TRACE ELEMENT CONCENTRATIONS IN SELECTED STREAMS IN CALIFORNIA: A SYNOPTIC SURVEY

California Regional Water Quality Control Board
Central Valley Region
3443 Routier Road
Sacramento, CA 95827-3098

October 1990

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

Board Members

John S. Corkins, Chair
Karl E. Longley, Vice Chair
Clifford C. Wisdom
Karen Vercruse
Paul E. Simpson
Hugh V. Johns
W. Steve Tompkins
Harry "Hank" C. Abraham

William H. Crooks, Executive Officer

The staff involved in the
preparation of this report are:

Dennis W. Westcot, Senior Land and Water Use Analyst

Brenda J. Grewell, Associate Land and Water Use Analyst

Jeanne E. Chilcott, Associate Land and Water Use Analyst

Special thanks goes to Kathryn Belden and Cassandra Enos
whose data management skills were invaluable
and to the numerous persons who assisted in the sample collection
program that made this study possible. Also special thanks
to Mary Knieriem who endured typing several drafts to produce this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX A

SUMMARY

The State Water Resources Control Board (State Board) and the Central Valley Regional Water Quality Control Board (Regional Board) have initiated efforts to formulate water quality objectives and implement a program to regulate discharges of agricultural subsurface drainage water that contains various levels of trace elements. Part of this regulatory program involves a sound knowledge of water quality and establishment of water quality objectives to protect beneficial uses. The method recommended by the State Board for establishing water quality criteria requires a knowledge of natural background concentrations of selected trace elements (SWRCB, 1987). For the discharge or disposal of subsurface tile drainage water, the most important trace elements are arsenic, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, silver, uranium and zinc. In order to develop the data needed for criteria development, the Regional Board carried out a one-time sampling survey to examine the range of natural concentrations of these 12 trace elements found in selected streams throughout Northern and Central California. This survey provided a preliminary data base that could be used to define background levels for these trace elements in California streams. The one-time reconnaissance sampling of 226 streams showed that very low concentrations occur naturally in the streams tested. The median electrical conductivity for the samples is 360 μmhos/cm. Of those tested, the most abundant trace element in California streams is boron with a median total recoverable concentration of 80 μg/L but approximately 25 percent of the streams tested showed a concentration in excess of 650 μg/L. Zinc and nickel were also naturally abundant in California streams with a median total recoverable concentration for the streams tested of 6 and 2 μg/L, respectively. The remaining elements tested showed a median concentration for total recoverable concentrations of arsenic (1 μg/L), cadmium (<0.1 μg/L), chromium (1.0 μg/L), copper (<1 μg/L), lead (<1 μg/L), molybdenum (1.2 μg/L), selenium (0.4 μg/L), silver (<1 μg/L), and uranium (<1 μg/L). A discussion of the variability found with each element is included along with a discussion of the variability in relation to the available water quality criteria for that element.

INTRODUCTION

The State Water Resources Control Board (State Board) hearings on the problems at Kesterson Reservoir found the disposal of agricultural subsurface drainage water at the site to be hazardous to the environment and ordered the site cleaned up. The principal concern was the trace element selenium which was linked to waterfowl deaths and deformities at the site; however, data presented in the hearings also showed elevated levels of chromium, copper, nickel, zinc and other trace elements. Concern was also expressed at the hearings that drainage water presently being discharged through the Grassland area and into the San Joaquin River may be causing similar problems to waterfowl and other aquatic life in the river. Programs on the Federal, State and local levels have been initiated to investigate the impacts this agricultural drainage may be having on the beneficial uses in the San Joaquin River and its tributaries.

The State Board and the Central Valley Regional Water Quality Control Board (Regional Board) have initiated efforts to formulate water quality objectives and implement regulatory programs. As part of the development of the regulatory program, the Regional Board intensified monitoring of agricultural discharges including gathering of data that could assist in establishing water quality criteria that can be used to establish water quality objectives through the Basin Planning process. The method recommended by the State Board (SWRCB, 1987) for development of criteria involves a sound knowledge of stream background concentrations especially for trace elements that present the most immediate concern. In this case background concentrations are meant to represent non-anthropogenic conditions. Because of the present water development and discharges into the San Joaquin River, obtaining reliable background concentrations is difficult. The alternative available was to utilize data from national studies which may or may not be applicable to conditions in California. Little or no site-specific background data is available for a wide range of California streams.

One of the first reconnaissance surveys was conducted by Silvey (1967) on 65 rivers and major streams in California. The actual sites are unknown and all the data are shown as below the high analytical detection limits used, therefore the data is not usable to determine background concentrations. Another reconnaissance survey was conducted on 170 high altitude lakes in Sequoia, Kings Canyon and Yosemite National Parks, and showed median trace element concentrations frequently at submicrogram per liter levels (Bradford et al., 1968). These concentrations represent High Sierra lakes and should not be considered representative of concentrations found in flowing waters elsewhere in the State, especially those that might be impacted by geologic units other than those found in the Sierras. Durum and others, (1971) sampled 32 California streams for selected trace elements during a nationwide reconnaissance survey of 720 streams. This reconnaissance study concentrated on streams that were water supplies for large urban areas or on water courses downstream of major municipal and industrial complexes. The majority of sites tested in California were influenced by urban and agricultural development and, therefore, would yield little data on natural background concentrations. A similar reconnaissance survey was conducted on 165 California streams (Bradford, 1971). The site locations were not reported; therefore, it is not possible to evaluate whether the concentrations noted represent background or those influenced by man's activities. The median and ranges found in the Bradford (1971) study can be useful for comparison purposes (Table 1). A more recent study (Smith et al., 1987) presented trace element concentrations from seven years of data collected

at over 300 river locations nationwide (Table 1). These recent data can act as baseline values for the nation's waters; however, many sites sampled are affected by discharges, both point and non-point sources, and may not show similar characteristics to California rivers and streams.

Table 1. Trace Element Concentrations Found in Baseline Studies Conducted on Various Streams (Adapted from Bradford, 1971 and Smith, et al., 1987).

	Bradford (1971) Data				Smith et al. (1987) Data			
Trace Element	No. of Stations	25th Percentile	Median	75th Percentile	No. of Stations	25th Percentile	Median	75th Percentile
Arsenic (As)					293	< 1	1	3
Boron (B)	134		110					
Cadmium (Cd)	165	< 5	< 5	< 5	285	< 2	< 2	< 2
Chromium (Cr)	165	< 0.5	< 0.5	< 0.5	161	9	10	10
Copper (Cu)	165		3					
Lead (Pb)	110		1		292	3	4	6
Molybdenum (Mo)	149		3					
Nickel (Ni)	123		1					
Selenium (Se)					211	< 1	< 1	1
Silver (Ag)	165	< 0.1	< 0.1	< 0.1				
Zinc (Zn)	164		10		288	12	15	21

This study was initiated to gain information about the range of natural background concentrations of selected trace elements in streams in Northern and Central California, including the San Joaquin River Basin. Trace element concentrations are often a reflection of the climate, geology, and hydrology of the area. California streams are strongly influenced by the Sierra Nevada and Coast Range geology and may be different from those found in other locations in the United States.

The study was not conducted to determine the range of concentrations found in a particular stream, rather the study objective was to examine, on a one-time reconnaissance basis, the range of natural concentrations that aquatic life are exposed to in California during a specific time of the year. A more complete picture of the range of concentrations that aquatic life in a particular stream are exposed to would require a long-term monitoring program. The goals of this study were to: a) develop a one-time sampling data base that could be used in establishing criteria for selected trace elements of concern in the San Joaquin River and its tributaries, and b) determine whether data from year-round national studies are comparable to a one-time sampling.

STUDY METHODS

A one-time sampling of 226 streams was conducted in 43 counties statewide during the winter of 1987. Each site was chosen to represent as closely as possible natural background concentrations from various watersheds in the State or in nearby border areas. Sampling sites were selected to avoid agricultural, urban and industrial activities and discharges to minimize their influence on stream quality; however, non-point source abandoned mine drainage may have impacted a few sites. These are noted.

All sampling was conducted during the cool, wet weather flow period (winter). The sampling time was chosen, however, to avoid major wet weather influences such as rainfall or snow-melt periods. In order to sample natural background quality,

no sample was taken within ten days following the last major rainstorm or within six days of lighter rainfall. All samples were taken before or after major snowmelt runoff. The cool weather period was chosen for sampling to avoid changes in concentration due to evaporation or uptake in the food chain occurring during periods of high bioproductivity. This sampling period permits a conservative (low) estimate of the trace element concentrations that aquatic life are exposed to. Cool weather sampling permitted evaluation of the concentrations that would give a conservative estimate of the higher concentrations likely found in lower flow periods (summer or fall) or during drought conditions.

A water quality sample was taken from each selected stream. All samples were taken in nitric acid washed and nitric acid rinsed polyethylene plastic bottles. All sample bottles were rinsed three times with the stream water prior to sampling. All trace element samples were preserved to a pH of less than 2.0 using ultra-pure nitric acid. No filtration of trace element samples was done, prior to or after fixation with acid. This procedure gave the best approximation of the Environmental Protection Agency (EPA) recommended procedure of acid soluble analysis. Total recoverable values also provide a worst-case estimate of actual exposure. Where the total recoverable concentration does not exceed water quality criteria based on dissolved or acid-soluble concentrations, the criteria likely have not been exceeded. In addition to collecting samples for laboratory analyses, field measurements included electrical conductance (EC) and temperature measurements at each site and pH measurements at selected sites.

A quality control and quality assurance program was conducted. For water analysis, spiked and duplicate samples were utilized in the laboratory. In addition, ten percent blind duplicate samples were submitted to the laboratory with 50 percent of these being spiked with known concentrations. Additional blank samples containing 2 ml Ultrex (ultra-pure) nitric acid in 500 ml distilled water were also submitted at random to check possible contamination problems. All quality assurance samples analyzed by the laboratories fell within acceptable ranges of accuracy. A full analysis of the quality assurance results is in the Regional Board files.

RESULTS

For the sites sampled, trace element analyses were conducted for total recoverable arsenic, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, silver, uranium and zinc. In addition, total hardness was calculated for each site based on the Ca and Mg concentrations. The analytical results from each site are shown in Tables A-1, A-2, and A-3 in Appendix A. A summary of the trace element concentrations in Appendix A is presented in Table 2. In addition to the median value for each element, Table 2 presents the 25th, 75th and 90th percentiles values determined for each element data set. The measured concentrations were compared to existing water quality criteria including those identified under the U.S. Environmental Protection Agency 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life. In those instances where the criteria varied with water hardness a calculated criteria was produced and is presented in Appendix A in Table A-4. The ratio of the criteria to the actual measured values is presented in Appendix A, Tables A-5 and A-6. A summary of these ratio comparisons is presented in Table 3 for those elements whose criteria varied with water hardness. The discussion that follows will review each trace element separately.

Table 2. Summary of Total Recoverable Trace Element Concentrations (µg/L) for Selected Streams in California.*

Trace Element	No. of Stream Sample Sites	Minimum	25th Percentile	Median	75th Percentile	90th Percentile	Maximum
Arsenic (As)	196	< 1	< 1	1	2	5	36
Boron (B)	177	< 50	< 50	80	640	3000	12500
Cadmium (Cd)	196	< 0.1	< 0.1	< 0.1	0.2	0.4	1.1
Chromium (Cr)	197	< 0.5	< 0.5	0.9	2.5	6.4	51
Copper (Cu)	209	<1	<1	<1	3	6	29
Lead (Pb)	210	<1	<1	<1	< 1	2	5
Molybdenum (Mo)	212	< 0.1	0.4	1.2	4.2	15	126
Nickel (Ni)	210	< 1	< 1	2	5	10	51
Selenium (Se)	226	< 0.2	0.2	0.4	0.9	2.7	73
Silver (Ag)	210	< 1	< 1	< 1	< 1	< 1	1
Uranium (U)	210	< 1	< 1	< 1	4	15	220
Zinc (Zn)	209	3	5	6	10	20	97
Selected Mineral Attributes							
Electrical Conductivity (µmhos/cm	211	< 50	160	360	1100	2200	> 10000
Hardness (as CaCO3) (mg/L)	211	12	60	130	330	650	4150
Calcium (Ca)	211	2.2	12	28	68	130	510
Magnesium (Mg)	211	1.4	6.1	14	35	96	730

* A limited number of streams from neighboring states were included where conditions were similar. Only samples representative of natural background conditions were included.

Table 3. Summary of the Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Trace Element	No. of Stream Sample Sites	90th Percentile	75th Percentile	Median	25th Percentile
Cadmium (Cd)	196	0.25	0.07	< 0.01	< 0.01
Chromium (Cr)	197	0.03	0.01	< 0.01	< 0.01
Copper (Cu)	209	0.77	0.19	< 0.01	< 0.01
Lead (Pb)	210	0.31	< 0.01	< 0.01	< 0.01
Nickel (Ni)	210	0.06	0.02	< 0.01	< 0.01
Silver (Ag)	210	< 0.01	< 0.01	< 0.01	< 0.01
Zinc (Zn)	209	0.25	0.13	0.05	0.01

Ratios were calculated by:

$$\frac{\text{Trace Concentration}}{\text{EPA Hardness Adjusted Abmient Water Quality Criterion For Protection of Freshwater Aquatic Life}}$$

Electrical Conductivity

The field recorded electrical conductivity, a measure of the relative salt concentration, varied widely between sites. Figure 1 shows the distribution of salinity concentrations found during this sampling program. The median salinity value of 360 μmhos/cm is reflected in the finding that 55 percent of the sites sampled showed salinity concentrations of less than 500 μmhos/cm. Approximately 34 percent of the samples collected showed salinity concentrations in excess of the EPA secondary drinking water criteria of 780 μmhos/cm (500 mg/L) (Marshack, 1989). Of this group, 20 of the sites (10 percent) showed salinity concentrations in excess of 2,000 μmhos/cm. Of these, eight showed concentrations in excess of 5,000 μmhos/cm. The greatest majority of the sites showing salinity in excess of 2,000 μmhos/cm were associated with ephemeral streams within the interior Coastal Range running down the Western San Joaquin Valley and Eastern Salinas River Valley. The streams showing the lowest salinity concentrations were associated with the Sierra Nevada Mountains and North Coastal areas.

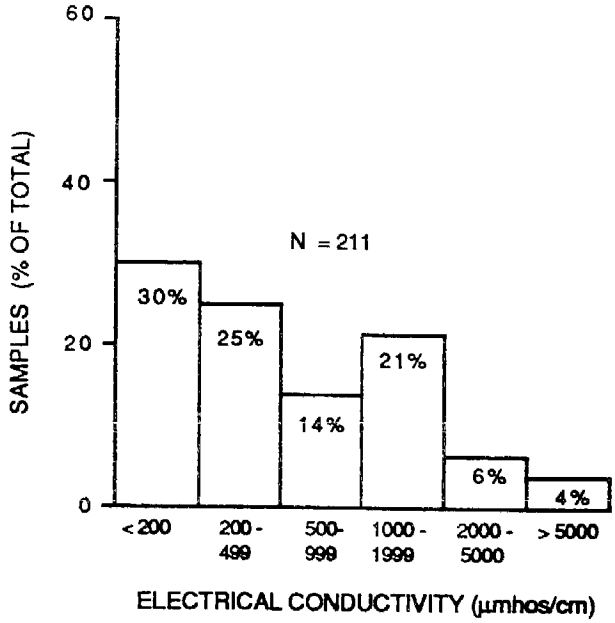

FIG. 1. Percentage of stream samples showing selected electrical conductivity values.

Arsenic

Arsenic concentrations in most California streams were very low. The median total recoverable value for all streams sampled was 1 μg/L. Figure 2 shows the distribution of total recoverable arsenic found during this sampling program. Almost 88 percent of the stream sample sites showed arsenic concentrations less than 5 μg/L with greater than half of this group showing total recoverable arsenic of <1 μg/L.

In an early study, Ferguson and Gavis (1972) listed 1 μg/L as the average arsenic concentration for pollution free rivers but noted that higher or lower concentrations could occur in certain geologic formations. For example, in a study of ten major rivers in the Southeastern United States, dissolved arsenic concentrations ranged from 0.15 - 0.45 μg/L (Waslenchuk, 1979) while in the Columbia River Basin in the Northwestern United States, dissolved arsenic averaged 1.6 μg/L (Wedepohl, 1980). Forstner and Wittmann (1979) cite 2 μg/L as the freshwater average.

The median and 75th percentile values found for California streams in this study are in close approximation to these two previously cited averages and to the

average arsenic concentration in freshwater of 1.7 μg/L cited by Chilvers and Peterson (1987). A recent analysis by Smith and others (1987) showed the average of seven years of arsenic concentrations collected at approximately 300 river locations nationwide (Table 1) to be in close agreement to the median values found in California streams during this study. The 75th percentile value of 2 μg/L found in this study is also in close approximation to the 75th percentile value of Smith and others (1987) and to the average arsenic value of 2-3 μg/L found in seawater (Forstner and Wittmann, 1979 and Hem, 1985) and the median value of 2 μg/L found in tile drainage water in the San Joaquin River Basin (Chilcott et al., 1988).

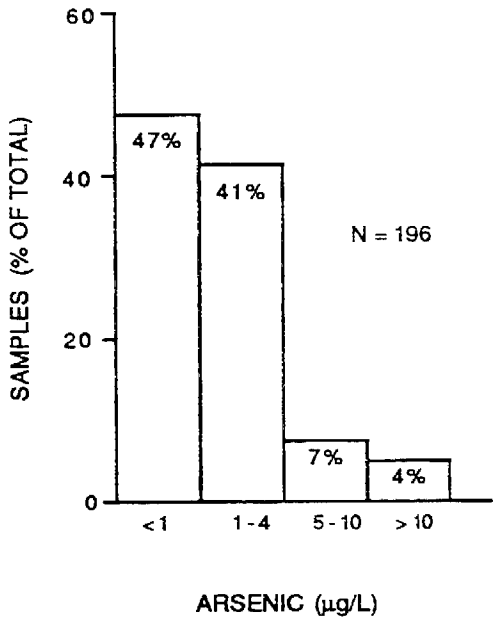

FIG. 2. Percentage of stream samples showing selected arsenic values.

The small percentage (ten percent) of samples collected in this study showing elevated arsenic concentrations (> 4 μg/L) may be affected by local geology since many locations in California and neighboring states are known arsenic enriched areas (Welch et al., 1988, Tamaki and Frankerberger, 1989). Only five percent of the sites showed arsenic at a concentration greater than 10 μg/L. These sites were widely scattered but were principally associated with foothill streams from the Sierras in the San Joaquin Valley or streams flowing on the eastern side of the Sierras. The five percent of the sites in California showing arsenic greater than 10 μg/L and the recent data of Smith and others (1987), shows a lower percentage of sites exceeding 10 μg/L than the 21 percent found during a 1968 USGS survey of 727 streams and rivers nationwide (cited by Welch et al., 1988). A survey of 1600 lakes in the United States at approximately the same time period (1968) showed that 94 percent had arsenic concentrations greater than 10 μg/L (Welch et al., 1988). Both of these older studies, however, may be of limited value because of the analytical method and detection levels achieved.

No streams showed total recoverable arsenic in excess of 50 μg/L, the State Primary Drinking Water Standard (Marshack, 1989). Thus, no streams exceeded the concentrations for protection of agricultural use which is presently set at 100 μg/L (Westcot and Ayers, 1984) nor the 4-day average concentration of 190 μg/L identified for protection of aquatic life through the EPA program to establish National Ambient Water Quality Criteria to Protect Freshwater Aquatic Life (EPA, 1980a, EPA, 1985a). Almost 40 percent of the streams sampled did exceed the recommended Proposition 65 "No Significant Risk Level" of 1 μg/L as calculated by the State Water Resources Control Board (SWRCB, 1988).

Boron

Boron occurs widely throughout streams in California. The median total recoverable value for all streams sampled in this survey was 80 µg/L. This compares closely with the ambient background level of 100 µg/L used by the San Joaquin River Technical Committee during the development of water quality criteria for boron (SWRCB, 1987) and the median value of 110 µg/L found by Bradford (1971) during a survey of 134 streams in California (Table 1). Although elevated levels of boron are known to occur throughout the State, the consistency of these values found in the two previous studies and the present study places doubt on usability of the median value of 500 µg/L given for 95 streams in California (Wedephol, 1980). Figure 3 shows the distribution of total recoverable boron found during this study.

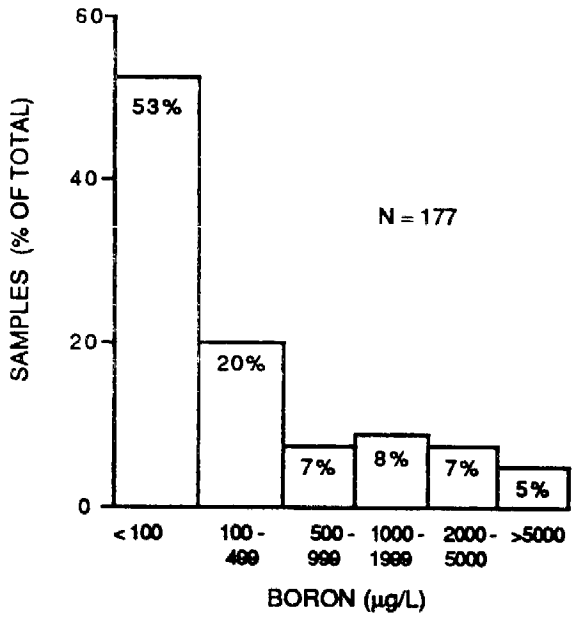

FIG. 3. Percentage of stream samples showing selected boron values.

Greater than 75 percent of the samples collected in this stream survey showed total recoverable boron concentrations less than 700 µg/L, the present guideline below which the water is considered safe for all agricultural crop irrigation uses (Westcot and Ayers, 1984). Of these samples the greatest majority showed boron concentrations below 100 µg/L. Of the stream samples collected that showed boron greater than the 700 µg/L guideline, over half of these showed boron concentrations in excess of 2,000 µg/L, a level where restrictions on agricultural irrigation use become moderately severe. Seventeen (17) of the 23 sites with levels in excess of 2,000 µg/L showed concentrations greater than 3,000 µg/L, a level over which agricultural irrigation usage is severely restricted. The majority of the streams showing concentrations in excess of 700 µg/L are ephemeral and are associated with the interior Coastal Range running down the western San Joaquin Valley and eastern Salinas River Valley. The 75th percentile value of 640 µg/L total recoverable boron is in contrast to the average for seawater of 4,500 µg/L (Forstner and Wittman, 1979 and Hem, 1985) and to the median value of 5,600 µg/L found in tile drainage water in the San Joaquin River Basin (Chilcott et al., 1988).

Cadmium

Total recoverable cadmium was detected at only a few locations sampled in this study. The median value for all streams sampled in this survey was <0.1 µg/L. Figure 4 shows the distribution of total recoverable cadmium found during this sampling program. Almost 60 percent of the sample sites showed total recoverable cadmium of less than 0.1 µg/L which was the level of detection in this study.

Obtaining a lower detection level is extremely difficult and requires a research level analysis which was not available in this study. The detection level used in this study was greater than the ambient background concentration of 0.01 μg/L which was used by the San Joaquin River Technical Committee during the development of water quality criteria for cadmium (SWRCB, 1987).

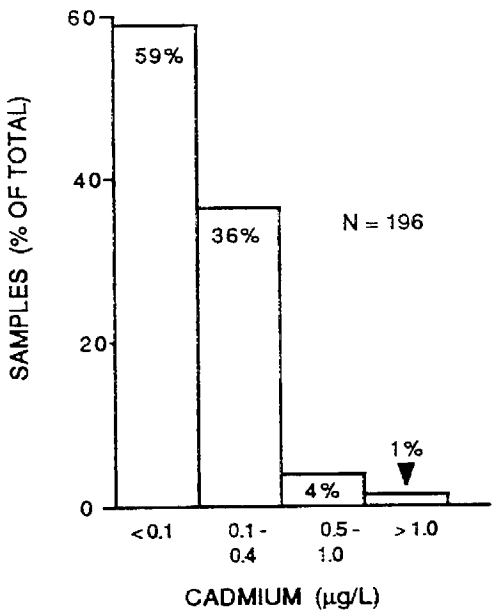

FIG. 4. Percentage of stream samples showing selected cadmium values.

Quantification of cadmium concentrations has been limited by the need for very low analytical detection levels. In an early study of 65 California streams, Silvey (1967) found cadmium concentrations to be <0.7 μg/L at all sites. Results from the present study support the Silvey findings; however, even using a 0.1 μg/L detection limit in this study did not allow for complete quantification. Below detection level results were also reported by Bradford (1971) and Smith and others (1987) during their surveys of California and nationwide streams, respectively (Table 1). Because of this lack of quantifiable data, Page and Bringham (1973) in their review of cadmium stated cadmium likely ranged between 0 - 0.7 μg/L in unpolluted water. The findings in this study show that concentrations in California streams likely range from 0 - 0.4 μg/L, as greater than 95 percent of the streams sampled showed concentrations in this range. The findings in this study of a median cadmium concentration of <0.1 μg/L is supported by Kennedy and Malcolm (1977) who, using high precision analysis showed cadmium concentrations in five northern California streams to range from 0.01 - 0.03 μg/L. Brewers and others (1987) using data from several researchers suggest that average dissolved cadmium concentrations in unpolluted rivers range from 0.005 - 0.020 μg/L although slightly higher ranges have been noted in Canadian, United States and Australian rivers. For example, recent data for Australian rivers shows cadmium ranging from 0.29 - 0.55 μg/L with a mean concentration of 0.42 μg/L (Moore and Ramamoorthy, 1984).

The EPA criterion for cadmium, the 4-day average concentration identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life, varies with hardness as described by the equation:

$$\text{cadmium } (\mu g/L) = e^{0.7852H - 3.490}$$

where H = ln (hardness) in mg/L (EPA, 1980b and EPA, 1985b). When the EPA (1985b) cadmium criterion was adjusted for hardness at the sampling sites only three of the sites tested exceeded the criteria. All three sites were found to be strongly influenced by non-point source abandoned mine drainage and are not representative of background concentrations. In most instances, the measured

concentrations were less than 25 percent of the EPA hardness adjusted cadmium criteria. Table 3 shows the median and percentile values for the ratio of the measured concentration to the hardness adjusted EPA cadmium criteria.

Although none of the cadmium concentrations measured in this study exceed the EPA criteria as adjusted for hardness, approximately 25 percent of the stream sites tested showed total recoverable cadmium concentrations equal to or exceeding the 0.2 μg/L level projected in the Technical Committee evaluation to be the adverse effect level in fresh water streams (SWRCB, 1987). Because of the very low concentrations detected in most of the streams (<0.1-0.4 μg/L), further testing would be needed to determine whether these levels remain consistent over a long period of time. None of the sites monitored exceeded 10 μg/L which is recommended as the maximum safe level for irrigation use (Westcot and Ayers, 1984).

The sites that showed detectable concentrations of total recoverable cadmium greater than 0.5 μg/L (10 sites) appeared to be concentrated in the upper Sacramento River Valley including tributaries to the River in Shasta and Tehama Counties. These sites may have been affected by past mining operations and should not be given heavy weight in determining background concentrations.

