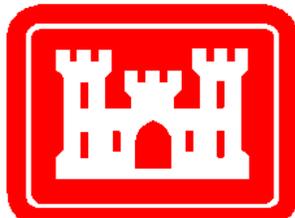


Annual Water Quality Report

LAKE SONOMA

Water Year 2002



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Lake Sonoma

I. Purpose

This report is part of an environmental monitoring program that restarted at Lake Sonoma in April 1985. The monitoring program was implemented to both ensure a continuous level of water quality in the lake for recreation and environmental health and to satisfy the Department of Army Engineering Regulation 1110-2-8154, “Water Quality and Environmental Management for Corps Civil Works Projects”.

II. Brief Description of Lake Sonoma

Lake Sonoma is located in the northern coast range of California, eleven miles northwest of Healdsburg, California. The lake was created by the completion of Warm Springs Dam in 1983. At capacity, the lake has 2,700 surface acres and is held in place by a dam that is 319 feet high and 3,000 feet long. The structure provides flood damage reduction and water conservation. Since being built for flood control and irrigation, the lake has also become a popular destination for recreation.

Water quality monitoring by the United States Army Corps of Engineers (USACE) began at Lake Sonoma in April 1985. Generally there are two sample events a year, spring (April) and late summer (August). Since the start of the monitoring program, a water quality report is produced yearly to list results and address any concerns of the previous water year.

Generally, Lake Sonoma has a depth of less than 250 feet during the sampling events, and is considered a mesotrophic lake when characterized by its clarity. A mesotrophic lake is one that has physical qualities in between an oligotrophic (clear and nutrient limited, example Lake Tahoe) and a eutrophic lake (low clarity and high in nutrients, example Clear Lake). Lake Sonoma is able to maintain the dissolved oxygen in its bottom waters near 5 mg/L during warm summer months. Lake Sonoma is cool (<20°C) in the late summer ~ 50 feet below the water surface. Due to the cool water temperatures and the relatively high summer dissolved oxygen concentration, coldwater fish species should be able to survive in Lake Sonoma . Although clearer than eutrophic (nutrient rich) lakes, mesotrophic lakes can have low water clarity due to algal blooms and sediments suspended by wind action. Water clarity is often measured in terms of Secchi Disc depth or SD (Appendix A). Historically, the water clarity in Lake Sonoma is very good with only ~2 % of the samples not meeting the recreational goal of 4 feet or greater (Figure 1). In 2001 the Spring SD measure was 15.58 feet and the late summer sample event had a SD of 10.67 feet.

III. Sample Summaries for this year.

Introduction

The following general summaries are split into their respective sample types. Each type of sample summary includes a discussion of both the spring (April) and late summer (August) samples to better examine trends within the current year. The types of parameters monitored this year include: Secchi Disc depths, water column profiles (temperature, DO and pH), phytoplankton characterization, metals concentrations, MTBE concentrations, and Inorganic characterization (alkalinity, phosphorous, nitrogen, etc.). Fish mercury sampling was not performed in 2002 due to coordination difficulties. For a more detailed explanation of the importance of each type of sample, please see Appendix A.

SECCHI DEPTH

The Secchi Disc depth found during the spring sampling events was higher than the historical average (historical mean SD = 8.3 feet), while the late summer Secchi depth was lower than the average. More often the clarity is better in the late summer than in the late spring, but it wasn't true of this year. At the spring sampling event the water clarity was high (Spring 2002 SD = 18.0 feet), which was better than the previous year (2001 Spring SD = 15.58 feet). The late summer SD of 11.58 feet was above the recreational goal of 4 feet and slightly higher than the previous year (Summer 2001 SD = 10.67) (Appendix B).

TEMPERATURE VALUES

The temperature profiles for Lake Sonoma are indicative of a well stratified lake. The lake appears to remain stratified through the warm temperatures of late summer. The lake water depth difference between the spring and late summer sampling events (spring depth = 216.5 feet, late summer depth = 223.1 feet) was minimal. While the surface temperatures were very different (spring surface temp. = 16.83 °C, late summer surface temp. = 22.71 °C), the average temperature for the lake was not much different (spring average temp. = 11.41 °C, late summer average temp. = 13.4 °C). Lake Sonoma is able to regulate its temperature due to having a cooler deep-water area throughout the year to buffer it from the warm summer air temperatures. It is likely that Lake Sonoma would be able to support coldwater fish species. For detailed results obtained during the sampling events, please see Appendix B.

DISSOLVED OXYGEN

The dissolved oxygen (DO) concentration in the lake differs greatly from spring to late summer. In the spring DO concentrations are 11.56 mg/L near the surface and 8.16 mg/L at the bottom of the lake. DO concentrations near the surface are reflect super saturation (DO saturation is 9.69 mg/L at 16.83 °C). Super saturation is caused by oxygen production during phytoplankton photosynthesis. DO concentrations in the late summer were highest near the surface (DO = 6.15mg/l) and was lowest near the middle of the lake (DO = 4.53 mg/L). Fish species that require greater than 5 mg/l DO at cooler water temperatures (< 20°C) should be able to survive year round in Lake Sonoma. For detailed results obtained during the sampling events, please see Appendix B.

PH Values

In the spring sampling event pH values in the lake were slightly basic throughout the water column. In the spring the highest pH was near the surface (Spring 2002 surface pH = 7.8) and the lowest was at the bottom (Spring 2002 bottom pH = 7.35). The pH values in the late summer profile varied widely and on average less basic and a region of slightly acidic pH was located at the bottom. The pH was most basic towards the middle waters (Late Summer 2002 max pH = 7.73) and slightly acidic bottom (Late Summer 2002 pH bottom = 6.83). For detailed results obtained during the sampling events, please see Appendix B.

PHYTOPLANKTON

In the spring sample, the algal biomass within the lake was higher than spring 2001 biomass values (2002 spring biomass = 155.75 ug/L ; 2001 spring biomass = 41.60 ug/L). In spring 2002 diatoms were the most dominant species, while in spring 2001 green algae was most plentiful. In late summer an opposite trend occurred. The phytoplankton population was lower in summer 2002 (2002 Summer Biomass = 173.44 ug/L) than summer 2001 (2001 Summer Biomass = 203.17 ug/L). In late summer 2002, diatoms had the largest population. Dinoflagellates were the most dominant species in the summer 2001 sample. For detailed results obtained during the 2002 sampling events, please see Appendix C.

METALS

None of the dissolved heavy metal samples exceeded the maximum contaminant level (MCL) or the freshwater fishery criteria during the 2002 spring and summer sampling events. Contaminants will continue to be monitored in the coming year for any changes. For detailed results obtained during the sampling events, please see Appendix D.

MTBE

The highest concentration of MTBE in both spring and late summer sampling events (MTBE high =3 ppb) was just above the detection limit of 2 ppb. Due to being found at such low concentrations, MTBE was not a contaminant of concern in 2002. For detailed results obtained during the sampling events, please see Appendix F.

INORGANIC ANALYSIS

The spring and summer sample results were within expected ranges and levels. For detailed results obtained during the 2002 sampling events, please see Appendix E.

IV. Conclusions

Lake Sonoma is a mesotrophic lake that can support both warmwater and coldwater fish species. Both temperatures and dissolved oxygen concentrations are maintained at levels adequate for the various fish species to thrive.

In the 2002, Lake Sonoma sampling results indicated that there were no contaminants of concern. An area that requires improvement is the coordination of fish sampling so that data will be available for the 2003 water quality report. This is especially important since it was listed as a contaminant of concern in the 2001 Water Quality Report.

V. References

- North American Lake Management Society (1990). *Lake and Reservoir Restoration Guidance Manual*, EPA 440/4-90-006, U.S. Environmental Protection Agency, Washington, DC.
- Novotny, V., and H. Olem (1994). *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*, Van Nostrand Reinhold, New York, New York.
- Tchobanoglous, G., F. L. Burton, and H. D. Stensel (2003) *Wastewater engineering: treatment and reuse / Metcalf & Eddy, Inc.*, McGraw-Hill, Boston, MA.
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- Wetzel, R.G. (1975). *Limnology*, W.B. Saunders Company, Philadelphia, PA.

VI. Appendices

Appendix A: Glossary of Sample Types

Glossary of Sample Types

This glossary of sample types is intended to provide a general background and indicate the importance of each sample in determining water quality. These are meant to be brief and basic. If a further explanation is desired please refer to the list of references provided in this report.

