Annual Water Quality Report

ISABELLA LAKE

Water Year 2001

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TABLE OF CONTENTS

I DISCUSSION

Isabella Lake

2001 Results

The dissolved oxygen, water temperature, and pH profiles are shown on the attached figures in Section II. In the summer of 2000, dissolved oxygen depletion occurred only in the hypolimnion or bottom layer of the lake but only at depths greater than 60 feet. The summer lake depth of 80 feet produced no thermal stratification and the bottom waters warmed up to 71 degrees F. The combination of warm temperatures and low dissolved oxygen occurring at the bottom of Isabella Lake make its use as a cold water fishery questionable. However, since the dissolved oxygen is relatively high on the surface, the lake may serve well as a warm water fishery.

The DO, temperature and pH profile changed very little from 2000 and 2001. The surface water pH was 7.0 in 1999; 7.5 in 2000; and 7.2 in 2001 during the summer. The summer phytophankton biomass has decreased significantly from 4.9 mg/L in 1999 to 0.48 mg/L in 2000 and rose slightly to 0.8 mg/L in 2001. This amount of phytophankton biomass is not considered a problem and there should be sufficient biomass that can provide a food source for a warm water fishery. It should be noted that levels of phytophankton will vary from year to year and will be monitored continuously to determine if eutrophication is occurring. It is interesting that this lake has low phytoplankton biomass in the spring followed by a higher phytoplankton biomass in the summer.

Eutrophication is the slow natural process in which a Lake moves from an oligotrophic condition to a mesotrophic condition then to a eutrophic condition. Oligotrophic waters contains low concentrations of essential nutrients such as nitrogen, phosphorus and iron and therefore life forms are generally present in small numbers. Lake Tahoe and Crater Lake in Oregon are examples of oligotrophic waters. Natural input of nutrients from runoff results in a gradual increase of phytophankton and higher life forms. This results in the transformation of oligotrophic waters into Mesotrophic waters which are characterized by the abundance of life forms at all levels. However, continued inflow of nutrients can further change the Mestrophic waters into Eutrophic waters which are characterized by high algue growth, high turbidity, and fewer species due to lower dissolved oxygen levels. The algue blooms and scarce fish makes Eutrophic waters less desirable. This process may occur over a long period of time but human activities almost always accelerate this process. One of the major goal of the water quality program is to reduce or mitigate the human effects on the eutrophication process. This requires a monitoring program to determine the levels of nutrient input and phytoplanton levels. The individual species within each individual phytoplankton group are shown in Section IV.

The nutrient, alkalinity and chemical oxygen demand (COD) data shown in Section V indicates that excessive nutrients are not present that would cause undesirable phytoplankton blooms, that the lake water is well buffered and there is not an excess of oxygen-demanding substances in the inflows.

The dissolved heavy metals did not exceed the drinking water standard or the freshwater fishery criteria during either the Spring or Summer except for dissolved manganese, dissolved selenium and dissolved mercury. Dissolved mercury and dissolved selenium levels were also higher than the criteria for inland freshwater aquatic life. The graphs are shown in Section V for the surface and bottom waters of the Lakes and it's inflows and outflows.

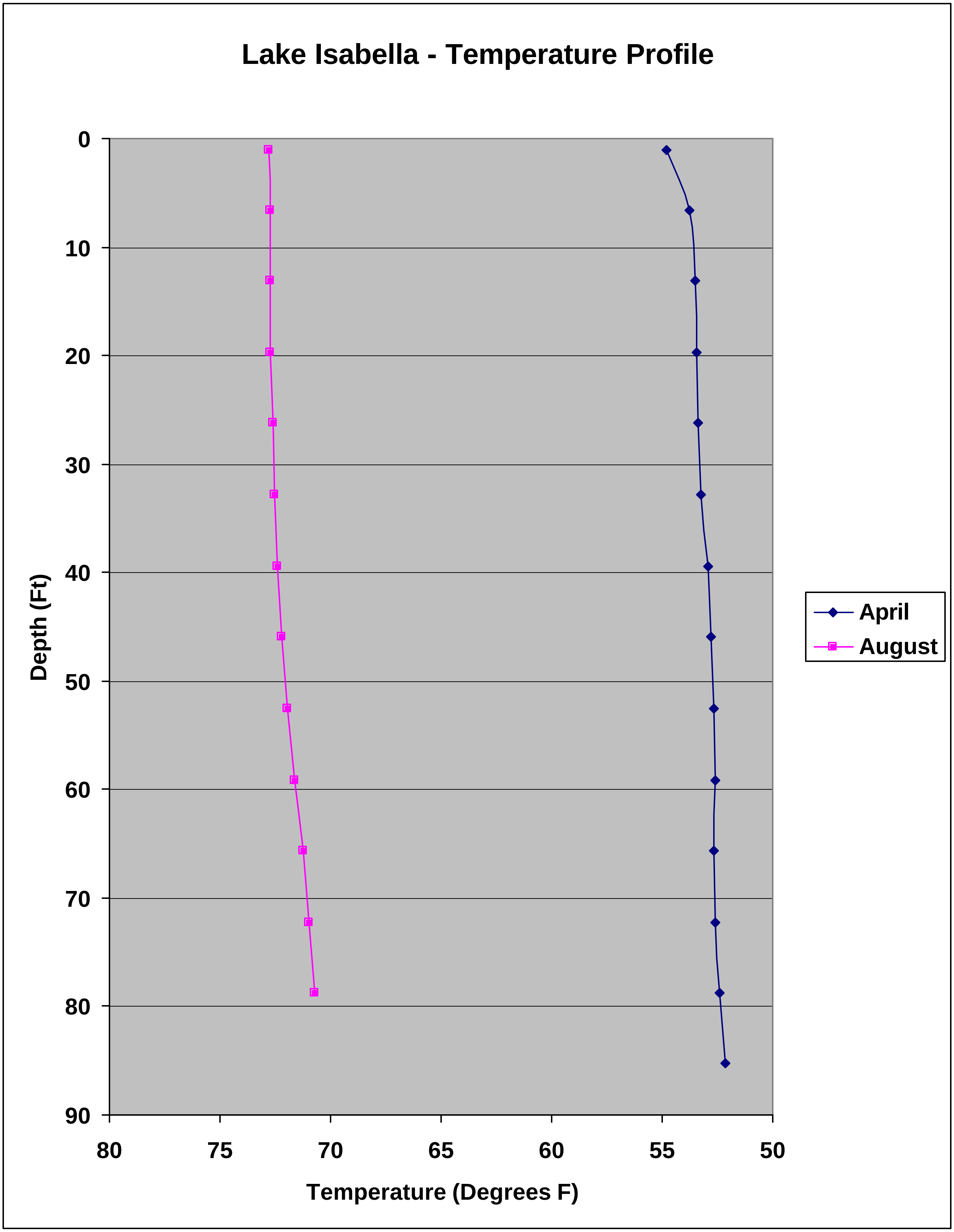
The dissolved mercury levels of 0.0005 ppb found on the lake surface and 0.026 ppb at the bottom of the lake are the main concerns since methyl mercury can bioaccummulate in fish tissue. Based on mercury levels found in 1999, a fish tissue program was initiated for the first time in 2000. The results from three composited crappie that were collected on Nov 8 and Nov 16, 2000 resulted in a mercury level below the laboratory detection limit of 0.02 ppm. For 2001, there was an unsuccessful attempt to collect fish so another attempt to collect fish is scheduled for 2002.. The 2001 results are provided in Section VI.

It should be emphasized that 2000 was the first year that fish tissue was analyzed for mercury. The 2000 results were based on only 3 crappie and therefore the results should not be considered conclusive. However, the 2000 fish tissue data is sufficient to justify expanding the fish tissue program in 2002 and determine if methly mercury in fish tissue tissue is a real concern to sensitive humans such as pregnant woman, small children and any groups of people who consumes a higher percentage of fish compared to the general population. At the end of Section VI are the EPA fact sheets on mercury in fish tissue. If the results are confirmed to be high and sufficient data is available, a human risk assessment will be conducted to determine if a fish advisory is necessary at Lake Hensley to protect sensitive humans. This potential fish advisory is not mandatory by the FDA but may be advisable based on the risk assessment study. The study will be conducted in 2003 which sufficient data becomes available.

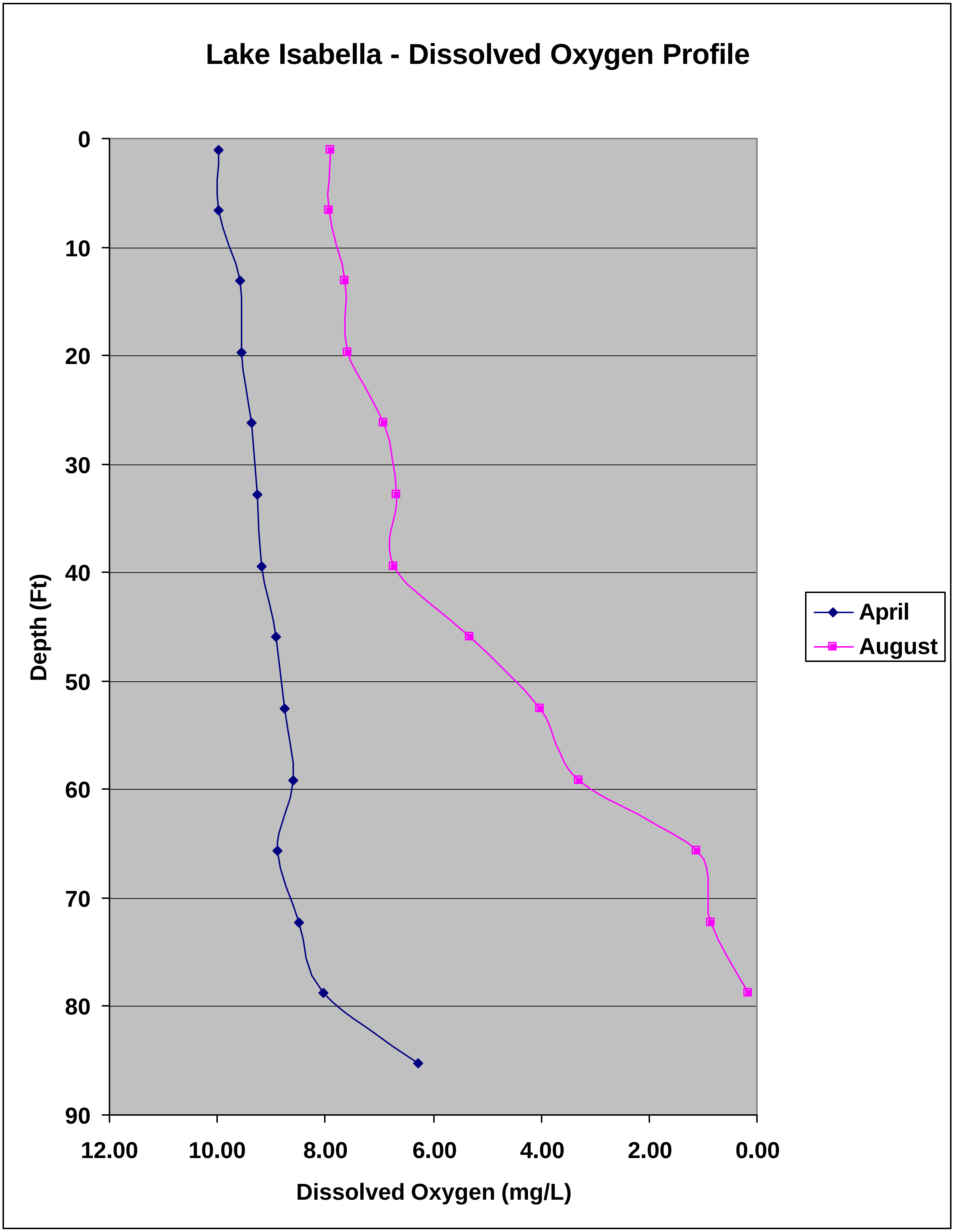
The MTBE results near the marinia were 21 ppb for the spring of 2000 and 18 ppb for the spring 2001. This is unusually high when compared to the other lakes. As a result, the number of MTBE water samples will be increased for Lake Isabella in 2002. At the end of Section VII is the EPA fact sheet on MTBE in drinking water. Unlike mercury, which has a known toxic effect on humans, there is little data connecting MTBE to human toxicity. However, since MTBE is considered controversial, it is recommended that MTBE data be continued to be collected.

In summary, dissolved selenium, dissolved manganese, dissolved mercury and MTBE are the only element of concerns at Lake Isabella. Some of this data did not follow any expected trends and therefore additional sampling should be taken for confirmation. The other elements do not indicate any significant problem but will continue to be monitored in the future.

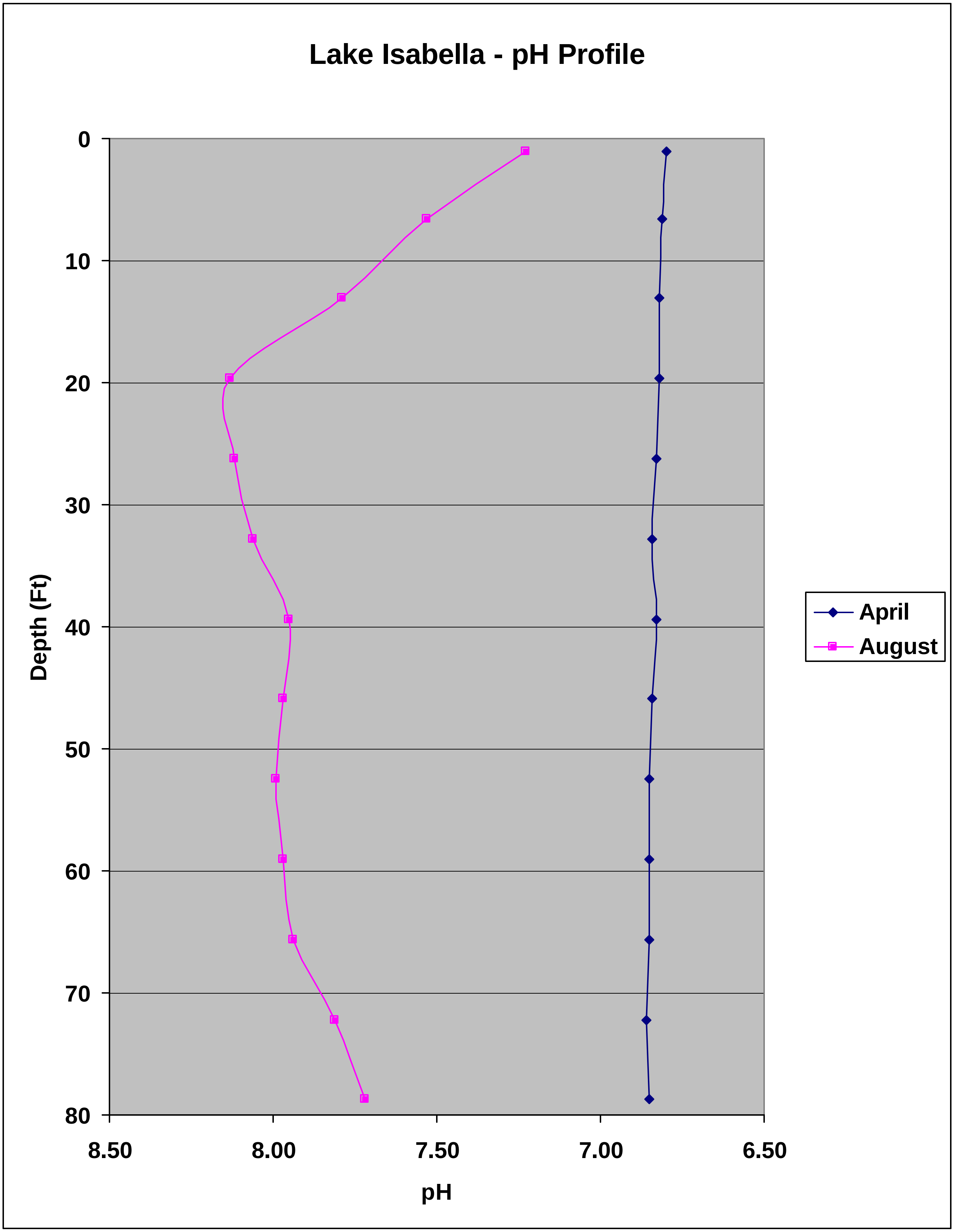
II Temperature/pH/DO profile



Lake Isabella - Temperature Profile
Depth (Ft)
0
10
20
30
40
50
60
70
80
90
80
75
70
65
60
55
50
Temperature (Degrees F)
April
August



Lake Isabella - Dissolved Oxygen Profile
Depth (Ft)
0
10
20
30
40
50
60
70
80
90
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Dissolved Oxygen (mg/L)
April
August