Chromium

Chromium occurs widely in the streams sampled in this study. The median total recoverable value for all streams sampled in this survey was 1.0 μg/L. This median concentration is below the estimated ambient background concentration of 5 μg/L used by the San Joaquin River Technical Committee during the development of water quality criteria for chromium (SWRCB, 1987). Only 12 percent of the samples collected in this study exceeded the 5 μg/L ambient background level suggested in the SWRCB study. The ambient background level used was for trivalent chromium (Cr+3), the most predominate form in well aerated water. The total recoverable concentrations reported here are likely to represent the total recoverable trivalent chromium (Cr+3) concentrations but no determination was made of the chromium form present because of the very low median value. Figure 5 shows the distribution of total recoverable chromium found in this study.

Previous studies have shown widely varying background concentrations. Two early studies cited by Wedepohl (1980) show chromium concentrations higher than found in this present survey of California streams. The first is a 1963 study of large rivers in North America that showed a median chromium concentration of 5.8 μg/L. This was similar to the 5.2 μg/L mean found in a 1961 study of 4,132 surface waters in Siberia also cited by Wedepohl (1980). In the same time period, Silvey (1967) showed that dissolved chromium concentrations in 65 California streams were all less than 0.7 μg/L, a concentration similar to those found in this study. During the same time period Kharkar and others (1968) showed the mean dissolved chromium concentrations varied from 0.7 - 3.1 μg/L for four large rivers along the north coast of California. Bradford (1971) in his survey of 165 California streams found only 20 had dissolved chromium concentrations that exceeded 0.5 μg/L and the median of the 20 streams was <1 μg/L. Kennedy and Malcolm (1977) showed a similar range for dissolved chromium (0.7 - 1.5 μg/L) for five northern California streams.

Total recoverable chromium was ≥1.0 μg/L in 50 percent of the samples collected with almost 30 percent of the samples collected showing total recoverable chromium concentrations from 1-3 μg/L. The slightly higher median chromium concentration found in this study (1.0 μg/L) may be due to this being a total recoverable value rather than a dissolved value which was determined in the earlier studies. The dissolved value may not be representative of the present EPA acid-soluble criteria value.

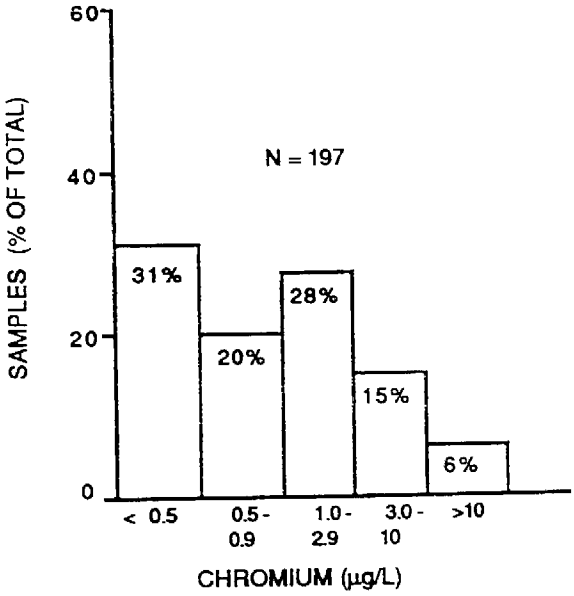

FIG. 5. Percentage of stream samples showing selected chromium values.

Recently Forstner and Wittmann (1979) presented 0.5 μg/L dissolved chromium as the average for fresh surface waters but this was based on a very limited data base. Moore and Ramamoorthy (1984) cite a freshwater range of 1 - 2 μg/L for dissolved chromium. In a recent study, Smith and others (1987) show a median chromium concentration of 10 μg/L during their survey of 161 nationwide streams. In the present study, however, only six percent of the samples collected showed total recoverable chromium greater than 10 μg/L. The six percent of the samples collected showing total recoverable chromium greater than 10 μg/L, may equal or exceed the 4-day average concentration for hexavalent chromium (Cr+6) of 11 μg/L identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life (EPA, 1985c). However, the likelihood that hexavalent chromium exists in such waters is very low and the remaining discussion will assume that the total recoverable concentrations represent the level of trivalent chromium present in the water. The EPA criterion for trivalent chromium varies with hardness as described by the equation:

$$Cr^{+3}\ (\mu g/L) = e^{0.8190H+1.561}$$

where H = ln (hardness) in mg/L (EPA, 1980c and EPA, 1985c). When the EPA (1985c) trivalent chromium criterion was adjusted for hardness at the sampling sites, none of the water samples collected in this study exceeded the criterion. In all instances, the measured concentrations were less than 25 percent of the EPA hardness adjusted trivalent chromium criteria. Table 3 shows the median and percentile values for the ratio of the measured concentration to the hardness adjusted EPA trivalent chromium criteria.

A high percentage of the samples showing greater than 5 μg/L occur in samples taken from North Coastal streams. This area has old chromium mines, as well the soils are known to have high natural chromium levels. Only six stream samples statewide exceeded the 24 μg/L criterion proposed for trivalent chromium for the San Joaquin River by the Technical Committee (SWRCB, 1987). None of the samples collected in this study exceeded the 100 μg/L guideline below which unrestricted irrigation use can be made of the water. For those streams showing

concentrations in excess of the 90th percentile value (Table 2), resampling and sample filtration should be conducted to determine whether the concentrations are available (dissolved) since trivalent chromium is often driven off of suspended sediment when total recoverable or acid-soluble techniques are used.

Copper

Copper occurs in low concentrations in most streams sampled in this study. The median total recoverable value for all streams sampled in this survey was <1 μg/L. Figure 6 shows the distribution of total recoverable copper found during this sampling program. Sixty percent of the samples tested showed a total recoverable copper concentration of 1 μg/L or less. The 1 μg/L concentration was the ambient background concentration used by the San Joaquin River Technical Committee during their development of water quality criteria for copper (SWRCB, 1987). The 75th percentile value of 3 μg/L is approximately the same as the median concentration found in seawater (Hem, 1985).

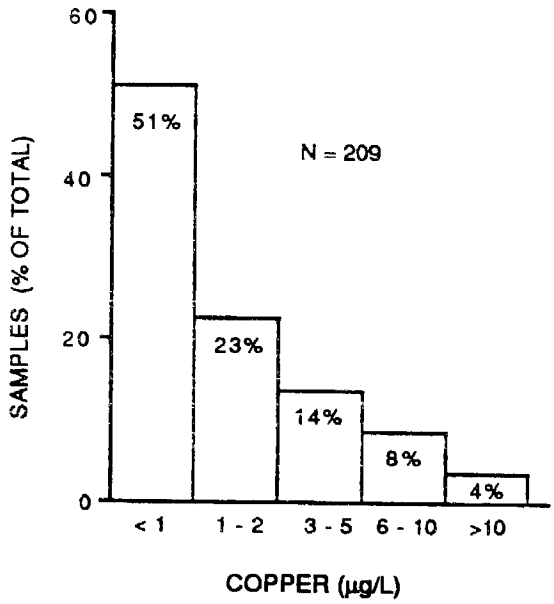

FIG. 6. Percentage of stream samples showing selected copper values.

Previous studies have shown widely varying background concentrations. Two early studies concentrated on California streams. Silvey (1967) found that 20 of 65 California streams showed dissolved copper concentrations greater than the 2.8 μg/L detection limit. The mean of these 20 streams was 18 μg/L. In contrast Bradford (1971) showed all 165 sites tested had dissolved copper concentrations greater than 0.9 μg/L with median value of 3 μg/L which is higher than the concentrations found in this study. Kennedy and Malcolm (1977) showed the range for dissolved copper as 0.8 - 1.3 μg/L for five northern California streams. A similar concentration was found by Spear and Pierce (1979) for several Canadian Rivers which averaged 1.5 μg/L. Moore and Ramamoorthy (1984) stated that the median dissolved copper concentrations for fresh surface water ranges from 0.5-1.0 μg/L, a range similar to the median value found in this study.

The EPA criterion for copper, the 4-day average concentration identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life, varies with water hardness as described by the equation:

$$\text{copper } (\mu g/L) = e^{0.8545H - 1.465}$$

where H = ln (hardness) in mg/L (EPA, 1980d, EPA, 1985d). When the EPA (1985d) copper criterion was adjusted for hardness at the sampling sites, five percent

of the sites sampled (12) exceeded the criteria. Several of these sites may be strongly influenced by non-point source abandoned mine drainage and such sites would not be representative of background concentrations. In more than 75 percent of the instances, the measured concentrations were less than 25 percent of the EPA hardness adjusted copper criteria. Table 3 shows the median and percentile values for the ratio of the measured concentration to the hardness adjusted EPA copper criteria.

The stream samples showing concentrations greater than the 90th percentile value of 6 μg/L (Table 2) were widely scattered and no defined pattern was noticeable although several of the elevated samples were taken in the Sacramento River Basin. The two highest concentration samples taken near Redding were disregarded due to likely impacts from acid-mine drainage. When these samples are disregarded, none of the stream samples tested showed copper concentrations exceeding the 200 μg/L irrigation use guideline or the 1300 μg/L State Drinking Water Standard.

Lead

Total recoverable lead concentrations are below the level of detection in most all streams sampled in this study. The 75th percentile value for all streams sampled in this survey was <1 μg/L. Figure 7 shows the distribution of total recoverable lead found during this sampling. Greater than 80 percent of the sample sites showed total recoverable lead of less than 1 μg/L which was the level of detection in this study.

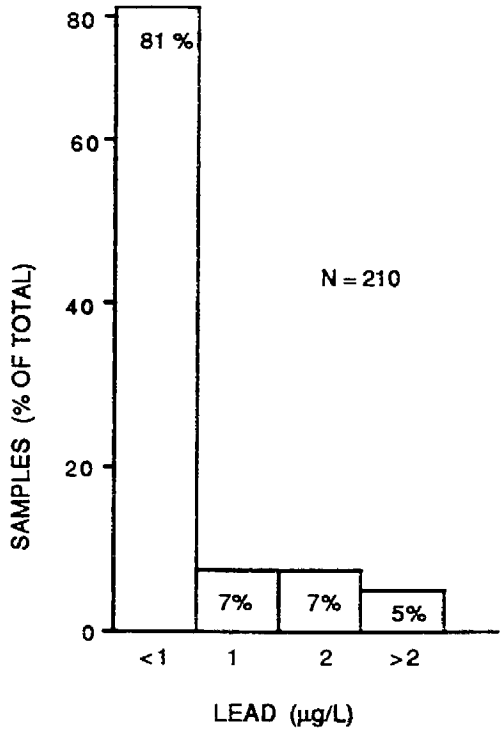

FIG. 7. Percentage of stream samples showing selected lead values.

Several in-depth studies of lead concentrations in surface water have been conducted. Silvey (1967) reported an average lead concentration of 5.7 μg/L in California streams in which the element could be detected. However, lead concentrations were below the detection limit (0.6 μg/L) in 78 percent of the stream samples analyzed. The median value in Silvey study of California streams was <0.6 μg/L. Bradford and others (1968) reported lead concentrations for 170 High Sierra Lakes ranging from less than 0.3 to 4.0 μg/L, with a median concentration of 0.5 μg/L. Bradford (1971) in a later study reported the median lead concentration was 1 μg/L for 110 of the 165 California streams tested. The remaining 55 streams all showed dissolved lead concentrations <0.5 μg/L. Lovering (1976), in a review of lead, stated the median concentration in river

water of the United States is 2 μg/L. The median concentration found in this study of <1 μg/L was consistent with results of Kennedy and Malcolm (1977) which showed a range of <0.1 - 0.1 μg/L dissolved lead for five northern California streams. More recent data of Smith and others (1987) for 292 sites nationwide, shows a median dissolved lead concentration of 4 μg/L (Table 1) which is considerably higher than concentrations found in the present study. Only four sites, or two percent of those sampled, showed lead concentrations at or above the 4 μg/L median concentration found by Smith and others (1987).

The EPA criterion for lead, the 4-day average concentration identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life, varies with water hardness as described by the equation:

$$\text{lead } (\mu g/L) = e^{1.273H - 4.705}$$

where H = ln (hardness) in mg/l (EPA, 1980e and EPA, 1985e). When the EPA (1985e) lead criterion was adjusted for hardness of the sample, 13 of the sites tested exceeded the calculated criteria. There was no pattern or similarities to the sites. Due to the low levels detected at many of these sites, retesting would be recommended to see if these levels remain consistent. In most instances, the measured concentrations were less than 30 percent of the EPA hardness adjusted lead criteria. Table 3 shows the median and percentile values for the ratio of the measured concentration to the hardness adjusted EPA lead criteria.

The stream samples showing concentrations greater than the 90th percentile (2 μg/L) were widely scattered and no defined pattern was noticeable. The two highest concentrations found, one from Spring Creek near Redding and the other from Cache Creek immediately below Clear Lake were likely impacted from acid-mine drainage and they should be disregarded when looking at natural background concentrations. When these two samples are disregarded, none of the stream samples tested showed total recoverable lead concentrations exceeding the 5,000 μg/L irrigation use guideline (Westcot and Ayers, 1984) or the 5 μg/L State Drinking Water Standard (Marshack, 1989). No determination was made of how many of the streams samples exceeded the recommended Proposition 65 "No Significant Risk Level" of 0.25 μg/L as calculated by the State Water Resources Control Board (SWRCB, 1988) as the detection level throughout this study was 1.0 μg/L.

Molybdenum

Total recoverable molybdenum results show widely scattered levels. The median value for all streams sampled in this study was 1.2 μg/L. The median concentration is higher than the 0.7 μg/L ambient background level used by the San Joaquin River Technical Committee during the development of water quality criteria for molybdenum (SWRCB, 1987).

There are few recent studies on the distribution of molybdenum in surface streams. Wedepohl (1980) reviewed molybdenum occurrence and estimated the median concentration at 0.5 μg/L for unpolluted rivers. This was based largely on a 1963 study of North American rivers. A similar concentration was found by Kharkar and others (1968) who estimated the median molybdenum concentration to

be 1 μg/L. Data, however, from rivers associated with streams in the Western United States show higher, but widely varying, concentrations. This may be due to the presence of high molybdenum in the arid zone soils and geology. For example, although the review by Wedepohl (1968) showed a median of 0.5 μg/L for all rivers, his data showed the median for the Columbia River at 2.1 μg/L and the Colorado River at Yuma varying from 5 - 7 μg/L with higher concentrations noted upstream. These high concentrations were confirmed by Voegeli and King (1969) who studied 16 river basins in Colorado and concluded that surface water containing greater than 5 μg/L molybdenum in the high mountainous areas of Colorado should be considered anomalous but higher concentrations can be expected downstream. Silvey (1967) in studying 65 California streams found a mean molybdenum concentration of 4 μg/L for 30 of these streams. The remaining 35 streams all showed dissolved molybdenum at <1 μg/L. The widely varying molybdenum concentration in California streams was confirmed by Bradford (1971) who found a median concentration of 3 μg/L for 149 of the 165 streams tested. The remaining 16 streams all showed dissolved molybdenum concentrations of <0.5 μg/L. The range of values found by Bradford were <0.5 - 130 μg/L, very similar to the range found in the present study. Earlier Bradford and others (1968) reported a median dissolved molybdenum concentration of 0.4 μg/L for 80 out of 170 High Sierra lakes, with the remaining lakes all showing concentrations <0.3 μg/L. This data shows the strong variability between different areas of the State. The differences in concentrations are likely due to the geology in the individual watersheds.

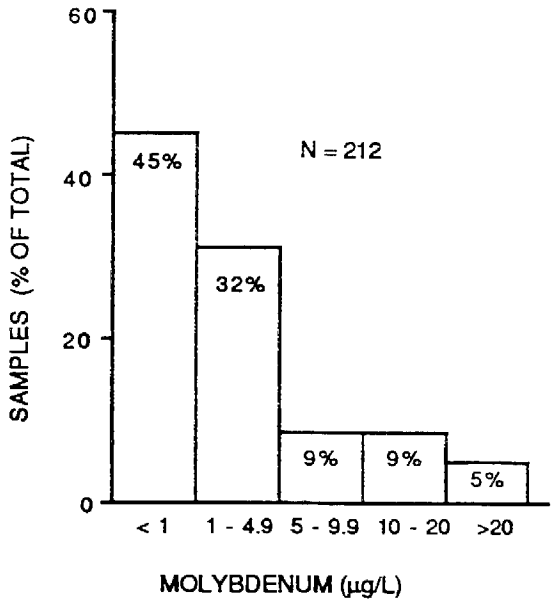

FIG. 8. Percentage of stream samples showing selected molybdenum values.

Figure 8 shows the distribution of total recoverable molybdenum found in this study. Although the median value is 1.2 μg/L and almost 45 percent of the sites sampled showed total recoverable molybdenum to be less than 1 μg/L, almost 25 percent of the sites sampled showed levels exceeding 5 μg/L including 12 sites where molybdenum exceeded 19 μg/L, a concentration beyond which adverse effects to aquatic life are possible (SWRCB, 1987). Fifteen (15) percent of the sample sites showed molybdenum exceeding the present guideline of 10 μg/L, the maximum concentration considered safe for agricultural irrigation use on pasture and forage (Westcot and Ayers, 1984). Only two sites sampled showed concentrations in excess of 50 μg/L, a new guideline suggested as being safe for irrigation use on pasture lands in the Western United States (Albasel and Pratt, 1989). These same two sites would also exceed the recent recommended level of 50 μg/L that is considered as acceptable as a drinking water supply for grazing cattle and sheep (Ward, 1989).

It was generally felt that molybdenum in surface and ground water is low and only rarely will values greater than 5 μg/L be found (EPA, 1987a). The data presented here, however, shows that elevated molybdenum concentrations are present in California surface water. The highest molybdenum values appear to be associated with areas in the Southern San Joaquin Valley and portions of the Central Coastal area. High molybdenum concentrations were also found in evaporation basins used for disposal of agricultural drainage water in the Southern San Joaquin Valley (Westcot et al., 1988a) and in the drainage water from portions of the San Joaquin River Basin (Chilcott et al., 1988). It is likely that elevated molybdenum concentrations are present in extensive ground water areas of California and Western Nevada (Welch, personal comm.). Recent data also shows that molybdenum has accumulated in several closed lake systems (Westcot et. al., 1990).

Nickel

Total recoverable nickel shows widely scattered levels. The median value for all streams sampled in this study was 2 μg/L. Figure 9 shows the distribution of total recoverable nickel found during this sampling program. This median concentration is higher than the 1 μg/L ambient background level used by the San Joaquin River Technical Committee during their development of water quality criteria for nickel (SWRCB, 1987). Previous studies have shown different concentrations. Boyle and Robinson (1988) after compiling available data on uncontaminated streams and rivers worldwide gave a range of nickel as 0.5 - 20 μg/L but were generally less than 10 μg/L. Snodgrass (1980) concluded that dissolved nickel levels in unpolluted freshwater usually range from 1 - 3 μg/L. One of the earliest surveys of California streams (Silvey, 1967) showed that 49 out of 65 California streams had dissolved nickel concentrations ranging from 1 to 5 μg/L with a median of 3.5 μg/L. The remaining 16 streams all had 1 μg/L. Bradford (1971) in a survey of 165 California streams found 123 had a median of 1 μg/L while the remaining 42 all showed dissolved nickel concentrations less than 0.5 μg/L.

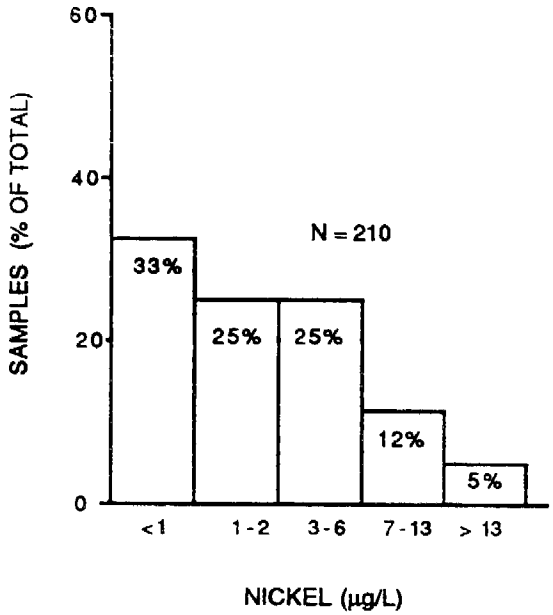

FIG. 9. Percentage of stream samples showing selected nickel values.

The results found by Silvey (1967), that nickel is one of the most abundant trace elements in California streams, was confirmed in the present study. Sixty-seven percent of the sample sites showed a total recoverable nickel concentration of 1 μg/L or more while 5 percent showed a concentration of greater than 13 μg/L. The EPA Public Health Effect criterion is 13.4 μg/L (Marshack, 1989). The 75th

percentile value of 5 μg/L is in the same range as the average seawater concentration of 7 μg/L (Hem, 1985). The highest value recorded during this survey is 51 μg/L which is far below the 2,000 μg/L criterion for irrigation use.

The EPA criterion for nickel, which is the 4-day average concentration identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life, varies with water hardness as described by the equation:

$$\text{nickel } (\mu g/L) = e^{0.8460H + 1.1645}$$

where H = ln (hardness) in mg/L (EPA, 1980f and EPA, 1986). When the EPA (1986) nickel criterion was adjusted for hardness of the water sample, none of the samples in this study exceeded the criteria. In all instances, the measured concentrations were less than six percent of the EPA hardness adjusted nickel criteria. Table 3 shows the median and percentile values for the ratio of the measured concentration to the hardness adjusted EPA nickel criteria.

The stream samples showing concentrations greater than the 90th percentile value (Table 2) were scattered but a majority were associated with smaller north coastal streams or streams that were carrying a noticeable suspended sediment load at the time of sampling. For those streams showing concentrations in excess of the 90th percentile value (Table 2), resampling and sample filtration should be conducted to determine whether the concentrations are in the dissolved or available form. Nickel is often strongly attached to suspended sediment and is released when total recoverable or acid-soluble techniques are used.

Selenium

Selenium concentration varies in the streams sampled in this study. The median total recoverable concentration for all the streams sampled in this survey was 0.4 μg/L. This median concentration is twice the ambient background level of 0.2 μg/L used by the San Joaquin River Technical Committee during the development of water quality criteria for selenium (SWRCB, 1987). Figure 10 shows the distribution of total recoverable selenium found. Very little data is available on selenium concentrations in freshwater streams and few on California streams. Kharkar and others (1968) found a mean dissolved selenium concentration in nine large rivers of 0.2 μg/L. Four of the rivers studied by Kharkar were in northern California. These four streams had a range of selenium concentration from 0.12 -0.35 μg/L. Wedepohl (1980) showed that selenium in four large United States rivers varied from 0.11 - 0.32 μg/L. Smith and others (1987) in a survey of 211 river sites throughout the United States showed a median selenium concentration of <1 μg/L.

The selenium concentration in California streams is very low. Almost 75 percent of the streams sampled showed selenium at less than 1 μg/L which indicates that the overall background concentration is low. However, 15 percent of the samples collected showed concentrations greater than 2 μg/L, the maximum value the U.S. Fish and Wildlife Service feels is needed for protection of wetlands (SWRCB, 1987). Those streams showing concentrations in excess of 2 μg/L are principally ephemeral and associated with the interior Coastal Range that makes up the western portion of the San Joaquin Valley and the eastern portion of the Salinas River Basin. These streams show concentrations similar to those found in the

more perennial Green, Colorado and Gunnison Rivers of Colorado and Utah which were sampled as part of this program for comparison purposes. The streams showing the lowest selenium concen-trations were those from the Sierra Nevada Mountains and North Coastal areas. Most all of these streams were consistently below 0.7 μg/L.

Thirteen of the streams sampled exceed 5 μg/L which is the four-day average concentration identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life (EPA, 1980g and EPA 1987b). The 5 μg/L concentration was adopted as a water quality objective by the Central Valley Regional Water Quality Control Board for the San Joaquin River (CRWQCB, 1988).

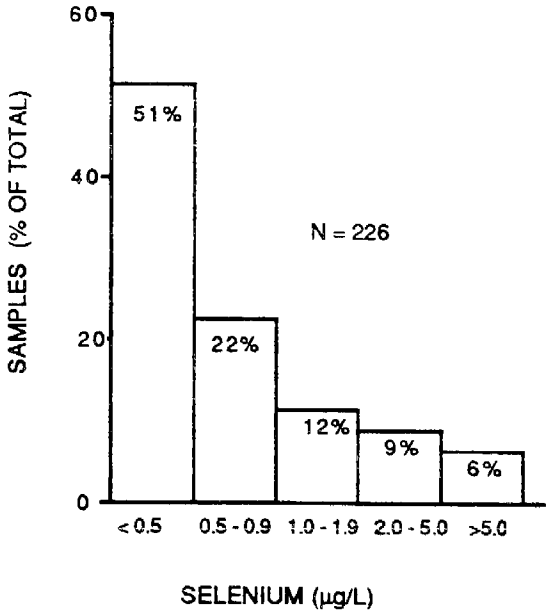

FIG. 10. Percentage of stream samples showing selected selenium values.

Seven of the stream sites sampled in this program showed concentrations in excess of 10 μg/L which is the State Primary Drinking Water Standard (Marshack, 1989). These, however, are small ephemeral streams and do not represent likely drinking water supplies. Only two of the samples showed concentrations that exceeded the recommended guideline of 20 μg/L for protection of irrigation use of the water (Westcot and Ayers, 1984). One of the sites did show a concentration which exceeds the recommended safe limit for animal drinking water of 50 μg/L (Palmer and Olson, 1989). Animal drinking water supply is a major use of many of the streams in California. None of the streams exceed the recently recommended guideline of 100 μg/L for continuous irrigation use (Albasel et al., 1989).

Silver

Total recoverable silver is very low in the streams sampled in this study. Figure 11 shows that 99 percent of all the samples tested showed total recoverable silver less than 1 μg/L which was the level of detection in this study. Only three sites showed detectable silver concentrations and all these showed a 1 μg/L concentration. Each of these three sites are ephemeral streams in the interior Coastal Range and flow into the Central Valley. The streams are Silver Creek in Fresno County and Black Gulch and Bennett Valley Creek in Stanislaus County. All three creeks have elevated selenium concentrations.

All of the previous studies confirm the findings in this study that very low levels of natural silver exist in streams in California. Quantification of silver concentrations, however, has been limited by the need for very low analytical detection levels. An early survey by Kharkar and others (1968) showed a mean dissolved silver concentration of 0.30 μg/L for 12 large rivers, ten of

which were located in the United States. Four of the rivers sampled in the Kharkar study were from Northern California and showed mean concentration ranges from 0.10 - 0.55 μg/L. Bradford and others (1968) in a survey of 170 High Sierra lakes found a median concentration of 0.1 μg/L with concentrations ranging from 0.03 - 6 μg/L. This lake survey was followed by a survey of 165 California streams that showed detectable levels of silver in 37 streams ranging from 0.1 -3 μg/L. The 37 streams showed a median concentration of 0.1 μg/L with the remaining 128 streams showing concentrations of <0.1 μg/L (Bradford, 1971). Further evidence of very low levels was found by Kennedy and Malcolm (1977) in a survey of five Northern California streams that showed a concentration range of <0.05 - 0.05 μg/L.

