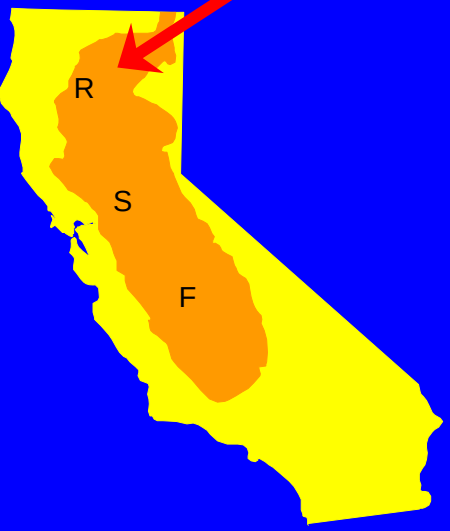
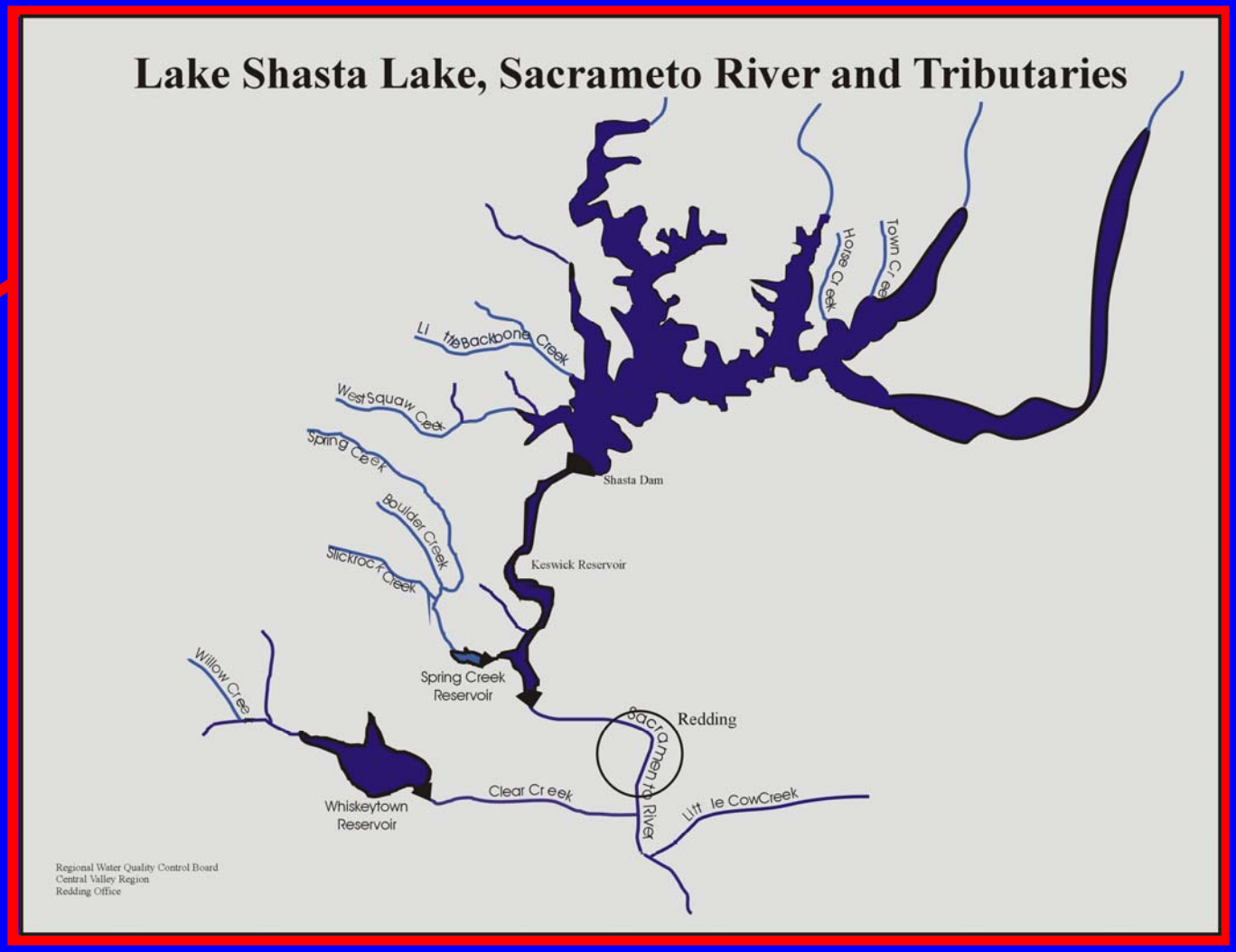
Distribution and Transport of Copper from Abandoned Mines Through Shasta Lake to the Sacramento River

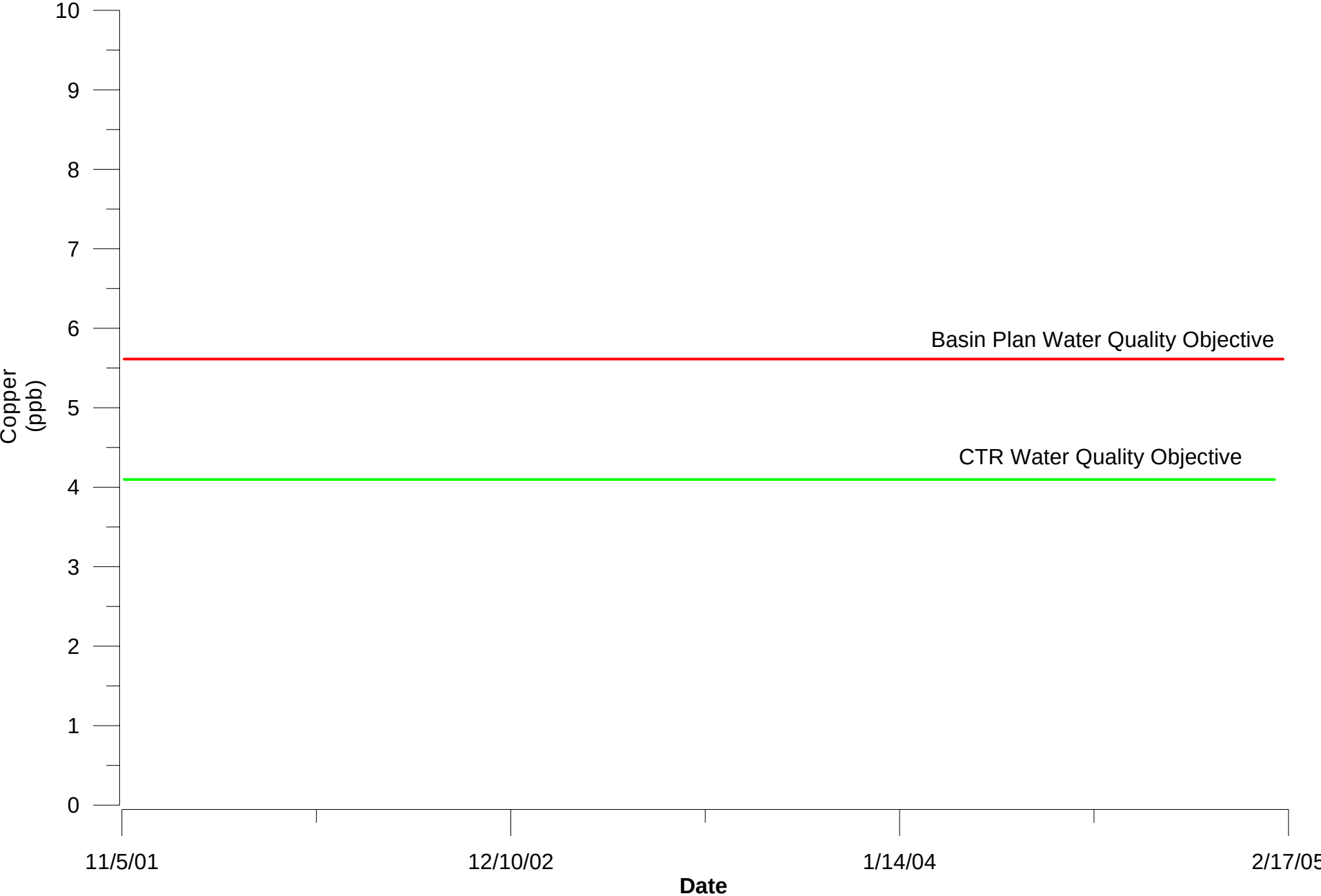
Philip Woodward, Senior Engineering Geologist
Mathew Boon, Environmental Scientist