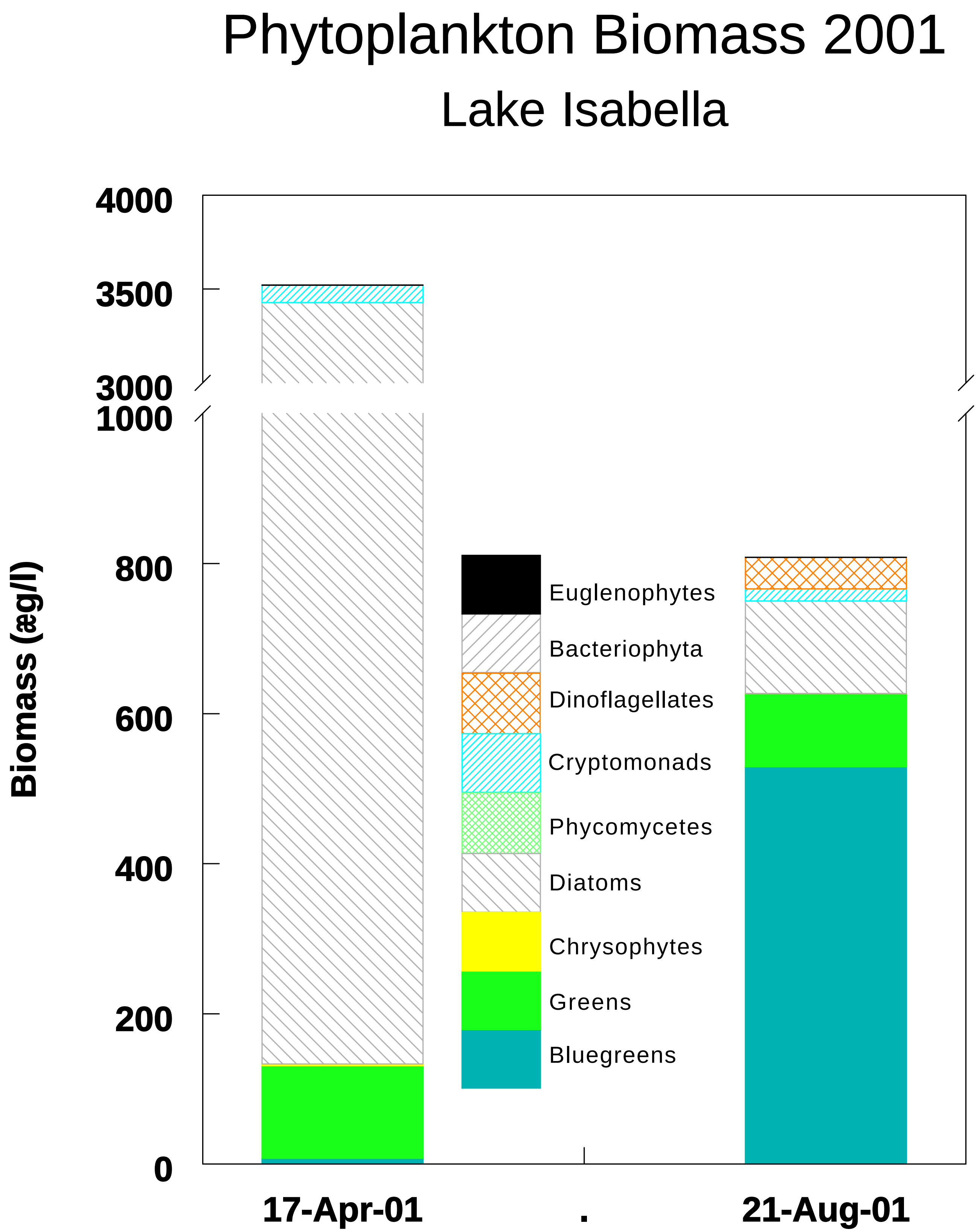


Lake Isabella - pH Profile
0
10
20
30
40
50
60
70
80
Depth (Ft)
8.50
8.00
7.50
7.00
6.50
pH
April
August

LAKE ISABELLA					
Sample Location: Behind dam				**Date:** 4/17/01	
Observers: Tim McLaughlin				**Time:** 10:00 am	
Lake Elevation: 2556.97					
Weather Conditions:					
Wind Speed: 0		**Precipitation:0**		**Temp (F):** 65	
SECCHI Depth: 4 feet and 1 inch					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
26.1	85.3	11.20	124	6.29	-
24	78.7	11.32	124	8.03	6.85
22	72.2	11.45	125	8.49	6.86
20	65.6	11.47	125	8.90	6.85
18	59.1	11.46	124	8.59	6.85
16	52.5	11.49	125	8.76	6.85
14	45.9	11.56	124	8.91	6.84
12	39.4	11.64	125	9.18	6.83
10	32.8	11.81	126	9.26	6.84
8	26.2	11.86	125	9.36	6.83
6	19.7	11.90	125	9.56	6.82
4	13.1	11.96	125	9.59	6.82
2	6.6	12.08	125	9.99	6.81
0.03	1	12.67	125	9.98	6.80
SOUTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
56.1	7.03		-	-	-
NORTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
53.8	7.14		-	-	706
VISUAL OBSERVATIONS:					

LAKE ISABELLA					
Sample Location: Behind dam				**Date:** 8/21/01	
Observers: Tim McLaughlin				**Time:** 9:00 am	
Lake Elevation: 2554.42					
Weather Conditions:					
Wind Speed: 15		**Precipitation:** 0		**Temp (F):** 70	
SECCHI Depth: 5 feet and 11 inches					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
23.6	78.7	21.51	133	0.16	7.72
22	72.2	21.64	139	0.85	7.81
20	65.6	21.80	126	1.12	7.94
18	59.1	22.01	133	3.29	7.97
16	52.5	22.20	133	4.01	7.99
14	45.9	22.33	137	5.32	7.97
12	39.4	22.46	133	6.72	7.95
10	32.8	22.53	132	6.69	8.06
8	26.2	22.57	133	6.92	8.12
6	19.7	22.61	133	7.58	8.13
4	13.1	22.62	132	7.63	7.79
2	6.6	22.63	133	7.92	7.53
0.03	1	22.65	133	7.89	7.23
SOUTH FORK KERN (Inflow) - DRY					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
-	-		-	-	-
NORTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs)**
72.6	8.11		-	-	124
VISUAL OBSERVATIONS: Lots of floating algae in water.					

III Phytoplankton


Phytoplankton Biomass 2001
Lake Isabella
Biomass (æg/l)
4000
3500
3000
1000
800
600
400
200
0
Euglenophytes
Bacteriophyta
Dinoflagellates
Cryptomonads
Phycomycetes
Diatoms
Chrysophytes
Greens
Bluegreens
17-Apr-01
.
21-Aug-01

Phytoplankton Normalized Sample Summary
Army Corps of Engineers - Standard samples

Sample location: **Isabella Lake**
Sample description:
Sampled on **04/17/01** **by AC**
Sample type: **Composite** **Cm settled: 1.00**

Species	Species name	Group	Units/L	BioVol (mg/L)
CRUCTE	Crucigenia tetrapedia	Chlorophytes	4000	0.720
ELAKGE	Elaktothrix gelatinosa	Chlorophytes	4000	0.496
KOLISL	Koliella spiculiformis	Chlorophytes	23000	1.833
LAGERG	Lagerheimia genevensis	Chlorophytes	559105	68.770
MONOC	Monoraphidium contortum	Chlorophytes	287540	19.265
PEDIBI	Pediastrum biradiatum	Chlorophytes	2000	1.256
PEDIDU	Pediastrum duplex	Chlorophytes	2000	4.242
PSELAC	Pseudosphaerocystis lacustris	Chlorophytes	36000	1.782
SCENAC	Scenedesmus acuminatus	Chlorophytes	1000	0.369
SCENCO	Scenedesmus communis	Chlorophytes	2000	4.718
SCENDE	Scenedesmus denticulatus	Chlorophytes	1000	0.060
SCENOA	Scenedesmus opoliensis v. aculeatus	Chlorophytes	31949	2.220
SCENOP	Scenedesmus opoliensis v. asymmetricus	Chlorophytes	6000	2.574
SCENSI	Scenedesmus semipulcher	Chlorophytes	15974	1.693
SPHAER	Sphaerocystis schroeteri	Chlorophytes	54000	3.062
TETRAC	Tetraedron caudatum	Chlorophytes	1000	0.219
TETRPE	Tetrastrum peterfii	Chlorophytes	191693	7.476
TREUSE	Treubaria setigera	Chlorophytes	15974	2.652
		Chlorophytes Totals:	1238235	123.407

Species	Species name	Group	Units/L	BioVol (mg/L)
CHYPAR	Chrysochromulina parva	Chrysophytes	31949	1.246
FLAGSM	Flagellates (<5µm)	Chrysophytes	63898	0.958
		Chrysophytes Totals:	95847	2.204

Species	Species name	Group	Units/L	BioVol (mg/L)
KATAOV	Kathablepharis ovalis	Cryptomonads	15974	2.764
RHODOM	Rhodomonas lacustris	Cryptomonads	814696	90.431
		Cryptomonads Totals:	830670	93.195

Species	Species name	Group	Units/L	BioVol (mg/L)
ANABSP	Anabaena spiroides	Cyanophytes	93000	4.120
MICROE	Microcystis elachista	Cyanophytes	479233	3.594
		Cyanophytes Totals:	572233	7.714

Species	Species name	Group	Units/L	BioVol (mg/L)
ASTERF	Asterionella formosa	Diatoms	4000	3.798
CYCGLO	Cyclotella glomerata	Diatoms	63898	19.891
CYMBVE	Cymbella ventricosa	Diatoms	2000	11.561
MELOAM	Aulacosira ambigua	Diatoms	17000	15.422
MELODI	Aulacosira distans	Diatoms	610000	282.430

Phytoplankton Normalized Sample Summary
Army Corps of Engineers - Standard samples

MELOGA	Aulacosira granulata v. angustissima	Diatoms	11000	11.198
MELOGR	Aulacosira granulata var.angustissima f.	Diatoms	4000	2.054
NAVIPU	Navicula pupula	Diatoms	1000	0.905
NITZAC	Nitzschia acicularis	Diatoms	1000	1.508
STEPHD	Stephanodiscus dubius	Diatoms	127000	2946.095
		Diatoms Totals:	840898	3294.862

Species	Species name	Group	Units/L	BioVol (mg/L)
STELEX	Stelexomonas dichotoma	Phycomycetes	3000	0.145
		Phycomycetes Totals:	3000	0.145

Sample total: 3521.527

Phytoplankton Normalized Sample Summary
Army Corps of Engineers - Standard samples

Sample location: **Isabella Lake**
Sample description:
Sampled on **08/21/01** **by AC**
Sample type: **Composite** **Cm settled: 0.50**

Species	Species name	Group	Units/L	BioVol (µg/L)
COELAS	Coelastrum sp.	Chlorophytes	7500	57.859
DICTYP	Dictyosphaerium pulchellum	Chlorophytes	16000	1.808
KOLILO	Koliella longiseta	Chlorophytes	2000	0.336
MONOC	Monoraphidium contortum	Chlorophytes	63898	4.281
MONOM	Monoraphidium minutum	Chlorophytes	31949	3.227
PEDIDG	Pediastrum duplex v. gracillimum	Chlorophytes	4000	2.512
PEDIDU	Pediastrum duplex	Chlorophytes	4000	0.316
SCENBI	Scenedesmus bicaudatus	Chlorophytes	63898	5.687
SCENCO	Scenedesmus communis	Chlorophytes	4000	9.436
SCENQU	Scenedesmus quadricauda	Chlorophytes	10000	9.660
SPHAER	Sphaerocystis schroeteri	Chlorophytes	48000	2.722
		Chlorophytes Totals:	255245	97.844

Species	Species name	Group	Units/L	BioVol (µg/L)
CRYPT	Cryptomonas sp.	Cryptomonads	14000	15.184
RHODMN	Rhodomonas minuta	Cryptomonads	15974	0.639
		Cryptomonads Totals:	29974	15.823

Species	Species name	Group	Units/L	BioVol (µg/L)
APHANI	Apanizomenon flos-aque	Cyanophytes	2508000	529.188
		Cyanophytes Totals:	2508000	529.188

Species	Species name	Group	Units/L	BioVol (µg/L)
ACHNMI	Achnanthes microcephala	Diatoms	15974	6.358
CYCGLO	Cyclotella glomerata	Diatoms	15974	4.973
CYCKUT	Cyclotella Kutzingiana	Diatoms	47923	32.540
CYCSTE	Cyclotella stelligera	Diatoms	143770	13.227
MELODI	Aulacosira distans	Diatoms	8000	3.704
MELOG	Aulacosira granulata	Diatoms	32000	60.714
NAVIPU	Navicula pupula	Diatoms	2000	1.810
		Diatoms Totals:	265641	123.326

Species	Species name	Group	Units/L	BioVol (µg/L)
PERIIN	Peridinium inconspicuum	Pyrrhophytes	2000	5.831
PERIPO	Peridinium polonicum	Pyrrhophytes	2000	36.481
		Pyrrhophytes Totals:	4000	42.312

Sample total: 808.493

IV Nutrient and Miscellaneous Parameters

2001 Lake Monitoring Results for Organics

Pesticides and Herbicides were discontinued in 2001 since the results from 1995 to 2000 were consistently “non-detect” and the program’s current effort is to focus on MTBE and mercury levels in fish tissue.

The following tables on the next page are the 2001 Lake Monitoring Results for general Organics related to nutrients (which may cause algue blooms) and miscellanous water quality parameters which may have an adverse impact on aquatic life such as Chemical Oxygen Demand and ammonia (which may cause a fish kill).

The results in the following tables indicate no potential for signficant adverse impact.

Notes:
Alkalinity is reported as “Total Alkalinity as CaCO3”
Ammonia is reported as “Ammonia as N”
Nitrate is reported as “Nitrate + Nitrate as N”
Total P is reported as “Phosphate as P. total”
Ortho P is reported as “Phosphate as P. Ortho”
Kjedahl N is reported as “Total Kjedahl Nitrogen”
COD is “Chemical Oxygen Demand”
Tot Solids is reported as “Solids, Tot”

Lake codes are as follows:

BB	Black Butte
EA	Eastmand
EN	Englebright
HE	Hensley
IS	Isabella
KA	Kaweah
MC	Martis Creek
ME	Mendocino
NH	New Hogan
PF	Pine Flat
SO	Sonoma
SU	Success

Inorganic Results (mg/L) For surface lake waters (spring)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	120	50	40	30	60	40	60	80	70	10	70	120
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Chloride	12	20	5	18	5	<1	3	2	7	1	3	6
Nitrate	<0.1		<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1			<0.1	<0.1	<0.1	<0.1		<0.1	<0.1		<0.1
Sulfate	15	2	3.6	4	7.8	1.8	1	7	8.5	2	6	4.8
Kjeldahl N	0.3	<0.1	<0.1	0.3	0.3	0.2	.4	0.3	0.3	0.2	0.3	0.3
COD		<50		<50	<50	<50	<50			<50		<50
Tot Solids	180	100	70	100	100	70	100	40	110	30	99	170

Inorganic Results (mg/L) For inlet waters to the lakes (spring) (I-1 only)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	110	50	40	30	40	20	40	80	90	10	100	50
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Chloride	10	15	5	19	2	<1	<1	2	9	1	4	1
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total P		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	13	0.9	2.1	2	4.8	0.8	<1	8	12	2	10	3.3
Kjeldahl N	0.1	0.2	<0.1	0.2	0.8	0.3	0.4	0.2	0.2	0.1	0.2	0.4
COD		<50	<50	<50	<50	<50		<50	<50	<50	<50	<50
Tot Solids	160	120	60	100	80	50	70	110	130	90	140	110

Inorganic Results (mg/L) For surface lake waters (summer)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	130	60	40	50	50	40	80	90	80	20	<10	120
Ammonia	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1		0.1
Chloride	20	14	<1	11	2	5	6	6	4	<1	7	8
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	1.4		<0.1	0.1		0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	13	1.7	2.6	1.8	4	1.5	<0.5		9.4	1	6.4	2.9
Kjeldahl N	0.2	0.7	<0.1	0.5	0.3	0.2	1.7		0.2	0.2		0.5
COD	<50	<50	<50	<50	<50		<50	<50	<50	<50	<50	
Tot Solids	190	120	59	100	90	70	120	120	110	30	99	170

Inorganic Results (mg/L) For inlet waters to the lakes (summer) (I-1 only)

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	150	100	40		60	50		90	100	20		
Ammonia												
Chloride	15	360	<1		4	5	3	7	6	1		
Nitrate												
Total P												
Ortho P												
Sulfate	9.8	3.5	2.3		5.9	1.9		3.2		2.2		
Kjeldahl N												
COD												
Tot Solids	190	1000	60		100	90	110	120	150	40		

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080764-3								
SAMPLE ID: IS-SU-B								
SAMPLED: 21 AUG 01 09:30								
Arsenic, dissolved	0.016	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	12.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	0.08	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	1.8	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.32	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Mercury, Trace Level	0.026	0.0005	ug/L	1	1631	08.31.01	A010843MER	3
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	10.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
LAB NUMBER: B080764-4								
SAMPLE ID: SU-SU-B								
SAMPLED: 22 AUG 01 13:40								
Arsenic, dissolved	0.006	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	31.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	0.49	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	5.4	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.26	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Mercury, Trace Level	0.026	0.0005	ug/L	1	1631	08.31.01	A010843MER	3
Potassium, dissolved	3.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	0.01	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	14.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
LAB NUMBER: B080764-5								
SAMPLE ID: IS-SU-I-1								
SAMPLED: 21 AUG 01 12:45								
Arsenic, dissolved	0.006	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)
3) Sample Preparation on 08-30-01 using 1631

Caltest

ANALYTICAL LABORATORY

ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

LAB NUMBER: B080764-5 (continued)

