality Control at Iron Gate Reservoir - 2013 Study Results (Draft). From: Crystal Bowman, Karuk Tribe. Date: March 24, 2014.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							5/6/14	Tribal comment on PacifiCorp IM11 report	Karuk_algaecide report comments_2013.docx	Corum, Susan. 2014. Karuk Tribe comments on: "2013 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Environmentally Safe Algaecide, Draft Technical Report, April 2014. Prepared for PacifiCorp by Watercourse Engineering Inc."
			x				5/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20140520_draft.doc	Asarian, Eli. 2014. Memo: to Klamath Basin Tribal Water Quality Work Group. RE: Review and comments on (Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: May 20, 2014
			x				10/20/14	Tribal comment on PacifiCorp IM11 report	Kier_IM11_Wetlands_20141021_draft.doc	Asarian, Eli. 2014. Memo to: Klamath Basin Tribal Water Quality Work Group. Review and comments on (Final Draft) Demonstration Wetland Facility Preliminary Research and Implementation Plan Klamath River, Oregon. From: Eli Asarian. Date: October, 2014 [note: header has incorrect date 5/13/2014]
				x			11/18/14	Tribal comment on PacifiCorp IM11 report	Karuk_IM11_OrgRemove_11.18.14.doc	Corum, Susan. 2014. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comments on (Draft) Conceptual Design Evaluation for Full-Scale Particulate Organic Matter Removal from Klamath River Source Water Using Stormwater Treatment Technology, 2013. From: Susan Corum, Karuk Tribe. Date: Nov 18, 2014.
				x			11/21/14	Tribal comment on PacifiCorp IM11 study plan	KHSA_IM11_AlgalRemoval_20150121.docx	Corum, Susan. 2014. Conceptual Proposal for Removal of Algae Near Outlet of Upper Klamath Lake and Evaluation of Options for Re-Use. November 21, 2014.
	x	x	x	x		x	2/5/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.studyplancomments.2015.020515.doc	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015. From: Susan Corum, Karuk Tribe. Date: February 5, 2015.
				x			2/23/15	Tribal comment on PacifiCorp IM11 study plan	Karuk.2015.7.8.Comments.022315.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 study plans 7 (Algae Biomatter Utilization) and 8 (Algae Harvesting/Processing Methods and Removal Rates). From: Susan Corum, Karuk Tribe. Date: February 23, 2015.

In-reservoir		Nutrient Reduction				Other			
Algaecides	Oxygenation/ Mixing	Iron Gate Outlet	Wetlands	Algae/OM remove	Chem. sequestration	KTAP	Approx. Date	Document Type	Document Filename(s)	Document Title and/or Citation
x							2/25/15	Tribal comment on PacifiCorp IM11 report	Karuk_2014_Algaecide Report_comments.pdf	Corum, Susan. 2015. Memo to: Pacificorp and Interim Measures Implementation Committee. Re: Review and comment on Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide. From: Susan Corum, Karuk Tribe. Date: February 25, 2015.
						x	4/9/15	PacifiCorp's response to comments on IM11 study plan	2014.04.16 Algaecide 2014 Comment Response.pdf	PacifiCorp. 2015. PacifiCorp Responses to Comments on the Draft Technical Report "Draft Technical Report - 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir Using Hydrogen Peroxide Based Algaecide". April 9, 2015.
	x	x	x	x		x	5/29/15	PacifiCorp IM11 study plan	IM 11 2015 WQ Study Plan F (May 29 2015).pdf	PacifiCorp. 2015. Study Plan Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2015, May 29, 2015.
		x					6/10/15	Tribal comment on PacifiCorp IM11 study plan	2015.06.10 Karuk Comments-IM11-Study Activity 5.pdf	Corum, Susan. 2015. Memo to: PacifiCorp and Interim Measures Implementation Committee. Re: Review and comment on Proposed IM11 Study Plan for 2015: Study Activity 5. From: Susan Corum, Karuk Tribe. Date: June 10, 2015.

Comments on components of PacifiCorp's Interim Measure 11 studies and Reservoir Management Plan

Reduce nutrient load delivered to KHP reservoirs

As part of implementing the KHSA and in cooperation with other interested parties, PacifiCorp has been evaluating methods for reducing the amount of nutrients delivered from Upper Klamath Basin down the Klamath River into the KHP reservoirs. Activities have included convening a water quality workshop to evaluate various technologies (Stillwater Sciences et al. 2012, 2013) as well as funding a series of technical investigations of the potential to reduce nutrient loads using treatment wetlands (Lyon et al. 2009; CH2M HILL 2012, 2014), chemical application (CH2M HILL 2015), removal of algal biomass near Link Dam using stormwater technology (hydrodynamic separators, Watercourse Engineering, Inc. 2013b, 2014b, 2014c,) or other methods (PacifiCorp 2015).

