
4.4 WATER QUALITY SAMPLING PROGRAM 4 – BIDWELL MARINA WQ SAMPLING

The U.S. Environmental Protection Agency (USEPA) found that marinas were one of the most important sources of non-point pollution, including pollutants discharged from boats and boat maintenance activities on land and in the water (USEPA 2004). Boat maintenance yards are sources of heavy metals from boat antifouling paints and chemicals from pesticides, wood preservatives, and biocides. They can also be sources of contamination from petroleum fuels and fuel additives (CCC 2002).

Tributyltin (TBT) is an organotin compound used primarily as a biocide in antifouling paints. It is extremely toxic to aquatic life and is an endocrine-disrupting chemical that causes severe reproductive effects in a wide variety of aquatic organisms. TBT is extremely stable and resistant to natural degradation in water. Because of its chemical properties and widespread use as an antifouling agent, concerns have been raised over the risks it poses to both freshwater and saltwater organisms. The recommended criterion for TBT is 0.46 µg/L for the one-hour average concentration (acute criterion) and 0.072 µg/L for the four-day average concentration (chronic criterion) (USEPA 2004).

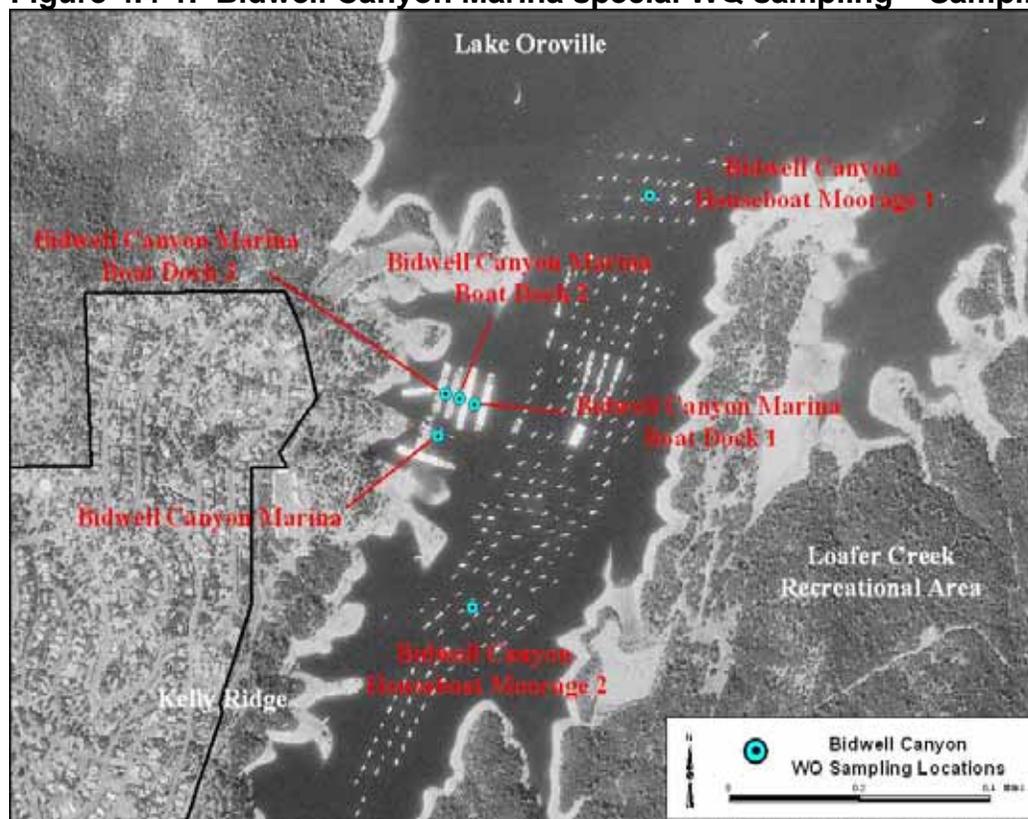
The polybrominated diphenyl ethers (PBDEs) are a class of chemicals widely used as flame retardants. PBDEs are believed to behave similarly to polychlorinated biphenyls (PCBs) in the environment (i.e., they are persistent, able to travel long distances from sources, and are bioaccumulative) (Betts 2001). Unlike many persistent and ubiquitous organic pollutants, such as PCBs or DDT which are largely a legacy of the past, brominated flame retardants are in current widespread use to prevent or deter fires in styrofoam, electronic devices, furniture, and textiles. PBDE residues have been found in sediments, marine mammals, fish, bird eggs, human milk, serum, and adipose tissue (Manchester-Neesvig *et al.* 2001). The toxicology of PBDEs is currently under investigation, but research has established that PBDEs, in addition to being persistent and bioaccumulative, can be toxic in relatively low levels (Betts 2001). PBDE has been reported from hatchery raised fish from the DFG American River Hatchery (Dave Crane, CDFG WQ Laboratory, Rancho Cordova, pers. comm.). At the Bidwell and Lime Saddle marinas, all of the floating docks and structures rely on large styrofoam blocks for buoyancy, and thus is a potential source of PBDE.

To address the concern about PBDE and TBT, six sampling sites were selected around Bidwell Marina (Table 4.4-1, Figures 4.4-1 through 5). Samples were also taken for MTBE, aromatic hydrocarbons, polynuclear aromatic hydrocarbons, oil and grease, total and dissolved metals, and total and methyl mercury. Sites were sampled monthly starting in October of 2003. All water samples, except the metals and mercury samples, were analyzed by Sequoia Analytical in Sacramento. The metals samples were analyzed by the DWR Bryte Laboratory in West Sacramento, while the mercury samples were analyzed by Frontier Geosciences in Seattle, Washington.

Table 4.4-1. Bidwell Canyon Marina special WQ sampling sites – Locations.

Sampling Site	Latitude/ Longitude
Bidwell Canyon Marina	N39° 32' 41.804" W121° 27' 23.066"
Bidwell Canyon Marina Boat Dock 1	N39° 32' 4.105" W121° 27' 13.583"
Bidwell Canyon Marina Boat Dock 2	N39° 32' 3.611" W121° 27' 15.150"
Bidwell Canyon Marina Boat Dock 3	N39° 32' 4.929" W121° 27' 16.493"
Bidwell Canyon Houseboat Moorage 1	N39° 32' 19.643" W121° 26' 55.106"
Bidwell Canyon Houseboat Moorage 2	N39° 31' 48.677" W121° 27' 14.151"

Figure 4.4-1. Bidwell Canyon Marina special WQ sampling – Sampling locations.



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Figure 4.4-2. Bidwell Marina (Boat docks on left side of photo).



Figure 4.4-3. Bidwell Canyon Houseboat Moorage 1.



Figure 4.4-4. Bidwell Canyon Houseboat Moorage 2.



Figure 4.4-5. Bidwell Canyon Boat Docks.

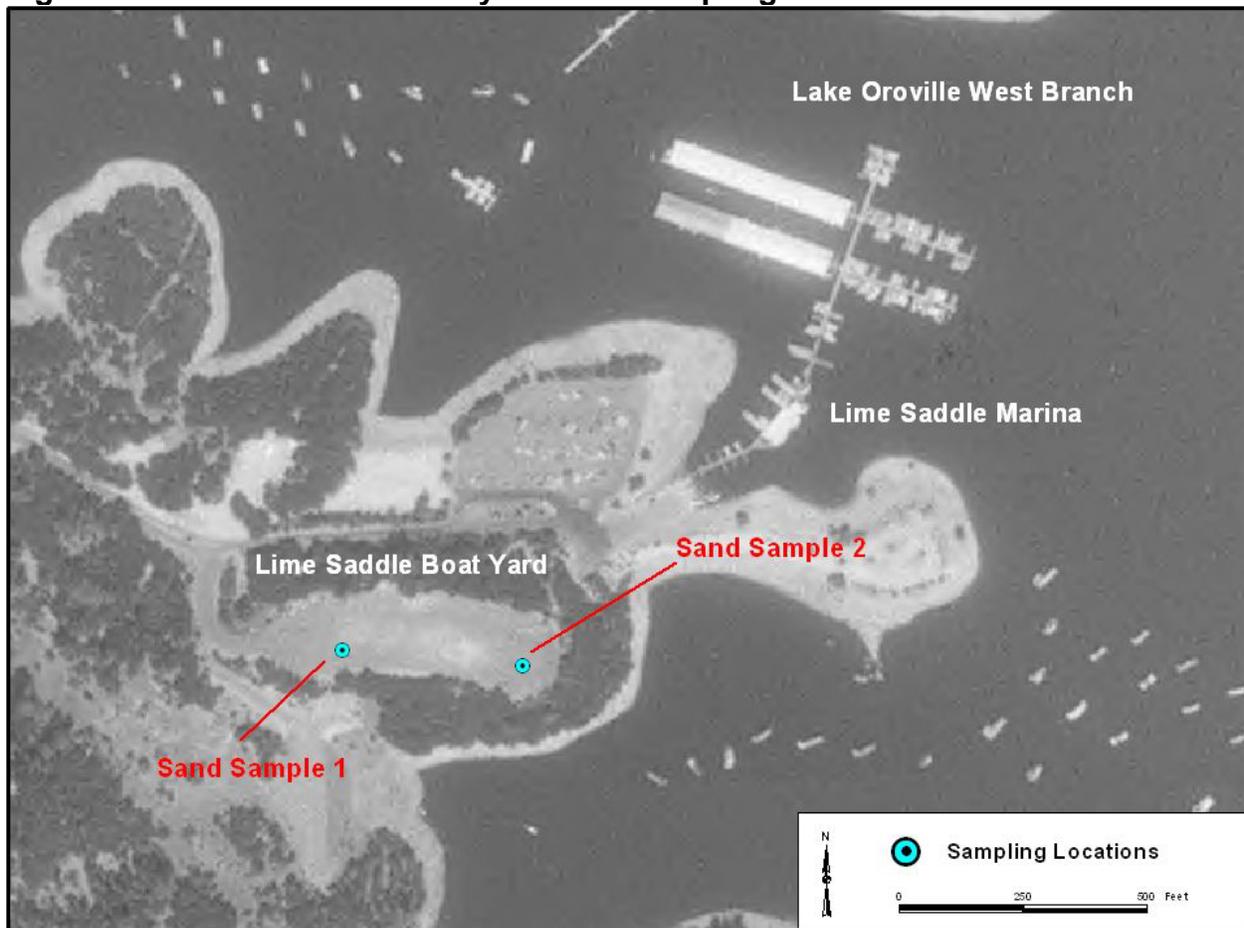


4.5 WQ SAMPLING PROGRAM 5 – LIME SADDLE BOAT YARD SAND ANALYSES

During the assessment performed for the Task 1A Report, it was observed that the boat yard at Lime Saddle Marina used large amounts of sand for sandblasting during boat maintenance. The sand from this operation is deposited on the ground during the sandblasting and remains there until natural processes (wind or rain) disperse it.

This sand could contain remnants of the paint from the boat hulls or other boat maintenance related contaminants. These contaminants would then be washed down by rain or blown by the wind into the surrounding Project waters. To address this issue, sand samples were taken for analysis from the opposite ends of the boat yard (Figures 4.5-1 through 3) and stored in sterile polyethylene pint bottles. The sand samples were analyzed for total solids, total metals (targeting arsenic, copper, lead, and zinc, though more were included in the analysis), aromatic hydrocarbons, polynuclear aromatic hydrocarbons, and oil and grease.

Figure 4.5-1. Lime Saddle Boatyard sand sampling locations.



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Figure 4.5-2. Lime Saddle Boatyard (facing east).



Figure 4.5-3. Lime Saddle Boatyard workshop facilities (facing west).



4.6 WQ SAMPLING PROGRAM 6 – STORM EVENT SAMPLING 2003

Some types of recreational facilities deposit contaminants of various sorts during the normal course of operations. Vehicular traffic, normal facility maintenance and operations, and landscape care can deposit numerous types of potential contaminants, such as petroleum byproducts, metals, excess nutrients, and pesticides. Fecal coliform bacteria are deposited by wildlife and visitors' pets. These substances can then be transported into Project waters by the first rainstorms of the rainy season. The lighter volatile substances, such as the petroleum byproducts, are carried off at the first flushing storm event. Other substances are transported in this and in one or two of the subsequent storm events.

For this reason, the first three storm events of the rainy season were sampled from those drains that appear to carry the majority or a sizeable portion of the runoff from a particular facility (Table 4.6-1; Figures 4.6-1 to 4.6-11). Samples were taken for nutrients, total and dissolved metals, total and methyl mercury, MTBE and other aromatic hydrocarbons, polynuclear aromatic hydrocarbons, oil and grease, and pesticides. Water samples for pesticides were taken in sample washed one liter amber glass bottles for chemical analysis. Two water samples were also taken per station for the analysis of total and fecal coliform, fecal streptococcus, and enterococcus bacteria.

Table 4.6-1. Storm event WQ sampling locations

Sampling Site	Latitude/ Longitude
Bidwell Canyon Boat Yard	N39° 32' 1.942" W121° 27' 32.556"
Bidwell Canyon Parking Lot	N39° 32' 14.606" W121° 26' 42.173"
Lime Saddle Boat Yard	N39° 40' 32.793" W121° 33' 32.635"
Lime Saddle Parking Lot 1	N39° 32' 33.252" W121° 33' 26.736"
Lime Saddle Parking Lot 2	N39° 40' 36.697" W121° 33' 33.860"
North Forebay Sailboat Marina	N39° 31' 54.842" W121° 35' 24.864"

Figure 4.6-1. Storm event WQ sampling locations – Bidwell Canyon.



Figure 4.6-2. Bidwell Canyon parking lot drain.



Figure 4.6-3a. Close up of Bidwell Canyon boat yard drain 1.



Figure 4.6-3b. Bidwell Canyon boat yard drain 1.



Figure 4.6-4. Bidwell Canyon boat yard drain 2.



Figure 4.6-5. Culvert downslope of Bidwell Canyon boat yard drain 2.



Figure 4.6-6. Storm event WQ sampling locations – Lime Saddle Marina.

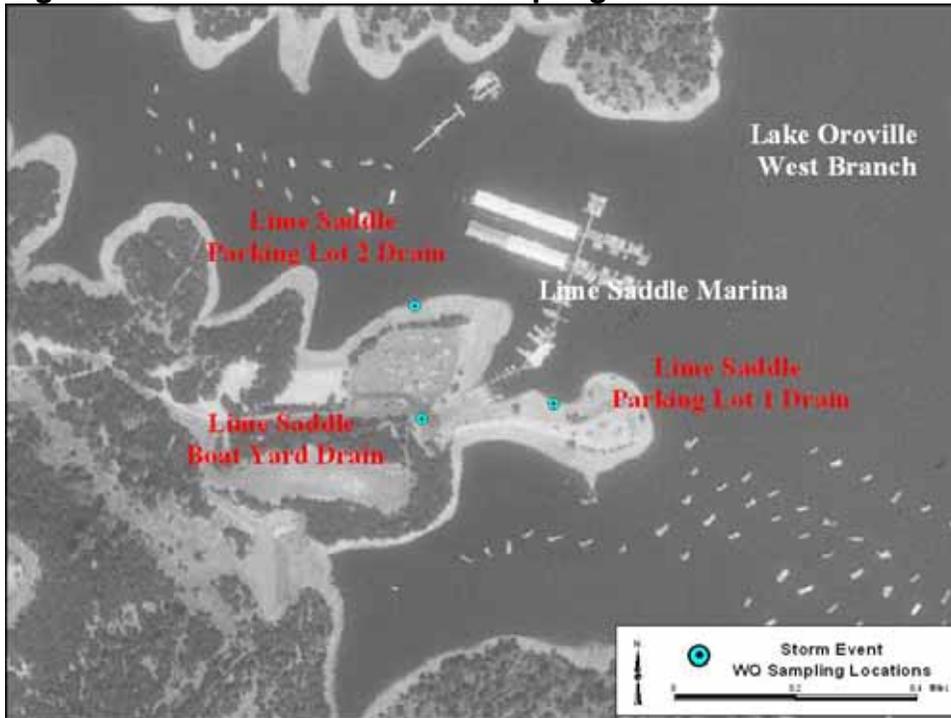


Figure 4.6-7a. Lime Saddle Marina boat yard drain (View from below).



Figure 4.6-7b. Lime Saddle Marina boat yard drain (View from above).

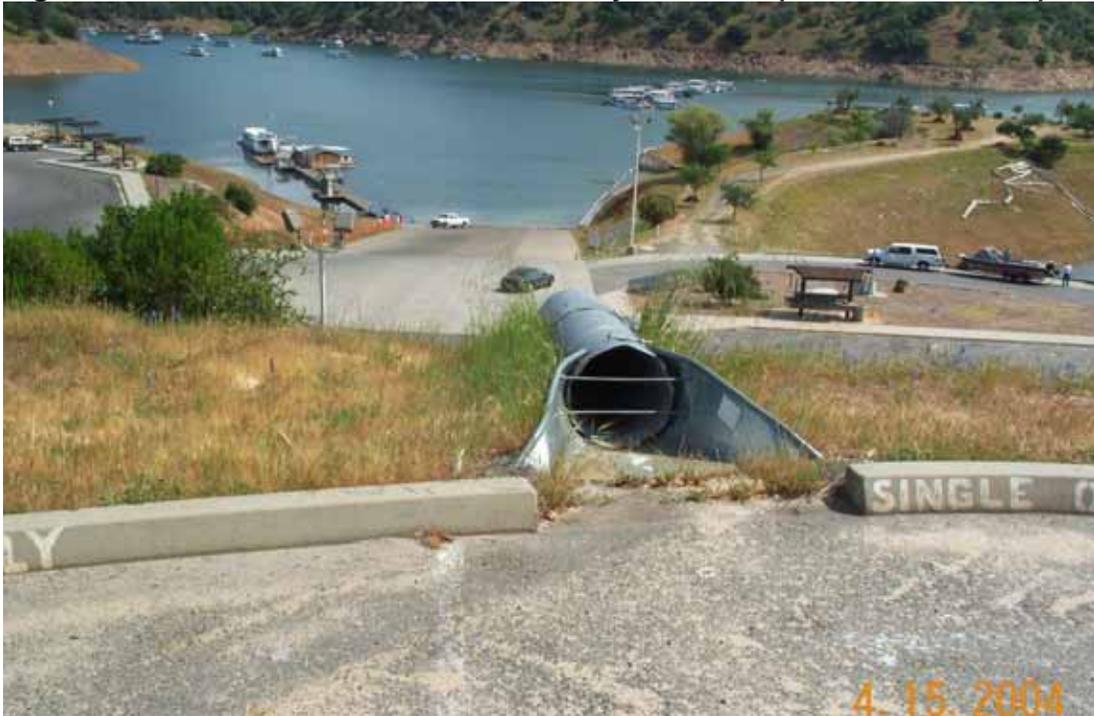


Figure 4.6-8. Lime Saddle Marina parking lot drain 1.



Figure 4.6-9a. Lime Saddle Marina parking lot drain 2.



Figure 4.6-9b. Lime Saddle Marina parking lot drain 2.



Figure 4.6-10. Storm event WQ sampling locations – North Forebay.



Figure 4.6-11. North Forebay Sailboat Marina drain.



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5.0 STUDY RESULTS

The recreational water quality sampling programs were sampled as per the recommended monitoring plan approved by the Environmental Work Group.

5.1 WQ SAMPLING PROGRAM 1 – RECREATION FACILITIES WQ SAMPLING

For the Project area-wide recreational water quality sampling program physical parameters and surface water grab samples were sampled monthly from June to September of 2003 (Appendix Section 8.1).

5.1.1 Physical parameters

Physical parameters measured at each station included water temperature, dissolved oxygen, conductivity, and pH (Appendix Table 8.1-1). Physical parameters were fairly uniform among the various stations over the entire sampling period from June to September of 2003 (Table 5.1.1-1). Water samples did not exceed any water quality criteria for lake physical parameters (RWQCB 2003). Overall, water temperatures taken at the time of sampling ranged from 72.9 °F to 84 °F, with a mean temperature of 77 °F. Monthly mean temperatures showed no large differences over the entire sampling period, ranging from 75.8 °F to 82.4 °F. Conductivity ranged from 74 to 103 µmhos/cm, with an overall average of 85 µmhos/cm. Dissolved oxygen ranged from 5.1 to 9.6 mg/L, with an overall mean of 8.2 mg/L. All but one of the dissolved oxygen measurements were above 7.0 mg/L. The lowest measurement of 5.1 mg/L was taken in the Bidwell Canyon Arm of Lake Oroville at the mouth of Deadman Ravine, which is a relatively stagnant area of the lake. Monthly pH values ranged from 7.1 to 8.3 pH units, with an overall mean of 7.8 pH units.

5.1.2 Nutrients

Water samples were taken for analysis of nutrients at the surface of each station, and included dissolved ammonia, dissolved nitrate/nitrite, dissolved orthophosphate, total Kjeldahl nitrogen, and total phosphorus (Appendix A, Table 2). Most samples had nutrients below detection levels (Table 5.1.2-1). Dissolved ammonia ranged from not detected in 65 percent of the samples to 0.05 mg/L as N, which occurred in two samples (Craig Saddle Floating Campground and Deadman Ravine in June 2003). Dissolved nitrate/nitrite ranged from not detected in 59 percent of the samples to 0.07 mg/L as N in the same two samples as above. Dissolved orthophosphate was not detected (ND mg/L as phosphorus) at any of the stations during this study. Total Kjeldahl nitrogen ranged from not detected (ND mg/L as N) in 34 percent of the samples to 0.4 mg/L as N at one station (Lake Oroville at Bidwell Canyon Boat Ramp in June 2003). Total phosphorus ranged from not detected (ND mg/L) in 76 percent of the samples to 0.07 mg/L at one station (Lake Oroville at Deadman Ravine). No criteria were exceeded for any of the tested nutrients at any of the stations (RWQCB 2003).

Table 5.1.1-1. Monthly physical parameters among all stations.

	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
June					
<i>Maximum</i>	79.5	26.3	85	9.6	8.3
<i>Minimum</i>	72.9	22.7	74	5.1	7.1
<i>Mean</i>	75.8	24.3	80	7.9	7.6
July					
<i>Maximum</i>	84.0	28.8	90	9.0	8.3
<i>Minimum</i>	80.4	26.8	76	7.7	7.8
<i>Mean</i>	82.4	28.0	83	8.2	8.1
August					
<i>Maximum</i>	78.8	26.0	96	8.8	8.2
<i>Minimum</i>	73.6	23.1	79	7.8	7.4
<i>Mean</i>	76.6	24.7	87	8.3	7.9
September					
<i>Maximum</i>	75.4	24.1	103	9.5	8.1
<i>Minimum</i>	73.0	22.7	78	7.4	7.6
<i>Mean</i>	74.2	23.4	92	8.4	7.8

Table 5.1.2-1. Monthly nutrient parameters among all stations

	Dissolved Ammonia (mg/L as N)	Dissolved NO ₂ +NO ₃ (mg/L as N)	Total Kjeldahl Nitrogen (mg/L as N)	Dissolved Ortho- phosphate (mg/L as P)	Total Phosphorus (mg/L)
June					
<i>Maximum</i>	0.05	0.07	0.4	<0.01	0.4
<i>Minimum</i>	<0.01	<0.01	<0.01	<0.01	<0.01
<i>Mean</i>	0.02	0.03	0.01	<0.01	0.01
July					
<i>Maximum</i>	0.02	0.02	0.3	<0.01	0.07
<i>Minimum</i>	<0.01	<0.01	<0.01	<0.01	<0.01
<i>Mean</i>	0.01	0.01	0.02	<0.01	0.02
August					
<i>Maximum</i>	0.03	0.05	0.2	<0.01	0.03
<i>Minimum</i>	<0.01	<0.01	ND	<0.01	<0.01
<i>Mean</i>	0.01	0.03	0.1	<0.01	0.01
September					
<i>Maximum</i>	0.02	0.03	0.2	<0.01	0.02
<i>Minimum</i>	<0.01	<0.01	<0.01	<0.01	<0.01
<i>Mean</i>	0.01	0.01	0.1	<0.01	0.01

5.1.3 Bacteria

Water samples were taken for bacterial analyses at the surface at each station, and included total and fecal coliform, fecal streptococcus, and enterococcus (Appendix Table 8.1-3). The results of the bacterial analyses were compared to USEPA and CDHS bacterial water quality criteria for total and fecal coliforms and for enterococcus (APHA 1998). A water quality criterion for fecal streptococcus has not been established by USEPA or CDHS; however, the test for fecal streptococcus is necessary to detect enterococcus, a pathogen that does have established criteria (APHA 1998).

