

TECHNICAL MEMORANDUM

Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project

Prepared for: Demian Ebert (PacifiCorp)
Prepared by: E&S Environmental Chemistry, Inc.
Date: July 6, 2020



Introduction

This technical memorandum summarizes the results for the 2020 public health monitoring for cyanobacteria species and an associated toxin, microcystin, from Upper Klamath Lake and within PacifiCorp's Klamath Hydroelectric Project (Project) from Keno Reservoir to the Klamath River downstream Iron Gate Dam. Microcystin results from 2020 baseline monitoring program are also included in the results summaries below. This monitoring is particularly focused on *Microcystis aeruginosa* (MSAE) which is known to produce microcystin. This monitoring also assesses the presence of other potentially-toxigenic cyanobacteria, including *Dolichospermum* sp., and others. Monitoring is being conducted pursuant to Interim Measure 15, Water Quality Monitoring Activities, contained in the Klamath Hydroelectric Settlement Agreement (KHSA) executed between the United States Department of Interior, the states of California and Oregon, PacifiCorp, and other parties.

Results from the baseline and public health sampling are used in coordination with the appropriate public health authority to determine if public health advisories are warranted^{1,2}. In addition to PacifiCorp's website (<https://www.pacifiCorp.com/energy/hydro/klamath-river.html>), these memos are also posted on the Klamath Basin Monitoring Program's (KBMP) website (www.kbmp.net) and inform the Blue Green Algae tracker on the KBMP website.

The data in Appendix 1 and Appendix 2 summarize results from all of the 2020 public health sampling events to date and microcystin results from the 2020 baseline sampling events, respectively.

¹ The California State Water Resources Control Board (SWRCB) provides guidelines for posting advisories in recreation water (California SWRCB 2016) for Project waters in California. SWRCB recommends posting advisories in recreation waters at three levels based on laboratory testing for microcystin. The posting levels are Caution, Warning, and Danger at microcystin concentrations of 0.8, 6, and 20 µg/L respectively. Toxin producing cells at concentrations of over 4,000 cells/mL or blooms, scums, or mats would result in posting at the Caution level.

² Postings of Project waters in Oregon are coordinated with the Oregon Health Authority (OHA). The health advisory guideline for recreational use in Oregon waters is microcystin concentrations of 8 µg/L (OHA 2019).

Methods

PacifiCorp and the Oregon Department of Environmental Quality (ODEQ) are conducting public health sampling at ten sites (Table 1). Samples are collected and sent for laboratory analysis of potentially toxigenic cyanobacteria, notably MSAE and microcystin, from:

- Three shoreline sites in Upper Klamath Lake, Oregon
- One shoreline site in Keno Reservoir, Oregon
- One shoreline site in J.C. Boyle Reservoir, Oregon
- Four shoreline sites in coves in Copco and Iron Gate reservoirs (i.e., two cove sites in each reservoir), California
- One Klamath River site below Iron Gate Dam near the hatchery bridge, California

Table 1. Sites of cyanobacteria and microcystin public health monitoring in Upper Klamath Lake, Keno Reservoir, J.C Boyle Reservoir, Copco Reservoir, Iron Gate Reservoir, and the Klamath River during 2019.			
Location	Approximate River Mile	Sampling Entity	Site ID
Upper Klamath Lake at Eagle Ridge County Park	N/A	ODEQ	UKEP
Upper Klamath Lake at Howard's Bay Park	N/A	ODEQ	UKHP
Upper Klamath Lake at Moore Park	N/A	ODEQ	UKMP
Keno Reservoir at Keno Park	234.0	ODEQ	KEKP
J.C. Boyle Reservoir at Topsy Campground	225.0	ODEQ	BRTC
Copco Reservoir at Mallard Cove	201.5	PacifiCorp	CRMC
Copco Reservoir at Copco Cove	200.0	PacifiCorp	CRCC
Iron Gate Reservoir at Camp Creek	192.8	PacifiCorp	IRCC
Iron Gate Reservoir at John Williams Campground	192.4	PacifiCorp	IRJW
Klamath River below Iron Gate dam near Hatchery Bridge	189.7	PacifiCorp	KRBI

Samples are planned to be taken once in May, November, and December and twice per month in June, July, August, September, and October.