Reducing nutrient loads is an important endeavor and specific reductions are prescribed in Total Maximum Daily Loads (TMDLs) for Upper Klamath Lake (ODEQ 2002), the Lost River (ODEQ 2010), and the Klamath River (NCRWCB 2010, ODEQ 2010). PacifiCorp's assessments have provided useful information which could assist in informing future development of projects to reduce the nutrient loads coming from the Upper Klamath Basin. However, most of the assessments lack cost estimates for full-scale deployment, and the one study that did provide a cost estimate (organic matter removal near Link Dam, Watercourse Engineering Inc. 2014b) indicated the cost per units of phosphorus removed was quite high relative to other approaches previously considered in other assessments (Corum 2014b).

We are a long way from having the comprehensive strategy and sufficient resources that would be required to substantially reduce nutrient loads. Numerous scientific, economic, political, and cultural obstacles remain, but with intensive effort and substantial investment over several decades, it may be possible to obtain the major reductions in nutrient load called for in the TMDLs. Even if such reductions were eventually achieved, they would at best only reduce the magnitude of the harmful algal blooms within KHP reservoirs, not eliminate them. Given that, the project location is relatively low in the watershed, the reservoirs would continue to receive nutrients from the upper basin including its agricultural lands, and will continue to foster cyanobacterial blooms by creating lacustrine habitat required for the massive planktonic blooms of toxigenic cyanobacteria currently observed. Meeting water quality standards within Iron Gate and Copco Reservoirs will be exceedingly difficult as long as the reservoirs remain in place.

Algaecide control of cyanobacteria

PacifiCorp has been evaluating various algaecides as a potential tool to locally improve water quality conditions in high public use areas of its reservoirs since 2008 (Deas et al. 2009, 2012; Watercourse 2013a, 2014a, 2015). While PacifiCorp acknowledges that algaecide treatment is likely not economic or feasible for fully addressing algal concerns in Project Reservoirs (which alone implies that the technique will not allow the hydro project to be water quality compliant) they go on to state that preliminary study results indicate that algaecide can be successful in reducing algal concentration while also reducing microcystin concentrations (see PacifiCorp's 2014 Application for Water Quality Certification; KHSA Implementation Report p. 23). This statement is strongly overstated and inconsistent with results of the pilot algaecide studies on which the tribes have submitted extensive comments (PacifiCorp 2012, Bowman 2013, Fetcho 2013a, Corum 2014b, Corum 2015a). For example, in comments provided on PacifiCorp's Draft Technical Report: 2014 Localized Treatment of Long Gulch Cove in Iron Gate, we demonstrated that when consideration was given to the control dynamics and when actual concentrations were compared through the course if the experiment, it was apparent that the algaecide

treatment was ineffective at controlling the toxic blooms in Copco Cove in 2012 (Corum 2015a). Specifically, the surface level of microcystin was higher post-event compared to pretreatment, and microcystin levels remained well above public health guideline values. Similarly for 2013, two out of three Post-Event samples in the integrated September sample from the treated area increased and showed much higher microcystin than all samples from the non-treated area showing that the treatment was not effective at reducing microcystin toxin (Corum 2014b). Finally regarding the 2014 study results, we also noted that algaecide treatment had little to no effect on microcystin or even increased it some instances, and in some cases algal biomass (chlorophyll) increased after some algaecide treatments (Corum 2015). It is clear from the IM 11 algaecide studies that algaecide application was not effective at controlling cyanobacterial blooms and toxins (in fact toxins often increased) in a small cove area, let alone on any scale that would allow the project to meet water quality criteria and public health objectives either in the reservoirs or downstream in areas of concern to the Tribes.

Selective withdrawal from Iron Gate Reservoir

PacifiCorp has pilot tested several configurations of selective withdrawal systems designed to reduce the amount of water withdrawn from the surface of Iron Gate Reservoir where algae are concentrated, with the goal of reducing the amount of *Microcystis* and associated toxins entrained into the Klamath River downstream. The initial design was a cover on the intake tower which did not work because after the cover was installed, the hydraulics adjusted to the presence of the intake (Miao and Deas 2014). In 2014 and again in 2015, a geotextile curtain was deployed upstream of the intake (PacifiCorp 2015).The Tribes have submitted extensive comments (Bowman 2013, 2014; Fetcho 2013a, 2013b, 2013c; Corum 2015b) on this IM 11 measure, and data to date do not show that the barriers tested were able to prevent cyanobacterial entrainment and prevent downstream public health exceedances of cyanobacteria and toxins. While results of the latest 2015 study are not yet available, previous testing showed the various barriers to be ineffective or not assessable due to poor study design. For example, comparisons of conditions in the reservoir vs. in the river downstream were not made on the same parcel of water in either 2012 or in 2013, and results were also confounded by diel patterns in the algae, patterns which PacifiCorp did not incorporate in their comparisons (Bowman 2014). Although they may be informative, study results for the 2015 intake barrier experiment will not provide the means to assess barrier efficacy due to very low algal and toxin levels above the barrier. Such a test would need to be performed in a year when algal concentrations are high (as often occurs) in order to evaluate whether the intake barrier might reduce downstream entrainment of cyanobacteria and toxins. Moreover, even low levels of toxins from Iron Gate Reservoir are associated with bioaccumulation in Klamath River mussels downstream (Kann et al. 2010), so marginal reductions in the amount of Microcystis released from Iron Gate Reservoirs will not be sufficient to meet all beneficial uses downstream.

