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June 29, 2007

## Technical Memorandum

### Copco/Iron Gate Reservoir Toxic Cyanobacteria Results: June 26-27<sup>th</sup>, 2007

To all concerned:

Recent phytoplankton cell count results for June-26<sup>th</sup>-27<sup>th</sup> were received from Aquatic Analysts (AA; see lab data sheets in Appendix I). Although additional stations and depths were sampled, Aquatic Analysts performed a “rush” analysis on surface samples from the red-labeled stations in Figure 1. Reservoir data are from the standard open-water sites IR01 and CR01; as well as two shoreline locations in Copco Reservoir (Copco Cove and Mallard Cove recreational access points CRCC and CRMC; Figure 1), and one in Iron Gate Reservoir (Jay Williams Boat Dock; IRJW; Figure 1). Samples from the Klamath River upstream from Copco (KRAC), directly downstream from Iron Gate (KRBI), at Seiad Valley (SV), and Orleans (OR) were also analyzed (Figure 1).

Toxigenic *Microcystis aeruginosa* (MSAE) increased substantially in both Copco and Iron Gate Reservoirs since the last sampling period of June 12-13 (Table 1). The open water station CR01 increased from 0 (non-detect) on June 13<sup>th</sup> to 18,910 cells/ml on June 27<sup>th</sup>, while the shoreline station CRCC increased by 12.6x to 4,578,497 cells/ml. The value at CRCC exceeds the California posting guidance level for MSAE by 114x (Table 1). Although lower than values on 6/13, CRCC continued to show *Anabaena flos-aquae* (ABFA) at a level of 30,283 cells/ml (previous Department of Health Services data from 2005 has shown the presence of anatoxin-a in the reservoir system). The station at Mallard Cove (CRMC) also exceeded the MSAE posting threshold with a value of 46,979 cells/ml.

MSAE levels at IR01 increased substantially (by 543.8x) to 3,856,736, and exceeded the posting level by 96x (Table 1). Although MSAE was not detected at the shoreline site IRJW, a photo of the northwestern shore of Iron Gate indicates that other shoreline areas were showing cyanobacterial scums on June 26<sup>th</sup> (photo labeled IRVIEW; Figure 2). No toxigenic cyanobacteria were detected at either the upstream station KRAC (above Copco Reservoir) or at any of the downstream stations (KRBI, SV, and OR; Table 1).

Data from the June 26-27<sup>th</sup>, 2007 sample period show that blooms of potentially toxic cyanobacteria have increased substantially, and that several stations showed MSAE levels that greatly exceeded (by 114 and 96x) the California harmful algal bloom public notification guidance level of 40,000 cell/ml (see Appendix II). ABFA levels at CRCC and IR01, although

elevated, were below the 100,000 cell/ml level for this species. The World Health Organization (WHO 2003) considers cyanobacterial scum formation (see Figure 2) in areas where whole-body contact and/or risk of ingestion/aspiration can occur to pose a high probability of adverse health effects.

Please let me know if you have any questions. Thank you.

Sincerely,

A handwritten signature in black ink, appearing to read 'Jacob Kann', with a long horizontal flourish extending to the right.

Jacob Kann, Ph.D.  
Aquatic Ecologist

***Disclaimer***

*Due to the patchy nature of blue-green algal blooms it is possible for higher *Microcystis aeruginosa* densities (and therefore higher microcystin toxin concentrations) to have been present in locations not covered in this survey, particularly along shorelines or protected coves and backwaters during calm conditions of little to no wind. Recreational users should always avoid contact with water whenever noticeable surface concentrations of algae are evident. Moreover, because pets or other domestic animals are the most likely to ingest contaminated water, these animals should not be allowed access to areas of either noticeable surface concentrations of algae or when an obvious green to blue-green appearance is evident*

WHO 2003. Chapter 8: Algae and Cyanobacteria in Fresh Water. *Pages 128-133* in: Volume 1: Coastal and Fresh Waters. World Health Organization, Geneva. ([http://www.who.int/water\\_sanitation\\_health/bathing/srwe1/en/](http://www.who.int/water_sanitation_health/bathing/srwe1/en/))

