TECHNICAL MEMORANDUM

Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project: May 24, 2011

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Introduction

This technical memorandum summarizes the latest results of public health monitoring during 2011 for cyanobacteria species and the associated toxin microcystin in Copco and Iron Gate reservoirs in PacifiCorp's Klamath Hydroelectric Project (Project) and at one monitoring station in the Klamath River below Iron Gate Dam. This monitoring is particularly focused on *Microcystis aeruginosa* (MSAE), a cyanobacterium that is known to produce microcystin, with a recent history of summertime blooms in Copco and Iron Gate reservoirs. This monitoring also estimates the presence of other potentially-toxigenic cyanobacteria, including *Anabaena* spp. and *Planktothrix (Oscillatoria)* spp. This 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.

The results addressed in this memorandum are specifically for samples collected on May 24, 2011. Subsequent memoranda will be prepared every two weeks to report the results of continued monitoring.

Methods

PacifiCorp is conducting phytoplankton sampling for laboratory analysis of potentially toxigenic cyanobacteria, notably MSAE, and microcystin at four sites in Copco and Iron Gate reservoirs and one site below Iron Gate Dam (listed in Table 1), including:

- Four shoreline sites in coves in Copco and Iron Gate reservoirs (i.e., two cove sites in each reservoir).
- One Klamath River site below Iron Gate Dam near the hatchery bridge.

Samples will be taken at the shoreline locations in the reservoirs once in May and twice per month in June, July, October, and November. Samples for the river site below Iron Gate Dam are scheduled to be collected twice per month in June, July and October and weekly in August and September but may change due to river conditions. Sampling in the river would increase when the potential for blooms exists.

Phytoplankton samples from the river sites are taken as grab samples offshore according to the standard operating procedure (SOP) developed by the Klamath Blue Green Algae Working Group (http://www.kbmp.net/collaboration/klamath-hydroelectric-settlement-agreement-monitoring). Additional samples at open water sites in Copco and Iron Gate reservoirs, including a grab sample at 0.5 m depth and an integrated sample over 8 m depth, will be collected as part of the baseline water quality monitoring.

Samples for potentially toxic phytoplankton are preserved in Lugol's solution and sent to Aquatic Analysts in Friday Harbor, Washington for analysis. The laboratory analysis of phytoplankton speciation and abundance is performed on prepared microscope slides of filtered samples using phase contrast microscopy. Species are counted as algal units of cell, filament, or colony depending on the natural growth form of the species. Algal forms are identified to species or otherwise to the lowest practicable taxonomic level. Biovolumes are estimated by multiplying the cell counts by the average geometric dimensions of the cells for a given phytoplankton taxon. 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 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 for Microcystins. The quantitation limit is 0.18 µg/L or parts per billion (ppb). 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 all measurable microcystin variants.

Table 1. Sites of cyanobacteria and microcystin public health monitoring in Copco and Iron Gate reservoirs during 2011.

Location	Approximate River Mile	Site ID
Copco Reservoir at Mallard Cove ramp	201.5	CRMC
Copco Reservoir at Copco Cove ramp	200.0	CRCC
Iron Gate Reservoir at Camp Creek ramp	192.8	IRCC
Iron Gate Reservoir at John Williams campground	192.4	IRJW
Klamath River below Iron Gate dam near hatchery bridge	189.7	KRBI

Results

Samples of May 24, 2011

Five samples were collected for public health purposes on May 24, 2011 from shoreline stations in Copco and Iron Gate reservoirs and the Klamath River below Iron Gate dam. Aliquots were sent to the EPA Region 9 laboratory for analysis for Microcystin via ELISA, to Aquatic Analysts for cyanobacteria species identification and enumeration, and held for potential subsequent analysis for microcystin via LCMS.

The results of cyanobacteria species identification and enumeration are summarized in Table 2. No toxic cyanobacteria species were observed in these samples.

The results of micryocystin analysis are summarized in Table 3. All of the samples were non-detect except for the sample on Copco Reservoir at Copco Cove which had a concentration of 0.19 µg/L.