In addition to public health sampling, monthly and bi-monthly baseline sampling for microcystin is conducted by PacifiCorp and the U.S. Bureau of Reclamation (BOR) from May through October at 12 locations extending from Link River Dam to the Klamath River downstream of Iron Gate Reservoir (Table 2).

Table 2. Sites of microcystin baseline monitoring from Link River Dam to the Klamath River downstream of Iron Gate reservoir during 2019.				
Site Description	Approximate River Mile	Depth (m)	Sampling Entity	Site ID
Link River Dam	254.4	0.5	BOR	KR254.4
Keno Reservoir at Miller Island	246.0	0.5	BOR	KR246.0
Klamath River below Keno Dam near a USGS Gage	231.8	0.5	BOR	KBK
Klamath River below JC Boyle Reservoir	224.6	0.5	PacifiCorp	KR22460
Klamath River at USGS Gage	219.5	0.5	PacifiCorp	KR21950
Klamath River above Shovel Creek	206.4	0.5	PacifiCorp	KR20642
Copco Reservoir at Buoy Line (surface)	198.7	0.5	PacifiCorp	KR19874
Copco Reservoir at Buoy Line (integrated)	198.7	0-8	PacifiCorp	KR19874
Klamath River below Copco 2 Reservoir	196.5	0.5	PacifiCorp	KR19645
Iron Gate Reservoir at Log Boom (surface)	190.2	0.5	PacifiCorp	KR19019
Iron Gate Reservoir at Log Boom (integrated)	190.2	0-8	PacifiCorp	KR19019
Klamath River below Hatchery Bridge	189.7	0.5	PacifiCorp	KR18973

Public health samples are taken as grab samples offshore according to the standard operating procedure (SOP) developed by the Klamath Blue Green Algae Working Group (www.kbmp.net/collaboration/klamath-hydroelectric-settlement-agreement-monitoring). Samples collected for potentially toxic phytoplankton are preserved in Lugol’s solution and sent to Aquatic Analysts in Friday Harbor, Washington for analysis. The samples are labeled “Rush” for timely analysis and only potentially toxic cyanobacteria are identified and enumerated. Results for cyanobacteria species are reported as individual cells per milliliter.

Samples for determination of microcystin toxin are placed in a cooler on ice and shipped to the U.S. Environmental Protection Agency (EPA) Region 9 Laboratory in Richmond, California. The samples are analyzed using the competitive Enzyme-Linked ImmunoSorbent Assay (ELISA) method based on the EnviroLogix QuantiPlate Kit with a detection limit of 0.10 µg/L and a quantification limit of 0.15 µg/L. This test method does not distinguish between the specific microcystin congeners, but detects their presence to differing degrees. That is, ELISA test results yield one value as the sum of measurable microcystin variants.

Results

Available public health sample results are reported in Table 3. Public health samples scheduled for collection by ODEQ during May bi-monthly and at KEKP during June monthly sampling were not collected. Although the remaining public health and all baseline microcystin samples (Tables 4 and 5) were collected as planned, results are not available because the EPA laboratory remains closed in response to COVID-19. Collected samples intended for the EPA laboratory remain frozen until the laboratory is able to receive and process them. Appendix 3 includes the raw phytoplankton results for the samples reported in Table 3.