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	13.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	2.0	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.006	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	14.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	
ALKALINITY				1	310.1	08.27.01	I010039ALK	
Bicarbonate as CaCO3	60.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	60.	10.	mg/L					
Chloride	4.	1.	mg/L	1	300.0	09.14.01	I010129IC	
Solids, Dissolved	70.	20.	mg/L	2	160.1	08.28.01	I010060TDS	
Solids, Total	100.	10.	mg/L	1	160.3	08.25.01	I010018TS	
Sulfate	5.9	0.5	mg/L	1	300.0	09.14.01	I010129IC	

LAB NUMBER: B080764-6
SAMPLE ID: SU-SU-I-2
SAMPLED: 22 AUG 01 11:45

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	0.005	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	41.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	9.7	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.009	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Potassium, dissolved	5.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	29.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)

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INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080764-13 (continued) 15-SW-S								
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	08.28.01	B010242COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	
ALKALINITY				1	310.1	08.27.01	I010039ALK	
Bicarbonate as CaCO3	50.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	50.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	09.05.01	I010094AMM	
Chloride	2.	1.	mg/L	1	300.0	09.14.01	I010129IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	01.13.01	I010034NNO	
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	08.31.01	I010098PHO	
Solids, Dissolved	ND	20.	mg/L	2	160.1	08.28.01	I010060TDS	
Solids, Total	90.	10.	mg/L	1	160.3	08.25.01	I010018TS	
Sulfate	4.0	0.5	mg/L	1	300.0	09.14.01	I010129IC	
Total Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	08.31.01	I010068TKN	
Total Organic Carbon	3.	1.	mg/L	1	415.1	09.05.01	I010042TOC	

LAB NUMBER: B080764-14
SAMPLE ID: KA-SU-B
SAMPLED: 23 AUG 01 09:30

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	12.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	1.6	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	ND	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Mercury, Trace Level	0.019	0.0005	ug/L	1	1631	08.31.01	A010843MER	3
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	4.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1

LAB NUMBER: B080764-15
SAMPLE ID: LAKE ISABELLA AUGUST
SAMPLED: 21 AUG 01 09:45

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Mercury, Low Level	ND	0.05	ug/L	1	245.2	08.28.01	A010820MER	4

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)
3) Sample Preparation on 08-30-01 using 1631
4) Sample Preparation on 08-27-01 using 245.2

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LAB ORDER No.: B040504

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040504-15								
SAMPLE ID: IS-SP-S								
SAMPLED: 17 APR 01 10:00								
Arsenic, dissolved	J0.003	0.004	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.26.01	A010396ICP	1
Calcium, dissolved	14.	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.26.01	A010396ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.26.01	A010396ICP	1
Magnesium, dissolved	2.2	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Manganese, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Mercury, Trace Level	1.0	0.5	ng/L	1	1631	05.02.01	A010423MER	3
Potassium, dissolved	2.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Selenium, dissolved	J0.0008	0.01	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Sodium, dissolved	13.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	5.	3.	mg/L	1	160.2	04.23.01	B010116TSS	
ALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	60.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	60.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	5.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	0.1	0.1	mg/L	1	353.2	05.11.01	I010022NNO	
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.21.01	I010038PHO	4
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.20.01	I010036PHO	
Solids, Dissolved	80.	20.	mg/L	2	160.1	04.23.01	I010029TDS	
Solids, total	100.	10.	mg/L	1	160.3	05.02.01	I010007TS	
Sulfate	7.8	1.	mg/L	2	300.0	05.16.01	I010063IC	
Total Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	04.24.01	I010034TKN	
Total Organic Carbon	2.	1.	mg/L	1	415.1	05.06.01	I010026TOC	
LAB NUMBER: B040504-16								
SAMPLE ID: IS-SP-B								
SAMPLED: 17 APR 01 10:30								
Mercury, Trace Level	17.	0.5	ng/L	1	1631	05.02.01	A010423MER	3

1) Sample Preparation on 04-26-01 using 200.2 (Filtrate)
2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).
3) Sample Preparation on 05-01-01 using 1631
) Sample filtered prior to analysis.

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INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	40.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	40.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	2.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	05.11.01	I010022NNO	
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.21.01	I010038PHO	1
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.27.01	I010041PHO	
Solids, Dissolved	40.	20.	mg/L	2	160.1	04.23.01	I010029TDS	
Solids, total	80.	10.	mg/L	1	160.3	05.02.01	I010007TS	
Sulfate	4.8	1.	mg/L	2	300.0	05.16.01	I010063IC	
Total Kjeldahl Nitrogen	0.8	0.1	mg/L	1	351.3	04.24.01	I010034TKN	
Total Organic Carbon	2.	1.	mg/L	1	415.1	05.06.01	I010026TOC	

LAB NUMBER: B040504-12
SAMPLE ID: IS-SP-I-2
SAMPLED: 17 APR 01 12:20

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.26.01	A010396ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.26.01	A010396ICP	2
Calcium, dissolved	16.	0.5	mg/L	1	200.7	04.26.01	A010396ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Iron, dissolved	0.33	0.05	mg/L	1	200.7	04.26.01	A010396ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.26.01	A010396ICP	2
Magnesium, dissolved	3.3	0.5	mg/L	1	200.7	04.26.01	A010396ICP	2
Manganese, dissolved	0.060	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Potassium, dissolved	3.	1.	mg/L	1	200.7	04.26.01	A010396ICP	2
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.26.01	A010396ICP	2,3
Sodium, dissolved	18.	1.	mg/L	1	200.7	04.26.01	A010396ICP	2
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.23.01	B010116TSS	
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	70.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	70.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	12.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	05.11.01	I010022NNO	

1) Sample filtered prior to analysis.
2) Sample Preparation on 04-26-01 using 200.2 (Filtrate)
3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

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ANALYTICAL LABORATORY

ENVIRONMENTAL ANALYSES

LAB ORDER No.: B040451

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040451-1 SAMPLE ID: IS-SP-S SAMPLED: 17 APR 01 10:00								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.19.01	I010035PHO	1
LAB NUMBER: B040451-5 SAMPLE ID: IS-SP-I-2 SAMPLED: 17 APR 01 12:20								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.19.01	I010035PHO	1
LAB NUMBER: B040451-6 SAMPLE ID: IS-SP-I-1 SAMPLED: 17 APR 01 13:35								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.19.01	I010035PHO	1

1) Sample filtered prior to analysis.

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INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080693-4 SAMPLE ID: IS-SU-S SAMPLED: 21 AUG 01 09:30								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	08.22.01	I010093PHO	1

1) Sample filtered prior to analysis.

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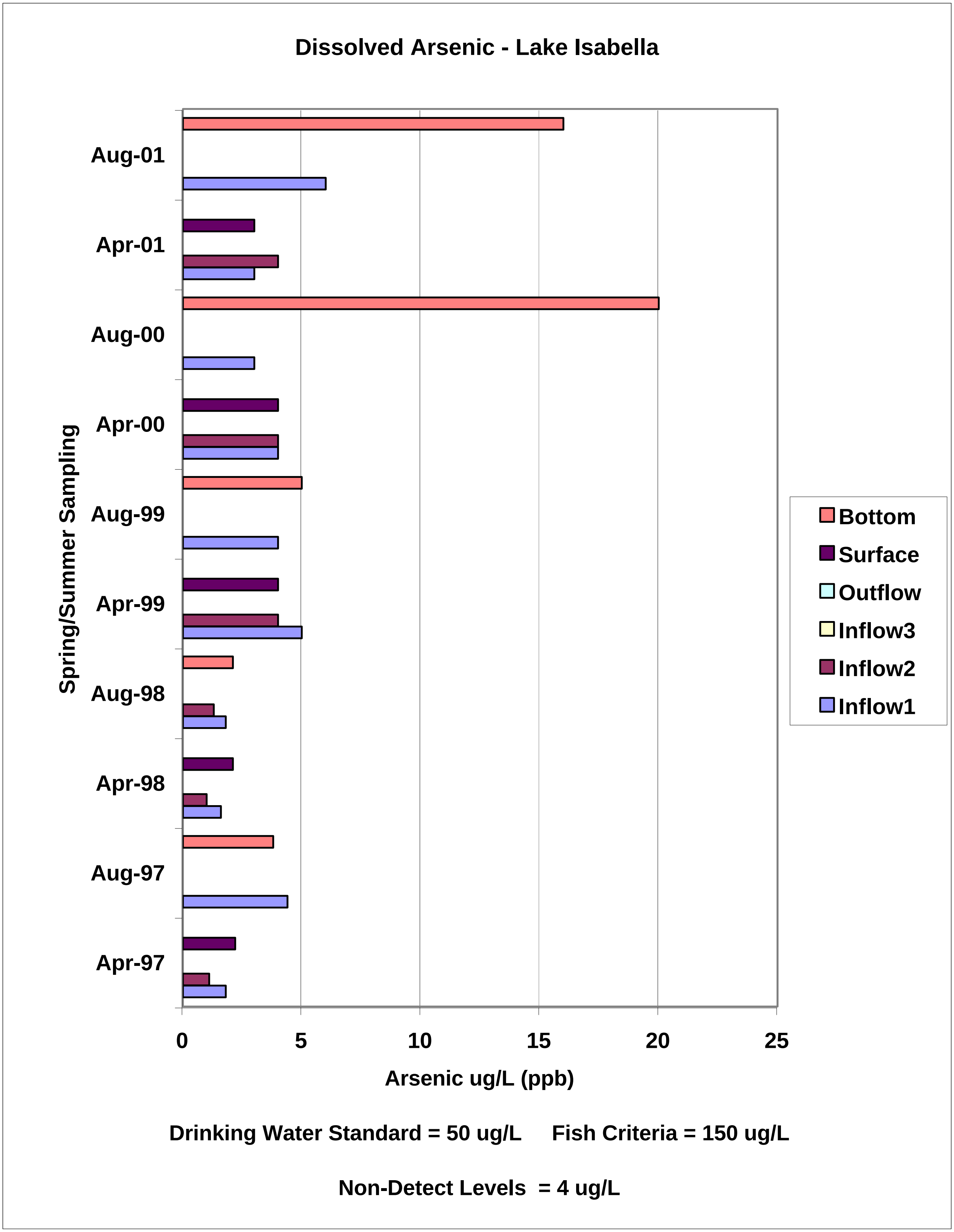
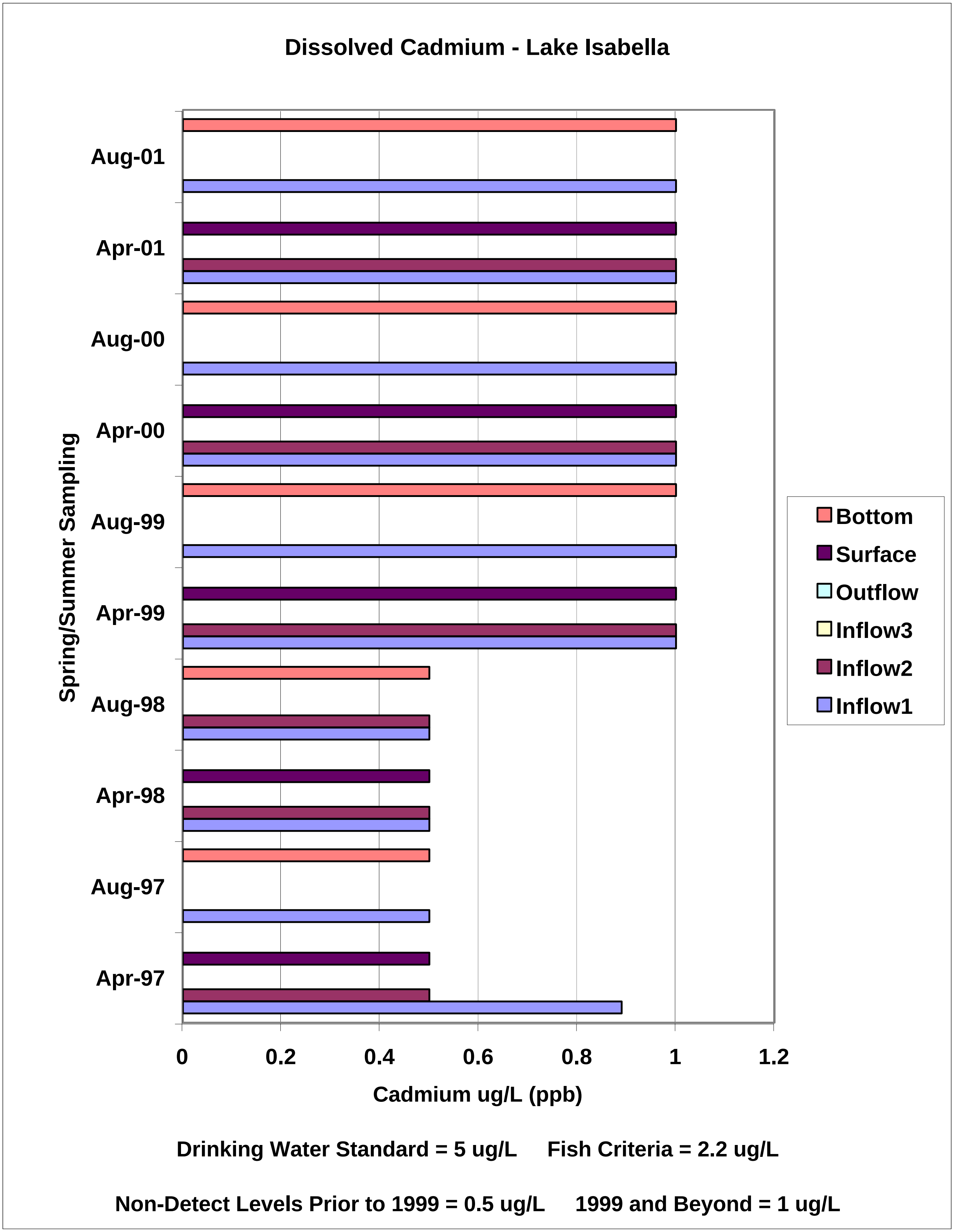
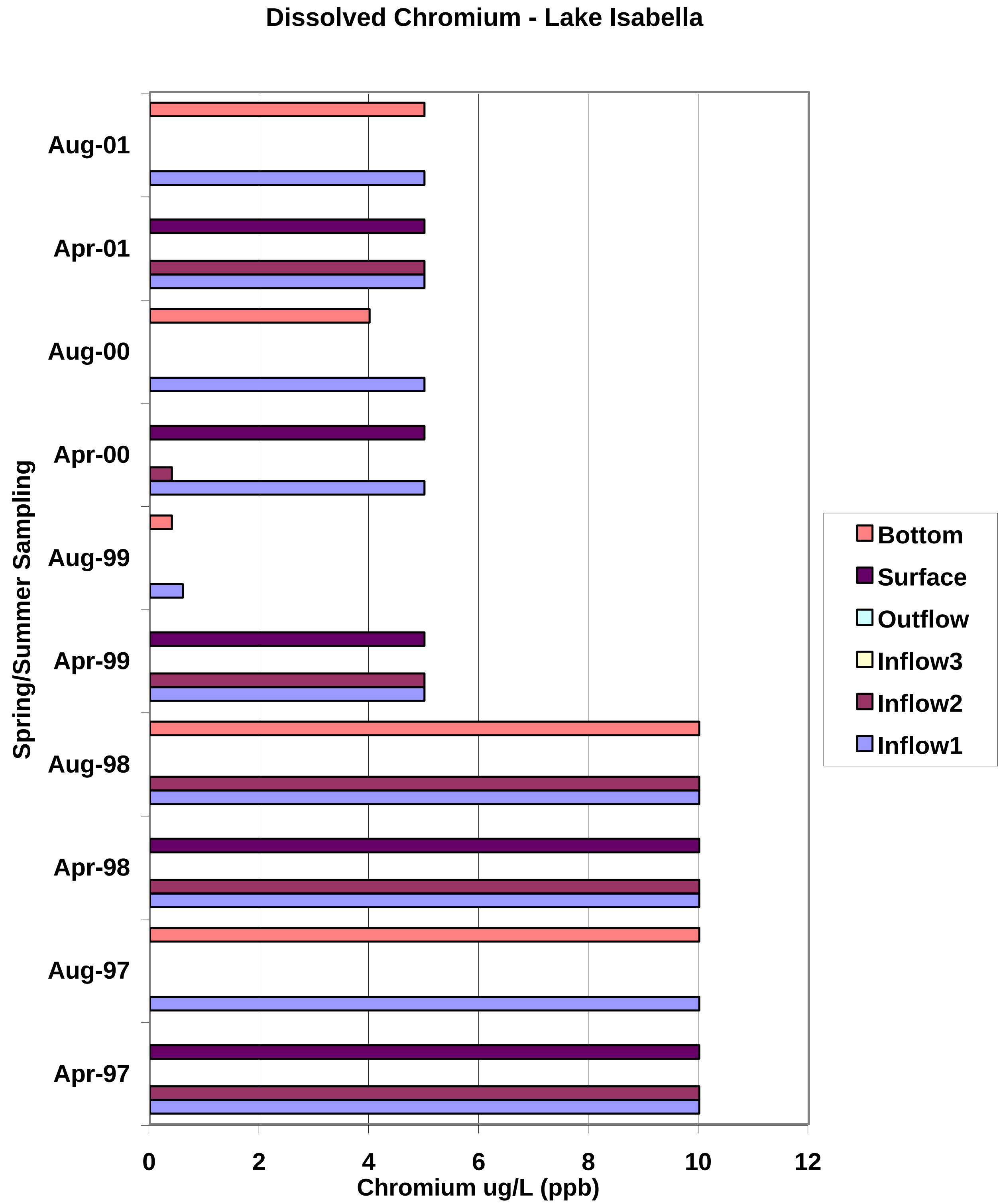
V Metals