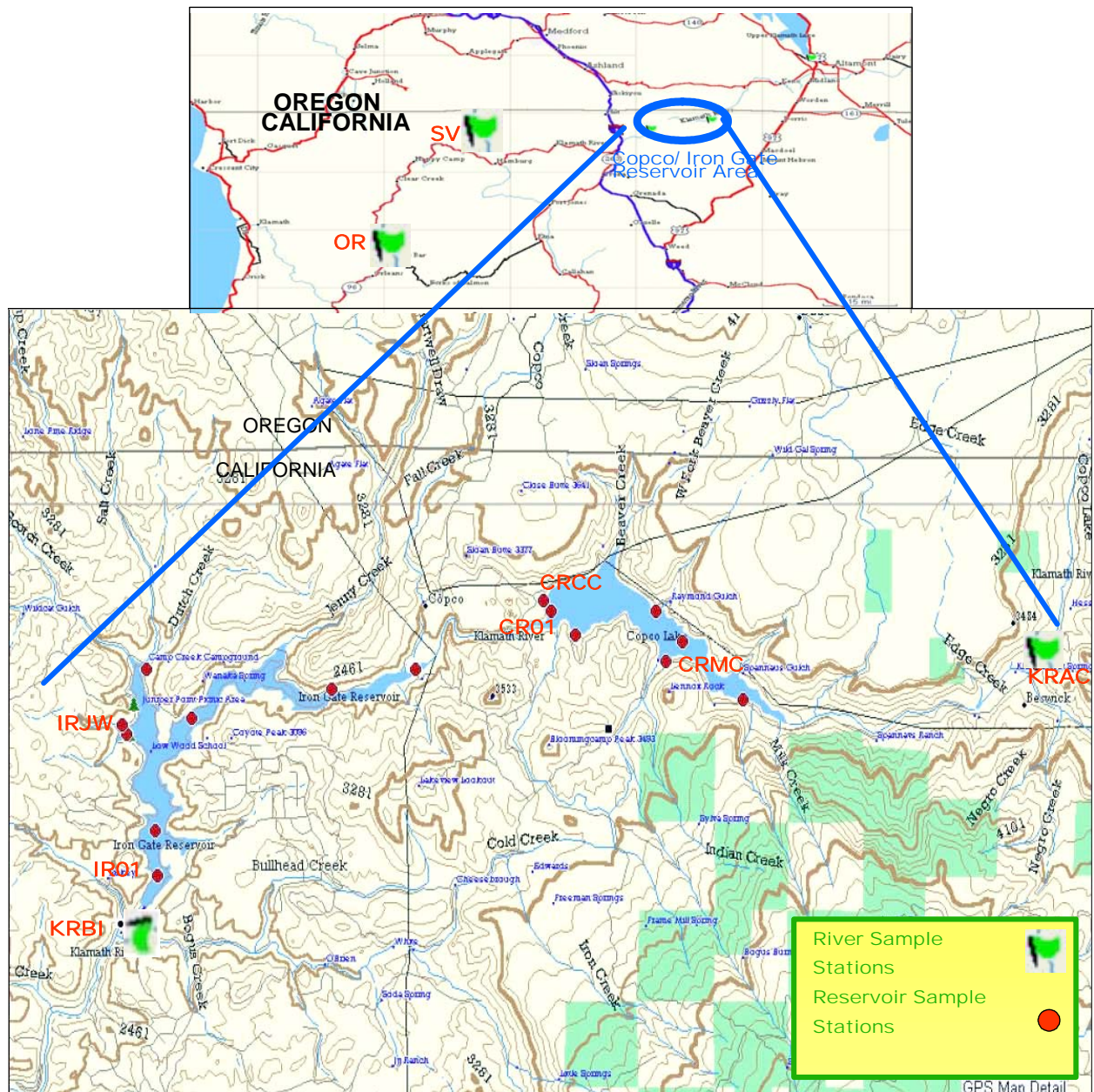


Figure 1. Location of Copco and Irongate Reservoir and Klamath River toxic cyanobacteria sampling/photo stations, 6-26 and 6/27, 2007 (only labeled stations analyzed for this report).