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Table 3. Summary of available public health laboratory algal identification and enumeration and microcystin results from sampling May and June 2020.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE ⁽¹⁾	AFA ⁽²⁾	DKFA ⁽³⁾	Other ^{(4),(5), (6), (7), (8), (9), (10), (11), (12), or (13)}	Microcystin (µg/L)
5/28/2020	16:25	CRMC	201.5	PacifiCorp	KR20800	SG	0	0	0	588 ¹⁰	*
5/28/2020	14:50	CRCC	200.0	PacifiCorp	KR20801	SG	0	0	0	17,134 ¹⁰	*
5/28/2020	14:10	IRCC	192.8	PacifiCorp	KR20802	SG	0	0	0	0	*
5/28/2020	13:45	IRJW	192.4	PacifiCorp	KR20803	SG	0	0	0	0	*
5/28/2020	15:30	KRBI	189.7	PacifiCorp	KR20804	SG	0	0	0	132 ¹⁰	*
5/XX/2020	XX:XX	UKEP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKHP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKMP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	KEKP	234	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	BRTC	225	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
6/9/2020	18:20	CRMC	201.5	PacifiCorp	KR20805	SG	0	0	0	0	*
6/9/2020	15:05	CRCC	200.0	PacifiCorp	KR20806	SG	0	0	0	0	*
6/9/2020	12:20	IRCC	192.8	PacifiCorp	KR20807	SG	0	0	0	0	*
6/9/2020	11:10	IRJW	192.4	PacifiCorp	KR20808	SG	0	889	0	0	*
6/9/2020	16:00	KRBI	189.7	PacifiCorp	KR20809	SG	0	0	0	0	*
6/15/2020	11:04	UKEP	N/A	ODEQ	UKEP20001	SG	0	113,266	4,131	0	*
6/15/2020	11:26	UKHP	N/A	ODEQ	UKHP20001	SG	0	133,581	0	0	*
6/15/2020	11:47	UKMP	N/A	ODEQ	UKMP20001	SG	0	78,771	515	0	*
6/XX/2020	XX:XX	KEKP	234	ODEQ	KEKP20001	SG	*	*	*	*	*
6/15/2020	10:05	BRTC	225	ODEQ	BRTC20001	SG	0	6,765	82	0	*
6/23/2020	11:05	CRMC	201.5	PacifiCorp	KR20810	SG	0	0	0	0	*
6/23/2020	09:40	CRCC	200.0	PacifiCorp	KR20811	SG	689	11,581	0	0	*
6/23/2020	09:05	IRCC	192.8	PacifiCorp	KR20812	SG	599	82	3,050	381 ¹⁰	*
6/23/2020	08:50	IRJW	192.4	PacifiCorp	KR20813	SG	0	17	0	51 ¹³	*
6/23/2020	11:50	KRBI	189.7	PacifiCorp	KR20814	SG	0	0	0	0	*
6/30/2020	11:30	UKEP	N/A	ODEQ	UKEP20202	SG	0	540,815	0	0	*
6/30/2020	11:58	UKHP	N/A	ODEQ	UKHP20202	SG	0	233,242	0	0	*
6/30/2020	12:18	UKMP	N/A	ODEQ	UKMP20202	SG	0	181,709	0	0	*
6/30/2020	10:36	KEKP	234	ODEQ	KEKP20202	SG	0	137,471	0	0	*
6/30/2020	10:12	BRTC	225	ODEQ	BRTC20202	SG	0	16,363	0	743 ¹⁰	*

¹MSAE = *Microcystis aeruginosa* (cells/mL)

²AFA = *Aphanizomenon flos-aquae* (cells/mL)

³DKFA = *Dolichospermum flos-aquae* (cells/mL)

Other = Cells/mL of either ⁴*Planktothrix (Oscillatoria) sp.*, ⁵*Gloeotrichia echinulata*, ⁶*Dolichospermum sp.*, ⁷*Lyngbya sp.*, ⁸*Dolichospermum circinalis*, ⁹*Dolichospermum planctonica*, ¹⁰*Planktothrix (Oscillatoria) limosa*, ¹¹*Pseudanabaena spp.*, ¹²*Limnothrix sp.*, or ¹³*Cylindrospermopsis sp.*

"0" value indicates non-detect by analytical laboratory

"*" value indicates no result available

"NS" indicates Not Sampled

Table 4. Summary of May and June 2020 baseline laboratory microcystin results for samples collected in Oregon.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/17/2020	11:40	KR246.0	246.0	BOR	2020KHSA-22	0.5	*
5/17/2020	10:30	KBK	231.8	BOR	2020KHSA-23	0.5	*
5/17/2020	07:40	KR22460	224.6	PacifiCorp	KR20047	0.5	*
5/17/2020	08:40	KR21950	219.5	PacifiCorp	KR20048	0.5	*
6/9/2020	08:50	KR246.0	246.0	BOR	2020KHSA-32	0.5	*
6/9/2020	11:35	KBK	231.8	BOR	2020KHSA-33	0.5	*
6/8/2020	15:05	KR22460	224.6	PacifiCorp	KR20064	0.5	*
6/8/2020	15:50	KR21950	219.5	PacifiCorp	KR20065	0.5	*

