TECHNICAL MEMORANDUM

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

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Introduction

This technical memorandum summarizes the results for the 2017 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 2017 baseline monitoring 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 (www.pacificorp.com/es/hydro/hl/kr.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 2017 public health sampling events to date and microcystin results from the 2017 baseline sampling events.

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[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; 2016). The health advisory guideline in Oregon waters is microcystin concentrations of 10 µg/L or more, over 100,000 cells/mL of all toxigenic species combined, or over 40,000 cells/mL of *Microcystis* spp. *or Planktothrix* spp.

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 2017.

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 Jay 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 Dam to the Klamath River downstream of Iron Gate Reservoir (Table 2).

Table 2. Sites of microcystin baseline monitoring from Link Dam to the Klamath River downstream of Iron Gate reservoir during 2017.

Site Description	Approximate River Mile	Depth (m)	Sampling Entity	Site ID
Link 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

All public health samples (Table 3) and baseline microcystin samples (Tables 4 and 5) were collected as planned. Appendix 3 includes the raw phytoplankton results for the samples reported in Table 3.

Table 3. Summary of available public health laboratory algal identification and enumeration and microcystin results from sampling May and June 2017.

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], or [12]	Microcystin (µg/L)
5/31/2017	17:50	CRMC	201.5	PacifiCorp	KR17800	SG	0	0	0	0	ND
5/31/2017	17:10	CRCC	200.0	PacifiCorp	KR17801	SG	0	25	0	0	ND
5/31/2017	16:35	IRCC	192.8	PacifiCorp	KR17802	SG	0	0	0	0	ND
5/31/2017	16:05	IRJW	192.4	PacifiCorp	KR17803	SG	0	0	0	0	ND
5/31/2017	18:30	KRBI	189.7	PacifiCorp	KR17804	SG	0	0	0	0	ND
6/15/2017	11:06	UKEP	N/A	ODEQ	UKEP17002	SG	0	9,364	0	0	ND
6/15/2017	11:22	UKHP	N/A	ODEQ	UKHP17002	SG	0	11,226	9,371	0	0.16
6/15/2017	11:36	UKMP	N/A	ODEQ	UKMP17002	SG	0	18,798	12,764	0	ND
6/15/2017	10:23	KEKP	234.0	ODEQ	KEKP17002	SG	4,840	141,988	946	0	1.3
6/15/2017	10:09	BRTC	225.0	ODEQ	BRTC17002	SG	0	26,394	0	0	ND
6/13/2017	16:45	CRMC	201.5	PacifiCorp	KR17805	SG	0	0	0	185[4]	ND
6/13/2017	15:10	CRCC	200.0	PacifiCorp	KR17806	SG	0	117	201	0	ND
6/13/2017	12:20	IRCC	192.8	PacifiCorp	KR17807	SG	0	150	24	0	ND
6/13/2017	12:00	IRJW	192.4	PacifiCorp	KR17808	SG	0	135	0	0	ND
6/13/2017	17:50	KRBI	189.7	PacifiCorp	KR17809	SG	0	0	0	0	ND
6/25/2017	13:35	CRMC	201.5	PacifiCorp	KR17810	SG	0	0	0	0	0.18
6/25/2017	12:20	CRCC	200.0	PacifiCorp	KR17811	SG	16,161	11,300	0	0	6.7
6/25/2017	11:40	IRCC	192.8	PacifiCorp	KR17812	SG	0	0	0	255[6], 44[12]	ND
6/25/2017	11:15	IRJW	192.4	PacifiCorp	KR17813	SG	0	0	0	490[6]	ND
6/25/2017	14:35	KRBI	189.7	PacifiCorp	KR17814	SG	0	0	0	0	ND
6/27/2017	11:22	UKEP	N/A	ODEQ	UKEP17003	SG	2,966	137,243	0	0	1.2
6/27/2017	11:38	UKHP	N/A	ODEQ	UKHP17003	SG	0	2,469,675	0	31,761[5]	1.2
6/27/2017	11:59	UKMP	N/A	ODEQ	UKMP17003	SG	0	460,204	0	0	0.50
6/27/2017	10:20	KEKP	234.0	ODEQ	KEKP17003	SG	0	1,458,901	0	0	2.5
6/27/2017	10:01	BRTC	225.0	ODEQ	BRTC17003	SG	0	9,364	0	0	ND