Table 1. Cell density and risk exceedance for toxigenic cyanobacteria in Copco and Irongate Reservoirs and the Klamath River, 2007.

DATE	STATION NAME	DEPTH	<i>Microcystis aeruginosa</i> (cells/ml)	<i>Planktothrix (Oscillatoria) sp.</i> (cells/ml)	<i>Anabaena sp.</i> (cells/ml)	Microcystin Total (µg/L)	Exceedance of SWRCB <sup>1</sup> risk level of 40,000 cells/ml <i>Microcystis</i> or <i>Planktothrix</i> (x greater than 4 <sup>5</sup> cells/ml)	Exceedance of SWRCB <sup>1</sup> risk level of 8 µg/L microcystin (x greater than 8 µg/L)	Exceedance of TDI of 0.04 µg/kg/day for a 40 lb (18kg) child ingesting 100 mls (x greater than TDI)
5/31/2007	IR01	0	12,528	0	863		0.31		
6/13/2007	KRAC	0	0	0	0		0		
6/12/2007	KRBI	0	0	0	0		0		
6/13/2007	CR01	0	0	0	2,747		0		
6/13/2007	CRCC	0	360,800	0	65,996		9.02		
6/13/2007	IR01	0	7,091	5,318	1,968		0.18		
6/27/2007	KRAC	0	0	0	0		0		
6/27/2007	CR01	0	18,910	0	0		0		
6/26/2007	CRCC	0	4,578,497	0	30,283		114		
6/27/2007	CRMC	0	46,979	0	542		1		
6/27/2007	IR01	0	3,856,736	0	11,808		96		
6/26/2007	IRJW	0	0	0	168		0		
6/26/2007	KRBI	0	0	0	0				
6/26/2007	SV	0	0	0	0				
6/26/2007	OR	0	0	0	0				

<sup>1</sup>From: Blue Green Algae Work Group of the State Water Resources Control Board and Office of Environmental Health and Hazard Assessment:

*Cyanobacteria in California Recreational Water Bodies Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification (DRAFT June 2007)*



CR01



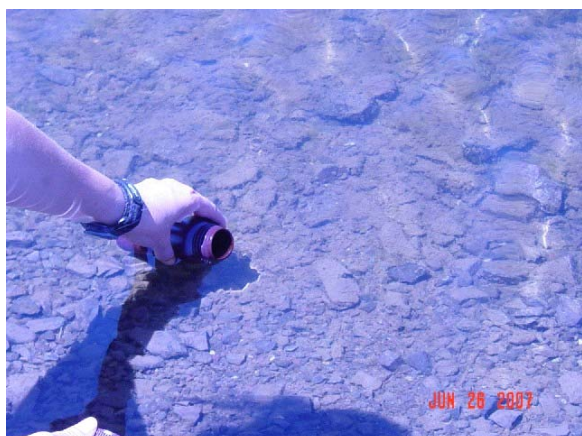
CRCC



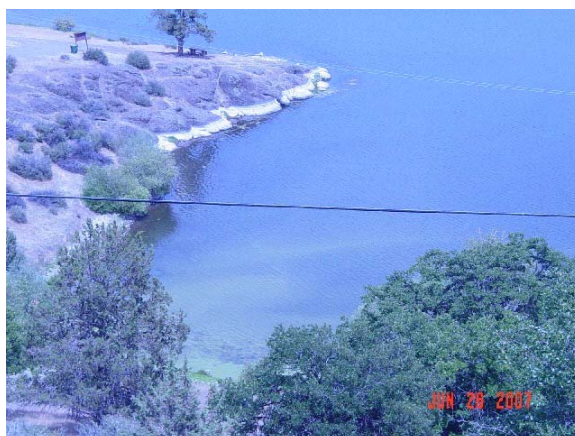
IR01



IR01



IRJW



IRVIEW

Figure 2. Bloom conditions in Copco and Iron Gate Reservoirs, June 26-27<sup>th</sup>, 2007.

