Klamath River Hydroelectric Settlement Agreement Interim Measure 15:

FINAL
2022 Water Quality Monitoring Study Plan

Prepared:

February 11, 2022

Table of Contents

List of Figures

List of Tables

Appendices

1. Introduction and Overview

On February 18, 2010, the United States, the States of California and Oregon, PacifiCorp, Native American tribes, and a number of other stakeholders signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA was subsequently amended and signed in April and November 2016; the amendments did not affect the interim measures. The KHSA lays out the process for transferring ownership of PacifiCorp's Klamath Hydroelectric Project to an independent dam removal entity (DRE) and then eventual decommissioning and removal of four dams on the Klamath River (i.e., J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams) by the DRE following approvals from the Federal Energy Regulatory Commission.

The KHSA includes provisions and detailed actions for the interim operation of the dams and mitigation activities prior to removal of the dams or the termination of KHSA. One of these measures titled: *Interim Measure 15 - Water Quality Monitoring* states that PacifiCorp shall fund ($500,000 per year) long-term baseline water quality monitoring to support water quality improvement activities, dam removal studies, permitting studies (as necessary), and form a long-term record to assess trends and other potential changes in the basin. This includes funding for cyanobacteria toxin monitoring, to protect public health. This plan addresses the thirteenth year of monitoring under Interim Measure 15 (hereafter referred to as IM 15). Since the goals and objectives of IM 15 remain the same and the sampling entities and locations are basically unchanged since monitoring began in 2009[1], this document provides a brief summary of the of IM 15 goals and objectives, sampling strategies, and any updates and/or changes to the sampling from previous plans. Detailed discussions on goals, objectives and the rationale for the parameters sampled can be found in the previous study plans, available on the Klamath Basin Monitoring Program (KBMP) website (http://www.kbmp.net under the Collaboration tab on the Home page). This website hosts all of the IM 15 study plans and results. These study plans are also available on the PacifiCorp Klamath Hydroelectric Project website under the water quality reports and data tab (https://www.pacificorp.com/energy/hydro/klamath-river.html).

This study plan outlines the parameters to be sampled, their frequency and location by sampling entity for the monitoring period from April through December 2022. The IM 15 monitoring program includes monitoring of the Klamath River mainstem (including reservoirs) from Upper Klamath Lake downstream through the estuary (Figure 1). The long-term baseline water quality monitoring includes 22 monitoring sites that have been sampled under this planning process since 2009, not including the two baseline sites near J.C. Boyle reservoir were dropped from sampling in 2017. The cyanobacteria and toxin monitoring includes 18 monitoring sites. Site coordinates for all sites regardless of program are presented in Appendix A.

The water quality parameters, locations, sampling frequency, and sampling methods for the 2022 IM 15 program represents consensus amongst the following participants: PacifiCorp, North Coast Regional Water Quality Control Board (NCRWQCB), Oregon

[1] Note that in 2009, sampling was done under an interim settlement agreement.

Department of Environmental Quality (ODEQ), Karuk Tribe, Yurok Tribe, U.S. Bureau of Reclamation (BOR), and the United States Environmental Protection Agency, Region 9 (EPA).