Secchi Depth

One of the oldest and easiest methods to determine lake clarity is the Secchi depth (SD). The Secchi depth is determined by dropping a Secchi disc into a water body and determining the depth that it is last visible from the surface of the water. Secchi discs are generally white and 20 cm in diameter. Secchi depth values are most impacted by the light intensity at the time of sampling and the scattering of light by solid particulates within the water column. Algal growth (phytoplankton) and sediment re-suspension are often major constituents of solid particulates within the water column. Secchi depth values can be used to estimate the Trophic state or the nutrient levels within the lake. The more nutrients are available, the larger likelihood of algal blooms that limit water clarity. Due to recreational concerns for safety, the goal for Secchi depth values is four feet or greater.

Temperature Profiles and Data Points

The temperature profile of a lake provides information how a lake is operating and the potential for aquatic biota to live within the lake. The temperature profile is a direct indicator if a lake is stratified. Stratification in lakes is created generally by temperature affecting the density of water molecules. Stratification is usually indicated by a region of similar temperature nearer the surface of the water (epilimnion), then a region of temperature transition (metalimnion), to another layer of nearly constant temperature at the bottom of the lake (hypolimnion). Each layer in a stratified lake is important, but the existence of a hypolimnion can drastically impact how well a lake can handle warmer temperatures such as those found in northern California during the summer. The hypolimnion acts as a buffer against large temperature shifts. The nature of dam operation is that water is discharged near the bottom, releasing the hypolimnion, and eliminating stratification. This operation limits the ability of reservoirs to regulate their temperature during the summer months. Stratification isn't always desirable. When a lake isn't stratified and is instead well mixed, the required nutrients near the bottom of the lake become available to phytoplankton for growth. Temperatures within lakes also indicate which species of fish will survive within a lake. Coldwater species of fish require temperatures below 20 degrees C in order to spawn and survive. If a lake is often above 20 degrees C, then only warmwater fish species will survive.

Dissolved Oxygen (DO) Concentration Profiles

DO is required by organisms for respiration and for chemical reactions within lake waters. The recommended level for DO for most aquatic species survival is 5mg/L. In lakes, biota waste (detritus) falls to the bottom of the lake to be utilized by bacteria. The bacteria need oxygen and will deplete levels near the bottom of a lake, especially during

warm temperature, high respiration conditions. For nutrient rich (eutrophic) lakes more organisms will grow, create wastes, and cause oxygen depleted regions at the lowest areas. Under these conditions only aquatic species that can survive low DO conditions in warm water near the surface will survive.

PH Profiles

The pH profiles of the lakes indicate the potential for certain chemical reactions to occur. In high pH (greater than pH = 7 or basic) aquatic systems, metal pollutants tend to form into insoluble compounds that fall onto the lake floor. In low pH (less than pH = 7 or acidic) systems or areas metal ions become soluble and available for uptake into aquatic organisms. Other compounds like ammonia that are introduced into a low pH aquatic environment will transform into soluble nitrate and be utilized by organisms.

Phytoplankton Analysis

Phytoplankton analysis indicates the health, nutrients, and biodiversity within a lake. Lakes that have few nutrients available (Oligotrophic) will generally have a much lower quantity of phytoplankton (high Secchi depth) but the number of phytoplankton species seen will be large. In a lake that is nutrient rich (eutrophic) there are generally large phytoplankton blooms (low Secchi depth), but they are made up of a couple of phytoplankton species. Certain species of phytoplankton are preferred food sources for zooplankton (small invertebrates). Generally species like diatoms and green algae can be consumed by the filter-feeding zooplankton, but species like bluegreen algae are low in nutrients and are difficult to consume. Some species like the dinoflagellates can grow horn like points to discourage potential predators. In nutrient rich waters where there is plenty of phosphorous, nitrogen can be limited for biological growth. While most species can't grow due to the lack of nitrogen, bluegreen algae (cyanobacteria) have the ability to utilize nitrogen from the atmosphere when required. This gives bluegreen algae the ability to dominate in many eutrophic lakes.

Soluble Metals Analysis

The soluble metals analysis indicates the exposure of humans and aquatic organisms to toxic metals. These metals often build up as they are consumed through the food chain. Water samples provide an indicator for additional problems. Soluble forms of metal ions are more prevalent in low pH (pH <7, or acidic) environments.

MTBE Analysis

MTBE (methyl tertiary-butyl ether) is a chemical additive to gasoline to improve combustion. Due to its high solubility, MTBE travels and blends into aquatic systems rapidly. While not found to be extremely hazardous at low levels, the offensive smell and taste is detectible by humans at extremely low concentrations. The effect of MTBE on humans and aquatic systems is still under investigation.

Inorganic Analysis

Alkalinity

Alkalinity is measured in terms of mg/L of calcium carbonate. It indicates a lakes ability to buffer incoming acidic pollution and situational changes.

Ammonia

Ammonia is a gas that is toxic to fish and is more visible at a higher pH. Ammonia is created through anthropogenic inputs, bacteria cell respiration, and the decomposition of dead cells. Due to being a gas, given time ammonia will volatilize from the water. At a lower pH, much of the ammonia is converted to ammonium (a nutrient for root bound plant life) and utilizes DO in the nitrification process.

Chloride

The chloride ion is an indicator of any salinity increases within a lake. Most fresh water aquatic species are sensitive to salinity changes.

Nitrate

Nitrate is the nitrogen product created through the nitrification of ammonium. Nitrate is a soluble form of the nutrient nitrogen and is utilized by phytoplankton.

Total Phosphorous

The total phosphorous provides a measure of both utilized and soluble phosphorous within water samples. Phosphorous is a required nutrient for plant growth and development.

Ortho Phosphorous

Ortho phosphorous is the soluble form of phosphorous that is utilized by free-floating aquatic plants (phytoplankton).

Kjeldahl N

Kjeldahl nitrogen or total Kjeldahl nitrogen (TKN) is a measure of the total concentration of nitrogen in a sample. This includes ammonia, ammonium, nitrite, nitrate, nitrogen gas, and nitrogen contained within organisms.

COD

Chemical Oxygen Demand (COD) is a measure of the total oxygen required to complete the chemical and biological demands of a sample.

Fish Tissue Analysis

Fish tissue is analyzed to examine potential exposure of humans to toxicants as well as the health of the aquatic food chain. In aquatic systems toxic contaminants can build up (or bioaccumulate) within animals at the top of the food chain. Contaminants (especially organic pollutants) are retained within the fat tissue of an organism, therefore in fish samples the lipid content is often measured.

Lake Code Designation

Laboratory Reports are provided in the previous sections.

Sample ID is “XX-YY-ZZ” where

XX designation:

BB for Black Butte

EA for Eastman

EN for Englebright

HE for Hensley

IS for Isabella

KA for Kaweah

ME for Mendocino

MC for Martis Creek

NH for New Hogan

PF for Pine Flat

SO for Sonoma

SU for Success

YY designation

SP for Spring

SU for Summer

ZZ designation

S for surface of Lake

B for bottom of Lake

I-1 for inflow 1

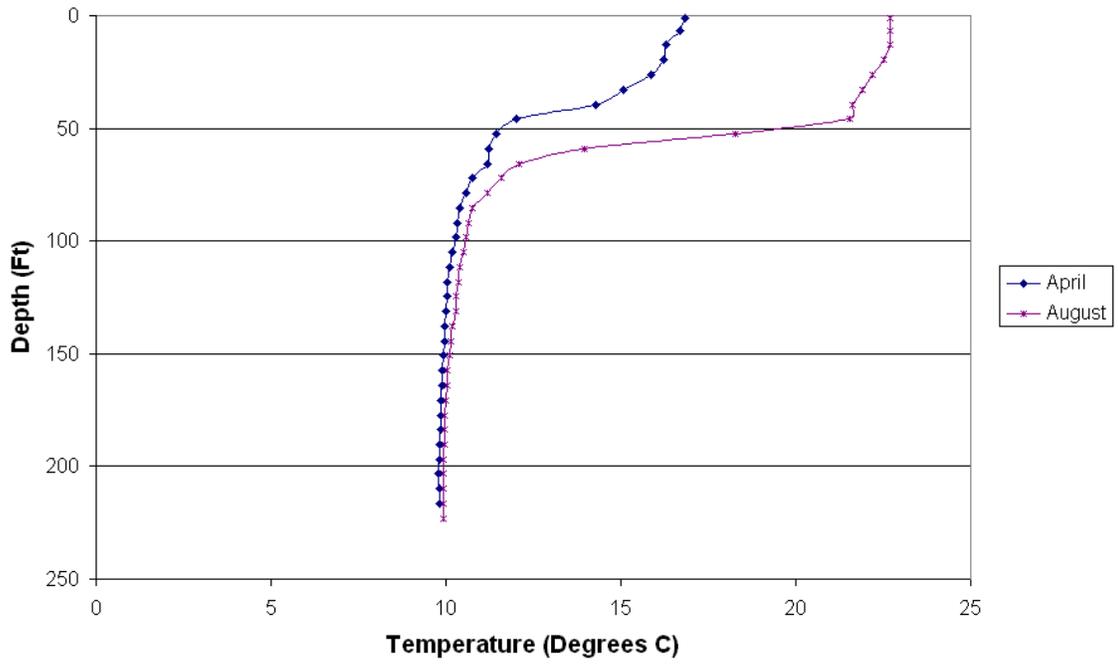
I-2 for inflow 2

O for outflow

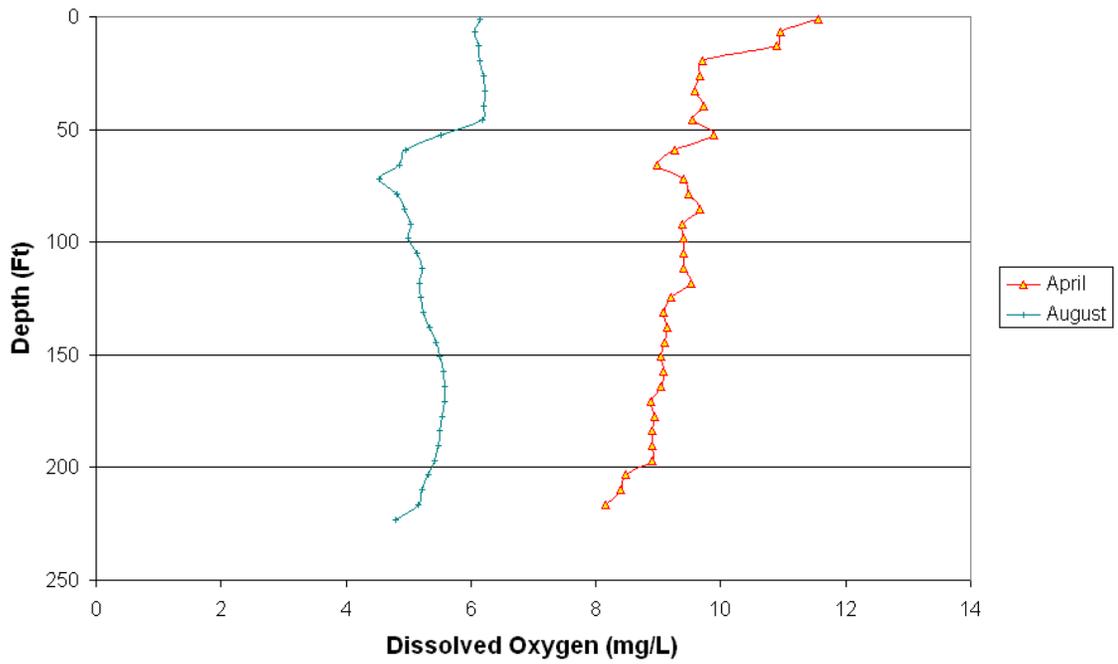
Example: BB-SU-S is for a water sample taken from Black Butte in the Summer on the Lake's Surface.

Appendix B: Profile Data and Charts (Secchi Disc, Temperature, DO, and pH)

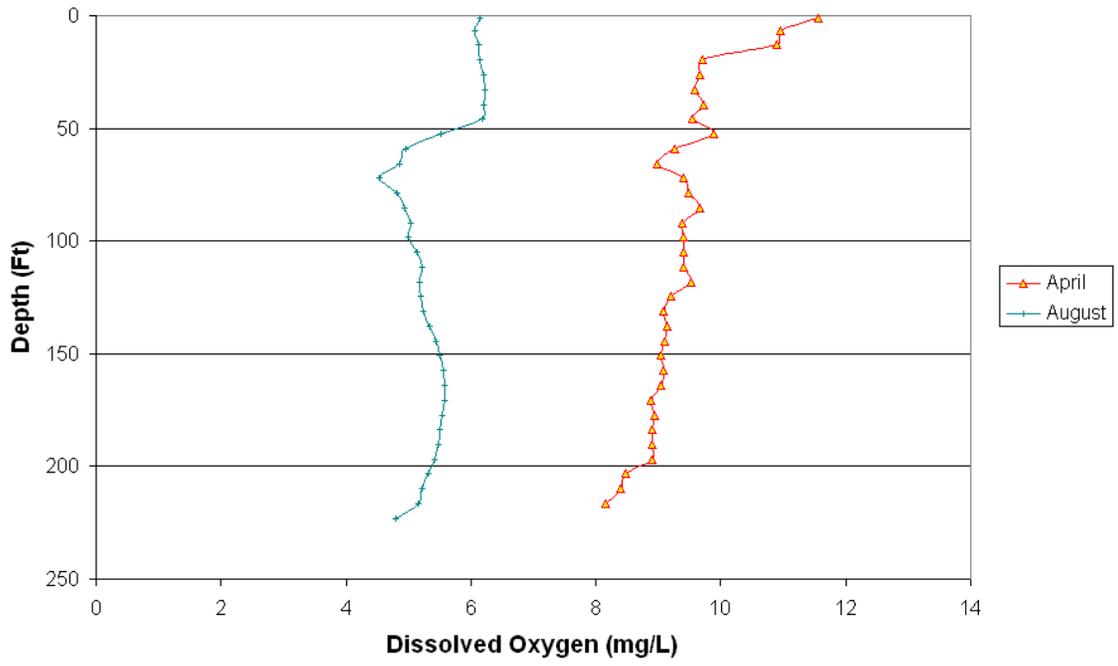
Lake Sonoma - Temperature Profile



Lake Sonoma - Dissolved Oxygen Profile



Lake Sonoma - Dissolved Oxygen Profile



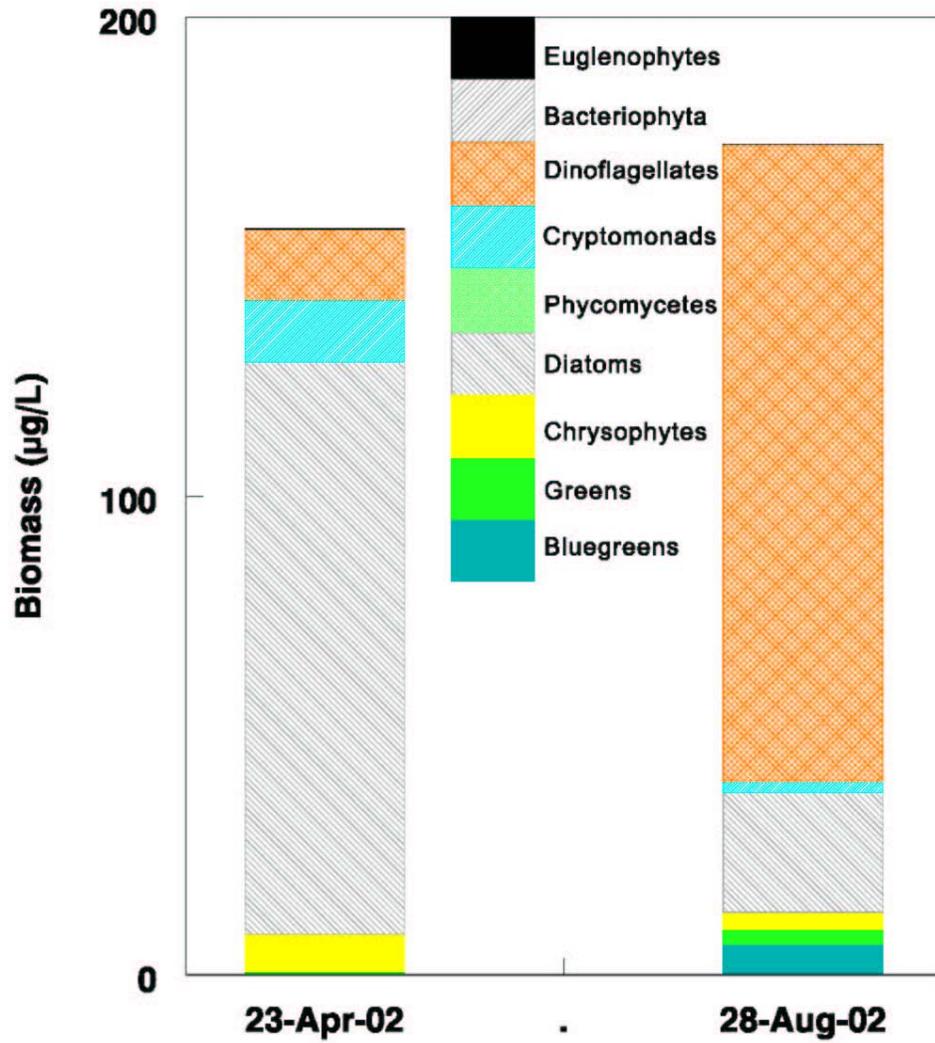
SONOMA					
Sample Location: Behind dam				Date: 4/23/02	
Observers: Tim McLaughlin				Time: 9:45 am	
Lake Elevation: 450.46					
Weather Conditions:					
Wind Speed (mph): 5		Precipitation: 0		Temp (F): 65	
SECCHI Depth: 18 feet					
Depth-M	Depth-F	Temp-C	Cond	DOmg/L	pH
65	216.5	9.81	107	8.16	7.35
64	210.0	9.81	108	8.41	7.40
62	203.4	9.80	108	8.48	7.42
60	196.9	9.82	108	8.91	7.46
58	190.3	9.83	109	8.91	7.47
56	183.7	9.84	109	8.91	7.48
54	177.2	9.84	108	8.94	7.50
52	170.6	9.86	108	8.88	7.50
50	164.1	9.89	107	9.04	7.51
48	157.5	9.91	109	9.09	7.53
46	150.9	9.93	110	9.05	7.55
44	144.4	9.96	109	9.10	7.56
42	137.6	9.97	109	9.14	7.58
40	131.2	10.00	110	9.09	7.61
38	124.7	10.02	109	9.20	7.60
36	118.1	10.05	111	9.52	7.58
34	111.5	10.11	112	9.40	7.60
32	105.0	10.19	112	9.41	7.60
30	98.4	10.29	111	9.40	7.61
28	91.9	10.32	112	9.39	7.64
26	85.3	10.41	112	9.67	7.65
24	78.7	10.56	113	9.48	7.67
22	72.2	10.76	112	9.40	7.69
20	65.6	11.19	113	8.99	7.70
18	59.1	11.21	112	9.27	7.71
16	52.5	11.43	112	9.90	7.71
14	45.9	12.02	115	9.55	7.72
12	39.4	14.29	115	9.73	7.76
10	32.8	15.07	115	9.59	7.75
8	26.2	15.88	116	9.66	7.75
6	19.7	16.22	115	9.70	7.75
4	13.1	16.29	115	10.89	7.77
2	6.6	16.69	115	10.95	7.78
0.03	1	16.83	116	11.56	7.79
DRY CREEK (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
61.6	7.43		-	-	-
WARM SPRINGS (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
63.6	7.65		-	-	-
VISUAL OBSERVATIONS:					