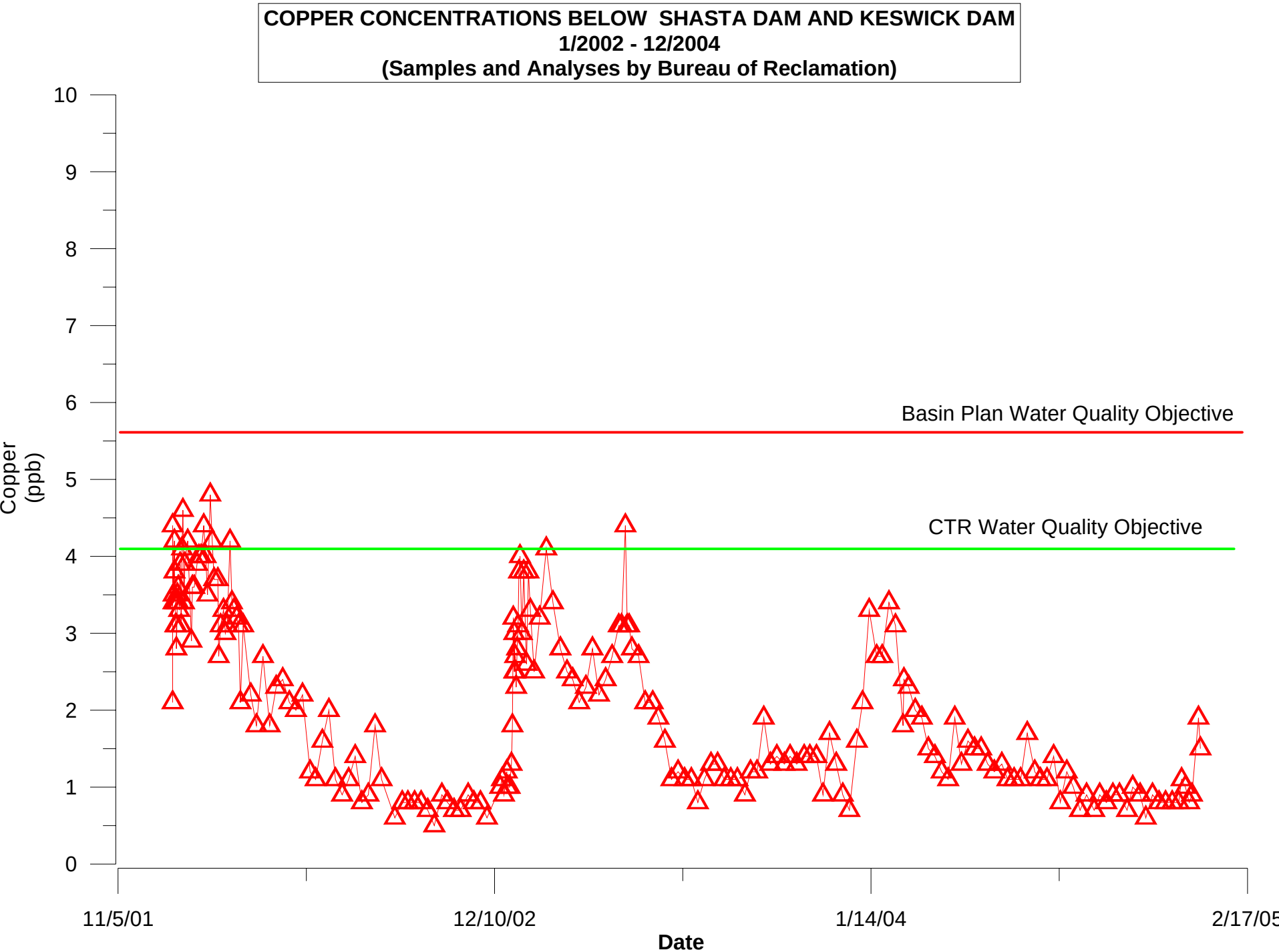
Watershed Location

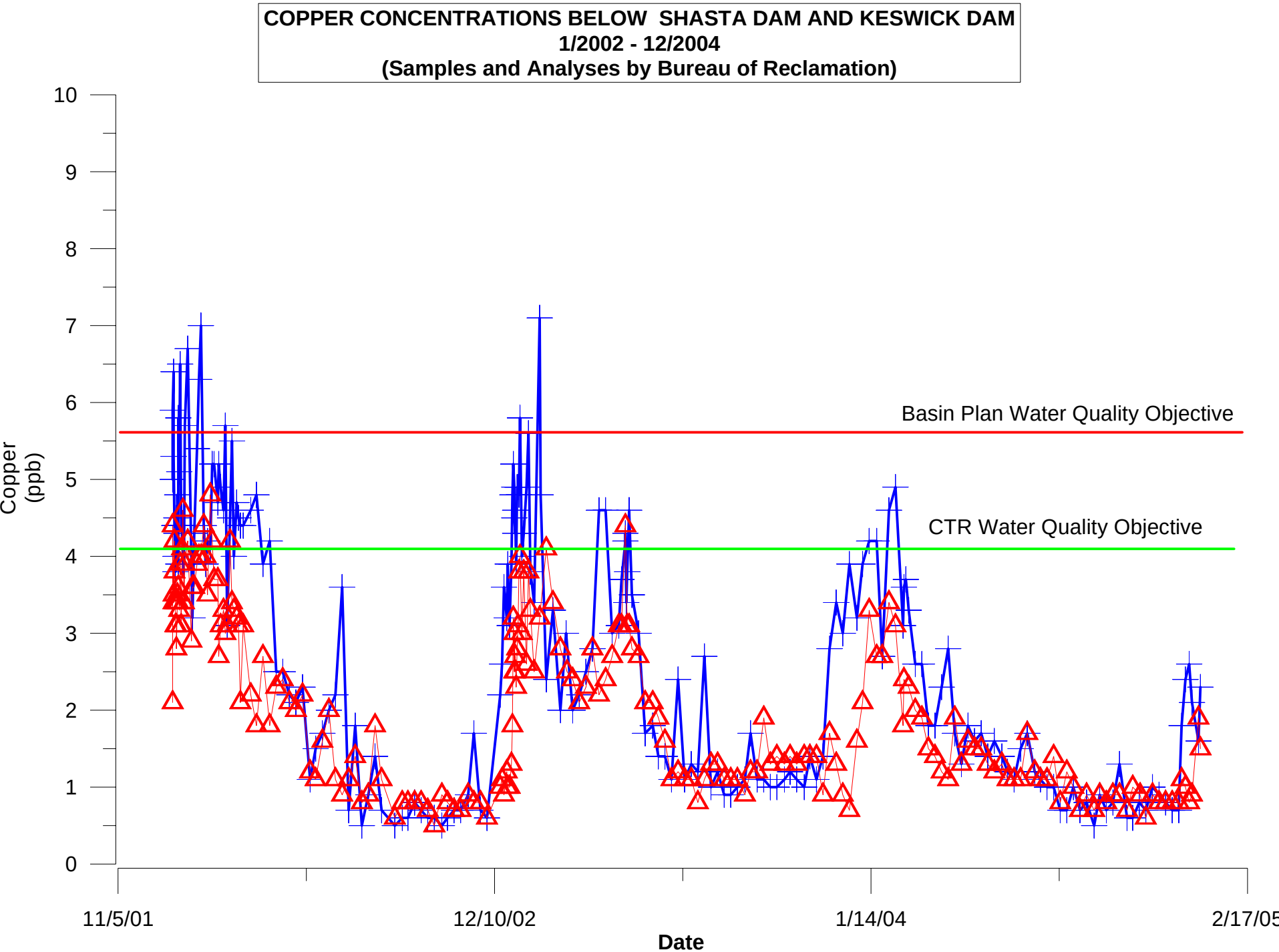


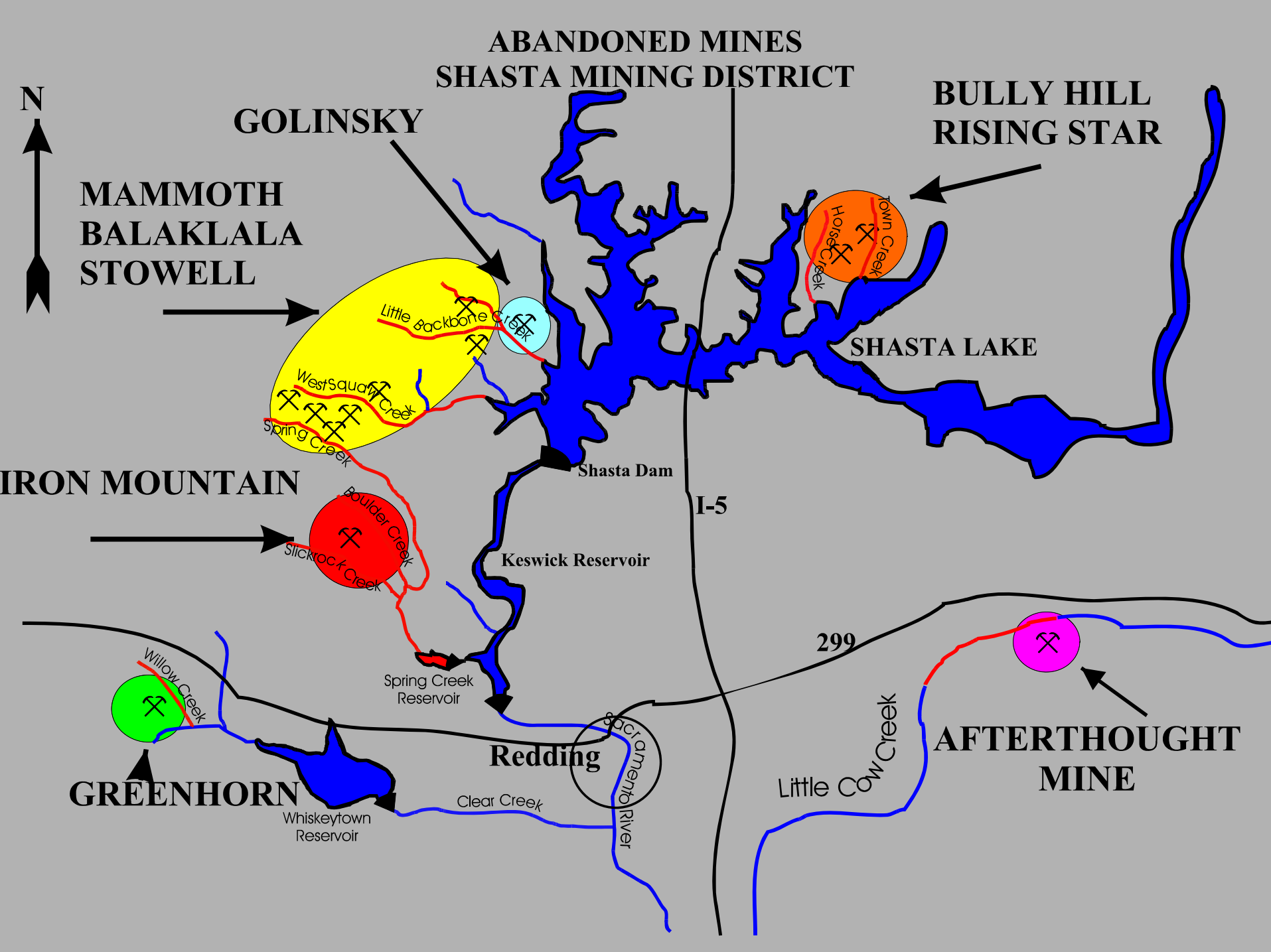


COPPER CONCENTRATIONS BELOW SHASTA DAM AND KESWICK DAM
1/2002 - 12/2004
(Samples and Analyses by Bureau of Reclamation)