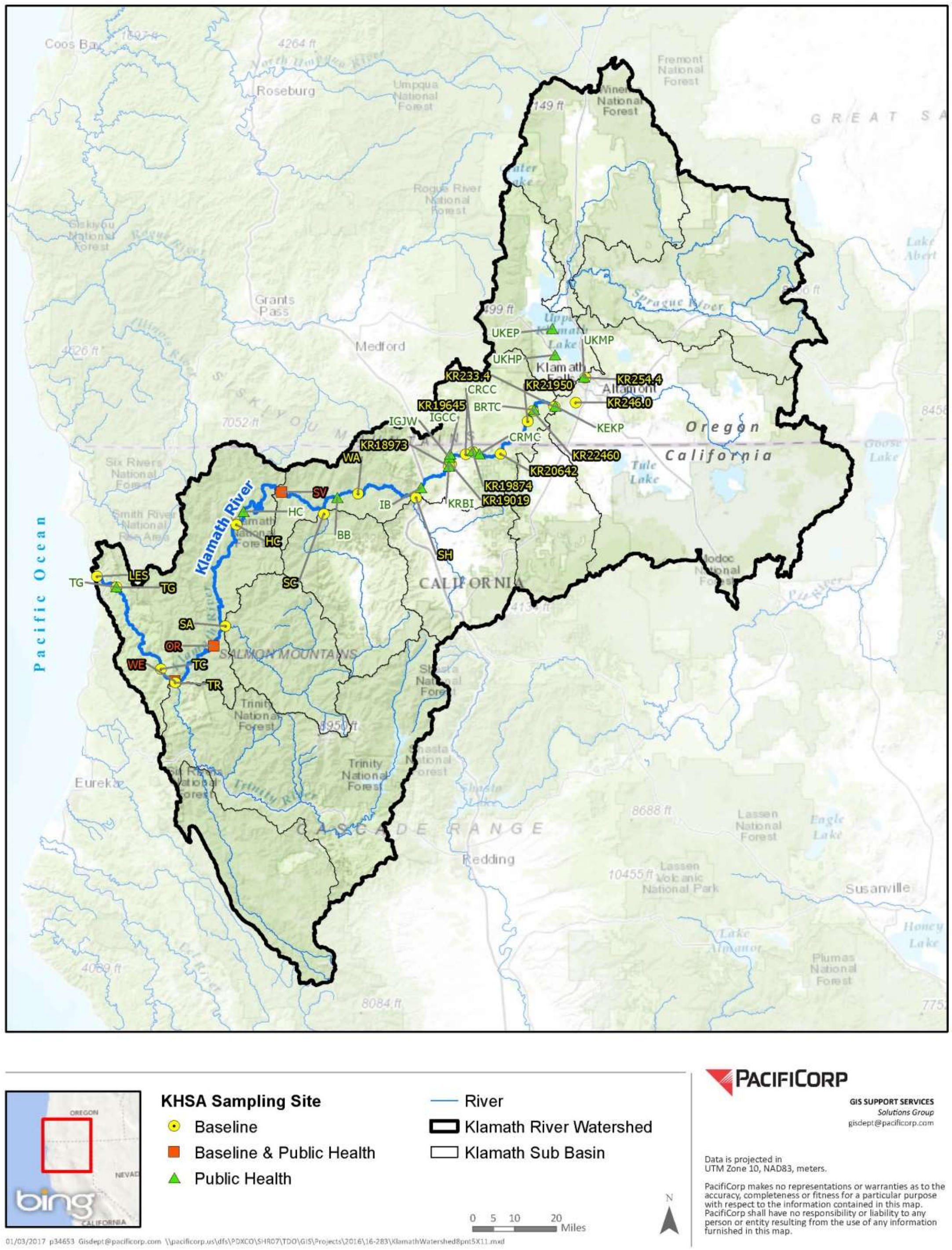

Figure 1. 2022 KHSA IM 15 monitoring stations

2. Objectives

The IM 15 monitoring objectives remain the same as previous years and include both public health monitoring for cyanobacteria and toxins and baseline monitoring. These key objectives are:

- Provide data on cyanobacteria-related toxins in a timely manner to support public health decisions.
- Support the science in the dam removal framework.
- Improve the current understanding of seasonal, annual, and long-term variations in a wide range of water quality parameters for Klamath River from Upper Klamath Lake to the estuary. A system-wide approach is necessary because influences from upstream sources extend downstream through the Klamath River.
- Support a long-term monitoring program that helps capture the effects of other activities in the system potentially affecting water quality in the Klamath River, including those related to: regulatory actions (e.g., Biological Opinions, Total Maximum Daily Load (TMDL) implementation, adjudications, etc.), climate change, wildfires, and land use activities, as well as other factors.
- Provide a long-term baseline data set of water quality conditions that can be readily extended to assess impacts of management actions and restoration processes, including:
    - Clearly identifying current conditions for a wide range of hydrology, meteorology, and water quality conditions.
    - Identifying and quantifying potential water quality changes, impacts, and implementation measures.
    - Determining progress towards restoration of the river system and evaluation of possible mitigation measures to minimize long term impacts or promote/accelerate recovery
- Collect data under a consistent Quality Assurance (QA) framework
- Disseminate water quality data in a timely fashion.

3. Monitoring Components

The 2022 IM 15 monitoring activities include public health and baseline monitoring components.

3.1 Public Health Monitoring of Cyanobacteria and Toxins

This monitoring component provides data to assess potential risks to public health from exposure to cyanobacteria and their toxins occurring in the Klamath River and is based on water column and/or shoreline water sampling within Upper Klamath Lake, Copco and Iron Gate reservoirs, and the Klamath River. A number of species of cyanobacteria have been documented in Upper Klamath Lake, the Klamath River, and reservoirs. The most abundant species include: *Aphanizomenon flos-aquae*, *Microcystis aeruginosa* (simply referred to as *Microcystis* in this document), *Dolichospermum* (formerly *Anabaena*) *flos-aquae*, *Gloeotrichia* sp., and *Oscillatoria* sp. Since 2004, Klamath River monitoring has documented elevated levels of toxin-producing cyanobacteria, primarily *Microcystis* and the toxin microcystin. Microcystins are a class of toxic chemicals produced by some strains of cyanobacteria, including *Microcystis*, that are released into waters during blooms and when cyanobacterial cells die, or cell membranes degrade. *Microcystis* blooms and microcystin concentrations at elevated levels can present risks to human health, and to terrestrial and aquatic species, and can result in impairments to a number of beneficial uses for the waterbody. Microcystins are capable of inducing skin rashes, sore throat, oral blistering, nausea, gastroenteritis, fever, and liver toxicity (WHO 2003; OEHHA 2012).

3.2 Baseline Water Quality Monitoring of the Klamath River

This program component is designed to characterize water quality conditions by monitoring for basic water quality parameters (temperature, dissolved oxygen (DO), pH, and conductance) as well as a suite of nutrients and other related indicators. Results from baseline monitoring will be used to support water quality improvement activities, dam removal studies, permitting studies (as necessary), and ultimately form a long-term record to assess trends and other potential changes in basin water quality.