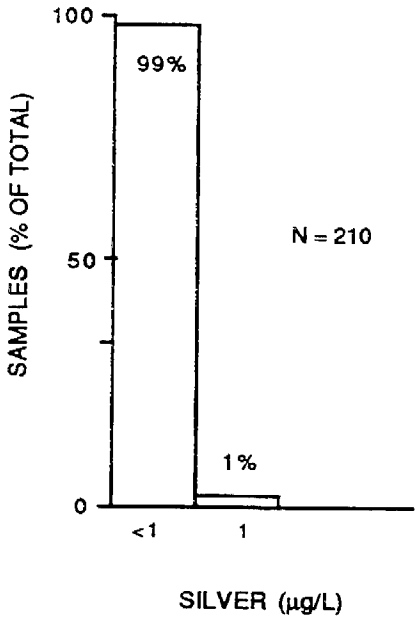

FIG. 11. Percentage of stream samples showing selected silver values.

The instantaneous maximum identified through the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life varies with water hardness as described by the equation:

$$\text{silver } (\mu g/L) = e^{1.72H - 6.52}$$

where H = ln (hardness) in mg/L (EPA, 1980h). When the EPA (1980h) silver criterion was adjusted for hardness of the water sample, none of the three sites showing detectable concentrations exceed the criteria. Because of the detection limit used in this study, 15 percent (31 sites) of the sites showing a <1 μg/L concentration also showed a water quality criterion less than 1 μg/L when the sample was adjusted for hardness of the water. Because of this difference it is not possible to determine whether the samples exceeded the criterion, but due to the very low levels detected in other studies, it is doubtful that the hardness adjusted criterion was exceeded in any sample. The samples tested were also far below the 50 μg/L State Drinking Water Standard and EPA Ambient Health Effects criterion (Marshack, 1989).

Uranium

The median value for total recoverable uranium in the streams sampled in this study is <1 μg/L. The 75th percentile value found in this study shows that the majority of streams carry very low concentrations and the 75th percentile value of 4 μg/L compares closely with the 3 μg/L level commonly found in ocean water (Hem, 1985). There are few water quality criteria upon which to compare the uranium concentrations found.

Little background data has been developed on uranium concentrations in freshwater with almost none for California streams. A study by Mallory et al. (1969) of 36 rivers representing 55 percent of the drainage area of the United States showed uranium concentrations ranging from <0.4 μg/L to 8.0 μg/L with the highest concentra-tions found in the San Joaquin River at Vernalis. Other western rivers, the Columbia, Colorado, Rio Grande and Red, also showed elevated concentrations. Tributaries to the Colorado River showed concentrations in excess of 20 μg/L but concentrations in the Colorado River at Yuma ranged from 6.6 to 7.6 μg/L. The Sacramento and Klamath Rivers were the only other rivers in California sampled and show levels consistently below 0.4 μg/L. The mean concentration found for all of the 36 rivers sampled was reported at 1.0 μg/L (Mallory et al., 1969). A second survey in the same time period showed a mean uranium concentration for 17 nationwide streams of 0.27 μg/L (Bertine and others, 1970). The range of concentrations found for the four rivers in California sampled in the Bertine study was 0.03 - 1.22 μg/L.

Figure 12 shows the distribution of total recoverable uranium found in this study. Although the median value is <1 μg/L, almost 20 percent of the sites sampled showed total recoverable uranium levels exceeding 5 μg/L including 15 sites where uranium exceeded 10 μg/L. Six of the sites sampled showed readings higher than the Environmental Protection Agency proposed drinking water standard for uranium of 30 μg/L (Murphy, 1990). All six sites are ephemeral streams whose use for drinking water is unlikely; however, small domestic wells in these watersheds may show similar elevated levels.

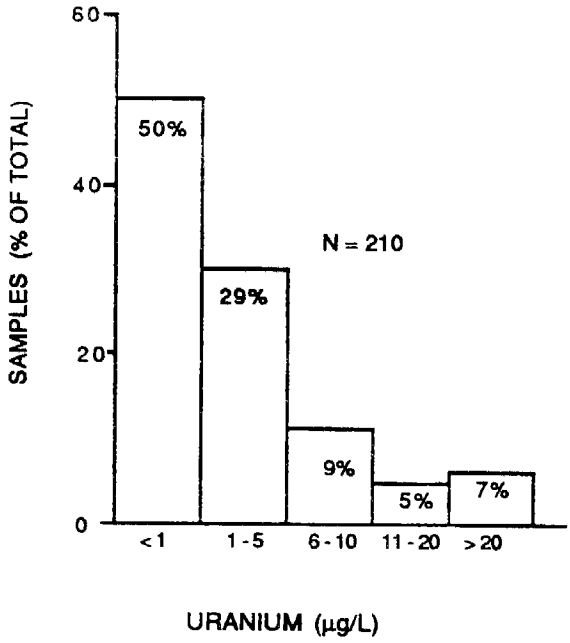

FIG. 12- Percentage of stream samples showing selected uranium values.

The highest uranium values appear to be associated with streams in the Southern San Joaquin Valley and portions of the Central Coastal area. Scattered streams sampled in the Southern California area also show detectable uranium concentrations. The Kern River Canyon in the Southern San Joaquin Valley has several former uranium mines and prospects especially in an area about 30 miles northeast of Bakersfield (Elevatorski, 1978). The elevated uranium concentrations found in streams in the Southern San Joaquin Valley were in areas where high levels were found in evaporation basins used for disposal of agricultural subsurface drainage water (Westcot et al., 1988b). Although similar high concentrations of molybdenum have been found in the evaporation basins and in streams in the Southern San Joaquin Valley and Central Coastal area, no correlation was found between uranium and molybdenum in the streams sampled in this study.

Zinc

Zinc concentrations in the streams sampled in this study were widely scattered ranging from 3 to 150 μg/L. The median value for total recoverable zinc in all streams sampled in this survey was 6 μg/L. Figure 13 shows the distribution of total recoverable zinc found. No streams sampled showed a total recoverable zinc concentration less than 3 μg/L even though the level of detection was 1 μg/L. The San Joaquin River Technical Committee (SWRCB, 1987) during their development of water quality criteria for zinc used 2 μg/L as the ambient background concentration. This is less than the median value found during this sampling. The 25th, 75th and 90th percentile values were also determined for the data set (Table 2) and are 5, 10 and 20 μg/L, respectively. The 75th percentile value found in this study is approximately equal to the average zinc concentration found in seawater (Hem, 1985).

As found in this study, zinc concentrations found in previous studies have varied widely. A very early study of California streams (Silvey, 1967) found only 5 of 65 sites exceeded the detection limit of 14 μg/L, thus zinc concentrations could not be quantified. Durum and others (1971) in a survey of nationwide waters, found a median dissolved zinc concentration near 25 μg/L but no distinction was made between natural and polluted waters. Greater than 75 percent of the 714 streams surveyed showed dissolved zinc concentrations between <10 - 50 μg/L. Bradford (1971) found a median dissolved zinc concentration of 10 μg/L for 165 California streams surveyed. Concentrations in that study ranged from 0.5 μg/L to 40 μg/L. Bradford and others (1968) in a related study of 170 High Sierra lakes in California showed a median dissolved zinc concentration of 1.5 μg/L. Kennedy and Malcolm (1977) showed a dissolved zinc concentration ranging from 0.2 - 0.6 μg/L for five northern California streams. In two recent reviews of freshwater zinc concentrations, Wedepohl (1980) concluded that 10 μg/L was an average for freshwater while Moore and Ramamoorthy (1984) did not conclude an average but estimated most freshwaters ranged from 0.5 - 15 μg/L. This range would include greater than 80 percent of the samples collected in this study; however, the mean or median value found in this study is much less than found in other studies. This result is surprising since samples collected in this study were for total recoverable zinc rather than the dissolved concentrations found in previous studies. The higher median values found in previous studies were confirmed in a recent survey of 288 rivers nationwide (Smith et al., 1987) which

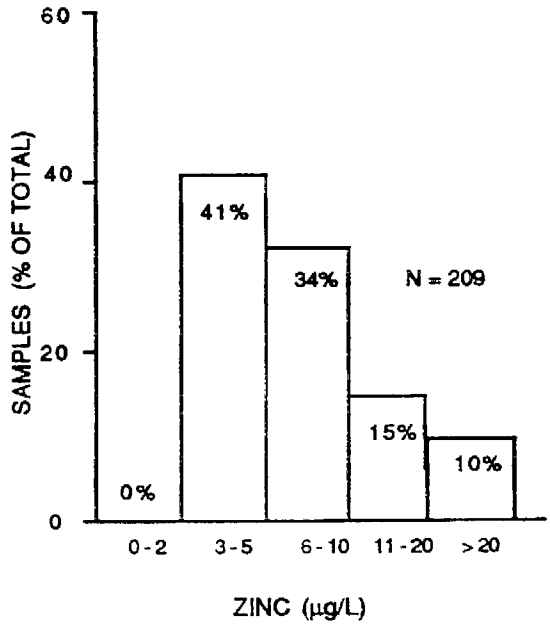

FIG. 13. Percentage of stream samples showing selected zinc values.

showed a median value of 15 μg/L with 25th and 75th percentile values of 12 and 21 μg/L, respectively. Although zinc is widespread in the environment, the slightly higher median value found in other studies may be attributed to those studies not differentiating between natural waters and those affected by man's activities. The emphasis of the present study has been on natural conditions in California streams.

The EPA criterion for zinc, identified as the four-day average concentration in the EPA 304(a) program to establish National Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life, varies with water hardness as described by the equation:

$$\text{zinc } (\mu g/L) = e^{0.8473H + 0.7614}$$

where H = ln (hardness) in mg/L (EPA, 1980i and EPA, 1987c). When the EPA (1987c) zinc criterion was adjusted for hardness of the sample, only two of the sites tested exceeded the calculated criteria. Both of these sites were not considered in the analysis as both were determined to be influenced by non-point source abandoned mine drainage and are not likely to represent background concentrations. In more than 90 percent of the samples collected, the measured concentrations were less than 25 percent of the EPA hardness adjusted zinc criteria. The median percentile is five percent of the EPA hardness adjusted zinc criteria. Table 3 shows the median and percentile values for the ratio of the measured concentrations to the hardness adjusted EPA zinc criteria.

None of the sites sampled showed concentrations in excess of the State Drinking Water Standard of 5,000 μg/L (Marshack, 1989) or the irrigation guideline of 2,000 μg/L (Westcot and Ayers, 1984).

REFERENCES

Albasel, N. and Pratt, P.F., 1989. Guidelines for Molybdenum in Irrigation Waters. Journal of Environmental Quality 18(3):259-264.

Albasel, N., Pratt, P.F., and Westcot, D.W., 1989. Guidelines for Selenium in Irrigation Waters. Journal of Environmental Quality 18(3) 253-258.

Bertine, K.K., Chan, O.H., Turekian, K.K., 1970. Uranium Determinations in Deep Sea Sediments and Natural Waters Using Fission Tracks. Geochin. Cosmochim. Acta 34:641-648.

Boyle, R.W. and Robinson, H.A., 1988. Nickel in the Natural Environment. In: Metals in Biological Systems. Vol 23, Nickel and Its Role in Biology, H. Sigel (Editor) pp 1-30.

Bradford, G.R., 1971. Trace Elements in the Water Resources of California. Hilgardia 41:45-53.

Bradford, G.R., Bair, F.L. and Hunsaker, V., 1968. Trace and Major Element Content of 170 High Sierra Lakes in California. Limnology and Oceanography 13(3):526-30.

Brewers, J.M., Barry, P.J. and MacGregor, D.J., 1987. Distribution and Cycling of Cadmium in the Environment. In: Cadmium in the Aquatic Environment (Nriagu, J.O. and Sprague, J.B. [editors]). Advances in Environmental Science and Technology No. 19. John Wiley and Sons, New York.

Chilcott, J.E., Westcot, D.W., Werner, K. and Belden, K.K., 1988. Water Quality Survey of Tile Drainage Discharges in the San Joaquin Rivei Basin. Central Valley Regional Water Quality Control Board Report, 65 pages.

Chilvers, D.C., and Peterson, P.J., 1987. Global Cycling of Arsenic. In: Lead, Mercury, Cadmium and Arsenic in the Environment (eds. T.C. Hutchinson and K.M. Meema). John Wiley and Sons Ltd. pp. 279-301.

CRWQCB (California Regional Water Quality Control Board, Central Valley Region), 1988. Amendments to the Water Quality Control Plan for the San Joaquin Basin (5C) for the Control of Agricultural Subsurface Drainage Discharges, Draft Staff Report, 61 pages.

Durum, W.H., Hem, J.D. and Heidel, S.G., 1971. Reconnaissance of Selected Minor Elements in Surface Waters of the United States, October, 1970. U.S. Geological Survey Circular 643, 29 pages.

Elevatorski, E.A., 1978. Uranium Deposits in Arizona, California and Nevada. Minobras Press, 125 pages.

EPA, 1980a. Ambient Water Quality Criteria for Arsenic. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-021, October 1980, 205 pages.

EPA, 1980b. Ambient Water Quality Criteria for Cadmium. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-025, October 1980, 183 pages.

EPA, 1980c. Ambient Water Quality Criteria for Chromium. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-035, October 1980, 104 pages.

EPA, 1980d. Ambient Water Quality Criteria for Copper. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-036, October 1980, 161 pages.

EPA, 1980e. Ambient Water Quality Criteria for Lead. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-057, October 1980, 151 pages.

EPA, 1980f. Ambient Water Quality Criteria for Nickel. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-060, October 1980, 206 pages.

EPA, 1980g. Ambient Water Quality Criteria for Selenium. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-070, October 1980, 123 pages.

EPA, 1980h. Ambient Water Quality Criteria for Silver. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-071, October 1980, 212 pages.

EPA, 1980i. Ambient Water Quality Criteria for Zinc. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-80-079, October 1980, 158 pages.

EPA, 1985a. Ambient Water Quality Criteria for Arsenic - 1984. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-84-033, January 1985, 66 pages.

EPA, 1985b. Ambient Water Quality Criteria for Cadmium - 1984. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-84-032, January 1985, 127 pages.

EPA, 1985c. Ambient Water Quality Criteria for Chromium - 1984. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-84-029, January 1985, 99 pages.

EPA, 1985d. Ambient Water Quality Criteria for Copper - 1984. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-84-031, January 1985, 142 pages.

EPA, 1985e. Ambient Water Quality Criteria for Lead - 1984. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-84-027, January 1985, 81 pages.

EPA, 1986. Ambient Water Quality Criteria for Nickel - 1986. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-86-004, September 1986, 93 pages.

EPA, 1987a. Draft Drinking Water Criteria Document for Molybdenum. Office of Drinking Water, EPA, Washington, D.C.

EPA, 1987b. Ambient Water Quality Criteria for Selenium - 1987. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-87-006, September 1987, 121 pages.

EPA, 1987c. Ambient Water Quality Criteria for Zinc - 1987. U.S. EPA Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. Report #EPA 440/5-87-003, February 1987, 207 pages.

Ferguson, J.G. and Gavis, J., 1972. A Review of the Arsenic Cycle in Natural Waters. Water Research 6:1259-1274.

Forstner, U. and Wittmann, G.T.W., 1979. Metal Pollution in the Aquatic Environment. Springer-Verlag, New York, 1979.

Hem, J.D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water, Third Edition. U.S. Geological Survey Water Supply Paper 2254. 263 pages.

Kennedy, V.C. and Malcolm, R.L., 1977. Geochemistry of the Mattole River of Northern California. U.S. Geological Survey Open File Report 78-205. 200+ pages.

Kharkar, D.P., Turekian, K.K., and Bertine, K.K., 1968. Stream Supply of Dissolved Silver, Molybdenum, Antimony, Selenium, Chromium, Colbat, Rubidium and Cesium to the Oceans. Geochim. Cosmochim. Acta 32:285-298.

Lovering, T.G., (Editor), 1976. Lead in the Environment. U.S. Geological Survey Professional Paper No. 957. 90 pages.

Mallory, E.C., Johnson, J.O. and Scott, R.C., 1969. Water Load of Uranium, Radium and Gross Beta Activity at Selected Gaging Stations in Water Year 1960-61. U.S. Geological Survey Water Supply Paper 1535-0.

Marshack, J.B., 1989. A Compilation of Water Quality Goals, Central Valley Regional Water Quality Control Board Report, November 1989.

Moore, J.W. and Ramamoorthy, S., 1984. Heavy Metals in Natural Waters. Springer-Verlag, New York, 268 pages.

Murphy, J. (editor), 1990. Drought Blamed for High Levels of Uranium Contamination in Ground Water at Fernald. Ground Water Monitor, Volume 6, No. 2 (ISSN 0882-6188), BPI, Silver Spring, MD. 16 January 1990.

Page, A.L. and Bingham, F.T., 1973. Cadmium Residues In the Environment. Vol 48 (F.A. Gunther, ed.). Springer-Verlag, New York, pp 1-44.

Palmer, I.S. and Olson, O.E., 1989. Recommended Guideline for Safe Levels of Selenium in Livestock Waters of the San Joaquin Valley of California. In: Recommended Guidelines for Safe Levels of Selenium and Molybdenum in Livestock Drinking Water. Central Valley Regional Water Quality Control Board Report, March 1989. pp 5-53.

Silvey, W.D. 1967. Occurrence of Selected Trace Elements in Water of California. U.S. Geological Survey Water Supply Paper 1535-L, 25 pages.

Smith, R.A., Alexander, R.B. and Wolman, M.G., 1987. Water Quality Trends in Nation's Rivers. Science Vol 235:1607-1615.

Snodgrass, W.J., 1980. Distribution and Behavior of Nickel in the Aquatic Environment. In: J.O. Nriagu (Ed), Nickel in the Environment. Wiley, New York, pp 203-274.

Spear, P.A. and Pierce, R.C., 1979. Copper in the Aquatic Environment: Chemistry, Distribution and Toxicology. National Research Council of Canada Publication No. 16454, 227 pages.

SWRCB (State Water Resources Control Board), 1987. Regulation of Agricultural Drainage to the San Joaquin River, Appendix D, Water Quality Criteria, 137 pages.

SWRCB (State Water Resources Control Board), 1988. Proposition 65 No Significant Risk Levels. Memo dated 18 February 1988 by David Cohen to James Baetge. State Water Resources Control Board, 3 pages.

Tamaki, S. and Frankenberger, W.T., 1989. Environmental Biochemistry of Arsenic. Report to the San Joaquin Valley Drainage Program. University of California, Riverside, 56 pages.

Voegeli, P.T. and King, R.U., 1969. Occurrence and Distribution of Molybdenum in Surface Water of Colorado. U.S. Geological Survey Water Supply Paper 1535-N.

Ward, G.M., 1989. Guidelines For Allowable Limits of Molybdenum in Drinking Water For Animals. In: Recommended Guidelines for Safe levels of Selenium and Molybdenum in Livestock Drinking Water. Central Valley Regional Water Quality Control Board Report, March 1989. pp 54-85.

Waslenchuk, D.G., 1979. The Geochemical Controls on Arsenic Concentrations in Southeastern United States Rivers. Chemical Geology 24:315-325.

Wedepohl, K.H., 1980. Handbook of Geochemistry. Wedepohl, K.H. (Ed), New York:Springer.

Welch, A.H., Lico, M.S. and Hughes, J.L., 1988. Arsenic in Groundwater of the Western United States. Groundwater 26(3) 333-347.

Westcot, D.W. and Ayers, R.S., 1984. Irrigation Water Quality Criteria. In: Irrigation With Reclaimed Municipal Wastewater - A Guidance Manual. Lewis Publishers, , Inc., Chelsea, Michigan. 37 pages.

Westcot, D.W., Rosenbaum, S.E., Grewell, B.J., and Belden, K.K., 1988a. Water and Sediment Quality in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California. Central Valley Regional Water Quality Control Board Report, 50 pages.

Westcot, D.W., Toto, A., Grewell, B.J., and Belden, K.K., 1988b. Uranium Levels in Water in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California. Central Valley Regional Water Quality Control Board Report. October 1988. 20 pages.

Westcot, D.W., Enos, C.A., Chilcott, J.E., and Belden, K.K., 1990. Water and Sediment Quality Survey of Selected Inland Saline Lakes. Central Valley Regional Water Quality Control Board Report. (In Press) 16 pages.

APPENDIX A

Table A-1 Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
1	Riverside	Whitewater Rvr @ I-10	Sec.11, T 3S, R 3W	2/27/87	1700			
2	Riverside	Smith Crk @ Domestic Water Intake	Sec.25, T 2S, R 1W	2/28/87	0700			
3	San Diego	San Luis Rey Rvr @ I-15	Sec. 6, T10S, R2W	2/28/87	1430			
4	Riverside	Temecula Crk @ Hwy 79 (above Vail Lake)	Sec. 9, T8S, R1W	2/28/87	1530			
5	Riverside	Potrero Crk (Massacre Cyn) @ HWY 79	Sec. 9, T 4S R 1W	2/28/87	1630			
6	San Bernadino	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)	Sec.15, T15, R3W	3/1/87	1500			
7	San Bernadino	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)	Sec. 26, T2N, R6W	3/1/87	1600			
8	Fresno	Kings Rvr @ Centerville	Sec. 8, T14S, R23E	3/11/87	1345	63		88
9	Fresno	Mill Crk @ HWY 180	Sec. 35, T13S, R25E	3/11/87	1405	59		225
10	Tulare	Sand Crk @ Gaging Station	Sec. 16, T15S, R25E	3/11/87	1430	72		540
11	Tulare	Cottonwood Crk @ HWY 201, Elderwood	Sec. 11, T17S, R26E	3/11/87	1515	77		520
12	Tulare	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	Sec. 11, T17S, R27E	3/11/87	1540	69		265
13	Tulare	South Fork Kaweah Rvr @ So Fork Rd	Sec. 8, T18S, R29E	3/11/87	1600	57		145
14	Tulare	Kaweah Rvr above Lake Kaweah	Sec. 27, T17S, R28E	3/11/87	1610	57		88
15	Tulare	Yokohl Crk @ HWY 181	Sec. 32, T18S, R27E	3/11/87	1640	75		600
16	Tulare	Tule Rvr @ USGS Gauge @ HWY 190	Sec. 17, T21S, R29E	3/11/87	1720	56		225
17	Tulare	Deer Crk @ Road 260	Sec. 19, T22S, R28E	3/11/87	1800	65		240
18	Washington,Utah	Virgin Rvr @ Zion Nat Prk Lodge 1/	Sec. 2, T41S, R10W	1/1/87				
19	Garfield, Utah	Sevier Rvr 1 mi so HWY 20 1/	Sec. 17, T33S, R5W	1/2/87				
20	Tulare	White Rvr @ HWY 65	Sec. 3, T24S, R27E	3/11/87	1815	68		435
21	Kern	Poso Crk @ HWY 65	Sec. 29, T27S R27E	3/11/87	1845	67		330
22	Kern	Caliente Crk @ Caliente Crk Rd	Sec. 24, T30S, R32E	3/11/87	2000	59		1100
23	Kern	Tehachapi Crk @ Bealville Rd, Caliente	Sec. 26, T30S, R31E	3/11/87	2015	55		620
24	Kern	Grapevine Crk @ Grapevine	Sec.20, T10N, R19W	3/12/87	0650	50		1200
25	Kern	Cuddy Crk @ Frazier Prk	Sec.32, T 9N, R19W	3/12/87	0715	50		1050
26	Ventura	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	Sec.18, T 7N, R19W	3/12/87	0800	43		1220
27	Los Angeles	Hungry Valley Crk @ Hungry Vly St Prk Hq	Sec.17, T 7N, R18W	3/12/87	0845	54		650
28	Los Angeles	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	Sec. 9, T 7N, R18W	3/12/87	0850	49		1500
29	Kern	San Emigdio Crk @ San Emigdio Ranch	Sec.36, T11N, R22W	3/12/87	1020	59		1600

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
30	Santa Barbara	Cuyama Rvr near Cuyama	Sec.31, T11N, R21E	3/12/87	1200	72		4500
31	Santa Barbara	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	Sec.12, T 6N, R17E	3/12/87	1515	63		1750
32	Santa Barbara	Santa Ynez Rvr @ HWY 101	Sec.13, T 6N, R16E	3/12/87	1530	63		1300
33	San Luis Obispo	Huasna Crk @ Huasna Rd	Sec.20, T32S, R15E	3/12/87	1700	60		1150
34	San Luis Obispo	Arroyo Grande Crk above Arroyo Grande	Sec. 21 T32S, R13E	3/12/87	1730	59		1400
35	San Luis Obispo	Salinas Rvr below Lake Santa Margarita (HWY 58)	Sec.15 T29S, R13E	3/12/87	1815	58		510
36	San Luis Obispo	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	Sec.19, T30S, R15E	3/12/87	1845	58		665
37	Solano	Encinosa Crk @ Pleasant Valley Rd	Sec. 19, T6N, R2W	2/24/87	0835	48	7.1	500
38	San Luis Obispo	Huerhuero Crk @ Creston Rd	Sec.15, T27S, R13E	3/13/87	0630	55		1300
39	San Luis Obispo	Cholame Crk @ HWY 46	Sec.16, T26S, R15E	3/13/87	0720	56		3600
40	San Luis Obispo	Estrella Rvr @ Jardine Rd	Sec. 5, T26S, R13E	3/13/87	0800	53		2300
41	San Luis Obispo	Salinas Rvr @ San Miguel	Sec.16, T25S, R12E	3/13/87	0815	52		1150
42	San Luis Obispo	San Marcos Crk west of HWY 101	Sec. 6, T26S, R12E	3/13/87	0830	55		1750
43	San Luis Obispo	Las Tablas Crk CDF Station, Chimney Rd	Sec.18, T26S, R10E	3/13/87	0900	54		700
44	San Luis Obispo	Nacimiento Rvr below Dam	Sec.15, T25S, R10E	3/13/87	0950	58		280
45	Monterey	San Antonio Rvr @ Nacimiento Lake Dr	Sec.26, T24S, R10E	3/13/87	1000	61		650
46	Monterey	San Antonio Rvr @ Interlake Rd	Sec.27, T23S, R 8E	3/13/87	1100	60		410
47	Monterey	Jolon Crk @ Jolon Rd	Sec. 6, T23S, R 7E	3/13/87	1120	60		1450
48	Monterey	Pine Canyon Crk @ Pine Canyon Rd	Sec.25, T20S, R 7E	3/13/87	1200	59		4100
49	Monterey	Salinas Rvr @ Kings City (San Lorenzo Prk)	Sec. 7, T20S, R 8E	3/13/87	1245	70		810
50	Monterey	San Lorenzo Crk @ Bitterwater Rd	Sec.23, T19S, R 8E	3/13/87	1310	74		5000
51	Monterey	Reliz Crk @ Reliz Canyon Rd	Sec.22, T19S, R 6E	3/13/87	1345	72		1650
52	Monterey	Arroyo Seco Rvr @ above Monterey Co Rd G16	Sec.28, T19S, R 5E	3/13/87	1400	58		285
53	Monterey	Paloma Crk @ Monterey Co Rd G16 Brdg	Sec.16, T19S, R 6E	3/13/87	1430	61		320
54	Monterey	Salinas Rvr @ Davis Rd	Sec. 18 T15S, R 3E	3/13/87	1600	64		900
55	Monterey	Carmel Rvr @ Garlad Ranch Regional Prk	Sec.29, T16S, R 2E	3/13/87	1645	63		365
56	Merced	Burns Crk @ Doug Rd	Sec.10, T 7S, R15E	3/19/87	1730			305
57	Merced	Bear Crk @ Bonner Rd	Sec.10, T 7S, R15E	3/19/87	1740			290
58	Merced	Owens Crk @ Cunningham Rd	Sec.29, T 7S, R16E	3/19/87	1800			470
59	Merced	Mariposa Crk A Cunningham Rd	Sec.17, T 8S, R16E	3/19/87	1830			270
60	Madera	San Joaquin Rvr @ HWY 41	Sec. 21, T12S, R20E	3/20/87	1530			115