“*” value indicates no result available

Table 5. Summary of May and June 2020 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/16/2020	18:20	KR20642	206.4	PacifiCorp	KR20043	0.5	*
5/16/2020	15:10	KR19874	198.7	PacifiCorp	KR20039	0.5	*
5/16/2020	16:10	KR19874	198.7	PacifiCorp	KR20040	0-8	*
5/16/2020	14:20	KR19645	196.5	PacifiCorp	KR20038	0.5	*
5/16/2020	11:10	KR19019	190.2	PacifiCorp	KR20034	0.5	*
5/16/2020	11:40	KR19019	190.2	PacifiCorp	KR20035	0-8	*
6/9/2020	17:45	KR20642	206.4	PacifiCorp	KR20060	0.5	*
6/9/2020	13:50	KR19874	198.7	PacifiCorp	KR20056	0.5	*
6/9/2020	14:10	KR19874	198.7	PacifiCorp	KR20057	0-8	*
6/9/2020	12:55	KR19645	196.5	PacifiCorp	KR20055	0.5	*
6/9/2020	09:15	KR19019	190.2	PacifiCorp	KR20051	0.5	*
6/9/2020	09:50	KR19019	190.2	PacifiCorp	KR20052	0-8	*

“*” value indicates no result available

References

California SWRCB 2016. Draft Statewide Voluntary Guidance on CyanoHABs in Recreational Waters. Available online at:

http://www.mywaterquality.ca.gov/monitoring_council/cyanoHab_network/docs/triggers.pdf

Oregon Health Authority. 2019. Oregon Harmful Algal Bloom Surveillance (HABS) Program – Recreational Use Public Health Advisory Guidelines, Cyanobacterial Blooms in Freshwater Bodies. 27 pp. Available online at:

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAE/BL/OOMS/Documents/Advisory-Guidelines-Harmful-Cyanobacterial-Blooms-Recreational-Waters.pdf>

Appendix 1 Cyanobacteria Species and Microcystin Data for 2020 Public Health Samples

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE ⁽¹⁾	AFA ⁽²⁾	DKFA ⁽³⁾	Other ^{(4),(5), (6), (7), (8), (9), (10), (11), (12), or (13)}	Microcystin (µg/L)
5/28/2020	16:25	CRMC	201.5	PacifiCorp	KR20800	SG	0	0	0	588 ¹⁰	*
5/28/2020	14:50	CRCC	200.0	PacifiCorp	KR20801	SG	0	0	0	17,134 ¹⁰	*
5/28/2020	14:10	IRCC	192.8	PacifiCorp	KR20802	SG	0	0	0	0	*
5/28/2020	13:45	IRJW	192.4	PacifiCorp	KR20803	SG	0	0	0	0	*
5/28/2020	15:30	KRBI	189.7	PacifiCorp	KR20804	SG	0	0	0	132 ¹⁰	*
5/XX/2020	XX:XX	UKEP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKHP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKMP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	KEKP	234	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	BRTC	225	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
6/9/2020	18:20	CRMC	201.5	PacifiCorp	KR20805	SG	0	0	0	0	*
6/9/2020	15:05	CRCC	200.0	PacifiCorp	KR20806	SG	0	0	0	0	*
6/9/2020	12:20	IRCC	192.8	PacifiCorp	KR20807	SG	0	0	0	0	*
6/9/2020	11:10	IRJW	192.4	PacifiCorp	KR20808	SG	0	889	0	0	*
6/9/2020	16:00	KRBI	189.7	PacifiCorp	KR20809	SG	0	0	0	0	*
6/15/2020	11:04	UKEP	N/A	ODEQ	UKEP20001	SG	0	113,266	4,131	0	*
6/15/2020	11:26	UKHP	N/A	ODEQ	UKHP20001	SG	0	133,581	0	0	*
6/15/2020	11:47	UKMP	N/A	ODEQ	UKMP20001	SG	0	78,771	515	0	*
6/XX/2020	XX:XX	KEKP	234	ODEQ	KEKP20001	SG	*	*	*	*	*
6/15/2020	10:05	BRTC	225	ODEQ	BRTC20001	SG	0	6,765	82	0	*
6/23/2020	11:05	CRMC	201.5	PacifiCorp	KR20810	SG	0	0	0	0	*
6/23/2020	09:40	CRCC	200.0	PacifiCorp	KR20811	SG	689	11,581	0	0	*
6/23/2020	09:05	IRCC	192.8	PacifiCorp	KR20812	SG	599	82	3,050	381 ¹⁰	*
6/23/2020	08:50	IRJW	192.4	PacifiCorp	KR20813	SG	0	17	0	51 ¹³	*
6/23/2020	11:50	KRBI	189.7	PacifiCorp	KR20814	SG	0	0	0	0	*
6/30/2020	11:30	UKEP	N/A	ODEQ	UKEP20202	SG	0	540,815	0	0	*
6/30/2020	11:58	UKHP	N/A	ODEQ	UKHP20202	SG	0	233,242	0	0	*
6/30/2020	12:18	UKMP	N/A	ODEQ	UKMP20202	SG	0	181,709	0	0	*
6/30/2020	10:36	KEKP	234	ODEQ	KEKP20202	SG	0	137,471	0	0	*
6/30/2020	10:12	BRTC	225	ODEQ	BRTC20202	SG	0	16,363	0	743 ¹⁰	*