4. Quality Assurance, Data Management, and Dissemination

4.1 KHSA Program Quality Assurance Strategy for 2022

Similar to previous years, the IM 15 sampling entities have developed common sample collection methods, addressed the use of different laboratories, and refined data management and dissemination strategies.

4.1.1 Quality Assurance

Quality Assurance (QA) requirements have been evaluated, compared and documented through the *2010 Klamath River Baseline Sampling Program QA Comparison* (on the KBMP website), which compares the existing QA plans and standard operating procedures of participating entities. In contracts with the analysis laboratories (labs), each reach monitoring entity includes requirements for a minimum level of laboratory QA procedures.

Water samples for public health monitoring are collected in accordance with the Standard Operating Procedures (SOP), *Environmental Sampling of Cyanobacteria for cell enumeration, identification and toxin analysis* (Cyanobacteria SOP; KBGAWG 2009). This Cyanobacteria SOP, developed for the Klamath River by the Klamath Blue-Green Algae Workgroup, is posted on the KBMP website.

Participants in the KHSA monitoring use common labs where possible and practical; however, there are instances where different labs are being used. The analysis of water quality samples by multiple labs requires additional QA procedures to enable comparisons of performance by participating labs. In previous years, to support such a comparison, a number of nutrient samples (described in the QA requirements) were divided into splits and those splits sent to each of the labs doing nutrient analyses and the results were formally compared to each other. The lab comparison memoranda prepared for 2009 through 2015 are available on the KBMP and PacifiCorp websites. Based on the 7 years of lab comparisons with samples from upper, middle, and lower Klamath River regions, the program was discontinued in 2016 by mutual agreement and has not been re-instated.

4.1.2 Data Management and Dissemination

Lab results for grab-samples collected as part of the long-term baseline and public health monitoring programs are provided to California Environmental Data Exchange Network (CEDEN). At this time CEDEN does not support time-series data (e.g., water temperature data collected by data sondes) or algae species data. Recently there has been a delay in getting data uploaded to CEDEN in a timely manner; this upload process is outside of the control of anyone involved in the IM15 program. Final reports and all data sets are posted on both the KBMP (www.kbmp.net) and PacifiCorp web sites (https://www.pacificorp.com/energy/hydro/klamath-river.html).

Public Health Sampling. Public health monitoring of algal toxins requires prompt and effective communication of data to the local and state agencies to support management decisions regarding the need to post waterbodies with informational signage or issue site-specific health advisories. Thus, results from toxin analyses are forwarded promptly to the appropriate local and state water quality and public health agencies (e.g., primarily Oregon Health Authority and NCRWQCB). For public health cyanobacteria toxin level analyses, each sampling entity (PacifiCorp, Karuk Tribe, and Yurok Tribe) is responsible for producing a memorandum about every two sampling events with the most recent analytical results and distributing that memorandum to regulatory agencies and interested parties, including KBMP. Results from ODEQ sampling will be included in the public health memoranda prepared by PacifiCorp. All lab results for microcystin will be included in these public health memoranda regardless of the source of the sampling (baseline or public health sampling programs). To facilitate timely management decisions regarding postings in California and Oregon, PacifiCorp will provide a sample list spreadsheet within a week of sampling that allows a complete crosswalk table between collected samples and locations. This preserves the integrity of the laboratory analysis process by keeping the lab blind to the sample locations while allowing rapid identification of sites when laboratory results are available.

Public health memoranda prepared by PacifiCorp are posted on the PacifiCorp and KBMP websites and those from other participating sampling organizations (Karuk Tribe and Yurok Tribe) are posted on the KBMP site. An interactive map of algae bloom conditions is also available on the KBMP website and is maintained by KBMP staff. A final summary of all public health sampling will be included in the annual program report (see below).

Baseline Sampling. There are no changes made to the baseline nutrient and phytoplankton sampling in 2022. The frequency for each location is presented in Appendix B below. A single annual report and associated data file will be created that contains the final data from both the public health and baseline monitoring components. This water quality monitoring report and associated data file will document the year's results for both monitoring components. The final report and data file will be posted on the PacifiCorp and KBMP websites.

5. Sampling Constituents and Frequency

The 2022 sampling locations for public health monitoring are listed in Table 1 and the sampling constituents and frequency can be found in Table 2. Baseline monitoring is summarized in Appendix B where the sampling entity, the parameters sampled, and the sampling frequency are listed by location. Changes in sampling patterns (constituents, frequency, etc.) for the 2022 program are discussed below (Section 5.3).

5.1 Public Health Monitoring of Cyanobacteria Related Toxins

Decisions about whether to post and issue public health notifications related to cyanobacteria and possible toxin exposure will be evaluated through toxin analysis and the observation of scums formed by aggregations of cyanobacteria.