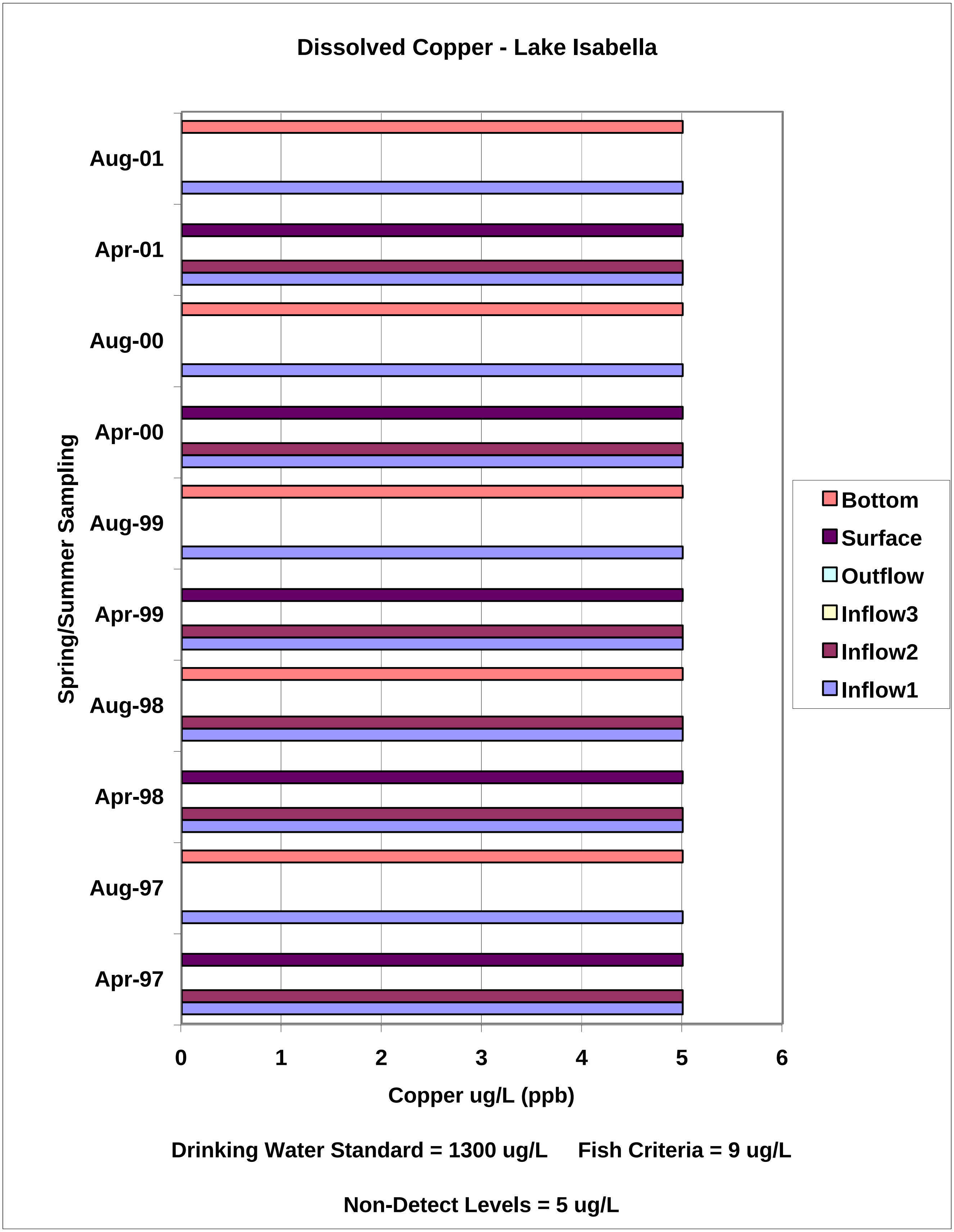

Dissolved Arsenic - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
5
10
15
20
25
Arsenic ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 50 ug/L
Fish Criteria = 150 ug/L
Non-Detect Levels = 4 ug/L

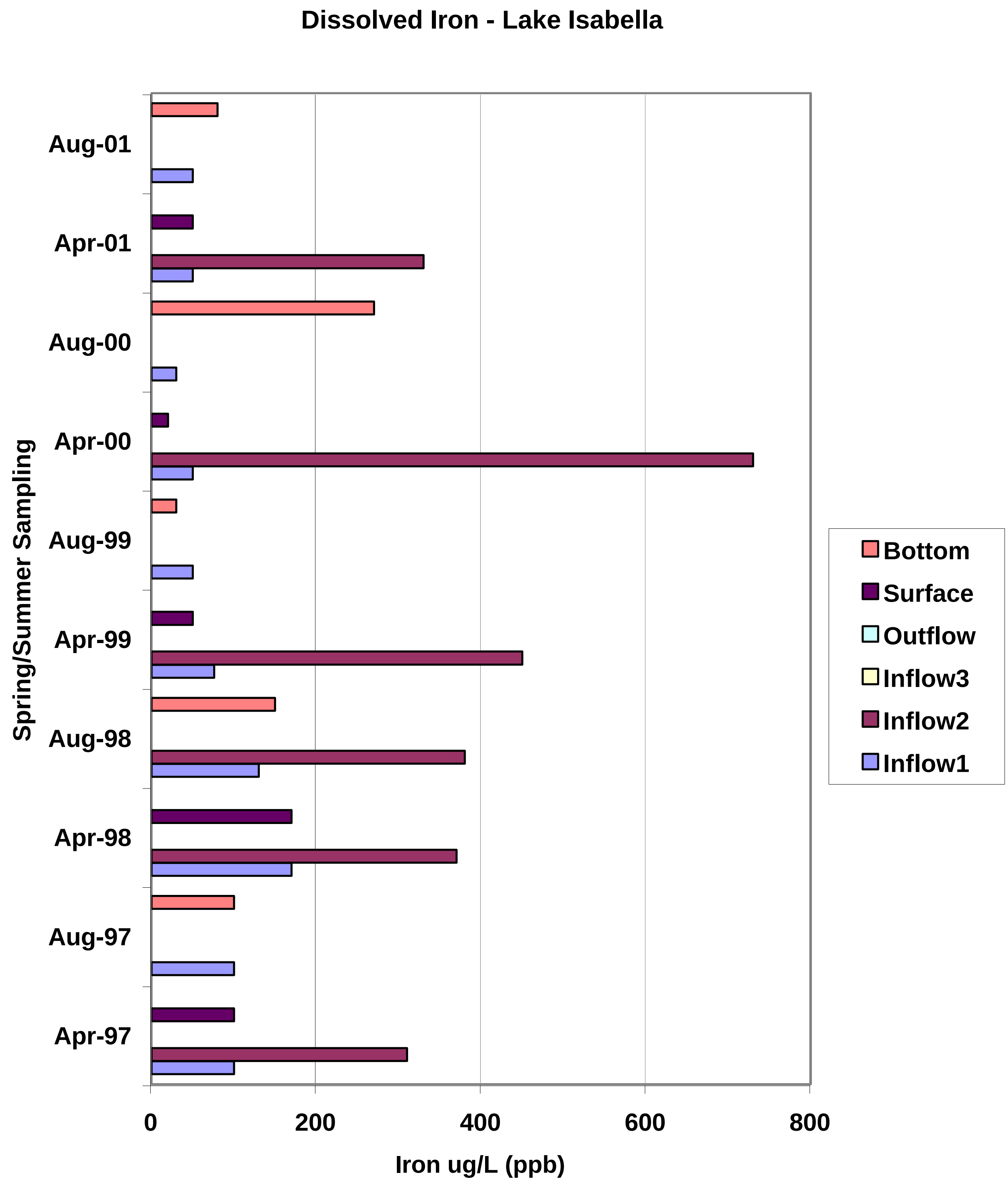

Dissolved Cadmium - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
0.2
0.4
0.6
0.8
1
1.2
Cadmium ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 5 ug/L
Fish Criteria = 2.2 ug/L
Non-Detect Levels Prior to 1999 = 0.5 ug/L
1999 and Beyond = 1 ug/L



Drinking Water Standard = 50 ug/L   Fish Criteria = 11 ug/L

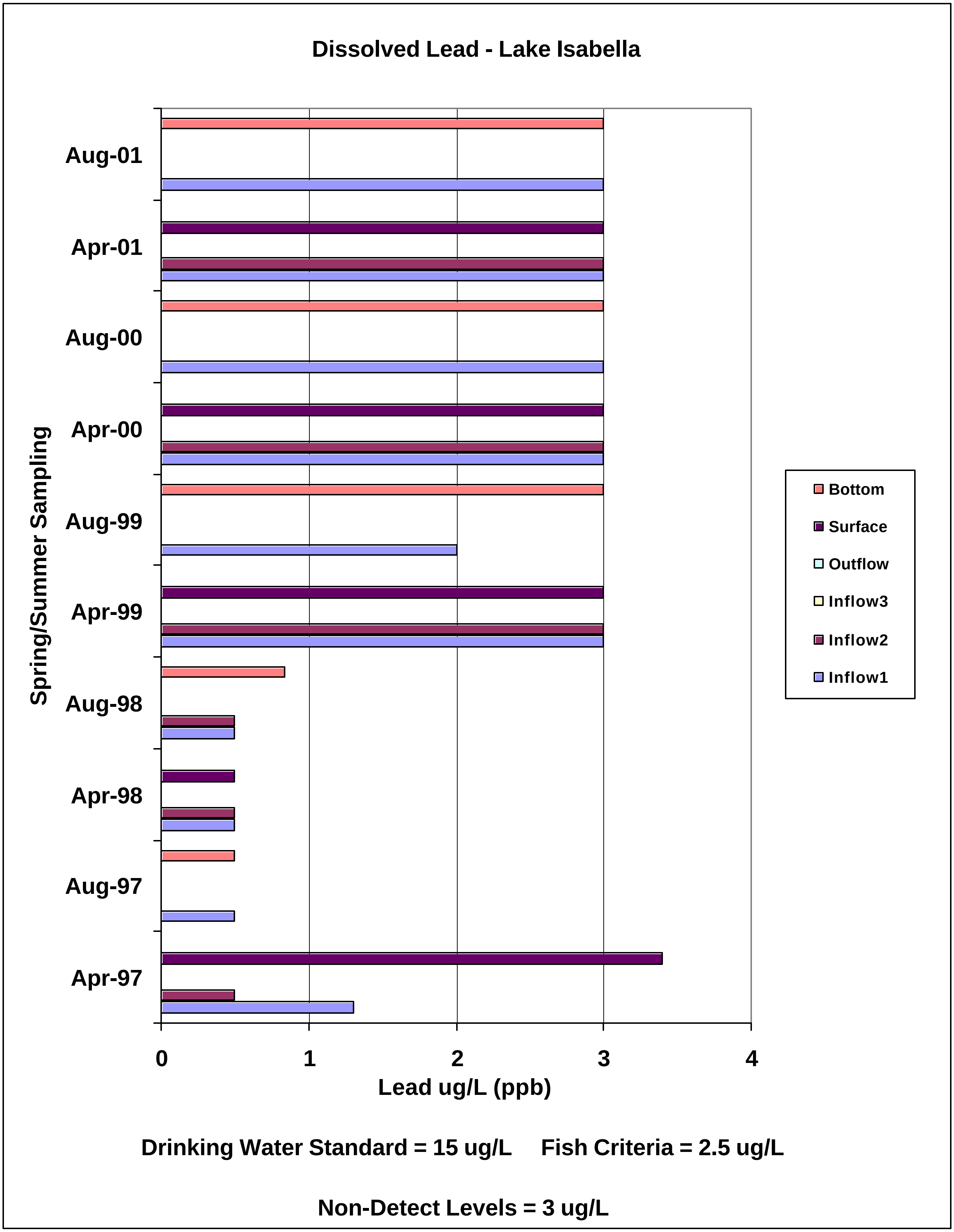
Non-Detect Levels Prior to 1999 = 10 ug/L   1999 and Beyond = 5 ug/L

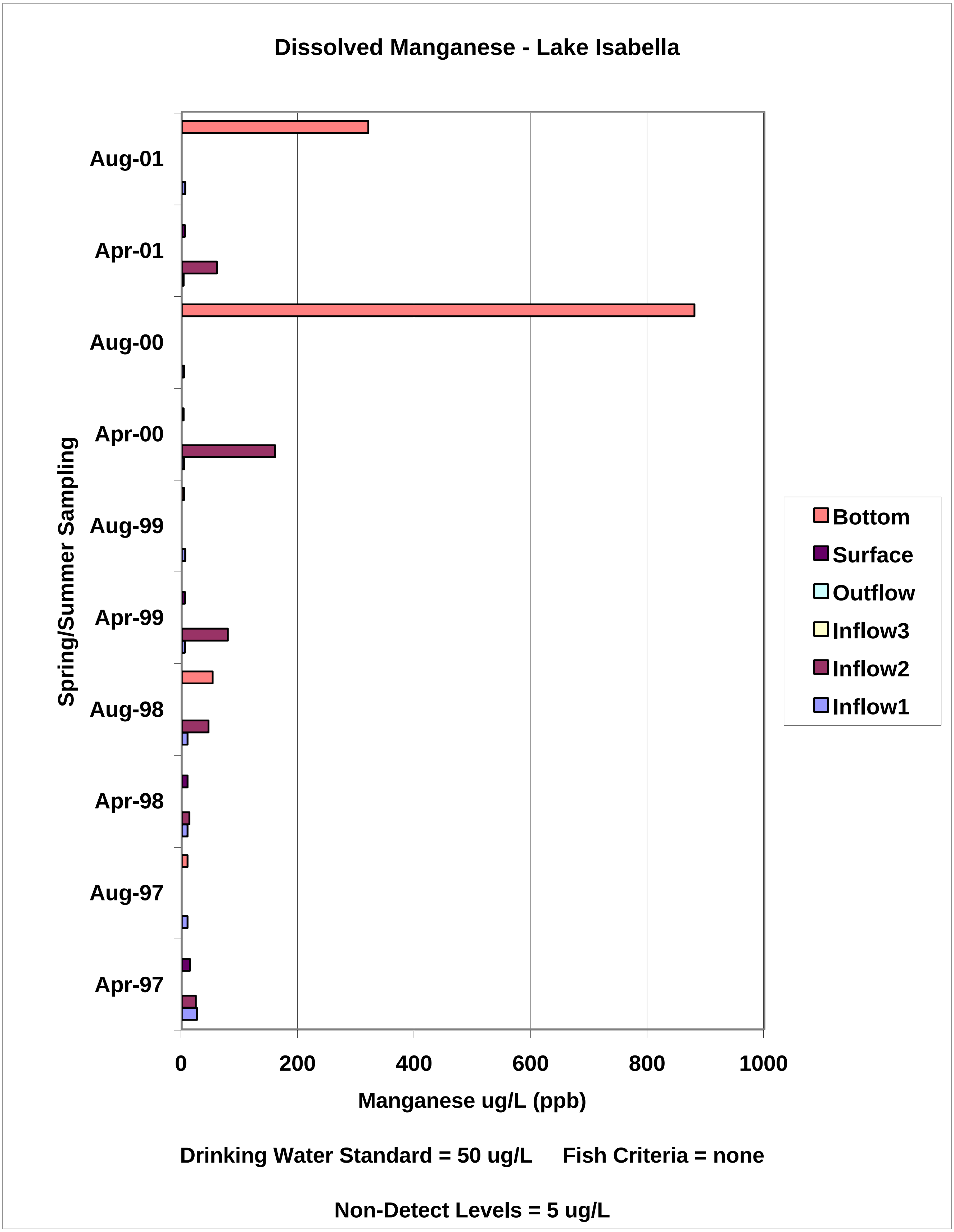

Dissolved Copper - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
1
2
3
4
5
6
Copper ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 1300 ug/L
Fish Criteria = 9 ug/L
Non-Detect Levels = 5 ug/L