Bacteria were found at most of the stations at some time during the sampling, but bacterial levels exceeded water quality criteria sporadically (Appendix Table 8.1-3). Generally, bacteria were not detected at many of the stations or were detected at very low levels. On the other hand, some stations, such as Lake Oroville at Bidwell Canyon Boat Ramp or the Lake Oroville at Loafer Creek Equestrian Campground, were found in levels too high to measure. Then, in the following sampling periods, these same stations would have little or no detectible levels of bacteria.

5.1.4 Total and dissolved metals

Water samples were taken for total and dissolved metals analyses at the surface at the four Lake Oroville sites with high boat traffic at Bidwell Canyon and Lime Saddle (Table 5.1.4-1). Samples were tested for twelve metals (Appendix Tables 8.1-4 and 8.1-5) that were considered a potential concern of marinas, boat yards, and boat ramps (Table 5.1.4-2). In addition, samples were taken for total and methyl mercury analyses (Appendix Table 8.1-6).

Table 5.1.4-1. Total and dissolved metals sampling stations.

Station Name	Latitude/ Longitude
Lake Oroville at Bidwell Canyon Boat Ramp	N39° 32' 20.017" W121° 27' 23.205"
Lake Oroville at Bidwell Canyon Marina	N39° 32' 1.699" W121° 27' 17.156"
Lake Oroville at Lime Saddle Boat Ramp	N39° 40' 33.610" W121° 33' 29.362"
Lake Oroville at Lime Saddle Marina	N39° 40' 35.569" W121° 33' 26.706"

For most of the metals tested, levels were at very low levels or non-detectable during the duration of sampling (Tables 5.1.4-2 to 5.1.4-4). The overall summary of results (Table 5.1.4-2) shows that all of the metals except aluminum and arsenic were below water quality criteria. Total aluminum was normally below the criteria, ranging from 12.7 to 89.6 mg/L. The higher value for total aluminum exceeded the USEPA criterion for freshwater aquatic life protection of 87 µg/L, but only once at the Lake Oroville at Bidwell Canyon Boat Ramp station in September 2003 (Table 5.1.4-4). One station, Lake Oroville at Bidwell Canyon Boat Ramp in July 2003 had an abnormally high value of 528.0 mg/L. A similar result of approximately 600 mg/L was obtained by a re-test of the water sample from this station by the Bryte Laboratory. Since both results were so much higher than all of the other results from this study and from the SP-W1 sampling, this lone sample was considered contaminated (Marilyn Toomey, DWR Bryte Laboratory, pers. comm.) and was therefore excluded from this analysis. Dissolved aluminum does not have a published criterion.

Table 5.1.4-2. Total and dissolved metals results summary: June to September.

Analyte (µg/L)		Maximum	Minimum	Mean
Aluminum	Total	89.6	12.7	35.3
	Dissolved	22.4	6.42	13.6
Arsenic	Total	0.714	0.52	0.58
	Dissolved	0.673	<0.01	0.52
Cadmium	Total	0.029	<0.01	0.002
	Dissolved	<0.004	<0.04	<0.004
Chromium	Total	1.56	0.119	0.40
	Dissolved	0.35	<0.072	0.13
Copper	Total	2.46	0.57	0.79
	Dissolved	0.74	0.49	0.60
Iron	Total	934	6.9	104.5
	Dissolved	18.3	<0.106	7.2
Lead	Total	0.2	<0.03	0.05
	Dissolved	0.024	<0.02	0.005
Manganese	Total	21.8	1.32	5.0
	Dissolved	10.8	0.048	1.7
Nickel	Total	1.48	0.59	0.78
	Dissolved	0.76	0.48	0.61
Selenium	Total	0.16	<0.016	0.02
	Dissolved	<0.285	<0.052	<0.052
Silver	Total	<0.165	<0.001	<0.001
	Dissolved	0.014	<0.062	0.004
Zinc	Total	2.96	<0.071	0.75
	Dissolved	1.04	0.04	0.32

Bold = exceeds criteria

Table 5.1.4-3. Total and dissolved metals results – summary by month: June and July 2003.

Analyte (µg/L)		June			July		
		Max- imum	Min- imum	Mean	Max- imum	Min- imum	Mean
Aluminum	Total	54.1	12.7	24.9	42.2	25.5	34.4
	Dissolved	26.4	9.65	16.0	11.1	6.42	8.2
Arsenic	Total	0.55	0.532	0.54	0.554	0.52	0.54
	Dissolved	0.531	0.488	0.517	0.55	<0.01	0.39
Cadmium	Total	<0.005	<0.005	<0.005	<0.013	<0.013	<0.013
	Dissolved	<0.005	<0.005	<0.005	<0.013	<0.013	<0.013
Chromium	Total	0.36	0.19	0.26	1.56	0.119	0.56
	Dissolved	0.15	0.05	0.10	0.112	ND	0.028
Copper	Total	0.91	0.72	0.80	2.46	0.574	1.07
	Dissolved	0.74	0.69	0.71	0.726	0.531	0.614
Iron	Total	83	6.9	33.2	934¹	32.8	270.8
	Dissolved	23.4	5.2	14.7	<0.106	<0.106	<0.106
Lead	Total	0.104	0.007	0.036	0.179	ND	0.056
	Dissolved	0.024	0.004	0.013	0.008	ND	0.002
Manganese	Total	12	1.32	4.76	21.8	2.68	8.2
	Dissolved	10.8	1.07	4.0	0.142	0.048	0.087
Nickel	Total	0.86	0.71	0.78	1.48	0.68	0.96
	Dissolved	0.8	0.5	0.7	0.616	0.553	0.598
Selenium	Total	0.16	<0.138	0.04	<0.242	<0.242	<0.242
	Dissolved	<0.285	<0.285	<0.285	<0.261	<0.261	<0.261
Silver	Total	<0.165	<0.165	<0.165	<0.106	<0.106	<0.106
	Dissolved	<0.006	<0.006	<0.006	0.014	0.007	0.010
Zinc	Total	0.87	0.45	0.6475	2.96	ND	0.90
	Dissolved	0.74	0.27	0.4825	0.146	0.04	0.09

Note: An abnormally high value of 528 mg/L for total aluminum was found in July 2003 sample. The sample was analyzed twice by Bryte Lab to verify; sampling or laboratory error is suspected (Marilyn Toomey, DWR Bryte Laboratory, pers. comm. 4/28/04)

Bold = exceeds criteria

¹Exceeds the USEPA and CDHS Drinking Water Standards Secondary Maximum Contaminant Level of 300 µg/L

Table 5.1.4-4. Total and dissolved metals results summary by month: August and September 2003.

Analyte (µg/L)		August			September		
		Maximum	Minimum	Mean	Maximum	Minimum	Mean
Aluminum	<i>Total</i>	51.7	13.3	32.9	89.6¹	38.8	57.6
	<i>Dissolved</i>	22.4	11.3	17.5	20.8	11.3	15.9
Arsenic	<i>Total</i>	0.65²	0.561²	0.61²	0.714²	0.576²	0.628²
	<i>Dissolved</i>	0.621²	0.53²	0.59²	0.673²	0.527²	0.582²
Cadmium	<i>Total</i>	0.029	<0.004	0.007	<0.002	<0.002	<0.002
	<i>Dissolved</i>	<0.004	<0.004	<0.004	<0.022	<0.022	<0.022
Chromium	<i>Total</i>	0.52	0.4	0.45	0.38	0.2	0.3
	<i>Dissolved</i>	0.35	0.2	0.28	0.2	<0.104	0.1
Copper	<i>Total</i>	0.79	0.58	0.64	0.71	0.57	0.63
	<i>Dissolved</i>	0.72	0.49	0.58	0.5	0.49	0.50
Iron	<i>Total</i>	61.9	9	37.1	114	37.5	71.5
	<i>Dissolved</i>	18.3	3.9	11.6	8.2	<0.164	4.7
Lead	<i>Total</i>	0.2	0.01	0.07	0.048	0.003	0.020
	<i>Dissolved</i>	<0.003	<0.003	<0.003	0.002	0.001	0.002
Manganese	<i>Total</i>	4.31	1.81	3.05	4.85	2.01	3.37
	<i>Dissolved</i>	4.13	0.98	1.87	0.99	0.55	0.76
Nickel	<i>Total</i>	0.77	0.59	0.66	0.84	0.59	0.73
	<i>Dissolved</i>	0.7	0.57	0.64	0.7	0.48	0.6
Selenium	<i>Total</i>	<0.038	<0.038	<0.038	0.14	<0.242	0.04
	<i>Dissolved</i>	<0.015	<0.015	<0.015	<0.052	<0.052	<0.052
Silver	<i>Total</i>	<0.144	<0.144	<0.144	<0.062	<0.062	<0.062
	<i>Dissolved</i>	<0.015	<0.015	<0.015	0.009	<0.001	0.004
Zinc	<i>Total</i>	1.04	0.22	0.52	2.51	0.27	0.89
	<i>Dissolved</i>	0.93	0.12	0.33	1.04	0.07	0.35

¹Exceeds the USEPA National Recommended Ambient Water Quality Criteria for Freshwater Aquatic Life Protection of 87 µg/L

²Exceeds the USEPA National Recommended Ambient Water Quality Criteria for Human Health and Welfare Protection, One-in-a-Million Cancer Risk Estimate for
 - Sources of Drinking Water (water +organisms) – 0.018 µg/L
 - Other Waters (aquatic organism consumption only) – 0.14 µg/L

Total arsenic levels exceeded criteria during the sampling period (Table 5.1.4-5), and ranged from 0.52 to 0.714 mg/L with a mean of 0.58 mg/L. This exceeds the USEPA criteria for sources of drinking water (water +organisms) of 0.018 µg/L and for other waters (aquatic organism consumption only) of 0.14 µg/L.

Table 5.1.4-5. Monthly maximum, minimum, and mean concentrations for total and dissolved arsenic.

	Total Arsenic (µg/L)			Dissolved Arsenic (µg/L)		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
<i>Facility Stations</i>						
Total	0.714	0.52	0.582	0.673	<0.01	0.519
June	0.550	0.532	0.546	0.531	0.524	0.517
July	0.554	0.520	0.537	0.575	<0.01	0.394
August	0.650	0.602	0.612	0.621	0.530	0.585
September	0.714	0.576	0.628	0.673	0.527	0.582
<i>Lake Stations</i>						
Total	0.703	0.380	0.616	0.858	0.480	0.554
June	0.562	0.380	0.628	0.858	0.480	0.464
July	0.557	0.502	0.537	0.557	0.485	0.526
August	0.658	0.500	0.631	0.668	0.519	0.615
September	0.703	0.512	0.669	0.728	0.538	0.610

Bold = Exceeds:

USEPA Integrated Risk Information System, One-in-a-Million Incremental Cancer Risk Estimates for Drinking Water Level of 0.02 µg/L;

USEPA National Recommended Ambient Water Quality Criteria for Human Health and Welfare Protection, One-in-a-Million Cancer Risk Estimate for Sources of Drinking Water (water +organisms) – 0.018 µg/L;

USEPA National Recommended Ambient Water Quality Criteria for Human Health and Welfare Protection, One-in-a-Million Cancer Risk Estimate for Other Waters (aquatic organism consumption only) – 0.14 µg/L; and

Cal/EPA Cancer Potency Factors as a Drinking Water Level – 0.023 µg/L.

The USEPA California Toxics Rule criteria for total mercury are 770 ng/L for aquatic life protection and 50 ng/L for drinking water sources (consumption of water and aquatic organisms) (RWQCB 2003). For methyl mercury, the USEPA IRIS Reference Dose for toxicity to humans is 70 ng/L. Overall, the detected amounts of total mercury ranged from 0.23 ng/L to 1.86 ng/L with a mean of 0.678 ng/L (Table 5.1.4-6). Methyl mercury ranged from less than 0.025 ng/L to 0.129 ng/L. At these levels, total and methyl mercury did not exceed water quality criteria.

Table 5.1.4-6. Monthly maximum, minimum, and mean concentrations for total and methyl mercury.

	Total Mercury ng/L			Methyl Mercury ng/L		
	Max- imum	Min- imum	Mean	Max- imum	Min- imum	Mean
Total	1.86	0.23	0.68	0.129	<0.025	0.020
June	0.85	0.43	0.66	0.055	<0.025	0.026
July	0.99	0.23	0.60	0.129	<0.025	0.043
August	1.86	0.34	0.91	0.026	<0.025	0.007
September	0.67	0.39	0.44	<0.025	<0.025	<0.025

5.1.5 Petroleum byproducts

Surface water samples from all of the recreational water quality stations where high boat traffic can be expected (marinas and boat ramps) were tested for petroleum byproducts, including aromatic hydrocarbons and polynuclear aromatic hydrocarbons (Table 4.1-3). Samples were also taken for oil –and grease analysis. Neither oil and grease nor polynuclear aromatic hydrocarbons were detected at any of the stations (Appendix Table 8.1-7). Five aromatic hydrocarbons were detected at the two boat ramps and marinas, though never in amounts that exceeded any criteria (Table 5.1.5-1).

MTBE was found at some stations in August and September (Table 5.1.5-2) in amounts exceeding the DHS drinking water primary MCL of 13 µg/L and secondary MCL of 5 µg/L (RWQCB 2003). MTBE was found at every station, and levels exceeded water quality criteria nine times in four months. All of the MTBE levels in excess of the criteria were found at the boat launching facilities: Bidwell Canyon Boat Ramp, Bidwell Canyon Marina, Lime Saddle Boat Ramp, Lime Saddle Marina, and Spillway Boat Ramp. No other Lake Oroville station was found to exceed the criteria for MTBE.

Table 5.1.5-1. Aromatic hydrocarbons results.

Station	Date	Benzene (µg/L)	Toluene (µg/L)	1,2,4- Trimethyl benzene (µg/L)	1,3,5- Trimethyl benzene (µg/L)	Xylenes (total) (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	8/20/03	<0.5	0.87	1.5	<0.5	2
	9/15/03	<0.5	0.75	<0.5	<0.5	0.52
Lake Oroville at Bidwell Canyon Marina	8/20/03	<0.5	<0.5	<0.5	<0.5	<0.5
	9/15/03	<0.5	<0.5	<0.5	<0.5	<0.5
Lake Oroville at Lime Saddle Boat Ramp	8/20/03	<0.5	<0.5	<0.5	<0.5	<0.5
	9/15/03	0.83	6.9	2.1	0.69	7
Lake Oroville at Lime Saddle Marina	8/20/03	<0.5	<0.5	<0.5	<0.5	<0.5
	9/15/03	<0.5	0.71	<0.5	<0.5	0.54

Table 5.1.5-2. Methyl tertiary butyl ether - summary of all stations, overall and by month.

	Overall 2003	June 2003	July 2003	August 2003	September 2003
Maximum	15.0¹	9.4	12.0	10.0²	15.0¹
Minimum	<0.5	<0.5	<0.5	<0.5	<0.5
Mean	1.96	1.89	2.35	2.00	1.63
% Detections	91	83	79	83	63
Exceedances	9	3	2	3	0

¹Exceeds the California Department of Health Services Drinking Water Standards Maximum Contaminant Levels – Primary MCL of 13 µg/L and Secondary MCL of 5 µg/L

² Exceeds the California Department of Health Services Drinking Water Standards Maximum Contaminant Levels – Secondary MCL of 5 µg/L

No water quality monitoring stations outside of the boat launching facilities had MTBE levels that exceeded the criteria (Table 5.1.5-3). The highest level of MTBE at these sites was 2.6 µg/L found in July 2003, which is less than the DHS criteria. However, MTBE levels at the boat launch water quality stations exceeded the criteria in each month sampled (Table 5.1.5-4). Mean values for June, August, and September exceed the criteria for MTBE, with the mean of July very close to the CDHS Secondary MCL of 5 µg/L criterion. All nine of the exceedances found during this study (Table 5.1.5-2) were found at the boat launch facility stations.

Table 5.1.5-3. Methyl tertiary butyl ether - summary of all stations outside of boat launch facilities.

	Overall 2003	June 2003	July 2003	August 2003	September 2003
Maximum	2.6	0.97	2.6	1.8	2.5
Minimum	<0.50	<0.50	<0.50	<0.50	<0.50
Mean	0.997	0.796	1.867	0.847	0.477
% Detections	67	75	75	75	50
Exceedances	0	0	0	0	0

Table 5.1.5-4. Methyl tertiary butyl ether - summary of all boat launch facility water quality stations.

	Overall 2003	June 2003	July 2003	August 2003	September 2003
Maximum	15	9.4	7.6	10	15
Minimum	1.5	1.9	1.5	1.9	2.1
Mean	5.23	5.56	4.56	5.54	5.26
% Detections	100	100	100	100	100
Exceedances	9	3	2	3	1

5.1.6 Visual Inspection Stations

The visual inspection stations were visited monthly and checked for erosion damage. Most of these sites, such as Dark Canyon and Vinton Gulch boat access ramps, were well maintained by the managing agency. However, the boat access ramps along the Feather River in the Oroville Wildlife Area showed a steady degradation of their structure from boat trailer use. Ruts and side-slope failures were readily visible in the Feather River boat access ramp upstream of the Thermalito Outfall (Figure 5.1.6-1).

The Stringtown boat ramp is the remnant of the old Stringtown blacktop road. The blacktop from the old road is crumbling in many spots due to exposure to the lake water and sun (Figure 5.1.6-2). The blacktop is not maintained.

5.1.7 Trails

The trail system around the Oroville Facilities totals 88.5 miles of three basic types: dirt, gravel, and paved (Table 5.1.7-1, Figure 5.1.7-1). The lone exception is the historic wood surfaced Bidwell Bar Bridge, which now serves as a tourist attraction and a portion of the Wyke Island Trail.

Figure 5.1.6-1. Damage to the boat access ramp on the Feather River upstream of the Thermalito Afterbay Outlet.



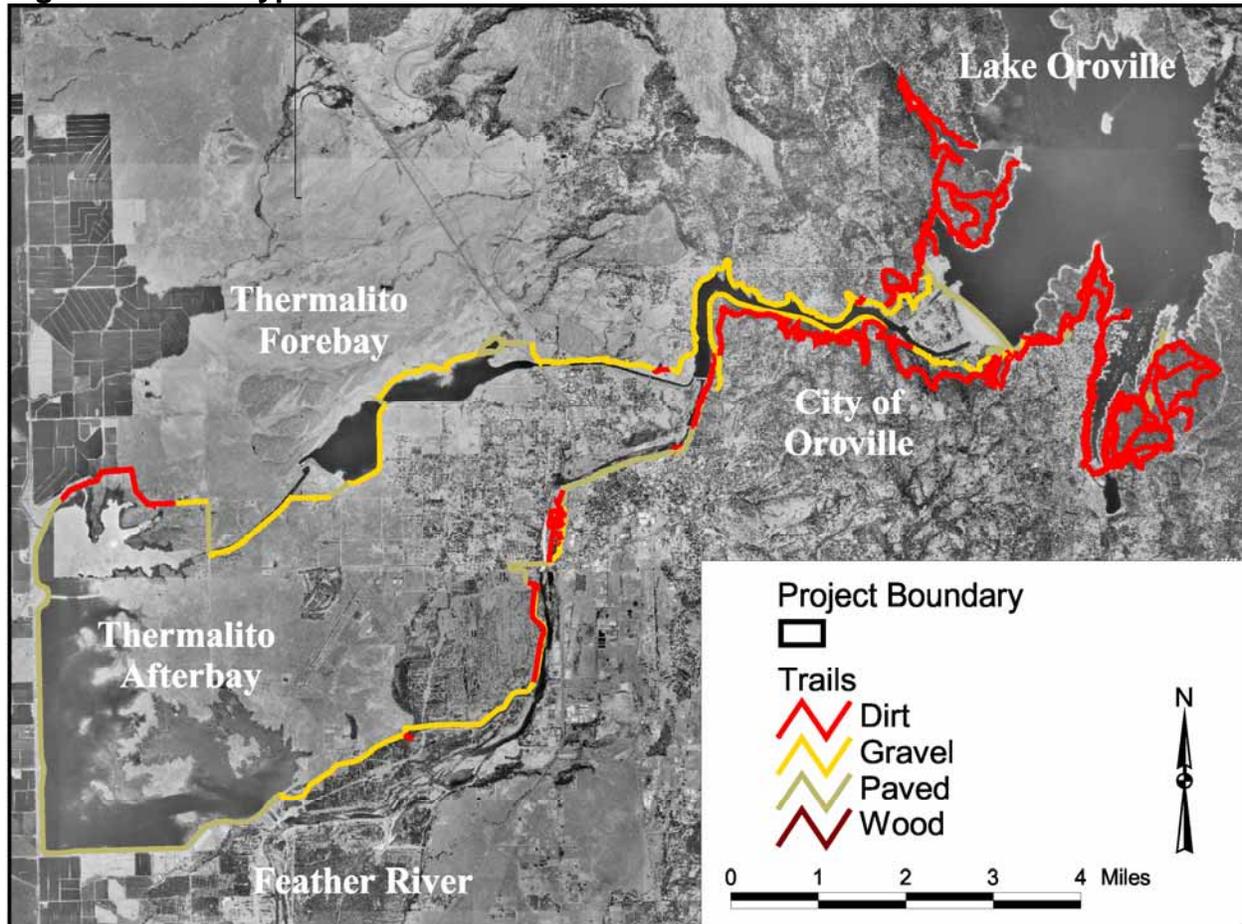
Figure 5.1.6-2. Damage to the boat access ramp at Stringtown on the South Fork Arm of Lake Oroville.



Table 5.1.7-1 Oroville multi-use trails – Length and surface type.

Trail	Surface	Width Range (Mean)(feet)	Length (miles)	Percent
Bidwell Bar Bridge	<i>Wood</i>	18 (18)	0.05	7
	<i>Dirt</i>	10 (10)	0.61	93
	<i>Total</i>	10-18 (14)	0.66	100
Brad Freeman	<i>Dirt</i>	2-20 (8)	8.0	18
	<i>Gravel</i>	5-30 (15)	21.2	48
	<i>Paved</i>	3-30 (12)	15.0	34
	<i>Total</i>	2-30 (11)	44.2	100
Dan Beebe	<i>Dirt</i>	1-25 (5)	13.9	96
	<i>Gravel</i>	15 (15)	0.5	3.5
	<i>Paved</i>	3-4 (3.5)	0.1	0.5
	<i>Total</i>	1-25 (6)	14.5	100
Chaparral Loop	<i>Dirt</i>	3 (3)	0.25	100
Kelly Ridge	<i>Dirt</i>	2-8 (5)	4.5	94
	<i>Gravel</i>	30 (30)	0.2	3.5
	<i>Paved</i>	5 (5)	0.1	2.5
	<i>Total</i>	2-30 (7)	4.8	100
Loafer Creek RA		3-10 (5)	13.8	
<i>Campfire Center</i>	<i>Paved</i>	3 (3)	0.5	100
<i>Day-Use Area</i>	<i>Paved</i>	10 (10)	0.6	100
<i>Loafer Creek</i>	<i>Dirt</i>	3-5 (5)	3.2	100
<i>Loafer Creek Loop</i>	<i>Dirt</i>	5 (5)	4.0	100
<i>Roy Rogers</i>	<i>Dirt</i>	5 (5)	5.6	100
North Fork		4-25 (11)	10.0	
<i>Dead Cow Ravine</i>	<i>Dirt</i>	10 (10)	1.2	100
<i>North Fork</i>	<i>Dirt</i>	25 (25)	1.4	100
<i>Potter Point</i>	<i>Dirt</i>	4 (4)	0.4	100
<i>Potter Ravine</i>	<i>Dirt</i>	5-7 (5)	7.0	100
Visitors Center	<i>Paved</i>	6-10 (9)	0.3	100
Totals	<i>Wood</i>	18 (18)	0.05	0.05
	<i>Dirt</i>	1-25 (6)	49.8	56.2
	<i>Gravel</i>	5-30 (16)	21.9	24.7
	<i>Paved</i>	3-30 (11)	16.9	19.0
	<i>Total</i>	1-30 (8)	88.5	100

Figure 5.1.7-1. Types of trails associated with the Oroville Facilities.



There are 49.8 miles (56.2 percent) of dirt trails out of the 88.5 miles, ranging in width from 1 to 15 feet (average 5 feet). This equals roughly 30 acres of exposed soils subject to direct impact from recreation activities and from natural processes.