5.1.1 Locations

Public health monitoring for microcystin toxin in water samples will occur during 2022 at a total of 18 designated locations used for public access and recreation (Table 1). These include:

- Three sites are in Upper Klamath Lake (Eagle Ridge County Park, Howard's Bay Park, and Moore Park) that allow monitoring of conditions within the lake and in the discharge from the lake into Lake Ewauna and Keno Reservoir.
- Two sites on the Klamath River upstream of J.C. Boyle Dam. One is in J.C. Boyle Reservoir at Topsy Campground and another site is in Keno Reservoir at Keno Park.
- Four shoreline sites in coves on Copco (Mallard Cove and Copco Cove) and Iron Gate reservoirs (Camp Creek and Jay Williams Boat Ramp). These cove sites provide public access, are known areas of accumulation during blooms, and have been monitored since 2005.
- Eight river sites from downstream of Iron Gate dam (river mile (RM) 189.7) to Turwar (RM 6.0). Most of these sites have been monitored since 2005, and all represent points of public access.
- One site in the Klamath River estuary, Klamath River at South Slough (KRSS), because this is an important public access and use area with a history of cyanobacteria blooms.

5.1.2 Sampling Frequency

Sampling for public health monitoring under this plan will occur at each of the identified sites as listed in Table 2.

Upper Klamath Lake and Keno, J.C. Boyle, Copco, and Iron Gate reservoirs
Public health sampling in Upper Klamath Lake and Keno, J.C. Boyle, Copco, and Iron Gate reservoirs will begin in May. Samples will continue to be sent to EPA for microcystin analysis once in May, and twice a month from June through November. Public health memos will include the microcystin toxin data as it is received from the EPA lab. Monitoring data from previous annual public health sampling efforts (2005-2021) indicates that microcystin levels in non-river samples (Iron Gate and Copco

reservoirs and Upper Klamath Lake) typically remain elevated until cooler weather and shorter days terminate the blooms.

Table 1. 2022 Klamath River sampling sites for public health monitoring of cyanobacteria and cyanotoxins in surface water samples, approximate river mile, and sampling entity.

Site ID	Location	River Mile	Sampling Entity
UKEP	Upper Klamath Lake at Eagle Ridge County Park (Public Health)	N/A	ODEQ
UKHP	Upper Klamath Lake at Howard's Bay Park (Public Health)	N/A	ODEQ
UKMP	Upper Klamath Lake at Moore Park (Public Health)	N/A	ODEQ
KEKP	Keno Reservoir at Keno Park (Public Health)	234.0	ODEQ
BRTC	J.C. Boyle Reservoir at Topsy Campground (Public Health)	225.0	ODEQ
CRMC	Copco Reservoir at Mallard Cove (Public Health)	200.8	PacifiCorp
CRCC	Copco Reservoir at Copco Cove (Public Health)	198.5	PacifiCorp
IGCC	Iron Gate Reservoir at Camp Creek (Public Health)	192.8	PacifiCorp
IGJW	Iron Gate Reservoir at Jay Williams Boat Ramp (Public Health)	192.4	PacifiCorp
KRBI	Klamath River below Iron Gate Dam (RM 189.73; Public Health)	189.73	PacifiCorp
KRIB	Klamath River at I-5 Rest Area (RM 179.20; Public Health)	179.20	Karuk
KRBB	Klamath River at Brown Bear River Access (RM 150.00; Public Health)	150.00	Karuk
KRSV	Klamath River below Seiad (RM 128.5; Public Health)	128.5	Karuk
KRHC	Klamath River below Happy Camp (RM 101.3; Public Health)	101.3	Karuk
KROR	Klamath River at Orleans (USGS) (RM 59.1; Public Health)	59.1	Karuk
KRWE	Klamath River at Weitchpec (RM 43.5; Public Health)	43.5	Yurok
KRTG	Klamath River near Klamath (RM 6.0; Public Health)	6.0	Yurok
KRSS	Klamath River at South Slough (RM 0.1; Public Health)	0.1	Yurok

Samples will be collected and submitted for analysis of total microcystins by Enzyme-Linked ImmunoSorbent Assay (ELISA) (Table 2). This data will then be provided to regulatory agencies (e.g., NCRWQCB and Oregon Health Authority) to inform whether criteria have been met to warrant the issuing of a public health advisory for a specific water body or river reach and to provide the necessary information and data to lift public health advisories once in place.

In reservoir samples analyzed to date, anatoxin-a has only been infrequently found. Regardless, screening tests will be run on all public health samples from within Copco and Iron Gate reservoirs. Specific screening tests will use Abraxis anatoxin-a test strips (Product no. 520042 or 520043). Following the manufacturer's methods, test strips will be exposed to public health samples and results will be photo documented. Positive results will be indicated by the complete absence of the test line on the anatoxin-a test strip. This qualitative result is approximately equivalent to 2.5 micrograms per liter (µg/L). Positive screening results would result in immediate quantitative analysis of that sample via Liquid Chromatography - tandem Mass Spectrometry (LC/MS/MS). PacifiCorp has budgeted for analysis of up to four samples for anatoxin-a during the sampling year. Quantitative tests for anatoxin-a will have a minimum detection limit of 1 µg/L or less and include analysis for related compounds (i.e., homoanatoxin-a, epoxyanatoxin-a, and dihydroanatoxin-a).