Mixing

PacifiCorp is current conducting modelling to determine whether mixing water within reservoir coves could reduce cyanobacterial blooms (PacifiCorp 2015). This technology is yet another example in which the goal is only to improve water quality in localized areas (e.g., reservoir coves), not to meet Clean Water Act and public health thresholds. Mixing could also potentially be used to destratify reservoirs rather than just coves (PacifiCorp 2014), but PacifiCorp has not

proposed to attempt this in Iron Gate and Copco Reservoirs. As noted in the RMP "PacifiCorp does not propose to conduct further evaluation of potential destratification of Copco and Iron Gate reservoirs under this RMP" (PacifiCorp 2014).

Oxygenation

It is conceptually possible to use mechanical oxygenation to increase oxygen levels enough to meet dissolved oxygen criteria (MEI 2007, PacifiCorp 2014); however, it would be quite expensive and would not solved the reservoirs' other water issues (e.g., promotion of cyanobacteria blooms and alteration of water temperature).

Upcoming Documents Relevant to Klamath River Water Quality

In this section, we provide a list of recent and upcoming documents relevant to Klamath River water quality that were not included in the Secretarial Determination EIS/EIR (US DOI and CDFG 2012), plus a few of the most relevant documents that were not included in the FERC (2007) EIS but were included in the Secretarial Determination EIS/EIR[5]. These and other relevant documents can be found on the websites for Karuk Tribe (http://www.karuk.us/index.php/departments/natural-resources/somes-bar-water-quality), Yurok Tribe (http://www.yuroktribe.org/departments/ytep/index.htm), and the Klamath Tribal Water Quality Consortium's website (http://klamathwaterquality.com/documents.html)

In addition, we would like to take this opportunity to inform SWRCB of some studies/analyses that are currently in progress and therefore are not cited in the Specific Documents listed below, which include: 1) Klamath Tribal Water Quality Consortium's analysis of continuous phycocyanin probe data, 2) Karuk Tribe's analysis of 2011-2015 harmful algal bloom (HAB) monitoring, 3) Karuk and Yurok Tribes' analysis of diel patterns in cyanobacteria and microcystin.

We also request that SWRCB obtain all documents within the following categories, which we do not list individually in the Specific Documents list:

- All public health HAB memos through 2015 (both weekly and seasonal summaries) from PacifiCorp, the Karuk Tribe, and the Yurok Tribe.
- All Tribal annual reports on KHSA monitoring (e.g., continuous YSI data and nutrients).

Specific Documents

Asarian, E. and J. Kann. 2011. Asarian, E. and J. Kann. 2011. Phytoplankton and Nutrient Dynamics in Iron Gate and Copco Reservoirs 2005-2010. Prepared by Kier Associates and Aquatic Ecosystem Sciences for the Klamath Basin Tribal Water Quality Work Group. 60p + appendices. http://www.klamathwaterquality.com/documents/asarian_kann_2011_CopIG_res_2005_2010_rpt.pdf

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[5] The Secretarial Determination EIS/EIR presents a quite comprehensive compilation of the water quality documents that were available at the time it was written, and including all the relevant documents cited there would overwhelm this list, which we intend to focus on the most recent information.

http://www.klamathwaterquality.com/documents/Klamath_2001_2011_sonde_rpt_20130502_final.pdf

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Karuk Tribe of California. 2011. Water Quality Assessment Report 2010. Karuk Tribe Department of Natural Resources, Orleans, CA. 23 p. http://www.klamathwaterquality.com/documents/Karuk_2011_WQ_Report_2010.pdf

Karuk Tribe of California. 2012. Water Quality Assessment Report 2012. Karuk Tribe Department of Natural Resources, Orleans, CA. 35 p. http://www.klamathwaterquality.com/documents/2012%20Karuk%20Water%20Quality%20Annual%20Report_FINAL.pdf

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Yurok Tribe Environmental Program. 2013. Draft 2012 Klamath River Continuous Water Quality Monitoring Summary Report. Prepared by Matthew Hanington. YTEP Water Division, Klamath, CA. 69 p.

Yurok Tribe Environmental Program. 2013. Final 2012 Klamath River Nutrient Summary Report. Prepared by Matthew Hanington and Kathleen Torso. YTEP Water Division, Klamath, CA. 56 p.

Karuk Tribe members and staff have unique knowledge of the Klamath River, fisheries, and water quality. The Karuk Tribe has conducted a number of studies related to water quality, cyanobacteria/cyanotoxins, and fisheries that are important to consider when preparing the Draft EIR. The Karuk Tribe will be directly affected by any changes to the operation of the KHP proposed by the State Water Board. Consistent with CEQA Guidelines section 15083 and the Karuk Tribe's Consultation Policy, we expect State Water Board staff to consult with Karuk Tribe members and staff during preparation of the Draft EIR.

Please contact Craig Tucker, ctucker@karuk.us, (916) 207-8294, with any questions regarding scheduling meetings with Tribal Council and staff regarding these comments.

Yootva,

Leaf G. Hillman
Director of Natural Resources and Environmental Policy

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