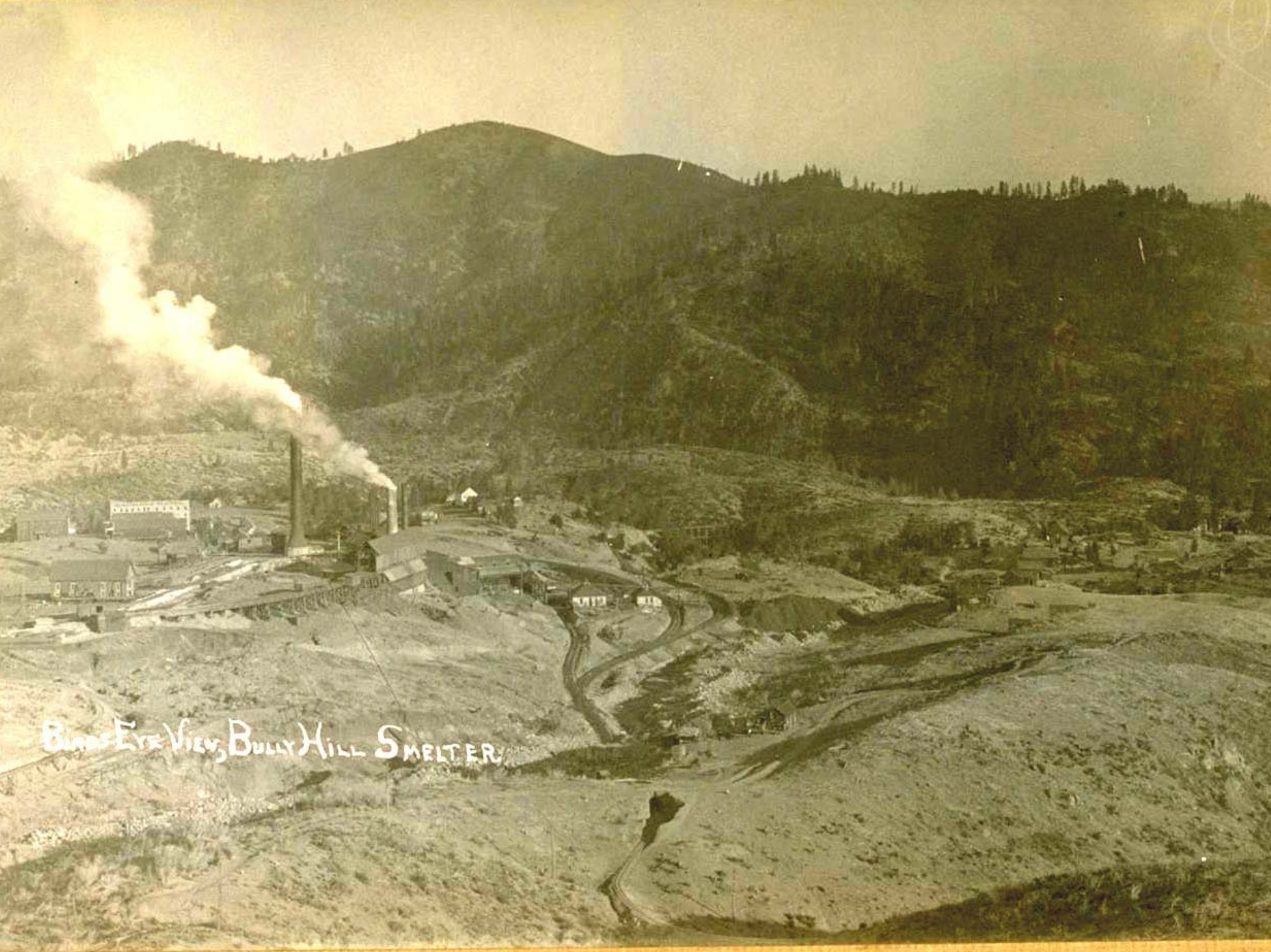

COPPER CONCENTRATIONS BELOW SHASTA DAM AND KESWICK DAM
1/2002 - 12/2004
(Samples and Analyses by Bureau of Reclamation)
Basin Plan Water Quality Objective
CTR Water Quality Objective
Copper (ppb)
0
1
2
3
4
5
6
7
8
9
10
11/5/01
12/10/02
1/14/04
2/17/05
Date


COPPER CONCENTRATIONS BELOW SHASTA DAM AND KESWICK DAM
1/2002 - 12/2004
(Samples and Analyses by Bureau of Reclamation)
Copper (ppb)
10
9
8
7
6
5
4
3
2
1
0
Basin Plan Water Quality Objective
CTR Water Quality Objective
11/5/01
12/10/02
1/14/04
2/17/05
Date

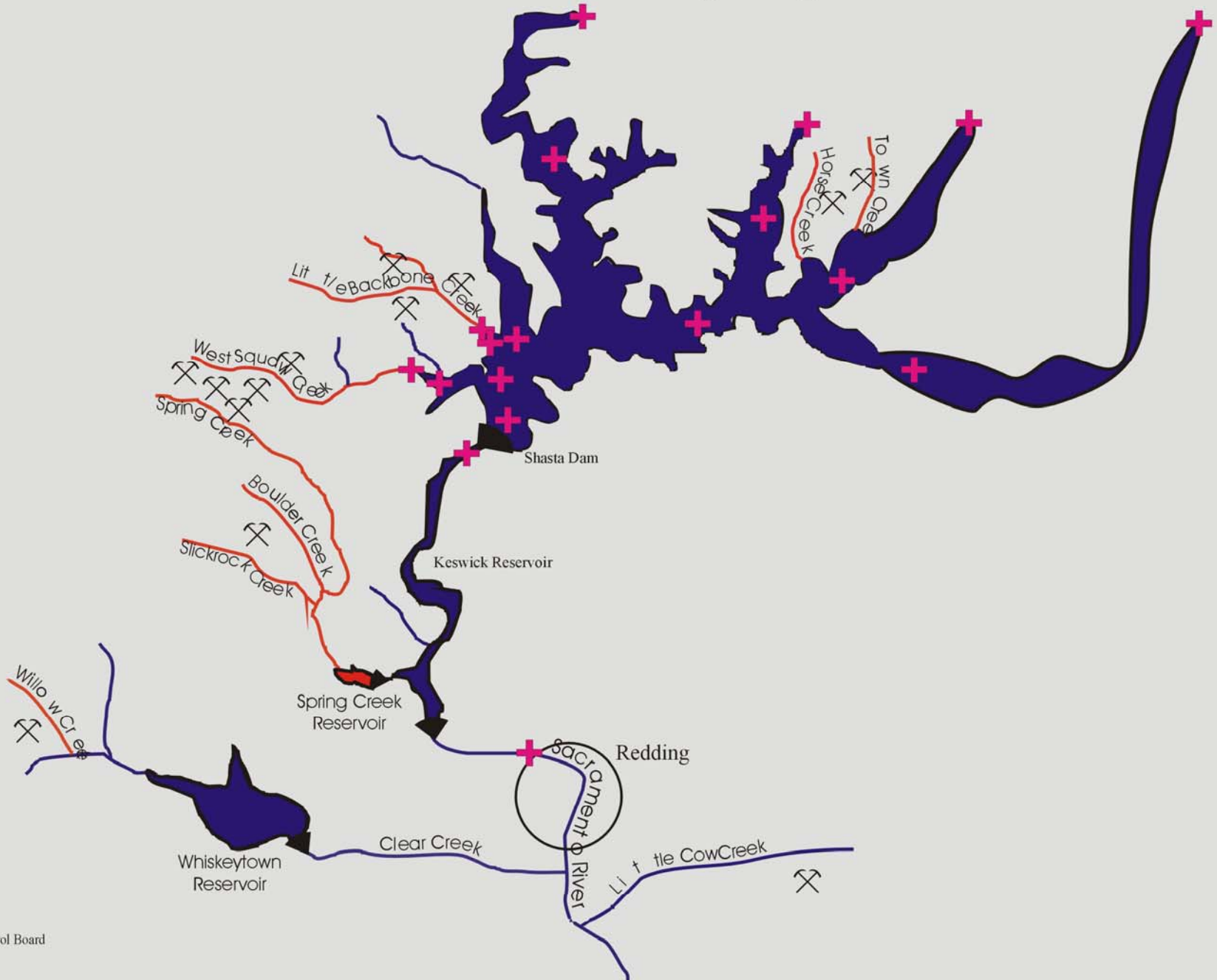

ABANDONED MINES
SHASTA MINING DISTRICT
N
GOLINSKY
BULLY HILL
RISING STAR
MAMMOTH
BALAKLALA
STOWELL
Little Backbone Creek
West Squaw Creek
Spring Creek
Town Creek
Horse Creek
SHASTA LAKE
Shasta Dam
IRON MOUNTAIN
Boulder Creek
Slickrock Creek
I-5
Keswick Reservoir
299
Willow Creek
Spring Creek
Reservoir
Sacramento River
Redding
Little Cow Creek
AFTERTHOUGHT
MINE
GREENHORN
Clear Creek
Whiskeytown
Reservoir

81 11 29

Head of Gravity Road at Mammoth Mine, No. 3.


Bird's Eye View, Bully Hill Smelter

Shasta lake Metal Sampling Locations



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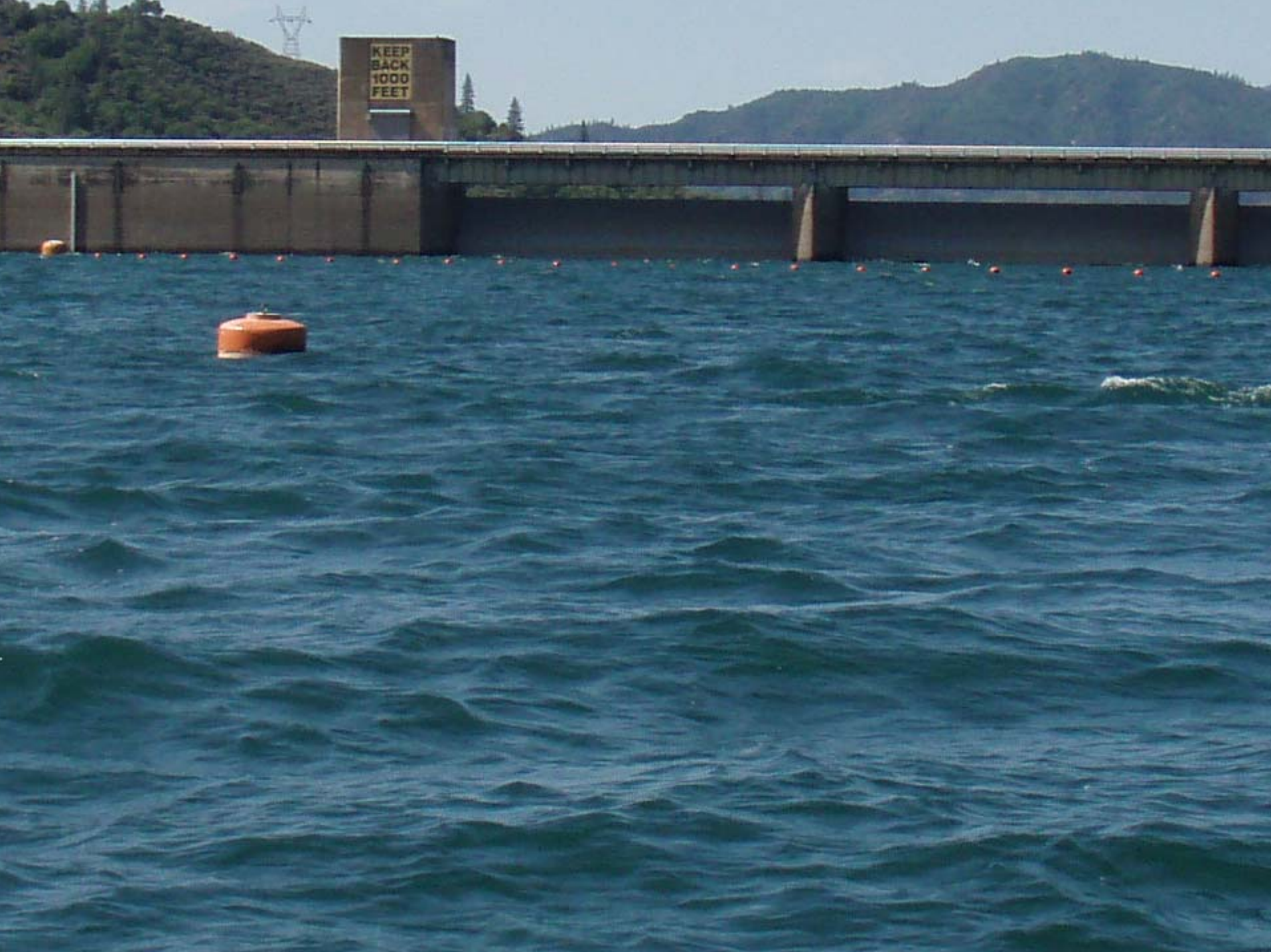
KEEP
BACK
1000
FEET