## Appendix I: Aquatic Analysts Phytoplankton Lab Sheets

### Phytoplankton Sample

#### Analysis

**Sample:** Klamath River  
**Sample Station:** KRAC  
**Sample Depth:** 0C  
 27-Jun-  
**Sample Date:** 07

**Total Density (#/mL):** 568  
**Total Biovolume ( $\mu\text{m}^3/\text{mL}$ ):** 232,994  
**Trophic State Index:** 39.4

Species	Density #/mL	Density Percent	Biovolume $\mu\text{m}^3/\text{mL}$	Biovolume Percent
-	-	-	-	-
Rhoicosphenia curvata	95	16.7	11,075	4.8
Nitzschia frustulum	89	15.7	10,690	4.6
Aphanizomenon flos-aquae	61	10.8	42,444	18.2
Cocconeis placentula	50	8.8	23,051	9.9
Navicula cryptocephala veneta	39	6.9	3,703	1.6
Nitzschia dissipata	33	5.9	8,987	3.9
Navicula tripunctata	28	4.9	31,180	13.4
Diatoma vulgare	22	3.9	43,652	18.7
Gomphonema angustatum	22	3.9	4,009	1.7
Nitzschia amphibia	22	3.9	2,138	0.9
Fragilaria vaucheria	11	2.0	4,811	2.1
Achnanthes minutissima	11	2.0	557	0.2
Achnanthes lanceolata	11	2.0	2,004	0.9
Melosira granulata	11	2.0	15,312	6.6
Nitzschia paleacea	11	2.0	1,637	0.7
Cryptomonas erosa	11	2.0	5,791	2.5
Gomphonema clevei	6	1.0	501	0.2
Melosira varians	6	1.0	3,619	1.6
Navicula minuscula	6	1.0	251	0.1
Caloneis sp.	6	1.0	1,336	0.6
Nitzschia innominata	6	1.0	267	0.1
Cymbella tumida	6	1.0	13,920	6.0
Cymbella minuta	6	1.0	2,060	0.9

Aphanizomenon flos-aquae cells/mL = 674

Aquatic Analysts

Sample ID: KP61

### Phytoplankton Sample

#### Analysis

**Sample:** Copco Res  
**Sample Station:** CRMC  
**Sample Depth:** SG  
**Sample Date:** 27-Jun-07

**Total Density (#/mL):** 1,590  
**Total Biovolume (um<sup>3</sup>/mL):** 843,854  
**Trophic State Index:** 48.6

Species	Density #/mL	Density Percent	Biovolume um <sup>3</sup> /mL	Biovolume Percent
-	-	-	-	-
Microcystis aeruginosa	470	29.5	375,833	44.5
Rhodomonas minuta	271	17.0	5,421	0.6
Cryptomonas erosa	181	11.4	93,958	11.1
Nitzschia frustulum	181	11.4	23,851	2.8
Cocconeis placentula	72	4.5	33,247	3.9
Gomphonema subclavatum	54	3.4	32,524	3.9
Nitzschia amphibia	36	2.3	3,469	0.4
Chromulina sp.	36	2.3	723	0.1
Rhoicosphenia curvata	36	2.3	4,228	0.5
Anabaena flos-aquae	36	2.3	36,319	4.3
Aphanizomenon flos-aquae	36	2.3	22,767	2.7
Melosira granulata	36	2.3	99,379	11.8
Nitzschia paleacea	36	2.3	3,542	0.4
Melosira varians	18	1.1	23,490	2.8
Scenedesmus quadricauda	18	1.1	4,698	0.6
Chlamydomonas sp.	18	1.1	5,872	0.7
Nitzschia sp.	18	1.1	2,168	0.3
Synedra ulna	18	1.1	71,914	8.5
Ankistrodesmus falcatus	18	1.1	452	0.1