Klamath River downstream of Iron Gate Dam
Microcystin analysis (via ELISA) at each of the nine sites downstream of Iron Gate Dam will be used from June through October (10 samples per site) to track cyanobacterial bloom conditions in the Klamath River downstream of Iron Gate Dam (Table 2). Ten water samples will be collected at the I-5 Rest Area site (Table 2) for anatoxin-a analysis by LC/MS/MS on a bimonthly basis from June through October. Samples collected at the South Slough site (Table 2) also will be analyzed for anatoxin-a by LC/MS/MS on a monthly basis from July through October.

5.1.3. Sampling Procedures

Under the IM 15 monitoring program, water samples will be collected for toxin analysis by one of two methods:

- ELISA for total microcystins, analyzed by the EPA Region 9 lab, in accordance with the U.S. EPA Region 9 Laboratory Standard Operating Procedure (SOP 1305 for Microcystin analysis by ELISA).
- Liquid Chromatography - tandem Mass Spectrometry (LC/MS/MS) for anatoxin-a analysis (per Mekebri et. al., 2009).

Sample collection and preservation will be conducted in accordance with the Cyanobacteria SOP (KBGAWG 2009).

5.2 Comprehensive Baseline Water Quality Monitoring of the Klamath River

5.2.1 Locations

Baseline monitoring will occur at 22 sites; 18 sites on the Klamath River from Link River Dam to the estuary; and 4 sites at the mouths of each of 4 major tributaries. The baseline water quality monitoring locations, constituents, and sampling frequency are presented in Appendix B.

5.2.2 Sampling Constituents and Frequency

The baseline monitoring will begin in April 2022 and continue through December 2022 (Appendix B).

Data Collection Using Sondes. For each of the following parameters, capturing sub-daily variability is important to understanding the dynamics present in the system. Continuous monitoring devices, with probes for the following parameters, at a minimum, will be deployed during the period May to November.

- Temperature
- Dissolved Oxygen
- pH
- Conductance

Table 2. Klamath River IM 15 Monitoring Program 2022 – Public health monitoring locations, constituents, method, and frequency.

Site ID	Location	Phyto-plankton Species	Microcystin - EPA	LC/MS/MS for Anatoxin-a	Sampling Entity
UKEP	Upper Klamath Lake at Eagle Ridge County Park	-	BM7-mod	-	ODEQ
UKHP	Upper Klamath Lake at Howard's Bay Park	-	BM7-mod	-	ODEQ
UKMP	Upper Klamath Lake at Moore Park	-	BM7-mod	-	ODEQ
KEKP	Keno Reservoir at Keno Park	-	BM7-mod	-	ODEQ
BRTC	J.C. Boyle Reservoir at Topsy Campground	-	BM7-mod	-	ODEQ
CRMC	Copco Reservoir at Mallard Cove	-	BM7-mod	S	PacifiCorp
CRCC	Copco Reservoir at Copco Cove	-	BM7-mod	S	PacifiCorp
IRCC	Iron Gate Reservoir at Camp Creek	-	BM7-mod	S	PacifiCorp
IRJW	Iron Gate Reservoir at Jay Williams Boat Ramp	-	BM7-mod	S	PacifiCorp
KRBI	Klamath River below Iron Gate Dam (Hatchery Bridge)	-	BM7-mod	-	PacifiCorp
KRIB	Klamath River at I-5 Rest Area (RM 179.20)	-	BM5	BM5	Karuk
KRBB	Klamath River at Brown Bear River Access (RM 150.00)	-	BM5	-	Karuk
KRSV	Klamath River below Seiad (RM 128.5)	-	BM5	-	Karuk
KRHC	Klamath River below Happy Camp (RM 101.3)	-	BM5	-	Karuk
KROR	Klamath River at Orleans (USGS) (RM 59.1)	-	BM5	-	Karuk
KRWE	Klamath River at Weitchpec (RM 43.5)	-	BM5	-	Yurok
KRTG	Klamath River near Klamath (RM 6.0)	-	BM5	-	Yurok
KRSS	Klamath River at South Slough (RM 0.1)	-	BM5	S2	Yurok

Frequency	# of sample events	Sampling frequency description
-	0	Not Sampled
BM7-mod	13	Monthly sampling in May and at least bimonthly sampling June - November
BM5	10	Bimonthly sampling June - October
S	4	Analysis for anatoxin-a will be tied to positive results from screening tests using Abraxis test strips, however; four test analysis are budgeted.
S2	4	Monthly sampling from July - October

Sample-based Data Collection. Sampling locations and frequency for all baseline monitoring are detailed in Appendix B. The following parameters will be sampled during 2022 at least monthly, with a few exceptions.