Graveled trails account for 21.9 miles (24.7 percent) of the total trails, ranging in width from 5 to 25 feet (average 16 feet), or roughly 42 acres of trail. Many of these trails are the access roads along the Diversion Pool, Thermalito Power Canal, and Thermalito Forebay. Additionally, the main levee road through the Oroville Wildlife Area on the west side of the Feather River is considered a part of the trail system.

There are 16.9 miles (19.0 percent) of paved trails, which are primarily surfaced with blacktop or composite. Some of these trails are located in and about those recreational facilities that serve the handicapped or the elderly, such as the Lake Oroville Visitor Center. Most of the length of paved trail, though, is found on the levees and access roads around the Thermalito Afterbay and Forebay, through the City of Oroville, and across Oroville Dam.

Erosion along the dirt trails is widespread, but each erosion event is highly localized. Most of the trails are well maintained, with some exceptions. Some fairly severe damage was observed along some of the steeper trails on both sides of the Diversion Pool where hikers, bicyclists, or horseback riders tended to take shortcuts across switchbacks. The action of shortcutting across switchbacks has led to the development of new overly steep (some near vertical) trails. The exposed soils of these shortcut trails will act as sources of sediment when the rainy season starts. Some segments of the trails within the Loafer Creek RA were constructed initially at too high a gradient, leading to rutting from normal recreational use and later from rain runoff. Bridges and culverts crossing intermittent streams or swales are rare or absent on many dirt trails, leading to erosion of the trail and transport of sediment downslope of the trail. In a few instances, trail maintenance itself along the Kelly Ridge and Dan Beebe Trails has led to erosion when vegetation was cut back and removed from the trail without adequate erosion prevention or sedimentation abatement measures in place. Physical damage from the vegetation cutting machinery and from the process of dragging the larger pieces of vegetation has exacerbated the damage to the trail. Additionally, the removal of the vegetation and soil retaining root system from the trail side can lead to further erosion damage of the now bare soil from rain runoff.

Erosion along gravel trails are rarer than along dirt trails, but can still be serious. A portion of the Dan Beebe Trail near the Visitor Center was graveled with native decomposed granite (DG). DG soils are fairly light soils and are easily transported by rain runoff. In the steep portions of the DG covered trails, rain runoff has cut into the trail and transported DG sediments downslope. The trail fill for some portions of this trail segment is maintained in place by downslope retaining walls. In those places where the retaining wall is not present or is not continuous, runoff has carried significant amounts of the trail fill downslope. The other graveled trails are actually parts of the levee roads and fence line access roads. Erosion is present in these trail segments, but not to a significant degree. Portions of the levee road through the OWA has have been severely damaged from the high recreational use (primarily by anglers' truck traffic) and rain runoff. The trail through this area is not well maintained.

5.2 WQ SAMPLING PROGRAM 2 – SWIM AREAS BACTERIA SAMPLING

Two water samples were taken for bacterial analyses near the surface at each swim area station (Table 4.2-2) from June 2003 to November 2003. Analyses included total and fecal coliform, fecal streptococcus, and enterococcus bacteria. The results of the bacterial analyses (Appendix Table 8.2-1) were compared to USEPA and DHS bacterial water quality criteria for total and fecal coliforms and for enterococcus (APHA 1998). A water quality criterion for fecal streptococcus has not been established by USEPA or DHS. However, the test for fecal streptococcus is necessary to detect enterococcus, which is a pathogen that does have established criteria.

The DHS single sample criteria are: for total coliforms, 10,000 per 100 mL; for fecal coliforms, 400 per 100 mL; and for enterococcus, 61 per 100 mL. The EPA criteria for enterococcus at freshwater swim beaches (full body contact) is 33 per 100 mL, and is based on no less than five samples equally spaced over a thirty day period.

Most of the stations had one or more maximum bacterial levels above the DHS criteria for fecal coliform and enterococcus at some time during the year (Table 5.2-1).

5.3 WQ SAMPLING PROGRAM 3 – FISHING TOURNAMENT/WEEKEND SAMPLING

Three stations at Bidwell Canyon and two stations at Spillway Boat Ramp (Table 4.3-1) were sampled for petroleum byproducts in August, September, and November 2003 (Appendix Table 8.3-1). For the weekend sampling, samples were taken on the afternoon of Saturday, August 24, 2003 and Saturday, August 30, 2003 at the Bidwell Canyon Boat Ramp and the Marina, a control station outside of the Bidwell Canyon Arm of Lake Oroville, and the Spillway Boat Ramp (Figure 4.3-1).

Most of the petroleum byproducts were at levels too low to be detected (Appendix Table 8.3-1), with the exception of benzene (Table 5.3-1) and MTBE (Table 5.3-2). Both of these analytes exceeded several water quality criteria.

Benzene is a natural component of crude and refined petroleum. The mandatory decrease of lead alkyls in gasoline has led to an increase in the aromatic hydrocarbon content of gasoline to maintain high octane levels and antiknock properties. In the United States, gasoline typically contains less than 2 percent benzene by volume, but in other countries the benzene concentration may be as high as 5 percent (Frank and Balk 2003). Benzene levels exceeded water quality criteria at both boat ramp stations, while being at levels too low to be detected at the other two stations (Table 5.3-1).

MTBE was detected at all of the stations, and exceeded, or came close to exceeding, water quality criteria at all but the control station (Table 5.3-2).

Table 5.2-1. Swim areas bacteria sampling – results summary by station (#/100mL).

		Total Coliform	Fecal Coliform	Enterococcus	Fecal Streptococcus
Bedrock Park Downstream	<i>Max</i>	900	300	300	500
	<i>Min</i>	70	8	4	11
	<i>Mean</i>	295	50	50	116
	<i>Exceedances</i>	0	0	3	-
Bedrock Park Upstream	<i>Max</i>	>1600	300	170	300
	<i>Min</i>	23	4	2	7
	<i>Mean</i>	384	54	41	82
	<i>Exceedances</i>	2	0	4	-
Foreman Creek Boat Access	<i>Max</i>	>1600	>1600	500	900
	<i>Min</i>	<2	<2	<2	<2
	<i>Mean</i>	269	127	57	85
	<i>Exceedances</i>	2	1	2	-
Loafer Creek Swim Area	<i>Max</i>	>1600	1600	>1600	>1600
	<i>Min</i>	4	2	0	0
	<i>Mean</i>	340	194	141	173
	<i>Exceedances</i>	2	3	2	-
Monument Hill Swim Area	<i>Max</i>	>1600	500	>1600	>1600
	<i>Min</i>	60	4	4	7
	<i>Mean</i>	433	103	167	238
	<i>Exceedances</i>	1	2	5	-
North Forebay Swim Area (Beach)	<i>Max</i>	50000	>1600	>1600	1600
	<i>Min</i>	170	23	22	50
	<i>Mean</i>	4433	1224	807	882
	<i>Exceedances</i>	7	11	13	-
North Forebay Swim Area (Cove)	<i>Max</i>	>16000	22000	>1600	1600
	<i>Min</i>	0	2	2	4
	<i>Mean</i>	11759	1718	473	487
	<i>Exceedances</i>	5	4	11	-
North Forebay Swim Area (Mouth)	<i>Max</i>	>1600	1600	>1600	>1600
	<i>Min</i>	140	4	<2	<2
	<i>Mean</i>	699	274	203	236
	<i>Exceedances</i>	4	2	6	-
South Forebay Boat Ramp	<i>Max</i>	>1600	>1600	900	900
	<i>Min</i>	17	4	4	4
	<i>Mean</i>	506	346	201	205
	<i>Exceedances</i>	2	3	6	-
Stringtown Boat Ramp	<i>Max</i>	>1600	>1600	>1600	>1600
	<i>Min</i>	2	<2	<2	<2
	<i>Mean</i>	247	230	321	368
	<i>Exceedances</i>	3	4	6	-

Table 5.3-1. Weekend WQ Sampling – Benzene.

Station	Date	Benzene (µg/L)
Bidwell Canyon Boat Ramp	8/24/03	0.67¹
	8/30/03	1.4²
Bidwell Canyon Boat Ramp Control	8/24/03	<0.5
	8/30/03	<0.5
Bidwell Canyon Marina	8/24/03	<0.5
	8/30/03	<0.5
Spillway Boat Ramp	8/24/03	2.5³
	8/30/03	0.73¹

¹ Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L

² Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L; exceeds California Primary MCL of 1.0 µg/L; exceeds USEPA Drinking Water Health Advisory criterion of 1.0 µg/L

³ Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L; exceeds California Primary MCL of 1.0 µg/L; exceeds USEPA Drinking Water Health Advisory criterion of 1.0 µg/L; exceeds USEPA California Toxics Rule for drinking water sources (consumption of water and aquatic organisms) criterion of 1.2 µg/L

Table 5.3-2. Weekend WQ Sampling – MTBE.

Station	Date	MTBE (µg/L)
Bidwell Canyon Boat Ramp	8/24/03	4.7
	8/30/03	10
Bidwell Canyon Boat Ramp Control	8/24/03	1.8
	8/30/03	2.6
Bidwell Canyon Marina	8/24/03	4.8
	8/30/03	5.7
Spillway Boat Ramp	8/24/03	7.5
	8/30/03	6.4

Bold = exceeds water quality criteria

5.4 WQ SAMPLING PROGRAM 4 – BIDWELL MARINA WQ SAMPLING

Since monthly sampling at Bidwell Canyon Marina started in September 2003, the first complete year of sampling at the Bidwell Canyon Marina is not yet complete. Monthly sampling was performed for TBT, PBDE, total and dissolved metals, and petroleum byproducts. The complete results are reported in Appendix Section 8.4 (Tables 8.4-1 to 8.4-8). Summaries of the results are included in the following sections.

5.4.1 Physical parameters

Physical parameters measured at each station included water temperature, dissolved oxygen, conductivity, and pH (Appendix Table 8.4-1). Physical parameters were fairly uniform among the various stations over the entire sampling period (Table 5.4.1-1). Water samples did not exceed any water quality criteria for lake physical parameters (RWQCB 2003). Overall, surface water temperatures reflected the seasonal changes across the entire system (see section 5.1, above), usually ranging no more than one degree among the stations in any given month (Table 5.4.1-1). Conductivity reflected the same trend as water temperature, with very little variation in any month. Dissolved oxygen remained uniformly high, ranging from a minimum of 8.4 mg/L to a maximum of 14.2 mg/L, with an overall mean of 10.0 mg/L. Monthly pH values remained within a narrow range from 7.2 to 8.0 pH units, with an overall mean of 7.7 pH units.

5.4.2 Total and dissolved metals

Water samples were taken for total and dissolved low level metals analyses at the surface at the six Bidwell Canyon sites. Samples were tested for twelve metals (Appendix Tables 8.4-2 and 8.4-3) that were considered a potential concern at marinas, boat yards, and boat ramps. In addition, samples were taken for total mercury and methyl mercury analyses (Appendix Table 8.4-4).

Most metals were found at levels below water quality criteria with the exception of arsenic (Table 5.4.2-1). Total arsenic levels exceeded criteria during the sampling period, and ranged from 0.472 to 1.15 µg/L. This level exceeds the USEPA criteria for sources of drinking water (water +organisms) of 0.018 µg/L and for other waters (aquatic organism consumption only) of 0.14 µg/L.

Total mercury levels did not exceed water quality criteria at any station (Appendix Table 8.4-4; Table 5.4.2-2). The USEPA California Toxics Rule criterion for total mercury is 0.77 µg/L (770 ng/L) for aquatic life protection and 0.05 µg/L (50 ng/L) for drinking water (RWQCB 2003). The detected amounts of total mercury ranged from 0.00023 µg/L (0.23 ng/L) to 0.00086 µg/L (0.86 ng/L) with a mean of 0.00068 µg/L (0.68 ng/L). The USEPA IRIS Reference Dose for toxicity to humans is 0.07 µg/L (70 ng/L). Methyl mercury was not found above the detection level of 0.000025 µg/L (0.025 ng/L).

Table 5.4.1-1. Monthly physical parameters among all stations (September 2003 to May 2004).

Month		Water Temperature °F	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
September	<i>Max</i>	73.2	96	8.6	7.6
	<i>Min</i>	72.3	94	8.4	7.5
	<i>Mean</i>	72.8	95	8.5	7.6
October	<i>Max</i>	68.4	96	9.0	8.0
	<i>Min</i>	68.2	95	8.7	8.0
	<i>Mean</i>	68.3	96	8.9	8.0
November	<i>Max</i>	61.7	95	9.1	8.0
	<i>Min</i>	61.2	95	8.8	7.8
	<i>Mean</i>	61.4	95	8.9	7.8
December	<i>Max</i>	54.0	94	10.4	7.5
	<i>Min</i>	53.6	90	10.2	7.5
	<i>Mean</i>	53.9	93	10.3	7.5
January	<i>Max</i>	49.8	90	10.9	7.4
	<i>Min</i>	49.5	90	10.0	7.2
	<i>Mean</i>	49.6	90	10.6	7.4
February	<i>Max</i>	48.6	85	14.2	7.5
	<i>Min</i>	48.2	84	12.2	7.3
	<i>Mean</i>	48.4	85	13.0	7.4
March	<i>Max</i>	59.0	85	10.9	7.9
	<i>Min</i>	57.7	84	10.6	7.9
	<i>Mean</i>	58.3	84	10.7	7.9
April	<i>Max</i>	65.5	81	10.0	7.9
	<i>Min</i>	63.1	81	9.8	7.9
	<i>Mean</i>	64.2	81	9.9	7.9
May	<i>Max</i>	65.5	81	10.0	7.9
	<i>Min</i>	63.1	81	9.8	7.9
	<i>Mean</i>	64.2	81	9.9	7.9

Table 5.4.2-1a. Total and dissolved metals results summary by month: September and October 2003.

Analyte (µg/L)		September		October	
		Maximum	Minimum	Maximum	Minimum
Aluminum	<i>Total</i>	30.2	22.4	28.8	22.3
	<i>Dissolved</i>	14.7	10.2	10.8	8.75
Arsenic	<i>Total</i>	0.884	0.668	0.809	0.519
	<i>Dissolved</i>	0.7	0.639	0.573	0.46
Cadmium	<i>Total</i>	<0.004	<0.004	0.007	<0.004
	<i>Dissolved</i>	<0.011	<0.011	<0.02	<0.02
Chromium	<i>Total</i>	0.328	0.253	1.23	1.13
	<i>Dissolved</i>	<0.075	<0.075	<0.209	<0.209
Copper	<i>Total</i>	0.527	0.431	0.78	0.69
	<i>Dissolved</i>	0.44	0.39	0.46	0.39
Iron	<i>Total</i>	32.3	22.3	30.3	17.7
	<i>Dissolved</i>	<1.02	<1.02	23.1	<3.98
Lead	<i>Total</i>	0.007	0.002	0.01	<0.001
	<i>Dissolved</i>	<0.026	<0.026	<0.007	<0.007
Manganese	<i>Total</i>	2.64	1.67	1.49	1.38
	<i>Dissolved</i>	1.1	0.56	0.61	0.51
Nickel	<i>Total</i>	0.626	0.535	0.59	0.58
	<i>Dissolved</i>	0.5	0.43	0.57	0.42
Selenium	<i>Total</i>	<0.162	<0.162	0.21	<0.121
	<i>Dissolved</i>	<0.327	<0.327	0.17	<0.075
Silver	<i>Total</i>	<0.131	<0.131	0.243	<0.04
	<i>Dissolved</i>	<0.01	<0.01	<0.02	<0.02
Zinc	<i>Total</i>	0.378	0.146	0.18	0.09
	<i>Dissolved</i>	0.18	0.04	0.17	<0.101

Table 5.4.2-1b. Total and dissolved metals results summary by month: November and December 2003.

Analyte (µg/L)		November		December	
		Maximum	Minimum	Maximum	Minimum
Aluminum	<i>Total</i>	19.5	12.6	26.4	14
	<i>Dissolved</i>	9.65	7.18	7.36	5.29
Arsenic	<i>Total</i>	1.15	0.748	0.787	0.749
	<i>Dissolved</i>	0.751	0.717	0.782	0.732
Cadmium	<i>Total</i>	<0.023	<0.023	<0.016	<0.016
	<i>Dissolved</i>	<0.016	<0.016	<0.008	<0.008
Chromium	<i>Total</i>	0.132	<0.056	0.57	0.41
	<i>Dissolved</i>	<0.039	<0.039	0.44	0.27
Copper	<i>Total</i>	1	0.734	1.07	0.75
	<i>Dissolved</i>	0.47	0.4	0.6	0.44
Iron	<i>Total</i>	26.1	14.3	26.7	7
	<i>Dissolved</i>	6.7	2.9	6.3	0
Lead	<i>Total</i>	0.014	<0.002	0.075	0.003
	<i>Dissolved</i>	<0.004	<0.004	0.046	<0.003
Manganese	<i>Total</i>	4.75	1.06	1.91	1.04
	<i>Dissolved</i>	4.7	0.548	0.35	0.17
Nickel	<i>Total</i>	0.655	0.621	0.7	0.65
	<i>Dissolved</i>	0.58	0.54	0.62	0.58
Selenium	<i>Total</i>	0.043	<0.033	<0.248	<0.248
	<i>Dissolved</i>	<0.232	<0.232	<0.072	<0.072
Silver	<i>Total</i>	0.029	<0.006	<0.014	<0.014
	<i>Dissolved</i>	<0.012	<0.012	0.04	<0.007
Zinc	<i>Total</i>	0.139	<0.035	0.45	0.14
	<i>Dissolved</i>	<0.112	<0.112	<0.191	<0.191

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Table 5.4.2-1c. Total and dissolved metals results summary by month: January and February 2004.

Analyte (µg/L)		January		February	
		Maximum	Minimum	Maximum	Minimum
Aluminum	<i>Total</i>	51.7	24.2	43.4	24.6
	<i>Dissolved</i>	27.5	20.1	23.8	13.9
Arsenic	<i>Total</i>	0.711	0.687	0.572	0.532
	<i>Dissolved</i>	0.704	0.639	0.516	0.375
Cadmium	<i>Total</i>	<0.039	<0.039	0.013	<0.005
	<i>Dissolved</i>	<0.032	<0.032	0.009	<0.004
Chromium	<i>Total</i>	0.532	0.404	0.53	0.43
	<i>Dissolved</i>	0.5	0.4	0.13	<0.081
Copper	<i>Total</i>	0.927	0.619	0.95	0.74
	<i>Dissolved</i>	0.71	0.49	0.5	0.45
Iron	<i>Total</i>	54.9	14.2	77.2	25.9
	<i>Dissolved</i>	12.4	9.4	9.2	<1.91
Lead	<i>Total</i>	0.009	0.004	<0.018	<0.018
	<i>Dissolved</i>	0.002	<0.001	<0.001	<0.001
Manganese	<i>Total</i>	197	1.58	2.07	1.48
	<i>Dissolved</i>	180	0.84	0.76	0.55
Nickel	<i>Total</i>	0.942	0.785	0.88	0.84
	<i>Dissolved</i>	0.87	0.46	0.73	0.68
Selenium	<i>Total</i>	<0.258	<0.258	<0.204	<0.204
	<i>Dissolved</i>	<0.163	<0.163	0.16	<0.132
Silver	<i>Total</i>	0.037	<0.025	<0.065	<0.065
	<i>Dissolved</i>	0.032	<0.004	0.05	<0.001
Zinc	<i>Total</i>	1.12	0.151	0.39	0.24
	<i>Dissolved</i>	0.89	0.09	0.17	0.11

Table 5.4.2-1d. Total and dissolved metals results summary by month: March and April 2004.

Analyte (µg/L)		March		April	
		Maximum	Minimum	Maximum	Minimum
Aluminum	<i>Total</i>	54.2	33.4	16.9	8.96
	<i>Dissolved</i>	38.1	18.2	7.32	5.09
Arsenic	<i>Total</i>	0.553	0.518	0.638	0.472
	<i>Dissolved</i>	0.516	0.504	0.549	0.366
Cadmium	<i>Total</i>	<0.004	<0.004	<0.007	<0.007
	<i>Dissolved</i>	<0.001	<0.001	<0.002	<0.002
Chromium	<i>Total</i>	0.35	0.27	0.53	0.23
	<i>Dissolved</i>	0.34	0.21	0.28	0.21
Copper	<i>Total</i>	1.14	0.79	1.28	0.81
	<i>Dissolved</i>	0.91	0.52	0.99	0.58
Iron	<i>Total</i>	43.3	19.3	20.3	9
	<i>Dissolved</i>	34.8	10.4	<4.71	<4.71
Lead	<i>Total</i>	0.013	0.01	<0.007	<0.007
	<i>Dissolved</i>	<0.002	<0.002	<0.004	<0.004
Manganese	<i>Total</i>	2.58	1.11	3.43	1.04
	<i>Dissolved</i>	2.44	0.83	2.31	0.72
Nickel	<i>Total</i>	0.91	0.83	0.89	0.81
	<i>Dissolved</i>	0.88	0.81	0.88	0.81
Selenium	<i>Total</i>	0.13	<0.092	<0.138	<0.138
	<i>Dissolved</i>	<0.056	<0.056	<0.157	<0.157
Silver	<i>Total</i>	<0.044	<0.044	0.059	<0.059
	<i>Dissolved</i>	<0.003	<0.003	<0.035	<0.035
Zinc	<i>Total</i>	0.3	0.2	0.34	0.13
	<i>Dissolved</i>	0.2	0.14	0.28	0.08

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Table 5.4.2-2. Total and methyl mercury results.

		Total Mercury (ng/L)	Methyl Mercury (ng/L)
Overall	<i>Max</i>	0.86	<0.025
	<i>Min</i>	0.23	<0.025
	<i>Mean</i>	0.523	<0.025
November 2003	<i>Max</i>	0.72	<0.025
	<i>Min</i>	0.23	<0.025
	<i>Mean</i>	0.3217	<0.025
December 2003	<i>Max</i>	0.37	<0.025
	<i>Min</i>	0.31	<0.025
	<i>Mean</i>	0.3367	<0.025
January 2004	<i>Max</i>	0.58	<0.025
	<i>Min</i>	0.48	<0.025
	<i>Mean</i>	0.5100	<0.025
February 2004	<i>Max</i>	0.84	<0.025
	<i>Min</i>	0.7	<0.025
	<i>Mean</i>	0.7833	<0.025
March 2004	<i>Max</i>	0.86	<0.025
	<i>Min</i>	0.58	<0.025
	<i>Mean</i>	0.6633	<0.025

5.4.3 Petroleum byproducts

Surface water samples from all Bidwell Canyon water quality stations were tested for petroleum byproducts, including aromatic hydrocarbons and polynuclear aromatic hydrocarbons, which are all components or byproducts of gasoline. Samples were also taken for oil –and grease analysis. Neither oil and grease nor polynuclear aromatic hydrocarbons were detected at any of the stations (Appendix Table 8.1-7). Three aromatic hydrocarbons were detected occasionally, though never in amounts that exceeded any criteria (Table 5.4.3-1).

MTBE was found at every station during sampling (Table 5.4.3-2), but detected levels did not exceed water quality criteria at any time.

Table 5.4.3-1. Aromatic hydrocarbons results.

Station	Date	Bromomethane (µg/L)	Toluene (µg/L)	Xylenes (total) (µg/L)
Lake Oroville at Bidwell Canyon Marina	9/30/03	<1.0	<0.5	<0.5
	10/28/03	<1.0	<0.5	<0.5
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	<0.5	<0.5
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	<1.0	<0.5	<0.5
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	9/30/03	<1.0	<0.5	<0.5
	10/28/03	<1.0	<0.5	<0.5
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	0.57	<0.5
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	3.3	<0.5	<0.5
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	9/30/03	<1.0	<0.5	<0.5
	10/28/03	<1.0	<0.5	<0.5
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	<0.5	<0.5
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	4.3	<0.5	<0.5
Lake Oroville at Bidwell Canyon Boat Dock 1	9/30/03	<1.0	<0.5	<0.5
	10/28/03	<1.0	0.7	0.57
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	0.63	0.56
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	4.3	<0.5	<0.5
Lake Oroville at Bidwell Canyon Boat Dock 2	9/30/03	<1.0	<0.5	<0.5
	10/28/03	<1.0	0.7	0.57
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	1.1	0.86
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	4.8	0.72	<0.5

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Station	Date	Bromomethane (µg/L)	Toluene (µg/L)	Xylenes (total) (µg/L)
Lake Oroville at Bidwell Canyon	9/30/03	<1.0	<0.5	<0.5
Boat Dock 3	10/28/03	<1.0	0.63	<0.5
	11/12/03	<1.0	<0.5	<0.5
	12/17/03	<1.0	<0.5	<0.5
	1/13/04	<1.0	<0.5	<0.5
	2/28/04	<1.0	<0.5	<0.5
	3/29/04	<1.0	<0.5	<0.5
	4/27/04	3.2	<0.5	<0.5

Table 5.4.3-2. Methyl tertiary butyl ether results - summary of all stations, overall and by month.