Table 2. Summary of cyanobacteria public health monitoring on May 24, 2010.					
Date	**Sample**	**Location**	**Species**	**Biovolume (μm^3/mL)**	**Cells/mL**
05/24/11	KR11800	CRMC	NA	0	0
05/24/11	KR11801	CRCC	NA	0	0
05/24/11	KR11802	IRCC	NA	0	0
05/24/11	KR11803	IRJW	NA	0	0
05/24/11	KR11804	CRCC	NA	0	0

Table 3. Summary of microcystin public health monitoring on May 24, 2010.				
Date	Sample	Location	Result	Units
5/24/2011	KR11800	CRMC	ND	µg/L
5/24/2011	KR11801	CRCC	ND	µg/L
5/24/2011	KR11802	IRCC	ND	µg/L
5/24/2011	KR11803	IRCJW	ND	µg/L
5/24/2011	KR11804	CRCC	0.19	µg/L

References

SWRCB. 2007. Cyanobacteria in California Recreational Water Bodies: Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification. June 2007. Document provided as part of Blue-green Algae Work Group of State Water Resources Control Board (SWRCB) and Office of Environmental Health and Hazard Assessment (OEHHA).

Appendix 1

Cumulative Species data for 2011 Public Health Samples.

Date	Sample	Location	Species	Biovolume, $\mu m^3/mL$	Cells/mL
05/24/11	KR11800	CRMC	*NA*	0	0
05/24/11	KR11801	CRCC	*NA*	0	0
05/24/11	KR11802	IRCC	*NA*	0	0
05/24/11	KR11803	IRJW	*NA*	0	0
05/24/11	KR11804	CRCC	*NA*	0	0

Appendix 2

Laboratory Data Sheets for May 24, 2011 Public Health Samples.

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 11800
Sample Depth:	
Sample Date:	24-May-11
Total Density (#/mL):	<10
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	No Toxic Algae Present	<10				

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** PM35

	Phytoplankton Sample Analysis						
	Sample:	Klamath Basin					
	Sample Site:	KR 11801					
	Sample Depth:						
	Sample Date:	24-May-11					
	Total Density (#/mL):	<3					
	Total Biovolume (um^3/mL):						
	Trophic State Index:						
		Density	**Density**	**Biovolume**	**Biovolume**		
	Species	**#/mL**	**Percent**	**um^3/mL**	**Percent**		**Group**
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1	No Toxic Algae Present	<3					
	Note: Toxic Algae Only						
	Aquatic Analysts			**Sample ID:**	PM36		

	Phytoplankton Sample Analysis						
	Sample:	Klamath Basin					
	Sample Site:	KR 11802					
	Sample Depth:						
	Sample Date:	24-May-11					
	Total Density (#/mL):	<10					
	Total Biovolume (um^3/mL):						
	Trophic State Index:						
		Density	**Density**	**Biovolume**	**Biovolume**		
	Species	**#/mL**	**Percent**	**um^3/mL**	**Percent**		**Group**
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1	No Toxic Algae Present	<10					
	Note: Toxic Algae Only						
	Aquatic Analysts			**Sample ID:**	PM37		

	Phytoplankton Sample Analysis						
	Sample:	Klamath Basin					
	Sample Site:	KR 11803					
	Sample Depth:						
	Sample Date:	24-May-11					
	Total Density (#/mL):	<10					
	Total Biovolume (um^3/mL):						
	Trophic State Index:						
		Density	**Density**	**Biovolume**	**Biovolume**		
	Species	**#/mL**	**Percent**	**um^3/mL**	**Percent**		**Group**
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1	No Toxic Algae Present	<10					
	Note: Toxic Algae Only						
	Aquatic Analysts			**Sample ID:**	PM38		

	Phytoplankton Sample Analysis						
	Sample:	Klamath Basin					
	Sample Site:	KR 11804					
	Sample Depth:						
	Sample Date:	24-May-11					
	Total Density (#/mL):	<3					
	Total Biovolume (um^3/mL):						
	Trophic State Index:						
		Density	**Density**	**Biovolume**	**Biovolume**		
	Species	**#/mL**	**Percent**	**um^3/mL**	**Percent**		**Group**
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1	No Toxic Algae Present	<3					
	Note: Toxic Algae Only						
	Aquatic Analysts			**Sample ID:**	PM39		