KEEP
BACK
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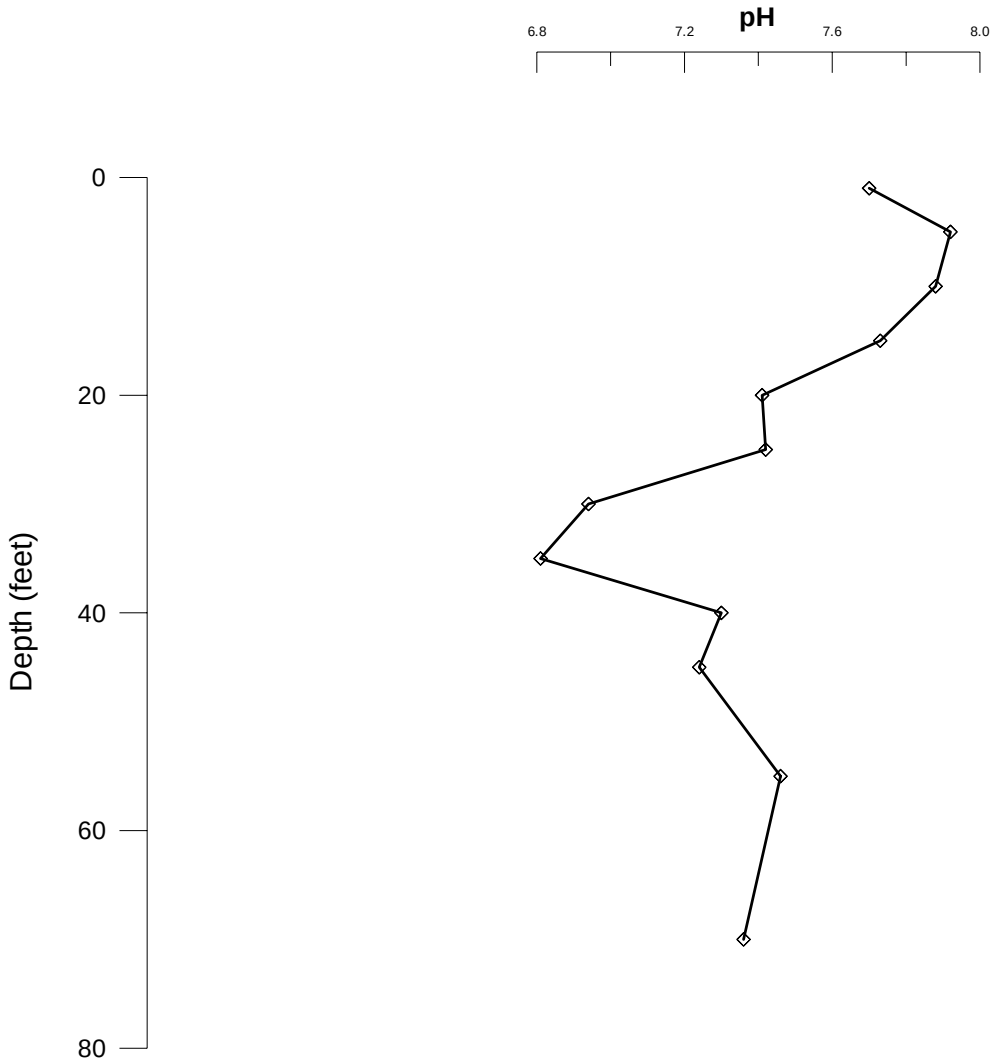
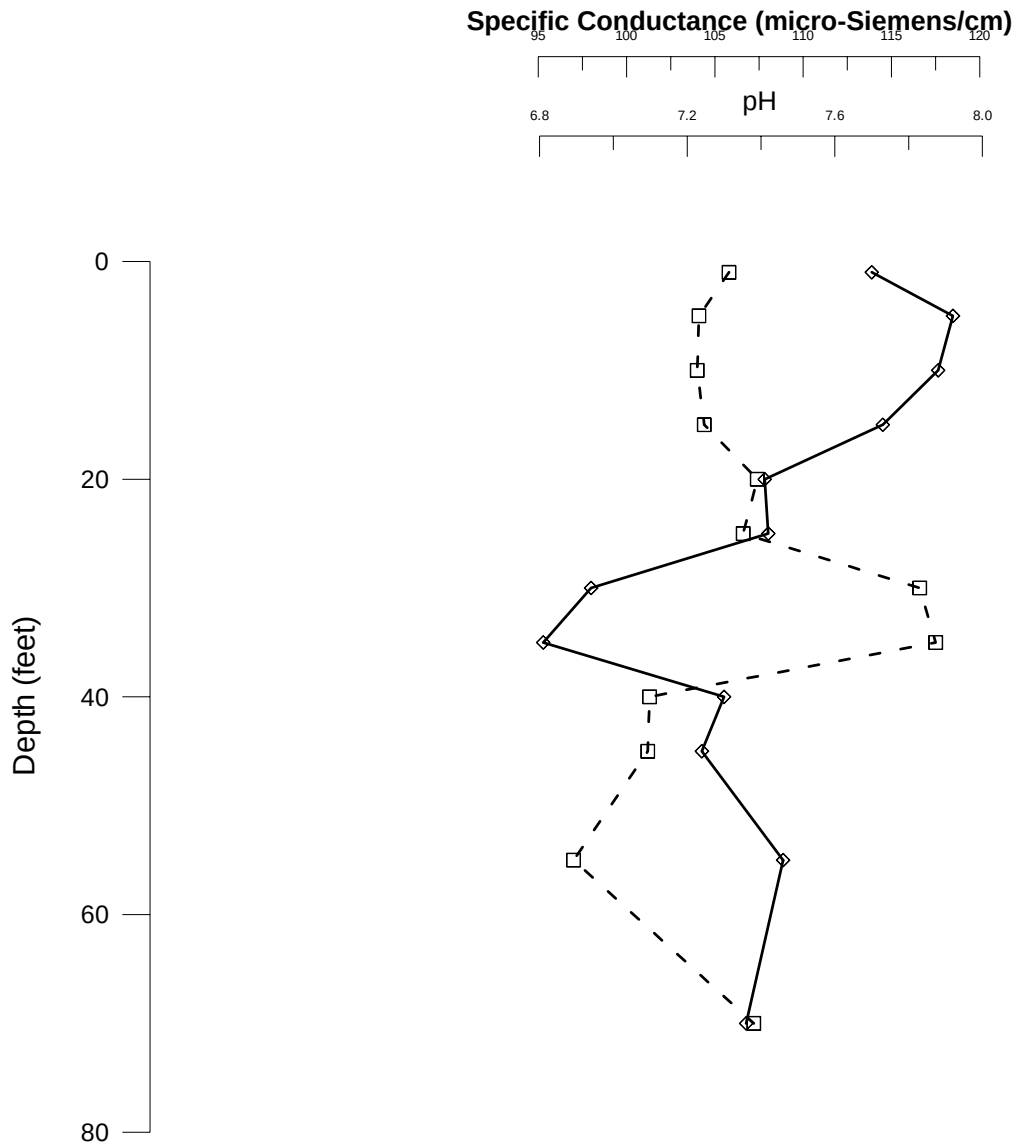
SHASTA LAKE AT LITTLE BACKBONE CREEK
31 May 1996

200 YARDS FROM CONFLUENCE WITH CREEK



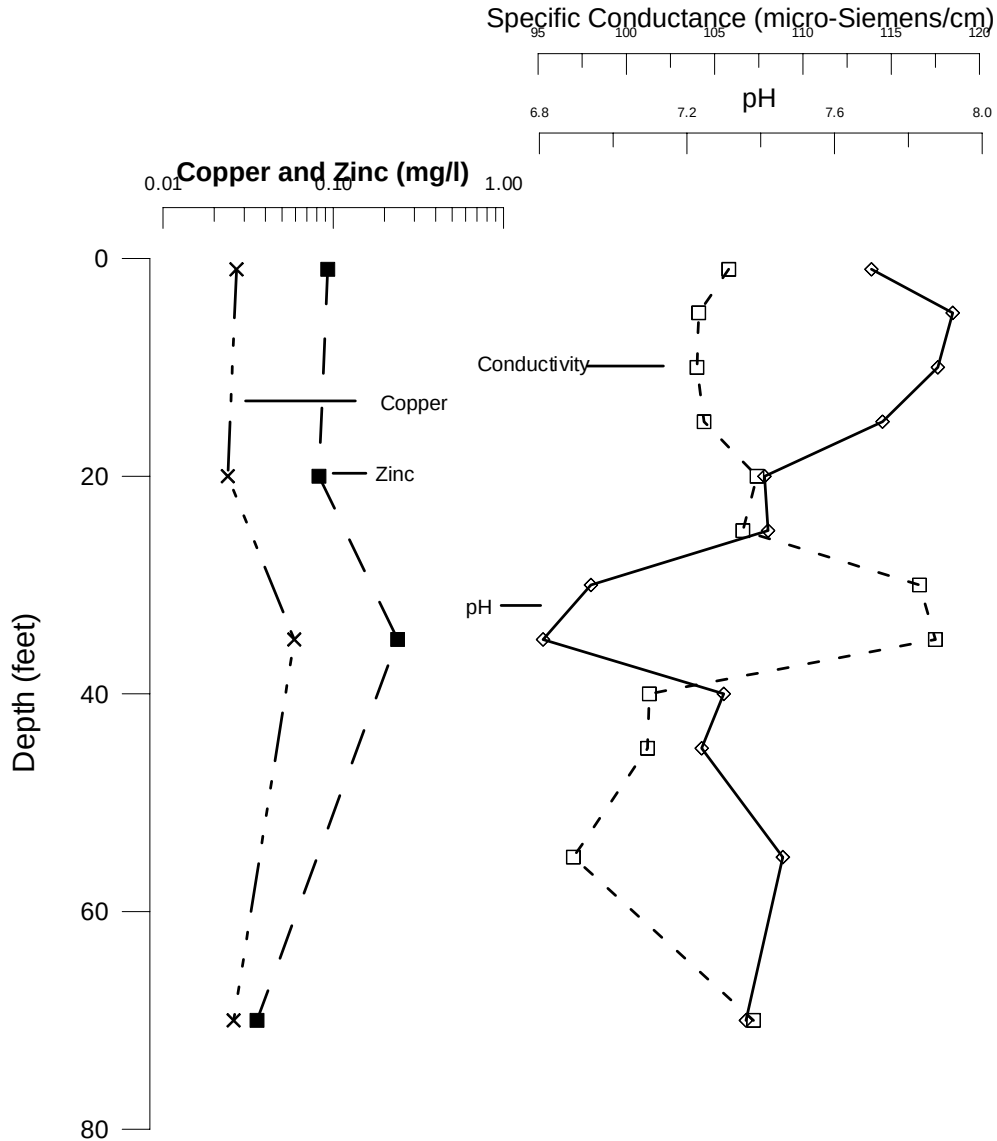
SHASTA LAKE AT LITTLE BACKBONE CREEK
31 May 1996