[1]MSAE = *Microcystis aeruginosa* (cells/mL)
[2]AFA = *Aphanizomenon flos-aquae* (cells/mL)
[3]DKFA = *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., or [12]Limnothrix sp.
"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)
"0" value indicates non-detect by analytical laboratory
"*" value indicates no result available

Table 4. Summary of June 2017 baseline laboratory microcystin results for samples collected in Oregon.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
6/06/2017	09:45	KR246.0	246.0	BOR	2017KHSA-32	0.5	ND
6/06/2017	07:50	KBK	231.8	BOR	2017KHSA-33	0.5	ND
6/12/2017	13:50	KR22460	224.6	PacifiCorp	KR17050	0.5	*
6/12/2017	13:15	KR21950	219.5	PacifiCorp	KR17051	0.5	*

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)
"*" value indicates no result available

Table 5. Summary of June 2017 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
6/13//2017	16:10	KR20642	206.4	PacifiCorp	KR17053	0.5	ND
6/13//2017	13:55	KR19874	198.7	PacifiCorp	KR17059	0.5	ND
6/13//2017	14:10	KR19874	198.7	PacifiCorp	KR17060	0-8	ND
6/13//2017	12:50	KR19645	196.5	PacifiCorp	KR17058	0.5	ND
6/13//2017	9:30	KR19019	190.2	PacifiCorp	KR17054	0.5	ND
6/13//2017	9:45	KR19019	190.2	PacifiCorp	KR17055	0-8	ND

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

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. 2016. Oregon Harmful Algal Bloom Surveillance (HABS) Program – Public Health Advisory Guidelines, Harmful Algae Blooms in Freshwater Bodies. 27 pp.
https://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Pages/resources_for_samplers.aspx

Appendix 1
Cyanobacteria Species and Microcystin Data for 2017 Public Health Samples

Table A1. Summary of 2017 public health laboratory algal identification and enumeration microcystin results.