Microcystis aeruginosa cells/mL = 46,979

Anabaena flos-aquae cells/mL = 542

Aphanizomenon flos-aquae cells/mL = 361

**Aquatic Analysts**

**Sample ID:** KP47

### Phytoplankton Sample Analysis

**Sample:** Copco Res  
**Sample Station:** CRCC  
**Sample Depth:** SG  
**Sample Date:** 26-Jun-07

**Total Density (#/mL):** 54,798  
**Total Biovolume (um<sup>3</sup>/mL):** 50,402,044  
**Trophic State Index:** 78.1

Species	Density #/mL	Density Percent	Biovolume um <sup>3</sup> /mL	Biovolume Percent
-	-	-	-	-
Microcystis aeruginosa	45,785	83.6	36,627,978	72.7
Chlamydomonas sp.	3,966	7.2	1,288,829	2.6
Gomphoneis herculeana	1,442	2.6	7,787,050	15.4
Anabaena flos-aquae	1,082	2.0	1,956,496	3.9
Cymbella mexicana	361	0.7	1,982,814	3.9
Staurastrum sp.	361	0.7	86,523	0.2
Sphaerocystis Schroeteri	361	0.7	201,886	0.4
Nitzschia frustulum	361	0.7	43,261	0.1
Aphanizomenon flos-aquae	361	0.7	227,122	0.5
Navicula cryptocephala veneta	361	0.7	34,249	0.1
Cocconeis placentula	361	0.7	165,835	0.3

Microcystis aeruginosa cells/mL = 4,578,497

Aphanizomenon flos-aquae cells/mL = 3,605

Anabaena flos-aquae cells/mL = 29,201

Anabaena flos-aquae heterocysts/mL = 1,082

**Aquatic Analysts**

**Sample ID:** KP46



**Phytoplankton Sample****Analysis**

**Sample:** Copco Res  
**Sample Station:** CR01  
**Sample Depth:** 0  
**Sample Date:** 27-Jun-07

**Total Density (#/mL):** 388  
**Total Biovolume (um<sup>3</sup>/mL):** 286,026  
**Trophic State Index:** 40.8

<b>Species</b>	<b>Density #/mL</b>	<b>Density Percent</b>	<b>Biovolume um<sup>3</sup>/mL</b>	<b>Biovolume Percent</b>
-	-	-	-	-
Microcystis aeruginosa	189	48.8	151,279	52.9
Cocconeis placentula	38	9.8	17,397	6.1
Chromulina sp.	28	7.3	567	0.2
Melosira granulata	24	6.1	85,803	30.0
Cryptomonas erosa	24	6.1	12,291	4.3
Ankistrodesmus falcatus	19	4.9	473	0.2
Fragilaria pinnata	9	2.4	567	0.2
Chlamydomonas sp.	9	2.4	3,073	1.1
Rhodomonas minuta	9	2.4	189	0.1
Sphaerocystis schroeteri	9	2.4	5,295	1.9
Fragilaria vaucheria	5	1.2	1,362	0.5
Cymbella minuta	5	1.2	1,749	0.6
Navicula pupula	5	1.2	1,276	0.4
Stephanodiscus astraea minutula	5	1.2	1,655	0.6
Schroderia sp.	5	1.2	213	0.1
Gomphonema subclavatum	5	1.2	2,836	1.0

Microcystis aeruginosa cells/mL = 18,910

**Aquatic Analysts**

**Sample ID:** KP42

### Phytoplankton Sample

#### Analysis

**Sample:** Klamath River  
**Sample Station:** KRBI  
**Sample Depth:** 0C  
**Sample Date:** 26-Jun-07

**Total Density (#/mL):** 272  
**Total Biovolume (um<sup>3</sup>/mL):** 112,739  
**Trophic State Index:** 34.2

Species	Density #/mL	Density Percent	Biovolume um <sup>3</sup> /mL	Biovolume Percent
-	-	-	-	-
Rhodomonas minuta	69	25.3	1,378	1.2
Cocconeis placentula	34	12.6	15,848	14.1
Cryptomonas erosa	34	12.6	17,915	15.9
Chromulina sp.	31	11.5	626	0.6
Ankistrodesmus falcatus	25	9.2	626	0.6
Rhoicosphenia curvata	19	6.9	2,858	2.5
Cryptomonas ovata	13	4.6	21,635	19.2
Gomphonema subclavatum	9	3.4	9,584	8.5
Schroderia sp.	6	2.3	282	0.3
Diatoma vulgare	6	2.3	18,416	16.3
Gomphonema angustatum	6	2.3	1,128	1.0
Navicula cryptocephala veneta	6	2.3	595	0.5
Gomphoneis herculeana	3	1.1	16,913	15.0
Melosira varians	3	1.1	4,072	3.6
Nitzschia amphibia	3	1.1	301	0.3
Nitzschia palea	3	1.1	564	0.5