200 YARDS FROM CONFLUENCE WITH CREEK



SHASTA LAKE AT LITTLE BACKBONE CREEK
31 May 1996

200 YARDS FROM CONFLUENCE WITH CREEK



SHASTA LAKE AT LITTLE BACKBONE CREEK
31 May 1996

200 YARDS FROM CONFLUENCE WITH CREEK

Parameters in Little Backbone Creek
Copper = 0.83 mg/l
Zinc = 2.5 mg/l
Temperature = 12.07 C
pH = 4.62
Specific Conductance = 195 micro-Siemens/cm
Dissolved Oxygen= 94.5%

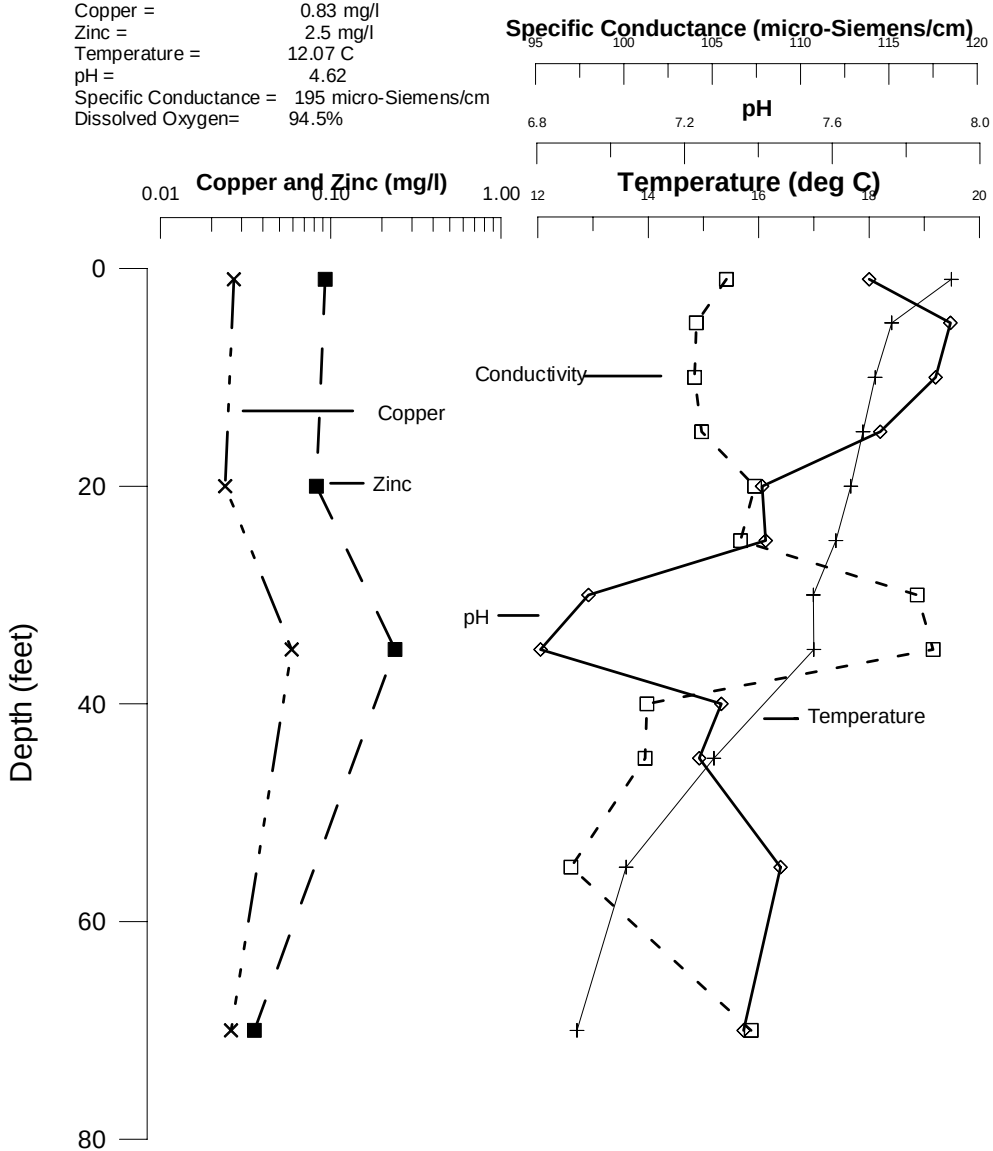
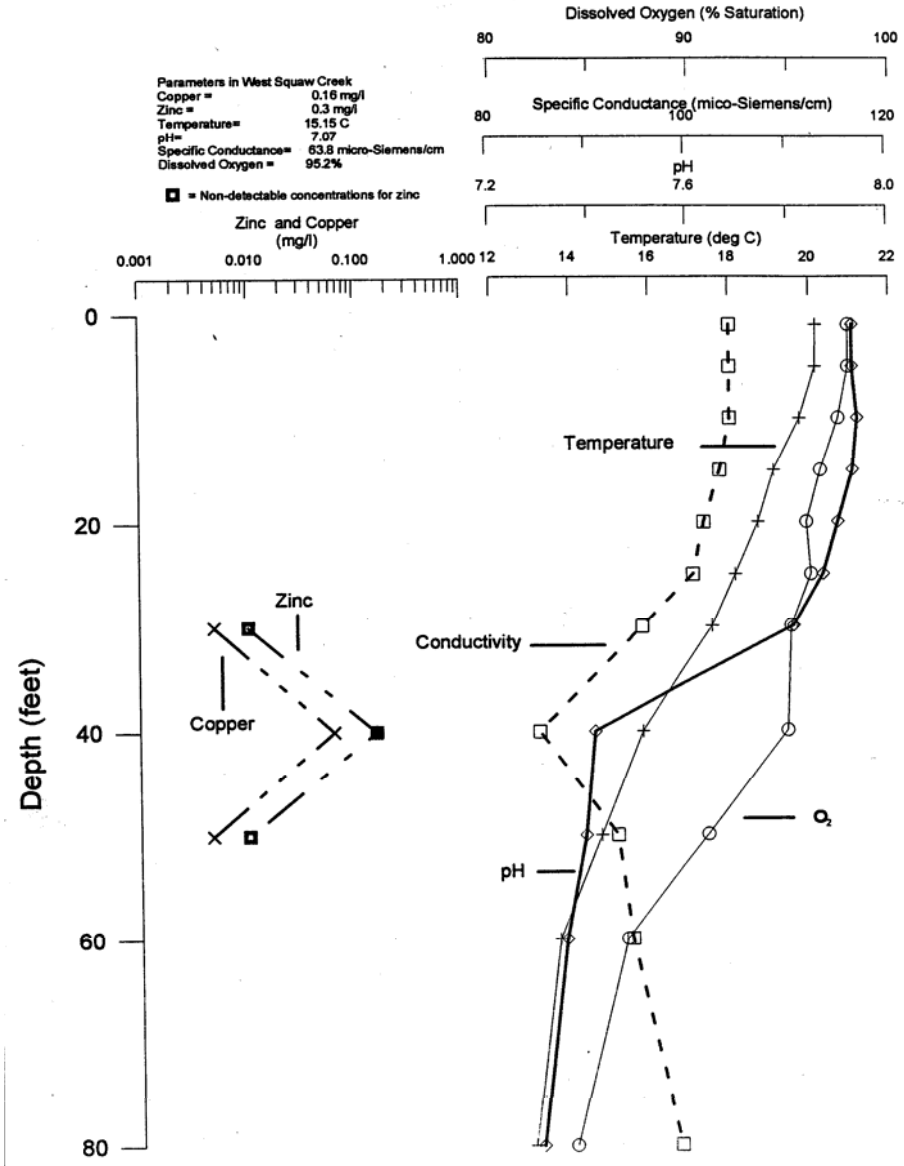