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], or [12]	Microcystin (µg/L)
5/30/2017	12:19	UKEP	N/A	ODEQ	UKEP17001	SG	0	0	2,662,890	0	15
5/30/2017	12:36	UKHP	N/A	ODEQ	UKHP17001	SG	0	0	44,670	0	ND
5/30/2017	12:53	UKMP	N/A	ODEQ	UKMP17001	SG	0	0	72,611	0	ND
5/30/2017	11:32	KEKP	234.0	ODEQ	KEKP17001	SG	0	0	2,075	0	ND
5/30/2017	11:14	BRTC	225.0	ODEQ	BRTC17001	SG	0	0	635	0	ND
5/31/2017	17:50	CRMC	201.5	PacifiCorp	KR17800	SG	0	0	0	0	ND
5/31/2017	17:10	CRCC	200.0	PacifiCorp	KR17801	SG	0	25	0	0	ND
5/31/2017	16:35	IRCC	192.8	PacifiCorp	KR17802	SG	0	0	0	0	ND
5/31/2017	16:05	IRJW	192.4	PacifiCorp	KR17803	SG	0	0	0	0	ND
5/31/2017	18:30	KRBI	189.7	PacifiCorp	KR17804	SG	0	0	0	0	ND
6/15/2017	11:06	UKEP	N/A	ODEQ	UKEP17002	SG	0	9,364	0	0	ND
6/15/2017	11:22	UKHP	N/A	ODEQ	UKHP17002	SG	0	11,226	9,371	0	0.16
6/15/2017	11:36	UKMP	N/A	ODEQ	UKMP17002	SG	0	18,798	12,764	0	ND
6/15/2017	10:23	KEKP	234.0	ODEQ	KEKP17002	SG	4,840	141,988	946	0	1.3
6/15/2017	10:09	BRTC	225.0	ODEQ	BRTC17002	SG	0	26,394	0	0	ND
6/13/2017	16:45	CRMC	201.5	PacifiCorp	KR17805	SG	0	0	0	185[4]	ND
6/13/2017	15:10	CRCC	200.0	PacifiCorp	KR17806	SG	0	117	201	0	ND
6/13/2017	12:20	IRCC	192.8	PacifiCorp	KR17807	SG	0	150	24	0	ND
6/13/2017	12:00	IRJW	192.4	PacifiCorp	KR17808	SG	0	135	0	0	ND
6/13/2017	17:50	KRBI	189.7	PacifiCorp	KR17809	SG	0	0	0	0	ND
6/25/2017	13:35	CRMC	201.5	PacifiCorp	KR17810	SG	0	0	0	0	0.18
6/25/2017	12:20	CRCC	200.0	PacifiCorp	KR17811	SG	16,161	11,300	0	0	6.7
6/25/2017	11:40	IRCC	192.8	PacifiCorp	KR17812	SG	0	0	0	255[6], 44[12]	ND
6/25/2017	11:15	IRJW	192.4	PacifiCorp	KR17813	SG	0	0	0	490[6]	ND
6/25/2017	14:35	KRBI	189.7	PacifiCorp	KR17814	SG	0	0	0	0	ND
6/27/2017	11:22	UKEP	N/A	ODEQ	UKEP17003	SG	2,966	137,243	0	0	1.2
6/27/2017	11:38	UKHP	N/A	ODEQ	UKHP17003	SG	0	2,469,675	0	31,761[5]	1.2
6/27/2017	11:59	UKMP	N/A	ODEQ	UKMP17003	SG	0	460,204	0	0	0.50
6/27/2017	10:20	KEKP	234.0	ODEQ	KEKP17003	SG	0	1,458,901	0	0	2.5
6/27/2017	10:01	BRTC	225.0	ODEQ	BRTC17003	SG	0	9,364	0	0	ND

[1]MSAE = *Microcystis aeruginosa* (cells/mL)
[2]AFA = *Aphanizomenon flos-aquae* (cells/mL)
[3]DKFA = *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., or [12]Limnothrix sp.
"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)
"0" value indicates non-detect by analytical laboratory
"*" value indicates no result available

Appendix 2
Microcystin Data for 2017 Baseline Samples

Table A2-1. Summary of 2017 baseline laboratory microcystin results for samples collected in Oregon.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/09/2017	10:00	KR246.0	246.0	BOR	2017KHSA-22	0.5	ND
5/09/2017	07:45	KBK	231.8	BOR	2017KHSA-23	0.5	ND
5/15/2017	9:40	KR22460	224.6	PacifiCorp	KR17033	0.5	ND
5/15/2017	8:59	KR21950	219.5	PacifiCorp	KR17034	0.5	ND
6/06/2017	09:45	KR246.0	246.0	BOR	2017KHSA-32	0.5	ND
6/06/2017	07:50	KBK	231.8	BOR	2017KHSA-33	0.5	ND
6/12/2017	13:50	KR22460	224.6	PacifiCorp	KR17050	0.5	*
6/12/2017	13:15	KR21950	219.5	PacifiCorp	KR17051	0.5	*