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
61	Madera	Fresno Rvr @ Road 415	Sec. 16, T8S, R20E	3/20/87	1615			140
62	Madera	Chowchilla Rvr @ Raymond Brdg (Road 613)	Sec. 1, T8S, R18E	3/20/87	1645			195
63	Lyon,Nevada	Carson Rvr @ HWY Alt 95 S. of Silver Springs 2/	Sec. 35, T17N, R24E	4/4/87	0900	50		400
64	Lyon,Nevada	Walker Rvr @ Yerington 2/	Sec. 21, T13N, R25E	4/4/87	0930	50		450
65	Washoe,Nevada	Truckee Rvr @ Wadsworth 2/	Sec. 3, T20N, R24E	4/4/87	1015	48		160
66	Lassen	Long Valley Crk @ Herlong	Sec. 9, T26N, R16E	4/5/87	1400	63		725
67	Lassen	Susan Rvr @ Susanville	Sec. 32, T30N, R12E	4/5/87	1500	52		105
68	Humbolt,Nevada	Humbolt Rvr @ HWY 95, Winnemucca 1/	Sec. 19, T36N, R38E	4/18/87	1615			
69	Alameda	Arroyo Valle above Lake Del Valle	Sec.30, T 4S, R 3E	4/16/87	0715	57		730
70	Alameda	Arroyo Mocho @ Mines Rd	Sec.36, T 3S, R 2E	4/16/87	0730	57		1100
71	Alameda	Alameda Crk @ Calaveras Rd	Sec.11, T 5S, R 1E	4/16/87	0800	59		670
72	Santa Clara	San Felipe Crk @ San Felipe Rd	Sec. 6, T 8S, R 3E	4/16/87	1000	60		630
73	Santa Clara	Uvas Crk @ HWY 152	Sec. 2, T11S, R 3E	4/16/87	1100	64		360
74	Santa Clara	Coyote Crk above Coyote Reservoir	Sec.11, T10S, R 4E	4/16/87	1130	64		560
75	San Benito	Pajaro Rvr @ Gauge Station HWY 129	Sec.12, T12S, R 3E	4/16/87	1230	67		1150
76	San Benito	Santa Ana Crk @ Santa Ana Valley Rd	Sec.11, T13S, R 6E	4/16/87	1300	66		1650
77	San Benito	Tres Pines Crk @ Bolado Park	Sec.28, T13S, R 6E	4/16/87	1315	70		1100
78	San Benito	Pescadero Crk @ Cienega Rd	Sec.20, T14S, R 6E	4/16/87	1400	66		575
79	San Benito	San Benito Rvr @ Cienega Rd	Sec.35, T14S, R 6E	4/16/87	1410	84		1500
80	San Benito	Chalone Crk @ Pinnacles Nat Mon	Sec. 1, T17S, R 7E	4/16/87	1500	74		495
81	San Benito	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	Sec.36, T17S, R 9E	4/16/87	1530	83		1150
82	San Benito	Clear Crk above San Benito Rvr	Sec.16, T18S, R11E	4/16/87	1600	74		1025
83	San Benito	San Benito Rvr above Hernandez Res (Clear Crk Rd)	Sec.17, T18S, R11E	4/16/87	1605	76		1000
84	Fresno	Los Gatos Crk @ County Park	Sec.32, T19S, R13E	4/16/87	1640	80		1450
85	Fresno	Los Gatos Crk @ USGS Gauge near Coalinga	Sec. 5, T20S, R14E	4/16/87	1700	80		2300
86	Fresno	Warthan Crk @ HWY 198 west of Coalinga	Sec.23, T21S, R14E	4/16/87	1730	83		5700
87	Fresno	Jacalitos Crk @ Jacalitos Crk Rd	Sec.23, T21S, R15E	4/16/87	1800	73		2300
88	Santa Cruz	Soquel Crk @ Soquel Dr, Soquel	Sec. 10, T11S, R1W	6/21/87	1300			620
89	Santa Cruz	San Lorenzo Rvr @ Covered Brdg @ Felton	Sec. 15, T10S, R2W	6/21/87	1400			290
90	Shasta	Sacramento Rvr @ Dunsmuir	Sec. 24, T39N, R4W	6/27/87	1500			130
91	Klamath,Oregon	Williamson Rvr @ Williamson NFS Cmpgrnd 1/	Sec. 2, T34S, R7E	6/28/87				94

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
92	Klamath,Oregon	Sprague Rvr @ Chiloquin 1/	Sec. 35, T34S, R7E	6/28/87				115
93	Josephine,Oregon	Rogue Rvr @ Galice 1/	Sec. 36, T34S, R8W	6/30/87				88
94	Josephine,Oregon	Illinois Rvr @ Kerby 1/	Sec. 9, T39S, R8W	7/2/87				150
95	Coos,Oregon	Coquille Rvr @ Coqille 1/	Sec. 1, T28S, R13W	7/8/87				120
96	San Joaquin	Hospital Crk @ Bird Rd 1/	Sec. 7, T 4S, R 6E	4/24/86	1210	74	8.5	880
97	Curry,Oregon	Chetco Rvr @ Loeb State Park 1/	Sec. 13, T40S, R13W	7/8/87				103
98	Carbon, Utah	Price Rvr @ Helper 1/	Sec. 24, T13S, R9E	8/29/88				
99	Emery, Utah	Green Rvr @ Green River 1/	Sec. 15, T21S, R16E	8/28/88				
100	Delta,Colorado	Gunnison Rvr above Delta 1/	Sec. 1, T15S, R95W	8/28/88				
101	Grand, Utah	Colorado Rvr @ Moab 1/	Sec. 26, T25S, R21E	8/25/88				
102	El Dorado	North Fork American Rvr @ HWY 49	Sec. 1, T12N, R8E	3/25/87		49		170
103	El Dorado	South Fork American Rvr @ HWY 49	Sec. 18, T11N, R10E	3/25/87		46		80
104	El Dorado	Carson Crk @ Latrobe Rd	Sec. 14, T9N, R8E	3/25/87		54		200
105	El Dorado	Deer Crk @ Latrobe Rb	Sec. 30, T9N, R9E	3/25/87		52		320
106	Amador	Consumnes Rvr @ Latrobe Rd	Sec. 26, T8N, R9E	3/25/87		52		140
107	Amador	Little Indian Crk @ Latrobe Rd	Sec. 12, T7N, R9E	3/25/87		56		430
108	Amador	Dry Crk @ HWY 124	Sec. 22, T7N, R10E	3/25/87		53		240
109	Amador	Sutter Crk @ HWY 124	Sec. 7, T6N, R11E	3/25/87		54		230
110	Amador	Jackson Crk @ HWY 124	Sec. 28, T6N, R11E	3/25/87		54		220
111	Calaveras	Mokelumne Rvr @ HWY 49	Sec. 1, T5N, R11E	3/25/87		50		80
112	Calaveras	North Fork Calaveras Rvr @ HWY 12	Sec. 6, T4N, R12E	3/25/87		54		170
113	Calaveras	Calaveritas Crk @ HWY 49	Sec. 33, T4N, R12E	3/25/87		56		200
114	Calaveras	Indian Crk @ HWY 49 (San Antonio Crk)	Sec. 10, T3N, R12E	3/25/87		52		110
115	Calaveras	San Domingo Crk @ HWY 49	Sec. 14, T3N R12E	3/25/87		58		190
116	Calaveras	Angeles Crk @ HWY 49	Sec. 33, T3N, R13E	3/25/87		50		50
117	Tuolumne	Stanislaus Rvr @ Parrots Ferry Brdg	Sec. 25, T2N, R13E	3/25/87		60		62
118	Tuolumne	Tuolumne Rvr @ HWY 49	Sec. 21, T1S, R15E	3/25/87		61		32
119	Mariposa	Merced Rvr @ HWY 49	Sec. 6, T4S, R17E	3/25/87		58		48
120	Napa	Conn Crk below Conn Dam	Sec. 2, T7N, R5W	3/18/87	0650	50	6.9	280
121	Napa	Glass Mountain Crk @ Silverado Trail	Sec. 25, T8N, R6W	3/18/87	0715	52	7.2	180
122	Napa	Napa Rvr @ Dunaweal Lane	Sec. 33, T7N, R5W	3/18/87	0735	54	7.0	200

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
123	Sonoma	Maacama Crk @ HWY 128	Sec. 9, T9N, R8W	3/18/87	0805	50	7.8	260
124	Sonoma	Big Sulfur Crk @ Geysers Rd	Sec. 8, T11N, R10W	3/18/87	0900	52	8.1	270
125	Mendocino	Russian Rvr @ HWY 101 (7 mi so of Hopland)	Sec. 14 T12N, R11W	3/18/87	0925	53	7.8	205
126	Mendocino	Outlet Crk @ HWY 101 & HWY 261	Sec. 28, T20N, R7E	3/18/87	1108	50	7.6	120
127	Mendocino	Long Valley Crk @ HWY 101, Longvale	Sec. 28, T20N, R7E	3/18/87	1122	48	7.4	125
128	Humbolt	South Fork Eel Rvr @ north end Richardson St Prk	Sec. 13, T5S, R3E	3/18/87	1240	52	7.5	130
129	Humbolt	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	Sec. 36, T4S, R3E	3/18/87	1305	52	7.7	170
130	Humbolt	Eel Rvr @ Pepperwood exit of HWY 101	Sec. 29, T1N, R2E	3/18/87	1405	50	7.8	170
131	Humbolt	Elk River @ HWY 101, Eureka	Sec. 9, T3N, R1W	3/18/87	1445	50	7.7	150
132	Humbolt	Redwood Crk @ HWY 101, north of Orick	Sec. 34, T11N, R1E	3/18/87	1620	52	7.2	85
133	Humbolt	Prairie Crk @ Davison Ranch Bridge	Sec. 27, T11N, R1E	3/18/87	1640	50	7.5	70
134	Del Norte	Klamath Rvr @ Klamath	Sec. 14, T13N, R1E	3/18/87	1715	49	7.5	140
135	Del Norte	Hunter Crk @ HWY 101	Sec. 33, T14N, R1E	3/18/87	1735	49	7.7	65
136	Del Norte	Wilson Crk @ HWY 101	Sec. 18, T14N, R1E	3/18/87	1745	49	8.0	80
137	Del Norte	Myrtle Crk @ HWY 199 (So. Rank Rd)	Sec. 3, T16N, R1E	3/19/87	1115	50	7.2	70
138	Del Norte	South Fork Smith Rvr @ HWY 199 & South Fork Rd	Sec. 10, T16N, R1E	3/19/87	1140	50	7.6	100
139	Del Norte	Middle Fork Smith Rvr	Sec. 26, T17N, R1E	3/19/87	1200	51	7.8	110
140	Del Norte	Hardscabble Crk @ HWY 199	Sec. 26, T17N, R1E	3/19/87	1215	52	7.8	115
141	Del Norte	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	Sec. 9, T17N, R3E	3/19/87	1245	50	7.7	85
142	Del Norte	Morrison Crk @ Fred Haight Dr	Sec. 35, T18N, R1W	3/19/87	1340	52	7.8	80
143	Del Norte	Rowdy Crk @ Fred Haight Dr	Sec. 26, T18N, R1W	3/19/87	1350	52	7.3	75
144	Humbolt	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	Sec. 8, T6N, R1E	3/20/87	0915	48	7.5	110
145	Trinity	East Fork Willow Crk @ East Fork NFS Cmpgrnd	Sec. 15, T35N, R4E	3/20/87	1025	46	7.7	110
146	Trinity	Willow Crk upstream of East Fork Willow Crk	Sec. 15, T35N, R4E	3/20/87	1035	46	7.6	100
147	Trinity	Italian Crk @ HWY 299	Sec. 23, T34N, R7E	3/20/87	1145	51	8.2	300
148	Trinity	Swede Crk @ HWY 299	Sec. 23, T34N, R7E	3/20/87	1200	50	8.2	340
149	Trinity	Trinity Rvr @ HWY 299 (Haden Flat)	Sec. 24, T34N, R7E	3/20/87	1212	48	8.0	160
150	Trinity	Big French Crk @ Big French Crk Rd, old brdg	Sec. 29, T34N, R8E	3/20/87	1230	50	8.0	240
151	Trinity	Manzanita Crk @ HWY 299	Sec. 35, T34N, R12W	3/20/87	1248	50	8.0	250
152	Trinity	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	Sec. 20, T5N, R11W	3/20/87	1310	46	8.1	110
153	Trinity	Canyon Crk @ HWY 299 (Junction City)	Sec. 12, T33N, R11W	3/20/87	1330	48	7.8	90

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
154	Trinity	Weaver Crk @ HWY 299 (east of Weaverville)	Sec. 19, T33N, R9W	3/20/87	1400	49	7.7	125
155	Shasta	Indian Crk @ HWY 299	Sec. 35, T33N, R7W	3/20/87	1412	50	7.9	200
156	Shasta	Clear Crk @ HWY 299	Sec. 35, T33N, R7W	3/20/87	1445	48	8.0	180
157	Colusa	Bear Crk upstream of Cache Crk	Sec. 19, T13N, R4W	3/17/88	1500			
158	Sacramento	American Rvr @ Sunrise Blvd	Sec. 25, T9N, R6E	4/11/88	0845	57	6.2	80
159	Sacramento	Sacramento Rvr @ Hood	Sec. 22, T6N, R4E	4/11/88	1000	64	6.6	150
160	Yolo	Putah Crk @ HWY 128 (below Lake Berryessa)	Sec. 36, T8N, R2W	4/11/88	1115	54	7.4	300
161	Lake	Putah Crk @ HWY 29	Sec. 35, T11N, R7W	4/11/88	1240	73	8.0	320
162	Lake	Cache Crk @ HWY 53 (below Clear Lake)	Sec. 34, T13N, R7W	4/11/88	1310	68	7.8	300
163	Lake	Cole Crk @ Clear Lake (below Kelsey Crk)	Sec. 4, T13N, R9W	4/11/88	1400	74	7.7	260
164	Lake	Scotts Crk @ HWY 29	Sec. 14, T15N, R10W	4/11/88	1445	70	7.4	450
165	Lake	Middle Crk @ HWY 20	Sec. 12, T15N, R10W	4/11/88	1455	68	8.2	250
166	Lake	N. Fork Cache Crk @ HWY 20	Sec. 5, T13N, R6W	4/11/88	1540	66	8.3	250
167	Glenn	Stoney Crk @ Black Butte Rd (above Black Butte Res)	Sec. 27, T22N, R5W	4/11/88	1740	74	8.0	300
168	Tehema	Stoney Crk @ Newville Rd (below Black Butte Res)	Sec. 28, T23N, R4W	4/11/88	1810	64	8.1	300
169	Tehema	Kendricks & Salt Crks above Black Butte Res	Sec. 33, T23N, R5W	4/11/88	1830	72	8.3	675
170	Tehema	Thomes Crk @ Paskenta	Sec. 5, T23N, R6W	4/11/88	1900	68	8.1	170
171	Shasta	Clear Crk below Whiskeytown Res	Sec. 28, T34N, R8W	4/12/88	0740	48	7.9	100
172	Shasta	Spring Crk @ Debris Dam	Sec. 18, T32N, R5W	4/12/88	0815	55	3.6	1250
173	Shasta	Sacramento Rvr @ Keswick Dam	Sec. 21, T32N, R5W	4/12/88	0835	48	6.0	130
174	Tehema	Cottonwood Crk @ I-5	Sec. 11, T29N, R4W	4/12/88	0915	63	6.9	270
175	Tehema	Mill Crk @ HWY 99	Sec. 4, T25N, R2W	4/12/88	1010	59	7.4	160
176	Glenn	Sacramento Rvr @ Hamilton City	Sec. 17, T22N, R1W	4/12/88	1100	58	7.6	140
177	Butte	Big Chico Crk @ River Rd	Sec. 2, T21N, R1W	4/12/88	1125	68	7.3	240
178	Butte	Feather Rvr @ Gridley (East Gridley Rd)	Sec. 33, T18N, R3E	4/12/88	1240	63	7.8	90
179	Yuba	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	Sec. 19, T15N, R4E	4/12/88	1320	63	7.6	100
180	Sutter	Sutter Bypass @ Tarke Rd	Sec. 14, T15N, R1E	4/12/88	1400	69	7.6	240
181	Butte	Butte Crk @ Butte Slough Rd	Sec. 29, T19N, R1E	4/12/88	1430	61	7.8	160
182	Colusa	Sacramento Rvr @ Grimes	Sec. 8, T14N, R1E	4/12/88	1500	62	7.8	140
183	Yolo	RD 108 Drain @ HWY 45	Sec. 30, T12N, R2E	4/12/88	1540	74	8.5	490
184	Yolo	Colusa Basin Drain @ Road 99E	Sec. 14, T11N, R2E	4/12/88	1600	69	8.2	400

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
185	Sacramento	Sacramento Slough @ Karnack	Sec. 20, T11N, R3E	4/12/88	1625	68	8.0	260
186	Sutter	Feather Rvr @ West Catlett Rd	Sec. 12, T12N, R3E	4/12/88	1720	65	8.3	90
187	Sacramento	Natomas East Drain @ Del Paso Rd	Sec. 6, T9N, R5E	4/12/88	1745	65	8.2	250
188	Stanislaus	Salado Crk (2.1 mi west of I-5)	Sec.10, T 6S, R 7E	3/17/87	1445	71	8.2	3000
189	Stanislaus	Kern Canon Crk @ I-5	Sec. 7, T 5S, R 7E	3/17/87	1245	56	8.4	5800
190	Merced	Ortigilita Crk west of I-5	Sec.31, T11S, R10E	3/17/87	1730	67	7.9	6200
191	San Joaquin	Corral Hollow Crk @ Corral Hollow Rd Brdg	Sec.24, T 3S, R 4E	3/17/87	1045	62	8.2	2200
192	Santa Clara	Pacheco Crk above reservoir	Sec. 16, T10S, R6E	3/18/87	1120	57	8.0	650
193	Stanislaus	Garzas Crk @ Sullivan Rd west of I-5	Sec.17, T 8S, R 8E	4/25/86	0810	62	8.5	1400
194	Solano	Suisun Crk @ Suisun Valley Rd	Sec. 29, T5N, R2W	12/12/86	1645	45	6.6	430
195	Stanislaus	Orestimba Crk upstream of Calif Aqueduct	Sec.19, T 7S, R 8E	3/17/87	1550	69	8.5	1400
196	Contra Costa	Deer Crk @ Deer Valley Rd	Sec.20, T 1N, R 2E	3/17/87	0930	60	7.4	7800
197	Fresno	Little Panche Crk below the dam	Sec.20, T13S, R11E	3/18/87	0730	44	7.7	3500
198	Fresno	Panoche Crk @ USGS Gauge (west of I-5)	Sec.10, T15S, R12E	3/18/87	0900	57	8.1	>10000
199	Stanislaus	Ingram Crk (west of I-5)	Sec.35, T 4S, R 6E	3/17/87	1145	68	8.8	2150
200	Contra Costa	Kellogg Crk @ Vasco Rd	Sec. 7, T 1S, R 3E	3/17/87	1015	57	8.1	1400
201	Contra Costa	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	Sec. 2, T 1S, R 2E	3/17/87	1000	57	8.2	1100
202	Santa Clara	South Fork Pacheco Crk @ HWY 152	Sec. 35, T10S, R6E	3/18/87	1120	56	7.6	640
203	Merced	Quinto Crk @ Howard Ranch	Sec.15, T 9S, R 8E	3/18/87	1330	60	8.1	1450
204	Merced	Romero Crk @ McCabe Rd	Sec.27, T 9S, R 8E	3/18/87	1300	61	8.3	1400
205	Stanislaus	Del Puerto Crk west of I-5	Sec.29, T 5S, R 7E	3/17/87	1400	57	8.5	1250
206	San Joaquin	Mountain House Crk @ Grant Line Rd	Sec.19, T 2S, R 4E	3/17/87	1045	59	8.2	3700
207	Fresno	Little Panoche Crk above Reservoir	Sec.35, T13S, R10E	3/18/87	0745	43	7.9	1800
208	Stanislaus	Bennett Valley Crk upstream of I-5	Sec. 9, T8S, R8E	3/18/87	1430	63	8.7	9200
209	Fresno	Silver Crk upstream of Panoche Crk	Sec.31, T15S, R12E	3/18/87	0845	53	8.1	8000
210	Stanislaus	Black Gulch Crk @ I-5	Sec.34, T 5S, R 7E	3/17/87	1420	73	8.2	8500
211	Stanislaus	Crow Crk upstream of I-5	Sec. 1, T 7S, R 7E	3/17/87	1515	68	8.2	5000
212	Contra Costa	Sand Crk @ Deer Valley Rd	Sec. 8, T 1N, R 2E	4/24/86	0815	55	8.3	3450
213	Solano	Pleasants Crk @ Pleasants Valley Rd	Sec. 1, T7N, R2W	4/22/87	0840	64	6.6	1100
214	Solano	Green Valley Crk @ Cordelia Rd	Sec. 7, T4N, R2W	4/22/87	0925	65	6.5	800
215	Solano	Suisun Crk @ Cordelia Rd	Sec. 5, T4N, R2W	4/22/87	0945	70	6.6	760

Table A-1 (continued) Water Quality Sampling Site Locations and Field Measured Data For Selected Streams in California

Site ID	County	Site Description	Section/Township/Range	Date	Time	Temp	pH	EC umhos/cm
216	Solano	Alamo Crk @ Pleasants Valley Rd	Sec. 10, T6M, R2W	4/22/87	1330	76	8.2	860
217	Solano	McCune Crk @ Midway Rd	Sec. 32, T8N, R1W	4/22/87	1350	76	8.6	580
218	Solano	Sweany Crk @ Midway Rd	Sec. 21, T7N, R1W	4/22/87	1405	72	9.2	460
219	Solano	Ulatis Crk @ Brown Rd	Sec. 7, T6N, R2W	4/22/87	1420	76	9.0	740
220	Napa	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)	Sec. 14, T10N, R4W	12/12/86	1015	46	8.6	1200
221	Napa	Maxwell Crk @ Pope Canyon Rd	Sec. 18, T9N, R4W	12/12/86	1130	42	6.4	975
222	Napa	Pope Crk @ Pope Canyon Rd	Sec. 18, T9N, R4W	12/12/86	1205	42	8.3	1100
223	Napa	Capell Crk @ HWY 128	Sec. 26, T7N, R3W	12/12/86	1255	44	7.6	610
224	Solano	Green Valley Crk @ Green Valley Rd	Sec. 1, T4N, R3W	12/12/86	1620	42	7.0	220
225	San Joaquin	Lone Tree Crk @ Bird Rd	Sec. 1, T 4S, R 5E	4/24/86	1145	76	8.3	1750
226	Glenn	Logan Creek at Rd 60	Sec. 34, T 19N, R 4W	03/25/87		59	7.8	750

1/ Sample taken for comparison purposes
2/ Interstate water

Table A-2 Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
		ug/L							
1	Whitewater Rvr @ I-10					4	<1	5.7	3
2	Smith Crk @ Domestic Water Intake					<1	<1	2.0	<1
3	San Luis Rey Rvr @ I-15					<5	<5	12	3
4	Temecula Crk @ Hwy 79 (above Vail Lake)					2	<1	9.8	<1
5	Potrero Crk (Massacre Cyn) @ HWY 79					2	2	16	1
6	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)					7	4	1.9	6
7	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)					<1	<1	3.7	<1
8	Kings Rvr @ Centerville	<1	<50	<0.1	<0.5	<1	<1	2.8	<1
9	Mill Crk @ HWY 180	<1	<50	<0.1	<0.5	<1	<1	2.4	<1
10	Sand Crk @ Gaging Station	2	<50	<0.1	<0.5	1	<1	6.6	<1
11	Cottonwood Crk @ HWY 201, Elderwood	2	<50	<0.1	<0.5	<1	<1	6.0	<1
12	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	1	<50	<0.1	1.4	<1	<1	4.2	1
13	South Fork Kaweah Rvr @ So Fork Rd	<1	<50	<0.1	<0.5	<1	<1	2.2	<1
14	Kaweah Rvr above Lake Kaweah	<1	<50	<0.1	<0.5	<1	<1	1.6	<1
15	Yokohl Crk @ HWY 181	5	80	<0.1	1.0	2	<1	15	2
16	Tule Rvr @ USGS Gauge @ HWY 190	1	60	<0.1	<0.5	1	<1	2.0	<1
17	Deer Crk @ Road 260	<1	<50	<0.1	1.1	<1	<1	5.6	<1
18	Virgin Rvr @ Zion Nat Prk Lodge								
19	Sevier Rvr 1 mi so HWY 20								
20	White Rvr @ HWY 65	9	50	<0.1	1.7	2	1	15	2
21	Poso Crk @ HWY 65	11	90	<0.1	1.2	2	1	7.9	3
22	Caliente Crk @ Caliente Crk Rd	11	550	<0.1	<0.5	<1	<1	15	<1
23	Tehachapi Crk @ Bealville Rd, Caliente	1	90	<0.1	<0.5	<1	<1	21	<1
24	Grapevine Crk @ Grapevine	1	850	<0.1	<0.5	<1	<1	41	<1
25	Cuddy Crk @ Frazier Prk	1	1110	<0.1	<0.5	<1	<1	29	<1
26	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	2	3140	<0.1	0.7	<1	<1	6.0	<1
27	Hungry Valley Crk @ Hungry Vly St Prk Hq	2	320	<0.1	0.5	<1	<1	6.2	<1
28	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	<1	470	<0.1	<0.5	<1	<1	30	<1
29	San Emigdio Crk @ San Emigdio Ranch	<1	1000	<0.1	<0.5	<1	<1	9.2	<1