**Aquatic Analysts**

**Sample ID:** KP63

**Phytoplankton Sample****Analysis**

**Sample:** Klamath Basin  
**Sample Station:** SV  
**Sample Depth:** 0C  
**Sample Date:** 26-Jun-07

**Total Density (#/mL):** 9,664  
**Total Biovolume (um<sup>3</sup>/mL):** 3,568,499  
**Trophic State Index:** 59.0

<b>Species</b>	<b>Density #/mL</b>	<b>Density Percent</b>	<b>Biovolume um<sup>3</sup>/mL</b>	<b>Biovolume Percent</b>
-	-	-	-	-
Cocconeis placentula	2,915	30.2	1,340,728	37.6
Achnanthes minutissima	1,764	18.3	88,206	2.5
Nitzschia frustulum	997	10.3	119,653	3.4
Diatoma vulgare	537	5.6	1,052,333	29.5
Diatoma tenue	460	4.8	133,459	3.7
Rhoicosphenia curvata	384	4.0	44,870	1.3
Navicula cryptocephala	307	3.2	56,759	1.6
Navicula cryptocephala veneta	230	2.4	21,860	0.6
Cymbella sinuata	230	2.4	32,214	0.9
Cymbella affinis	230	2.4	414,184	11.6
Nitzschia amphibia	230	2.4	22,090	0.6
Nitzschia communis	230	2.4	10,355	0.3
Navicula sp.	153	1.6	23,010	0.6
Stephanodiscus hantzschii	153	1.6	18,408	0.5
Nitzschia dissipata	153	1.6	41,265	1.2
Achnanthes lanceolata	153	1.6	27,612	0.8
Nitzschia innominata	77	0.8	3,682	0.1
Nitzschia paleacea	77	0.8	7,517	0.2
Gomphonema angustatum	77	0.8	13,806	0.4
Navicula viridula	77	0.8	34,515	1.0
Achnanthes clevei	77	0.8	11,505	0.3
Fragilaria vaucheria	77	0.8	22,090	0.6
Cymbella minuta	77	0.8	28,379	0.8

**Aquatic Analysts****Sample ID:** KP60

**Phytoplankton Sample****Analysis**

**Sample:** Klamath Basin  
**Sample Station:** OR  
**Sample Depth:** 0C  
**Sample Date:** 26-Jun-07

**Total Density (#/mL):** 474  
**Total Biovolume (um<sup>3</sup>/mL):** 226,043  
**Trophic State Index:** 39.1

<b>Species</b>	<b>Density #/mL</b>	<b>Density Percent</b>	<b>Biovolume um<sup>3</sup>/mL</b>	<b>Biovolume Percent</b>
-	-	-	-	-
Cocconeis placentula	173	36.5	79,631	35.2
Achnanthes minutissima	82	17.3	4,100	1.8
Rhoicosphenia curvata	36	7.7	5,117	2.3
Diatoma vulgare	36	7.7	78,574	34.8
Navicula tripunctata	18	3.8	20,409	9.0
Diatoma tenue	14	2.9	3,963	1.8
Navicula cryptocephala veneta	14	2.9	1,298	0.6
Cymbella sinuata	14	2.9	1,913	0.8
Cymbella minuta	14	2.9	5,057	2.2
Amphora perpusilla	9	1.9	1,512	0.7
Navicula cryptocephala	9	1.9	1,686	0.7
Coelastrum microporum	5	1.0	4,373	1.9
Stephanodiscus hantzschii	5	1.0	547	0.2
Cyclotella meneghiniana	5	1.0	1,731	0.8
Chromulina sp.	5	1.0	91	0.0
Nitzschia communis	5	1.0	205	0.1
Gomphonema angustatum	5	1.0	820	0.4
Nitzschia frustulum	5	1.0	1,093	0.5
Navicula decussis	5	1.0	875	0.4
Synedra ulna	5	1.0	9,066	4.0
Chlamydomonas sp.	5	1.0	1,481	0.7
Nitzschia dissipata	5	1.0	1,225	0.5
Nitzschia acicularis	5	1.0	1,276	0.6