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

"*" value indicates no result available

Table A2-2. Summary of 2017 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/16/2017	16:20	KR20642	206.4	PacifiCorp	KR17036	0.5	ND
5/16/2017	14:30	KR19874	198.7	PacifiCorp	KR17042	0.5	ND
5/16/2017	14:45	KR19874	198.7	PacifiCorp	KR17043	0-8	ND
5/16/2017	13:40	KR19645	196.5	PacifiCorp	KR17041	0.5	ND
5/16/2017	10:55	KR19019	190.2	PacifiCorp	KR17037	0.5	ND
5/16/2017	10:45	KR19019	190.2	PacifiCorp	KR17038	0-8	ND
5/16/2017	17:15	KR18973	189.7	PacifiCorp	KR17035	0.5	ND
5/16/2017	17:25	KR18973	189.7	PacifiCorp	KR17048	0.5	ND
6/13//2017	16:10	KR20642	206.4	PacifiCorp	KR17053	0.5	ND
6/13//2017	13:55	KR19874	198.7	PacifiCorp	KR17059	0.5	ND
6/13//2017	14:10	KR19874	198.7	PacifiCorp	KR17060	0-8	ND
6/13//2017	12:50	KR19645	196.5	PacifiCorp	KR17058	0.5	ND
6/13//2017	9:30	KR19019	190.2	PacifiCorp	KR17054	0.5	ND
6/13//2017	9:45	KR19019	190.2	PacifiCorp	KR17055	0-8	ND

"ND" value indicates a result less than the laboratory analytical detection limit

Appendix 3
Laboratory Phytoplankton Results

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	BRTC17002	
Sample Depth:		
Sample Date:	15-Jun-17	1009

Total Density (#/mL):	1,320
Total Biovolume (um^3/mL):	1,662,847
Trophic State Index:	53.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-	-	-	-	-
1	Aphanizomenon flos-aquae	1,320	100.0	1,662,847	100.0

Aphanizomenon flos-aquae cells/mL =	26,394

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	KEKP17002	
Sample Depth:		
Sample Date:	15-Jun-17	1023

Total Density (#/mL):	6,798
Total Biovolume (um^3/mL):	9,047,346
Trophic State Index:	65.7

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	6,761	99.5	8,945,244	98.9
2	Dolichospermum flos-aquae	22	0.3	63,382	0.7
3	Microcystis aeruginosa	15	0.2	38,720	0.4

Aphanizomenon flos-aquae cells/mL =	141,988
Dolichospermum flos-aquae cells/mL =	946
Microcystis aeruginosa cells/mL =	4,840

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17805	
Sample Depth:		
Sample Date:	13-Jun-17	1645

Total Density (#/mL):	6
Total Biovolume (um³/mL):	11,460
Trophic State Index:	18.2

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-	-	-	-
1	Planktothrix sp.	6	100.0	11,460	100.0

Planktothrix sp. cells/mL =	185

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	UKMP17002	
Sample Depth:		
Sample Date:	15-Jun-17	1136

Total Density (#/mL):	1,462
Total Biovolume (um^3/mL):	2,039,410
Trophic State Index:	55.0

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	854	58.4	1,184,245	58.1
2	Dolichospermum flos-aquae	608	41.6	855,165	41.9

Aphanizomenon flos-aquae cells/mL =	18,798
Dolichospermum flos-aquae cells/mL =	12,764

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	UKHP17002	
Sample Depth:		
Sample Date:	15-Jun-17	1122

Total Density (#/mL):	879
Total Biovolume (um^3/mL):	1,335,136
Trophic State Index:	51.9

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	488	55.6	707,250	53.0
2	Dolichospermum flos-aquae	390	44.4	627,886	47.0

Dolichospermum flos-aquae cells/mL =	9,371
Aphanizomenon flos-aquae cells/mL =	11,226

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	BRTC17003	
Sample Depth:		
Sample Date:	28-Jun-17	1001

Total Density (#/mL):	551
Total Biovolume (um³/mL):	589,949
Trophic State Index:	46.0

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	551	100.0	589,949	100.0

Aphanizomenon flos-aquae cells/mL =	9,364

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17806	
Sample Depth:		
Sample Date:	13-Jun-17	1510

Total Density (#/mL):	15
Total Biovolume (um³/mL):	20,811
Trophic State Index:	22.2

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Dolichospermum flos-aquae	9	60.0	13,469	64.7
2	Aphanizomenon flos-aquae	6	40.0	7,342	35.3

Dolichospermum flos-aquae cells/mL =	201
Aphanizomenon flos-aquae cells/mL =	117

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17807	
Sample Depth:		
Sample Date:	13-Jun-17	1220

Total Density (#/mL):	9
Total Biovolume (um^3/mL):	11,083
Trophic State Index:	18.0