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
		ug/L							
30	Cuyama Rvr near Cuyama	2	1550	<0.1	2.8	3	<1	13	2
31	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	5	220	0.4	3.0	<1	<1	38	6
32	Santa Ynez Rvr @ HWY 101	<1	350	0.1	0.9	<1	<1	12	3
33	Huasna Crk @ Huasna Rd	6	60	0.2	0.5	<1	<1	10	1
34	Arroyo Grande Crk above Arroyo Grande	2	100	0.4	0.6	<1	<1	23	3
35	Salinas Rvr below Lake Santa Margarita (HWY 58)	<1	70	<0.1	<0.5	<1	<1	1.3	1
36	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	<1	80	<0.1	<0.5	<1	<1	1.5	<1
37	Encinosa Crk @ Pleasant Valley Rd								
38	Huerhuero Crk @ Creston Rd	4	800	<0.1	<0.5	4	<1	3.8	9
39	Cholame Crk @ HWY 46	5	2110	0.2	1.8	4	<1	126	8
40	Estrella Rvr @ Jardine Rd	6	1140	<0.1	<0.5	<1	1	40	3
41	Salinas Rvr @ San Miguel	3	300	0.3	0.8	2	<1	6.6	4
42	San Marcos Crk west of HWY 101	2	360	0.2	<0.5	<1	<1	15	2
43	Las Tablas Crk CDF Station, Chimney Rd	<1	120	<0.1	0.9	1	<1	4.6	6
44	Nacimiento Rvr below Dam	1	<50	<0.1	1.0	<1	<1	1.6	2
45	San Antonio Rvr @ Nacimiento Lake Dr	2	110	0.4	<0.5	<1	<1	17	4
46	San Antonio Rvr @ Interlake Rd	<1	<50	0.1	1.0	<1	<1	5.8	<1
47	Jolon Crk @ Jolon Rd	7	110	0.4	0.5	<1	<1	20	1
48	Pine Canyon Crk @ Pine Canyon Rd	<1	500	0.4	<0.5	<1	2	33	5
49	Salinas Rvr @ Kings City (San Lorenzo Prk)	3	300	0.4	32	5	2	3.7	32
50	San Lorenzo Crk @ Bitterwater Rd	1	3090	0.2	1.4	<1	<1	16	10
51	Reliz Crk @ Reliz Canyon Rd	2	170	0.5	<0.5	<1	<1	18	2
52	Arroyo Seco Rvr @ above Monterey Co Rd G16	<1	<50	<0.1	0.9	<1	<1	1.7	1
53	Paloma Crk @ Monterey Co Rd G16 Brdg	<1	<50	0.2	<0.5	<1	<1	1.9	<1
54	Salinas Rvr @ Davis Rd	3	250	0.2	11	4	<1	5.2	19
55	Carmel Rvr @ Garlad Ranch Regional Prk	<1	<50	<0.1	<0.5	<1	<1	2.7	<1
56	Burns Crk @ Doug Rd	3	<50	0.4	1.1	6	<1	0.7	2
57	Bear Crk @ Bonner Rd	2	<50	0.2	<0.5	2	<1	0.5	<1
58	Owens Crk @ Cunningham Rd	3	<50	0.2	0.6	2	<1	1.4	2
59	Mariposa Crk A Cunningham Rd	3	<50	0.1	0.5	2	<1	0.7	2
60	San Joaquin Rvr @ HWY 41	2	<50	0.1	<0.5	<1	<1	1.9	<1

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
		.....	.....	.....	.....	...ug/L.....	.....	.....	.....
61	Fresno Rvr @ Road 415	1	<50	0.1	<0.5	<1	1	2.0	2
62	Chowchilla Rvr @ Raymond Brdg (Road 613)	<1	<50	0.1	<0.5	<1	<1	1.3	<1
63	Carson Rvr @ HWY Alt 95 S. of Silver Springs	4	230	<0.1	4.9	3	1	8.0	2
64	Walker Rvr @ Yerington	13	380	0.2	0.6	2	<1	10	1
65	Truckee Rvr @ Wadsworth	11	220	0.2	1.7	4	3	1.2	2
66	Long Valley Crk @ Herlong	28	560	0.3	2.4	8	1	37	2
67	Susan Rvr @ Susanville	<1	<50	<0.1	<0.5	<1	<1	1.0	<1
68	Humbolt Rvr @ HWY 95, Winnemucca	14	280	0.2	3.0	24	2	3.4	5
69	Arroyo Valle above Lake Del Valle	<1	560	0.1	0.6	<1	1	1.8	1
70	Arroyo Mocho @ Mines Rd	2	1010	0.2	<0.5	2	<1	2.4	1
71	Alameda Crk @ Calaveras Rd	2	640	0.1	<0.5	1	<1	2.3	3
72	San Felipe Crk @ San Felipe Rd	<1	150	<0.1	<0.5	4	2	1.3	<1
73	Uvas Crk @ HWY 152	<1	70	0.1	<0.5	<1	2	1.0	<1
74	Coyote Crk above Coyote Reservoir	<1	300	<0.1	<0.5	<1	<1	1.2	<1
75	Pajaro Rvr @ Gauge Station HWY 129	1	380	0.1	3.5	2	2	1.5	11
76	Santa Ana Crk @ Santa Ana Valley Rd	3	2440	0.2	11	1	<1	5.2	2
77	Tres Pines Crk @ Bolado Park	2	870	<0.1	<0.5	<1	<1	2.8	2
78	Pescadero Crk @ Cienega Rd	2	<50	0.1	0.6	<1	2	5.0	<1
79	San Benito Rvr @ Cienega Rd	1	1390	0.1	2.6	2	<1	4.2	4
80	Chalone Crk @ Pinnacles Nat Mon	4	60	<0.1	0.5	<1	1	2.7	<1
81	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	2	680	<0.1	6.0	2	1	1.7	8
82	Clear Crk above San Benito Rvr	<1	1150	0.1	26	<1	<1	0.9	3
83	San Benito Rvr above Hernandez Res (Clear Crk Rd)	<1	650	0.1	13	<1	<1	1.7	2
84	Los Gatos Crk @ County Park	<1	1020	<0.1	<0.5	<1	<1	2.8	<1
85	Los Gatos Crk @ USGS Gauge near Coalinga	<1	1390	0.1	1.9	<1	<1	3.5	10
86	Warthan Crk @ HWY 198 west of Coalinga	1	9360	<0.1	0.8	<1	1	12	3
87	Jacalitos Crk @ Jacalitos Crk Rd	1	980	0.1	3.6	1	<1	11	8
88	Soquel Crk @ Soquel Dr, Soquel		<50					3.0	
89	San Lorenzo Rvr @ Covered Brdg @ Felton		<50					3.0	
90	Sacramento Rvr @ Dunsmuir	11	170	<0.1	1.3	<1	<1	0.7	4
91	Williamson Rvr @ Williamson NFS Cmpgrnd	2	80	<0.1	0.6	<1	<1	0.6	<1

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
						ug/L			
92	Sprague Rvr @ Chiloquin	<1	<20	<0.1	0.6	<1	<1	0.8	<1
93	Rogue Rvr @ Galice	<1	<20	0.1	0.5	<1	<1	0.4	<1
94	Illinois Rvr @ Kerby	<1	<20	<0.1	1.6	<1	<1	0.4	4
95	Coquille Rvr @ Coqille	<1	<20	<0.1	1.2	<1	<1	0.6	2
96	Hospital Crk @ Bird Rd		1100						
97	Chetco Rvr @ Loeb State Park	<1	<20	<0.1	1.2	<1	1	0.4	1
98	Price Rvr @ Helper	1	50	0.4	<0.5	<1	<1	1.0	<1
99	Green Rvr @ Green River	1	180	0.1	<0.5	<1	<2	4.9	<1
100	Gunnison Rvr above Delta	3	90	<0.1	<0.5	<1	<2	2.6	<1
101	Colorado Rvr @ Moab	3	120	<0.1	<0.5	<1	<2	15	2
102	North Fork American Rvr @ HWY 49	<1	<50	<0.1	1.0	<1	<1	0.2	<1
103	South Fork American Rvr @ HWY 49	<1	<50	<0.1	1.6	<1	<1	0.2	1
104	Carson Crk @ Latrobe Rd	<1	<50	<0.1	0.6	2	<1	0.1	<1
105	Deer Crk @ Latrobe Rb	<1	<50	<0.1	1.3	4	<1	0.1	3
106	Consumnes Rvr @ Latrobe Rd	<1	<50	<0.1	0.9	1	<1	0.2	<1
107	Little Indian Crk @ Latrobe Rd	8	<50	<0.1	1.0	1	<1	0.4	3
108	Dry Crk @ HWY 124	9	<50	<0.1	<0.5	<1	<1	0.6	<1
109	Sutter Crk @ HWY 124	7	<50	<0.1	0.9	29	<1	0.4	2
110	Jackson Crk @ HWY 124	2	<50	<0.1	0.9	2	<1	0.3	1
111	Mokelumne Rvr @ HWY 49	<1	<50	<0.1	<0.5	<1	<1	0.1	<1
112	North Fork Calaveras Rvr @ HWY 12	<1	<50	<0.1	<0.5	<1	<1	0.5	<1
113	Calaveritas Crk @ HWY 49	<1	<50	<0.1	<0.5	1	<1	0.5	<1
114	Indian Crk @ HWY 49 (San Antonio Crk)	<1	<50	<0.1	<0.5	<1	<1	0.2	<1
115	San Domingo Crk @ HWY 49	<1	<50	<0.1	0.6	<1	<1	0.4	<1
116	Angeles Crk @ HWY 49	<1	<50	<0.1	0.8	2	<1	<0.1	1
117	Stanislaus Rvr @ Parrots Ferry Brdg	<1	<50	<0.1	<0.5	3	<1	0.3	1
118	Tuolumne Rvr @ HWY 49	<1	<50	<0.1	<0.5	<1	<1	0.2	<1
119	Merced Rvr @ HWY 49	<1	<50	<0.1	<0.5	<1	<1	0.4	<1
120	Conn Crk below Conn Dam	1	130	<0.1	1.1	2	<1	0.5	8
121	Glass Mountain Crk @ Silverado Trail	<1	60	<0.1	<0.5	<1	<1	0.4	<1
122	Napa Rvr @ Dunaweal Lane	3	320	0.1	2.0	2	<1	0.5	4

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
						ug/L			
123	Maacama Crk @ HWY 128	1	70	<0.1	2.8	<1	<1	0.4	4
124	Big Sulfur Crk @ Geysers Rd	<1	270	<0.1	4.7	1	<1	0.6	7
125	Russian Rvr @ HWY 101 (7 mi so of Hopland)	<1	270	<0.1	6.6	2	<1	0.5	7
126	Outlet Crk @ HWY 101 & HWY 261	<1	180	<0.1	5.0	1	<1	0.5	4
127	Long Valley Crk @ HWY 101, Longvale	<1	240	<0.1	4.6	3	<1	0.2	5
128	South Fork Eel Rvr @ north end Richardson St Prk	<1	60	<0.1	6.4	3	<1	0.3	6
129	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	3	<50	0.1	51	15	4	0.3	51
130	Eel Rvr @ Pepperwood exit of HWY 101	1	80	<0.1	29	9	2	0.3	27
131	Elk River @ HWY 101, Eureka	<1	<50	<0.1	32	6	2	0.6	21
132	Redwood Crk @ HWY 101, north of Orick	2	<50	<0.1	16	7	2	0.7	10
133	Prairie Crk @ Davison Ranch Bridge	<1	<50	<0.1	3.4	3	2	0.1	3
134	Klamath Rvr @ Klamath	1	<50	<0.1	11	5	<1	0.3	18
135	Hunter Crk @ HWY 101	<1	<50	<0.1	<0.5	1	<1	0.3	<1
136	Wilson Crk @ HWY 101	2	<50	<0.1	4.6	2	1	<0.1	4
137	Myrtle Crk @ HWY 199 (So. Rank Rd)	<1	<50	<0.1	8.0	<1	<1	<0.1	9
138	South Fork Smith Rvr @ HWY 199 & South Fork Rd	1	<50	<0.1	4.2	<1	<1	0.3	12
139	Middle Fork Smith Rvr	<1	<50	<0.1	6.7	<1	<1	0.1	13
140	Hardscabble Crk @ HWY 199	<1	<50	<0.1	7.3	<1	<1	0.4	13
141	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	<1	<50	<0.1	1.7	<1	<1	0.1	12
142	Morrison Crk @ Fred Haight Dr	<1	<50	<0.1	0.7	<1	<1	<0.1	1
143	Rowdy Crk @ Fred Haight Dr	<1	<50	<0.1	2.8	<1	1	0.3	6
144	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	1	<50	<0.1	20	6	2	0.2	21
145	East Fork Willow Crk @ East Fork NFS Cmpgrnd	<1	<50	<0.1	1.6	<1	<1	0.3	6
146	Willow Crk upstream of East Fork Willow Crk	<1	<50	<0.1	1.9	<1	<1	0.2	6
147	Italian Crk @ HWY 299	2	<50	<0.1	<0.5	<1	<1	0.6	<1
148	Swede Crk @ HWY 299	1	<50	<0.1	0.5	<1	<1	1.0	<1
149	Trinity Rvr @ HWY 299 (Haden Flat)	<1	<50	<0.1	1.2	<1	<1	0.5	2
150	Big French Crk @ Big French Crk Rd, old brdg	<1	<50	<0.1	2.0	<1	<1	0.6	1
151	Manzanita Crk @ HWY 299	<1	<50	<0.1	1.2	2	<1	0.6	<1
152	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	<1	<50	<0.1	1.9	<1	<1	0.6	<1
153	Canyon Crk @ HWY 299 (Junction City)	<1	<50	<0.1	0.9	<1	<1	0.4	<1

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
						ug/L			
154	Weaver Crk @ HWY 299 (east of Weaverville)	<1	<50	<0.1	1.4	2	<1	0.2	2
155	Indian Crk @ HWY 299	<1	<50	<0.1	2.0	<1	<1	0.3	2
156	Clear Crk @ HWY 299	2	<50	1.0	4.2	140	<1	1.1	3
157	Bear Crk upstream of Cache Crk	<1		0.1	3.9	<1	<1	1.0	4
158	American Rvr @ Sunrise Blvd	<1		0.4	0.8	9	<1	0.4	3
159	Sacramento Rvr @ Hood	2		0.8	3.2	14	<1	0.1	5
160	Putah Crk @ HWY 128 (below Lake Berryessa)	<1		0.1	0.8	2	<1	<0.1	3
161	Putah Crk @ HWY 29	<1		0.3	1.5	5	<1	<0.1	3
162	Cache Crk @ HWY 53 (below Clear Lake)	<1		0.6	4.3	11	15	<0.1	9
163	Cole Crk @ Clear Lake (below Kelsey Crk)	<1		0.1	1.7	3	1	0.2	5
164	Scotts Crk @ HWY 29	<1		0.2	1.1	4	2	0.3	6
165	Middle Crk @ HWY 20	<1		<0.1	<0.5	<1	<1	<0.1	<1
166	N. Fork Cache Crk @ HWY 20	1		<0.1	1.5	1	<1	0.1	3
167	Stoney Crk @ Black Butte Rd (above Black Butte Res)	<1		1.1	2.3	24	5	0.8	7
168	Stoney Crk @ Newville Rd (below Black Butte Res)	2		0.2	4.7	7	<1	0.4	7
169	Kendricks & Salt Crks above Black Butte Res	<1		0.7	1.2	4	<1	1.3	2
170	Thomes Crk @ Paskenta	<1		0.2	<0.5	3	<1	0.3	1
171	Clear Crk below Whiskeytown Res	<1		<0.1	<0.5	2	<1	0.1	2
172	Spring Crk @ Debris Dam	11		110	4.7	1500	11	1.2	9
173	Sacramento Rvr @ Keswick Dam	2		0.5	0.8	8	<1	0.5	1
174	Cottonwood Crk @ I-5	<1		0.1	0.8	2	<1	0.3	<1
175	Mill Crk @ HWY 99	30		<0.1	0.6	2	<1	<0.1	<1
176	Sacramento Rvr @ Hamilton City	2		0.4	1.4	6	<1	0.6	2
177	Big Chico Crk @ River Rd	1		0.3	1.5	3	5	0.2	1
178	Feather Rvr @ Gridley (East Gridley Rd)	<1		<0.1	1.1	4	1	0.2	1
179	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	<1		0.4	0.7	3	1	0.2	<1
180	Sutter Bypass @ Tarke Rd	4		0.1	3.6	7	1	0.4	5
181	Butte Crk @ Butte Slough Rd	3		0.2	3.0	7	<1	0.4	2
182	Sacramento Rvr @ Grimes	2		0.3	2.9	8	<1	0.2	4
183	RD 108 Drain @ HWY 45	6		0.5	8.2	8	<1	5.2	10
184	Colusa Basin Drain @ Road 99E	2		0.2	13	9	<1	0.4	12

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
						ug/L			
185	Sacramento Slough @ Karnack	4		0.5	3.7	6	<1	0.6	5
186	Feather Rvr @ West Catlett Rd	<1		0.2	2.0	5	<1	0.2	3
187	Natomas East Drain @ Del Paso Rd	2		0.6	26	24	3	0.1	24
188	Salado Crk (2.1 mi west of I-5)	<1	1500	0.2	0.9	1	<1	3.2	8
189	Kern Canon Crk @ I-5	5	8800	0.3	7.5	3	1	6.1	9
190	Ortigilita Crk west of I-5	<1	5300	0.3	2.5	<1	<1	4.1	<1
191	Corral Hollow Crk @ Corral Hollow Rd Brdg	2	4200	0.1	<0.5	<1	<1	3.4	<1
192	Pacheco Crk above reservoir	<1	250	<0.1	<0.5	1	<1	1.1	1
193	Garzas Crk @ Sullivan Rd west of I-5		790						
194	Suisun Crk @ Suisun Valley Rd		170						
195	Orestimba Crk upstream of Calif Aqueduct	<1	600	<0.1	1.3	<1	<1	1.5	1
196	Deer Crk @ Deer Valley Rd	<1	1400	0.3	<0.5	<5	<1	1.5	5
197	Little Panche Crk below the dam	4	10800	0.1	0.5	1	<1	4.1	4
198	Panoche Crk @ USGS Gauge (west of I-5)	<1	12500	0.2	2.1	<5	<1	11	34
199	Ingram Crk (west of I-5)	2	6000	0.1	0.8	1	<1	3.0	<1
200	Kellogg Crk @ Vasco Rd	2	3800	<0.1	2.3	2	<1	0.9	3
201	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	<1	2600	<0.1	<0.5	1	<1	1.1	28
202	South Fork Pacheco Crk @ HWY 152	2	160	<0.1	<0.5	1	<1	1.1	2
203	Quinto Crk @ Howard Ranch	2	2000	<0.1	<0.5	1	<1	2.8	1
204	Romero Crk @ McCabe Rd	1	1800	<0.1	<0.5	<1	<1	2.2	<1
205	Del Puerto Crk west of I-5	1	1100	<0.1	<0.5	<1	<1	2.1	<1
206	Mountain House Crk @ Grant Line Rd	2	7200	0.2	0.9	2	<1	7.1	3
207	Little Panoche Crk above Reservoir	<1	4900	<0.1	0.7	<1	<1	3.0	<1
208	Bennett Valley Crk upstream of I-5	36	3000	<0.2	6.0	<5	<1	116	20
209	Silver Crk upstream of Panoche Crk	1	10000	<0.1	6.1	<5	<1	9.6	24
210	Black Gulch Crk @ I-5	6	4800	0.3	1.5	<5	<1	11	5
211	Crow Crk upstream of I-5	2	2000	<0.1	1.5	<1	<1	4.6	4
212	Sand Crk @ Deer Valley Rd		6200						
213	Pleasants Crk @ Pleasants Valley Rd					<1	<1	1.4	1
214	Green Valley Crk @ Cordelia Rd					7	<1	0.6	2
215	Suisun Crk @ Cordelia Rd					4	<1	0.6	1

Table A-2 (continued) Trace Element Concentrations for Selected Streams in California As Found in a Synoptic Survey

Site ID	Site Description	As	B	Cd	Cr	Cu	Pb	Mo	Ni
						ug/L			
216	Alamo Crk @ Pleasants Valley Rd					5	<1	1.1	6
217	McCune Crk @ Midway Rd					3	<1	0.6	5
218	Sweany Crk @ Midway Rd					3	<1	0.5	4
219	Ulatis Crk @ Brown Rd					4	3	1.4	6
220	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)		100						
221	Maxwell Crk @ Pope Canyon Rd		110						
222	Pope Crk @ Pope Canyon Rd								
223	Capell Crk @ HWY 128								
224	Green Valley Crk @ Green Valley Rd		100						
225	Lone Tree Crk @ Bird Rd		3100						
226	Logan Creek at Rd 60		240	<0.1	<0.5	<1			

Table A-3 Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
1	Whitewater Rvr @ I-10	2.6	<1	4	7	68	24	268
2	Smith Crk @ Domestic Water Intake	0.4	<1	<1	6	21	8.7	88
3	San Luis Rey Rvr @ I-15	2.7	<5	17	9	120	59	542
4	Temecula Crk @ Hwy 79 (above Vail Lake)	1.3	<1	7	9	96	28	355
5	Potrero Crk (Massacre Cyn) @ HWY 79	0.9	<1	6	11	84	19	288
6	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)	<0.2	<1	23	25	32	8.2	114
7	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)	0.3	<1	5	4	46	7.1	144
8	Kings Rvr @ Centerville	<0.2	<1	<1	4	29	9.8	113
9	Mill Crk @ HWY 180	<0.2	<1	1	4	22	6	80
10	Sand Crk @ Gaging Station	0.3	<1	2	5	56	19	218
11	Cottonwood Crk @ HWY 201, Elderwood	0.3	<1	4	4	50	17	195
12	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	0.4	<1	<1	7	28	7	99
13	South Fork Kaweah Rvr @ So Fork Rd	<0.2	<1	2	4	16	2.3	49
14	Kaweah Rvr above Lake Kaweah	0.8	<1	1	4	10	1.7	32
15	Yokohl Crk @ HWY 181	0.5	<1	10	7	48	22	210
16	Tule Rvr @ USGS Gauge @ HWY 190	0.2	<1	2	5	30	4.6	94
17	Deer Crk @ Road 260	0.2	<1	3	7	21	5.8	76
18	Virgin Rvr @ Zion Nat Prk Lodge	0.5						
19	Sevier Rvr 1 mi so HWY 20	0.6						
20	White Rvr @ HWY 65	0.5	<1	6	9	37	12	142
21	Poso Crk @ HWY 65	0.3	<1	3	7	28	6.5	97
22	Caliente Crk @ Caliente Crk Rd	1.5	<1	11	4	84	37	362
23	Tehachapi Crk @ Bealville Rd, Caliente	0.4	<1	18	5	55	24	236
24	Grapevine Crk @ Grapevine	0.9	<1	51	3	70	49	376
25	Cuddy Crk @ Frazier Prk	1.3	<1	19	4	72	32	311
26	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	0.6	<1	7	6	140	40	514
27	Hungry Valley Crk @ Hungry Vly St Prk Hq	0.7	<1	5	5	70	9.6	214
28	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	0.4	<1	28	13	82	26	311

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
29	San Emigdio Crk @ San Emigdio Ranch	1.7	<1	15	4	160	83	740
30	Cuyama Rvr near Cuyama	0.4	<1	6	11	400	110	1450
31	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	31	<1	29	5	130	130	859
32	Santa Ynez Rvr @ HWY 101	9.9	<1	7	5	110	69	558
33	Huasna Crk @ Huasna Rd	0.8	<1	4	5	130	27	435
34	Arroyo Grande Crk above Arroyo Grande	11	<1	9	6	150	67	650
35	Salinas Rvr below Lake Santa Margarita (HWY 58)	0.3	<1	1	3	42	24	203
36	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	1.8	<1	1	4	50	27	236
37	Encinosa Crk @ Pleasant Valley Rd	0.7						
38	Huerhuero Crk @ Creston Rd	0.9	<1	3	4	40	16	166
39	Cholame Crk @ HWY 46	13	<1	37	6	150	100	785
40	Estrella Rvr @ Jardine Rd	1.2	<1	12	5	72	77	496
41	Salinas Rvr @ San Miguel	2.5	<1	5	5	78	32	326
42	San Marcos Crk west of HWY 101	1.0	<1	7	6	107	77	584
43	Las Tablas Crk CDF Station, Chimney Rd	0.8	<1	1	5	75	35	331
44	Nacimiento Rvr below Dam	0.3	<1	<1	4	28	12	119
45	San Antonio Rvr @ Nacimiento Lake Dr	1.2	<1	2	5	62	20	237
46	San Antonio Rvr @ Interlake Rd	0.7	<1	1	5	51	15	189
47	Jolon Crk @ Jolon Rd	0.7	<1	22	5	180	44	630
48	Pine Canyon Crk @ Pine Canyon Rd	73	<1	21	6	390	280	2124
49	Salinas Rvr @ Kings City (San Lorenzo Prk)	2.8	<1	4	18	120	38	456
50	San Lorenzo Crk @ Bitterwater Rd	2.8	<1	8	6	180	200	1271
51	Reliz Crk @ Reliz Canyon Rd	2.7	<1	7	6	190	68	754
52	Arroyo Seco Rvr @ above Monterey Co Rd G16	0.3	<1	<1	5	38	8.6	130
53	Paloma Crk @ Monterey Co Rd G16 Brdg	0.4	<1	<1	4	40	9.3	138
54	Salinas Rvr @ Davis Rd	2.4	<1	5	12	70	32	306
55	Carmel Rvr @ Garlad Ranch Regional Prk	0.5	<1	1	4	35	11.5	135
56	Burns Crk @ Doug Rd	0.2	<1	<1	11	20	12	99
57	Bear Crk @ Bonner Rd	0.4	<1	<1	5	19	12	97
58	Owens Crk @ Cunningham Rd	0.3	<1	1	6	32	17	150

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
59	Mariposa Crk A Cunningham Rd	0.2	<1	<1	6	20	13	103
60	San Joaquin Rvr @ HWY 41	<0.2	<1	2	5	7.7	2.6	30
61	Fresno Rvr @ Road 415	<0.2	<1	1	7	11	2.4	37
62	Chowchilla Rvr @ Raymond Brdg (Road 613)	<0.2	<1	<1	6	16	3.9	56
63	Carson Rvr @ HWY Alt 95 S. of Silver Springs	0.3	<1	7	8	33	7.9	115
64	Walker Rvr @ Yerington	0.3	<1	16	8	33	8.8	119
65	Truckee Rvr @ Wadsworth	0.2	<1	2	17	13	5.1	53
66	Long Valley Crk @ Herlong	0.4	<1	22	16	48	16	186
67	Susan Rvr @ Susanville	<0.2	<1	<1	6	11	4.9	48
68	Humbolt Rvr @ HWY 95, Winnemucca	1.3	<1	7	27	66	19	243
69	Arroyo Valle above Lake Del Valle	<0.2	<1	1	5	53	36	280
70	Arroyo Mocho @ Mines Rd	0.4	<1	1	7	44	90	480
71	Alameda Crk @ Calaveras Rd	0.3	<1	1	5	68	28	285
72	San Felipe Crk @ San Felipe Rd	0.7	<1	<1	4	66	22	255
73	Uvas Crk @ HWY 152	<0.2	<1	<1	5	39	18	171
74	Coyote Crk above Coyote Reservoir	<0.2	<1	1	4	63	22	248
75	Pajaro Rvr @ Gauge Station HWY 129	2.1	<1	2	10	91	66	498
76	Santa Ana Crk @ Santa Ana Valley Rd	1.4	<1	3	8	70	82	512
77	Tres Pines Crk @ Bolado Park	3.0	<1	6	5	75	58	426
78	Pescadero Crk @ Cienega Rd	0.4	<1	8	6	69	16	238
79	San Benito Rvr @ Cienega Rd	1.4	<1	2	7	22	115	528
80	Chalone Crk @ Pinnacles Nat Mon	<0.2	<1	2	6	35	9.8	128
81	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	1.3	<1	<1	10	30	120	568
82	Clear Crk above San Benito Rvr	<0.2	<1	<1	5	2.7	170	706
83	San Benito Rvr above Hernandez Res (Clear Crk Rd)	0.7	<1	<1	4	20	130	584
84	Los Gatos Crk @ County Park	0.6	<1	4	6	54	70	423
85	Los Gatos Crk @ USGS Gauge near Coalinga	1.0	<1	1	5	34	170	784
86	Warthan Crk @ HWY 198 west of Coalinga	1.0	<1	18	6	275	260	1755
87	Jacalitos Crk @ Jacalitos Crk Rd	4.4	<1	7	8	130	85	674
88	Soquel Crk @ Soquel Dr, Soquel	0.6						