SONOMA					
Sample Location: Behind dam				Date: 8/28/02	
Observers: Tim McLaughlin				Time: 10:05 am	
Lake Elevation: 438.81					
Weather Conditions:					
Wind Speed (mph): 15		Precipitation: 0		Temp (F): 80	
SECCHI Depth: 11 feet and 7 inches					
Depth-M	Depth-F	Temp-C	Cond	DOmg/L	pH
67.1	223.1	9.94	146	4.8	6.83
66	216.5	9.93	146	5.16	6.86
64	210.0	9.93	145	5.21	6.87
62	203.4	9.94	145	5.31	6.89
60	196.9	9.94	145	5.41	6.89
58	190.3	9.95	145	5.48	6.92
56	183.7	9.96	145	5.5	6.91
54	177.2	9.97	144	5.53	6.93
52	170.6	9.99	144	5.57	6.94
50	164.1	10.02	144	5.58	6.95
48	157.5	10.05	145	5.56	6.96
46	150.9	10.09	145	5.50	6.95
44	144.4	10.14	146	5.43	6.96
42	137.6	10.17	146	5.34	6.98
40	131.2	10.27	147	5.24	6.97
38	124.7	10.29	147	5.20	6.97
36	118.1	10.36	148	5.17	6.98
34	111.5	10.41	148	5.22	7.00
32	105.0	10.50	147	5.13	7.09
30	98.4	10.58	148	5.00	7.13
28	91.9	10.64	148	5.03	7.16
26	85.3	10.76	148	4.94	7.20
24	78.7	11.19	148	4.81	7.20
22	72.2	11.59	147	4.53	7.25
20	65.6	12.10	150	4.86	7.30
18	59.1	13.96	152	4.96	7.35
16	52.5	18.26	155	5.51	7.45
14	45.9	21.54	165	6.18	7.72
12	39.4	21.62	166	6.20	7.71
10	32.8	21.91	165	6.22	7.73
8	26.2	22.20	165	6.21	7.64
6	19.7	22.53	166	6.15	7.52
4	13.1	22.69	165	6.12	7.39
2	6.6	22.70	165	6.07	7.28
0.03	1	22.71	165	6.15	7.05
DRY CREEK (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
71.5	7.34		-	-	-
WARM SPRINGS (Inflow) - DRY					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
-	-		-	-	-
VISUAL OBSERVATIONS:					