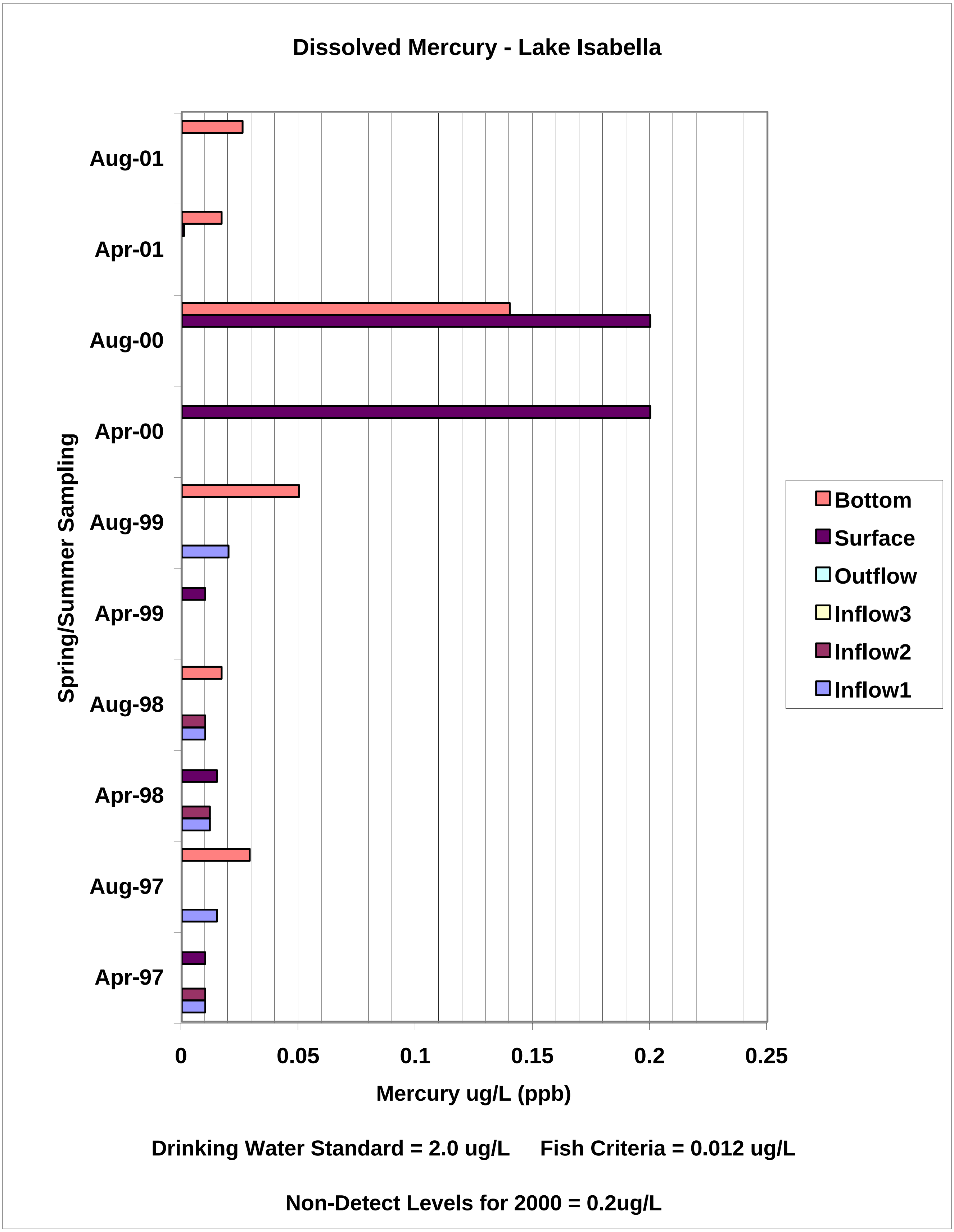


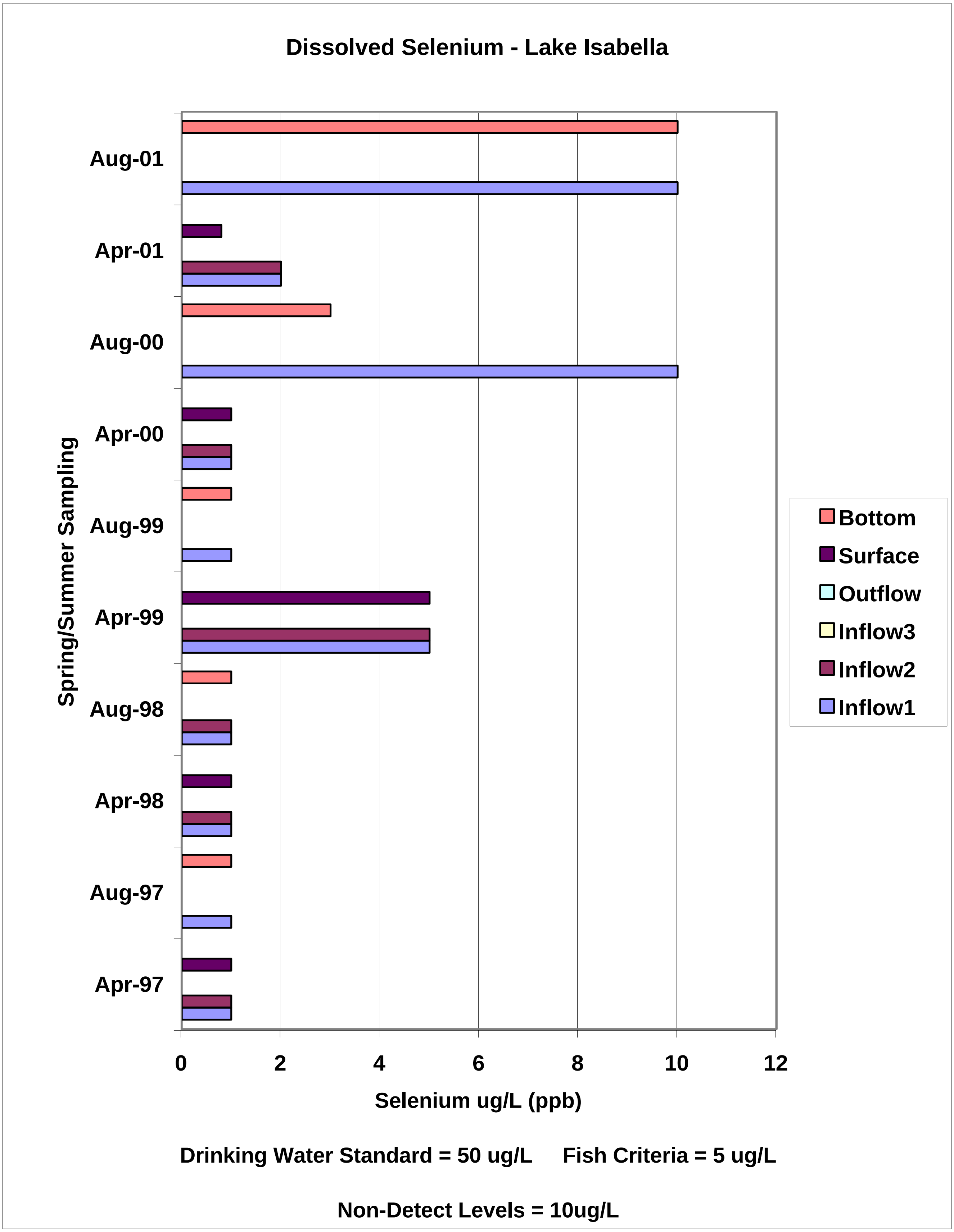
Drinking Water Standard = 300 ug/L Fish Criteria = 1000 ug/L

Non-Detect Levels Prior to 1999 = 100 ug/L 1999 and Beyond = 50 ug/L

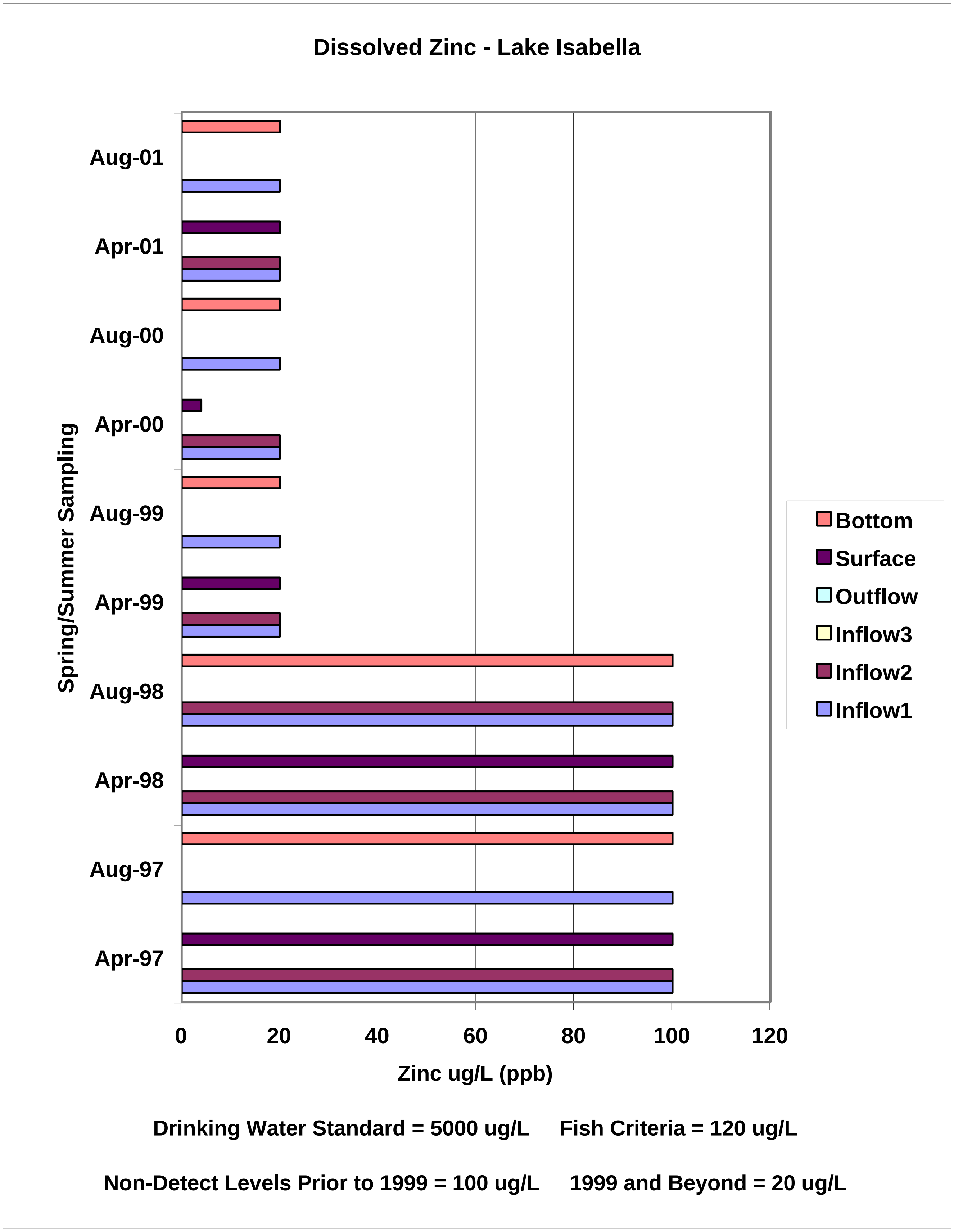

Dissolved Lead - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
1
2
3
4
Lead ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 15 ug/L
Fish Criteria = 2.5 ug/L
Non-Detect Levels = 3 ug/L


Dissolved Manganese - Lake Isabella
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
Spring/Summer Sampling
0
200
400
600
800
1000
Manganese ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 50 ug/L
Fish Criteria = none
Non-Detect Levels = 5 ug/L


Dissolved Mercury - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
0.05
0.1
0.15
0.2
0.25
Mercury ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 2.0 ug/L
Fish Criteria = 0.012 ug/L
Non-Detect Levels for 2000 = 0.2ug/L



Dissolved Selenium - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
2
4
6
8
10
12
Selenium ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 50 ug/L
Fish Criteria = 5 ug/L
Non-Detect Levels = 10ug/L



Dissolved Zinc - Lake Isabella
Spring/Summer Sampling
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Aug-97
Apr-97
0
20
40
60
80
100
120
Zinc ug/L (ppb)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Drinking Water Standard = 5000 ug/L
Fish Criteria = 120 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L
1999 and Beyond = 20 ug/L

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040504-15								
SAMPLE ID: IS-SP-S								
SAMPLED: 17 APR 01 10:00								
Arsenic, dissolved	J0.003	0.004	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.26.01	A010396ICP	1
Calcium, dissolved	14.	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.26.01	A010396ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.26.01	A010396ICP	1
Magnesium, dissolved	2.2	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Manganese, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Mercury, Trace Level	1.0	0.5	ng/L	1	1631	05.02.01	A010423MER	3
Potassium, dissolved	2.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Selenium, dissolved	J0.0008	0.01	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Sodium, dissolved	13.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	5.	3.	mg/L	1	160.2	04.23.01	B010116TSS	
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	60.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	60.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	5.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	0.1	0.1	mg/L	1	353.2	05.11.01	I010022NNO	
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.21.01	I010038PHO	4
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.20.01	I010036PHO	
Solids, Dissolved	80.	20.	mg/L	2	160.1	04.23.01	I010029TDS	
Solids, total	100.	10.	mg/L	1	160.3	05.02.01	I010007TS	
Sulfate	7.8	1.	mg/L	2	300.0	05.16.01	I010063IC	
Total Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	04.24.01	I010034TKN	
Total Organic Carbon	2.	1.	mg/L	1	415.1	05.06.01	I010026TOC	
LAB NUMBER: B040504-16								
SAMPLE ID: IS-SP-B								
SAMPLED: 17 APR 01 10:30								
Mercury, Trace Level	17.	0.5	ng/L	1	1631	05.02.01	A010423MER	3

1) Sample Preparation on 04-26-01 using 200.2 (Filtrate)
2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).
3) Sample Preparation on 05-01-01 using 1631
4) Sample filtered prior to analysis.

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Caltest ANALYTICAL LABORATORY

ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040504-10 (continued)								
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Sodium, dissolved	3.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.23.01	B010116TSS	
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	20.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	20.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	ND	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	05.11.01	I010022NNO	
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.20.01	I010037PHO	3
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.20.01	I010036PHO	
Solids, Dissolved	ND	20.	mg/L	2	160.1	04.23.01	I010029TDS	
Solids, total	50.	10.	mg/L	1	160.3	05.02.01	I010007TS	
Sulfate	J0.8	1.	mg/L	2	300.0	05.16.01	I010063IC	2
[illegible]l Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	04.24.01	I010034TKN	
Total Organic Carbon	3.	1.	mg/L	1	415.1	05.06.01	I010026TOC	

LAB NUMBER: B040504-11
SAMPLE ID: IS-SP-I-1
SAMPLED: 17 APR 01 13:35

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	J0.003	0.004	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.26.01	A010396ICP	1
Calcium, dissolved	9.3	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1
Iron, dissolved	J0.05	0.05	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.26.01	A010396ICP	1
Magnesium, dissolved	1.4	0.5	mg/L	1	200.7	04.26.01	A010396ICP	1
Manganese, dissolved	J0.003	0.005	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Potassium, dissolved	2.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.26.01	A010396ICP	1,2
Sodium, dissolved	9.	1.	mg/L	1	200.7	04.26.01	A010396ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.23.01	B010116TSS	

1) Sample Preparation on 04-26-01 using 200.2 (Filtrate)
2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).
[illegible]) Sample filtered prior to analysis.

Caltest ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	40.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	40.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	2.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	05.11.01	I010022NNO	
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.21.01	I010038PHO	1
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.27.01	I010041PHO	
Solids, Dissolved	40.	20.	mg/L	2	160.1	04.23.01	I010029TDS	
Solids, total	80.	10.	mg/L	1	160.3	05.02.01	I010007TS	
Sulfate	4.8	1.	mg/L	2	300.0	05.16.01	I010063IC	
Total Kjeldahl Nitrogen	0.8	0.1	mg/L	1	351.3	04.24.01	I010034TKN	
Total Organic Carbon	2.	1.	mg/L	1	415.1	05.06.01	I010026TOC	

LAB NUMBER: B040504-12
SAMPLE ID: IS-SP-I-2
SAMPLED: 17 APR 01 12:20

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.26.01	A010396ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.26.01	A010396ICP	2
Calcium, dissolved	16.	0.5	mg/L	1	200.7	04.26.01	A010396ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Iron, dissolved	0.33	0.05	mg/L	1	200.7	04.26.01	A010396ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.26.01	A010396ICP	2
Magnesium, dissolved	3.3	0.5	mg/L	1	200.7	04.26.01	A010396ICP	2
Manganese, dissolved	0.060	0.005	mg/L	1	200.7	04.26.01	A010396ICP	2
Potassium, dissolved	3.	1.	mg/L	1	200.7	04.26.01	A010396ICP	2
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.26.01	A010396ICP	2,3
Sodium, dissolved	18.	1.	mg/L	1	200.7	04.26.01	A010396ICP	2
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.26.01	A010396ICP	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.30.01	B010124COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.23.01	B010116TSS	
ALKALINITY				1	310.1	04.22.01	I010021ALK	
Bicarbonate as CaCO3	70.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	70.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.23.01	I010049AMM	
Chloride	12.	1.	mg/L	1	SM4500	05.15.01	I010001CHL	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	05.11.01	I010022NNO	

1) Sample filtered prior to analysis.
2) Sample Preparation on 04-26-01 using 200.2 (Filtrate)
3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

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LAB ORDER No.: B080764

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
ALKALINITY				1	310.1	08.27.01	I010039ALK	
Bicarbonate as CaCO3	170.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	170.	10.	mg/L					
Chloride	16.	5.	mg/L	5	300.0	09.14.01	I010129IC	
Solids, Dissolved	170.	20.	mg/L	2	160.1	08.28.01	I010060TDS	
Solids, Total	250.	10.	mg/L	1	160.3	08.25.01	I010018TS	
Sulfate	5.4	0.5	mg/L	1	300.0	09.14.01	I010129IC	

LAB NUMBER: B080764-7
SAMPLE ID: KA-SU-I
SAMPLED: 22 AUG 01 15:40

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	15.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	2.0	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	ND	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	8.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	
ALKALINITY				1	310.1	08.27.01	I010039ALK	
Bicarbonate as CaCO3	50.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	50.	10.	mg/L					
Chloride	5.	1.	mg/L	1	300.0	09.14.01	I010129IC	
Solids, Dissolved	ND	20.	mg/L	2	160.1	08.28.01	I010060TDS	
Solids, Total	90.	10.	mg/L	1	160.3	08.25.01	I010018TS	
Sulfate	1.9	0.5	mg/L	1	300.0	09.14.01	I010129IC	