- Inorganic/Organic Nitrogen (ammonia, nitrate, nitrite, organic nitrogen) and Total Nitrogen
- Inorganic/Organic Phosphorus (orthophosphate, organic phosphorus)
- Particulate and Dissolved Carbon
- Total Suspended Solids (TSS)
- Alkalinity
- Chlorophyll-*a*/pheophytin
- Microcystin
- Phytoplankton
- Particulate and Dissolved Organic Carbon
- Particulate Nitrogen
- Particulate Phosphorous and Particulate Inorganic Phosphorus
- Dissolved Organic Nitrogen and Phosphorus
- Turbidity

Most of the parameters listed above have been part of the baseline monitoring program since 2009. Slight modifications have been made through the years (e.g. particulate and dissolved organic carbon, particulate nitrogen, and turbidity were added to the parameters sampled in 2012). Physical parameters for temperature, dissolved oxygen, pH, and conductance are collected with a hand-held sonde coincidentally with grab sample collection at each location.

5.3 Program Changes and Updates

This sampling program has been in place since 2009. The 2016 study plan presented a review of changes to the sampling plan that had not been captured in previous study plans. The reader is referred to that study plan for documentation of past changes. Changes made to the sampling programs and implemented in 2017 and 2019 are discussed in the 2017 and 2019 study plans respectively. These changes were necessary to reduce program costs and bring the program back to the budget set in IM 15, though funds from IM 11 were also diverted to allow the IM 15 sampling program to continue.

Due to multiple years of program costs exceeding the IM 15 budget, additional changes were necessary to reduce program costs for the 2021sampling program. Program changes were determined with input from the Interim Measures Implementation Committee (IMIC) Water Quality Group to bring the program costs back to the $500,000 available IM 15 budget. The final program changes reduced overall costs while retaining the integrity of the sampling program; these are discussed in detail in the 2021 final study plan.

No changes were made to the 2022 study plan. All constituents, locations, and frequencies of sampling remain the same as in 2021.

6.0 References

KBGAWG (Klamath Blue Green Algae Working Group). 2009. Cyanobacteria Sampling SOP, Standard Operating Procedures Environmental Sampling of Cyanobacteria for Cell Enumeration, Identification and Toxin Analysis; Developed for the 2009 AIP Interim Measure 12, Water Quality Monitoring Activities, Klamath River, V6, June 24, 2009

Mekebri, A., G.J. Blondina, and D.B. Crane. 2009. Method validation of microcystins in water and tissue by enhanced liquid chromatography tandem mass spectrometry. Journal of Chromatography A. 1216 (2009) 3147-3155.

OEHHA (California Office of Environmental Health Hazard Assessment) 2012. Toxicological Summary and Suggested Action Levels to Reduce Potential Adverse Effects of Six Cyanotoxins. Final Report-May 2012. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California 95812-4010

WHO (World Health Organization). 2003. Cyanobacterial Toxins: Microcystin-LR in Drinking Water. Background document for the development of WHO Guidelines for Drinking-Water Quality. World Health Organization. Geneva.

Appendix A

2022 KHSA Interim Measure 15 Site Coordinates

Appendix A

Site ID, Location, and longitude and lattitude information for both 2022 baseline and public health program sampling sites.