**Aquatic Analysts****Sample ID:** KP56

**Phytoplankton Sample**

**Analysis**

**Sample:** Irongate  
**Res**  
**Sample Station:** IRJW  
**Sample Depth:** SG  
**Sample Date:** 26-Jun-07

**Total Density (#/mL):** 1,488  
**Total Biovolume (um<sup>3</sup>/mL):** 542,473  
**Trophic State Index:** 45.4

Species	Density #/mL	Density Percent	Biovolume um <sup>3</sup> /mL	Biovolume Percent
1 Cocconeis placentula	322	21.6	148,186	27.3
2 Cryptomonas erosa	245	16.5	127,630	23.5
3 Chromulina sp.	199	13.4	3,988	0.7
4 Rhodomonas minuta	169	11.3	3,375	0.6
5 Nitzschia frustulum	138	9.3	18,224	3.4
6 Ankistrodesmus falcatus	61	4.1	1,534	0.3
7 Nitzschia paleacea	46	3.1	4,510	0.8
8 Nitzschia amphibia	46	3.1	4,418	0.8
9 Cryptomonas ovata	31	2.1	52,985	9.8
10 Rhoicosphenia curvata	31	2.1	3,590	0.7
11 Fragilaria construens	31	2.1	17,181	3.2
12 Fragilaria capucina mesolepta	15	1.0	31,294	5.8
13 Melosira varians	15	1.0	29,913	5.5
14 Fragilaria construens venter	15	1.0	5,154	1.0
15 Anabaena planctonica	15	1.0	28,072	5.2
16 Chlamydomonas sp.	15	1.0	4,986	0.9
17 Glenodinium sp.	15	1.0	10,738	2.0
18 Amphora ovalis	15	1.0	8,867	1.6
19 Navicula sp.	15	1.0	2,301	0.4
20 Fragilaria vaucheria	15	1.0	8,836	1.6
21 Gomphonema subclavatum	15	1.0	9,204	1.7
22 Epithemia sorex	15	1.0	17,488	3.2

Anabaena planctonica cells/mL = 153  
 Anabaena planctonica heterocysts/mL = 15

**Aquatic Analysts**

**Sample ID:** KP53

### Phytoplankton Sample Analysis

Sample: Irongate  
 Res  
 Sample Station: IR01  
 Sample Depth: 0  
 Sample Date: 27-Jun-07

Total Density (#/mL): 17,332  
 Total Biovolume (um<sup>3</sup>/mL): 32,889,861  
 Trophic State Index: 75.0

Species	Density #/mL	Density Percent	Biovolume um <sup>3</sup> /mL	Biovolume Percent
-	-	-	-	-
Microcystis aeruginosa	10,285	59.3	30,853,885	93.8
Rhodomonas minuta	1,905	11.0	38,091	0.1
Chlamydomonas sp.	1,905	11.0	618,982	1.9
Sphaerocystis Schroeteri	952	5.5	466,617	1.4
Chromulina sp.	762	4.4	15,236	0.0
Anabaena flos-aquae	762	4.4	765,633	2.3
Nitzschia frustulum	381	2.2	68,564	0.2
Navicula sp.	190	1.1	28,568	0.1
Nitzschia palea	190	1.1	34,282	0.1