Month	MTBE (µg/L)	
Overall	<i>Maximum</i>	3.8
	<i>Minimum</i>	<0.05
	<i>Mean</i>	0.62
September	<i>Maximum</i>	<1.0
	<i>Minimum</i>	<1.0
	<i>Mean</i>	<1.0
October	<i>Maximum</i>	2.5
	<i>Minimum</i>	<1.0
	<i>Mean</i>	1.07
November	<i>Maximum</i>	3.8
	<i>Minimum</i>	<1.150
	<i>Mean</i>	1.52
December	<i>Maximum</i>	0.54
	<i>Minimum</i>	<0.5
	<i>Mean</i>	0.09
January	<i>Maximum</i>	1.4
	<i>Minimum</i>	0.51
	<i>Mean</i>	0.82
February	<i>Maximum</i>	0.7
	<i>Minimum</i>	<0.5
	<i>Mean</i>	0.12
March	<i>Maximum</i>	0.79
	<i>Minimum</i>	<0.5
	<i>Mean</i>	0.46
April	<i>Maximum</i>	1.2
	<i>Minimum</i>	0.65
	<i>Mean</i>	0.91

5.4.4 Tributyltin, polybrominated diphenyl ethers, and congeners

Surface water samples from all Bidwell Canyon water quality stations were tested for TBT and PBDE. TBT was detected only three times during this study: once at Bidwell Marina in November 2003 and twice at the Bidwell Canyon Houseboat Moorage #1 in October and November 2003 (Appendix Table 8.4-5). The recommended criteria for TBT are 0.46 µg/L for the one-hour average concentration (acute criterion) and 0.072 µg/L for the four-day average concentration (chronic criterion) (USEPA 2004). Detected levels of TBT did not exceed these water quality criteria at any time.

Due to problems with the scientific validity of the current testing methods for PDBE (Alan Kemp, Sequoia Analytical Laboratory, pers. comm.), results for PBDE are not available.

5.5 WQ SAMPLING PROGRAM 5 – LIME SADDLE BOAT YARD SAND ANALYSES

Sand samples were taken from opposite ends of the boat yard for analysis and stored in sterile polyethylene pint bottles. The sand samples were analyzed for total solids, total metals (targeting arsenic, copper, lead, and zinc, though more were included in the analyses), aromatic hydrocarbons, polynuclear aromatic hydrocarbons, and oil and grease.

5.5.1 Total metals

Neither of the samples contained any amounts of metals (Table 5.5.1-1) exceeding any of the soil criteria as set by the California Department of Toxic Substances Control (DWR 1995).

5.5.2 Petroleum byproducts

The samples were analyzed for 57 aromatic hydrocarbons, which were all reported to be at levels below the detection limit (Appendix Table 8.5-1). The oil and grease analysis detected some amounts of oil and grease and total solids. While there are no criteria for these parameters, these results do indicate that the boat cleaning sands contain petroleum byproducts.

Twelve polynuclear aromatic hydrocarbons (semi-volatile organic compounds) out of 71 tested (Appendix Table 8.5-2) were found in the samples. There are no sediment related criteria for any of these hydrocarbons.

Table 5.5.1-1. Total metals results from sand samples.

Analyte (in mg/kg)	Sand Sample 1	Sand Sample 2
Antimony	<10	<10
Arsenic	<10	<10
Barium	20	38
Beryllium	<1	<1
Cadmium	<1	<1
Chromium	5.7	10
Cobalt	<4	<4
Copper	5.2	9.2
Lead	<10	14
Mercury	<0.02	<0.02
Molybdenum	<4	<4
Nickel	5.4	7.2
Selenium	<0.02	<0.02
Silver	1.9	2.4
Thallium	<20	<20
Vanadium	5.5	5.6
Zinc	15	48

Table 5.5.2-1. Oil and grease and total organic solids results.

Analyte (in mg/kg)	Sand Sample 1	Sand Sample 2	Reporting Limit
Oil & grease	150	5000	50 mg/kg dry weight
Total organic solids	100	100	0.01% by weight

Table 5.5.2-2. Polynuclear aromatic hydrocarbons results.

Analyte (in mg/kg)	Sand Sample 1	Sand Sample 2	Reporting Limit
Anthracene	2030	<2000	<2000
Benzo(a) anthracene	15900	20600	<2000
Benzo (a) pyrene	15600	20100	<2000
Benzo (b & k) fluoranthene (total)	33000	51000	<4000
Benzo (ghi) perylene	8650	10100	<2000
Carbazole	5850	7880	<2000
Chrysene	20200	26500	<2000
Dibenz (a,h) anthracene	<2000	5190	<2000
Fluoranthene	34500	42300	<2000
Indeno (1,2,3-cd) pyrene	<2000	10000	<2000
Phenanthrene	12500	17800	<2000
Pyrene	26500	40800	<2000

5.6 WQ SAMPLING PROGRAM 6 – STORM EVENT SAMPLING 2003

Storm event sampling in 2003 occurred on November 7, November 14, and December 1. The rainfall tended to be patchy, with some areas receiving relatively heavy rains and other areas receiving little or no rain. Attempts at sampling were tried later in the month of December, but the rains were too light to produce enough flow to sample. The cumulative effect of these light and variable rains probably was to slowly mobilize potential contaminants over a longer period, rather than in one or two flushing events.

5.6.1 Physical parameters

Physical parameters were measured at each sampling point, including water temperature, conductivity, dissolved oxygen, and pH (Appendix Table 8.6-1).

The water temperature of the runoff ranged from 50.5 °F to 57.9 °F across all stations at all of the sampling events. Conductivity was uniformly low, ranging from 7 to 122 µmhos/cm, with most values below 100 µmhos/cm. The one exception was at Lime Saddle Parking Lot #1 outfall, which had conductivity of 249 µmhos/cm. Dissolved oxygen was found to be relatively high, ranging from 7.7 to 12.0 mg/L. The values for pH ranged from 6.1 to 7.5 pH units, and averaged 6.8 pH units.

Table 5.6.1-1. Ranges (and means) of physical parameters across all stations.

Date	Water Temperature °F	Conductivity (µmhos/cm)	Dissolved oxygen (mg/L)	pH
11/7/03	55.0 - 57.9 (56.4)	17 – 122 (47)	9.0 - 11.1 (10.4)	6.3 - 7.3 (7.1)
11/14/03	54.5 - 57.7 (55.6)	9 – 96 (37)	9.4 - 12.0 (10.2)	6.3 - 7.1 (6.6)
12/1/03	50.5 - 53.6 (51.8)	7 – 249 (85)	7.7 - 11.0 (9.9)	6.1 - 7.5 (6.7)
Overall	50.5 – 57.9 (54.6)	7 - 249 (56)	7.7 - 12.0 (10.2)	6.1 - 7.5 (6.8)

5.6.2 Nutrients and Minerals

Water samples were taken at each sampling point for the analyses of nutrients, including dissolved ammonia, dissolved nitrite/nitrate, dissolved orthophosphate, dissolved sulfate, total phosphorus, and total ammonia (Appendix Table 8.6-2). The samples were also tested for minerals, including dissolved boron, dissolved and total calcium, dissolved and total magnesium, dissolved potassium, and dissolved sodium (Appendix Table 8.6-3).

No samples contained nutrients or minerals in concentrations that exceeded any water quality criteria.

5.6.3 Total and dissolved metals

Water samples were taken at each sampling point for the analyses of total and dissolved metals, including aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, and zinc (Appendix Tables 8.6-4 and 8.6.5). Water samples were also taken for the analyses of total and methyl mercury.

The detected amounts of most of the metals did not exceed water quality criteria. Three metals (arsenic, manganese, and zinc) did exceed water quality criteria at some time in the sampling (Table 5.6.3-1). Total arsenic levels exceeded water criteria in every sample, while manganese exceeded criteria only twice.

The criteria for total and dissolved zinc is determined as a function of hardness (RWQCB 2003). Both dissolved and total zinc exceeded water quality criteria in the

majority of the water samples under the California Toxics Rule for the protection of aquatic life.

Table 5.6.3-1. Total metals that exceeded water quality criteria.

Station Name	Date	Total Arsenic (µg/L)	Total Manganese (µg/L)	Total Zinc (µg/L)	Dissolved Zinc (µg/L)
Bidwell Canyon	11/7/03	0.783 ^{1,2,3,4}	14.3	377 ⁷	357 ⁸
Boat Yard 1	11/14/03	0.812 ^{1,2,3,4}	17.1	257 ⁷	253 ⁸
Bidwell Canyon Boat Yard 2	11/14/02	6.38 ^{1,2,3,4,5}	60.3 ⁶	21.3	10.3
Bidwell Canyon Parking Lot	11/7/03	0.419 ^{1,2,3,4}	28.4	30.2	28
	11/14/03	0.732 ^{1,2,3,4}	31.6	31.9	29
Lime Saddle Boat Yard 1	11/14/03	5.05 ^{1,2,3,4,5}	44.2	181 ⁷	177 ⁸
	12/1/03	7.43 ^{1,2,3,4,5}	24.4	88.5 ⁷	74.9 ⁸
Lime Saddle Parking Lot 1	11/14/03	2.39 ^{1,2,3,4,5}	14.9	79.1 ⁷	78.7 ⁸
	12/1/03	1.8 ^{1,2,3,4,5}	62.7 ⁶	169 ⁷	141 ⁸
Lime Saddle Parking Lot 2	11/14/03	0.405 ^{1,2,3,4}	14.6	37.3 ⁷	35.6
	12/1/03	0.259 ^{1,2,3,4}	41.7	74.6 ⁷	63.6 ⁸
North Forebay	11/7/03	1.63 ^{1,2,3,4}	9.91	417 ⁷	397 ⁸
Sailboat Marina	11/14/03	1.46 ^{1,2,3,4}	10.2	285 ⁷	282 ⁸
	12/1/03	1.02 ^{1,2,3,4}	7.86	258 ⁷	254 ⁸

1 Exceeds the California EPA Cancer Potency Factor as a Drinking Water Level - 0.023 µg/L

2 Exceeds the USEPA Integrated Risk Information System One-in-a-Million Incremental Cancer Risk Estimate for Drinking Water - 0.02 µg/L

3 Exceeds the USEPA Recommended Ambient Water Quality Criteria for human Health and Welfare Protection for Sources of Drinking Water (water +organisms) - 0.018 µg/L

4 Exceeds the USEPA Recommended Ambient Water Quality Criteria for human Health and Welfare Protection for Sources of Drinking Water (aquatic organism consumption only) - 0.14 µg/L

5 Exceeds the USEPA Integrated Risk Information Reference Dose as a Drinking Water Level - 2.1µg/L

6 Exceeds the California Department of Health Services and USEPA Drinking Standards Maximum Contaminant Levels Secondary MCL - 50 µg/L

7 Exceed the California Toxics Rule and USEPA National Recommended Water Quality Criteria to Protect Freshwater Aquatic Life for Total Recoverable Zinc

8 Exceed the California Toxics Rule and USEPA National Recommended Water Quality Criteria to Protect Freshwater Aquatic Life for Dissolved Zinc

5.6.4 Petroleum byproducts

Water samples were taken at each sampling site for petroleum byproducts, including aromatic hydrocarbons (volatile organic compounds and volatile organic compounds in water) and polynuclear aromatic hydrocarbons (semi-volatile organic compounds). No aromatic hydrocarbons were detected during sampling (Appendix Tables 8.6-7 to 8.6-9).

5.6.5 Pesticides

Water samples were taken at each sampling site for pesticides, including chlorinated organic pesticides, chlorinated phenoxy acid herbicides, carbamate pesticides, and phosphorus/nitrogen pesticides. No pesticides were detected during sampling (Appendix Table 8.6-10).

6.0 ANALYSES

6.1 EXISTING CONDITIONS/ENVIRONMENTAL SETTING

The purpose of this study was to determine any effects to water quality from recreational facilities and associated recreational activities at Lake Oroville, the Thermalito Afterbay and Forebay, and the lower Feather River. To address the issue of point source contamination, site specific water quality sampling was performed in and about several of the existing recreational facilities starting in June 2003. To assess potential non-point source contamination and ambient environmental conditions, water quality sampling was performed at the SPW1 stations across Lake Oroville.

6.1.1 Recreational Facilities

There are 76 recreational facilities of 24 types associated with the Oroville Facilities (Table 4.1-1). Twenty-seven water quality stations were sampled during the high recreational use period from June to September 2003 to assess the potential impact to water quality from these facilities and activities.

6.1.2 Swim Areas

There are eight swim areas associated with the Oroville Facilities (Table 4.2-1), including four developed swim areas within the Project and one developed swim area outside of the Project area within the City of Oroville. There are also three undeveloped swim areas within the Project area that are heavily used by the public during holidays. Sampling for bacteria (fecal and total coliform, fecal streptococcus, and enterococcus) was performed at all of these swim areas (except one) from June 2003 to November 2003.

6.1.3 Fishing Tournament and Weekend WQ

A large number of fishing tournaments occur during the year on Lake Oroville, with as many as six or seven scheduled tournaments a month from March to November. Some of these tournaments can launch as many as 300 boats (R. Grizak, DPR, pers. comm.). The most popular staging area for Lake Oroville fishing tournaments is the Spillway boat ramp. Water quality sampling for petroleum byproducts was performed during two fishing tournaments at the Spillway boat ramp on the day of the tournament. Sampling was also performed at the Bidwell Canyon boat ramp and marina as a gauge of the weekend use level.

6.1.4 Bidwell Canyon Marina Complex

The Bidwell Canyon Marina complex is contained within the Bidwell Canyon Recreational Area (which is managed by the DPR) and is the largest boating related recreational facility within the Project area. The Bidwell Canyon Marina has a large floating marina facility that contains a convenience store, fuel pumps, restrooms, fish cleaning facilities, large docking areas, boat slips and shelters, an extensive houseboat moorage, and house- and party-boat rentals. Additionally, there is a large six-lane boat ramp, truck and trailer parking area, and an adjacent campground. A boat maintenance and repair facility, the Bidwell Canyon Boat Yard, is also present.

6.1.5 Lime Saddle Marina Boat Yard

The Lime Saddle Marina Boat Yard is a boat maintenance and repair facility located within the Lime Saddle Marina complex. This facility appears to service and maintain a large number of houseboats. Maintenance activities include sandblasting for paint removal and subsequent repainting. Samples taken from the boat yard were analyzed for potential contaminants.

6.1.6 Storm Event Sampling

The storm event sampling, which was performed at seven stations at Bidwell Canyon Marina, Lime Saddle Marina, and North Forebay Sailboat Marina, resulted in patchy monitoring. The first three rain events were scattered and uneven, with some areas receiving heavy rains and other areas receiving none.

6.2 PROJECT RELATED EFFECTS

6.2.1 Recreational Facilities

Overall, there seems to be only a minimal effect to water quality from the presence of the current recreational facilities. Most of the tested parameters at the facility stations were no different from the background levels found in Lake Oroville stations, with the exception of MTBE. Arsenic did exceed water quality criteria. However, the arsenic levels at the facility water quality stations were the same as the levels found at the lake (non-facility) water quality stations, indicating that there was no effect from any facility.

MTBE levels were significantly higher at the boating related water quality stations than the lake water quality stations. Samples exceeding water quality criteria were found only at the boat launch facility stations, indicating that the presence of the facilities is affecting water quality. MTBE is a chemical compound which contains oxygen and is often added to gasoline to boost the octane content or to meet clean fuel oxygen requirements (i.e., reformulated gasoline and winter oxygenate gasoline). It benefits air

quality by making gasoline burn cleaner, thus reducing automotive emissions. But MTBE can also find its way into groundwater supplies and give drinking water an unpleasant taste and odor. At present, more than 20 public drinking water wells in California have ceased water production for this reason (Happel 1999). MTBE plumes are more mobile than hydrocarbon plumes, and may attenuate primarily through dispersion because MTBE resists biodegradation (Happel 1999). Worse yet, the health effects of MTBE are uncertain. The U.S. Environmental Protection Agency currently classifies MTBE as a possible human carcinogen. MTBE does not bioconcentrate in fish and is excreted or metabolized rapidly (Werner and Hinton, 1998).

The boat access ramps have little to insignificant effect on water quality due to their small size and numbers. The degradation of the Stringtown boat access ramp may be releasing petroleum products from the blacktop, but any deleterious effects are probably minimal given that this roadway has been subject to over 30 years of leaching from lake inundation.

The trails system around the Oroville Facilities may affect water quality in Project waters through erosion. The trails adjacent to Project waters or to streams that drain into Project waters are possible sources of sediment. There are some unprotected stream crossings along the trails that can lead to sediment transport. Poor or no maintenance of trails, such as the levee trail through the OWA, can lead to severe sedimentation problems through road fill and side-slope failures of the road bed. Though erosion was identified at several sites along the trails, sediment transport to Project waters was not identified at this time.

6.2.2 Swim Areas

The results of the bacteria sampling indicate that water quality at the swim areas is poor. Bacteria levels are routinely high at most of the developed swim areas and occasionally at the undeveloped swim areas, sometimes greatly exceeding water quality criteria (Table 5.2-1 and Appendix Table 8.2-1).

The presence of swimmers may or may not be the main cause of the bacteria levels. It is interesting to note that the bacteria levels at the upstream end of the Bedrock Park swim area at the inlet off the Feather River is routinely higher in bacteria levels than at the downstream end at the outlet (Table 5.2-1). The bacteria levels were extremely high at the North Forebay swim area during high recreational use (June to August), then remained fairly high well into November, two months after human swimming had ceased (Appendix Table 8.2-1). Wildlife, especially waterfowl, were observed using the swim areas in large numbers throughout the sampling period, especially at the North Forebay and South Forebay swim areas. However, the extremely high levels of bacteria seen during the high recreational use period of July and August may indicate that human bacterial contamination is a significant factor in the poor water quality at the swim areas.

Criteria developed by health agencies do not distinguish between bacteria from wildlife and humans, since bacteria from wildlife may potentially affect human health.

6.2.3 Fishing Tournament and Weekend WQ

Results of water quality sampling during fishing tournaments indicate that the large number of boats launching at roughly the same time does have some impact on water quality of the surface waters. MTBE is found in relatively high amounts in surface waters around the Spillway boat ramp during fishing tournaments. The heavy weekend use, which was observed at Bidwell Canyon, also impacts water quality through increased boat traffic discharging MTBE into the surface waters.

6.2.4 Bidwell Canyon Marina Complex

Results of water quality sampling at Bidwell Marina indicate that there is very little effect from the presence of the facility on water quality of Lake Oroville other than as a high density boat traffic location. Arsenic did exceed quality criteria at the Bidwell Canyon Marina water quality stations. However, the observed levels of arsenic were consistent with background arsenic levels found at the lake (non-facility) water quality stations.

MTBE exceeded water quality criteria, as did the levels at the other boating related facilities. MTBE may be entering the surface waters of Lake Oroville through a variety of ways, including accidental spills during fueling, fuel tank leakage, unburned fuel from boat exhausts, and draining of bilge water.

6.2.5 Lime Saddle Marina Boat Yard

Analyses of sand samples from the Lime Saddle Boat Yard indicate that cleaning sand could potentially contribute some amount of contamination to Project waters. While there were no criteria exceeded, the samples did contain a number of metals and petroleum byproducts in detectable amounts.

Sand expended during the paint removal process remains on the ground. Removal is apparently through the natural processes of wind, and later, during the rainy season, by rain. The runoff from the boat yard work area, which is a paved parking lot, is drained through a large corrugated metal pipe to the lower parking lot drainage system. The parking lot drainage system empties into Lake Oroville.

While any given sample probably would not contain contaminants in amounts over water quality criteria, the cumulative effect of the input of these contaminated sands could be significant.

6.2.6 Storm Event Sampling

The storm event sampling indicates that storm runoff from recreational facilities could affect water quality in Project waters. While the detected amounts of most of the analytes from the storm event sampling did not exceed water quality criteria, arsenic, manganese, and zinc did exceed water quality criteria.

Arsenic (total) was found in levels well above the previously noted background arsenic level found in Lake Oroville (see section 6.2.1), and was sometimes on the order of ten times the background level. Arsenic levels exceeded water quality criteria in every sample. Manganese concentrations in the lake normally range from undetectable to 10.8 µg/L, with most levels below 1.0 µg/L. In the storm event samples, manganese was found to range from 7.86 to 62.0 µg/L, with most of the samples having levels above 10.0 µg/L. Total zinc, which is normally found in the lake at levels ranging from undetectable to 2.96 µg/L, was instead found at levels ranging from 21.3 to 417.0 µg/L. Dissolved zinc levels range from 10.3 to 397.0 µg/L in the storm event samples. The normal background level of dissolved zinc was found to range from undetectable to 0.75 µg/L.

However, the overall results are inconclusive. The results indicate that there could be an adverse effect on water quality from storm runoff from the recreational facilities, at least as far as the three metals discussed above. However, other more volatile substances could have been missed due to the scattered rainfall patterns. The expected flushing event for any particular area or facility could have been missed. Further sampling during the next rainy season is necessary to clear up any ambiguities in the results.