Program	SiteID	Location	Longitude	Latitude	Coordinate System
Baseline	KR25444	Link Dam (RM 254.44; Baseline)	42.233611	-121.8025	WGS84
Baseline	KR24600	Keno Reservoir at Miller Island (RM 246.0; Baseline)	42.148107	-121.848646	WGS84
Baseline	KR23340	Klamath River below Keno Dam near a USGS gage (RM 233.4; Baseline)	42.134525	-121.948071	WGS84
Dropped	KR22822	Klamath River above J.C. Boyle Reservoir (RM 228.22; Baseline)	42.149770757	-122.014881282	NAD83
Dropped	KR22478	J.C. Boyle Reservoir (RM 224.78; Baseline)	42.122204454	-122.047292577	NAD83
Baseline	KR22460	Klamath River below J.C. Boyle Dam (RM 224.60; Baseline)	42.121216272	-122.049258541	NAD83
Baseline	KR21950	Klamath River below USGS Gage (RM 219.50; Baseline)	42.084779584	-122.073102465	NAD83
Baseline	KR20642	Klamath River above Shovel Creek (RM 206.42; Baseline)	41.972428556	-122.201586816	NAD83
Baseline	KR19874	Copco Reservoir (RM 198.74; Baseline)	41.980385184	-122.331208998	NAD83
Baseline	KR19645	Klamath River below Copco Dam (RM 196.45; Baseline)b	41.972889774	-122.364389084	NAD83
Baseline	KR19019	Iron Gate Reservoir (RM 190.19; Baseline)	41.938214229	-122.432227627	NAD83
Baseline	KR18973	Klamath River below Iron Gate Dam (RM 189.73; Baseline)	41.930994108	-122.442067789	NAD83
Baseline	KR15626	Klamath River at Walker Bridge (RM 156.26; Baseline, WA)	41.837411	-122.864806	WGS84
Baseline	KR12850	Klamath River below Seiad (RM 128.5; Baseline, SV)	41.842331	-123.220106	WGS84
Baseline	KR10130	Klamath River below Happy Camp (RM 101.3; Baseline, HC)	41.729654	-123.429207	WGS84
Baseline	KR05910	Klamath River at Orleans (USGS) (RM 59.1; Baseline, OR)	41.307133	-123.5311	WGS84
Baseline	KR04350	Klamath River at Weitchpec (RM 43.5; Baseline, WE)	41.18575	-123.708525	WGS84
Baseline	KR03850	Klamath River below Trinity River (RM 38.5; Baseline, TC)	41.226617	-123.772406	WGS84
Baseline	KR00600	Klamath River near Klamath (RM 6.0; Baseline, TG)	41.515966	-124.000613	WGS84
Baseline	KR00050	Klamath River Estuary (RM 0.5; Baseline, LES)	41.545308	-124.072956	WGS84
Baseline	SH00000	Shasta River near mouth (Baseline, SH)	41.823	-122.595	WGS84
Baseline	SC00000	Scott River near mouth (Baseline, SC)	41.766631	-123.024386	WGS84
Baseline	SA00000	Salmon River near mouth (Baseline, SA)	41.377331	-123.477297	WGS84
Baseline	TR00000	Trinity River near mouth (Baseline, TR)	41.184619	-123.70663	WGS84
Public Health	UKEP	Upper Klamath Lake at Eagle Ridge County Park (Public Health)	42.40558889	-121.95338	WGS84
Public Health	UKHP	Upper Klamath Lake at Howard's Bay Park (Public Health)	42.31438333	-121.94229	WGS84
Public Health	UKMP	Upper Klamath Lake at Moore Park (Public Health)	42.23552778	-121.80812	WGS84
Public Health	KEKP	Keno Reservoir at Keno Park (Public Health)	42.13561389	-121.94249	WGS84
Public Health	BRTC	J.C. Boyle Reservoir at Topsy Campground (Public Health)	42.12443056	-122.04301	WGS84
Public Health	CRMC	Copco Reservoir at Mallard Cove (Public Health)	41.98350777	-122.330997237	NAD83
Public Health	CRCC	Copco Reservoir at Copco Cove (Public Health)	41.97399725	-122.299017388	NAD83
Public Health	IGCC	Iron Gate Reservoir at Camp Creek (Public Health)	41.96218147	-122.440236014	NAD83
Public Health	IGJW	Iron Gate Reservoir at Jay Williams Boat Ramp (Public Health)	41.97265938	-122.436119002	NAD83
Public Health	KRBI	Klamath River below Iron Gate Dam (RM 189.73; Public Health)	41.93099411	-122.442067789	NAD83
Public Health	KRIB	Klamath River at I-5 Rest Area (RM 179.20; Public Health)	41.856947	-122.57085	WGS84
Public Health	KRBB	Klamath River at Brown Bear River Access (RM 150.00; Public Health)	41.823067	-122.961967	WGS84
Public Health	KRSV	Klamath River below Seiad (RM 128.5; Public Health)	41.842331	-123.220106	WGS84
Public Health	KRHC	Klamath River below Happy Camp (RM 101.3; Public Health)	41.729654	-123.429207	WGS84
Public Health	KROR	Klamath River at Orleans (USGS) (RM 59.1; Public Health)	41.307133	-123.5311	WGS84
Public Health	KRWE	Klamath River at Weitchpec (RM 43.5; Public Health)	41.18575	-123.708525	WGS84
Public Health	KRTG	Klamath River near Klamath (RM 6.0; Public Health)	41.515966	-124.000613	WGS84
Public Health	KRSS	Klamath River at South Slough (RM 0.1; Public Health)	41.53649	-124.07645	WGS84