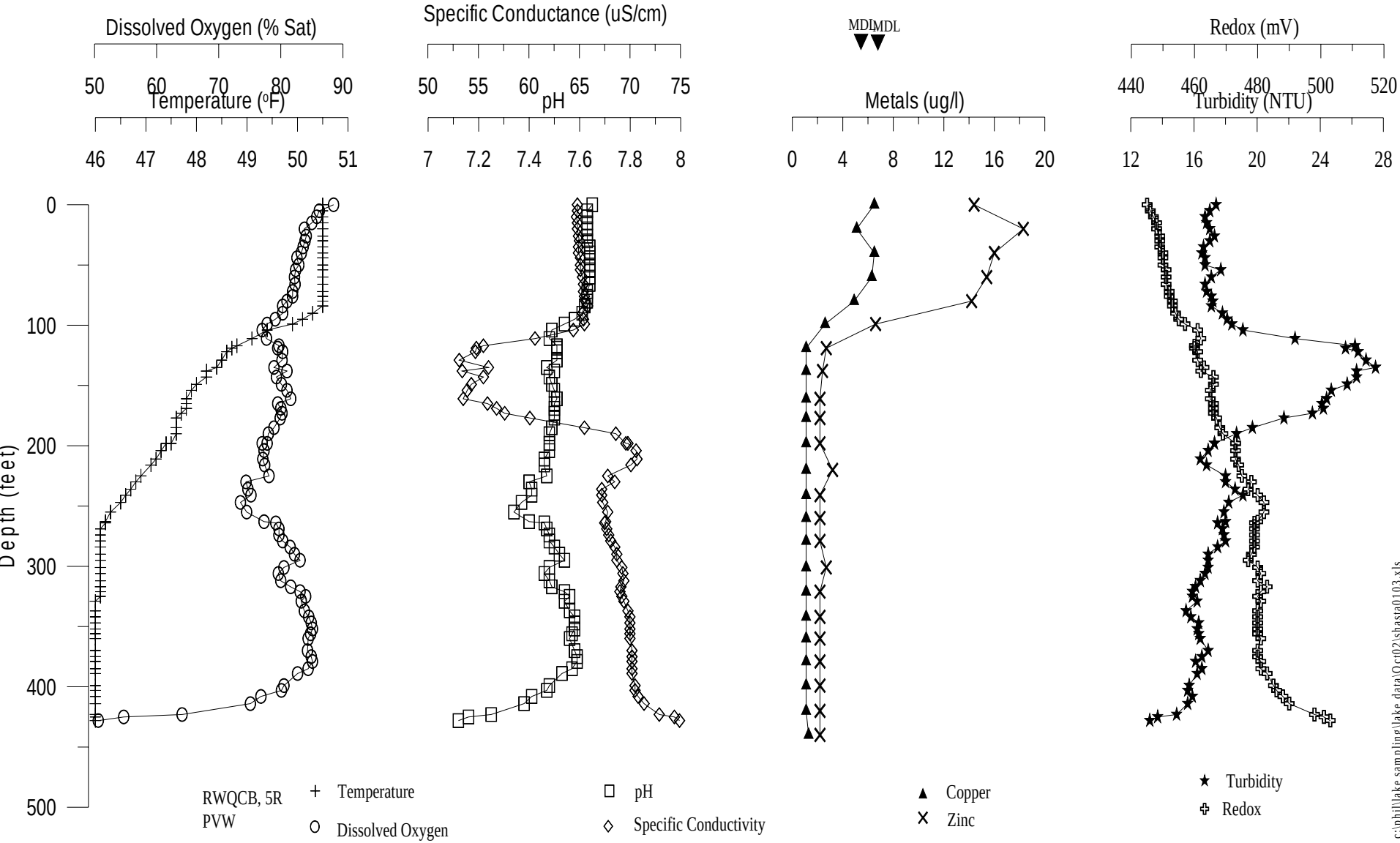
FIGURE 5

SHASTA LAKE AT WEST SQUAW CREEK
31 May 1996

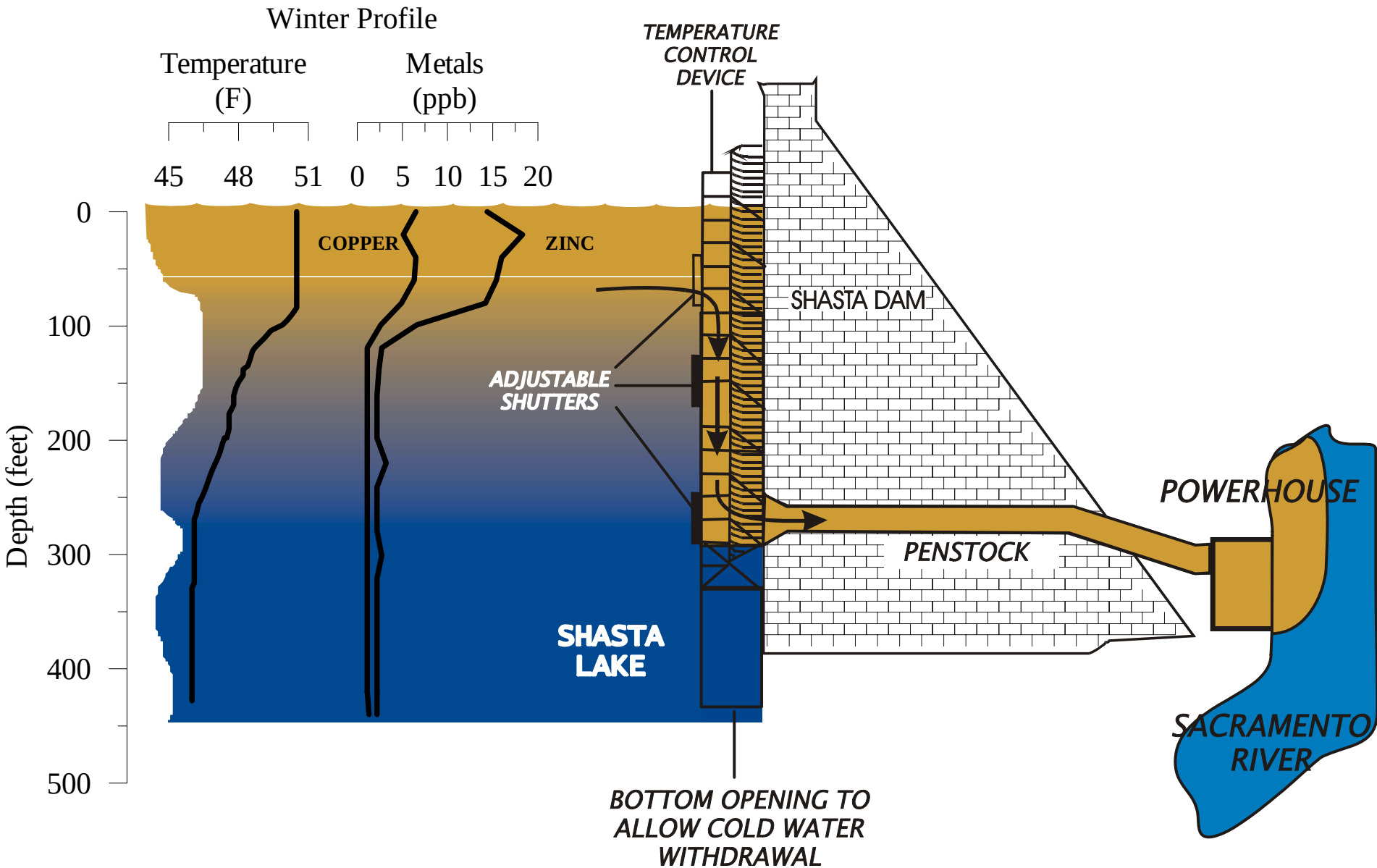
200 YARDS FROM CONFLUENCE WITH CREEK



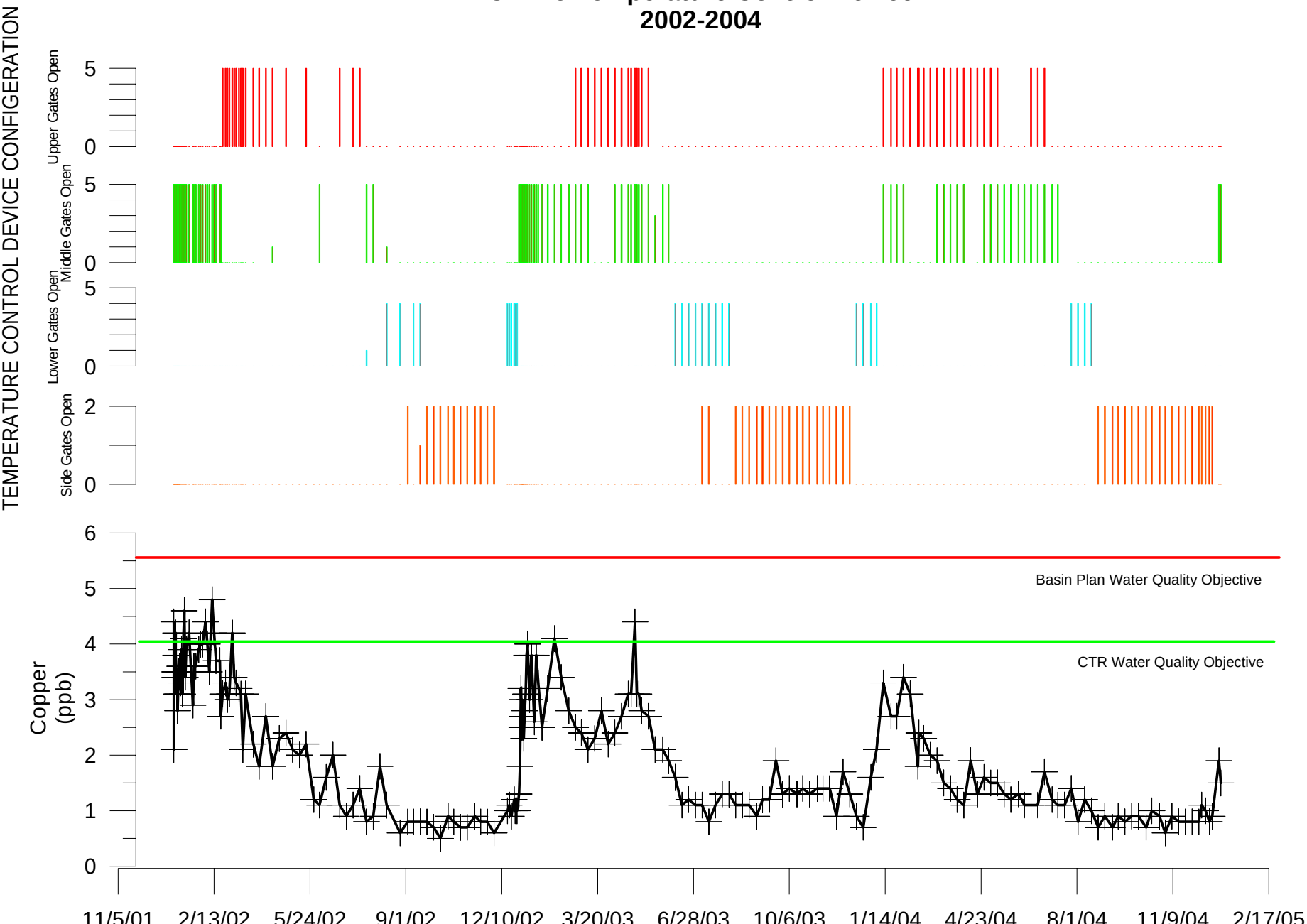
SHASTA DAM
January 2003



c:\phil\lake sampling\lake data\Oct02\shasta0103.xls


Winter Profile
Temperature (F)
Metals (ppb)
45
48
51
0
5
10
15
20
0
100
200
300
400
500
Depth (feet)
COPPER
ZINC
TEMPERATURE CONTROL DEVICE
SHASTA DAM
ADJUSTABLE SHUTTERS
POWERHOUSE
PENSTOCK
SHASTA LAKE
SACRAMENTO RIVER
BOTTOM OPENING TO ALLOW COLD WATER WITHDRAWAL