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result in the July 2003 sample for the Lake Oroville at Bidwell Canyon Boat Ramp station, April 28, 2004

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Oroville Facilities Relicensing Team

August 23, 2004

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8.0 APPENDIX

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Oroville Facilities Relicensing Team

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August 23, 2004

8.1. Water Quality Sampling Program 1 – Recreation facilities WQ sampling

Table 8.1-1. Lake Oroville recreational WQ sampling - Physical parameters

Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	75.9	24.4	81	8.6	7.7
	7/21/03	81.1	27.3	85	8.0	7.9
	8/20/03	75.4	24.1	86	8.9	8.0
	9/15/03	75.2	24.0	92	8.1	7.6
Lake Oroville at Bidwell Canyon Marina	6/17/03	77.2	25.1	81	8.7	7.8
	7/21/03	81.0	27.2	86	8.2	7.9
	8/20/03	75.7	24.3	85	7.9	8.0
	9/15/03	74.5	23.6	93	9.2	7.6
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	6/17/03	75.7	24.3	81	9.4	7.8
	7/28/03	81.1	27.3	86	7.7	8.0
	8/20/03	76.1	24.5	86	7.9	8.0
	9/15/03	73.4	23.0	78	7.6	8.0
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	6/17/03	74.8	23.8	83	9.6	7.1
	7/28/03	81.7	27.6	87	9.0	8.2
	8/20/03	76.8	24.9	85	7.8	8.1
	9/15/03	74.5	23.6	92	8.2	7.6
Lake Oroville (North Fork) at Bloomer Primitive Boat-In Campground	6/25/03	74.3	23.5	81	8.2	7.3
	7/24/03	84.0	28.9	81	7.9	7.8
	8/27/03	78.3	25.7	89	8.6	7.9

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Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
	9/24/03	74.1	23.4	94	8.3	8.0
Lake Oroville (North Fork) at Bloomer Island Floating Restroom	6/25/03	72.9	22.7	81	8.4	7.4
	7/24/03	84.0	28.9	81	8.2	8.2
	8/27/03	78.8	26.0	90	8.6	8.1
	9/24/03	74.3	23.5	95	8.2	7.9
Lake Oroville (Middle Fork) at Canyon Creek Floating Campground	6/25/03	74.3	23.5	77	7.4	8.3
	7/24/03	82.6	28.1	79	8.1	8.3
	8/27/03	76.5	24.7	89	8.8	7.5
	9/24/03	74.1	23.4	103	8.3	7.9
Lake Oroville (South Fork) at Craig Saddle Floating Campground	6/25/03	74.1	23.4	76	7.1	7.5
	7/24/03	82.6	28.1	78	7.7	8.1
	8/27/03	77.9	25.5	83	8.7	7.5
	9/24/03	73.9	23.3	87	8.4	8.0
Lake Oroville at Deadman Ravine	6/18/03	74.3	23.5	85	5.1	7.4
	7/21/03	80.4	26.9	84	8.4	8.0
Lake Oroville (North Fork) at Goat Ranch Boat-In Campground	6/25/03	73.8	23.2	81	8.3	7.5
	7/24/03	82.8	28.2	82	7.8	8.3
	8/27/03	77.0	25.0	91	8.3	7.7
	9/24/03	73.6	23.1	94	8.1	7.9

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Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
Lake Oroville at Kelly Ridge Floating Restroom	6/25/03	73.8	23.2	77	8.9	7.4
	7/24/03	81.3	27.4	79	7.9	8.1
	8/27/03	76.1	24.5	90	8.7	7.4
	9/24/03	73.8	23.2	95	8.2	7.9
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	78.8	26.0	80	7.5	7.8
	7/21/03	82.2	27.9	86	9.0	8.0
	8/20/03	73.6	23.1	85	8.2	8.2
	9/15/03	75.4	24.1	89	7.4	7.6
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	79.5	26.4	82	8.3	7.3
	7/21/03	82.2	27.9	88	8.0	8.1
	8/20/03	75.2	24.0	85	8.3	8.2
	9/15/03	75.0	23.9	89	8.0	7.6
Lake Oroville (West Branch) at Lime Saddle Houseboat Moorage 1	6/17/03	79.3	26.3	84	6.3	7.2
	7/28/03	83.5	28.6	90	8.6	8.2
	8/20/03	75.2	24.0	85	8.2	8.1
	9/15/03	74.3	23.5	90	8.8	7.6
Lake Oroville (West Branch) at Lime Saddle Houseboat Moorage 2	6/17/03	79.2	26.2	83	-	7.6
	7/28/03	83.8	28.8	90	8.8	8.2
	8/20/03	76.8	24.9	86	8.0	8.1
	9/15/03	74.3	23.5	90	8.3	7.6
Lake Oroville at Loafer Creek	6/18/03	77.2	25.1	81	7.1	7.8

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Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
RA Equestrian Campground	7/28/03	81.7	27.6	87	8.8	8.2
	8/20/03	74.3	23.5	83	7.9	8.0
	9/15/03	73.4	23.0	92	9.5	7.6
Lake Oroville at Potter Ravine Floating Restroom	6/25/03	76.6	24.8	79	7.4	8.2
	7/24/03	81.9	27.7	79	7.9	8.7
	8/27/03	78.3	25.7	89	8.6	7.9
	9/24/03	74.3	23.5	94	8.7	8.1
Lake Oroville (South Fork) at Stringtown Floating Campground	6/25/03	74.8	23.8	74	8.5	7.3
	7/24/03	83.3	28.5	76	7.7	8.1
	8/27/03	78.4	25.8	79	8.5	7.5
	9/24/03	74.3	23.5	85	8.3	8.0
Lake Oroville (Middle Fork) at Union Creek Floating Campground	6/25/03	74.5	23.6	78	8.0	7.5
	7/24/03	84.0	28.9	81	7.9	8.2
	8/27/03	77.7	25.4	96	8.5	7.4
	9/24/03	73.0	22.8	95	8.2	8.1

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Table 8.1-2. Lake Oroville recreational WQ sampling - Nutrients

Station Name	Date	Dissolved Ammonia (mg/L as N)	Dissolved NO ₂ +NO ₃ (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Total Kjeldahl Nitrogen (mg/L as N)	Total Phosphorus (mg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	0.01	<0.01	<0.01	0.4	<0.01
	7/21/03	0.01	0.01	<0.01	0.3	0.02
	8/20/03	<0.01	<0.01	<0.01	0.2	0.01
	9/15/03	<0.01	<0.01	<0.01	0.1	<0.01
Lake Oroville at Bidwell Canyon Marina	6/17/03	<0.01	<0.01	<0.01	<0.1	<0.01
	7/21/03	0.02	<0.01	<0.01	0.1	0.01
	8/20/03	<0.01	<0.01	<0.01	0.2	<0.01
	9/15/03	<0.01	<0.01	<0.01	0.1	<0.01
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	6/17/03	<0.01	<0.01	<0.01	0.1	<0.01
	7/28/03	<0.01	0.015	<0.01	<0.1	<0.01
	8/20/03	<0.01	<0.01	<0.01	0.1	0.01
	9/15/03	<0.01	0.01	<0.01	0.2	<0.01
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	6/17/03	<0.01	<0.01	<0.01	<0.1	<0.01
	7/28/03	<0.01	<0.01	<0.01	<0.1	<0.01
	8/20/03	<0.01	<0.01	<0.01	0.1	<0.01
	9/15/03	<0.01	0.01	<0.01	0.1	<0.01
Lake Oroville (North Fork) at Bloomer Boat-In Primitive Campground	6/25/03	<0.01	0.02	<0.01	<0.1	<0.01
	7/24/03	<0.01	0.01	<0.01	0.15	<0.01
	8/27/03	0.01	<0.01	<0.01	0.1	<0.01
	9/24/03	<0.01	0.01	<0.01	0.1	<0.01

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Station Name	Date	Dissolved Ammonia (mg/L as N)	Dissolved NO2+NO3 (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Total Kjeldahl Nitrogen (mg/L as N)	Total Phosphorus (mg/L)
Lake Oroville (North Fork) at Bloomer Floating Restroom	6/25/03	0.02	0.06	<0.01	<0.1	0.01
	7/24/03	0.01	0.02	<0.01	0.11	<0.01
	8/27/03	<0.01	<0.01	<0.01	<0.1	<0.01
	9/24/03	<0.01	<0.01	<0.01	0.1	<0.01
Lake Oroville (Middle Fork) at Canyon Creek Floating Campground	6/25/03	0.01	0.03	<0.01	<0.1	<0.01
	7/24/03	<0.01	<0.01	<0.01	0.1	0.01
	8/27/03	<0.01	<0.01	<0.01	0.1	<0.01
	9/24/03	<0.01	<0.01	<0.01	<0.1	0.02
Lake Oroville (Middle Fork) at Craig Saddle Floating Campground	6/25/03	0.05	0.07	<0.01	<0.1	<0.01
	7/24/03	<0.01	<0.01	<0.01	<0.1	<0.1
	8/27/03	<0.01	<0.01	<0.01	<0.1	<0.01
	9/24/03	<0.01	<0.01	<0.01	0.1	<0.01
Lake Oroville at Deadman Ravine	6/18/03	0.05	0.07	<0.01	<0.01	<0.01
	7/21/03	<0.01	<0.01	<0.01	<0.01	0.07
Lake Oroville (North Fork) at Goat Ranch Boat-In Campground	6/25/03	0.02	0.03	<0.01	<0.01	0.01
	7/24/03	0.01	<0.01	<0.01	0.24	0.01
	8/27/03	<0.01	<0.01	<0.01	0.1	<0.01
	9/24/03	0.01	<0.01	<0.01	0.1	0.01
Lake Oroville at Kelly Ridge Floating Restroom	6/25/03	0.04	0.06	<0.01	<0.01	<0.01
	7/24/03	<0.01	<0.01	<0.01	0.11	<0.01
	8/27/03	0.03	0.04	<0.01	0.2	<0.01
	9/24/03	<0.01	<0.01	<0.01	0.1	<0.01

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Station Name	Date	Dissolved Ammonia (mg/L as N)	Dissolved NO2+NO3 (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Total Kjeldahl Nitrogen (mg/L as N)	Total Phosphorus (mg/L)
Lake Oroville (West Branch) at Lime	6/17/03	0.02	0.04	<0.01	0.01	<0.01
Saddle Boat Ramp	7/21/03	<0.01	<0.01	<0.01	0.2	<0.02
	8/20/03	<0.01	<0.01	<0.01	0.2	0.01
	9/15/03	0.02	0.01	<0.01	0.2	<0.01
Lake Oroville (West Branch) at Lime	6/17/03	0.01	0.04	<0.01	0.3	<0.01
Saddle Marina	7/21/03	<0.01	<0.01	<0.01	0.2	<0.01
	8/20/03	0.01	0.05	<0.01	0.2	<0.01
	9/15/03	0.02	0.01	<0.01	0.2	<0.01
Lake Oroville (West Branch) at Lime	6/17/03	<0.01	<0.01	<0.01	0.2	0.01
Saddle Houseboat Moorage 1	7/28/03	0.02	0.01	<0.01	0.14	<0.01
	8/20/03	<0.01	<0.01	<0.01	0.1	0.03
	9/15/03	0.01	<0.01	<0.01	0.2	<0.01
Lake Oroville (West Branch) at Lime	6/17/03	<0.01	0.01	<0.01	0.1	<0.01
Saddle Houseboat Moorage 2	7/28/03	<0.01	<0.01	<0.01	0.18	<0.01
	8/20/03	<0.01	<0.01	<0.01	0.2	0.02
	9/15/03	0.01	0.01	<0.01	0.1	<0.01
Lake Oroville at Loafer Creek RA Equestrian Campground	6/18/03	<0.01	<0.01	<0.01	0.2	<0.01
	7/28/03	<0.01	<0.01	<0.01	<0.1	<0.01
	8/20/03	<0.01	<0.01	<0.01	<0.1	<0.01
	9/15/03	0.01	0.01	<0.01	<0.1	<0.01

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Station Name	Date	Dissolved Ammonia (mg/L as N)	Dissolved NO2+NO3 (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Total Kjeldahl Nitrogen (mg/L as N)	Total Phosphorus (mg/L)
Lake Oroville at Potter Ravine Floating Restroom	6/25/03	<0.01	0.02	<0.01	73	0.02
	7/24/03	<0.01	<0.01	<0.01	0.1	<0.01
	8/27/03	<0.01	<0.01	<0.01	0.1	<0.01
	9/24/03	0.01	<0.01	<0.01	0.1	<0.01
Lake Oroville (South Fork) at Stringtown Floating Campground	6/25/03	0.01	0.03	<0.01	<0.01	<0.01
	7/24/03	0.02	0.01	<0.01	<0.1	<0.01
	8/27/03	<0.01	0.01	<0.01	0.1	<0.01
	9/24/03	0.01	0.03	<0.01	0.2	0.02
Lake Oroville (South Fork) at Union Creek Floating Campground	6/25/03	<0.01	0.02	<0.01	242	<0.01
	7/24/03	<0.01	0.01	<0.01	<0.1	<0.01
	8/27/03	<0.01	<0.01	<0.01	<0.1	<0.01
	9/24/03	<0.01	<0.01	<0.01	0.1	<0.01

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Table 8.1-3. Lake Oroville recreational WQ sampling - Bacteria

Station Name	Date	¹ Total Coliform (#/100 ml)	¹ Fecal Coliform (#/100 ml)	¹ Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	500	80	>1600	>1600
	7/21/03	500	23	900	900
	8/20/03	12	<2	<2	<2
	9/15/03	14	2	2	2
Lake Oroville at Bidwell Canyon Marina	6/17/03	1600	900	900	1600
	7/21/03	50	11	36	36
	8/20/03	9	2	<2	<2
	9/15/03	130	2	4	4
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	6/17/03	240	2	2	2
	7/28/03	4	<2	<2	<2
	8/20/03	11	<2	2	2
	9/15/03	14	8	8	8
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	6/17/03	27	<2	<2	<2
	7/28/03	50	17	4	4
	8/20/03	80	<2	<2	<2
	9/15/03	50	13	13	13
Lake Oroville (North Fork) at Bloomer Primitive Boat-In Campground	6/25/03	385	2	<2	<2
	7/24/03	30	2	23	23
	8/27/03	2	2	<2	<2
	9/24/03	11	<2	<2	<2

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Station Name	Date	¹Total Coliform (#/100 ml)	¹Fecal Coliform (#/100 ml)	¹Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
Lake Oroville (North Fork) at Bloomer Island Floating Restroom	6/25/03	446	10	<2	<2
	7/24/03	<2	<2	2	2
	8/27/03	13	2	<2	<2
	9/24/03	4	<2	<2	<2
Lake Oroville (Middle Fork) at Canyon Creek Floating Campground	6/25/03	264	<2	<2	<2
	7/24/03	30	4	6	6
	8/27/03	13	<2	<2	<2
	9/24/03	11	<2	<2	<2
Lake Oroville (South Fork) at Craig Saddle Floating Campground	6/25/03	6	<2	<2	<2
	7/24/03	2	<2	2	2
	8/27/03	14	<2	<2	<2
	9/24/03	4	<2	<2	<2
Lake Oroville (North Fork) at Goat Ranch Boat-In Campground	6/25/03	29	<2	40	<2
	7/24/03	8	<2	4	4
	8/27/03	2	<2	<2	<2
	9/24/03	22	4	4	4
Lake Oroville at Kelly Ridge Floating Restroom	6/25/03	170	<2	<2	10
	7/24/03	<2	<2	30	30
	8/27/03	4	<2	2	2
	9/24/03	9	<2	<2	<2

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Station Name	Date	¹Total Coliform (#/100 ml)	¹Fecal Coliform (#/100 ml)	¹Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	50	2	500	500
	7/21/03	130	14	4	4
	8/20/03	1600	14	ND	<2
	9/15/03	170	7	14	14
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	80	7	70	170
	7/21/03	30	2	6	6
	8/20/03	500	7	<2	<2
	9/15/03	30	<2	<2	<2
Lake Oroville (West Branch) at Lime Saddle Houseboat Moorage 1	6/17/03	50	2	500²	500
	7/28/03	130	14	4	4
	8/20/03	1600	14	<2	<2
	9/15/03	30	<2	<2	<2
Lake Oroville (West Branch) at Lime Saddle Houseboat Moorage 2	6/17/03	13	<2	37	37
	7/28/03	4	4	<2	<2
	8/20/03	110	4	<2	<2
	9/15/03	70	2	<2	<2
Lake Oroville at Loafer Creek Equestrian Campground	6/18/03	21	13	>1600	>1600
	7/28/03	30	13	<2	<2
	8/20/03	70	4	2	2
	9/15/03	14	8	<2	<2

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Station Name	Date	¹ Total Coliform (#/100 ml)	¹ Fecal Coliform (#/100 ml)	¹ Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
Lake Oroville at Potter Ravine Floating Restroom	6/25/03	<2	10	<2	<2
	7/24/03	<2	<2	<2	<2
	8/27/03	<2	<2	<2	<2
	9/24/03	6	<2	<2	<2
Lake Oroville (South Fork) at Stringtown Floating Campground	6/25/03	62	<2	<2	<2
	7/24/03	4	2	50	50
	8/27/03	17	<2	2	2
	9/24/03	2	<2	<2	<2
Lake Oroville (Middle Fork) at Union Creek Floating Campground	6/25/03	<2	<2	<2	<2
	7/24/03	<2	<2	2	2
	8/27/03	11	<2	<2	<2
	9/24/03	<2	<2	<2	<2

¹EPA criteria – freshwater designated bathing beach area: Enterococci 61 per 100 ml; CDHS recommended freshwater public beach criteria: Total coliforms 10,000/100 ml; Fecal coliforms 400/100 ml; Enterococcus 33/100 ml

²Bold indicates values exceeds one or more criteria

Table 8.1-4a. Lake Oroville recreational WQ sampling – Total metals

Station Name	Date	Total Aluminum (µg/L)	Total Arsenic (µg/L)	Total Cadmium (µg/L)	Total Chromium (µg/L)	Total Copper (µg/L)	Total Iron (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	54.1	0.55	<0.02	0.36	0.77	83
	7/21/03	528	0.55	<0.016	1.56	2.46	934
	8/20/03	51.7	0.636	<0.01	0.41	0.58	61.9
	9/15/03	89.6	0.714	<0.023	0.34	0.71	114
Lake Oroville at Bidwell Canyon Marina	6/17/03	12.7	0.532	<0.02	0.19	0.79	6.9
	7/21/03	25.5	0.52	<0.016	0.119	0.599	32.8
	8/20/03	13.3	0.65	0.029	0.4	0.79	9
	9/15/03	38.8	0.641	<0.023	0.2	0.57	37.5
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	17.4	0.546	<0.02	0.23	0.72	25.1
	7/21/03	35.4	0.524	<0.016	0.203	0.574	45.1
	8/20/03	38.4	0.602	<0.01	0.52	0.59	50.3
	9/15/03	54.8	0.581	<0.023	0.38	0.64	82.2
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	15.4	0.544	<0.02	0.27	0.91	17.7
	7/21/03	42.2	0.554	<0.016	0.342	0.659	71.2
	8/20/03	28.2	0.561	<0.01	0.48	0.59	27.1
	9/15/03	47.1	0.576	<0.023	0.34	0.6	52.1
Lake Oroville at Dam	6/23/03	15.3	0.742	<0.02	1.48	3.23	23.4
	7/21/03	23.5	0.548	<0.016	0.11	0.614	27
	8/25/03	18.4	0.656	<0.01	0.37	0.59	<3.1
	9/22/03	27	0.728	<0.023	0.15	0.49	20.5

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Station Name	Date	Total Aluminum (µg/L)	Total Arsenic (µg/L)	Total Cadmium (µg/L)	Total Chromium (µg/L)	Total Copper (µg/L)	Total Iron (µg/L)
Lake Oroville - North Fork	6/24/03	16.1	0.573	<0.02	0.6	0.6	20.6
	7/22/03	22.7	0.553	<0.016	0.148	1.09	20.3
	8/26/03	24.5	0.656	<0.01	0.42	0.8	13.4
	9/23/03	28.1	.685	<.023	<.07	.56	20.6
Lake Oroville - South Fork	6/23/03	35.3	0.48	<0.02	0.51	0.65	20
	7/23/03	61	0.502	<0.016	<0.094	0.499	28.9
	8/26/03	41.3	0.519	<0.01	0.33	0.37	15.2
	9/23/03	47.2	.538	<.023	<.07	.43	15
Lake Oroville - Middle Fork	6/24/03	22.5	0.491	<0.02	0.52	0.52	13.1
	7/23/03	45.7	0.557	<0.016	0.178	0.429	22.3
	8/26/03	27.6	0.668	<0.01	0.38	0.94	<3.1
	9/23/03	26.2	.678	<.023	.09	.36	6.1

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Table 8.1-4b. Lake Oroville recreational WQ sampling – Total metals

Station Name	Date	Total Lead (µg/L)	Total Manganese (µg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (µg/L)	Total Zinc (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	0.016	2.92	0.86	<0.138	<0.165	0.55
	7/21/03	0.179	21.8	1.48	<0.242	<0.106	2.96
	8/20/03	0.01	2.64	0.59	<0.21	<0.144	0.34
	9/15/03	0.009	4.85	0.67	<0.116	<0.062	0.42
Lake Oroville at Bidwell Canyon Boat Marina	6/17/03	0.007	1.32	0.78	0.16	<0.165	0.72
	7/21/03	<0.002	2.68	0.68	<0.242	<0.106	ND
	8/20/03	0.024	4.31	0.59	<0.21	<0.144	1.04
	9/15/03	0.003	2.01	0.59	<0.116	<0.062	0.27
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	0.104	12	0.71	<0.138	<0.165	0.87
	7/21/03	0.016	3.16	0.686	<0.242	<0.106	0.318
	8/20/03	0.2	3.44	0.77	<0.21	<0.144	0.48
	9/15/03	0.048	3.57	0.84	<0.116	<0.062	2.51
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	0.017	2.79	0.75	<0.138	<0.165	0.45
	7/21/03	0.027	5.24	0.983	<0.242	<0.106	0.339
	8/20/03	0.029	1.81	0.69	<0.21	<0.144	0.22
	9/15/03	0.019	3.06	0.83	0.14	<0.062	0.34
Lake Oroville at Dam	6/23/03	<0.003	1.71	0.92	<0.138	<0.165	0.1
	7/21/03	<0.002	2.5	0.719	<0.242	<0.106	<0.071
	8/25/03	<0.007	2	0.51	<0.21	<0.144	0.08
	9/22/03	<0.001	1.67	0.52	<0.116	<0.062	0.1

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Station Name	Date	Total Lead (µg/L)	Total Manganese (µg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (µg/L)	Total Zinc (µg/L)
Lake Oroville - North Fork	6/24/03	<0.003	1.66	0.75	<0.138	<0.165	0.08
	7/22/03	<0.002	2.39	0.736	<0.242	<0.106	<0.071
	8/26/03	<0.007	2.36	0.53	<0.21	<0.144	0.19
	9/23/03	<.001	1.77	.66	<.116	<.062	.11
Lake Oroville - South Fork	6/23/03	0.008	1.74	0.79	0.16	<0.165	<0.068
	7/23/03	0.005	3.37	0.571	<0.242	<0.106	<0.071
	8/26/03	0.05	2.7	0.46	<0.21	<.144	0.1
	9/23/03	.013	2.27	.48	<.116	.195	.27
Lake Oroville - Middle Fork	6/24/03	0.007	1.61	0.73	<0.138	<0.165	2.58
	7/23/03	0.003	2.18	0.707	<0.242	<0.106	0.109
	8/26/03	<0.007	1.72	0.55	<0.21	<0.144	0.08
	9/23/03	.003	1	.53	<.116	<.062	.09

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Table 8.1-5a. Lake Oroville recreational WQ sampling – Dissolved metals

Station Name	Date	Dissolved Aluminum (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	26.4	0.524	<0.005	0.15	0.69	23.4
	7/21/03	6.55	0.55	<0.013	<0.072	0.726	<1.06
	8/20/03	15.1	0.621	<0.004	0.33	0.56	6.7
	9/15/03	20.8	0.673	<0.022	0.11	0.50	8
Lake Oroville at Bidwell Canyon Marina	6/17/03	9.65	0.488	<0.005	0.05	0.74	5.2
	7/21/03	6.42	0.516	<0.013	<0.072	0.531	<1.06
	8/20/03	11.3	0.614	<0.004	0.2	0.72	3.9
	9/15/03	11.3	0.527	<0.022	<0.104	0.49	<1.64
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	14.9	0.524	<0.005	0.1	0.7	15.8
	7/21/03	11.1	<0.01	<0.013	<0.072	0.568	<1.06
	8/20/03	22.4	0.575	<0.004	0.35	0.49	18.3
	9/15/03	14	0.572	<0.022	0.2	0.49	2.4
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	13	0.531	<0.005	0.11	0.72	14.4
	7/21/03	8.91	0.509	<0.013	0.112	0.63	<1.06
	8/20/03	21.3	0.53	<0.004	0.25	0.53	17.4
	9/15/03	17.5	0.557	<0.022	0.13	0.5	8.2
Lake Oroville at Dam	6/23/03	7.26	0.489	<0.039	0.62	0.66	7.1
	7/21/03	6.41	0.515	<0.013	<0.072	0.506	<1.06
	8/25/03	15.4	0.624	<0.01	0.14	0.45	<1.33
	9/22/03	22.6	0.701	<0.002	<0.104	0.43	7.3

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Station Name	Date	Dissolved Aluminum (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)
Lake Oroville - North Fork	6/24/03	6.71	0.562	<0.039	0.25	0.58	4.3
	7/22/03	7.83	0.546	<0.013	<0.072	0.465	<1.06
	8/26/03	10.9	0.655	0.19	0.19	0.45	<1.33
	9/23/03	12.8	0.518	<.011	<.075	0.48	<1.02
Lake Oroville - South Fork	6/23/03	21.6	0.421	<0.039	0.16	0.56	5.4
	7/23/03	35	0.485	<0.013	<0.072	0.396	<1.06
	8/26/03	29.1	0.5	<0.01	<0.065	0.33	<1.33
	9/23/03	14.5	.512	<.011	<.075	.32	<1.02
Lake Oroville - Middle Fork	6/24/03	10.7	0.468	<0.039	0.24	0.51	1.5
	7/23/03	29.7	0.557	<0.013	<0.072	0.345	<1.06
	8/26/03	22	0.658	<0.01	0.11	0.94	<1.33
	9/23/03	9.08	.617	<.011	<.075	.34	<1.02

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Table 8.1-5b. Lake Oroville recreational WQ sampling – Dissolved metals