Appendix B

2022 KHSA Interim Measure 15 Baseline Water Quality Monitoring Table

Appendix B

2022 KHSA Interim Measure 15 baseline water quality monitoring sites and constituents.

Location	Temperature (°C)	Dissolved Oxygen (mg/l)	pH (log[H+])	Conductance (µS/cm)	Total N (mg/l)	Ammonia N (mg/l)	Nitrite+Nitrate (mg/l)	Total P (mg/L)	Ortho P (mg/L)	Particulate P and Particulate Inorganic P (mg/l)	Dissolved Organic N & P (mg/l)	Particulate and Dissolved C (mg/l)	Particulate N (mg/l)	TSS (mg/l)	Alkalinity (mg/l)	Water Column Chl_a/Pheo	Phytoplankton Species	Microcystin (µg/l)	LCMS Anatoxin-a	Turbidity (NTU)	Sampling Entity
Sampling Method:	*T,P*	*P*	*P*	*P*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	
Link Dam (RM 254.44; Baseline)	H	H	H	H	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	A1/BM	BM/S	-	A1/BM2	**PacifiCorp**
Keno Reservoir at Miller Island (RM 246.0; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	A1	M/S	M/S	-	A1	**PacifiCorp**
Klamath River below Keno Dam near a USGS gage (RM 233.4; Baseline)	H	D	D	D	A1/BM2	A1/BM2	A1/BM2	A1/BM2	A1/BM2	A1	-	A1	A1	A1	A1/BM2	A1	M/S	M/S	-	A1/BM2	**PacifiCorp**
Klamath River above J.C. Boyle Reservoir (RM 228.22; Baseline)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Dropped**
J.C. Boyle Reservoir (RM 224.78; Baseline)[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Dropped**
Klamath River below J.C. Boyle Dam (RM 224.60; Baseline)	H	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	A1	M/S	M/S	-	-	**PacifiCorp**
Klamath River below USGS Gage (RM 219.50; Baseline)	H	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	A1	M/S	M/S	-	A1	**PacifiCorp**
Klamath River above Shovel Creek (RM 206.42; Baseline)	H	D	D	D	A1/BM2	A1/BM2	A1/BM2	A1/BM2	A1/BM2	A1	-	A1	A1	A1	A1	A1	M/S	M/S	-	A1	**PacifiCorp**
Copco Reservoir (RM 198.74; Baseline)	VP	VP	VP	VP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**PacifiCorp**
Copco Res 0.5 m from Surface					A1	A1	A1	A1	A1	-	-	A1	-	A1	-	A1	M/S	M/S	-	-	**PacifiCorp**
Copco Res Thermocline					A1	A1	A1	A1	A1	-	-	A1	-	A1	-	A1	-	-	-	-	**PacifiCorp**
Copco Res 1 m from Bottom					A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	-	-	-	-	-	**PacifiCorp**
Copco Res 0-8 m Integrated					-	-	-	-	-	-	-	-	-	-	-	A1	M/S	M/S	-	-	**PacifiCorp**
Klamath River below Copco Dam (RM 196.45; Baseline)[b]	H	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	A1	M/S	M/S	-	-	**PacifiCorp**
Iron Gate Reservoir (RM 190.19; Baseline)	VP	VP	VP	VP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**PacifiCorp**
Iron Gate Res 0.5 m from Surface					A1	A1	A1	A1	A1	-	-	A1	-	A1	-	A1	M/S	M/S	-	-	**PacifiCorp**
Iron Gate Res Thermocline					A1	A1	A1	A1	A1	-	-	A1	-	A1	-	A1	-	-	-	-	**PacifiCorp**
Iron Gate Res 1 m from Bottom					A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	-	-	-	-	-	**PacifiCorp**
Iron Gate Res 0-8 m Integrated					-	-	-	-	-	-	-	-	-	-	-	A1	M/S	M/S	-	-	**PacifiCorp**
Klamath River below Iron Gate Dam (RM 189.73; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	A1	-	A1	A1	A1	A1	A1	A1	S2	-	A1	**PacifiCorp**
Klamath River at Walker Bridge (RM 156.26; Baseline)	H	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	S3	S3	S2	-	**Karuk**
Klamath River below Seiad (RM 128.5; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	A1	-	A1	A1	A1	*	A1	S3	S3	-	A1	**Karuk**
Klamath River below Happy Camp (RM 101.3; Baseline)	H	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	S3	S3	-	-	**Karuk**
Klamath River at Orleans (USGS) (RM 59.1; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	A1	A1	S3	S3	-	A1	**Karuk**
Klamath River at Weitchpec (RM 43.5; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	S3	S3	-	-	**Yurok**
Klamath River below Trinity River (RM 38.5; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	S3	S3	-	-	**Yurok**
Klamath River near Klamath (RM 6.0; Baseline)	H	H	H	H	A1	A1	A1	A1	A1	A1	-	A1	A1	A1	*	A1	S3	S3	-	A1	**Yurok**
Klamath River Estuary (RM 0.5; Baseline)[c]	HP	D	D	D	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	S3	S3	-	-	**Yurok**
Salmon River near mouth (Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	*	-	-	A1	**Karuk**
Scott River near mouth (Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	*	-	-	A1	**Karuk**
Shasta River near mouth (Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	*	-	-	A1	**Karuk**
Trinity River near mouth (Baseline)	H	H	H	H	A1	A1	A1	A1	A1	-	-	A1	-	A1	*	A1	*	-	-	A1	**Yurok**

[a] Sampling at one depth in J.C. Boyle reservoir (0.5 m depth = surface)

[b] Site actually located downstream of Copco 2 Powerhouse

[c] Hourly sampling in the estuary at four locations (two in lower estuary, one in mid estuary and one in upper estuary) at two depths (0.5 m and bottom)

KEY

Sampling Method

T = thermistor

P = probe or data sonde

G = grab sample

Sampling Frequency

D = Discrete Sample

H = Hourly meaurements by sonde (in some instances sub-hourly data may be desired)

HP = Hourly measurements in a profile

VP = Vertical Profile at sampling frequency associated with grab sampling

- = Not Sampled

* = Not sampled. Parameter covered at M/S frequency by Tribal WQ Workgroup

A1 = Monthly sampling April - December

A1/BM = Bimonthly sampling May - October, and monthly sampling April, November & December

A1/BM2 = Bimonthly sampling June - September, and monthly sampling April, May, October, November & December

BM/S = Bimonthly sampling July - October

M/S = Monthly seasonal sampling May - October

S2 = Monthly seasonal sampling July - October

S3 = Monthly seasonal sampling June - October