LAB NUMBER: B080764-13
SAMPLE ID: IS-SU-S
SAMPLED: 21 AUG 01 09:00

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Mercury, Trace Level	0.0010	0.0005	ug/L	1	1631	08.31.01	A010843MER	3

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)
3) Sample Preparation on 08-30-01 using 1631

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INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080764-3								
SAMPLE ID: IS-SU-B								
SAMPLED: 21 AUG 01 09:30								
Arsenic, dissolved	0.016	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	12.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	0.08	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	1.8	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.32	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Mercury, Trace Level	0.026	0.0005	ug/L	1	1631	08.31.01	A010843MER	3
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	10.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
LAB NUMBER: B080764-4								
SAMPLE ID: SU-SU-B								
SAMPLED: 22 AUG 01 13:40								
Arsenic, dissolved	0.006	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	31.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	0.49	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	5.4	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Manganese, dissolved	0.26	0.005	mg/L	1	200.7	09.11.01	A010873ICP	2
Mercury, Trace Level	0.026	0.0005	ug/L	1	1631	08.31.01	A010843MER	3
Potassium, dissolved	3.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	0.01	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	14.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
LAB NUMBER: B080764-5								
SAMPLE ID: IS-SU-I-1								
SAMPLED: 21 AUG 01 12:45								
Arsenic, dissolved	0.006	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)
3) Sample Preparation on 08-30-01 using 1631

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ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

LAB ORDER No.: B080764

INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080764-5 (continued)								
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	13.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	2.0	0.5	mg/L	1	200.7	09.11.01	A010873ICP	2
Manganese, dissolved	0.006	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Potassium, dissolved	2.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	14.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	
ALKALINITY				1	310.1	08.27.01	I010039ALK	
Bicarbonate as CaCO3	60.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	60.	10.	mg/L					
[illegible]oride	4.	1.	mg/L	1	300.0	09.14.01	I010129IC	
Solids, Dissolved	70.	20.	mg/L	2	160.1	08.28.01	I010060TDS	
Solids, Total	100.	10.	mg/L	1	160.3	08.25.01	I010018TS	
Sulfate	5.9	0.5	mg/L	1	300.0	09.14.01	I010129IC	

LAB NUMBER: B080764-6
SAMPLE ID: SU-SU-I-2
SAMPLED: 22 AUG 01 11:45

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
Arsenic, dissolved	0.005	0.004	mg/L	1	200.7	09.04.01	A010845ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	09.04.01	A010845ICP	1
Calcium, dissolved	41.	0.5	mg/L	1	200.7	09.04.01	A010845ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	09.04.01	A010845ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	09.04.01	A010845ICP	1
Magnesium, dissolved	9.7	0.5	mg/L	1	200.7	09.11.01	A010873ICP	2
Manganese, dissolved	0.009	0.005	mg/L	1	200.7	09.04.01	A010845ICP	1
Potassium, dissolved	5.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Selenium, dissolved	ND	0.01	mg/L	1	200.7	09.04.01	A010845ICP	1
Sodium, dissolved	29.	1.	mg/L	1	200.7	09.04.01	A010845ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	09.04.01	A010845ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	08.27.01	B010243TSS	

1) Sample Preparation on 09-04-01 using 200.2 (Filtrate)
2) Sample Preparation on 09-10-01 using 200.2 (Filtrate)

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VI Fish Tissue

2001 Fish Tissue Results

The following table provides an overview of the lab results for the 2001 fish tissue program. N/A indicates data is not available due to lack of fish collection. Sample Preparation, filleting and Extraction were in accordance with EPA 823-R-95-007, Sep 95, Volume 1, Section 7.2 (Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisory) which requires the following: Only the edible portion of the fillet shall be analyzed (i.e no skin, tail, fin, head). Tissue digestion shall be accomplished by adding concentrated nitric acid and heating the tube in an aluminum block to reflux the acid. The digestate shall be cooled, diluted to a final volume of 25 ml and analyzed by CVAA. The laboratory conductng the preparation and analysis was Toxscan, Inc in Watsonville, CA and the laboratory mercury analysis was in accordance with CVAA per EPA 7471. The Percent Lipids were per EPA 1664. The FDA criteria for a fish advisory is 1 ppm. The EPA's action level to continue fish tissue monitoring is 0.3 ppm.

Lake	Type of Fish	Type of Analysis (number of fish)	Date collected	Percent Lipids	Total Mercury	FDA Criteria
Black Butte	Lg M Bass	Composite (3)	8/29/01	0.12	0.58	1 ppm
Eastman	Note 4	-	-	-	-	1 ppm
Englebright	Sm M Bass	Composite (2)	8/4/01	0.12	0.25	1 ppm
Hensley	Sm M Bass	Composite (2)	1/30/02	0.079	0.30	1 ppm
Isabella	Note 5	-	-	-	-	1 ppm
Kaweah	Blk Bass	Composite (3)	9/28/01	0.76	0.40	1 ppm
Martis Cr	Note 4	-	-	-	-	-
Mendocino	Lg M Bass	Composite (3)	9/25/01	1.4	0.34	1 ppm
New Hogan	Lg M Bass	Composite (3)	8/14/01	0.75	0.60	1 ppm
Pine Flat	Spotted Bass	Composite (3)	7/08/01	0.53	0.23	1 ppm
Sonoma	Lg M Bass	Composite (3)	11/08/01	0.058	0.43	1 ppm
Success	Blk Bass	Composite (3)	9/10/01	0.44	0.29	1 ppm

Notes:

1. Non-Detect is indicated by "<0.02" since the lab Detection Limit is 0.02 ppm.

2. Total Mercury was reported in mg/L or ppm.

3. Total Mercury was conducted instead of Methyl Mercury since EPA 832 allows Total Mercury analysis for an initial screening program. When specific problem areas are identified, methyl mercury analysis are normally performed later as part of the actual health risk assessment.

4. The fish tissue program was terminated at Eastman and Martis Creek in 2001 due to low total mercury results in 2000. In 2000, the total mercury was only 0.089 ppm for Eastman (Catfish) and the total mercury was <0.02 ppm for Martis Creek (Brown Trout).

5. Due to seasonal conditions, a fish could not be successfully collected at Lake Isabella. Another attempt will be accomplished for the 2002 report.

The above 2001 total mercury results indicate only New Hogan and Black Butte are relatively higher than average. However, in 2000, the total mercury results were only 0.52 ppm for New Hogan (catfish) and only 0.37 ppm for Black Butte (catfish). The 2002 fish tissue program should provide additional data. The attached EPA fact sheet on fish advisory indicates that the mean average mercury results from numerous lakes in the Northeast United States were found to be 0.46-0.51 ppm for largemouth bass and 0.34-0.53 for smallmouth bass.

EPA United States Environmental Protection Agency
Office of Water

FACT SHEET

United States Environmental Protection Agency	Office of Water 4305	EPA-823-F-99-016 September 1999

Mercury Update: Impact on Fish Advisories

Summary

Mercury is distributed throughout the environment from both natural sources and human activities. Methylmercury is the main form of organic mercury found in the environment and is the form that accumulates in both fish and human tissues. Three major episodes of methylmercury poisoning through consumption of contaminated food have occurred; these resulted in central nervous system effects such as impairment of peripheral vision, mental symptoms, loss of feeling, and, at high doses, seizures, very severe neurological impairment, and death. Methylmercury has also been shown to be a developmental toxicant, causing subtle to severe neurological effects. EPA considers there is sufficient evidence for methylmercury to be considered a developmental toxicant, to be of concern for potential human mutagenicity, and to be a possible human carcinogen (Group C). As of December 1998, 40 states have issued 1,931 fish advisories for mercury. These advisories inform the public that concentrations of mercury have been found in local fish at levels of public health concern. State advisories recommend either limiting or avoiding consumption of certain fish from specific waterbodies or, in some cases, from specific waterbody types (e.g., all freshwater lakes or rivers).

> The purpose of this fact sheet is to summarize current information on sources, fate and transport, occurrence in human tissues, range of concentrations in fish tissue, fish advisories, fish consumption limits, toxicity, and regulations for mercury. The fact sheets also illustrate how this information may be used for developing fish consumption advisories. An electronic version of this fact sheet and fact sheets for dioxins/furans, PCBs, and toxaphene are available at http://www.epa.gov/OST/fish. Future revisions will be posted on the web as they become available.

Sources of Mercury in the Environment

Mercury is found in the environment in the metallic form and in different inorganic and organic forms. Most of the mercury in the atmosphere is elemental mercury vapor; most of the mercury in water, soil, plants, and animals is inorganic and organic mercury (primarily methylmercury).

Mercury occurs naturally and is distributed throughout the environment by both natural processes and human activities. Solid waste incineration and fossil fuel combustion facilities contribute approximately 87% of the emissions of mercury in the United States. Other sources of mercury releases to the air include mining and smelting, industrial processes involving the use of mercury such as chlor-alkali production facilities and production of cement.

Mercury is released to surface waters from naturally occurring mercury in rocks and soils and from industrial activities, including pulp and paper mills, leather tanning, electroplating, and chemical manufacturing. Wastewater treatment facilities may also release mercury to water. An indirect source of mercury to surface waters is mercury in the air; it is deposited from rain and other processes directly to water surfaces and to soils. Mercury also may be mobilized from sediments if disturbed (e.g., flooding, dredging).

Sources of mercury in soil include direct application of fertilizers and fungicides and disposal of solid waste, including batteries and thermometers, to landfills. The disposal of municipal incinerator ash in landfills and the application of sewage sludge to crop land result in increased levels of mercury in soil. Mercury in air may also be deposited in soil and sediments.

Fate and Transport of Mercury

The global cycling of mercury is a complex process. Mercury evaporates from soils and surface waters to the atmosphere, is redeposited on land and surface water, and then is absorbed by soil or sediments. After redeposition on land and water, mercury is commonly volatilized back to the atmosphere as a gas or as adherents to particulates.

Mercury exists in a number of inorganic and organic forms in water. Methylmercury, the most common organic form of mercury, quickly enters the aquatic food chain. In most adult fish, 90% to 100% of the mercury is methylmercury. Methylmercury is found primarily in the fish muscle (fillets) bound to proteins.

Skinning and trimming the fish does not significantly reduce the mercury concentration in the fillet, nor is it removed by cooking processes. Because moisture is lost during cooking, the concentration of mercury after cooking is actually higher than it is in the fresh uncooked fish.

Concentrations of total mercury in fish at the top of the food chain, such as pike, shark, and swordfish, are approximately 10,000 to 100,000 times higher than the concentrations of inorganic mercury found in the surrounding waters. The bioconcentration factor (BCF) of methylmercury in fish is on the order of 3 million. The bioaccumulation of methylmercury is even greater. Methylmercury levels in predator fish are, on average, approximately 7 million times higher than the concentrations of dissolved methylmercury found in the surrounding waters.

In 1984 and 1985, the U.S. Fish and Wildlife Service collected 315 composite samples of whole fish from 109 stations nationwide as part of the National Contaminant Biomonitoring Program (NCBP). The maximum, geometric mean, and 85th percentile concentrations for mercury were 0.37, 0.10, and 0.17 ppm (wet weight), respectively. An analysis of mercury levels in tissues of bottom-feeding and predatory fish using the data from the NCBP study showed that the mean mercury tissue concentration of 0.12 ± 0.08 ppm in predatory fish species (e.g., trout, walleye, largemouth bass) was significantly higher than the mean tissue concentration of 0.08 ± 0.06 ppm in bottom feeders (e.g., carp, white sucker, and channel catfish).

Mercury, the only metal analyzed as part of EPA's 1987 National Study of Chemical Residues in Fish (NSCRF), was detected at 92% of 374 sites surveyed. Maximum, arithmetic mean, and median concentrations in fish tissue were 1.77, 0.26, and 0.17 ppm (wet weight), respectively. Mean mercury concentrations in bottom feeders (whole body samples) were generally lower than concentrations for predator fish (fillet samples) (see Table 1). Most of the higher tissue concentrations of mercury were detected in freshwater fish samples collected in the Northeast.

Most recently, the northeast states and eastern Canadian provinces issued their own mercury study, including a comprehensive analysis of mercury concentrations in a variety of freshwater sportfish collected from the late 1980s to 1996. Top level predatory fish such as walleye, chain pickerel, and large and smallmouth bass were typically found to exhibit the highest concentrations, with mean tissue residues greater than 0.5 ppm and maximum residues exceeding 2 ppm. One largemouth bass sample was found to contain 8.94 ppm of mercury, while a smallmouth bass sampled contained 5 ppm. Table 2 summarizes the range and the mean concentrations found in eight species of sportfish sampled.

Mercury has also been detected in marine fish species. Concentrations of methylmercury in muscle tissue in nine species of Atlantic shark averaged 0.88 µg/g (ppm) (wet weight) and ranged from 0.06 to 2.87 µg/g (ppm). Bluefin tuna from the northwest Atlantic Ocean contained mercury at a mean muscle concentration of 3.41 µg/g (ppm)(dry weight).

Table 1. Mean Mercury Concentration in Freshwater Fish*

Species	Mean concentration (ppm)**
Bottom Feeders	
Carp	0.11
White sucker	0.11
Channel catfish	0.09
Predator Fish	
Largemouth bass	0.46
Smallmouth bass	0.34
Walleye	0.52
Brown trout	0.14

*EPA National Study of Chemical Residues in Fish conducted in 1987; species included freshwater, estuarine, and marine finfish; and a small number of marine shellfish.
**Concentration are reported on wet weight basis
Source: Bahnick et al., 1994

Table 2. Mercury Concentration for Selected Fish Species in the Northeast

Species	Mean concentration* (ppm)	Minimum-maximum range* (ppm)
Largemouth bass	0.51	0-8.94
Smallmouth bass	0.53	0.08-5.0
Yellow perch	0.40	0-3.15
Eastern chain pickerel	0.64	0-2.81
Lake trout	0.32	0-2.70
Walleye	0.77	0.10-2.04
Brown bullhead	0.20	0-1.10
Brook trout	0.26	0-0.98

*Concentration are reported on a wet weight basis.
Source: NESCAUM, 1998.

Because of the higher cost of methylmercury analysis, EPA recommends that total mercury rather than methylmercury concentrations be determined in state fish contaminant monitoring programs. EPA also recommends that the conservative assumption be made that all mercury is present as methylmercury in order to be most protective of human health.

Potential Sources of Exposure and Occurrence in Human Tissues

Potential sources of human exposure to mercury include food contaminated with mercury, inhalation of mercury vapors in ambient air, and exposure to mercury through dental and medical treatments. Dietary intake is by far the most important source of exposure to mercury for the general population. Fish and other seafood products are the main source of methylmercury in the diet; studies have shown that methylmercury concentrations in fish and shellfish are approximately 10 to 100 times greater than in other foods, including cereals, potatoes, vegetables, fruits, meats, poultry, eggs, and milk.

Individuals who may be exposed to higher than average levels of methylmercury include recreational and subsistence fishers who routinely consume large amounts of locally caught fish and subsistence hunters who routinely consume the meat and organ tissues of marine mammals.

Analytical methods are available to measure mercury in blood, urine, tissue, hair, and breast milk.

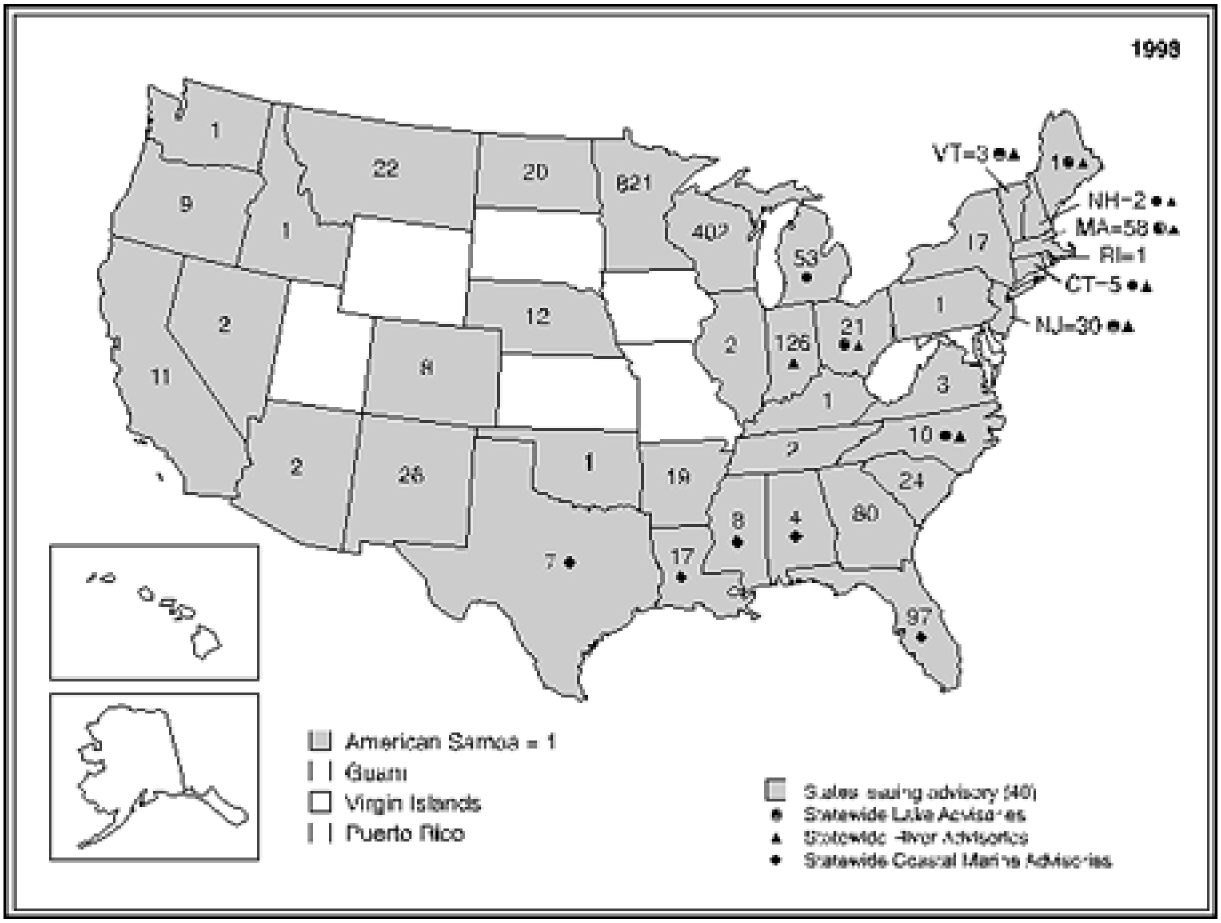
Fish Advisories

The states have primary responsibility for protecting their residents from the health risks of consuming contaminated noncommercially caught fish. They do this by issuing consumption advisories for the general population, including recreational and subsistence fishers, as well as sensitive subpopulations (such as pregnant women/fetus, nursing mothers and their infants, and children). These advisories inform the public that high concentrations of chemical contaminants, such as mercury, have been found in local fish. The advisories recommend either limiting or avoiding consumption of certain fish from specific waterbodies or, in some cases, from specific waterbody types (such as lakes or rivers).