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	6	66.7	9,471	85.5
2	Dolichospermum flos-aquae	3	33.3	1,612	14.5

Aphanizomenon flos-aquae cells/mL =	150
Dolichospermum flos-aquae cells/mL =	24

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR17809
Sample Depth:
Sample Date: 13-Jun-17 1750

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

	Species		Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-		-	-	-
1	No Toxic Algae Present		<3			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17808	
Sample Depth:		
Sample Date:	13-Jun-17	1200

Total Density (#/mL):	5
Total Biovolume (um³/mL):	8,517
Trophic State Index:	16.3

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	5	100.0	8,517	100.0

Aphanizomenon flos-aquae cells/mL =	135

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR17810
Sample Depth:
Sample Date: 25-Jun-17 1335

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

	Species		Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-		-	-	-
1	No Toxic Algae Present		<3			

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17811	
Sample Depth:		
Sample Date:	25-Jun-17	1220

Total Density (#/mL):	2,130
Total Biovolume (um³/mL):	841,190
Trophic State Index:	48.6

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Microcystis aeruginosa	1,616	75.9	129,287	15.4
2	Aphanizomenon flos-aquae	514	24.1	711,904	84.6

Aphanizomenon flos-aquae cells/mL =	11,300
Microcystis aeruginosa cells/mL =	16,161

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17812	
Sample Depth:		
Sample Date:	25-Jun-17	1140

Total Density (#/mL):	15
Total Biovolume (um^3/mL):	19,341
Trophic State Index:	21.7

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Dolichospermum sp.	11	75.0	17,345	89.7
2	Limnothrix sp.	4	25.0	1,996	10.3

Dolichospermum sp. cells/mL =	255
Limnothrix sp. cells/mL =	44

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR17813	
Sample Depth:		
Sample Date:	25-Jun-17	1115

Total Density (#/mL):	20
Total Biovolume (um^3/mL):	33,335
Trophic State Index:	25.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Dolichospermum sp.	20	100.0	33,335	100.0

Dolichospermum sp. cells/mL = 490

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR17814
Sample Depth:
Sample Date: 25-Jun-17 1435

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 Site:	KEKP17003	
Sample Depth:		
Sample Date:	28-Jun-17	1020
Total Density (#/mL):	66,314	
Total Biovolume (um³/mL):	91,910,793	
Trophic State Index:	82.5	

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-	-	-	-
1	Aphanizomenon flos-aquae	66,314	100.0	91,910,793	100.0

Aphanizomenon flos-aquae cells/mL = 1,458,901

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	UKMP	
Sample Depth:		
Sample Date:	28-Jun-17	1159
Total Density (#/mL):	23,010	
Total Biovolume (um³/mL):	28,992,857	
Trophic State Index:	74.1	

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-	-	-	-
1	Aphanizomenon flos-aquae	23,010	100.0	28,992,857	100.0

Aphanizomenon flos-aquae cells/mL = 460,204

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	UKHP17003	
Sample Depth:		
Sample Date:	28-Jun-17	1138
Total Density (#/mL):	107,404	
Total Biovolume (um³/mL):	157,749,240	
Trophic State Index:	86.4	

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	107,377	100.0	155,589,521	98.6
2	Gloeotrichia echinulata	26	0.0	2,159,718	1.4

Aphanizomenon flos-aquae cells/mL =	2,469,675
Gloeotrichia echinulata cells/mL =	31,761

Note: Toxic Algae Only

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample Site:	UKEP17003	
Sample Depth:		
Sample Date:	28-Jun-17	1122

Total Density (#/mL):	6,123
Total Biovolume (um³/mL):	8,670,024
Trophic State Index:	65.4

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
1	Aphanizomenon flos-aquae	5,967	97.5	8,646,294	99.7
2	Microcystis aeruginosa	156	2.5	23,730	0.3

Aphanizomenon flos-aquae cells/mL =	137,243
Microcystis aeruginosa cells/mL =	2,966

Note: Toxic Algae Only