¹MSAE = *Microcystis aeruginosa* (cells/mL)

²AFA = *Aphanizomenon flos-aquae* (cells/mL)

³DKFA = *Dolichospermum flos-aquae* (cells/mL)

Other = Cells/mL of either ⁴*Planktothrix (Oscillatoria)* sp., ⁵*Gloeotrichia echinulata*, ⁶*Dolichospermum* sp., ⁷*Lyngbya* sp., ⁸*Dolichospermum circinalis*, ⁹*Dolichospermum planctonica*, ¹⁰*Planktothrix (Oscillatoria) limosa*, ¹¹*Pseudanabaena* spp, ¹²*Limnothrix* sp., or ¹³*Cylindrospermopsis* sp.

"0" value indicates non-detect by analytical laboratory

"*" value indicates no result available

"NS" indicates Not Sampled

Appendix 2

Microcystin Data for 2020 Baseline Samples

Table A2-1. Summary of May and June 2020 baseline laboratory microcystin results for samples collected in Oregon.							
Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/17/2020	11:40	KR246.0	246.0	BOR	2020KHSA-22	0.5	*
5/17/2020	10:30	KBK	231.8	BOR	2020KHSA-23	0.5	*
5/17/2020	07:40	KR22460	224.6	PacifiCorp	KR20047	0.5	*
5/17/2020	08:40	KR21950	219.5	PacifiCorp	KR20048	0.5	*
6/9/2020	08:50	KR246.0	246.0	BOR	2020KHSA-32	0.5	*
6/9/2020	11:35	KBK	231.8	BOR	2020KHSA-33	0.5	*
6/8/2020	15:05	KR22460	224.6	PacifiCorp	KR20064	0.5	*
6/8/2020	15:50	KR21950	219.5	PacifiCorp	KR20065	0.5	*

“*” value indicates no result available

Table A2-2. Summary of May and June 2020 baseline laboratory microcystin results for samples collected in California.							
Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/16/2020	18:20	KR20642	206.4	PacifiCorp	KR20043	0.5	*
5/16/2020	15:10	KR19874	198.7	PacifiCorp	KR20039	0.5	*
5/16/2020	16:10	KR19874	198.7	PacifiCorp	KR20040	0-8	*
5/16/2020	14:20	KR19645	196.5	PacifiCorp	KR20038	0.5	*
5/16/2020	11:10	KR19019	190.2	PacifiCorp	KR20034	0.5	*
5/16/2020	11:40	KR19019	190.2	PacifiCorp	KR20035	0-8	*
6/9/2020	17:45	KR20642	206.4	PacifiCorp	KR20060	0.5	*
6/9/2020	13:50	KR19874	198.7	PacifiCorp	KR20056	0.5	*
6/9/2020	14:10	KR19874	198.7	PacifiCorp	KR20057	0-8	*
6/9/2020	12:55	KR19645	196.5	PacifiCorp	KR20055	0.5	*
6/9/2020	09:15	KR19019	190.2	PacifiCorp	KR20051	0.5	*
6/9/2020	09:50	KR19019	190.2	PacifiCorp	KR20052	0-8	*