As of December 1998, mercury was the chemical contaminant responsible, at least in part, for the issuance of 1,931 fish consumption advisories by 40 states, including the U.S. territory of American Samoa. Almost 68% of all advisories issued in the United States are a result of mercury contamination in fish and shellfish. Advisories for mercury have increased steadily, by 115% from 899 advisories in 1993 to 1,931 advisories in 1998. The number of states that have issued mercury advisories also has risen steadily from 27 states in 1993 to 40 states in 1997, and remains at 40 states for 1998. Advisories for mercury increased nearly 8% from 1997 (1,782 advisories) to 1998 (1,931 advisories).

Ten states have issued statewide advisories for mercury in their freshwater lakes and/or rivers: Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, North Carolina, Ohio, and Vermont. Another five Gulf Coast states (Alabama, Florida, Louisiana, Mississippi, and Texas) have statewide mercury advisories in effect for their coastal marine waters. To date, 90% of the 1,931 mercury advisories in effect have been issued by the following 11 states; Minnesota (821), Wisconsin (402), Indiana (126), Florida (97), Georgia (80), Massachusetts (58), Michigan (53), New Jersey (30), New Mexico (26), South Carolina (24), and Montana (22). Figure 1 shows the total number of fish advisories for mercury in each state in 1998.

Figure 1. Fish Advisories for Mercury



Fish Consumption Limits—EPA indicated in the *Mercury Study Report to Congress* (U.S. EPA, 1997) that the typical U.S. consumer was not in danger of consuming harmful levels of methylmercury from fish and was not advised to limit fish consumption on the basis of mercury content. This advice is appropriate for typical consumers who eat less than 10 grams of fish and shellfish per day with mercury concentrations averaging between 0.1 and 0.15 ppm, which are typical for most species of commercially obtained fish. At these rates of fish intake, methylmercury exposures are considerably less than the interim reference dose (RfD) of 1×10^{-4} mg/kg-d. However, eating more fish than is typical or eating fish that are more contaminated, can increase the risk to a developing fetus.

Two groups of women of childbearing age are of concern: (1) those who eat more than 10 grams of fish a day and (2) those who eat fish with higher methylmercury levels. Ten grams of fish is a little over one-quarter cup of tuna per week or about one fish sandwich per week. Based on diet surveys, 10% of women of childbearing age eat five times or more fish than does the average consumer. If the fish have average mercury concentrations of 0.1 to 0.15 ppm, the women's mercury exposures range from near or slightly over the interim RfD to about twice the interim RfD.

The second group of women of concern are those who eat fish with higher mercury concentrations (e.g., 0.5 ppm and higher). Examples of fish with above average mercury levels are king mackerel, various bass species, orange roughy, pike, swordfish, shark and freshwater fish from contaminated waters. Even women eating average amounts of fish (i.e., <10 g/d) have mercury exposures near the interim RfD, if the mercury concentration is 0.5 ppm. If women eat these fish species and their average fish intake is between 40 and 70 grams/day (or about a quarter cup per day), their mercury exposures would range from three to six times the interim RfD. Consumers who eat fish with 1 ppm mercury (e.g., swordfish and shark) at the level of 40 to 70 g/d have intakes that range from 6 to nearly 12 times the interim RfD.

Some women of childbearing age in certain ethnic groups (Asians, Pacific Islanders, and Native Americans) eat much more fish than the general population. Because of the higher amounts of fish in their diets, women in these ethnic groups need to be aware of the level of mercury in the fish they eat.

The RfD is not a "bright line" between safety and toxicity; however, there is progressively greater concern about the likelihood of adverse effects above this level. Consequently, people are advised to consume fish in moderate amounts and be aware of the amount of mercury in the fish they eat.

For sensitive populations, such as pregnant women, nursing mothers, and young children, some states have issued either "no consumption" advisories or "restricted consumption" advisories for methyl-mercury. Additional information on calculating specific limits for these sensitive populations is available in EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2, Section 3.

Table 3 shows the recommended monthly fish consumption limits for methylmercury in fish for fish consumers based on EPA's default values for risk assessment parameters. Consumption limits have been calculated as the number of allowable fish meals per month based on the ranges of methylmercury in the consumed fish tissue. The following assumptions were used to calculate the consumption limits:

- Consumer adult body weight of 72 kg
- Average fish meal size of 8 oz (0.227 kg)
- Time-averaging period of 1 mo (30.44 d)
- EPA's interim reference dose for methylmercury ($1x10^{-4}$ mg/kg-d) from EPA's
- Integrated Risk Information System (U.S. EPA, 1999c).

For example, when methylmercury levels in fish tissue are 0.4 ppm, then two 8-oz. meals per month can safely be consumed.

Table 3. Monthly Fish Consumption Limits for Methylmercury

Risk-based consumption limit	Noncancer health endpoints
Fish meals/month	**Fish tissue concentrations (ppm, wet weight)**
16	> 0.03–0.06
12	> 0.06–0.08
8	> 0.08–0.12
4	> 0.12–0.24

3	> 0.24–0.32
2	> 0.32–0.48
1	> 0.48–0.97
0.5	> 0.97–1.9
None (<0.5)*	> 1.9

*None = No consumption recommended.
NOTE: In cases where >16 meals per month are consumed, refer to EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*, Volume 2, Section 3 for methods to determine safe consumption limits.

Toxicity of Mercury

Pharmacokinetics—Methylmercury is rapidly and nearly completely absorbed from the gastrointestinal tract; 90% to 100% absorption is estimated. Methylmercury is somewhat lipophilic, allowing it to pass through lipid membranes of cells and facilitating its distribution to all tissues, and it binds readily to proteins. Methylmercury binds to amino acids in fish muscle tissue.

The highest methylmercury levels in humans are generally found in the kidneys. Methylmercury in the body is considered to be relatively stable and is only slowly transformed to form other forms of mercury. Methylmercury readily crosses the placental and blood/brain barriers. Estimates for its half-life in the human body range from 44 to 80 days.

Excretion of methylmercury is via the feces, urine, and breast milk. Methylmercury is also distributed to human hair and to the fur and feathers of wildlife; measurement of mercury in hair and these other tissues has served as a useful biomonitor of contamination levels.

Acute Toxicity—Acute high-level exposures to methylmercury may result in impaired central nervous system function, kidney damage and failure, gastro-intestinal damage, cardiovascular collapse, shock, and death. The estimated lethal dose is 10 to 60 mg/kg.

Chronic Toxicity—Although both elemental mercury and methylmercury produce a variety of health effects at relatively high exposures, neurotoxicity is the effect of greatest concern. This is true whether exposure occurs to the developing embryo or fetus during pregnancy or to adults and children. Human exposure to methylmercury has generally been through consumption of contaminated food. Two major episodes of methylmercury poisoning through fish consumption have occurred. The first occurred in the early 1950s among people, fish consuming domestic animals such as cats, and wildlife living near Minamata City on the shores of Minamata Bay, Kyushu, Japan. The source of the methylmercury contamination was effluent from a chemical factory that used mercury as a catalyst and discharged wastes into the bay where it accumulated in fish and shellfish that were a dietary staple of this population. Average fish consumption was reported to be in excess of 300 g/d, 20 times greater than is typical for recreational fishers in the United States.

By comparison, about 3% to 5% of U.S. consumers routinely eat 100 grams of fish per day. Among women of childbearing age, 3% routinely eat 100 grams of fish per day.

In 1965, another methylmercury poisoning incident occurred in the area of Niigata, Japan. The signs and symptoms of the disease in Niigata were similar to those of methylmercury poisoning in Minamata.

Symptoms of Minamata disease in children and adults included: impairment of peripheral vision, disturbances in sensations ("pins and needles" feelings, numbness) usually in the hands and feet and sometimes around the mouth; incoordination of movements; impairment of speech, hearing, and walking; and mental disturbances. It sometimes took several years before individuals were aware that they were developing the signs and symptoms of methylmercury poisoning. Over the years, it became clear that nervous system damage could occur to a fetus whose mother ate fish contaminated with methylmercury during the pregnancy.

Methylmercury poisoning also occurred in Iraq following consumption of seed grain that had been treated with a fungicide containing methylmercury. The first outbreak occurred prior to 1960; the second occurred in the early 1970s. Imported mercury-treated seed grains that arrived after the planting season were ground into flour and baked into bread. Unlike the long-term exposures in Japan, the epidemic of methylmercury poisoning in Iraq was short in duration lasting approximately 6 months. The signs and symptoms of disease in Iraq were predominantly in the nervous system: difficulty with peripheral vision or blindness, sensory disturbances, incoordination, impairment of walking, and slurred speech. Both children and adults were affected. Infants born to mothers who had consumed methylmercury contaminated grain (particularly during the second trimester of pregnancy) showed nervous system damage even though the mother was only slightly affected.

Recent studies have examined populations that are exposed to lower levels of methylmercury as a consequence of routine consumption of fish and marine mammals including studies of populations around the Great Lakes and in New Zealand, the Amazon basin, the Seychelles Islands, and the Faroe Islands. The last two studies are of large populations of children presumably exposed to methylmercury in utero. Very sensitive measures of developmental neurotoxicity in these populations are still being analyzed and published. A recent workshop discussed these studies and concluded that they have provided valuable new information on the potential health effects of methylmercury. Significant uncertainties remain, however, because of issues related to exposure, neurobehavioral endpoints, confounders and statistics, and study design.

Developmental Toxicity—Data are available on developmental effects in rats, mice, guinea pigs, hamsters, and monkeys. Also, convincing data from a number of human studies (i.e., Minamata, Iraq) indicate that methylmercury causes subtle to severe neurologic effects depending on dose and individual susceptibility. EPA considers methylmercury to have sufficient human and animal data to be classified as a developmental toxicant.

Methylmercury accumulates in body tissue; consequently, maternal exposure occurring prior to pregnancy can contribute to the overall maternal body burden and result in exposure to the developing fetus. In addition, infants may be exposed to methyl-mercury through breast milk. Therefore, it is advisable to reduce methylmercury exposure to women with childbearing potential to reduce overall body burden (see Fish Consumption Limits section).

Mutagenicity—Methylmercury appears to be clastogenic but not to be a point mutagen; that is, mercury causes chromosome damage but not small heritable changes in DNA.

EPA has classified methylmercury as being of high concern for potential human germ cell mutagenicity. The absence of positive results in a heritable mutagenicity assay keeps methylmercury from being included under the highest level of concern. The data on mutagenicity are not sufficient, however, to permit estimation of the amount of methylmercury that would cause a measurable mutagenic effect in the human population.

Carcinogenicity—Experimental animal data suggest that methylmercury may be tumorigenic in animals. Chronic dietary exposures of mice to methylmercury resulted in significant increases in the incidences of kidney tumors in males but not in females. The tumors were seen only at toxic doses of methylmercury. Three human studies have been identified that examined the relationship between methylmercury exposure and cancer. There was no persuasive evidence of increased carcinogenicity attributable to methylmercury exposure in any of these studies. Interpretation of these studies was limited by poor study design and incomplete descriptions of methodology and/or results. EPA has not calculated quantitative carcinogenic risk values for methylmercury. EPA has found methylmercury to have inadequate data in humans and limited evidence in animals, and has classified it as a possible human carcinogen, Group C.

All of the carcinogenic effects in animals were observed in the presence of profound damage to the kidneys. Tumors may be formed as a consequence of repair in the damaged organs. Evidence points to a mode of action for methylmercury carcinogenicity that operates at high doses certain to produce other types of toxicity in humans. Given the levels of exposure most likely to occur in the U.S. population, even among consumers of large amounts of fish, methylmercury is not likely to present a carcinogenic risk.

Summary of EPA Health Benchmarks

- Chronic Toxicity–Interim Reference Dose: 1×10^{-4} mg/kg-d (U.S. EPA, 1999c)
- Carcinogenicity: No carcinogenic risk values calculated

Special Susceptibilities—The developing fetus is at greater risk from methylmercury exposure than are adults. Data on children exposed only after birth are insufficient to determine if this group has increased susceptibility to the adverse central nervous system effects of methylmercury. In addition, children are considered to be at increased risk of methylmercury exposure by virtue of their greater food consumption as a percentage of body weight (mg food/kg body weight) compared to adult exposures. Additional risk from higher mercury ingestion rates may also result from the apparent decreased ability of children's bodies to eliminate mercury.

Interactive Effects—Potassium dichromate and atrazine may increase the toxicity of mercury, although these effects have been noted only with metallic and inorganic mercury. Ethanol increases the toxicity of methylmercury in experimental animals. Vitamins D and E, thiol compounds, selenium, copper, and possibly zinc are antagonistic to the toxic effects of mercury.

Critical Data Gaps—Additional data are needed on the exposure levels at which humans experience subtle, but persistent, adverse neurological effects. Data on immunologic effects and reproductive effects are not sufficient for evaluation of low-dose methylmercury toxicity for these endpoints.

EPA Regulations and Advisories

- Maximum Contaminant Level in drinking water = 0.002 mg/L
- Toxic Criteria for those States Not Complying with CWA Section 303(c)(2)(B) - criterion concentration for priority toxic pollutants:
  - Freshwater: maximum = 2.10 µg/L, continuous = 0.012 µg/L
  - Saltwater: maximum = 1.80 µg/L, continuous = 0.025 µg/L
  - Human health consumption of water and organisms = 0.14 µg/L
  - Human health consumption of organisms only = 0.15 µg/L.
- Water Quality Guidance for the Great Lakes System — protection of aquatic life in ambient water:

  - acute water quality criteria for mercury total recoverable: maximum = 1.694 µg/L
  - chronic water quality criteria for mercury total recoverable: continuous = 0.908 µg/L
  - water quality criteria for protection of human health, drinking water and nondrinking water: maximum = 1.8×10^{-3} µg/L
  - water quality criteria for protection of human health (mercury including methylmercury) = 1.3×10^{-3} µg/L.
- Listed as a hazardous air pollutant under Section 112 of the Clean Air Act
- Emissions from mercury ore processing facilities and mercury chlor-alkali plants = 2,300 g maximum/24 h
- Emissions from sludge incineration plants, sludge drying plants, or a combination of these that process wastewater treatment plant sludge = 3,200 g maximum/24 h
- Ban of phenylmercuric acetate as a fungicide in interior and exterior latex paints
- Reportable quantities: Mercury, mercuric cyanide = 1 lb; mercuric nitrate, mercuric sulfate, mercuric thiocyanate, mercurous nitrate, mercury fulminate = 10 lb; phenylmercury acetate = 100 lb.
- Listed as a hazardous substance: Mercuric cyanide, mercuric nitrate, mercuric sulfate, mercuric thiocyanate, mercurous nitrate
- Reporting threshold for Toxic Release Inventory (proposed) = 10 lb

Sources of Information

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U.S. EPA (Environmental Protection Agency). IRIS (Integrated Risk Information System) for Methylmercury. 1999c. National Center for Environmental Assessment, Office of Research and Development, Cincinnati, OH.

For more information about the National Fish and Wildlife Contamination Program, contact:

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The 1998 update of the database *National Listing of Fish and Wildlife Advisories* is available for downloading from the following Internet site: http://www.epa.gov/OST

URL:http://www.epa.gov/OST/fish/mercury.html
Revised September 20, 1999

VII MTBE Results

2001 MTBE Results
Units are ug/L (ppb)

The following table provides an overview of the lab results for the 2001 MTBE monitoring program.