Station Name	Date	Dissolved Lead (µg/L)	Dissolved Manganese (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Zinc (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	0.004	1.52	0.8	<0.285	<0.006	0.27
	7/21/03	<0.004	0.055	0.553	<0.261	0.007	0.127
	8/20/03	<0.003	0.98	0.57	<0.163	<0.015	0.15
	9/15/03	0.002	0.99	0.51	<0.052	<0.001	0.07
Lake Oroville at Bidwell Canyon Marina	6/17/03	0.007	1.07	0.76	<0.285	<0.006	0.74
	7/21/03	<0.004	0.048	0.614	<0.261	0.008	0.04
	8/20/03	<0.003	4.13	0.59	<0.163	<0.015	0.93
	9/15/03	0.001	0.55	0.48	<0.052	<0.001	0.18
Lake Oroville at Lime Saddle Boat Ramp	6/17/03	0.024	10.8	0.58	<0.285	<0.006	0.54
	7/21/03	0.008	0.142	0.616	<0.261	0.01	0.146
	8/20/03	<0.003	1.08	0.7	<0.163	<0.015	0.12
	9/15/03	0.001	0.69	0.69	<0.052	0.005	1.04
Lake Oroville at Lime Saddle Marina	6/17/03	0.018	2.76	0.5	<0.285	<0.006	0.38
	7/21/03	<0.004	0.104	0.607	<0.261	0.014	0.051
	8/20/03	<0.003	1.28	0.69	<0.163	<0.015	0.12
	9/15/03	0.002	0.81	0.7	<0.052	0.009	0.11
Lake Oroville at Dam	6/23/03	7.26	<0.002	0.37	0.8	<0.109	<0.011
	7/21/03	6.41	<0.004	0.034	0.604	<0.261	0.008
	8/25/03	15.4	<0.008	0.89	0.51	<0.1	<0.014
	9/22/03	22.6	<0.001	1.21	0.48	<0.052	<0.001

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Station Name	Date	Dissolved Lead (µg/L)	Dissolved Manganese (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Zinc (µg/L)
Lake Oroville - North Fork	6/24/03	6.71	<0.002	0.6	0.74	<0.109	<0.011
	7/22/03	7.83	<0.004	1.56	0.53	<0.261	<0.005
	8/26/03	10.9	<0.008	0.64	0.49	<0.1	<0.014
	9/23/03	12.8	<0.026	0.54	0.47	<0.327	<0.01
Lake Oroville - South Fork	6/23/03	21.6	<0.002	0.64	0.73	0.11	<0.011
	7/23/03	35	<0.004	1.8	0.485	<0.261	<0.005
	8/26/03	29.1	<0.008	1.03	0.39	<0.1	<0.014
	9/23/03	14.5	<0.026	.44	0.39	<0.327	<0.01
Lake Oroville - Middle Fork	6/24/03	10.7	<0.002	0.52	0.69	<0.109	<0.011
	7/23/03	29.7	<0.004	1.1	0.524	<0.261	<0.005
	8/26/03	22	<0.008	0.62	0.52	0.12	<0.014
	9/23/03	9.08	<0.026	0.16	0.55	<0.327	<0.01

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Table 8.1-6. Lake Oroville recreational WQ sampling – Total and dissolved arsenic results

Station Name	Date	Dissolved Arsenic (µg/L)	Total Arsenic¹ (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	0.524	0.55
	7/21/03	0.550	0.55
	8/20/03	0.621	0.636
	9/15/03	0.673	0.714
Lake Oroville at Bidwell Canyon Marina	6/17/03	0.488	0.532
	7/21/03	0.516	0.52
	8/20/03	0.614	0.65
	9/15/03	0.527	0.641
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	0.524	0.546
	7/21/03	<0.01	0.524
	8/20/03	0.575	0.602
	9/15/03	0.572	0.581
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	0.531	0.544¹
	7/21/03	0.509	0.554¹
	8/20/03	0.530	0.561¹
	9/15/03	0.557	0.576¹
Lake Oroville at Dam	6/23/03	0.489	0.742
	7/21/03	0.515	0.548
	8/25/03	0.624	0.656
	9/22/03	0.701	0.728

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Station Name	Date	Dissolved Arsenic (µg/L)	Total Arsenic¹ (µg/L)
Lake Oroville - North Fork	6/24/03	0.562	0.573
	7/22/03	0.546	0.553
	8/26/03	0.655	0.656
	9/23/03	0.518	0.685
Lake Oroville - South Fork	6/23/03	0.421	0.48
	7/23/03	0.485	0.502
	8/26/03	0.5	0.519
	9/23/03	.512	0.538
Lake Oroville - Middle Fork	6/24/03	0.468	0.491
	7/23/03	0.557	0.557
	8/26/03	0.658	0.668
	9/23/03	.617	0.678

¹Criteria established for total arsenic only

Bold = Exceeds the USEPA National Recommended Ambient Water Quality Criteria for Human Health and Welfare Protection, One-in-a-Million Cancer Risk Estimate for - Sources of Drinking Water (water +organisms) – 0.018 µg/L and - Other Waters (aquatic organism consumption only) – 0.14 µg/L

Table 8.1-7. Lake Oroville recreational WQ sampling – Petroleum byproducts

Compound	Compound	Compound
<i>Polynuclear aromatic hydrocarbons (Semivolatile organic compounds)</i>	n-Butylbenzene	2,2-Dichloropropane
Acenaphthylene	sec-Butylbenzene	1,1-Dichloropropene
Anthracene	tert-Butylbenzene	Ethylbenzene
Benzo (a) anthracene	Carbon tetrachloride	Hexachlorobutadiene
Benzo (a) pyrene	Chlorobenzene	Isopropylbenzene
Benzo (b&k) fluoranthene	Chloroethane	p-Isopropyltoluene
Benzo (ghi) perylene	Chloroform	Methylene chloride
Chrysene	Chloromethane	Methyl tert-butyl ether
Dibenz (a,h) anthracene	2-Chlorotoluene	Naphthalene
Fluoranthene	4-Chlorotoluene	n-Propylbenzene
Fluorene	Dibromochloromethane	Styrene
Indeno (1,2,3-cd) pyrene	1,2-Dibromoethane	1,1,1,2-
Naphthalene	Dibromomethane	Tetrachloroethane
Phenanthrene	1,2-Dibromo-3-chloropropane	1,1,2,2-
Pyrene	1,2-Dichlorobenzene	Tetrachloroethane
Oil & Grease	1,3-Dichlorobenzene	Tetrachloroethane
	1,4-Dichlorobenzene	Toluene
<i>Aromatic hydrocarbons (Volatile organic compounds)</i>	Dichlorodifluoromethane	1,2,3-Trichlorobenzene
Benzene	1,1-Dichloroethane	1,2,4-Trichlorobenzene
Bromobenzene	1,2-Dichloroethane	1,1,1-Trichloroethane
Bromochloromethane	1,1-Dichloroethene	1,1,2-Trichloroethane
Bromoform	cis-1,2-Dichloroethene	Trichlorofluoromethane
Bromomethane	trans-1,2-Dichloroethene	1,2,3-Trichloropropane
	1,2-Dichloropropane	1,2,4-Trimethylbenzene
	1,3-Dichloropropane	1,3,5-Trimethylbenzene
		Vinyl chloride
		Xylenes (total)

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Compound

Compound

Compound

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Oroville Facilities Relicensing Team

August 23, 2004

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Table 8.1-8. Lake Oroville recreational WQ sampling – Methyl tertiary butyl ether (MTBE)

Station	Date	MTBE (µg/L)	Station	Date	MTBE (µg/L)
Lake Oroville at Bidwell Canyon Boat Ramp	6/17/03	6	Lake Oroville (South Fork) at Stringtown Floating Campground	6/25/03	0.94
	7/21/03	3.4		7/24/03	2.4
	8/20/03	6.4		8/25/03	1.4
	9/15/03	2.8		9/24/03	2.5
Lake Oroville at Bidwell Canyon Marina	6/17/03	3	Lake Oroville (Middle Fork) at Union Creek Floating Campground	6/25/03	0.97
	7/21/03	3.6		7/24/03	2.5
	8/30/03	5.7		8/27/03	1.2
	9/15/03	2.2		9/24/03	<1.0
Lake Oroville (North Fork) at Bloomer Boat-In Primitive Campground	6/25/03	1.2	Lake Oroville at Dam	6/22/03	<0.5
	7/24/03	0.86		7/21/03	1.2
	8/27/03	1.3		8/25/03	1
	9/24/03	<1.0		9/22/03	<0.5
Lake Oroville (Middle Fork) at Canyon Creek Floating Campground	6/25/03	0.65	Lake Oroville Main Body	6/24/03	1.4
	7/24/03	1.3		7/21/03	12
	8/27/03	0.64		8/25/03	1
	9/24/03	0.6		9/22/03	<0.5
Lake Oroville (Middle Fork) at Craig Saddle Floating Campground	6/25/03	1.1	Lake Oroville Middle Fork	6/24/03	1.4
	7/24/03	2.2		7/23/03	2.6
	8/27/03	1.8		8/26/03	1.2
	9/24/03	0.77		9/23/03	0.72

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Station	Date	MTBE (µg/L)	Station	Date	MTBE (µg/L)
Lake Oroville (North Fork) at Goat Ranch Boat-In Campground	6/24/03	0.74	Lake Oroville North Fork	6/24/03	0.85
	7/24/03	1.2		7/23/03	<1.0
	8/27/03	0.77		8/26/03	0.97
	9/24/03	<1.0		9/23/03	<1.0
Lake Oroville (West Branch) at Lime Saddle Boat Ramp	6/17/03	7.5	Lake Oroville South Fork	6/24/03	1.8
	7/21/03	7.6		7/23/03	2.3
	8/20/03	4.5		8/25/03	1.5
	9/15/03	15		9/23/03	0.74
Lake Oroville (West Branch) at Lime Saddle Marina	6/17/03	9.4	Thermalito Afterbay North	6/24/03	<0.5
	7/21/03	6.7		7/21/03	<0.5
	8/20/03	3.8		8/27/03	<0.5
	9/15/03	4.2		9/22/03	<0.5
Lake Oroville at Loafer Creek RA Equestrian Campground	6/18/03	<1.0	Thermalito Afterbay South	6/24/03	<0.5
	7/28/03	<1.0		7/21/03	<0.5
	8/20/03	<1.0		8/27/03	<0.5
	9/29/03	1.1		9/22/03	1.2
Potter Ravine Floating CG	6/25/03	1.1	Thermalito Forebay South	6/24/03	0.58
	7/24/03	1.3		7/21/03	<0.5
	8/27/03	0.76		8/27/03	<0.5
	9/24/03	<1.0		9/22/03	<0.5

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8.2. Water Quality Sampling Program 2 – Swim Areas Bacteria Sampling

Table 8.2-1. Swim area bacteria sampling - Results

Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
Bedrock Park DS	6/10/03	0905	300	170	300	500
	6/23/03	0855	350	14	17	27
	6/26/03	0955	500	23	30	170
	6/30/03	1025	110	13	4	30
	7/3/03	1140	220	30	11	22
	7/7/03	1010	189	8	12	16
	7/10/03	1045	80	17	4	26
	7/14/03	1100	240	17	11	140
	7/17/03	1055	240	80	23	80
	8/6/03	0855	900	300	4	11
	9/3/03	0755	130	30	22	80
	10/8/03	0840	300	23	170	500
	10/22/03	0910	70	8	80	80
	11/5/03	0920	500	8	6	12
11/19/03	1000	300	11	50	50	
Bedrock Park US	6/10/03	0905	300	300	170	170
	6/23/03	0845	70	50	30	50
	6/26/03	0945	90	11	2	8
	6/30/03	1020	130	8	14	22
	7/3/03	1030	90	4	4	11
	7/7/03	1005	240	9	4	14

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	7/10/03	1035	70	6	2	7
	7/14/03	1045	23	23	4	8
	7/17/03	1045	80	23	30	50
	8/6/03	0850	>1600	170	50	280
	9/3/03	0740	300	80	27	130
	10/8/03	0830	170	50	140	140
	10/22/03	0900	500	26	110	300
	11/5/03	0915	>1600	30	8	8
	11/19/03	0950	500	13	13	30
Foreman Creek Boat Access	6/10/03	0810	>1600	>1600	500	900
	6/23/03	0700	220	80	<2	<2
	6/26/03	0845	22	2	2	7
	6/30/03	0845	50	8	7	7
	7/3/03	0850	170	4	280	280
	7/7/03	0755	50	8	6	6
	7/10/03	0830	220	140	<2	2
	7/14/03	0900	>1600	13	20	23
	7/17/03	0850	17	7	2	4
	8/6/03	0815	21	<2	<2	<2
	9/3/03	0835	30	13	7	7
	10/8/03	0955	2	<2	<2	<2
	10/22/03	0800	<2	<2	8	8
	11/5/03	1020	17	8	8	8
	11/19/03	1030	23	23	17	17
Loafer Creek Swim Area	6/10/03	0830	>1600	1600	>1600	>1600

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	6/23/03	0830	>1600	500	59	123
	6/26/03	0805	240	50	300	500
	6/30/03	0900	300	130	23	23
	7/3/03	0910	300	50	<2	33
	7/7/03	0815	220	11	27	110
	7/10/03	0855	30	8	2	2
	7/14/03	0920	70	8	17	33
	7/17/03	0905	130	30	7	80
	8/6/03	0745	14	2	6	6
	9/3/03	0815	17	4	2	2
	10/8/03	1015	30	4	<2	<2
	10/22/03	0825	4	4	11	11
	11/5/03	1000	500	500	17	17
	11/19/03	1020	40	4	50	50
Monument Hill Swim Area	6/10/03	1005	80	30	50	50
	6/23/03	0930	60	4	110	170
	6/26/03	0910	130	50	280	900
	6/30/03	0950	80	8	27	27
	7/3/03	1005	500	30	23	30
	7/7/03	920	900	23	30	130
	7/10/03	1000	900	500	130	130
	7/14/03	1020	220	7	4	7
	7/17/03	1010	900	170	30	70
	8/6/03	1000	>1600	110	17	22
	9/3/03	0630	500	500	80	300
	10/8/03	0730	80	4	30	30

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	10/22/03	1015	110	30	50	50
	11/5/03	0825	130	50	1600	1600
	11/19/03	0915	300	23	50	50
North Forebay Swim Area (Beach)	6/10/03	0935	220	23	22	50
	6/23/03	0920	>1600	>1600	1600	1600
	6/26/03	1010	1600	1600	>1600	>1600
	6/30/03	1040	900	500	140	140
	7/3/03	1105	>1600	>1600	1600	1600
	7/7/03	1040	170	130	50	70
	7/10/03	1115	300	50	1600	1600
	7/14/03	1125	>1600	500	220	500
	7/17/03	1125	1600	900	80	130
	8/6/03	0915	50000	5000	>1600	>1600
	9/3/03	0710	>1600	>1600	900	>1600
	10/8/03	0810	>1600	>1600	>1600	>1600
	10/22/03	0935	>1600	>1600	170	170
	11/5/03	0855	500	50	30	70
	11/19/03	1125	1600	1600	900	900
North Forebay Swim Area (Cove)	6/10/03	0930	500	500	500	500
	6/23/03	0915	1300	140	300	300
	6/26/03	1005	1600	300	80	80
	6/30/03	1035	1600	240	70	140
	7/3/03	1100	500	130	1600	>1600
	7/7/03	1035	1600	300	80	110
	7/10/03	1110	80	22	2	4

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	7/14/03	1120	>1600	900	70	70
	7/17/03	1115	>1600	300	220	280
	8/6/03	0905	>160000	22000	>1600	>1600
	9/3/03	0715	>1600	300	220	900
	10/8/03	0815	>1600	500	1600	1600
	10/22/03	0940	1600	2	27	27
	11/5/03	0905	300	80	50	50
	11/19/03	1135	900	50	17	40
North Forebay Swim Area (Mouth)	6/10/03	0925	300	70	900	900
	6/23/03	0900	500	50	13	13
	6/26/03	1015	140	30	23	23
	6/30/03	1050	600	30	14	14
	7/3/03	1050	280	220	110	110
	7/7/03	1025	>1600	80	29	29
	7/10/03	1055	220	14	21	21
	7/14/03	1110	900	50	11	11
	7/17/03	1105	>1600	500	110	220
	8/6/03	0920	>1600	>1600	1600	>1600
	9/3/03	0725	>1600	170	110	500
	10/8/03	0800	500	170	80	80
	10/22/03	0925	240	50	11	11
	11/5/03	0850	240	17	9	9
	11/19/03	1120	170	4	NA	<2
South Forebay Boat Ramp	6/10/03	0945	22	22	23	23
	6/23/03	0950	130	8	900	900

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	6/26/03	0920	17	4	4	4
	6/30/03	1000	300	130	220	220
	7/3/03	1015	170	50	7	7
	7/7/03	940	900	130	80	80
	7/10/03	1015	280	11	50	50
	7/14/03	1030	900	500	300	300
	7/17/03	1020	>1600	>1600	500	500
	8/6/03	0945	>1600	>1600	300	300
	9/3/03	0645	300	110	30	80
	10/8/03	0745	500	50	50	50
	10/22/03	1000	80	23	23	23
	11/5/03	0835	130	13	17	17
	11/19/03	0930	50	23	13	23
South Forebay Swim Area	6/10/03	0950	30	17	2	30
	6/23/03	0945	17	13	7	7
	6/26/03	0925	110	26	30	30
	6/30/03	1005	500	30	11	11
	7/3/03	1020	300	30	>1600	>1600
	7/7/03	945	140	7	2	6
	7/10/03	1020	40	8	17	17
	7/14/03	1035	>1600	1600	1600	1600
	7/17/03	1030	300	50	30	50
	8/6/03	0950	>1600	>1600	>1600	>1600
	9/3/03	0650	300	70	22	50
	10/8/03	0750	>1600	>1600	500	500
	10/22/03	1005	500	500	80	80

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Station Name	Date	Time	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Enterococcus (#/100 ml)	Fecal Streptococcus (#/100 ml)
	11/5/03	0840	300	300	900	900
	11/19/03	0935	80	50	17	17
Stringtown Boat Ramp	6/10/03	0735	300	130	900	1600
	6/23/03	0800	70	4	900	900
	6/26/03	0830	50	2	29	44
	6/30/03	0915	2	2	2	2
	7/3/03	0930	1600	1600	>1600	>1600
	7/7/03	0835	30	<2	2	4
	7/10/03	0915	11	<2	<2	2
	7/14/03	0945	37	4	4	6
	7/17/03	0930	22	<2	2	29
	8/6/03	0720	17	<2	<2	2
	9/3/03	0905	2	2	<2	2
	10/8/03	0920	17	<2	<2	<2
	10/22/03	0730	23	2	8	8
	11/5/03	1100	300	300	70	70
	11/19/03	1050	110	30	17	17

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8.3. Water Quality Sampling Program 3 – Fishing Tournament/Weekend Sampling

Table 8.3-1. Weekend WQ sampling –Petroleum Byproducts

	Bidwell Canyon Boat Ramp		Bidwell Canyon BR Control		Bidwell Canyon Marina		Spillway Boat Ramp	
	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03
	1705	1745	1645	1815	1745	1730	1600	1845
<i>Aromatic Hydrocarbons</i>								
Benzene	0.67¹	1.4²	<0.5	<0.5	<0.5	<0.5	2.5³	0.73
Bromobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlormethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-chloropropane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

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	Bidwell Canyon Boat Ramp		Bidwell Canyon BR Control		Bidwell Canyon Marina		Spillway Boat Ramp	
	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03
	1705	1745	1645	1815	1745	1730	1600	1845
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	0.92	0.63
Hexachlorobutadiene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
p-Isopropyltoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
n-Propylbenzene	<0.5	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	1.2
Styrene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	2.3	6	0.71	1.4	1.4	1.6	5.1	3
1,2,3-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	0.92	0.92	<0.5	<0.5
1,2,4-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

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	Bidwell Canyon Boat Ramp		Bidwell Canyon BR Control		Bidwell Canyon Marina		Spillway Boat Ramp	
	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03	8/24/03	8/30/03
	1705	1745	1645	1815	1745	1730	1600	1845
1,2,3-Trichloropropane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	0.72	1.8	<0.5	<0.5	0.58	0.61	1.2	1.2
1,3,5-Trimethylbenzene	<0.5	0.52	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes (total)	2.5	6.3	<0.5	0.9	2	1.8	4.6	3.4
<i>Polynuclear aromatic hydrocarbons</i>								
Acenaphthene	<5	<5	<5	<5	<5	<5	<5	<5
Acenaphthylene	<5	<5	<5	<5	<5	<5	<5	<5
Anthracene	<5	<5	<5	<5	<5	<5	<5	<5
Benzo (a) anthracene	<5	<5	<5	<5	<5	<5	<5	<5
Benzo (a) pyrene	<5	<5	<5	<5	<5	<5	<5	<5
Benzo (b & k) fluoranthene (total)	<10	<10	<10	<10	<10	<10	<10	<10
Benzo (ghi) perylene	<5	<5	<5	<5	<5	<5	<5	<5
Chrysene	<5	<5	<5	<5	<5	<5	<5	<5
Dibenz (a,h) anthracene	<5	<5	<5	<5	<5	<5	<5	<5
Fluoranthene	<5	<5	<5	<5	<5	<5	<5	<5
Fluorene	<5	<5	<5	<5	<5	<5	<5	<5
Indeno (1,2,3-cd) pyrene	<5	<5	<5	<5	<5	<5	<5	<5
Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	<5	<5	<5	<5	<5	<5	<5	<5
Pyrene	<5	<5	<5	<5	<5	<5	<5	<5
Oil & Grease	<5	<5	<5	<5	<5	<5	<5	<5

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- 1 Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L
 - 2 Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L; exceeds California Primary MCL of 1.0 µg/L; exceeds USEPA Drinking Water Health Advisory criterion of 1.0 µg/L
 - 3 Exceeds California Public Health Goal for Drinking Water for Toxicity to Humans of 0.15 µg/L; exceeds Cal/EPA Cancer Potency Factor as a Drinking Water Level criterion of 0.35 µg/L; exceeds California Primary MCL of 1.0 µg/L; exceeds USEPA Drinking Water Health Advisory criterion of 1.0 µg/L; exceeds USEPA California Toxics Rule for drinking water sources (consumption of water and aquatic organisms) criteria of 1.2 µg/L

8.4. WATER QUALITY SAMPLING PROGRAM 4 – BIDWELL MARINA WQ SAMPLING

Table 8.4-1. Bidwell Marina WQ Sampling - Physical Parameters

Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
Lake Oroville at Bidwell Canyon Marina	10/2/03	72.9	22.7	95	8.6	7.6
	10/28/03	68.4	20.2	96	8.8	8.0
	11/12/03	61.3	16.3	95	8.9	7.8
	12/17/03	53.8	12.1	93	10.3	7.5
	1/13/04	49.5	9.7	90	10.7	7.2
	3/2/04	48.6	9.2	84	12.2	7.5
	4/27/04	65.5	18.6	81	9.9	7.9
	5/19/04	67.5	19.7	80	9.3	7.9
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	10/2/03	72.3	22.4	95	8.5	7.5
	10/28/03	68.4	20.2	95	8.7	8.0
	11/12/03	61.2	16.2	95	9.1	8.0
	12/17/03	53.6	12.0	94	10.2	7.5
	1/13/04	49.5	9.7	90	10.0	7.4
	3/2/04	48.4	9.1	84	12.8	7.5
	4/27/04	63.1	17.3	81	9.9	7.9
	5/19/04	66.0	18.9	79	9.9	7.9
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	10/2/03	72.5	22.5	94	8.5	7.6
	10/28/03	68.2	20.1	96	8.9	8.0
	11/12/03	61.5	16.4	95	8.8	7.8
	12/17/03	54.0	12.2	90	10.2	7.5
	1/13/04	49.5	9.7	90	10.5	7.4
	4/27/04	64.2	17.9	81	9.8	7.9

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Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH
Lake Oroville at Bidwell Canyon Boat Dock 1	5/19/04	67.5	19.7	80	9.3	7.9
	10/2/03	72.9	22.7	96	8.4	7.6
	10/28/03	68.2	20.1	96	9.0	8
	11/12/03	61.3	16.3	95	8.9	7.8
	12/17/03	54.0	12.2	94	10.2	7.5
	1/13/04	49.6	9.8	90	10.6	7.4
	3/2/04	48.2	9.0	85	12.4	7.3
	4/27/04	64.2	17.9	81	10.0	7.9
	5/19/04	67.8	19.9	80	9.4	7.9
Lake Oroville at Bidwell Canyon Boat Dock 2	10/2/03	73.0	22.8	95	8.5	7.6
	10/28/03	68.4	20.2	96	8.9	8.0
	11/12/03	61.3	16.3	95	8.9	7.8
	12/17/03	54.0	12.2	94	10.4	7.5
	1/13/04	49.8	9.9	90	10.8	7.3
	3/2/04	48.2	9.0	85	12.3	7.4
	4/27/04	63.9	17.7	81	9.8	7.9
	5/19/04	68.0	20.0	80	9.3	7.9
	10/2/03	73.2	22.9	95	8.6	7.6
Lake Oroville at Bidwell Canyon Boat Dock 3	10/28/03	68.4	20.2	96	9.0	8.0
	11/12/03	61.7	16.5	95	9.0	7.8
	12/17/03	54.0	12.2	93	10.2	7.5
	1/13/04	49.6	9.8	90	10.9	7.4
	3/2/04	48.6	9.2	85	14.2	7.4
	4/27/04	64.2	17.9	81	10.0	7.9
	5/19/04	68.4	20.2	79	9.4	7.9