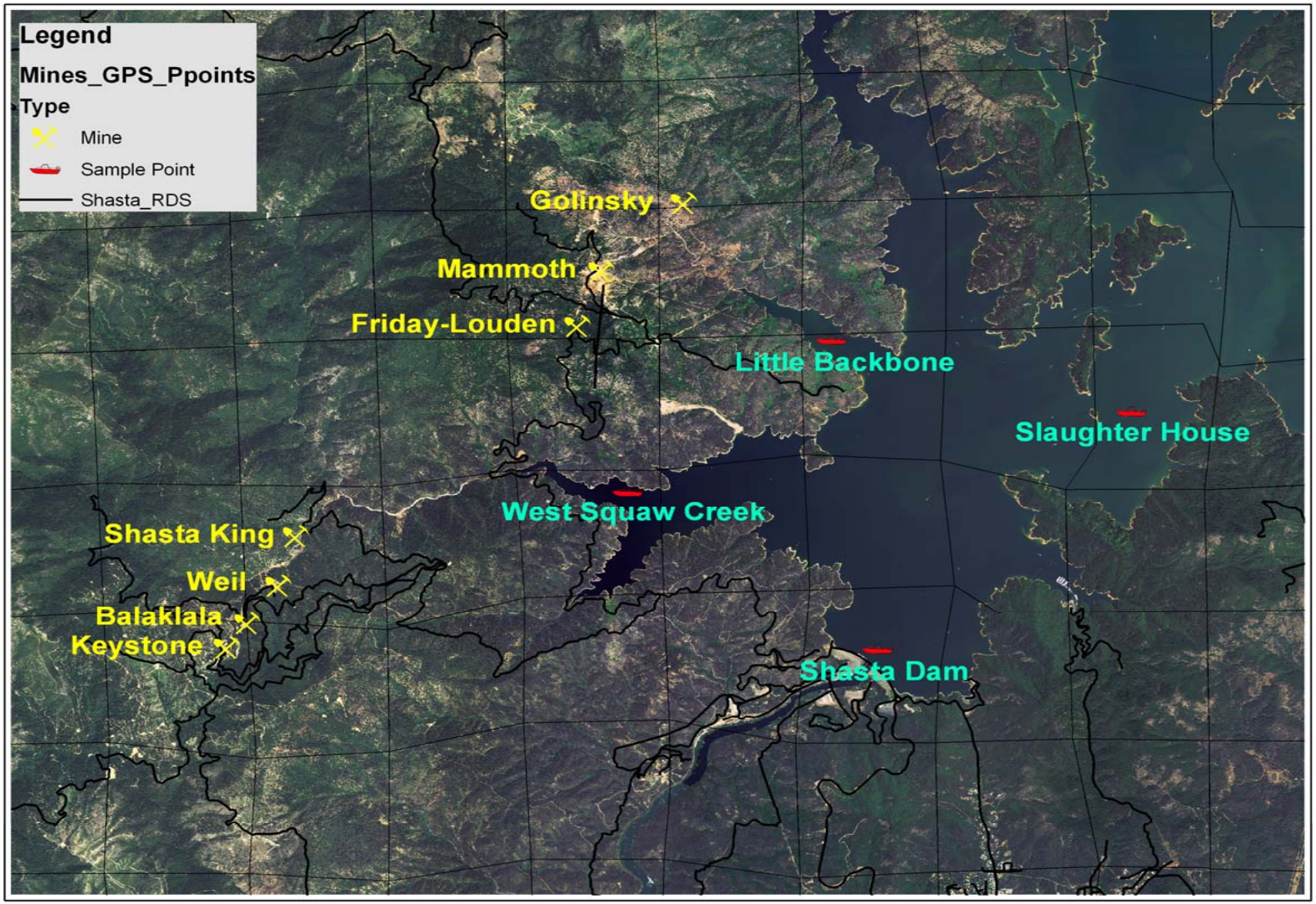
SHASTA DAM
Copper Concentrations And Configeration Of The Temperature Control Device 2002-2004



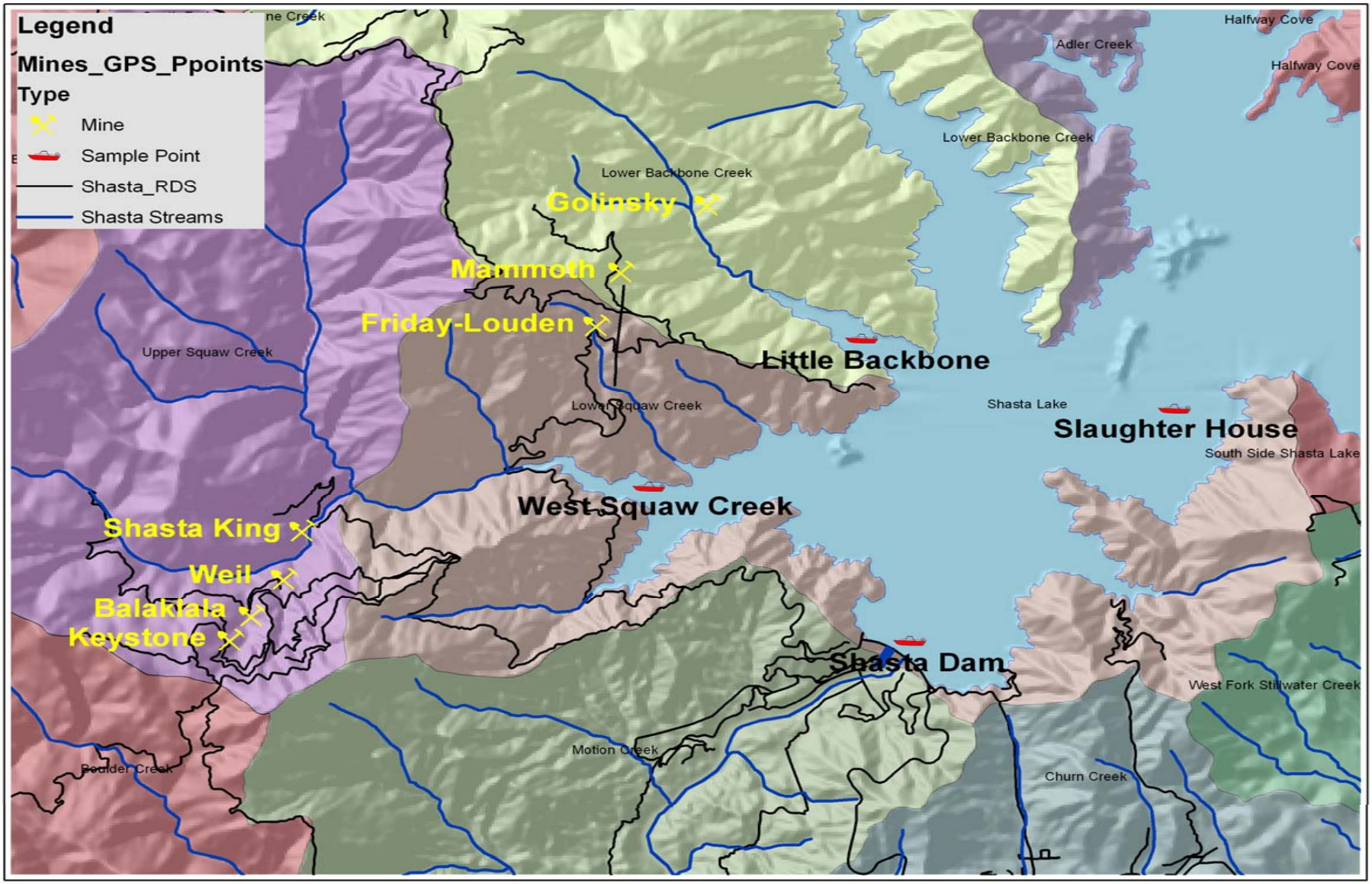
DATA MANAGEMENT

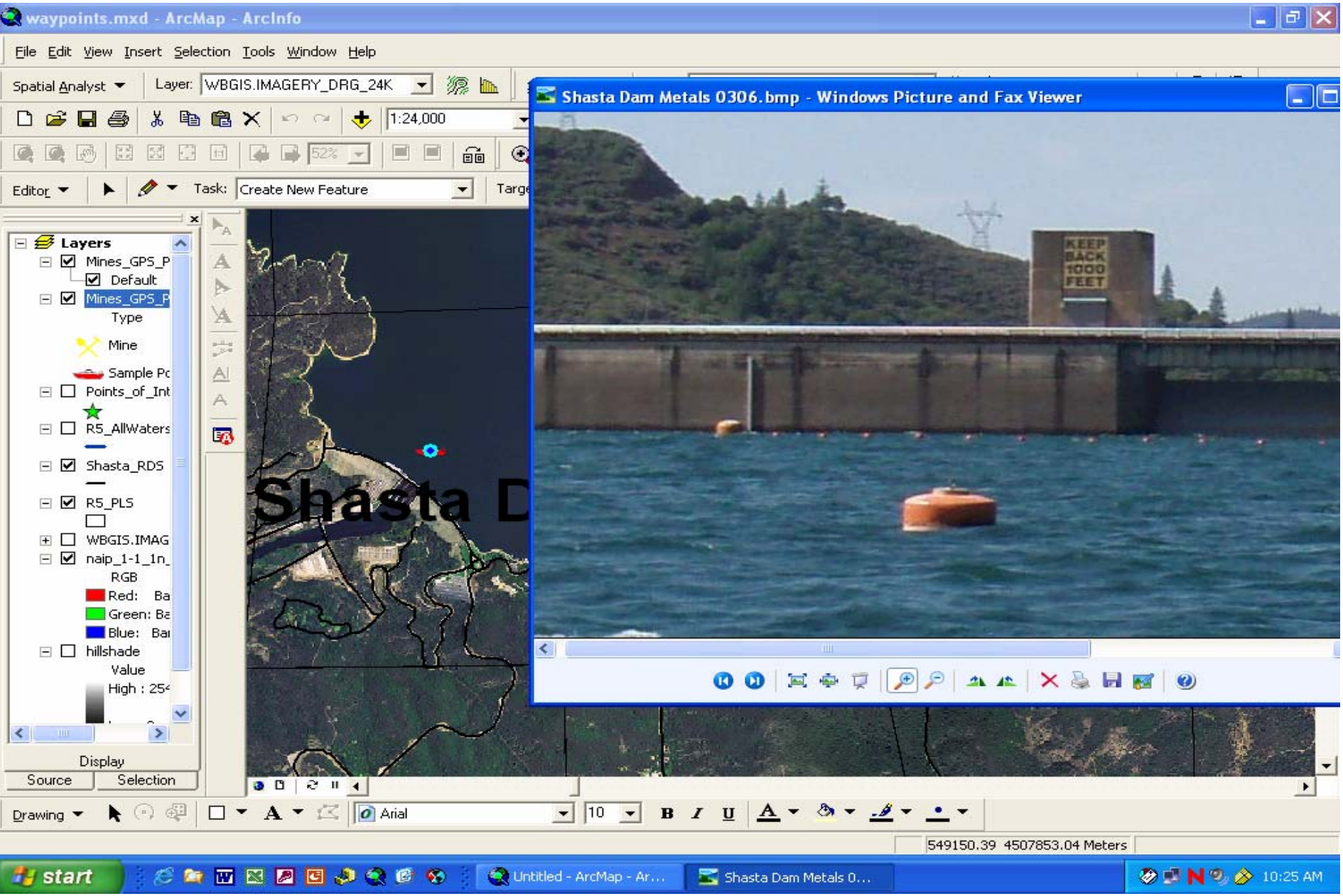
- Single Sampling Event = 5,700 data points
- Three times per year = 17,000 data points
- Sample three years = 50,000 data points
- GPS sample locations
- GIS system allows for easy access, visualization, and manipulation of data