Appendix C: Phytoplankton Data and Charts

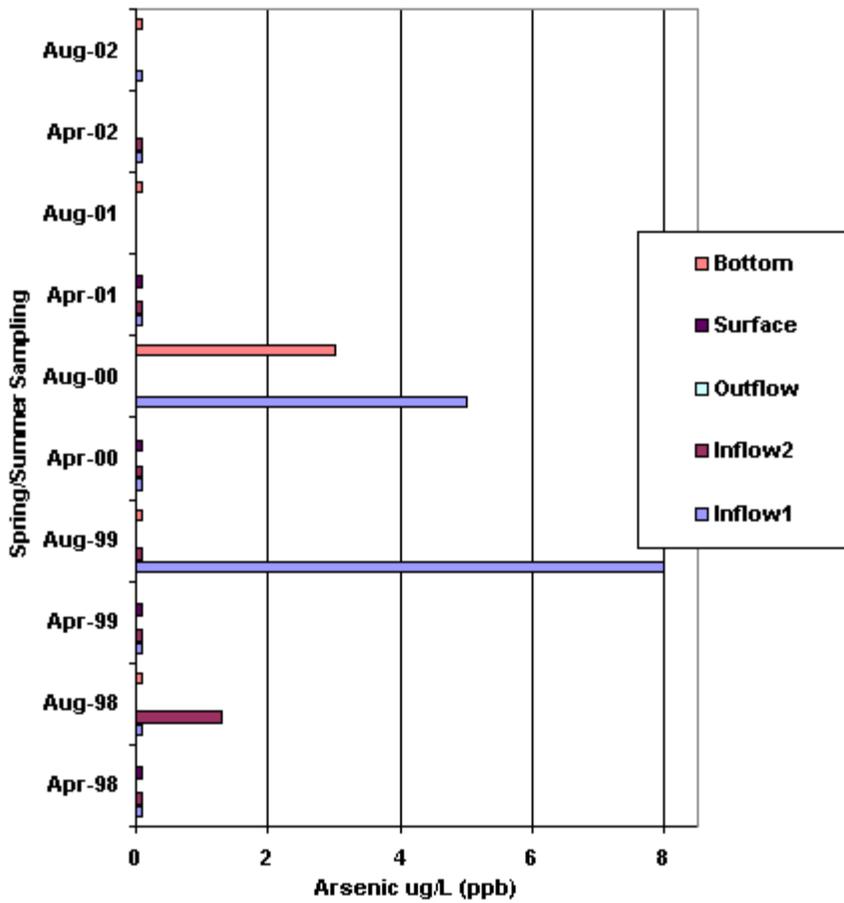
Phytoplankton Biomass 2002

Lake Sonoma / Warm Springs Dam



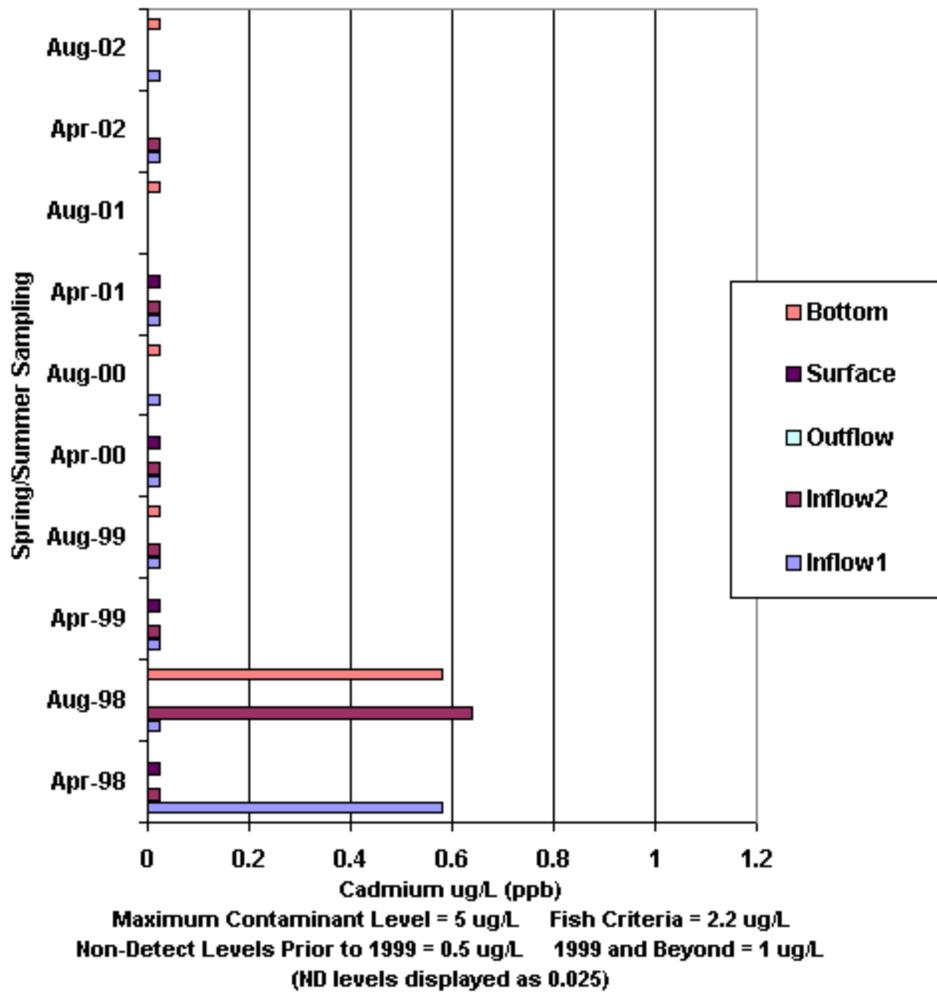
Appendix D: Metals Data and Charts

Dissolved Arsenic - Lake Sonoma

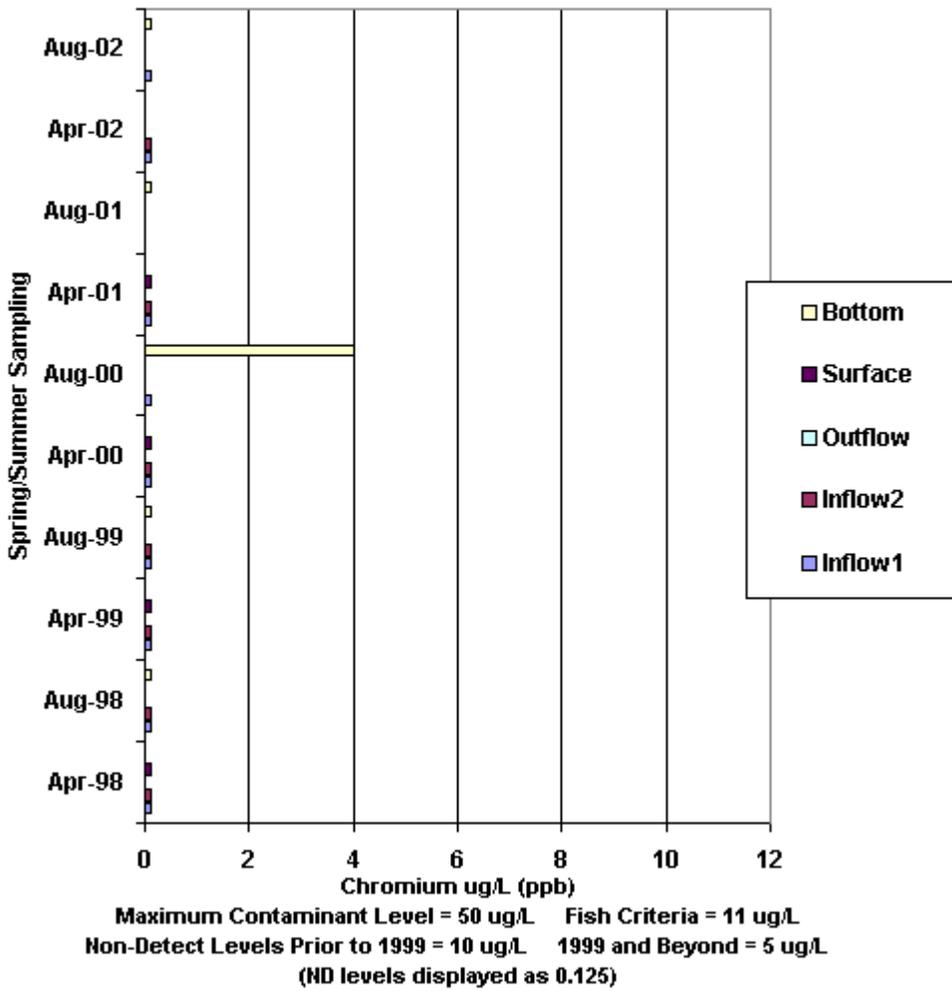


Maximum Contaminant Level = 10 ug/L Fish Criteria = 150 ug/L
 Non-Detect Levels = 1 ug/L before 1999, 4 ug/L after 1999
 (ND levels displayed as 0.1)