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Table 8.4-2a. Bidwell Marina WQ Sampling - Total metals results

Station Name	Date	Total Aluminum (µg/L)	Total Arsenic (µg/L)	Total Cadmium (µg/L)	Total Chromium (µg/L)	Total Copper (µg/L)	Total Iron (µg/L)
Lake Oroville at Bidwell Canyon Marina	10/2/03	25.6	0.715	<0.004	0.304	0.509	28
	10/28/03	22.3	0.627	<0.004	1.17	0.78	30.3
	11/12/03	15.9	0.771	<0.023	ND	0.867	19.9
	12/17/03	24.7	0.787	<0.016	0.57	0.77	25.5
	1/13/04	51.5	0.702	<0.039	0.532	0.902	54.9
	3/2/04	36.4	0.556	0.013	0.51	0.95	37.7
	3/29/04	43.3	0.518	<0.004	0.31	0.89	21.8
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	10/2/03	22.4	0.884	<0.004	0.262	0.431	22.3
	10/28/03	28.8	0.556	<0.004	1.2	0.72	29.5
	11/12/03	14.2	1.15	<0.023	0.132	0.744	17.8
	12/17/03	15.2	0.755	<0.016	0.48	0.75	9.8
	1/13/04	51.7	0.711	<0.039	0.512	0.927	53.5
	3/2/04	31.6	0.532	<0.005	0.5	0.77	.03
	3/29/04	54.2	0.539	<0.004	0.34	0.87	43.3
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	10/2/03	27.3	0.687	<0.004	0.328	0.512	32.3
	10/28/03	26	0.809	<0.004	1.13	0.72	29.9
	11/12/03	19.5	0.748	<0.023	0.117	0.768	26.1
	12/17/03	24.6	0.753	<0.016	0.53	0.89	24.3
	1/13/04	45	0.687	<0.039	0.486	0.657	51.1
	3/2/04	24.6	0.551	<0.005	0.43	0.74	25.9
	3/29/04	37.4	0.524	<0.004	0.29	0.79	21.1

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Station Name	Date	Total Aluminum (µg/L)	Total Arsenic (µg/L)	Total Cadmium (µg/L)	Total Chromium (µg/L)	Total Copper (µg/L)	Total Iron (µg/L)
Lake Oroville at Bidwell Canyon Boat Dock 1	10/2/03	29.4	0.668	<0.004	0.292	0.459	32.2
	10/28/03	25.6	0.536	<0.004	1.23	0.69	28.8
	11/12/03	18.6	0.755	<0.023	0.084	0.926	17.5
	12/17/03	26.4	0.751	<0.016	0.53	1.07	26.7
	1/13/04	46.1	0.708	<0.039	0.522	0.902	46.7
	3/2/04	32.8	0.552	<0.005	0.49	0.82	32.8
	3/29/04	40.2	0.553	<0.004	0.35	0.8	24.8
Lake Oroville at Bidwell Canyon Boat Dock 2	10/2/03	29.7	0.698	<0.004	0.253	0.527	31.9
	10/28/03	23.4	0.626	0.007	1.16	0.72	20.8
	11/12/03	12.6	1.14	<0.023	0.078	0.734	14.3
	12/17/03	14	0.749	<0.016	0.47	0.76	7
	1/13/04	30.3	0.698	<0.039	0.477	0.78	22.1
	3/2/04	33.6	0.567	<0.005	0.53	0.84	36.4
	3/29/04	40.6	0.536	<0.004	0.31	0.92	22.6
Lake Oroville at Bidwell Canyon Boat Dock 3	10/2/03	30.2	0.68	<0.004	0.264	0.472	31.2
	10/28/03	22.4	0.519	<0.004	1.18	0.77	17.7
	11/12/03	19.4	0.779	<0.023	0.12	1	23.7
	12/17/03	15	0.761	<0.016	0.41	0.89	9.5
	1/13/04	24.2	0.7	<0.039	0.404	0.619	14.2
	3/2/04	43.4	0.572	<0.005	0.53	0.88	77.2
	3/29/04	33.4	0.54	<0.004	0.27	1.14	19.3

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Table 8.4-2b. Bidwell Marina WQ Sampling - Total metals results

Station Name	Date	Total Lead (µg/L)	Total Manganese (µg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (µg/L)	Total Zinc (µg/L)
Lake Oroville at Bidwell Canyon Marina	10/2/03	0.003	2.19	0.535	<0.162	<0.131	0.257
	10/28/03	<0.001	1.38	0.58	0.14	<0.04	0.11
	11/12/03	0.006	1.13	0.647	0.038	<0.006	0.117
	12/17/03	0.01	1.65	0.7	<0.248	<0.014	0.23
	1/13/04	0.005	2.45	0.932	<0.258	<0.025	0.318
	3/2/04	<0.018	1.85	0.86	<0.204	<0.065	0.39
	3/29/04	0.01	1.17	0.83	0.13	<0.044	0.29
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	10/2/03	0.002	1.67	0.554	<0.162	<0.131	0.146
	10/28/03	<0.001	1.47	0.59	0.18	<0.04	0.12
	11/12/03	<0.002	1.06	0.653	0.05	<0.006	ND
	12/17/03	0.075	1.04	0.69	<0.248	<0.014	0.17
	1/13/04	0.004	2.36	0.942	<0.258	<0.025	0.151
	3/2/04	<0.018	1.54	0.85	<0.204	<0.065	0.24
	3/29/04	0.012	1.7	0.91	<0.092	<0.044	0.3
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	10/2/03	0.007	1.76	0.626	<0.162	<0.131	0.378
	10/28/03	<0.001	1.49	0.58	<0.121	<0.04	0.09
	11/12/03	<0.002	1.34	0.655	<0.033	<0.006	ND
	12/17/03	0.006	1.59	0.67	<0.248	<0.014	0.2
	1/13/04	0.005	2.38	0.91	<0.258	0.037	0.327
	3/2/04	<0.018	1.48	0.848	<0.204	<0.065	0.27
	3/29/04	0.013	1.11	0.91	<0.092	<0.044	0.25

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Station Name	Date	Total Lead (µg/L)	Total Manganese (µg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (µg/L)	Total Zinc (µg/L)
Lake Oroville at Bidwell Canyon Boat Dock 1	10/2/03	0.004	2.64	0.545	<0.162	<0.131	0.245
	10/28/03	<0.001	1.43	0.58	0.15	<0.04	0.18
	11/12/03	0.014	1.09	0.648	<0.033	0.029	0.124
	12/17/03	0.019	1.91	0.67	<0.248	<0.014	0.45
	1/13/04	0.006	16.3	0.9	<0.258	<0.025	0.4
	3/2/04	<0.018	1.68	0.84	<0.204	<0.065	0.24
	3/29/04	<0.008	1.17	0.89	<0.092	<0.044	0.22
Lake Oroville at Bidwell Canyon Boat Dock 2	10/2/03	0.003	1.88	0.542	<0.162	<0.131	0.257
	10/28/03	<0.001	1.49	0.58	0.16	0.094	0.17
	11/12/03	<0.002	4.75	0.621	0.1	<0.006	0.046
	12/17/03	0.003	1.22	0.65	<0.248	<0.014	0.16
	1/13/04	0.009	197	0.914	<0.258	<0.025	1.12
	3/2/04	<0.018	1.68	0.87	<0.204	<0.065	0.26
	3/29/04	<0.008	1.12	0.85	<0.092	<0.044	0.2
Lake Oroville at Bidwell Canyon Boat Dock 3	10/2/03	0.002	1.85	0.574	<0.162	<0.131	0.232
	10/28/03	0.01	1.43	0.59	0.21	0.243	0.15
	11/12/03	0.011	1.32	0.626	0.043	<0.006	0.139
	12/17/03	0.004	1.4	0.69	<0.248	<0.014	0.14
	1/13/04	<0.004	1.58	0.785	<0.258	<0.025	0.368
	3/2/04	<0.018	2.07	0.88	<0.204	<0.065	0.35
	3/29/04	<0.008	2.58	0.91	<0.092	<0.044	0.22

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Table 8.4-3a. Bidwell Marina WQ Sampling - Dissolved metals results

Station Name	Date	Dissolved Aluminum (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)
Lake Oroville at Bidwell Canyon	9/30/03	14.7	0.686	<0.011	<0.075	0.44	<1.02
Marina	10/28/03	10.8	0.481	<0.02	<0.209	0.42	18.8
	11/12/03	9.65	0.717	<0.016	<0.039	0.47	6.7
	12/17/03	5.99	0.782	<0.008	0.35	0.45	<3.25
	1/13/04	22.4	0.674	<0.032	0.5	0.49	9.4
	2/28/04	19.4	0.442	0.009	<0.081	0.49	2.5
	3/29/04	25.1	0.504	<0.001	0.3	0.53	15.6
	4/27/04	6.31	0.432	<0.002	0.21	0.99	<4.71
Lake Oroville at Bidwell Canyon	9/30/03	10.2	0.7	<0.011	<0.075	0.39	<1.02
Houseboat Moorage 1	10/28/03	8.75	0.517	<0.02	<0.209	0.4	23.1
	11/12/03	7.18	0.751	<0.016	<0.039	0.4	2.9
	12/17/03	6.69	0.754	<0.008	0.44	0.6	6.3
	1/13/04	27.5	0.696	<0.032	0.5	0.49	12.4
	2/28/04	17.7	0.375	<0.004	<0.081	0.48	<1.91
	3/29/04	38.1	0.515	<0.001	0.34	0.55	34.8
	4/27/04	7.32	0.366	<0.002	0.28	0.58	<4.71
Lake Oroville at Bidwell Canyon	9/30/03	10.7	0.677	<0.011	<0.075	0.41	<1.02
Houseboat Moorage 2	10/28/03	9.15	0.541	<0.02	<0.209	0.46	21
	11/12/03	9.23	0.729	<0.016	<0.039	0.42	4.1
	12/17/03	7.36	0.732	<0.008	0.31	0.51	<3.25
	1/13/04	22.1	0.639	<0.032	0.48	0.52	12.2
	2/28/04	13.9	0.457	<0.004	0.13	0.45	2.2
	3/29/04	22	0.509	<0.001	0.21	0.52	18.3

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Station Name	Date	Dissolved Aluminum (µg/L)	Dissolved Arsenic (µg/L)	Dissolved Cadmium (µg/L)	Dissolved Chromium (µg/L)	Dissolved Copper (µg/L)	Dissolved Iron (µg/L)
Lake Oroville at Bidwell Canyon Boat Dock 1	4/27/04	6.23	0.496	<0.002	0.27	0.66	<4.71
	9/30/03	11.6	0.668	<0.011	<0.075	0.42	<1.02
	10/28/03	8.95	0.46	<0.02	<0.209	0.41	21.4
	11/12/03	8.18	0.722	<0.016	<0.039	0.41	4.2
	12/17/03	5.43	0.747	<0.008	0.32	0.49	<3.25
	1/13/04	24.8	0.704	<0.032	0.5	0.54	11
	2/28/04	21.8	0.423	<0.004	<0.081	0.45	6
	3/29/04	21.2	0.514	<0.001	0.3	0.55	14.1
4/27/04	5.09	0.511	<0.002	0.24	0.74	<4.71	
Lake Oroville at Bidwell Canyon Boat Dock 2	9/30/03	11.1	0.639	<0.011	<0.075	0.41	<1.02
	10/28/03	8.92	0.573	<0.02	<0.209	0.39	<3.98
	11/12/03	9.48	0.751	<0.016	<0.039	0.42	5.6
	12/17/03	5.29	0.749	<0.008	0.27	0.44	<3.25
	1/13/04	21.9	0.682	<0.032	0.45	0.71	11.3
	2/28/04	23.8	0.436	<0.004	<0.081	0.48	5.5
	3/29/04	18.2	0.516	<0.001	0.3	0.69	19.3
	4/27/04	6.59	0.501	<0.002	0.27	0.83	<4.71
Lake Oroville at Bidwell Canyon Boat Dock 3	9/30/03	12.1	0.641	<0.011	<0.075	0.41	<1.02
	10/28/03	8.77	0.475	<0.02	<0.209	0.4	<3.98
	11/12/03	8.35	0.736	<0.016	<0.039	0.46	6.6
	12/17/03	5.33	0.76	<0.008	0.3	0.46	<3.25
	1/13/04	20.1	0.691	<0.032	0.4	0.59	11.2
	2/28/04	18.5	0.516	<0.004	<0.081	0.5	9.2
	3/29/04	22.5	0.512	<0.001	0.26	0.91	10.4
	4/27/04	7.11	0.549	<0.002	0.25	0.87	<4.71

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Table 8.4-3b. Bidwell Marina WQ Sampling - Dissolved metals results

Station Name	Date	Dissolved Lead (µg/L)	Dissolved Manganese (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Zinc (µg/L)
Lake Oroville at Bidwell Canyon Marina	9/30/03	<0.026	1.1	0.5	<0.327	<0.01	0.18
	10/28/03	<0.007	0.58	0.57	<0.075	<0.02	<0.101
	11/12/03	<0.004	0.59	0.54	<0.232	<0.012	<0.112
	12/17/03	<0.003	0.17	0.59	<0.072	<0.007	<0.191
	1/13/04	<0.001	0.84	0.79	<0.163	<0.004	0.19
	2/28/04	<0.001	0.67	0.71	<0.132	0.05	0.17
	3/29/04	<0.002	0.92	0.83	<0.056	<0.003	0.2
	4/27/04	<0.004	1.07	0.81	<0.157	<0.035	0.28
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	9/30/03	<0.026	0.56	0.46	<0.327	<0.01	0.04
	10/28/03	<0.007	0.51	0.51	<0.075	<0.02	<0.101
	11/12/03	<0.004	0.57	0.57	<0.232	<0.012	<0.112
	12/17/03	0.046	0.3	0.62	<0.072	<0.007	<0.191
	1/13/04	0.001	0.86	0.83	<0.163	<0.004	0.09
	2/28/04	<0.001	0.55	0.68	<0.132	0.02	0.17
	3/29/04	<0.002	1	0.87	<0.056	<0.003	0.14
	4/27/04	<0.004	0.83	0.88	<0.157	<0.035	0.08
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	9/30/03	<0.102	0.62	0.47	<0.327	<0.01	0.13
	10/28/03	<0.007	0.6	0.54	<0.075	<0.02	<0.101
	11/12/03	<0.004	0.548	0.55	<0.232	<0.012	<0.112
	12/17/03	0.003	0.18	0.59	<0.072	<0.007	<0.191
	1/13/04	0.001	0.9	0.87	<0.163	0.032	0.22

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Station Name	Date	Dissolved Lead (µg/L)	Dissolved Manganese (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Zinc (µg/L)
	2/28/04	<0.001	0.67	0.71	<0.132	0.01	0.13
	3/29/04	<0.002	0.83	0.85	<0.056	<0.003	0.17
	4/27/04	<0.004	2.31	0.87	<0.157	<0.035	0.12
Lake Oroville at Bidwell Canyon	9/30/03	<0.026	0.89	0.45	<0.327	<0.01	0.1
Boat Dock 1	10/28/03	<0.007	0.61	0.54	<0.075	<0.02	0.16
	11/12/03	<0.004	0.61	0.57	<0.232	0.02	<0.112
	12/17/03	<0.003	0.19	0.58	<0.072	<0.007	<0.191
	1/13/04	0.001	13.2	0.86	<0.163	<0.004	0.34
	2/28/04	<0.001	0.73	0.72	0.16	0.01	0.11
	3/29/04	<0.002	0.87	0.87	<0.056	<0.003	0.14
	4/27/04	<0.004	1.77	0.81	<0.157	<0.035	0.18
Lake Oroville at Bidwell Canyon	9/30/03	<0.026	0.68	0.44	<0.327	<0.01	0.09
Boat Dock 2	10/28/03	<0.007	0.6	0.42	<0.075	<0.02	<0.101
	11/12/03	<0.004	4.7	0.57	<0.232	<0.012	<0.112
	12/17/03	<0.003	0.29	0.59	<0.072	<0.007	<0.191
	1/13/04	0.002	180	0.59	<0.163	<0.004	0.89
	2/28/04	<0.001	0.7	0.72	<0.132	0.014	0.11
	3/29/04	<0.002	0.9	0.81	<0.056	<0.003	0.16
	4/27/04	<0.004	0.72	0.81	<0.157	<0.035	0.15
Lake Oroville at Bidwell Canyon	9/30/03	<0.026	0.72	0.43	<0.327	<0.01	0.09
Boat Dock 3	10/28/03	<0.007	0.56	0.5	0.17	<0.02	0.13
	11/12/03	<0.004	0.64	0.58	<0.232	<0.012	<0.112
	12/17/03	<0.003	0.35	0.6	<0.072	0.04	<0.191
	1/13/04	0.001	0.92	0.46	<0.163	<0.004	0.22
	2/28/04	<0.001	0.76	0.73	<0.132	<0.001	0.17

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Station Name	Date	Dissolved Lead (µg/L)	Dissolved Manganese (µg/L)	Dissolved Nickel (µg/L)	Dissolved Selenium (µg/L)	Dissolved Silver (µg/L)	Dissolved Zinc (µg/L)
	3/29/04	<0.002	2.44	0.88	<0.056	<0.003	0.17
	4/27/04	<0.004	1.61	0.81	<0.157	<0.035	0.26

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Table 8.4-4. Bidwell Marina WQ Sampling – Total and methyl mercury results

Station Name	Date	Total Mercury (ng/L)	Methyl Mercury (ng/L)
Lake Oroville at Bidwell Canyon Marina	11/12/03	0.24	<0.025
	12/17/03	0.37	<0.025
	1/13/04	0.48	<0.025
	2/28/04	0.78	<0.025
	3/29/04	0.86	<0.025
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	11/12/03	0.26	<0.025
	12/17/03	0.37	<0.025
	1/13/04	0.52	<0.025
	2/28/04	0.75	<0.025
	3/29/04	0.61	<0.025
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	11/12/03	0.23	<0.025
	12/17/03	0.32	<0.025
	1/13/04	0.48	<0.025
	2/28/04	0.79	<0.025
	3/29/04	0.68	<0.025
Lake Oroville at Bidwell Canyon Boat Dock 1	11/12/03	0.72	<0.025
	12/17/03	0.33	<0.025
	1/13/04	0.58	<0.025
	2/28/04	0.84	<0.025
	3/29/04	0.64	<0.025
Lake Oroville at Bidwell Canyon Boat Dock 2	11/12/03	0.24	<0.025
	12/17/03	0.31	<0.025
	1/13/04	0.49	<0.025
	2/28/04	0.7	<0.025
	3/29/04	0.58	<0.025
Lake Oroville at Bidwell Canyon Boat Dock 3	11/12/03	0.24	<0.025
	12/17/03	0.32	<0.025
	1/13/04	0.51	<0.025
	2/28/04	0.84	<0.025
	3/29/04	0.61	<0.025

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Table 8.4-5. Bidwell Marina WQ Sampling – Tributyltin and congeners

Station	Date	Tributyltin (µg/L)	Dibutyltin (µg/L)	Monobutyltin (µg/L)
Lake Oroville at Bidwell Canyon Marina	9/30/03	<0.005	<0.020	<0.020
	10/28/03	<0.005	<0.020	<0.020
	11/12/03	0.005	<0.020	<0.020
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020
Lake Oroville at Bidwell Canyon Houseboat Moorage 1	9/30/03	<0.005	<0.020	<0.020
	10/28/03	0.009	<0.020	<0.020
	11/12/03	0.005	<0.020	<0.020
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020
Lake Oroville at Bidwell Canyon Houseboat Moorage 2	9/30/03	<0.005	<0.020	<0.020
	10/28/03	<0.005	<0.020	<0.020
	11/12/03	<0.005	<0.020	<0.020
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020
Lake Oroville at Bidwell Canyon Boat Dock 1	9/30/03	<0.005	<0.020	<0.020
	10/28/03	<0.005	<0.020	<0.020
	11/12/03	<0.005	<0.005	<0.005
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020
Lake Oroville at Bidwell Canyon Boat Dock 2	9/30/03	<0.005	<0.020	<0.020
	10/28/03	<0.005	<0.020	<0.020
	11/12/03	<0.005	<0.005	<0.005

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Station	Date	Tributyltin (µg/L)	Dibutyltin (µg/L)	Monobutyltin (µg/L)
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020
Lake Oroville at Bidwell Canyon	9/30/03	<0.005	<0.020	<0.020
Boat Dock 3	10/28/03	0.007	<0.020	<0.020
	11/12/03	<0.005	<0.005	<0.005
	12/17/03	<0.005	<0.020	<0.020
	1/13/04	<0.005	<0.020	<0.020
	2/28/04	<0.005	<0.020	<0.020
	3/29/04	<0.005	<0.020	<0.020
	4/27/04	<0.005	<0.020	<0.020

8.5. Water Quality Sampling Program 5 - Lime Saddle Marina Boat Yard Sand Sampling

Table 8.5-1. Lime Saddle boat yard sand analyses - Aromatic hydrocarbons (Volatile organic compounds)

Analyte (in mg/kg)	Sand Sample 1	Sand Sample 2
Benzene	<0.005	<0.005
Bromobenzene	<0.005	<0.005
Bromochloromethane	<0.005	<0.005
Bromodichloromethane	<0.005	<0.005
Bromoform	<0.005	<0.005
Bromomethane	<0.025	<0.025
n-Butylbenzene	<0.005	<0.005
sec-Butylbenzene	<0.005	<0.005
tert-Butylbenzene	<0.005	<0.005
Carbon tetrachloride	<0.005	<0.005
Chlorobenzene	<0.005	<0.005
Chloroethane	<0.005	<0.005
Chloroform	<0.025	<0.025
Chloromethane	<0.025	<0.025
2-Chlorotoluene	<0.005	<0.005
4-Chlorotoluene	<0.005	<0.005
Dibromochloromethane	<0.005	<0.005
1,2-Dibromochloromethane (EDB)	<0.005	<0.005
Dibromomethane	<0.005	<0.005
1,2-Dibromo-3-chloropropane	<0.025	<0.025
1,2-Dichlorobenzene	<0.005	<0.005
1,3-Dichlorobenzene	<0.005	<0.005
1,4-Dichlorobenzene	<0.005	<0.005
Dichlorodifluoromethane	<0.025	<0.025
1,1-Dichloroethane	<0.005	<0.005
1,2-Dichloroethane	<0.005	<0.005
1,1-Dichloroethene	<0.005	<0.005
cis-1,2-Dichloroethene	<0.005	<0.005
trans-1,2-Dichloroethene	<0.005	<0.005
1,1-Dichloropropane	<0.005	<0.005
1,3-Dichloropropane	<0.005	<0.005
2,2-Dichloropropane	<0.005	<0.005
1,1-Dichloropropene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
Hexachlorobutadiene	<0.005	<0.005
Isopropylbenzene	<0.005	<0.005
p-Isopropyltoluene	<0.005	<0.005

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Analyte (in mg/kg)	Sand Sample 1	Sand Sample 2
Methylene chloride	<0.025	<0.025
Methyl tert-butyl-ether	<0.005	<0.005
Naphthalene	<0.005	<0.005
n-Propylbenzene	<0.005	<0.005
Styrene	<0.005	<0.005
1,1,1,2-Tetrachloroethane	<0.005	<0.005
1,1,2,2-Tetrachloroethane	<0.005	<0.005
Tetrachloroethene	<0.005	<0.005
Toluene	<0.005	<0.005
1,2,3-Trichlorobenzene	<0.005	<0.005
1,2,4-Trichlorobenzene	<0.005	<0.005
1,1,1-Trichloroethane	<0.005	<0.005
1,1,2-Trichloroethane	<0.005	<0.005
Trichloroethene	<0.005	<0.005
Trichlorofluoromethane	<0.005	<0.005
1,2,3-Trichloropropane	<0.005	<0.005
1,2,4-Trimethylbenzene	<0.005	<0.005
1,2,5-Trimethylbenzene	<0.005	<0.005
Vinyl chloride	<0.025	<0.025
Xylenes (total)	<0.01	<0.01