Mine Locations & Sampling Points

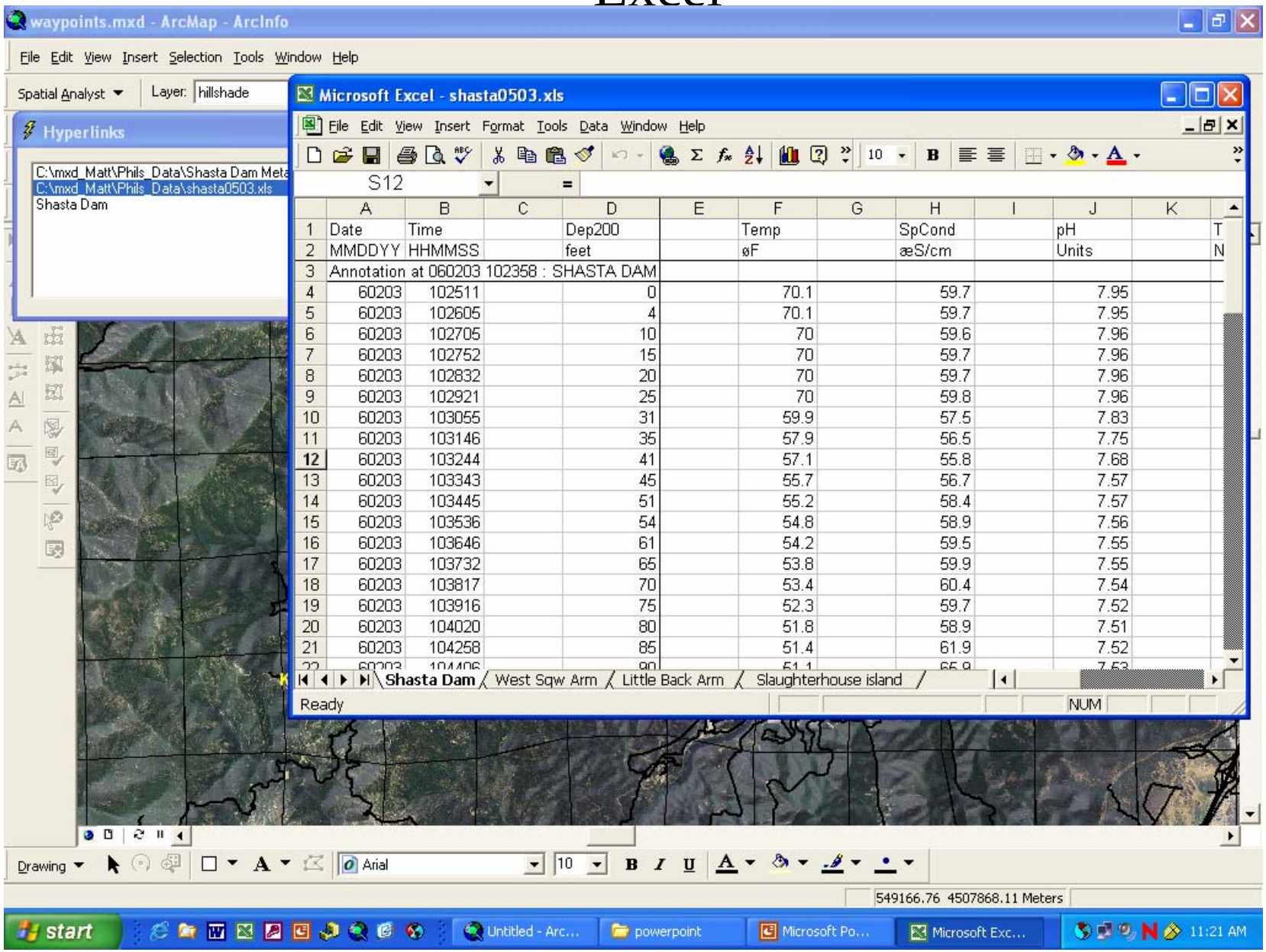


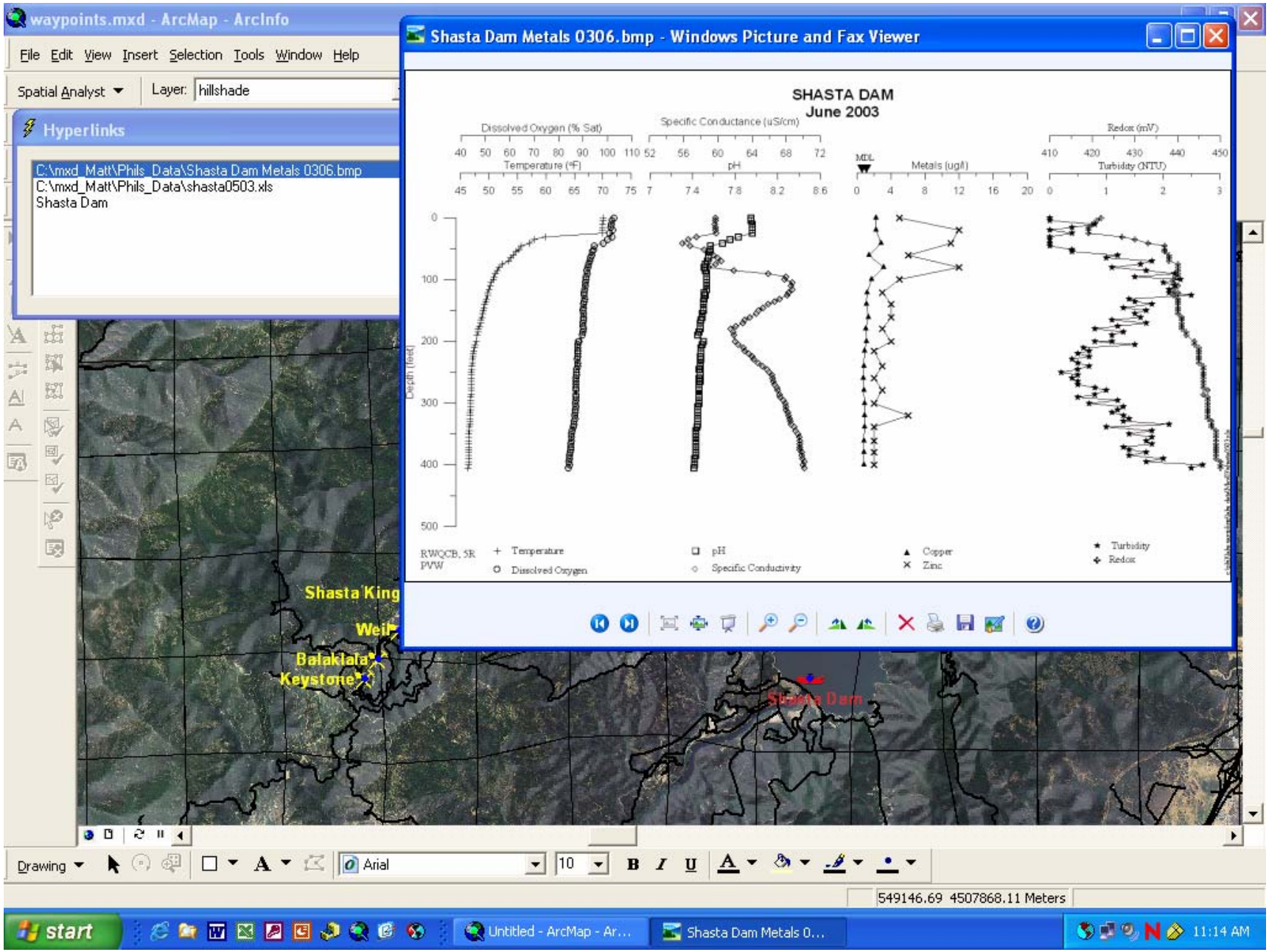
Mine Location & Flow Direction




waypoints.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Spatial Analyst
Layer: WBGIS.IMAGERY_DRG_24K
1:24,000
Editor
Task: Create New Feature
Layers
Mines_GPS_P
Default
Mines_GPS_P
Type
Mine
Sample Pc
Points_of_Int
R5_AllWaters
Shasta_RDS
R5_PLS
WBGIS.IMAG
naip_1-1_1n_
RGB
Red: Ba
Green: Ba
Blue: Ba
hillshade
Value
High : 254
Display
Source
Selection
Shasta D
Shasta Dam Metals 0306.bmp - Windows Picture and Fax Viewer
KEEP BACK 1000 FEET
Drawing
Arial
10
549150.39 4507853.04 Meters
start
Untitled - ArcMap - Ar...
Shasta Dam Metals 0...
10:25 AM

Hyperlink To Data
Excel



	A	B	C	D	E	F	G	H	I	J	K
1	Date	Time		Dep200		Temp		SpCond		pH	T
2	MMDDYY	HHMMSS		feet		øF		æS/cm		Units	N
3	Annotation at 060203 102358 : SHASTA DAM										
4	60203	102511		0		70.1		59.7		7.95	
5	60203	102605		4		70.1		59.7		7.95	
6	60203	102705		10		70		59.6		7.96	
7	60203	102752		15		70		59.7		7.96	
8	60203	102832		20		70		59.7		7.96	
9	60203	102921		25		70		59.8		7.96	
10	60203	103055		31		59.9		57.5		7.83	
11	60203	103146		35		57.9		56.5		7.75	
12	60203	103244		41		57.1		55.8		7.68	
13	60203	103343		45		55.7		56.7		7.57	
14	60203	103445		51		55.2		58.4		7.57	
15	60203	103536		54		54.8		58.9		7.56	
16	60203	103646		61		54.2		59.5		7.55	
17	60203	103732		65		53.8		59.9		7.55	
18	60203	103817		70		53.4		60.4		7.54	
19	60203	103916		75		52.3		59.7		7.52	
20	60203	104020		80		51.8		58.9		7.51	
21	60203	104258		85		51.4		61.9		7.52	

Hyperlinks to Data