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/l				mg/L		
89	San Lorenzo Rvr @ Covered Brdg @ Felton	0.5						
90	Sacramento Rvr @ Dunsmuir	<0.2	<1	<1	4	6.7	8.5	52
91	Williamson Rvr @ Williamson NFS Cmpgrnd	<0.2	<1	<1	6	5.4	3.6	28
92	Sprague Rvr @ Chiloquin	0.3	<1	<1	5	7.9	4.7	39
93	Rogue Rvr @ Galice	<0.2	<1	<1	6	4.3	3	23
94	Illinois Rvr @ Kerby	0.2	<1	<1	5	6.2	14	73
95	Coquille Rvr @ Coqille	<0.2	<1	<1	5	8.1	6	45
96	Hospital Crk @ Bird Rd	1.3	<1					
97	Chetco Rvr @ Loeb State Park	<0.2	<1	<1	5	10	4.5	43
98	Price Rvr @ Helper	0.7	<1	1	5	44	20	192
99	Green Rvr @ Green River	1.4	<1	4	3	65	30	286
100	Gunnison Rvr above Delta	3.4	<1	5	3	79	31	325
101	Colorado Rvr @ Moab	3.8	<1	8	3	120	41	468
102	North Fork American Rvr @ HWY 49	<0.2	<1	<1	7	9.4	3	36
103	South Fork American Rvr @ HWY 49	<0.2	<1	<1	6	4.3	1.9	19
104	Carson Crk @ Latrobe Rd	0.2	<1	<1	5	11	10	69
105	Deer Crk @ Latrobe Rb	<0.2	<1	<1	8	26	16	131
106	Consumnes Rvr @ Latrobe Rd	0.5	<1	<1	5	11	6.6	55
107	Little Indian Crk @ Latrobe Rd	0.4	<1	<1	4	39	29	217
108	Dry Crk @ HWY 124	0.2	<1	<1	4	22	9	92
109	Sutter Crk @ HWY 124	0.2	<1	<1	17	24	8.8	96
110	Jackson Crk @ HWY 124	0.9	<1	<1	9	21	8.6	88
111	Mokelumne Rvr @ HWY 49	<0.2	<1	<1	5	7.6	2.2	28
112	North Fork Calaveras Rvr @ HWY 12	<0.2	<1	<1	4	19	5.9	72
113	Calaveritas Crk @ HWY 49	0.5	<1	1	5	23	6	82
114	Indian Crk @ HWY 49 (San Antonio Crk)	<0.2	<1	<1	7	9.8	3.5	39
115	San Domingo Crk @ HWY 49	<0.2	<1	<1	5	19	7.1	77
116	Angeles Crk @ HWY 49	<0.2	<1	<1	7	4.7	1.6	18
117	Stanislaus Rvr @ Parrots Ferry Brdg	0.2	<1	<1	5	6.9	2.2	26
118	Tuolumne Rvr @ HWY 49	0.5	<1	<1	4	2.5	1.5	12

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		.....	.....	.....ug/L.....	.....	.....	.....mg/L.....	.....
119	Merced Rvr @ HWY 49	<0.2	<1	<1	4	4.7	1.7	19
120	Conn Crk below Conn Dam	2.1	<1	<1	5	15	20	120
121	Glass Mountain Crk @ Silverado Trail	0.8	<1	<1	7	6	3.5	29
122	Napa Rvr @ Dunaweal Lane	0.5	<1	<1	12	10	5.3	47
123	Maacama Crk @ HWY 128	<0.2	<1	<1	9	17	19	121
124	Big Sulfur Crk @ Geysers Rd	0.3	<1	<1	6	23	15	119
125	Russian Rvr @ HWY 101 (7 mi so of Hopland)	0.3	<1	<1	8	18	10	86
126	Outlet Crk @ HWY 101 & HWY 261	1.0	<1	<1	6	9.6	5.2	45
127	Long Valley Crk @ HWY 101, Longvale	2.6	<1	<1	6	10	5	46
128	South Fork Eel Rvr @ north end Richardson St Prk	0.4	<1	<1	13	13	6.1	58
129	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	0.3	<1	<1	44	17	14	100
130	Eel Rvr @ Pepperwood exit of HWY 101	0.2	<1	<1	24	18	9.4	84
131	Elk River @ HWY 101, Eureka	0.4	<1	<1	25	7.5	7.8	51
132	Redwood Crk @ HWY 101, north of Orick	0.4	<1	<1	20	11	3.6	42
133	Prairie Crk @ Davison Ranch Bridge	0.3	<1	<1	8	3.4	2.2	18
134	Klamath Rvr @ Klamath	0.4	<1	<1	15	14	8.4	69
135	Hunter Crk @ HWY 101	<0.2	<1	<1	7	5.8	1.4	20
136	Wilson Crk @ HWY 101	<0.2	<1	<1	15	6.6	3	29
137	Myrtle Crk @ HWY 199 (So. Rank Rd)	0.3	<1	<1	5	2.2	5.8	29
138	South Fork Smith Rvr @ HWY 199 & South Fork Rd	0.3	<1	<1	5	2.8	9.7	47
139	Middle Fork Smith Rvr	<0.2	<1	<1	5	2.4	12	55
140	Hardscabble Crk @ HWY 199	0.3	<1	<1	4	2.4	13	59
141	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	0.7	<1	<1	4	3.4	7.6	40
142	Morrison Crk @ Fred Haight Dr	0.3	<1	<1	6	4.2	1.8	18
143	Rowdy Crk @ Fred Haight Dr	<0.2	<1	<1	11	3.4	5.4	31
144	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	<0.2	<1	<1	19	14	6.3	61
145	East Fork Willow Crk @ East Fork NFS Cmpgrnd	0.5	<1	<1	4	6.5	6.6	43
146	Willow Crk upstream of East Fork Willow Crk	<0.2	<1	<1	4	6.9	6.8	45
147	Italian Crk @ HWY 299	0.7	<1	<1	5	46	7.5	146
148	Swede Crk @ HWY 299	0.5	<1	<1	5	52	6.9	158

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
149	Trinity Rvr @ HWY 299 (Haden Flat)	0.4	<1	<1	5	17	5.8	66
150	Big French Crk @ Big French Crk Rd, old brdg	0.6	<1	<1	6	24	4.2	77
151	Manzanita Crk @ HWY 299	0.7	<1	<1	4	33	4.4	100
152	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	0.2	<1	<1	6	12	4.1	47
153	Canyon Crk @ HWY 299 (Junction City)	<0.2	<1	<1	5	8.6	3.1	34
154	Weaver Crk @ HWY 299 (east of Weaverville)	0.3	<1	<1	11	11	4.9	48
155	Indian Crk @ HWY 299	0.4	<1	<1	6	18	7.9	77
156	Clear Crk @ HWY 299	0.9	<1	<1	150	17	6.6	70
157	Bear Crk upstream of Cache Crk	0.4	<1	<1	5	25	96	457
158	American Rvr @ Sunrise Blvd	0.5	<1	<1	31	7.5	2.6	29
159	Sacramento Rvr @ Hood	0.6	<1	<1	38	12	6	55
160	Putah Crk @ HWY 128 (below Lake Berryessa)	<0.2	<1	<1	6	17	26	149
161	Putah Crk @ HWY 29	0.4	<1	<1	17	18	29	164
162	Cache Crk @ HWY 53 (below Clear Lake)	0.5	<1	<1	52	25	17	132
163	Cole Crk @ Clear Lake (below Kelsey Crk)	<0.2	<1	<1	12	23	17	127
164	Scotts Crk @ HWY 29	0.2	<1	<1	14	54	24	233
165	Middle Crk @ HWY 20	0.2	<1	<1	5	26	12	114
166	N. Fork Cache Crk @ HWY 20	0.2	<1	<1	5	19	17	117
167	Stoney Crk @ Black Butte Rd (above Black Butte Res)	1.0	<1	<1	97	33	11	128
168	Stoney Crk @ Newville Rd (below Black Butte Res)	0.8	<1	<1	22	32	12	129
169	Kendricks & Salt Crks above Black Butte Res	0.9	<1	<1	25	43	47	301
170	Thomes Crk @ Paskenta	0.2	<1	<1	13	25	5.1	83
171	Clear Crk below Whiskeytown Res	0.3	<1	<1	6	6	5.4	37
172	Spring Crk @ Debris Dam	1.2	<1	2	8800	10	14	83
173	Sacramento Rvr @ Keswick Dam	<0.2	<1	<1	36	10	5.1	46
174	Cottonwood Crk @ I-5	<0.2	<1	<1	11	27	13	121
175	Mill Crk @ HWY 99	<0.2	<1	<1	9	11	4.7	47
176	Sacramento Rvr @ Hamilton City	0.2	<1	<1	29	12	5.7	53
177	Big Chico Crk @ River Rd	0.4	<1	<1	17	19	11	93
178	Feather Rvr @ Gridley (East Gridley Rd)	0.4	<1	<1	18	8.8	3.9	38

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
179	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	0.2	<1	<1	14	10	4.1	42
180	Sutter Bypass @ Tarke Rd	0.3	<1	1	18	20	12.5	101
181	Butte Crk @ Butte Slough Rd	0.3	<1	<1	15	14	7.4	65
182	Sacramento Rvr @ Grimes	0.4	<1	<1	24	12	6	55
183	RD 108 Drain @ HWY 45	0.8	<1	1	18	22	20	137
184	Colusa Basin Drain @ Road 99E	0.8	<1	1	21	25	17	132
185	Sacramento Slough @ Karnack	0.4	<1	1	17	21	14	110
186	Feather Rvr @ West Catlett Rd	0.3	<1	<1	15	8.9	4.4	40
187	Natomas East Drain @ Del Paso Rd	1.2	<1	1	39	17	14	100
188	Salado Crk (2.1 mi west of I-5)	4.9	<1	12	5	120	120	793
189	Kern Canon Crk @ I-5	6.5	<1	21	11	170	240	1411
190	Ortigilita Crk west of I-5	5.7	<1	12	6	170	260	1493
191	Corral Hollow Crk @ Corral Hollow Rd Brdg	1.2	<1	4	5	130	59	567
192	Pacheco Crk above reservoir	<0.2	<1	1	6	78	45	380
193	Garzas Crk @ Sullivan Rd west of I-5	0.6						
194	Suisun Crk @ Suisun Valley Rd	0.4						
195	Orestimba Crk upstream of Calif Aqueduct	1.8	<1	3	5	74	69	468
196	Deer Crk @ Deer Valley Rd	5.3	<1	42	6	510	380	2835
197	Little Panche Crk below the dam	0.4	<1	3	6	92	66	501
198	Panoche Crk @ USGS Gauge (west of I-5)	1.9	<1	39	9	430	590	3499
199	Ingram Crk (west of I-5)	2.9	<1	4	5	53	78	453
200	Kellogg Crk @ Vasco Rd	3.3	<1	3	8	50	35	269
201	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	0.7	<1	<1	5	66	40	329
202	South Fork Pacheco Crk @ HWY 152	0.4	<1	1	5	46	29	234
203	Quinto Crk @ Howard Ranch	1.0	<1	3	6	67	45	352
204	Romero Crk @ McCabe Rd	0.8	<1	2	4	68	44	351
205	Del Puerto Crk west of I-5	0.5	<1	1	5	42	100	516
206	Mountain House Crk @ Grant Line Rd	7.4	<1	12	8	120	85	649
207	Little Panoche Crk above Reservoir	0.9	<1	2	5	100	38	406
208	Bennett Valley Crk upstream of I-5	11	1	220	21	88	32	351

Table A-3 (continued) Water Hardness, Major Cation and Trace Element Concentrations for Selected Streams in California as Found in a Synoptic Survey.

Site ID	Site Description	Se	Ag	U	Zn	Ca	Mg	HDNS
		ug/L				mg/L		
209	Silver Crk upstream of Panoche Crk	5.4	1	27	14	260	510	2746
210	Black Gulch Crk @ I-5	13	1	58	10	460	730	4149
211	Crow Crk upstream of I-5	15	<1	27	8	310	220	1678
212	Sand Crk @ Deer Valley Rd	3.9						
213	Pleasants Crk @ Pleasants Valley Rd	2.0	<1	3	6	72	31	307
214	Green Valley Crk @ Cordelia Rd	0.3	<1	<1	8	20	19	128
215	Suisun Crk @ Cordelia Rd	0.4	<1	<1	10	30	27	186
216	Alamo Crk @ Pleasants Valley Rd	0.9	<1	1	17	34	27	196
217	McCune Crk @ Midway Rd	1.4	<1	<1	8	23	30	181
218	Sweany Crk @ Midway Rd	0.3	<1	1	9	22	26	162
219	Ulatis Crk @ Brown Rd	0.6	<1	2	14	32	32	211
220	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)	0.3						
221	Maxwell Crk @ Pope Canyon Rd	0.6						
222	Pope Crk @ Pope Canyon Rd	0.2						
223	Capell Crk @ HWY 128	0.4						
224	Green Valley Crk @ Green Valley Rd	0.3						
225	Lone Tree Crk @ Bird Rd	1.7						
226	Logan Creek at Rd 60	0.4			4	18	33	181

Table A-4 Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
					ug/L			
1	Whitewater Rvr @ I-10	2.46	464.55	27.48	11.18	363.42	22.17	244.63
2	Smith Crk @ Domestic Water Intake	1.03	186.70	10.62	2.71	141.73	3.27	95.27
3	San Luis Rey Rvr @ I-15	4.28	826.19	50.11	27.35	658.72	74.28	443.80
4	Temecula Crk @ Hwy 79 (above Vail Lake)	3.06	583.74	34.88	15.94	460.12	35.81	309.83
5	Potrero Crk (Massacre Cyn) @ HWY 79	2.60	491.83	29.17	12.21	385.48	24.99	259.50
6	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)	1.25	229.70	13.18	3.74	175.57	5.05	118.05
7	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)	1.51	278.96	16.14	5.06	214.60	7.60	144.33
8	Kings Rvr @ Centerville	1.25	228.19	13.09	3.70	174.38	4.98	117.25
9	Mill Crk @ HWY 180	0.95	171.64	9.73	2.38	129.94	2.74	87.32
10	Sand Crk @ Gaging Station	2.09	391.63	23.00	8.57	304.66	15.49	205.01
11	Cottonwood Crk @ HWY 201, Elderwood	1.91	357.14	20.89	7.43	276.98	12.76	186.36
12	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	1.12	204.68	11.69	3.13	155.85	3.96	104.77
13	South Fork Kaweah Rvr @ So Fork Rd	0.65	116.13	6.47	1.30	86.79	1.21	58.29
14	Kaweah Rvr above Lake Kaweah	0.46	81.28	4.46	0.74	60.04	0.57	40.30
15	Yokohl Crk @ HWY 181	2.03	380.37	22.31	8.19	295.61	14.57	198.92
16	Tule Rvr @ USGS Gauge @ HWY 190	1.08	196.35	11.19	2.93	149.31	3.63	100.36
17	Deer Crk @ Road 260	0.92	165.75	9.38	2.25	125.34	2.55	84.23
18	Virgin Rvr @ Zion Nat Prk Lodge							
19	Sevier Rvr 1 mi so HWY 20							
20	White Rvr @ HWY 65	1.49	275.30	15.92	4.96	211.68	7.39	142.37
21	Poso Crk @ HWY 65	1.10	201.18	11.48	3.04	153.10	3.82	102.92
22	Caliente Crk @ Caliente Crk Rd	3.11	593.25	35.47	16.35	467.86	37.05	315.05
23	Tehachapi Crk @ Bealville Rd, Caliente	2.23	418.03	24.62	9.49	325.90	17.76	219.33
24	Grapevine Crk @ Grapevine	3.21	612.54	36.68	17.18	483.58	39.63	325.65
25	Cuddy Crk @ Frazier Prk	2.77	524.51	31.19	13.50	411.97	28.61	277.36
26	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	4.10	790.78	47.88	25.55	629.58	67.75	424.14
27	Hungry Valley Crk @ Hungry Vly St Prk Hq	2.06	386.14	22.66	8.39	300.25	15.04	202.04
28	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	2.77	524.90	31.22	13.51	412.29	28.65	277.57
29	San Emigdio Crk @ San Emigdio Ranch	5.46	1066.76	65.43	40.69	857.72	127.05	578.11

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
		ug/L						
30	Cuyama Rvr near Cuyama	9.26	1849.99	116.21	95.76	1514.72	403.75	1021.83
31	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	6.14	1204.56	74.27	49.15	972.41	163.97	655.54
32	Santa Ynez Rvr @ HWY 101	4.38	846.32	51.39	28.40	675.30	78.13	454.99
33	Huasna Crk @ Huasna Rd	3.60	690.49	41.56	20.70	547.28	50.96	368.62
34	Arroyo Grande Crk above Arroyo Grande	4.93	958.45	58.51	34.46	767.92	101.47	517.50
35	Salinas Rvr below Lake Santa Margarita (HWY 58)	1.98	370.34	21.70	7.86	287.56	13.77	193.50
36	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	2.22	417.83	24.61	9.48	325.73	17.75	219.22
37	Encinosa Crk @ Pleasant Valley Rd							
38	Huerhuero Crk @ Creston Rd	1.69	312.84	18.19	6.05	241.57	9.66	162.50
39	Cholame Crk @ HWY 46	5.72	1119.51	68.81	43.87	901.57	140.60	607.71
40	Estrella Rvr @ Jardine Rd	3.99	768.62	46.48	24.45	611.36	63.83	411.85
41	Salinas Rvr @ San Miguel	2.87	545.09	32.47	14.33	428.68	31.01	288.63
42	San Marcos Crk west of HWY 101	4.53	877.75	53.38	30.05	701.22	84.35	472.48
43	Las Tablas Crk CDF Station, Chimney Rd	2.90	551.72	32.88	14.60	434.07	31.81	292.26
44	Nacimiento Rvr below Dam	1.30	239.01	13.74	3.98	182.92	5.49	123.00
45	San Antonio Rvr @ Nacimiento Lake Dr	2.23	419.51	24.71	9.54	327.08	17.90	220.13
46	San Antonio Rvr @ Interlake Rd	1.87	348.51	20.36	7.15	270.07	12.12	181.71
47	Jolon Crk @ Jolon Rd	4.81	934.56	56.99	33.13	748.15	96.23	504.16
48	Pine Canyon Crk @ Pine Canyon Rd	12.50	2528.92	161.02	155.67	2092.05	778.46	1412.00
49	Salinas Rvr @ Kings City (San Lorenzo Prk)	3.73	716.73	43.21	21.93	568.77	55.11	383.12
50	San Lorenzo Crk @ Bitterwater Rd	8.35	1660.96	103.85	80.99	1355.12	321.96	914.01
51	Reliz Crk @ Reliz Canyon Rd	5.54	1082.28	66.42	41.62	870.61	130.96	586.81
52	Arroyo Seco Rvr @ above Monterey Co Rd G16	1.40	256.88	14.81	4.45	197.07	6.39	132.53
53	Paloma Crk @ Monterey Co Rd G16 Brdg	1.46	269.53	15.57	4.80	207.10	7.07	139.28
54	Salinas Rvr @ Davis Rd	2.73	517.61	30.77	13.22	406.38	27.82	273.59
55	Carmel Rvr @ Garlad Ranch Regional Prk	1.43	264.03	15.24	4.64	202.74	6.77	136.35
56	Burns Crk @ Doug Rd	1.13	205.70	11.75	3.15	156.65	4.01	105.31
57	Bear Crk @ Bonner Rd	1.11	201.45	11.49	3.05	153.32	3.83	103.06
58	Owens Crk @ Cunningham Rd	1.56	288.10	16.70	5.32	221.86	8.13	149.22
59	Mariposa Crk A Cunningham Rd	1.16	212.65	12.16	3.32	162.13	4.30	109.00
60	San Joaquin Rvr @ HWY 41	0.44	77.01	4.21	0.68	56.78	0.51	38.11

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
					ug/L			
61	Fresno Rvr @ Road 415	0.52	92.32	5.09	0.91	68.48	0.74	45.97
62	Chowchilla Rvr @ Raymond Brdg (Road 613)	0.72	128.65	7.20	1.52	96.48	1.50	64.81
63	Carson Rvr @ HWY Alt 95 S. of Silver Springs	1.26	231.78	13.31	3.79	177.22	5.15	119.16
64	Walker Rvr @ Yerington	1.30	237.89	13.67	3.95	182.04	5.44	122.40
65	Truckee Rvr @ Wadsworth	0.69	123.83	6.92	1.43	92.74	1.38	62.30
66	Long Valley Crk @ Herlong	1.84	343.40	20.05	6.99	265.98	11.75	178.95
67	Susan Rvr @ Susanville	0.63	112.68	6.27	1.24	84.13	1.13	56.50
68	Humbolt Rvr @ HWY 95, Winnemucca	2.28	428.00	25.23	9.84	333.93	18.66	224.74
69	Arroyo Valle above Lake Del Valle	2.55	481.38	28.52	11.81	377.03	23.89	253.80
70	Arroyo Mocho @ Mines Rd	3.89	747.75	45.16	23.43	594.22	60.24	400.29
71	Alameda Crk @ Calaveras Rd	2.58	487.74	28.92	12.06	382.18	24.56	257.27
72	San Felipe Crk @ San Felipe Rd	2.37	445.73	26.32	10.48	348.22	20.33	234.38
73	Uvas Crk @ HWY 152	1.73	321.68	18.73	6.31	248.62	10.25	167.25
74	Coyote Crk above Coyote Reservoir	2.31	434.99	25.66	10.09	339.56	19.31	228.54
75	Pajaro Rvr @ Gauge Station HWY 129	4.00	771.38	46.65	24.59	613.63	64.31	413.38
76	Santa Ana Crk @ Santa Ana Valley Rd	4.09	788.32	47.72	25.43	627.55	67.31	422.77
77	Tres Pines Crk @ Bolado Park	3.54	677.79	40.76	20.11	536.89	49.01	361.61
78	Pescadero Crk @ Cienega Rd	2.24	420.99	24.80	9.59	328.27	18.03	220.93
79	San Benito Rvr @ Cienega Rd	4.19	808.36	48.99	26.44	644.04	70.95	433.90
80	Chalone Crk @ Pinnacles Nat Mon	1.37	252.75	14.56	4.34	193.80	6.17	130.32
81	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	4.44	858.85	52.18	29.05	685.63	80.58	461.96
82	Clear Crk above San Benito Rvr	5.26	1025.60	62.80	38.28	823.56	116.97	555.05
83	San Benito Rvr above Hernandez Res (Clear Crk Rd)	4.54	878.81	53.45	30.11	702.10	84.57	473.08
84	Los Gatos Crk @ County Park	3.52	673.81	40.51	19.93	533.63	48.41	359.41
85	Los Gatos Crk @ USGS Gauge near Coalinga	5.71	1117.65	68.69	43.75	900.02	140.11	606.67
86	Warthan Crk @ HWY 198 west of Coalinga	10.76	2162.91	136.78	122.09	1780.07	560.59	1201.13
87	Jacalitos Crk @ Jacalitos Crk Rd	5.07	987.49	60.36	36.09	791.96	108.03	533.73
88	Soquel Crk @ Soquel Dr, Soquel							
89	San Lorenzo Rvr @ Covered Brdg @ Felton							
90	Sacramento Rvr @ Dunsmuir	0.68	120.52	6.73	1.37	90.18	1.30	60.57
91	Williamson Rvr @ Williamson NFS Cmpgrnd	0.42	73.56	4.02	0.64	54.15	0.46	36.35

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
					ug/L			
92	Sprague Rvr @ Chiloquin	0.54	95.80	5.29	0.96	71.14	0.80	47.77
93	Rogue Rvr @ Galice	0.36	62.26	3.38	0.49	45.58	0.33	30.58
94	Illinois Rvr @ Kerby	0.89	160.02	9.04	2.13	120.86	2.36	81.22
95	Coquille Rvr @ Coqille	0.60	107.39	5.96	1.15	80.05	1.02	53.76
96	Hospital Crk @ Bird Rd							
97	Chetco Rvr @ Loeb State Park	0.59	104.59	5.80	1.10	77.89	0.97	52.31
98	Price Rvr @ Helper	1.89	353.17	20.65	7.30	273.81	12.47	184.22
99	Green Rvr @ Green River	2.59	488.78	28.98	12.10	383.02	24.67	257.84
100	Gunnison Rvr above Delta	2.86	542.87	32.34	14.24	426.88	30.75	287.41
101	Colorado Rvr @ Moab	3.81	732.58	44.21	22.69	581.77	57.70	391.89
102	North Fork American Rvr @ HWY 49	0.51	89.22	4.91	0.86	66.10	0.69	44.38
103	South Fork American Rvr @ HWY 49	0.30	52.06	2.80	0.37	37.89	0.22	25.42
104	Carson Crk @ Latrobe Rd	0.84	151.95	8.56	1.97	114.57	2.12	76.98
105	Deer Crk @ Latrobe Rb	1.40	257.66	14.86	4.47	197.69	6.43	132.95
106	Consumnes Rvr @ Latrobe Rd	0.71	126.06	7.05	1.47	94.47	1.43	63.46
107	Little Indian Crk @ Latrobe Rd	2.08	389.72	22.88	8.51	303.12	15.33	203.98
108	Dry Crk @ HWY 124	1.06	193.14	11.00	2.86	146.79	3.51	98.67
109	Sutter Crk @ HWY 124	1.10	200.29	11.43	3.02	152.40	3.79	102.45
110	Jackson Crk @ HWY 124	1.02	185.99	10.58	2.69	141.17	3.24	94.89
111	Mokelumne Rvr @ HWY 49	0.42	72.99	3.99	0.63	53.72	0.45	36.05
112	North Fork Calaveras Rvr @ HWY 12	0.87	157.55	8.89	2.08	118.94	2.29	79.92
113	Calaveritas Crk @ HWY 49	0.97	176.03	9.99	2.47	133.38	2.89	89.64
114	Indian Crk @ HWY 49 (San Antonio Crk)	0.54	95.41	5.27	0.95	70.84	0.80	47.57
115	San Domingo Crk @ HWY 49	0.92	166.38	9.42	2.27	125.83	2.57	84.56
116	Angeles Crk @ HWY 49	0.30	51.52	2.77	0.37	37.49	0.22	25.15
117	Stanislaus Rvr @ Parrots Ferry Brdg	0.40	69.24	3.77	0.58	50.87	0.41	34.14
118	Tuolumne Rvr @ HWY 49	0.22	37.46	1.99	0.22	26.97	0.11	18.08
119	Merced Rvr @ HWY 49	0.30	52.47	2.82	0.38	38.20	0.23	25.62
120	Conn Crk below Conn Dam	1.31	239.76	13.78	4.00	183.52	5.53	123 40
121	Glass Mountain Crk @ Silverado Trail	0.43	75.87	4.15	0.67	55.91	0.49	37.52
122	Napa Rvr @ Dunaweal Lane	0.62	111.03	6.17	1.21	82.85	1.10	55.64