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Table 8.5-2. Lime Saddle boat yard sand analyses - Polynuclear aromatic hydrocarbons (Semivolatile organic compounds)

Analyte (in µg/kg)	Sand Sample 1	Sand Sample 2
N-Nitrosodimethylamine	<2000	<2000
Phenol	<2000	<2000
Aniline	<2000	<2000
Bis(2-chloroethyl)ether	<2000	<2000
2-Chlorophenol	<2000	<2000
1,3-Dichlorobenzene	<2000	<2000
1,4-Dichlorobenzene	<2000	<2000
Benzyl alcohol	<2000	<2000
1,2-Dichlorobenzene	<2000	<2000
2-Methylphenol	<2000	<2000
Bis(2-chloroisopropyl)ether	<2000	<2000
4-Methylphenol	<2000	<2000
N-Nitrosodi-n-propylamine	<2000	<2000
Hexachloroethane	<2000	<2000
Nitrobenzene	<2000	<2000
Isophorone	<2000	<2000
2-Nitrophenol	<2000	<2000
2,4-Dimethylphenol	<2000	<2000
Bis(2-chloroethoxy)methane	<2000	<2000
Benzoic acid	<5000	<5000
2,4-Dichlorophenol	<2000	<2000
1,2,4-Trichlorobenzene	<2000	<2000
Naphthalene	<2000	<2000
4-Chloroaniline	<2000	<2000
Hexachlorobutadiene	<2000	<2000
4-Chloro-3-methylphenol	<2000	<2000
2-Methylnaphthalene	<2000	<2000
Hexachlorocyclopentadiene	<2000	<2000
2,4,5-Trichlorophenol	<2000	<2000
2,4,6-Trichlorophenol	<2000	<2000
2-Chloronaphthalene	<2000	<2000
2-Nitroaniline	<2000	<2000
Dimethyl phthalate	<2000	<2000
Acenaphthylene	<2000	<2000
2,6-Dinitrotoluene	<2000	<2000
3-Nitroaniline	<2000	<2000
Acenaphthene	<2000	<2000
2,4-Dinitrophenol	<5000	<5000
4-Nitrophenol	<2000	<2000
Dibenzofuran	<2000	<2000
2,4-Dinitrotoluene	<2000	<2000

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Analyte (in µg/kg)	Sand Sample 1	Sand Sample 2
Diethyl phthalate	<2000	<2000
4-Chlorophenyl phenyl ether	<2000	<2000
Fluorene	<2000	<2000
4,6-Dinitro-2-methylphenol	<2000	<2000
N-Nitrosodiphenylamine	<2000	<2000
Azobenzene	<2000	<2000
4-Nitroaniline	<2000	<2000
4-Bromophenyl phenyl ether	<2000	<2000
Hexachlorobenzene	<2000	<2000
Pentalchlorophenol	<2000	<2000
Phenanthrene	12500	17800
Anthracene	2030	<2000
Carbazole	5850	7880
Di-n-butyl phthalate	<2000	<2000
Fluoranthene	34500	42300
Pyrene	26500	40800
Benzyl butyl phthalate	<2000	<2000
3,3'-Dichlorobenzidine	<5000	<5000
Bis(2-ethylhexyl)phthalate	<5000	<5000
Benzo(a) anthracene	15900	20600
Chrysene	20200	26500
Di-n-octyl phthalate	<2000	<2000
Benzo (b & k) fluoranthene (total)	33000	51000
Benzo (a) pyrene	15600	20100
Indeno (1,2,3-cd) pyrene	<2000	10000
Dibenz (a,h) anthracene	<2000	5190
Benzo (ghi) perylene	8650	10100

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8.6 WQ Sampling Program 6 - Storm Event Sampling 2003

Table 8.6-1. Storm event sampling 2003 - Physical parameters

Station Name	Date	Water Temperature °F	Water Temperature °C	Conductivity (µmhos/cm)	D.O. (mg/L)	pH
Bidwell Canyon	11/7/03	57.9	14.4	33	10.3	7.3
Boat Yard 1	11/14/03	54.9	12.7	39	10.5	6.8
	12/1/03	Dry	-	-	-	-
Bidwell Canyon	11/7/03	Dry	-	-	-	-
Boat Yard 2	11/14/03	54.9	12.7	68	9.6	6.8
	12/1/03	Dry	-	-	-	-
Bidwell Canyon	11/7/03	55.0	12.8	17	11.1	7.0
Parking Lot	11/14/03	57.7	14.3	24	12.0	6.8
	12/1/03	Dry	-	-	-	-
Lime Saddle	11/7/03	Dry	-	-	-	-
Boat Yard 1	11/14/03	54.5	12.5	11	10.2	6.3
	12/1/03	50.5	10.3	7	11.0	6.1
Lime Saddle	11/7/03	Dry	-	-	-	-
Parking Lot 1	11/14/03	55.4	13.0	12	10.0	6.3
	12/1/03	51.8	11.0	249	10.4	7.5
Lime Saddle	11/7/03	55.0	12.8	17	11.1	7.0
Parking Lot 2	11/14/03	55.4	13.0	9	10.0	6.3
	12/1/03	51.4	10.8	7	10.6	6.1

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North Forebay	11/7/03	57.7	14.3	122	9.0	7.0
Sailboat Marina	11/14/03	56.7	13.7	96	9.4	7.1
	12/1/03	53.6	12.0	76	7.7	7.2

Table 8.6-2. Storm event sampling 2003 - Nutrients

Station Name	Date	Dissolved ammonia (mg/L as N)	Dissolved nitrite+nitrate (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Dissolved sulfate (mg/L)	Total Phosphorus (mg/L)	Total ammonia (mg/L)
Bidwell Canyon	11/7/03	0.15	0.62	<0.01	4	0.06	<0.1
Boat Yard 1	11/14/03	0.38	0.57	0.01	6	0.06	0.43
	12/1/03	Dry	-	-	-	-	-
Bidwell Canyon	11/7/03	Dry	-	-	-	-	-
Boat Yard 2	11/14/02	0.1	0.66	0.04	4	0.08	0.11
	12/1/03	Dry	-	-	-	-	-
Bidwell Canyon	11/7/03	0.52	0.76	0.08	<1	0.11	
Parking Lot	11/14/03	0.25	0.22	0.01	1	0.06	0.93
	12/1/03	Dry	-	-	-	-	-
Lime Saddle Boat Yard 1	11/7/03	Dry	-	-	-	-	-
Boat Yard 1	11/14/03	0.39	0.43	0.05	1	0.07	0.43
	12/1/03	0.1	0.06	0.02	<1	0.04	0.13
Lime Saddle Parking Lot 1	11/7/03	Dry	-	-	-	-	-
Parking Lot 1	11/14/03	0.36	0.39	0.03	1	0.08	0.35
	12/1/03	0.1	0.51	0.03	2	0.08	<0.1
Lime Saddle Parking Lot 2	11/7/03	Dry	-	-	-	-	-
Parking Lot 2	11/14/03	0.34	0.49	0.02	<1	0.04	0.51

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Station Name	Date	Dissolved ammonia (mg/L as N)	Dissolved nitrite+nitrate (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Dissolved sulfate (mg/L)	Total Phosphorus (mg/L)	Total ammonia (mg/L)
	12/1/03	0.13	0.25	0.02	<1	0.03	0.15
North Forebay	11/7/03	0.08	4.62	0.2	6	0.25	<0.1
Sailboat							
Marina	11/14/03	0.13	2.97	0.13	5	0.23	<0.1
	12/1/03	0.02	2.25	0.17	4	0.23	<0.1

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Table 8.6-3. Storm event sampling 2003 - Minerals

Station Name	Date	Dissolved Boron (mg/L)	Dissolved Calcium (mg/L)	Total Calcium (mg/L)	Dissolved Chloride (mg/L)	Dissolved Magnesium (mg/L)	Total Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)
Bidwell Canyon	11/7	<0.1	2	2	<1	1	1	0.6	2
Boat Yard 1	11/14	<0.1	1	1	<1	1	1	0.6	2
	12/1	-	-	-	-	-	-	-	-
Bidwell Canyon	11/7	-	-	-	-	-	-	-	-
Boat Yard 2	11/14	<0.1	3	4	2	2	3	0.6	2
	12/1	-	-	-	-	-	-	-	-
Bidwell Canyon	11/7	<0.1	1	1	<1	<1	<1	<0.5	<1
Parking Lot	11/14	<0.1	1	1	<1	<1	<1	<0.5	1
	12/1	-	-	-	-	-	-	-	-
Lime Saddle	11/7	-	-	-	-	-	-	-	-
Boat Yard 1	11/14	<0.1	1	1	<1	<1	<1	<0.5	1
	12/1	<0.1	<1	<1	1	<1	<1	<0.5	1
Lime	11/7	-	-	-	-	-	-	-	-

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Station Name	Date	Dissolved Boron (mg/L)	Dissolved Calcium (mg/L)	Total Calcium (mg/L)	Dissolved Chloride (mg/L)	Dissolved Magnesium (mg/L)	Total Magnesium (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)
Saddle Parking Lot 1	11/14	<0.1	1	1		<1	<1	<0.5	<1
	12/1	<0.1	3	1		1	1	0.5	5
Lime Saddle Parking Lot 2	11/7	-	-	-	-	-	-	-	-
	11/14	<0.1	1	1	<1	<1	<1	<0.5	<1
	12/1	<0.1	1	1	<1	<1	<1	<0.5	<1
North Forebay Sailboat Marina	11/7	<0.1	10	11	<1	4	4	2.2	4
	11/14	<0.1	8	8	1	3	3	1.8	2
	12/1	<0.1	6	6	<1	3	3	2	2

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Table 8.6-4a. Storm event sampling 2003 - Total metals

Station Name	Date	Total Aluminum (ug/L)	Total Arsenic (ug/L)	Total Cadmium (ug/L)	Total Chromium (ug/L)	Total Copper (ug/L)	Total Iron (ug/L)
Bidwell Canyon Boat Yard 1	11/7/03	143	0.783	0.343	2.92	6.12	448
	11/14/03	98.7	0.812	0.351	1.32	3.77	421
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Boat Yard 2	11/7/03	-	-	-	-	-	-
	11/14/03	334	6.38	<0.023	3.81	7.46	576
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Parking Lot	11/7/03	56.1	0.419	<0.023	0.06	2.49	62
	11/14/03	73.1	0.732	<0.023	0.084	8.68	98.4
	12/1/03	-	-	-	-	-	-
Lime Saddle Boat Yard 1	11/7/03	-	-	-	-	-	-
	11/14/03	172	5.05	0.159	1.28	63.2	271
	12/1/03	184	7.43	0.301	1.91	27.4	311
Lime Saddle Parking Lot 1	11/7/03	-	-	-	-	-	-
	11/14/03	66.1	2.39	<0.023	0.276	13.8	95.7
	12/1/03	312	1.8	0.242	1.68	16.1	436
Lime Saddle Parking Lot 2	11/7/03	-	-	-	-	-	-
	11/14/03	131	0.405	<0.023	0.28	2.54	200
	12/1/03	104	0.259	0.062	0.64	2.51	120
North Forebay	11/7/03	89.2	1.63	<0.023	62	5.58	139
Sailboat Marina	11/14/03	137	1.46	<0.023	0.663	4.55	243
	12/1/03	181	1.02	0.02	1.66	4.37	294

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Table 8.6-4b. Storm event sampling 2003 - Total metals

Station Name	Date	Total Lead (ug/L)	Total Manganese (ug/L)	Total Nickel (ug/L)	Total Selenium (ug/L)	Total Silver (ug/L)	Total Zinc (ug/L)
Bidwell Canyon Boat Yard 1	11/7/03	0.725	14.3	2.71	0.11	0.103	377
	11/14/03	0.577	17.1	2.78	0.177	<0.006	257
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Boat Yard 2	11/7/03	-	-	-	-	-	-
	11/14/03	1.29	60.3	1.89	0.191	<0.006	21.3
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Parking Lot	11/7/03	0.224	28.4	1.36	0.1	0.183	30.2
	11/14/03	0.628	31.6	1.74	0.178	<0.006	31.9
	12/1/03	-	-	-	-	-	-
Lime Saddle Boat Yard 1	11/7/03	-	-	-	-	-	-
	11/14/03	3.16	44.2	2.21	<0.033	<0.006	181
	12/1/03	3.97	24.4	1.25	<0.061	0.08	88.5
Lime Saddle Parking Lot 1	11/7/03	-	-	-	-	-	-
	11/14/03	0.653	14.9	1.17	<0.033	<0.006	79.1
	12/1/03	1.22	62.7	2.26	0.08	0.076	169
Lime Saddle Parking Lot 2	11/7/03	-	-	-	-	-	-
	11/14/03	0.654	14.6	1.31	0.117	<0.006	37.3
	12/1/03	0.414	41.7	1.15	<0.061	0.124	74.6
North Forebay Sailboat Marina	11/7/03	0.101	9.91	2.85	0.24	0.173	417
	11/14/03	0.163	10.2	2.5	0.23	0.036	285

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Station Name	Date	Total Lead (ug/L)	Total Manganese (ug/L)	Total Nickel (ug/L)	Total Selenium (ug/L)	Total Silver (ug/L)	Total Zinc (ug/L)
	12/1/03	0.188	7.86	2.35	<0.061	0.19	258

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Oroville Facilities Relicensing Team

August 23, 2004

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Table 8.6-5a. Storm event sampling 2003 - Dissolved metals

Station Name	Date	Dissolved Aluminum (ug/L)	Dissolved Arsenic (ug/L)	Dissolved Cadmium (ug/L)	Dissolved Chromium (ug/L)	Dissolved Copper (ug/L)	Dissolved Iron (ug/L)
Bidwell Canyon Boat Yard 1	11/7/03	142	0.656	0.237	1.4	5.22	395
	11/14/03	98	0.784	0.31	1.3	3.5	420
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Boat Yard 2	11/7/03	-	-	-	-	-	-
	11/14/02	119	5.59	<0.016	2.42	5.14	127
	12/1/03	-	-	-	-	-	-
Bidwell Canyon Parking Lot	11/7/03	56.1	0.402	<0.016	<0.039	2.04	62
	11/14/03	73	0.666	<0.016	<0.039	2.83	72.4
	12/1/03	-	-	-	-	-	-
Lime Saddle Boat Yard 1	11/7/03	-	-	-	-	-	-
	11/14/03	64.5	4.38	1	0.63	44.1	60.8
	12/1/03	38.8	6.53	0.222	0.96	14.4	23.2
Lime Saddle Parking Lot 1	11/7/03	-	-	-	-	-	-
	11/14/03	55.6	2.3	<0.016	<0.039	12.6	53
	12/1/03	214	1.68	0.149	1.58	13.3	381
Lime Saddle Parking Lot 2	11/7/03	-	-	-	-	-	-
	11/14/03	78.1	0.372	<0.016	0.28	1.77	72.4
	12/1/03	100	0.225	<0.009	0.57	2.01	69.6
North Forebay Sailboat Marina	11/7/03	89	1.438	<0.016	<0.039	4.61	76.9
	11/14/03	136	1.31	<0.016	0.6	3.46	212
	12/1/03	180	1	<0.009	0.94	4.03	235

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Table 8.6-5b. Storm event sampling 2003 - Dissolved metals

Station Name	Date	Dissolved Lead (ug/L)	Dissolved Manganese (ug/L)	Dissolved Nickel (ug/L)	Dissolved Selenium (ug/L)	Dissolved Silver (ug/L)	Dissolved Zinc (ug/L)
Bidwell Canyon	11/7/03	0.606	13.4	2.52	<0.232	<0.012	357
Boat Yard 1	11/14/03	0.57	17	2.64	<0.232	<0.012	253
	12/1/03	-	-	-	-	-	-
Bidwell Canyon	11/7/03	-	-	-	-	-	-
Boat Yard 2	11/14/03	0.246	3.07	0.89	<0.232	<0.012	10.3
	12/1/03	-	-	-	-	-	-
Bidwell Canyon	11/7/03	0.184	25.5	1.27	<0.232	0.124	28
Parking Lot	11/14/03	0.378	30.5	1.65	<0.232	<0.012	29
	12/1/03	-	-	-	-	-	-
Lime Saddle	11/7/03	-	-	-	-	-	-
Boat Yard 1	11/14/03	0.598	36.7	1.6	<0.232	<0.012	177
	12/1/03	0.476	15.3	0.61	<0.119	<0.018	74.9
Lime Saddle	11/7/03	-	-	-	-	-	-
Parking Lot 1	11/14/03	0.414	14	0.96	<0.232	<0.012	78.7
	12/1/03	0.649	14.8	2.02	<0.119	<0.018	141
Lime Saddle	11/7/03	-	-	-	-	-	-
Parking Lot 2	11/14/03	0.264	12.9	0.86	<0.232	<0.012	35.6
	12/1/03	0.218	21.9	1	<0.119	<0.018	63.6
North Forebay	11/7/03	0.024	5.85	2.48	<0.232	0.138	397
Sailboat Marina	11/14/03	0.101	4.77	2.37	<0.119	<0.012	282
	12/1/03	0.115	5.05	2.17		<0.018	254

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Table 8.6-6. Storm event sampling 2003 -Total and methyl mercury

Station Name	Date	Total Mercury (ng/L)	Methyl Mercury ng/L
Bidwell Canyon Boat Yard 1	11/7/03	5.64	NA
	11/14/03	6.66	0.136
	12/1/03	-	-
Bidwell Canyon Boat Yard 2	11/7/03	-	-
	11/14/03	6.81	0.087
	12/1/03	-	-
Bidwell Canyon Parking Lot	11/7/03	13.2	0.22
	11/14/03	11.8	0.14
	12/1/03	-	-
Lime Saddle Boat Yard 1	11/7/03	-	-
	11/14/03	8.58	0.151
	12/1/03	7.63	0.139
Lime Saddle Parking Lot 1	11/7/03	-	-
	11/14/03	6.3	0.217
	12/1/03	11.2	0.13
Lime Saddle Parking Lot 2	11/7/03	-	-
	11/14/03	7.4	0.187
	12/1/03	5.12	0.167
North Forebay Sailboat Marina	11/7/03	11.2	0.156
	11/14/03	10.2	0.15
	12/1/03	8.83	0.122

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Table 8.6-7. Storm event sampling 2003 - Aromatic hydrocarbons (volatile organic compounds)

Compound	Compound	Compound
<i>Aromatic hydrocarbons (volatile organic compounds)</i>		
Benzene	1,2-Dibromo-3-chloropropane	Methylene chloride
Bromobenzene	1,2-Dichlorobenzene	Methyl tert-butyl ether
Bromochloromethane	1,3-Dichlorobenzene	Naphthalene
Bromoform	1,4-Dichlorobenzene	n-Propylbenzene
Bromomethane	Dichlorodifluoromethane	Styrene
n-Butylbenzene	1,1-Dichloroethane	1,1,1,2-Tetrachloroethane
sec-Butylbenzene	1,2-Dichloroethane	1,1,2,2-Tetrachloroethane
tert-Butylbenzene	1,1-Dichloroethene	Tetrachloroethane
Carbon tetrachloride	cis-1,2-Dichloroethene	Toluene
Chlorobenzene	trans-1,2-Dichloroethene	1,2,3-Trichlorobenzene
Chloroethane	1,2-Dichloropropane	1,2,4-Trichlorobenzene
Chloroform	1,3-Dichloropropane	1,1,1-Trichloroethane
Chloromethane	2,2-Dichloropropane	1,1,2-Trichloroethane
2-Chlorotoluene	1,1-Dichloropropene	Trichlorofluoromethane
4-Chlorotoluene	Ethylbenzene	1,2,4-Trimethylbenzene
Dibromochloromethane	Hexachlorobutadiene	1,3,5-Trimethylbenzene
1,2-Dibromoethane	Isopropylbenzene	Vinyl chloride
Dibromomethane	p-Isopropyltoluene	Xylenes (total)

Table 8.6-8. Storm event sampling 2003 - Aromatic hydrocarbons (volatile organic compounds in water)

Compound	Compound	Compound
1,1,1,2-Tetrachloroethane	4-Isopropyltoluene	m+p Xylene
1,1,1-Trichloroethane	Benzene	Methyl tert-butyl ether
1,1,2,2-Tetrachloroethane	Bromobenzene	Methylene chloride
1,1,2-Trichloroethane	Bromochloromethane	n-Butylbenzene
1,1-Dichloroethane	Bromodichloromethane	n-Propylbenzene
1,1-Dichloroethene	Bromoform	Naphthalene
1,1-Dichloropropene	Bromomethane	o-Xylene
1,2,3-Trichlorobenzene	Carbon tetrachloride	Styrene
1,2,3-Trichloropropane	Chlorobenzene	tert-Butylbenzene
1,2,4-Trimethylbenzene	Chloroethane	Tetrachloroethene
1,2-Dibromo-3-chloropropane	Chloroform	Toluene
1,2-Dibromoethane	Chloromethane	trans-1,2-Dichloroethene
1,2-Dichlorobenzene	cis-1,2-Dichloroethene	trans-1,3-Dichloropropene
1,2-Dichloroethane	cis-1,3-Dichloropropene	Trichloroethene
1,3,5-Trimethylbenzene	Dibromochloromethane	Trichlorofluorene
1,3-Dichlorobenzene	Dibromomethane	Vinyl chloride
1,3-Dichloropropane	Dichlorodifluoromethane	
1,4-Dichlorobenzene	Ethyl benzene	
2,2-Dichloropropane	Hexachlorobutadiene	
4-Chlorotoluene	Isopropylbenzene	

Table 8.6-9. Storm event sampling 2003 - Aromatic hydrocarbons (volatile organic compounds in water)

Compound	Compound	Compound
Acenaphthene	Benzo (ghi) perylene	Naphthalene
Acenaphthylene	Chrysene	Phenanthrene
Anthracene	Dibenz (a,h) anthracene	Pyrene
Benzo (a) anthracene	Fluoranthene	Oil & Grease
Benzo (a) pyrene	Fluorene	
Benzo (b & k) fluoranthene (total)	Indeno (1,2,3-cd) pyrene	

Table 8.6-10a. Storm event sampling 2003 - Pesticides

Compound	Compound	Compound
<i>Chlorinated Organic Pesticides</i>		
Alachlor	Heptachlor epoxide	2,4-D
Aldrin	Methoxychlor	2,4-DB
Atrazine	Metolachlor	Dacthal (DCPA)
BHC-alpha	o,p'-DDE	Dicamba
BHC-beta	Oxyfluorfen	Dichloroprop
BHC-delta	p,p'-DDD	Dinoseb (DNPB)
BHC-gamma (Lindane)	p,p'-DDE	MCPA
Captan	p,p'-DDT	MCCP
Chlordane	PCB-1016	Pentachlorophenol (PCP)
Chlorothalonil	PCB-1221	Picloram
Chlorpropham	PCB-1232	Triclopyr
Chlorpyrifos	PCB-1242	
Cyanizine	PCB-1248	<i>Carbamate Pesticides</i>
Dacthal (DCPA)	PCB-1254	3-Hydroxycarbofuran
Dichloran	PCB-1260	Aldicarb
Dicofol	PCNB	Aldicarb sulfone
Dieldrin	Permethrin	Aldicarb sulfoxide
Diuron	Simazine	Carbaryl
Endosulfan sulfate	Thiobencarb	Carbofuran
Endosulfan-I	Toxaphene	Formetanate hydrochloride
Endosulfan-II		Methiocarb
Endrin	<i>Chlorinated Phenoxy Acid Herbicides</i>	Methomyl
Endrin aldehyde	2,4,5-T	Oxamyl
Heptachlor	2,4,5-TP (Silvex)	Glyphosate

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Table 8.6-10b. Storm event sampling 2003 - Pesticides

Compound	Compound	Compound
<i>Phosphorus/Nitrogen Pesticides</i>		
Azinphos methyl (Guthion)	Ethion	Phorate
Benflurin	Malathion	Phosalone
Bromacil	Methidathion	Phosmet
Carbophenothion (Trithion)	Mevinphos	Profenofos
Chlorpyrifos	Molinate	Prometryn
Cyanazine	Naled	Propetamphos
Demeton (O +S)	Napropamide	s,s,s-Tributyl Phosphorotrithioate
Diazinon	Norflurazon	Thiobencarb
Dimethoate	Parathion (Ethyl)	Trifluralin
Disulfoton	Parathion (Methyl)	
Esfenvalerate	Pendimethalin	