Microcystis aeruginosa cells/mL = 3,856,736

Anabaena flos-aquae cells/mL = 11,427

Anabaena flos-aquae heterocysts/mL = 381

**Aquatic Analysts**

**Sample ID:** KP48

**Appendix II**

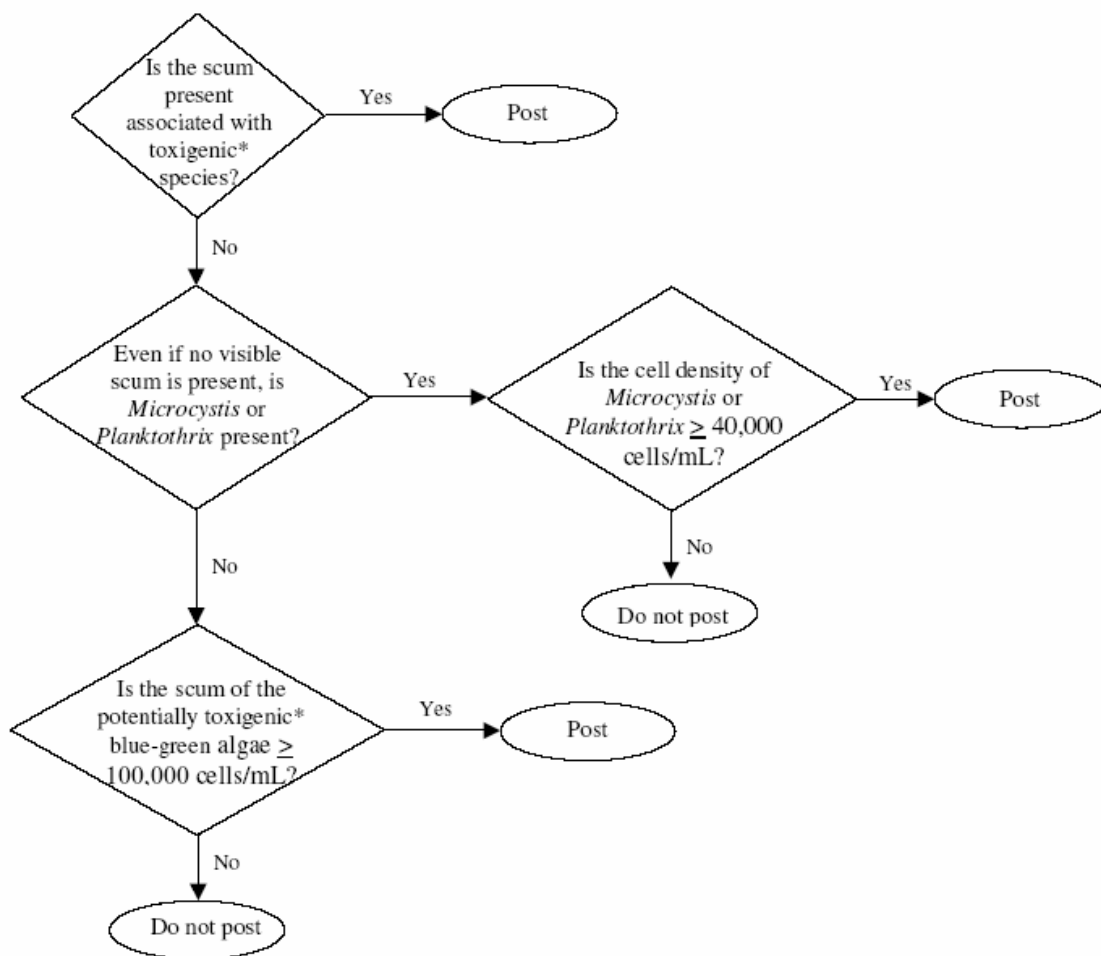
From: Blue Green Algae Work Group of the State Water Resources Control Board and Office of Environmental Health and Hazard Assessment

*Cyanobacteria in California Recreational Water Bodies Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification (DRAFT June 2007)*

<http://www.waterboards.ca.gov/bluegreenalgae/index.html>

Posting Decisions:

- If visible scum is present: Post warning signs and distribute informational brochures.
- When sampling with microbial identification is available, the following decision chart is recommended:



\*Potentially toxic blue-green algae that have been detected in California include those of the genera *Anabaena*, *Microcystis*, *Aphanizomenon*, and *Gloeotrichia*. Additional blue-green algae that are known to be potentially toxic may be added to this list.