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
					ug/L			
123	Maacama Crk @ HWY 128	1.31	241.20	13.87	4.04	184.66	5.60	124.17
124	Big Sulfur Crk @ Geysers Rd	1.30	238.78	13.72	3.97	182.74	5.48	122.88
125	Russian Rvr @ HWY 101 (7 mi so of Hopland)	1.01	182.98	10.40	2.63	138.82	3.13	93.30
126	Outlet Crk @ HWY 101 & HWY 261	0.61	108.28	6.01	1.16	80.74	1.04	54.22
127	Long Valley Crk @ HWY 101, Longvale	0.61	108.62	6.03	1.17	81.00	1.05	54.40
128	South Fork Eel Rvr @ north end Richardson St Prk	0.73	131.59	7.37	1.57	98.75	1.57	66.34
129	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	1.13	206.95	11.82	3.18	157.64	4.06	105.97
130	Eel Rvr @ Pepperwood exit of HWY 101	0.99	178.67	10.14	2.53	135.44	2.98	91.03
131	Elk River @ HWY 101, Eureka	0.67	118.83	6.63	1.34	88.88	1.27	59.70
132	Redwood Crk @ HWY 101, north of Orick	0.58	102.20	5.66	1.06	76.06	0.92	51.08
133	Prairie Crk @ Davison Ranch Bridge	0.29	49.72	2.67	0.35	36.14	0.20	24.24
134	Klamath Rvr @ Klamath	0.85	153.59	8.66	2.00	115.85	2.17	77.84
135	Hunter Crk @ HWY 101	0.32	55.91	3.02	0.42	40.79	0.26	27.37
136	Wilson Crk @ HWY 101	0.43	74.68	4.08	0.65	55.01	0.48	36.92
137	Myrtle Crk @ HWY 199 (So. Rank Rd)	0.43	75.82	4.15	0.67	55.87	0.49	37.50
138	South Fork Smith Rvr @ HWY 199 & South Fork Rd	0.63	111.28	6.19	1.21	83.05	1.10	55.77
139	Middle Fork Smith Rvr	0.71	127.47	7.13	1.50	95.56	1.47	64.19
140	Hardscabble Crk @ HWY 199	0.75	135.18	7.58	1.64	101.54	1.66	68.21
141	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	0.55	97.19	5.37	0.98	72.21	0.83	48.49
142	Morrison Crk @ Fred Haight Dr	0.29	50.54	2.72	0.36	36.75	0.21	24.65
143	Rowdy Crk @ Fred Haight Dr	0.45	78.66	4.31	0.71	58.04	0.53	38.96
144	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	0.77	137.77	7.73	1.69	103.54	1.73	69.56
145	East Fork Willow Crk @ East Fork NFS Cmpgrnd	0.59	104.39	5.79	1.10	77.75	0.96	52.21
146	Willow Crk upstream of East Fork Willow Crk	0.61	107.97	6.00	1.16	80.50	1.03	54.06
147	Italian Crk @ HWY 299	1.52	281.57	16.30	5.13	216.67	7.75	145.73
148	Swede Crk @ HWY 299	1.63	301.22	17.49	5.70	232.31	8.93	156.26
149	Trinity Rvr @ HWY 299 (Haden Flat)	0.82	147.76	8.32	1.88	111.31	2.00	74.79
150	Big French Crk @ Big French Crk Rd, old brdg	0.93	167.36	9.47	2.29	126.60	2.60	85.08
151	Manzanita Crk @ HWY 299	1.14	207.71	11.87	3.20	158.24	4.09	106.38
152	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	0.62	111.14	6.18	1.21	82.94	1.10	55.70
153	Canyon Crk @ HWY 299 (Junction City)	0.49	85.97	4.73	0.81	63.62	0.64	42.71

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
		ug/L						
154	Weaver Crk @ HWY 299 (east of Weaverville)	0.63	112.68	6.27	1.24	84.13	1.13	56.50
155	Indian Crk @ HWY 299	0.93	167.80	9.50	2.30	126.93	2.61	85.30
156	Clear Crk @ HWY 299	0.85	153.74	8.67	2.00	115.97	2.17	77.92
157	Bear Crk upstream of Cache Crk	3.74	718.61	43.33	22.02	570.32	55.42	384.16
158	American Rvr @ Sunrise Blvd	0.43	75.95	4.15	0.67	55.98	0.49	37.57
159	Sacramento Rvr @ Hood	0.71	126.12	7.05	1.47	94.51	1.43	63.48
160	Putah Crk @ HWY 128 (below Lake Berryessa)	1.55	287.44	16.66	5.30	221.33	8.09	148.87
161	Putah Crk @ HWY 29	1.67	310.62	18.06	5.98	239.79	9.52	161.31
162	Cache Crk @ HWY 53 (below Clear Lake)	1.41	260.27	15.02	4.54	199.76	6.57	134.34
163	Cole Crk @ Clear Lake (below Kelsey Crk)	1.37	252.20	14.53	4.33	193.37	6.15	130.03
164	Scotts Crk @ HWY 29	2.21	414.41	24.40	9.36	322.98	17.44	217.36
165	Middle Crk @ HWY 20	1.26	230.78	13.25	3.77	176.43	5.10	118.62
166	N. Fork Cache Crk @ HWY 20	1.29	235.89	13.55	3.90	180.46	5.34	121.34
167	Stoney Crk @ Black Butte Rd (above Black Butte Res)	1.37	252.66	14.56	4.34	193.73	6.17	130.27
168	Stoney Crk @ Newville Rd (below Black Butte Res)	1.39	255.28	14.72	4.41	195.80	6.30	131.67
169	Kendricks & Salt Crks above Black Butte Res	2.69	509.73	30.28	12.91	399.99	26.94	269.28
170	Thomes Crk @ Paskenta	0.98	178.29	10.12	2.52	135.15	2.97	90.83
171	Clear Crk below Whiskeytown Res	0.52	92.04	5.08	0.90	68.26	0.74	45.83
172	Spring Crk @ Debris Dam	0.98	176.84	10.03	2.49	134.01	2.92	90.06
173	Sacramento Rvr @ Keswick Dam	0.62	109.43	6.08	1.18	81.62	1.06	54.81
174	Cottonwood Crk @ I-5	1.32	241.66	13.90	4.05	185.02	5.62	124.41
175	Mill Crk @ HWY 99	0.62	111.08	6.18	1.21	82.90	1.10	55.67
176	Sacramento Rvr @ Hamilton City	0.69	123.78	6.91	1.43	92.70	1.38	62.27
177	Big Chico Crk @ River Rd	1.07	194.41	11.08	2.89	147.78	3.56	99.34
178	Feather Rvr @ Gridley (East Gridley Rd)	0.53	93.69	5.17	0.93	69.53	0.77	46.68
179	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	0.57	101.33	5.61	1.05	75.39	0.91	50.63
180	Sutter Bypass @ Tarke Rd	1.15	209.18	11.95	3.23	159.40	4.15	107.16
181	Butte Crk @ Butte Slough Rd	0.81	146.10	8.22	1.85	110.02	1.95	73.92
182	Sacramento Rvr @ Grimes	0.71	126.12	7.05	1.47	94.51	1.43	63.48
183	RD 108 Drain @ HWY 45	1.45	268.06	15.49	4.76	205.94	6.99	138.50
184	Colusa Basin Drain @ Road 99E	1.41	260.27	15.02	4.54	199.76	6.57	134.34

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
					ug/L			
185	Sacramento Slough @ Karnack	1.22	223.72	12.82	3.59	170.85	4.78	114.87
186	Feather Rvr @ West Catlett Rd	0.56	98.32	5.44	1.00	73.08	0.85	49.07
187	Natomas East Drain @ Del Paso Rd	1.13	206.95	11.82	3.18	157.64	4.06	105.97
188	Salado Crk (2.1 mi west of I-5)	5.76	1128.13	69.36	44.39	908.74	142.88	612.55
189	Kern Canon Crk @ I-5	9.06	1808.82	113.51	92.47	1479.91	385.11	998.31
190	Ortigilita Crk west of I-5	9.48	1894.71	119.14	99.38	1552.56	424.52	1047.39
191	Corral Hollow Crk @ Corral Hollow Rd Brdg	4.43	857.21	52.08	28.97	684.28	80.26	461.05
192	Pacheco Crk above reservoir	3.23	617.22	36.97	17.39	487.40	40.26	328.23
193	Garzas Crk @ Sullivan Rd west of I-5							
194	Suisun Crk @ Suisun Valley Rd							
195	Orestimba Crk upstream of Calif Aqueduct	3.81	733.04	44.23	22.71	582.15	57.78	392.14
196	Deer Crk @ Deer Valley Rd	15.68	3203.09	206.04	224.77	2670.48	1278.73	1803.08
197	Little Panche Crk below the dam	4.02	774.54	46.85	24.74	616.23	64.86	415.13
198	Panoche Crk @ USGS Gauge (west of I-5)	18.49	3805.46	246.63	293.81	3190.77	1836.33	2154.96
199	Ingram Crk (west of I-5)	3.71	713.26	42.99	21.77	565.93	54.55	381.20
200	Kellogg Crk @ Vasco Rd	2.46	465.00	27.51	11.20	363.79	22.21	244.87
201	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	2.89	549.13	32.72	14.50	431.96	31.50	290.84
202	South Fork Pacheco Crk @ HWY 152	2.21	415.28	24.45	9.39	323.68	17.52	217.84
203	Quinto Crk @ Howard Ranch	3.05	580.43	34.67	15.80	457.42	35.39	308.01
204	Romero Crk @ McCabe Rd	3.04	578.25	34.54	15.71	455.65	35.11	306.81
205	Del Puerto Crk west of I-5	4.11	793.55	48.05	25.69	631.86	68.25	425.68
206	Mountain House Crk @ Grant Line Rd	4.93	957.44	58.45	34.40	767.08	101.24	516.93
207	Little Panoche Crk above Reservoir	3.41	651.78	39.13	18.92	515.61	45.14	347.26
208	Bennett Valley Crk upstream of I-5	3.04	579.00	34.58	15.74	456.26	35.21	307.23
209	Silver Crk upstream of Panoche Crk	15.29	3120.30	200.49	215.80	2599.21	1210.30	1754.88
210	Black Gulch Crk @ I-5	21.14	4375.82	285.31	365.03	3685.93	2462.21	2489.93
211	Crow Crk upstream of I-5	10.39	2084.73	131.63	115.30	1713.65	518.88	1156.25
212	Sand Crk @ Deer Valley Rd							
213	Pleasants Crk @ Pleasants Valley Rd	2.74	518.83	30.84	13.27	407.37	27.96	274.25
214	Green Valley Crk @ Cordelia Rd	1.38	253.40	14.60	4.36	194.32	6.21	130.67
215	Suisun Crk @ Cordelia Rd	1.85	343.89	20.08	7.00	266.37	11.79	179.21

Table A-4 (continued) Calculated Water Hardness Adjusted Water Quality Criteria For Protection of Freshwater Aquatic Life for Selected Streams in California (Calculation Based on EPA Hardness Adjusted Formulas in Text).

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
		ug/L						
216	Alamo Crk @ Pleasants Valley Rd	1.92	358.94	21.00	7.49	278.42	12.90	187.33
217	McCune Crk @ Midway Rd	1.81	336.10	19.61	6.76	260.14	11.23	175.01
218	Sweany Crk @ Midway Rd	1.66	306.96	17.84	5.87	236.88	9.29	159.34
219	Ulatis Crk @ Brown Rd	2.04	382.14	22.42	8.25	297.04	14.71	199.88
220	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)							
221	Maxwell Crk @ Pope Canyon Rd							
222	Pope Crk @ Pope Canyon Rd							
223	Capell Crk @ HWY 128							
224	Green Valley Crk @ Green Valley Rd							
225	Lone Tree Crk @ Bird Rd							
226	Logan Creek at Rd 60	1.80	335.88	19.59	6.75	259.97	11.22	174.90

Table A-5 Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
1	Whitewater Rvr @ I-10	0.00	0.00	0.15	0.00	0.01	0.00	0.03
2	Smith Crk @ Domestic Water Intake	0.00	0.00	0.00	0.00	0.00	0.00	0.06
3	San Luis Rey Rvr @ I-15	0.00	0.00	0.00	0.00	0.00	0.00	0.02
4	Temecula Crk @ Hwy 79 (above Vail Lake)	0.00	0.00	0.06	0.00	0.00	0.00	0.03
5	Potrero Crk (Massacre Cyn) @ HWY 79	0.00	0.00	0.07	0.16	0.00	0.00	0.04
6	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)	0.00	0.00	0.53	1.07	0.03	0.00	0.21
7	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)	0.00	0.00	0.00	0.00	0.00	0.00	0.03
8	Kings Rvr @ Centerville	0.00	0.00	0.00	0.00	0.00	0.00	0.03
9	Mill Crk @ HWY 180	0.00	0.00	0.00	0.00	0.00	0.00	0.05
10	Sand Crk @ Gaging Station	0.00	0.00	0.04	0.00	0.00	0.00	0.02
11	Cottonwood Crk @ HWY 201, Elderwood	0.00	0.00	0.00	0.00	0.00	0.00	0.02
12	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	0.00	0.01	0.00	0.00	0.01	0.00	0.07
13	South Fork Kaweah Rvr @ So Fork Rd	0.00	0.00	0.00	0.00	0.00	0.00	0.07
14	Kaweah Rvr above Lake Kaweah	0.00	0.00	0.00	0.00	0.00	0.00	0.10
15	Yokohl Crk @ HWY 181	0.00	0.00	0.09	0.00	0.01	0.00	0.04
16	Tule Rvr @ USGS Gauge @ HWY 190	0.00	0.00	0.09	0.00	0.00	0.00	0.05
17	Deer Crk @ Road 260	0.00	0.01	0.00	0.00	0.00	0.00	0.08
18	Virgin Rvr @ Zion Nat Prk Lodge							
19	Sevier Rvr 1 mi so HWY 20							
20	White Rvr @ HWY 65	0.00	0.01	0.13	0.20	0.01	0.00	0.06
21	Poso Crk @ HWY 65	0.00	0.01	0.17	0.33	0.02	0.00	0.07
22	Caliente Crk @ Caliente Crk Rd	0.00	0.00	0.00	0.00	0.00	0.00	0.01
23	Tehachapi Crk @ Bealville Rd, Caliente	0.00	0.00	0.00	0.00	0.00	0.00	0.02
24	Grapevine Crk @ Grapevine	0.00	0.00	0.00	0.00	0.00	0.00	0.01
25	Cuddy Crk @ Frazier Prk	0.00	0.00	0.00	0.00	0.00	0.00	0.01
26	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	0.00	0.00	0.00	0.00	0.00	0.00	0.01
27	Hungry Valley Crk @ Hungry Vly St Prk Hq	0.00	0.00	0.00	0.00	0.00	0.00	0.02
28	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	0.00	0.00	0.00	0.00	0.00	0.00	0.05
29	San Emigdio Crk @ San Emigdio Ranch	0.00	0.00	0.00	0.00	0.00	0.00	0.01

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
30	Cuyama Rvr near Cuyama	0.00	0.00	0.03	0.00	0.00	0.00	0.01
31	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	0.07	0.00	0.00	0.00	0.01	0.00	0.01
32	Santa Ynez Rvr @ HWY 101	0.02	0.00	0.00	0.00	0.00	0.00	0.01
33	Huasna Crk @ Huasna Rd	0.06	0.00	0.00	0.00	0.00	0.00	0.01
34	Arroyo Grande Crk above Arroyo Grande	0.08	0.00	0.00	0.00	0.00	0.00	0.01
35	Salinas Rvr below Lake Santa Margarita (HWY 58)	0.00	0.00	0.00	0.00	0.00	0.00	0.02
36	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	0.00	0.00	0.00	0.00	0.00	0.00	0.02
37	Encinosa Crk @ Pleasant Valley Rd							
38	Huerhuero Crk @ Creston Rd	0.00	0.00	0.22	0.00	0.04	0.00	0.02
39	Cholame Crk @ HWY 46	0.03	0.00	0.06	0.00	0.01	0.00	0.01
40	Estrella Rvr @ Jardine Rd	0.00	0.00	0.00	0.04	0.00	0.00	0.01
41	Salinas Rvr @ San Miguel	0.10	0.00	0.06	0.00	0.01	0.00	0.02
42	San Marcos Crk west of HWY 101	0.04	0.00	0.00	0.00	0.00	0.00	0.01
43	Las Tablas Crk CDF Station, Chimney Rd	0.00	0.00	0.03	0.00	0.01	0.00	0.02
44	Nacimiento Rvr below Dam	0.00	0.00	0.00	0.00	0.01	0.00	0.03
45	San Antonio Rvr @ Nacimiento Lake Dr	0.18	0.00	0.00	0.00	0.01	0.00	0.02
46	San Antonio Rvr @ Interlake Rd	0.05	0.00	0.00	0.00	0.00	0.00	0.03
47	Jolon Crk @ Jolon Rd	0.08	0.00	0.00	0.00	0.00	0.00	0.01
48	Pine Canyon Crk @ Pine Canyon Rd	0.03	0.00	0.00	0.01	0.00	0.00	0.00
49	Salinas Rvr @ Kings City (San Lorenzo Prk)	0.11	0.04	0.12	0.09	0.06	0.00	0.05
50	San Lorenzo Crk @ Bitterwater Rd	0.02	0.00	0.00	0.00	0.01	0.00	0.01
51	Reliz Crk @ Reliz Canyon Rd	0.09	0.00	0.00	0.00	0.00	0.00	0.01
52	Arroyo Seco Rvr @ above Monterey Co Rd G16	0.00	0.00	0.00	0.00	0.01	0.00	0.04
53	Paloma Crk @ Monterey Co Rd G16 Brdg	0.14	0.00	0.00	0.00	0.00	0.00	0.03
54	Salinas Rvr @ Davis Rd	0.07	0.02	0.13	0.00	0.05	0.00	0.04
55	Carmel Rvr @ Garlad Ranch Regional Prk	0.00	0.00	0.00	0.00	0.00	0.00	0.03
56	Burns Crk @ Doug Rd	0.35	0.01	0.51	0.00	0.01	0.00	0.10
57	Bear Crk @ Bonner Rd	0.18	0.00	0.17	0.00	0.00	0.00	0.05
58	Owens Crk @ Cunningham Rd	0.13	0.00	0.12	0.00	0.01	0.00	0.04
59	Mariposa Crk A Cunningham Rd	0.09	0.00	0.16	0.00	0.01	0.00	0.06
60	San Joaquin Rvr @ HWY 41	0.23	0.00	0.00	0.00	0.00	0.00	0.13

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
61	Fresno Rvr @ Road 415	0.19	0.00	0.00	1.10	0.03	0.00	0.15
62	Chowchilla Rvr @ Raymond Brdg (Road 613)	0.14	0.00	0.00	0.00	0.00	0.00	0.09
63	Carson Rvr @ HWY Alt 95 S. of Silver Springs	0.00	0.02	0.23	0.26	0.01	0.00	0.07
64	Walker Rvr @ Yerington	0.15	0.00	0.15	0.00	0.01	0.00	0.07
65	Truckee Rvr @ Wadsworth	0.29	0.01	0.58	2.10	0.02	0.00	0.27
66	Long Valley Crk @ Herlong	0.16	0.01	0.40	0.14	0.01	0.00	0.09
67	Susan Rvr @ Susanville	0.00	0.00	0.00	0.00	0.00	0.00	0.11
68	Humbolt Rvr @ HWY 95, Winnemucca	0.09	0.01	0.95	0.20	0.01	0.00	0.12
69	Arroyo Valle above Lake Del Valle	0.04	0.00	0.00	0.08	0.00	0.00	0.02
70	Arroyo Mocho @ Mines Rd	0.05	0.00	0.04	0.00	0.00	0.00	0.02
71	Alameda Crk @ Calaveras Rd	0.04	0.00	0.03	0.00	0.01	0.00	0.02
72	San Felipe Crk @ San Felipe Rd	0.00	0.00	0.15	0.19	0.00	0.00	0.02
73	Uvas Crk @ HWY 152	0.06	0.00	0.00	0.32	0.00	0.00	0.03
74	Coyote Crk above Coyote Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.02
75	Pajaro Rvr @ Gauge Station HWY 129	0.02	0.00	0.04	0.08	0.02	0.00	0.02
76	Santa Ana Crk @ Santa Ana Valley Rd	0.05	0.01	0.02	0.00	0.00	0.00	0.02
77	Tres Pines Crk @ Bolado Park	0.00	0.00	0.00	0.00	0.00	0.00	0.01
78	Pescadero Crk @ Cienega Rd	0.04	0.00	0.00	0.21	0.00	0.00	0.03
79	San Benito Rvr @ Cienega Rd	0.02	0.00	0.04	0.00	0.01	0.00	0.02
80	Chalone Crk @ Pinnacles Nat Mon	0.00	0.00	0.00	0.23	0.00	0.00	0.05
81	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	0.00	0.01	0.04	0.03	0.01	0.00	0.02
82	Clear Crk above San Benito Rvr	0.02	0.03	0.00	0.00	0.00	0.00	0.01
83	San Benito Rvr above Hernandez Res (Clear Crk Rd)	0.02	0.01	0.00	0.00	0.00	0.00	0.01
84	Los Gatos Crk @ County Park	0.00	0.00	0.00	0.00	0.00	0.00	0.02
85	Los Gatos Crk @ USGS Gauge near Coalinga	0.02	0.00	0.00	0.00	0.01	0.00	0.01
86	Warthan Crk @ HWY 198 west of Coalinga	0.00	0.00	0.00	0.01	0.00	0.00	0.00
87	Jacalitos Crk @ Jacalitos Crk Rd	0.02	0.00	0.02	0.00	0.01	0.00	0.01
88	Soquel Crk @ Soquel Dr, Soquel							
89	San Lorenzo Rvr @ Covered Brdg @ Felton							
90	Sacramento Rvr @ Dunsmuir	0.00	0.01	0.00	0.00	0.04	0.00	0.07
91	Williamson Rvr @ Williamson NFS Cmpgrnd	0.00	0.01	0.00	0.00	0.00	0.00	0.17

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
92	Sprague Rvr @ Chiloquin	0.00	0.01	0.00	0.00	0.00	0.00	0.10
93	Rogue Rvr @ Galice	0.28	0.01	0.00	0.00	0.00	0.00	0.20
94	Illinois Rvr @ Kerby	0.00	0.01	0.00	0.00	0.03	0.00	0.06
95	Coquille Rvr @ Coqille	0.00	0.01	0.00	0.00	0.02	0.00	0.09
96	Hospital Crk @ Bird Rd							
97	Chetco Rvr @ Loeb State Park	0.00	0.01	0.00	0.91	0.01	0.00	0.10
98	Price Rvr @ Helper	0.21	0.00	0.00	0.00	0.00	0.00	0.03
99	Green Rvr @ Green River	0.04	0.00	0.00	0.00	0.00	0.00	0.01
100	Gunnison Rvr above Delta	0.00	0.00	0.00	0.00	0.00	0.00	0.01
101	Colorado Rvr @ Moab	0.00	0.00	0.00	0.00	0.00	0.00	0.01
102	North Fork American Rvr @ HWY 49	0.00	0.01	0.00	0.00	0.00	0.00	0.16
103	South Fork American Rvr @ HWY 49	0.00	0.03	0.00	0.00	0.03	0.00	0.24
104	Carson Crk @ Latrobe Rd	0.00	0.00	0.23	0.00	0.00	0.00	0.06
105	Deer Crk @ Latrobe Rb	0.00	0.01	0.27	0.00	0.02	0.00	0.06
106	Consumnes Rvr @ Latrobe Rd	0.00	0.01	0.14	0.00	0.00	0.00	0.08
107	Little Indian Crk @ Latrobe Rd	0.00	0.00	0.04	0.00	0.01	0.00	0.02
108	Dry Crk @ HWY 124	0.00	0.00	0.00	0.00	0.00	0.00	0.04
109	Sutter Crk @ HWY 124	0.00	0.00	2.54	0.00	0.01	0.00	0.17
110	Jackson Crk @ HWY 124	0.00	0.00	0.19	0.00	0.01	0.00	0.09
111	Mokelumne Rvr @ HWY 49	0.00	0.00	0.00	0.00	0.00	0.00	0.14
112	North Fork Calaveras Rvr @ HWY 12	0.00	0.00	0.00	0.00	0.00	0.00	0.05
113	Calaveritas Crk @ HWY 49	0.00	0.00	0.10	0.00	0.00	0.00	0.06
114	Indian Crk @ HWY 49 (San Antonio Crk)	0.00	0.00	0.00	0.00	0.00	0.00	0.15
115	San Domingo Crk @ HWY 49	0.00	0.00	0.00	0.00	0.00	0.00	0.06
116	Angeles Crk @ HWY 49	0.00	0.02	0.72	0.00	0.03	0.00	0.28
117	Stanislaus Rvr @ Parrots Ferry Brdg	0.00	0.00	0.80	0.00	0.02	0.00	0.15
118	Tuolumne Rvr @ HWY 49	0.00	0.00	0.00	0.00	0.00	0.00	0.22
119	Merced Rvr @ HWY 49	0.00	0.00	0.00	0.00	0.00	0.00	0.16
120	Conn Crk below Conn Dam	0.00	0.00	0.15	0.00	0.04	0.00	0.04
121	Glass Mountain Crk @ Silverado Trail	0.00	0.00	0.00	0.00	0.00	0.00	0.19
122	Napa Rvr @ Dunaweal Lane	0.16	0.02	0.32	0.00	0.05	0.00	0.22