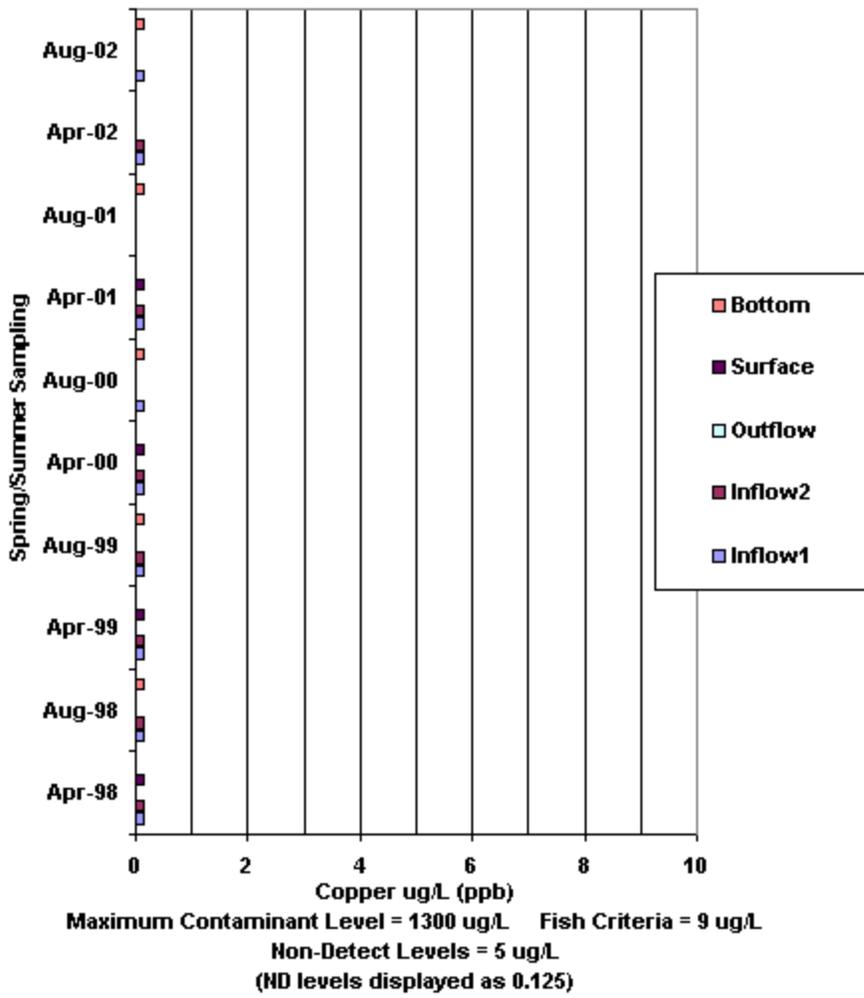
Dissolved Cadmium - Lake Sonoma



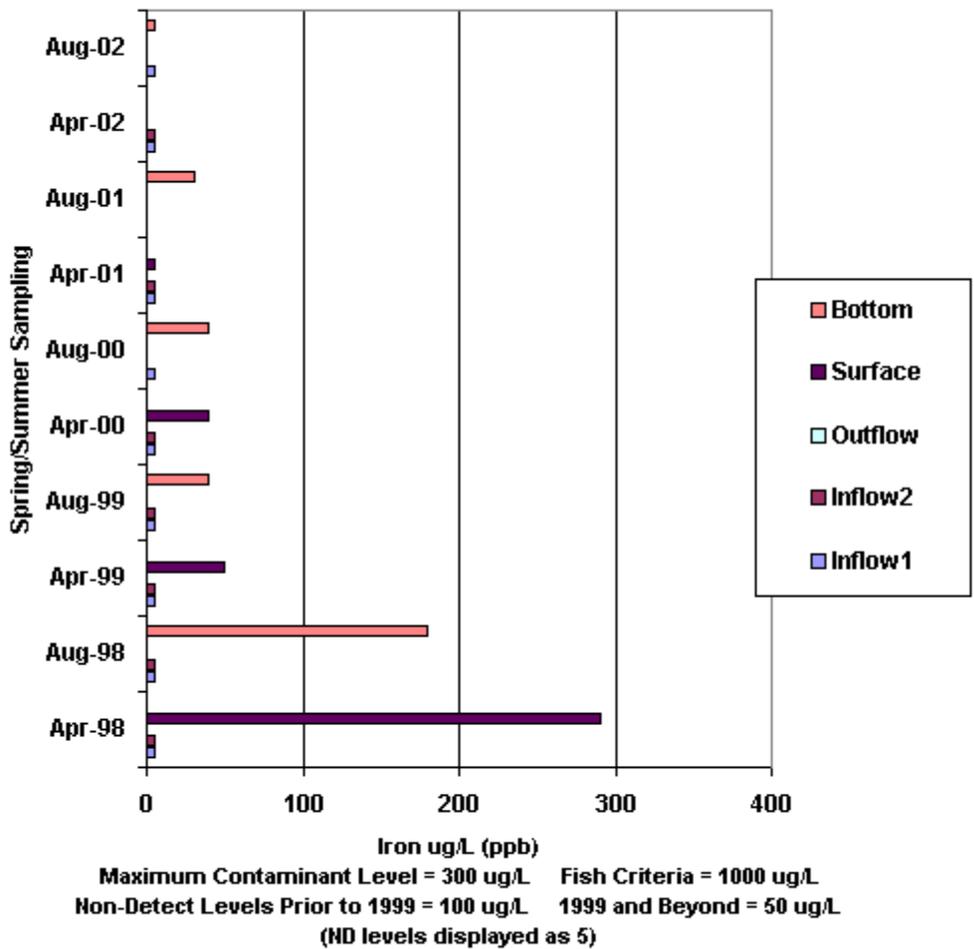
Dissolved Chromium - Lake Sonoma



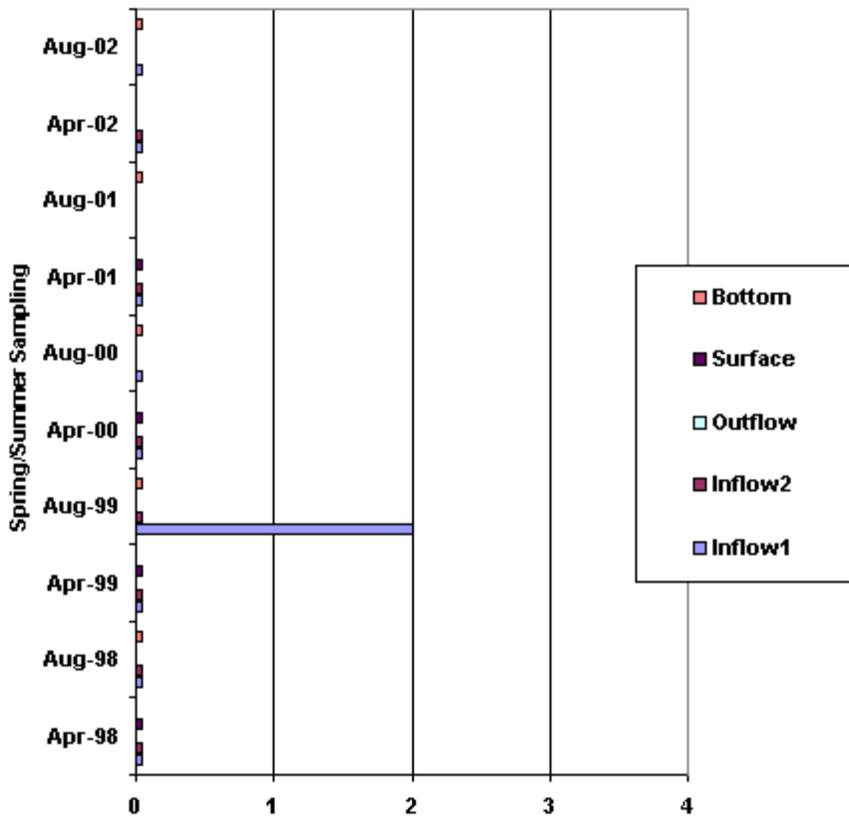
Dissolved Copper - Lake Sonoma



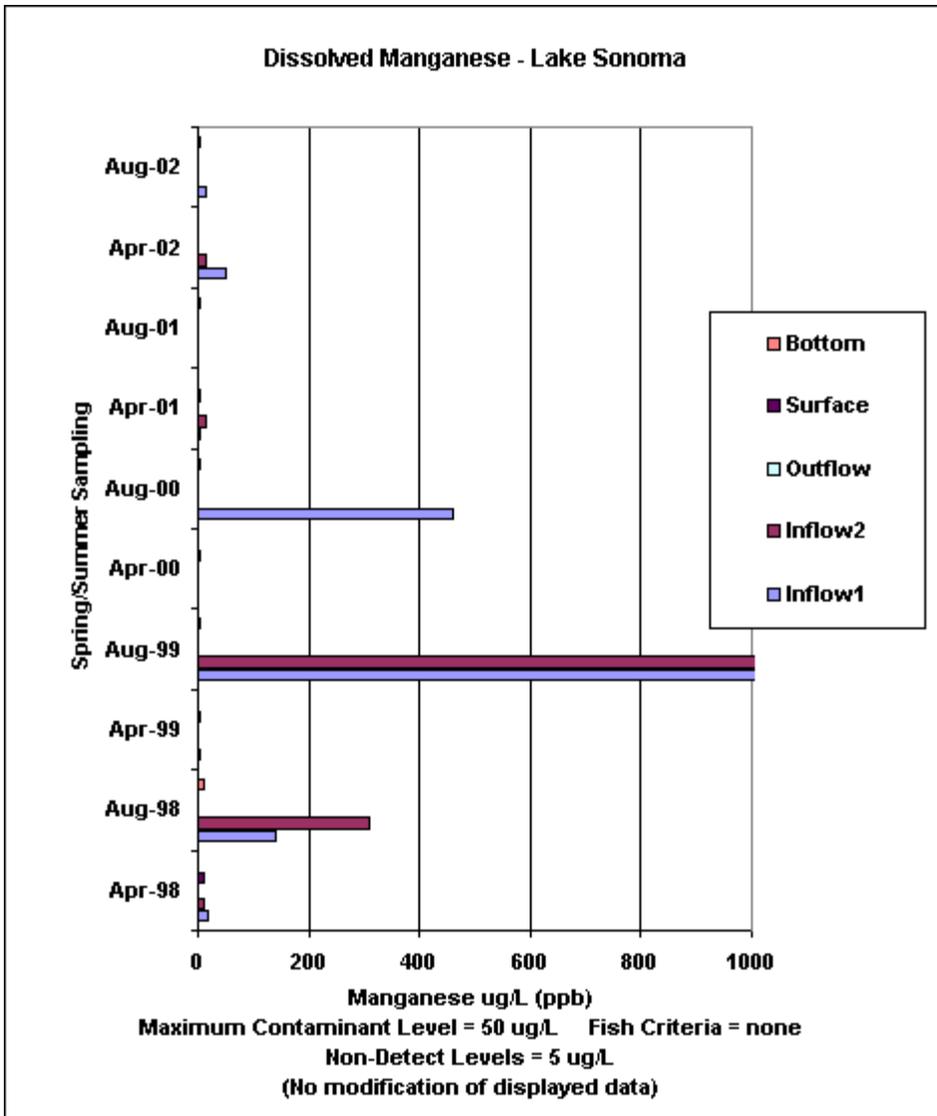
Dissolved Iron - Lake Sonoma



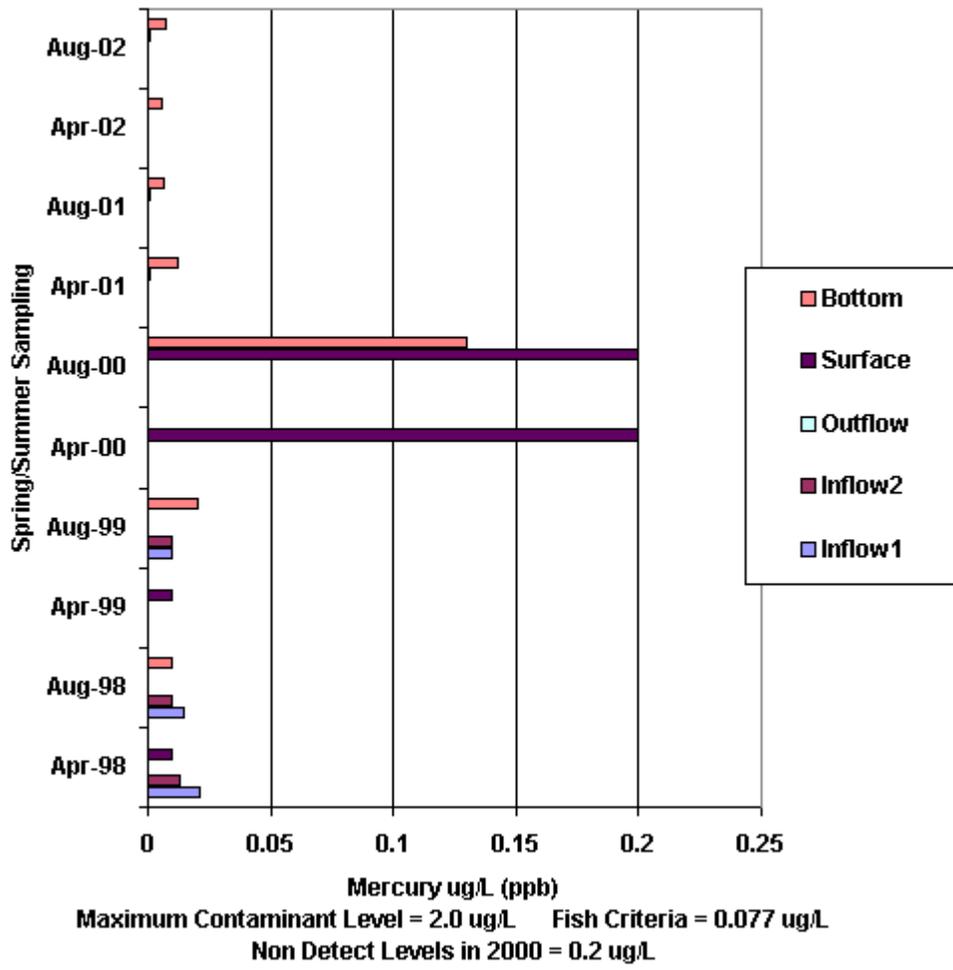
Dissolved Lead - Lake Sonoma

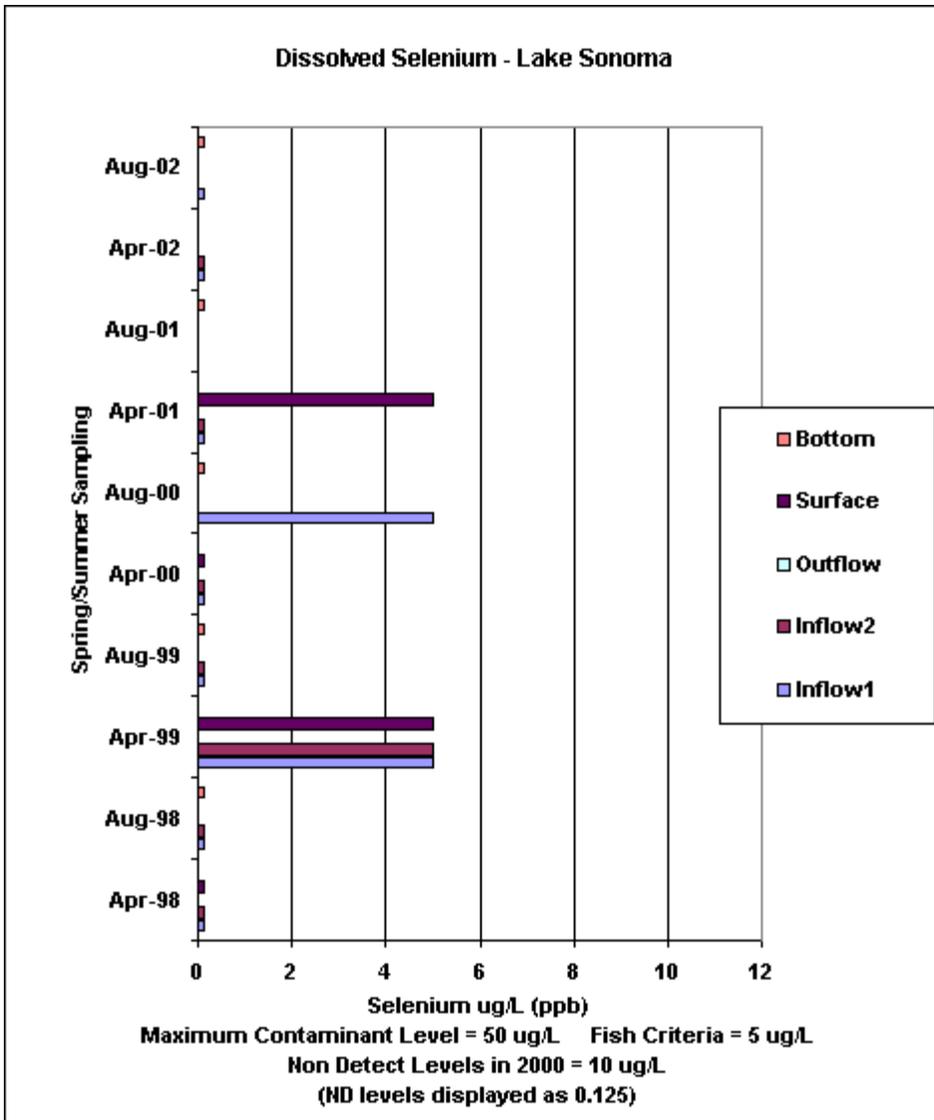


Lead ug/L (ppb)