Lake	Spring S	Spring S-1	Spring S-M	Spring S-C	Summer S	Summer S-1	Summer S-M	Summer S-C	Remarks
Black Butte	<2		<2		<2		<2		No MTBE
Eastman	0.4				3				
Englebright	<2	<2	<2	<2	<2		<2	<2	No MTBE
Hensley	1.5		1.7		2		3		
Isabella	1.4	1.3	18	0.8	3	3	3	3	Note 8
Kaweah	3		3	1.7	4		6	6	
Martis Cr.	<2				<2				No MTBE
Mendocino	<2				<2				No MTBE
New Hogan	<2				<2				No MTBE
Pine Flat	0.9		1		2		2		
Sonoma	1.9		1.6		<2		2		
Success	4		5	4	4	4	5	4	

Notes:

1. Non-Detect is indicated by "<2" since the Reporting Limit is 2 ppb or 0.002 ppm.
2. No enforceable acceptance criteria has been established for MTBE. See EPA Fact sheet.
3. Maps are provided to illustrate the sampling locations for samples: S / S-1, S-M, and S-C. Sample S and sample S1 are located near the dam; sample S-M is located within 50 ft of the Marina; and sample S-C is located near the center of the lake.
4. For 2001, the number of MTBE water sampling at each lake is based on last year's lab results.
5. 2 samples were taken from Eastman, Martis Creek, Mendocino, and New Hogan because MTBE was non-detectable for 2000. The 2001 results of non-detectable levels were similar except Lake Eastman now reported detectable levels of MTBE.
6. 4 samples were taken from Black Butte, Hensley, Pine Flat and Sonoma because relatively low detectable levels was found for 2000. The 2001 results were similar except Black Butte now reported non-detectible levels.
7. 6 to 8 samples were taken from Englebright, Isabella, Kaweah and Success because relatively higher MTBE was found for 2000. The 2001 results were similar except Englebright now reported non-detectible levels.
8. Very high MTBE was reported at Lake Isabella during the Spring for 2 straight years. During Spring 2000, Lake Isabella reported 21 ug/L. The 2001 results indicated that the high MTBE is restricted near the marina and during the Spring only. An on-site investigation will be conducted this Spring at Lake Isabella to determine the cause.


S
S-1

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

ORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040451-3 (continued) SAMPLE ID: IS-SP-SM SAMPLED: 17 APR 01 09:30 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS (continued)				1	05.01.01	V010062MSB	
Surrogate Dibromofluoromethane	95.		%				
Surrogate 1,2-DCA-d4	94.		%				
Surrogate Toluene-d8	90.		%				
Surrogate 4-BFB	87.		%				
LAB NUMBER: B040451-4 SAMPLE ID: IS-SP-SC SAMPLED: 17 APR 01 11:00 METHOD: EPA 8260B							
ATILE ORGANIC COMPOUNDS				1	05.01.01	V010062MSB	1,2
rt-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
thyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	J.8	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	94.		%				
Surrogate 1,2-DCA-d4	92.		%				
Surrogate Toluene-d8	88.		%				
Surrogate 4-BFB	89.		%				

1) Sample Preparation on 04-30-01 using EPA 5030
2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

LAB ORDER No.: B040451

ORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040451-1 SAMPLE ID: IS-SP-S SAMPLED: 17 APR 01 10:00 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	05.01.01	V010062MSB	1,2
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	J1.4	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	101.		%				
Surrogate 1,2-DCA-d4	94.		%				
Surrogate Toluene-d8	88.		%				
Surrogate 4-BFB	88.		%				
LAB NUMBER: B040451-2 SAMPLE ID: IS-SP-S1 SAMPLED: 17 APR 01 10:00 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	05.01.01	V010062MSB	1,2
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	J1.3	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	98.		%				
Surrogate 1,2-DCA-d4	94.		%				
Surrogate Toluene-d8	88.		%				
Surrogate 4-BFB	90.		%				
LAB NUMBER: B040451-3 SAMPLE ID: IS-SP-SM SAMPLED: 17 APR 01 09:30 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	05.01.01	V010062MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	18.	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				

1) Sample Preparation on 04-30-01 using EPA 5030
2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

ORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080693-1							
SAMPLE ID: IS-SU-SM							
SAMPLED: 21 AUG 01 09:00							
METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	08.27.01	V010116MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	3.	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	110.		%				
Surrogate 1,2-DCA-d4	108.		%				
Surrogate Toluene-d8	118.		%				
Surrogate 4-BFB	125.		%				
LAB NUMBER: B080693-2							
SAMPLE ID: IS-SU-SC							
SAMPLED: 21 AUG 01 10:05							
METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	09.01.01	V010119MSB	2
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	3.	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	98.		%				
Surrogate 1,2-DCA-d4	90.		%				
Surrogate Toluene-d8	97.		%				
Surrogate 4-BFB	112.		%				
LAB NUMBER: B080693-3							
SAMPLE ID: IS-SU-S1							
SAMPLED: 21 AUG 01 09:30							
METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	09.01.01	V010119MSB	2
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	3.	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	101.		%				

1) Sample Preparation on 08-27-01 using EPA 5030
2) Sample Preparation on 08-31-01 using EPA 5030

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ORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080693-3 (continued) SAMPLE ID: IS-SU-S1 SAMPLED: 21 AUG 01 09:30 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS (continued)				1	09.01.01	V010119MSB	
Surrogate 1,2-DCA-d4	86.		%				
Surrogate Toluene-d8	95.		%				
Surrogate 4-BFB	100.		%				
LAB NUMBER: B080693-4 SAMPLE ID: IS-SU-S SAMPLED: 21 AUG 01 09:30 METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS				1	09.01.01	V010119MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
hyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
.isopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	3	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	103.		%				
Surrogate 1,2-DCA-d4	90.		%				
Surrogate Toluene-d8	98.		%				
Surrogate 4-BFB	105.		%				

1) Sample Preparation on 08-31-01 using EPA 5030

United States Environmental Protection Agency
Office of Water 4304
EPA-822-F-97-009
December 1997

FACT SHEET

Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MtBE)

The Advisory

The U.S. Environmental Protection Agency (EPA) Office of Water is issuing an Advisory on methyl tertiary-butyl ether (MtBE)in drinking water. This Advisory provides guidance to communities exposed to drinking water contaminated with MtBE. This document supersedes any previous drafts of drinking water health advisories for this chemical.

What is an Advisory?

The U.S. EPA Health Advisory Program was initiated to provide information and guidance to individuals or agencies concerned with potential risk from drinking water contaminants for which no national regulations currently exist. Advisories are not mandatory standards for action. Advisories are used only for guidance and are not legally enforceable. They are subject to revision as new information becomes available. EPA's Health Advisory program is recognized in the Safe Drinking Water Act Amendments of 1996, which state in section 102(b)(1)(F):

> “The Administrator may publish health advisories (which are not regulations) or take other appropriate actions for contaminants not subject to any national primary drinking water regulation”.

As its title indicates, this Advisory includes consumer acceptability advice as "appropriate" under this statutory provision, as well as a health effects analysis.

What is MtBE?

MtBE is a volatile, organic chemical. Since the late 1970's, MtBE has been used as an octane enhancer in gasoline. Because it promotes more complete burning of gasoline, thereby reducing carbon monoxide and ozone levels, it is commonly used as a gasoline additive in localities which do not meet the National Ambient Air Quality Standards.

In the Clean Air Act of 1990 (Act), Congress mandated the use of reformulated gasoline (RFG) in areas of the country with the worst ozone or smog problems. RFG must meet certain technical specifications set forth in the Act, including a specific oxygen content. Ethanol and MtBE are the primary oxygenates used to meet the oxygen content requirement. MtBE is used in about 84% of RFG supplies. Currently, 32 areas in a total of 18 states are participating in the RFG program, and RFG accounts for about 30% of gasoline nationwide.

Studies identify significant air quality and public health benefits that directly result from the use of fuels oxygenated with MtBE, ethanol or other chemicals. The refiners’ 1995/96 fuel data submitted to EPA indicate that the national emissions benefits exceeded those required. The 1996 Air Quality Trends Report shows that toxic air pollutants declined significantly between 1994 and 1995. Early analysis indicates this progress may be attributable to the use of RFG. Starting in the year 2000, required emission reductions are substantially greater, at about 27% for volatile organic compounds, 22% for toxic air pollutants, and 7% for nitrogen oxides.

Why is MtBE a Drinking Water Concern?

A limited number of instances of significant contamination of drinking water with MtBE have occurred due to leaks from underground and above ground petroleum storage tank systems and pipelines. Due to its small molecular size and solubility in water, MtBE moves rapidly into groundwater, faster than do other constituents of gasoline. Public and private wells have been contaminated in this manner. Non-point sources, such as recreational watercraft, are most likely to be the cause of small amounts of contamination in a large number of shallow aquifers and surface waters. Air deposition through precipitation of industrial or vehicular emissions may also contribute to surface water contamination. The extent of any potential for build-up in the environment from such deposition is uncertain.

Is MtBE in Drinking Water Harmful?

Based on the limited sampling data currently available, most concentrations at which MtBE has been found in drinking water sources are unlikely to cause adverse health effects. However, EPA is continuing to evaluate the available information and is doing additional research to seek more definitive estimates of potential risks to humans from drinking water.

There are no data on the effects on humans of drinking MtBE-contaminated water. In laboratory tests on animals, cancer and noncancer effects occur at high levels of exposure. These tests were conducted by inhalation exposure or by introducing the chemical in oil directly to the stomach. The tests support a concern for potential human hazard. Because the animals were not exposed through drinking water, there are significant uncertainties about the degree of risk associated with human exposure to low concentrations typically found in drinking water.

How Can People be Protected?

MtBE has a very unpleasant taste and odor, and these properties can make contaminated drinking water unacceptable to the public. This Advisory recommends control levels for taste and odor acceptability that will also protect against potential health effects.

Studies have been conducted on the concentrations of MtBE in drinking water at which individuals can detect the odor or taste of the chemical. Humans vary widely in the concentrations they are able to detect. Some who are sensitive can detect very low concentrations, others do not taste or smell the chemical even at much higher concentrations. Moreover, the presence or absence of other natural or water treatment chemicals can mask or reveal the taste or odor effects.

Studies to date have not been extensive enough to completely describe the extent of this variability, or to establish a population threshold of response. Nevertheless, we conclude from the available studies that keeping concentrations in the range of 20 to 40 micrograms per liter (µg/L) of water or below will likely avert unpleasant taste and odor effects, recognizing that some people may detect the chemical below this.

Concentrations in the range of 20 to 40 µg/L are about 20,000 to 100,000 (or more) times lower than the range of exposure levels in which cancer or noncancer effects were observed in rodent tests. This margin of exposure is in the range of margins of exposure typically provided to protect against cancer effects by the National Primary Drinking Water Standards under the Federal Safe Drinking Water Act. This margin is greater than such standards typically provided to protect against noncancer effects. Thus, protection of the water source from unpleasant taste and odor as recommended will also protect consumers from potential health effects.

EPA also notes that occurrences of ground water contamination observed at or above this 20-40 μg/l taste and odor threshold -- that is, contamination at levels which may create consumer acceptability problems for water suppliers -- have to date resulted from leaks in petroleum storage tanks or pipelines, not from other sources.

What is Being Done About the Problem?

<u>Research</u>

The EPA, other federal and state agencies, and private entities are conducting research and developing a strategy for future research on all health and environmental issues associated with the use of oxygenates. To address the research needs associated with oxygenates in water, a public, scientific workshop to review the EPA's Research Strategy for Oxygenates in Water document was held on October 7, 1997.

Discussions included current, or soon to be started, oxygenate projects in the areas of environmental monitoring/occurrence, source characterization, transport and fate, exposure, toxicity, remediation, among others. The identified research will help provide the necessary information to better understand the health effects related to MtBE and other oxygenates in water, to further our knowledge on remediation techniques, and to direct future research planning towards the areas of highest priority. This document is expected to be available for external review by January, 1998. EPA plans to hold a workshop with industry to secure commitments on conducting the needed research in the Spring of 1998.

The EPA has also recently notified a consortium of fuel and fuel additive manufacturers of further air-related research requirements of industry under section 211(b) of the Clean Air Act (CAA). The proposed animal inhalation research focuses on the short and long term inhalation effects of conventional gasoline and MtBE gasoline in the areas of neurotoxicity, immunotoxicity, reproductive and developmental toxicity, and carcinogenicity. The testing requirements will also include an extensive array of human exposure research. This research will be completed at varying intervals over the next five years and could be very useful for assessing risks from MtBE in water, depending on the outcome of studies underway on the extrapolation of inhalation risks to oral ingestion.

When adequate research on the human health effects associated with ingestion of oxygenates becomes available, the EPA Office of Water will issue a final health advisory to replace the present advisory.

Monitoring

The EPA's Office of Water has also entered into a cooperative agreement with the United States Geological Survey (USGS) to conduct an assessment of the occurrence and distribution of MtBE in the 12 mid-Atlantic and Northeastern states. Like California, these States have used MtBE extensively in the RFG and Oxygenated Fuels programs. This study will supplement the data gathered in California and will attempt to shed light on the important issues of (1) whether or not MtBE has entered drinking water distribution systems or impacted drinking water source supplies, and (2) determine if point (land) or nonpoint sources (air) are associated with detections of MtBE in ground water resources. Activities are underway to begin collecting data in early 1998.

Underground Storage Tanks

Under EPA regulations, leaks from underground storage tank systems (USTs) which may cause contamination of groundwater with MtBE or other materials are required to be reported to the "implementing agency" which, in most cases, is a state agency. The EPA Office of Underground Storage Tanks and State and local authorities are addressing the cleanup of water contaminated by such leaks. All USTs installed after December 1988 have been required to meet EPA regulations for preventing leaks and spills. All USTs that were installed prior to December 1988 must be upgraded, replaced, or closed to meet these requirements by December 1998.

Safe Drinking Water Act Candidate List

The Safe Drinking Water Act (SDWA), as amended in 1996, requires EPA to publish a list of contaminants that may require regulation, based on their known or anticipated occurrence in public drinking water systems. The SDWA, as amended, specifically directs EPA to publish the first list of contaminants (Contaminant Candidate List, or CCL) by February 1998, after consultation with the scientific community, including EPA's Science Advisory Board, and after notice and opportunity for public comment. The amendments also require EPA to select at least five contaminants from the final CCL and make a determination of whether or not to develop regulations, including drinking water standards, for them by 2001. The EPA Office Water published a draft CCL for public comment in the Federal Register on October 6, 1997 (62 FR 52194). MtBE is included on the draft CCL based on actual MtBE contamination of certain drinking water supplies, e.g., Santa Monica, and the potential for contamination of other drinking water supplies in areas of the country where MtBE is used in high levels.

How Can I Get My Water Tested?

A list of local laboratories that can test your water for MtBE can be obtained from your state drinking water agency. The cost for testing is approximately $150 per sample. The analysis should be performed by a laboratory certified to perform EPA certified methods. The laboratory should follow EPA Method 524.2 (gas chromatography/mass spectrometry).

How Can I Get Rid of MtBE If It's In My Water?

In most cases it is difficult and expensive for individual home owners to treat their own water. Any detection of MtBE should be reported to your local water authority, who can work with you to have your water tested and treated.

Are There Any Recommendations for State or Public Water Suppliers?

Public water systems that conduct routine monitoring for volatile organic chemicals can test for MtBE at little additional cost, and some States are already moving in this direction.

Public water systems detecting MtBE in their source water at problematic concentrations can remove MtBE from water using the same conventional treatment techniques that are used to clean up other contaminants originating from gasoline releases, such as air stripping and granular activated carbon (GAC). However, because MtBE is more soluble in water and more resistant to biodegradation than other chemical constituents in gasoline, air stripping and GAC treatment requires additional optimization and must often be used together to remove MtBE effectively from water. The costs of removing MtBE will be higher than when treating for gasoline releases that do not contain MtBE. Oxidization of MtBE using UV/peroxide/ozone treatment may also be feasible, but typically has higher capital and operating costs than air stripping and GAC.

To Obtain the Advisory:
Call the National Center for Environmental Publications and Information (NCEPI) at 1-800-490-9198 to be sent a copy or write to NCEPI, EPA Publications Clearinghouse, P.O. Box 42419, Cincinnati, OH 45242 .

Internet download:
www.epa.gov/OST/Tools/MtBEaa.pdf

To Obtain the Research Strategy on Oxygenates in Water, External Review Draft, Contact: Diane Ray, U.S. EPA, Office of Research and Development, NCEA, MD-52, RTP, NC 27711 or by phone (919)541-3637.

Internet download:
www.epa.gov/ncea/oxywater.htm

To Obtain the 211(b) Air-Related Research Requirements, Contact:

John Brophy, U.S. EPA, Office of Air and Radiation; phone (202) 564-9068;
www.epa.gov/omswww/omsfuels.htm

For Further Information on the Advisory, Contact:
Charles Abernathy
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mtbe.advisory@epa.gov
(202)260-5374

For Further Information on the Research Strategy, Contact:
Diane Ray, U.S. EPA, Office of Research and Development, NCEA, MD-52, RTP, NC 27711 or by phone (919)541-3637.

VIII Lake Code Designation

Laboratory Reports are provided in the previous sections.

Sample ID is "XX-YY-ZZ" where

XX designation:	YY designation	ZZ designation
BB for Black Butte	SP for Spring	S for surface of Lake
EA for Eastman	SU for Summar	B for bottom of Lake
EN for Englebright		I-1 for inflow1
HE for Hensley		I-2 for inflow 2
IS for Isabella		O for outflow
KA for Kaweah		
ME for Mendocino		
MC for Martis Creek		
NH for New Hogan		
PF for Pine Flat		
SO for Sonoma		
SU for Success		

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