“*” value indicates no result available

Appendix 3 Laboratory Phytoplankton Results

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20800
Sample Depth:
Sample Date: 28-May-20 1625

Total Density (#/mL): 27
Total Biovolume (um³/mL): 36,454
Trophic State Index: 26.1

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Oscillatoria limosa	27	100.0	36,454	100.0

Oscillatoria limosa cells/mL = 588

Note: Toxic Algae Only

Aquatic Analysts

Sample ID: WT27

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20801
Sample Depth:
Sample Date: 28-May-20 1450

Total Density (#/mL): 553
Total Biovolume (um³/mL): 1,062,282
Trophic State Index: 50.3

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Oscillatoria limosa	553	100.0	1,062,282	100.0

Oscillatoria limosa cells/mL = 17,134

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20802
Sample Depth:
Sample Date: 28-May-20 1410

Total Density (#/mL): <4
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<4			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20803
Sample Depth:
Sample Date: 28-May-20 1345

Total Density (#/mL): <4
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<4			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20804
Sample Depth:
Sample Date: 28-May-20 1530

Total Density (#/mL): 7
Total Biovolume (um³/mL): 8,164
Trophic State Index: 16.0

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Oscillatoria limosa	7	100.0	8,164	100.0

Oscillatoria limosa cells/mL = 132

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20805
Sample Depth:
Sample Date: 9-Jun-20 1820

Total Density (#/mL): <21
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<21			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: ~~KR80206~~ KR20806
Sample Depth:
Sample Date: 9-Jun-20 1505

Total Density (#/mL): <5
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<5			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20807
Sample Depth:
Sample Date: 9-Jun-20 1220

Total Density (#/mL): <7
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<7			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20808
Sample Depth:
Sample Date: 9-Jun-20 1110

Total Density (#/mL): 49
Total Biovolume (um³/mL): 55,996
Trophic State Index: 29.2

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	49	100.0	55,996	100.0

Aphanizomenon flos-aquae cells/mL = 889

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20809
Sample Depth:
Sample Date: 9-Jun-20 1600

Total Density (#/mL): <3
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<3			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: UKEP20001
Sample Depth:
Sample Date: 15-Jun-20 1104

Total Density (#/mL): 4,849
Total Biovolume (um³/mL): 7,412,581
Trophic State Index: 64.3

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	4,719	97.3	7,135,784	96.3
2 Dolichospermum flos-aquae	129	2.7	276,797	3.7

Aphanizomenon flos-aquae cells/mL = 113,266

Dolichospermum flos-aquae cells/mL = 4,131

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
 UKHP
Sample Site: UKHP20001
Sample Depth:
Sample Date: 15-Jun-20 1126

Total Density (#/mL): 6,072
Total Biovolume (um³/mL): 8,415,594
Trophic State Index: 65.2

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Aphanizomenon flos-aquae	6,072	100.0	8,415,594	100.0

Aphanizomenon flos-aquae cells/mL = 133,581

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: UKMP20001
Sample Depth:
Sample Date: 15-Jun-20 1147

Total Density (#/mL): 2,639
Total Biovolume (um³/mL): 4,997,039
Trophic State Index: 61.4

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	2,626	99.5	4,962,545	99.3
2 Dolichospermum flos-aquae	13	0.5	34,494	0.7

Aphanizomenon flos-aquae cells/mL = 78,771

Dolichospermum flos-aquae cells/mL = 515

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: BRTC20001
Sample Depth:
Sample Date: 15-Jun-20 1005

Total Density (#/mL): 298
Total Biovolume (um³/mL): 431,669
Trophic State Index: 43.8