Maximum Contaminant Level= 15 ug/L Fish Criteria = 2.5 ug/L
Non-Detect Levels = 3 ug/L
(ND levels displayed as 0.0375)

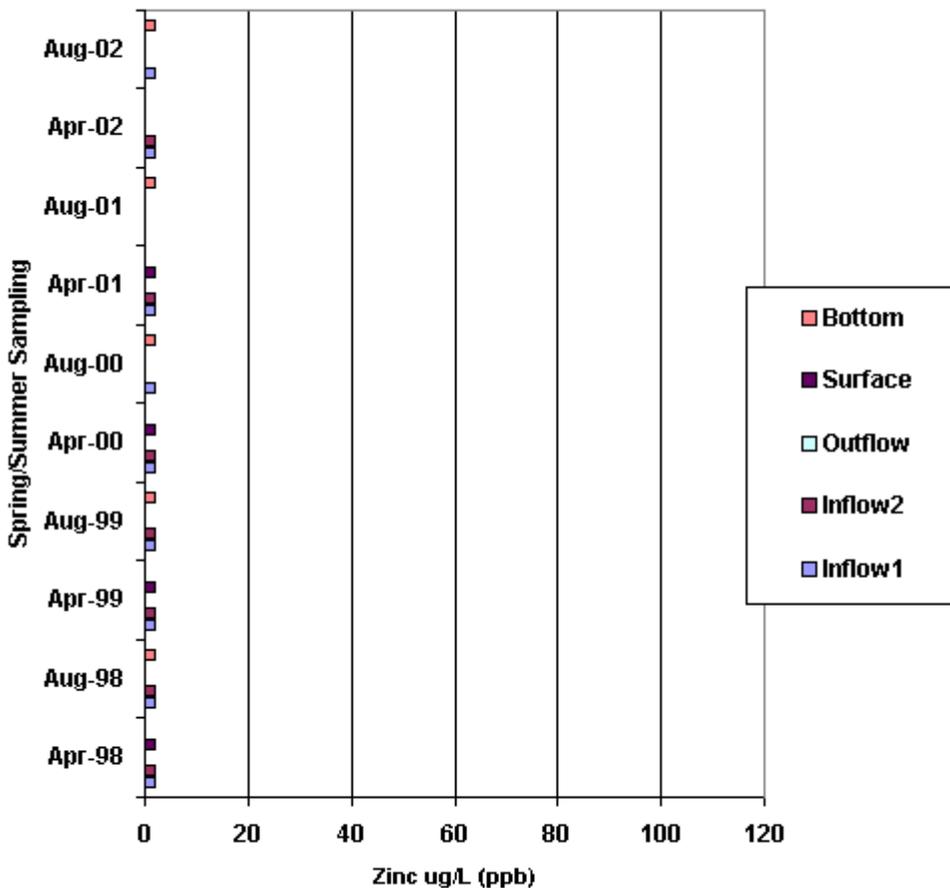


Dissolved Mercury - Lake Sonoma





Dissolved Zinc - Lake Sonoma



Zinc ug/L (ppb)
Maximum Contaminant Level = 5000 ug/L Fish Criteria = 120 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L 1999 and Beyond = 20 ug/L
(ND levels displayed as 2.0)

Appendix E: Inorganic Sample Data

Inorganic Results (mg/L) For surface lake waters (spring)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity		60	40	50	60	30	40	70	80	20		100
Ammonia		<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Chloride		21	2	21	4	4	3	<1	6	5		4
Nitrate		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1		<0.1
Total P		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Sulfate		5.3	2.6	4.2	8.9	2	1	8.2	9	2.1		4.7
Kjeldahl N		0.6	0.1	0.4	0.2	<0.1	0.3	0.2	0.2	0.2		<0.1
COD					<50							
Tot Solids		120	70	100	110	60	78	100	120	21		150

Inorganic Results (mg/L) For inlet waters to the lakes (spring) (I-1 only)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	100	70	40	50	20	30	40	80	90	10	100	50
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride	13	25	3	21	<1	<1	4	<1	6	4	3	2
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	
Sulfate	18	2.1	2.3	3	2.8	1.9	0.8	8.8	11	1.6	11	3.5
Kjeldahl N	<0.1	0.2	<0.1	0.3	<0.1	<0.1	0.2	0.2	0.1	0.1	0.1	<0.1
COD	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	170	130	59	110	60	60	90	110	150	30	130	90

Inorganic Results (mg/L) For surface lake waters (summer)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	140	70	40	50	50	40	70	90	80	10	80	110
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1
Chloride	16	26	4	19	6	5	5	5	9	3	5	8
Nitrate	<0.1	1.5	<0.1	1.3	0.7	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1
Total P	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	16	4.1	3.6	3.5	5.9	2	0.7	7.4	14	1.6	6.4	4.4
Kjeldahl N	<0.1	2.7	<0.1	0.4	0.4	0.3	<0.1	0.2	<0.1	<0.1	0.2	0.6
COD	<50	60	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	200	190	50	120	98	80	80	120	120	52	100	170

Inorganic Results (mg/L) For inlet waters to the lakes (summer) (I-1 only)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	150	90	40		60	40	80	100	130	20	110	180
Ammonia												
Chloride	16	490	5		10	8	3	5	14	4	5	22
Nitrate												
Total P												
Ortho P												
Sulfate	16	4.5	3		9.8	3.2	<0.5	6	14	2.7	5.4	8.7
Kjeldahl N												
COD												
Tot Solids	200	1300	50		140	100	100	150	200	50	140	280

Appendix F: MTBE Table

2002 MTBE Results Units are ug/L (ppb)

The following table provides an overview of the lab results for the 2002 MTBE monitoring program.

Lake	Spring S	Spring S-1	Spring S-M	Spring S-C	Summer S	Summer S-1	Summer S-M	Summer S-C	Remarks
Black Butte	2		2		<2		<2		
Eastman	5				<2				
Englebright	3		3		10		10	10	
Hensley	3		3		3		3		
Isabella	<2	<2	<2	<2	<2	<2	<2	<2	
Kaweah	2		2	<2	8		6	6	
Martis Cr.	<2				<2				
Mendocino	<2				<2				
New Hogan	<2				3				
Pine Flat	<2		<2		2		2		
Sonoma		3	<2		<2		2		
Success	4		4	4	11	12	11	11	

Notes:

1. Non-Detect is indicated by "<2" since the Reporting Limit is 2 ppb or 0.002 ppm.
2. No enforceable acceptance criteria has been established for MTBE. See EPA Fact sheet.
3. Maps are provided to illustrate the sampling locations for samples: S / S-1, S-M, and S-C. Sample S and sample S1 are located near the dam; sample S-M is located within 50 ft of the Marina; and sample S-C is located near the center of the lake.
4. For 2002, the number of MTBE water sampling at each lake is based on last year's lab results.
5. 2 samples were taken from Eastman, Martis Creek, Mendocino, and New Hogan because MTBE was historically non-detectable. The 2002 results of non-detectable levels were similar except Lake Eastman and New Hogan now reported low, detectable levels of MTBE.
6. 4 samples were taken from Black Butte, Hensley, Pine Flat and Sonoma because of historically low detectable levels of MTBE.
7. 6 to 8 samples were taken from Englebright, Isabella, Kaweah and Success because of historically higher MTBE being found. The 2002 results were similar except Isabella now reported non-detectible levels.
8. In 2001, very high MTBE levels were reported at Lake Isabella during the Spring (18 ug/L near the marina) . During Spring 2000, Lake Isabella reported 21 ug/L. The 2002 results indicate that the previous MTBE problem near the marina was not visible during the Spring 2002 sampling event, and may have been rectified.

Appendix G: Fish tissue analysis table

2002 Fish Tissue Results

The following table provides an overview of the lab results for the 2002 fish tissue program. N/A indicates data is not available due to lack of fish collection. Sample Preparation, filleting and Extraction were in accordance with EPA 823-R-95-007, Sep 95, Volume 1, Section 7.2 (Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisory) which requires the following: Only the edible portion of the fillet shall be analyzed (i.e no skin, tail, fin, head). Tissue digestion shall be accomplished by adding concentrated nitric acid and heating the tube in an aluminum block to reflux the acid. The digestate shall be cooled, diluted to a final volume of 25 ml and analyzed by CVAA. The laboratory conducting the preparation and analysis was Toxscan, Inc in Watsonville, CA and the laboratory mercury analysis was in accordance with CVAA per EPA 7471. The Percent Lipids were per EPA 1664. The FDA criteria for a fish advisory is 1 ppm. The California OEHHA's action level to continue fish tissue monitoring is 0.3 ppm.

Lake	Type of Fish	Type of Analysis (number of fish)	Date collected	Percent Lipids	Mercury Total ppm	FDA Criteria
Black Butte	Sm M Bass	Composite (3)	6/12/02	0.24	0.26	1 ppm
Eastman	Note 4	-----	-----	-----	-----	< Mon 00
Englebright	Note 5	N/A	N/A	N/A	N/A	
Hensley	Black Bass	Composite (3)	4/23/02	<0.10	0.72	1 ppm
Isabella	Black Bass	Composite (3)	6/4/02	0.20	0.21	1 ppm
Kaweah	Sm M Bass	Composite (3)	7/14/02	0.11	0.53	1 ppm
Martis Cr	Note 4	-----	-----	-----	-----	< Mon 00
Mendocino	Note 6	N/A	N/A	N/A	N/A	
New Hogan	Lg M Bass	Single (1)	6/3/02	<0.10	0.34	1 ppm
Pine Flat	Note 4	-----	-----	-----	-----	< Mon 01
Sonoma	Note 6	N/A	N/A	N/A	N/A	
Success	Black Bass	Composite (3)	4/15/02	<0.10	0.18	1 ppm

Notes:

9. Non-Detect is indicated by "<0.02". The lab Detection Limit for mercury is 0.02 ppm.
10. Total Mercury was reported in mg/g or ppm.
11. Total Mercury was conducted instead of Methyl Mercury since EPA 832 allows Total Mercury analysis for an initial screening program. When specific problem areas are identified, methyl mercury analysis are normally performed later as part of the actual health risk assessment.
12. The fish tissue program was terminated at Eastman and Martis Creek in 2001 and in Pine Flat in 2002 due to low total mercury results. In 2000, the total mercury was only 0.089 ppm for Eastman (Catfish) and the total mercury was <0.02 ppm for Martis Creek (Brown Trout). For Pine Flat total mercury was 0.21 ppm in 2000 (composite of three Sacramento Sucker fish) and 0.23 in 2001 (composite of three spotted bass).

13. Due to seasonal conditions, a fish could not be successfully collected at Lake Englebright. Another attempt will be accomplished for the 2003 report.
14. Fish were not collected at Mendocino or Sonoma due to communication difficulties.

The above 2002 total mercury results indicate only Hensley is higher than average. However, in 2001, the total mercury results were only 0.30 ppm for Hensley (small mouth bass). The 2003 fish tissue program should provide additional data. EPA fact sheet on fish advisories (EPA-823-F-99-016) indicates that the mean average mercury results from numerous lakes in the Northeast United States were found to be 0.46-0.51 ppm for largemouth bass and 0.34-0.53 for smallmouth bass.