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	294	98.6	426,195	98.7
2 Dolichospermum flos-aquae	4	1.4	5,474	1.3

Aphanizomenon flos-aquae cells/mL = 6,765

Dolichospermum flos-aquae cells/mL = 82

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20810
Sample Depth:
Sample Date: 23-Jun-20 1105

Total Density (#/mL): <4
Total Biovolume (um³/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-	-	-	-
1	No Toxic Algae Present	<4			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20811
Sample Depth:
Sample Date: 23-Jun-20 940

Total Density (#/mL): 572
Total Biovolume (um³/mL): 735,083
Trophic State Index: 47.6

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	504	88.0	729,574	99.3
2 Microcystis aeruginosa	69	12.0	5,508	0.7

Aphanizomenon flos-aquae cells/mL = 11,581
 Microcystis aeruginosa cells/mL = 689

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20812
Sample Depth:
Sample Date: 23-Jun-20 905

Total Density (#/mL): 117
Total Biovolume (um³/mL): 237,946
Trophic State Index: 39.5

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Microcystis aeruginosa	60	51.2	4,793	2.0
2 Dolichospermum flos-aquae	44	37.2	204,366	85.9
3 Oscillatoria limosa	11	9.3	23,639	9.9
4 Aphanizomenon flos-aquae	3	2.3	5,147	2.2

Microcystis aeruginosa cells/mL = 599
 Dolichospermum flos-aquae cells/mL = 3,050
 Oscillatoria limosa cells/mL = 381
 Aphanizomenon flos-aquae cells/mL = 82

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20813
Sample Depth:
Sample Date: 23-Jun-20 850

Total Density (#/mL): 3
Total Biovolume (um³/mL): 4,920
Trophic State Index: 12.8

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
1 Cylindrospermopsis sp.	2	50.0	3,844	78.1
2 Aphanizomenon flos-aquae	2	50.0	1,076	21.9

Cylindrospermopsis sp. cells/mL = 51

Aphanizomenon flos-aquae cells/mL = 17

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR20814
Sample Depth:
Sample Date: 23-Jun-20 1150

Total Density (#/mL): <4
Total Biovolume (um³/mL):
Trophic State Index:

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 No Toxic Algae Present	<4			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: UKEP20202
Sample Depth:
Sample Date: 30-Jun-20 1130

Total Density (#/mL): 23,514
Total Biovolume (um³/mL): 34,071,315
Trophic State Index: 75.3

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	23,514	100.0	34,071,315	100.0

Aphanizomenon flos-aquae cells/mL = 540,815

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: UKHP20202
Sample Depth:
Sample Date: 30-Jun-20 1158

Total Density (#/mL): 9,330
Total Biovolume (um³/mL): 14,694,223
Trophic State Index: 69.2

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	9,330	100.0	14,694,223	100.0

Aphanizomenon flos-aquae cells/mL = 233,242

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: UKMP20202
Sample Depth:
Sample Date: 30-Jun-20 1218

Total Density (#/mL): 7,268
Total Biovolume (um³/mL): 11,447,648
Trophic State Index: 67.4

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	7,268	100.0	11,447,648	100.0

Aphanizomenon flos-aquae cells/mL = 181,709

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: KEKP20202
Sample Depth:
Sample Date: 30-Jun-20 1036

Total Density (#/mL): 6,546
Total Biovolume (um³/mL): 8,660,664
Trophic State Index: 65.4

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	6,546	100.0	8,660,664	100.0

Aphanizomenon flos-aquae cells/mL = 137,471

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample Site: BRTC20202
Sample Depth:
Sample Date: 30-Jun-20 1012

Total Density (#/mL): 990
Total Biovolume (um³/mL): 1,076,873
Trophic State Index: 50.4

Species	Density #/mL	Density Percent	Biovolume um ³ /mL	Biovolume Percent
-	-	-	-	-
1 Aphanizomenon flos-aquae	963	97.2	1,030,838	95.7
2 Oscillatoria limosa	28	2.8	46,035	4.3

Aphanizomenon flos-aquae cells/mL = 16,363

Oscillatoria limosa cells/mL = 743

Note: Toxic Algae Only

Aquatic Analysts

Sample ID: VF90