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
123	Maacama Crk @ HWY 128	0.00	0.01	0.00	0.00	0.02	0.00	0.07
124	Big Sulfur Crk @ Geysers Rd	0.00	0.02	0.07	0.00	0.04	0.00	0.05
125	Russian Rvr @ HWY 101 (7 mi so of Hopland)	0.00	0.04	0.19	0.00	0.05	0.00	0.09
126	Outlet Crk @ HWY 101 & HWY 261	0.00	0.05	0.17	0.00	0.05	0.00	0.11
127	Long Valley Crk @ HWY 101, Longvale	0.00	0.04	0.50	0.00	0.06	0.00	0.11
128	South Fork Eel Rvr @ north end Richardson St Prk	0.00	0.05	0.41	0.00	0.06	0.00	0.20
129	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	0.09	0.25	1.27	1.26	0.32	0.00	0.42
130	Eel Rvr @ Pepperwood exit of HWY 101	0.00	0.16	0.89	0.79	0.20	0.00	0.26
131	Elk River @ HWY 101, Eureka	0.00	0.27	0.91	1.49	0.24	0.00	0.42
132	Redwood Crk @ HWY 101, north of Orick	0.00	0.16	1.24	1.88	0.13	0.00	0.39
133	Prairie Crk @ Davison Ranch Bridge	0.00	0.07	1.12	5.77	0.08	0.00	0.33
134	Klamath Rvr @ Klamath	0.00	0.07	0.58	0.00	0.16	0.00	0.19
135	Hunter Crk @ HWY 101	0.00	0.00	0.33	0.00	0.00	0.00	0.26
136	Wilson Crk @ HWY 101	0.00	0.06	0.49	1.53	0.07	0.00	0.41
137	Myrtle Crk @ HWY 199 (So. Rank Rd)	0.00	0.11	0.00	0.00	0.16	0.00	0.13
138	South Fork Smith Rvr @ HWY 199 & South Fork Rd	0.00	0.04	0.00	0.00	0.14	0.00	0.09
139	Middle Fork Smith Rvr	0.00	0.05	0.00	0.00	0.14	0.00	0.08
140	Hardscabble Crk @ HWY 199	0.00	0.05	0.00	0.00	0.13	0.00	0.06
141	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	0.00	0.02	0.00	0.00	0.17	0.00	0.08
142	Morrison Crk @ Fred Haight Dr	0.00	0.01	0.00	0.00	0.03	0.00	0.24
143	Rowdy Crk @ Fred Haight Dr	0.00	0.04	0.00	1.41	0.10	0.00	0.28
144	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	0.00	0.15	0.78	1.18	0.20	0.00	0.27
145	East Fork Willow Crk @ East Fork NFS Cmpgrnd	0.00	0.02	0.00	0.00	0.08	0.00	0.08
146	Willow Crk upstream of East Fork Willow Crk	0.00	0.02	0.00	0.00	0.07	0.00	0.07
147	Italian Crk @ HWY 299	0.00	0.00	0.00	0.00	0.00	0.00	0.03
148	Swede Crk @ HWY 299	0.00	0.00	0.00	0.00	0.00	0.00	0.03
149	Trinity Rvr @ HWY 299 (Haden Flat)	0.00	0.01	0.00	0.00	0.02	0.00	0.07
150	Big French Crk @ Big French Crk Rd, old brdg	0.00	0.01	0.00	0.00	0.01	0.00	0.07
151	Manzanita Crk @ HWY 299	0.00	0.01	0.17	0.00	0.00	0.00	0.04
152	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	0.00	0.02	0.00	0.00	0.00	0.00	0.11
153	Canyon Crk @ HWY 299 (Junction City)	0.00	0.01	0.00	0.00	0.00	0.00	0.12

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
154	Weaver Crk @ HWY 299 (east of Weaverville)	0.00	0.01	0.32	0.00	0.02	0.00	0.19
155	Indian Crk @ HWY 299	0.00	0.01	0.00	0.00	0.02	0.00	0.07
156	Clear Crk @ HWY 299	1.17	0.03	16.15	0.00	0.03	0.00	1.92
157	Bear Crk upstream of Cache Crk	0.03	0.01	0.00	0.00	0.01	0.00	0.01
158	American Rvr @ Sunrise Blvd	0.92	0.01	2.17	0.00	0.05	0.00	0.83
159	Sacramento Rvr @ Hood	1.13	0.03	1.99	0.00	0.05	0.00	0.60
160	Putah Crk @ HWY 128 (below Lake Berryessa)	0.06	0.00	0.12	0.00	0.01	0.00	0.04
161	Putah Crk @ HWY 29	0.18	0.00	0.28	0.00	0.01	0.00	0.11
162	Cache Crk @ HWY 53 (below Clear Lake)	0.42	0.02	0.73	3.30	0.05	0.00	0.39
163	Cole Crk @ Clear Lake (below Kelsey Crk)	0.07	0.01	0.21	0.23	0.03	0.00	0.09
164	Scotts Crk @ HWY 29	0.09	0.00	0.16	0.21	0.02	0.00	0.06
165	Middle Crk @ HWY 20	0.00	0.00	0.00	0.00	0.00	0.00	0.04
166	N. Fork Cache Crk @ HWY 20	0.00	0.01	0.07	0.00	0.02	0.00	0.04
167	Stoney Crk @ Black Butte Rd (above Black Butte Res)	0.80	0.01	1.65	1.15	0.04	0.00	0.74
168	Stoney Crk @ Newville Rd (below Black Butte Res)	0.14	0.02	0.48	0.00	0.04	0.00	0.17
169	Kendricks & Salt Crks above Black Butte Res	0.26	0.00	0.13	0.00	0.01	0.00	0.09
170	Thomes Crk @ Paskenta	0.20	0.00	0.30	0.00	0.01	0.00	0.14
171	Clear Crk below Whiskeytown Res	0.00	0.00	0.39	0.00	0.03	0.00	0.13
172	Spring Crk @ Debris Dam	112.78	0.03	149.50	4.42	0.07	0.00	97.71
173	Sacramento Rvr @ Keswick Dam	0.81	0.01	1.32	0.00	0.01	0.00	0.66
174	Cottonwood Crk @ I-5	0.08	0.00	0.14	0.00	0.00	0.00	0.09
175	Mill Crk @ HWY 99	0.00	0.01	0.32	0.00	0.00	0.00	0.16
176	Sacramento Rvr @ Hamilton City	0.58	0.01	0.87	0.00	0.02	0.00	0.47
177	Big Chico Crk @ River Rd	0.28	0.01	0.27	1.73	0.01	0.00	0.17
178	Feather Rvr @ Gridley (East Gridley Rd)	0.00	0.01	0.77	1.08	0.01	0.00	0.39
179	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	0.70	0.01	0.53	0.95	0.00	0.00	0.28
180	Sutter Bypass @ Tarke Rd	0.09	0.02	0.59	0.31	0.03	0.00	0.17
181	Butte Crk @ Butte Slough Rd	0.25	0.02	0.85	0.00	0.02	0.00	0.20
182	Sacramento Rvr @ Grimes	0.43	0.02	1.13	0.00	0.04	0.00	0.38
183	RD 108 Drain @ HWY 45	0.34	0.03	0.52	0.00	0.05	0.00	0.13
184	Colusa Basin Drain @ Road 99E	0.14	0.05	0.60	0.00	0.06	0.00	0.16

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
185	Sacramento Slough @ Karnack	0.41	0.02	0.47	0.00	0.03	0.00	0.15
186	Feather Rvr @ West Catlett Rd	0.36	0.02	0.92	0.00	0.04	0.00	0.31
187	Natomas East Drain @ Del Paso Rd	0.53	0.13	2.03	0.94	0.15	0.00	0.37
188	Salado Crk (2.1 mi west of I-5)	0.03	0.00	0.01	0.00	0.01	0.00	0.01
189	Kern Canon Crk @ I-5	0.03	0.00	0.03	0.01	0.01	0.00	0.01
190	Ortigilita Crk west of I-5	0.03	0.00	0.00	0.00	0.00	0.00	0.01
191	Corral Hollow Crk @ Corral Hollow Rd Brdg	0.02	0.00	0.00	0.00	0.00	0.00	0.01
192	Pacheco Crk above reservoir	0.00	0.00	0.03	0.00	0.00	0.00	0.02
193	Garzas Crk @ Sullivan Rd west of I-5							
194	Suisun Crk @ Suisun Valley Rd							
195	Orestimba Crk upstream of Calif Aqueduct	0.00	0.00	0.00	0.00	0.00	0.00	0.01
196	Deer Crk @ Deer Valley Rd	0.02	0.00	0.00	0.00	0.00	0.00	0.00
197	Little Panche Crk below the dam	0.02	0.00	0.02	0.00	0.01	0.00	0.01
198	Panoche Crk @ USGS Gauge (west of I-5)	0.01	0.00	0.00	0.00	0.01	0.00	0.00
199	Ingram Crk (west of I-5)	0.03	0.00	0.02	0.00	0.00	0.00	0.01
200	Kellogg Crk @ Vasco Rd	0.00	0.00	0.07	0.00	0.01	0.00	0.03
201	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	0.00	0.00	0.03	0.00	0.06	0.00	0.02
202	South Fork Pacheco Crk @ HWY 152	0.00	0.00	0.04	0.00	0.01	0.00	0.02
203	Quinto Crk @ Howard Ranch	0.00	0.00	0.03	0.00	0.00	0.00	0.02
204	Romero Crk @ McCabe Rd	0.00	0.00	0.00	0.00	0.00	0.00	0.01
205	Del Puerto Crk west of I-5	0.00	0.00	0.00	0.00	0.00	0.00	0.01
206	Mountain House Crk @ Grant Line Rd	0.04	0.00	0.03	0.00	0.00	0.00	0.02
207	Little Panoche Crk above Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.01
208	Bennett Valley Crk upstream of I-5	0.00	0.01	0.00	0.00	0.04	0.03	0.07
209	Silver Crk upstream of Panoche Crk	0.00	0.00	0.00	0.00	0.01	0.00	0.01
210	Black Gulch Crk @ I-5	0.01	0.00	0.00	0.00	0.00	0.00	0.00
211	Crow Crk upstream of I-5	0.00	0.00	0.00	0.00	0.00	0.00	0.01
212	Sand Crk @ Deer Valley Rd							
213	Pleasants Crk @ Pleasants Valley Rd	0.00	0.00	0.00	0.00	0.00	0.00	0.02
214	Green Valley Crk @ Cordelia Rd	0.00	0.00	0.48	0.00	0.01	0.00	0.06
215	Suisun Crk @ Cordelia Rd	0.00	0.00	0.20	0.00	0.00	0.00	0.06

Table A-5 (Continued) Ratio of the Trace Element Concentrations for Selected Streams in California to the EPA Calculated Hardness Adjusted Ambient Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	Cd	Cr	Cu	Pb	Ni	Ag	Zn
216	Alamo Crk @ Pleasants Valley Rd	0.00	0.00	0.24	0.00	0.02	0.00	0.09
217	McCune Crk @ Midway Rd	0.00	0.00	0.15	0.00	0.02	0.00	0.05
218	Sweany Crk @ Midway Rd	0.00	0.00	0.17	0.00	0.02	0.00	0.06
219	Ulatis Crk @ Brown Rd	0.00	0.00	0.18	0.36	0.02	0.00	0.07
220	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)							
221	Maxwell Crk @ Pope Canyon Rd							
222	Pope Crk @ Pope Canyon Rd							
223	Capell Crk @ HWY 128							
224	Green Valley Crk @ Green Valley Rd							
225	Lone Tree Crk @ Bird Rd							
226	Logan Creek at Rd 60	0.00	0.00	0.00	0.00	0.00	0.00	0.02

Table A-6 Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
1	Whitewater Rvr @ I-10			0.52	0.30	0.13
2	Smith Crk @ Domestic Water Intake			0.08	0.11	0.00
3	San Luis Rey Rvr @ I-15			0.54	0.63	0.57
4	Temecula Crk @ Hwy 79 (above Vail Lake)			0.26	0.52	0.23
5	Potrero Crk (Massacre Cyn) @ HWY 79			0.18	0.84	0.20
6	Santa Ana Rvr @ Orange Ave Brdg (HWY 30)			0.00	0.10	0.77
7	Lytle Crk @ U.S.Forest Sta.(Lytle Crk Rd)			0.06	0.19	0.17
8	Kings Rvr @ Centerville	0.00	0.00	0.00	0.15	0.00
9	Mill Crk @ HWY 180	0.00	0.00	0.00	0.13	0.03
10	Sand Crk @ Gaging Station	0.01	0.00	0.06	0.35	0.07
11	Cottonwood Crk @ HWY 201, Elderwood	0.01	0.00	0.06	0.32	0.13
12	Dry Crk @ USGS Gauge, Dry Crk Rd (J21) 2.6 mi. north HWY 26	0.01	0.00	0.08	0.22	0.00
13	South Fork Kaweah Rvr @ So Fork Rd	0.00	0.00	0.00	0.12	0.07
14	Kaweah Rvr above Lake Kaweah	0.00	0.00	0.16	0.08	0.03
15	Yokohl Crk @ HWY 181	0.03	0.11	0.10	0.79	0.33
16	Tule Rvr @ USGS Gauge @ HWY 190	0.01	0.09	0.04	0.11	0.07
17	Deer Crk @ Road 260	0.00	0.00	0.04	0.29	0.10
18	Virgin Rvr @ Zion Nat Prk Lodge			0.10		
19	Sevier Rvr 1 mi so HWY 20			0.12		
20	White Rvr @ HWY 65	0.05	0.07	0.10	0.79	0.20
21	Poso Crk @ HWY 65	0.06	0.13	0.06	0.42	0.10
22	Caliente Crk @ Caliente Crk Rd	0.06	0.79	0.30	0.79	0.37
23	Tehachapi Crk @ Bealville Rd, Caliente	0.01	0.13	0.08	1.11	0.60
24	Grapevine Crk @ Grapevine	0.01	1.21	0.18	2.16	1.70
25	Cuddy Crk @ Frazier Prk	0.01	1.59	0.26	1.53	0.63
26	Piru Crk @ Gold Hill Rd (Gold Hill Cmpgrnd)	0.01	4.49	0.12	0.32	0.23
27	Hungry Valley Crk @ Hungry Vly St Prk Hq	0.01	0.46	0.14	0.33	0.17
28	Gorman Crk 1 mi north Hungry Valley Crk (adjacent to Water Project Aqueduct)	0.00	0.67	0.08	1.58	0.93
29	San Emigdio Crk @ San Emigdio Ranch	0.00	1.43	0.34	0.48	0.50

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
30	Cuyama Rvr near Cuyama	0.01	2.21	0.08	0.68	0.20
31	Alamo Pintado Crk @ HWY 26 (Zanja de Cota Crk)	0.03	0.31	6.20	2.00	0.97
32	Santa Ynez Rvr @ HWY 101	0.00	0.50	1.98	0.63	0.23
33	Huasna Crk @ Huasna Rd	0.03	0.09	0.16	0.53	0.13
34	Arroyo Grande Crk above Arroyo Grande	0.01	0.14	2.20	1.21	0.30
35	Salinas Rvr below Lake Santa Margarita (HWY 58)	0.00	0.10	0.06	0.07	0.03
36	Salinas Rvr above Lake Santa Margarita (@ Pozo Rd)	0.00	0.11	0.36	0.08	0.03
37	Encinosa Crk @ Pleasant Valley Rd			0.14		
38	Huerhuero Crk @ Creston Rd	0.02	1.14	0.18	0.20	0.10
39	Cholame Crk @ HWY 46	0.03	3.01	2.60	6.63	1.23
40	Estrella Rvr @ Jardine Rd	0.03	1.63	0.24	2.11	0.40
41	Salinas Rvr @ San Miguel	0.02	0.43	0.50	0.35	0.17
42	San Marcos Crk west of HWY 101	0.01	0.51	0.20	0.79	0.23
43	Las Tablas Crk CDF Station, Chimney Rd	0.00	0.17	0.16	0.24	0.03
44	Nacimiento Rvr below Dam	0.01	0.00	0.06	0.08	0.00
45	San Antonio Rvr @ Nacimiento Lake Dr	0.01	0.16	0.24	0.89	0.07
46	San Antonio Rvr @ Interlake Rd	0.00	0.00	0.14	0.31	0.03
47	Jolon Crk @ Jolon Rd	0.04	0.16	0.14	1.05	0.73
48	Pine Canyon Crk @ Pine Canyon Rd	0.00	0.71	14.60	1.74	0.70
49	Salinas Rvr @ Kings City (San Lorenzo Prk)	0.02	0.43	0.56	0.19	0.13
50	San Lorenzo Crk @ Bitterwater Rd	0.01	4.41	0.56	0.84	0.27
51	Reliz Crk @ Reliz Canyon Rd	0.01	0.24	0.54	0.95	0.23
52	Arroyo Seco Rvr @ above Monterey Co Rd G16	0.00	0.00	0.06	0.09	0.00
53	Paloma Crk @ Monterey Co Rd G16 Brdg	0.00	0.00	0.08	0.10	0.00
54	Salinas Rvr @ Davis Rd	0.02	0.36	0.48	0.27	0.17
55	Carmel Rvr @ Garlad Ranch Regional Prk	0.00	0.00	0.10	0.14	0.03
56	Burns Crk @ Doug Rd	0.02	0.00	0.04	0.04	0.00
57	Bear Crk @ Bonner Rd	0.01	0.00	0.08	0.03	0.00
58	Owens Crk @ Cunningham Rd	0.02	0.00	0.06	0.07	0.03
59	Mariposa Crk A Cunningham Rd	0.02	0.00	0.04	0.04	0.00
60	San Joaquin Rvr @ HWY 41	0.01	0.00	0.00	0.10	0.07

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
61	Fresno Rvr @ Road 415	0.01	0.00	0.00	0.11	0.03
62	Chowchilla Rvr @ Raymond Brdg (Road 613)	0.00	0.00	0.00	0.07	0.00
63	Carson Rvr @ HWY Alt 95 S. of Silver Springs	0.02	0.33	0.06	0.42	0.23
64	Walker Rvr @ Yerington	0.07	0.54	0.06	0.53	0.53
65	Truckee Rvr @ Wadsworth	0.06	0.31	0.04	0.06	0.07
66	Long Valley Crk @ Herlong	0.15	0.80	0.08	1.95	0.73
67	Susan Rvr @ Susanville	0.00	0.00	0.00	0.05	0.00
68	Humbolt Rvr @ HWY 95, Winnemucca	0.07	0.40	0.26	0.18	0.23
69	Arroyo Valle above Lake Del Valle	0.00	0.80	0.00	0.09	0.03
70	Arroyo Mocho @ Mines Rd	0.01	1.44	0.08	0.13	0.03
71	Alameda Crk @ Calaveras Rd	0.01	0.91	0.06	0.12	0.03
72	San Felipe Crk @ San Felipe Rd	0.00	0.21	0.14	0.07	0.00
73	Uvas Crk @ HWY 152	0.00	0.10	0.00	0.05	0.00
74	Coyote Crk above Coyote Reservoir	0.00	0.43	0.00	0.06	0.03
75	Pajaro Rvr @ Gauge Station HWY 129	0.01	0.54	0.42	0.08	0.07
76	Santa Ana Crk @ Santa Ana Valley Rd	0.02	3.49	0.28	0.27	0.10
77	Tres Pines Crk @ Bolado Park	0.01	1.24	0.60	0.15	0.20
78	Pescadero Crk @ Cienega Rd	0.01	0.00	0.08	0.26	0.27
79	San Benito Rvr @ Cienega Rd	0.01	1.99	0.28	0.22	0.07
80	Chalone Crk @ Pinnacles Nat Mon	0.02	0.09	0.00	0.14	0.07
81	San Benito Rvr @ Old Hernandez Rd & Coalinga Rd	0.01	0.97	0.26	0.09	0.00
82	Clear Crk above San Benito Rvr	0.00	1.64	0.00	0.05	0.00
83	San Benito Rvr above Hernandez Res (Clear Crk Rd)	0.00	0.93	0.14	0.09	0.00
84	Los Gatos Crk @ County Park	0.00	1.46	0.12	0.15	0.13
85	Los Gatos Crk @ USGS Gauge near Coalinga	0.00	1.99	0.20	0.18	0.03
86	Warthan Crk @ HWY 198 west of Coalinga	0.01	13.37	0.20	0.63	0.60
87	Jacalitos Crk @ Jacalitos Crk Rd	0.01	1.40	0.88	0.58	0.23
88	Soquel Crk @ Soquel Dr, Soquel		0.00	0.12	0.16	
89	San Lorenzo Rvr @ Covered Brdg @ Felton		0.00	0.10	0.16	
90	Sacramento Rvr @ Dunsmuir	0.06	0.24	0.00	0.04	0.00
91	Williamson Rvr @ Williamson NFS Cmpgrnd	0.01	0.11	0.00	0.03	0.00

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
92	Sprague Rvr @ Chiloquin	0.00	0.00	0.06	0.04	0.00
93	Rogue Rvr @ Galice	0.00	0.00	0.00	0.02	0.00
94	Illinois Rvr @ Kerby	0.00	0.00	0.04	0.02	0.00
95	Coquille Rvr @ Coqille	0.00	0.00	0.00	0.03	0.00
96	Hospital Crk @ Bird Rd		1.57	0.26		
97	Chetco Rvr @ Loeb State Park	0.00	0.00	0.00	0.02	0.00
98	Price Rvr @ Helper	0.01	0.07	0.14	0.05	0.03
99	Green Rvr @ Green River	0.01	0.26	0.28	0.26	0.13
100	Gunnison Rvr above Delta	0.02	0.13	0.68	0.14	0.17
101	Colorado Rvr @ Moab	0.02	0.17	0.76	0.79	0.27
102	North Fork American Rvr @ HWY 49	0.00	0.00	0.00	0.01	0.00
103	South Fork American Rvr @ HWY 49	0.00	0.00	0.00	0.01	0.00
104	Carson Crk @ Latrobe Rd	0.00	0.00	0.04	0.01	0.00
105	Deer Crk @ Latrobe Rb	0.00	0.00	0.00	0.01	0.00
106	Consumnes Rvr @ Latrobe Rd	0.00	0.00	0.10	0.01	0.00
107	Little Indian Crk @ Latrobe Rd	0.04	0.00	0.08	0.02	0.00
108	Dry Crk @ HWY 124	0.05	0.00	0.04	0.03	0.00
109	Sutter Crk @ HWY 124	0.04	0.00	0.04	0.02	0.00
110	Jackson Crk @ HWY 124	0.01	0.00	0.18	0.02	0.00
111	Mokelumne Rvr @ HWY 49	0.00	0.00	0.00	0.01	0.00
112	North Fork Calaveras Rvr @ HWY 12	0.00	0.00	0.00	0.03	0.00
113	Calaveritas Crk @ HWY 49	0.00	0.00	0.10	0.03	0.03
114	Indian Crk @ HWY 49 (San Antonio Crk)	0.00	0.00	0.00	0.01	0.00
115	San Domingo Crk @ HWY 49	0.00	0.00	0.00	0.02	0.00
116	Angeles Crk @ HWY 49	0.00	0.00	0.00	0.00	0.00
117	Stanislaus Rvr @ Parrots Ferry Brdg	0.00	0.00	0.04	0.02	0.00
118	Tuolumne Rvr @ HWY 49	0.00	0.00	0.10	0.01	0.00
119	Merced Rvr @ HWY 49	0.00	0.00	0.00	0.02	0.00
120	Conn Crk below Conn Dam	0.01	0.19	0.42	0.03	0.00
121	Glass Mountain Crk @ Silverado Trail	0.00	0.09	0.16	0.02	0.00
122	Napa Rvr @ Dunaweal Lane	0.02	0.46	0.10	0.03	0.00

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
123	Maacama Crk @ HWY 128	0.01	0.10	0.00	0.02	0.00
124	Big Sulfur Crk @ Geysers Rd	0.00	0.39	0.06	0.03	0.00
125	Russian Rvr @ HWY 101 (7 mi so of Hopland)	0.00	0.39	0.06	0.03	0.00
126	Outlet Crk @ HWY 101 & HWY 261	0.00	0.26	0.20	0.03	0.00
127	Long Valley Crk @ HWY 101, Longvale	0.00	0.34	0.52	0.01	0.00
128	South Fork Eel Rvr @ north end Richardson St Prk	0.00	0.09	0.08	0.02	0.00
129	East Branch, So Fork Eel Rvr @ E Brnch Rd, Benbow	0.02	0.00	0.06	0.02	0.00
130	Eel Rvr @ Pepperwood exit of HWY 101	0.01	0.11	0.04	0.02	0.00
131	Elk River @ HWY 101, Eureka	0.00	0.00	0.08	0.03	0.00
132	Redwood Crk @ HWY 101, north of Orick	0.01	0.00	0.08	0.04	0.00
133	Prairie Crk @ Davison Ranch Bridge	0.00	0.00	0.06	0.01	0.00
134	Klamath Rvr @ Klamath	0.01	0.00	0.08	0.02	0.00
135	Hunter Crk @ HWY 101	0.00	0.00	0.00	0.02	0.00
136	Wilson Crk @ HWY 101	0.01	0.00	0.00	0.00	0.00
137	Myrtle Crk @ HWY 199 (So. Rank Rd)	0.00	0.00	0.06	0.00	0.00
138	South Fork Smith Rvr @ HWY 199 & South Fork Rd	0.01	0.00	0.06	0.02	0.00
139	Middle Fork Smith Rvr	0.00	0.00	0.00	0.01	0.00
140	Hardscabble Crk @ HWY 199	0.00	0.00	0.06	0.02	0.00
141	Patricks Crk @ Patricks Crk Rd (0.2 mi no HWY 199)	0.00	0.00	0.14	0.01	0.00
142	Morrison Crk @ Fred Haight Dr	0.00	0.00	0.06	0.00	0.00
143	Rowdy Crk @ Fred Haight Dr	0.00	0.00	0.00	0.02	0.00
144	Mad Rvr @ North Bank Rd (0.4 mi no HWY 101)	0.01	0.00	0.00	0.01	0.00
145	East Fork Willow Crk @ East Fork NFS Cmpgrnd	0.00	0.00	0.10	0.02	0.00
146	Willow Crk upstream of East Fork Willow Crk	0.00	0.00	0.00	0.01	0.00
147	Italian Crk @ HWY 299	0.01	0.00	0.14	0.03	0.00
148	Swede Crk @ HWY 299	0.01	0.00	0.10	0.05	0.00
149	Trinity Rvr @ HWY 299 (Haden Flat)	0.00	0.00	0.08	0.03	0.00
150	Big French Crk @ Big French Crk Rd, old brdg	0.00	0.00	0.12	0.03	0.00
151	Manzanita Crk @ HWY 299	0.00	0.00	0.14	0.03	0.00
152	North Fork Trinity Rvr @ Hobo Gulch Ridge Rd (Helena)	0.00	0.00	0.04	0.03	0.00
153	Canyon Crk @ HWY 299 (Junction City)	0.00	0.00	0.00	0.02	0.00

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
154	Weaver Crk @ HWY 299 (east of Weaverville)	0.00	0.00	0.06	0.01	0.00
155	Indian Crk @ HWY 299	0.00	0.00	0.08	0.02	0.00
156	Clear Crk @ HWY 299	0.01	0.00	0.18	0.06	0.00
157	Bear Crk upstream of Cache Crk	0.00		0.08	0.05	0.00
158	American Rvr @ Sunrise Blvd	0.00		0.10	0.02	0.00
159	Sacramento Rvr @ Hood	0.01		0.12	0.01	0.00
160	Putah Crk @ HWY 128 (below Lake Berryessa)	0.00		0.00	0.00	0.00
161	Putah Crk @ HWY 29	0.00		0.08	0.00	0.00
162	Cache Crk @ HWY 53 (below Clear Lake)	0.00		0.10	0.00	0.00
163	Cole Crk @ Clear Lake (below Kelsey Crk)	0.00		0.00	0.01	0.00
164	Scotts Crk @ HWY 29	0.00		0.04	0.02	0.00
165	Middle Crk @ HWY 20	0.00		0.04	0.00	0.00
166	N. Fork Cache Crk @ HWY 20	0.01		0.04	0.01	0.00
167	Stoney Crk @ Black Butte Rd (above Black Butte Res)	0.00		0.20	0.04	0.00
168	Stoney Crk @ Newville Rd (below Black Butte Res)	0.01		0.16	0.02	0.00
169	Kendricks & Salt Crks above Black Butte Res	0.00		0.18	0.07	0.00
170	Thomes Crk @ Paskenta	0.00		0.04	0.02	0.00
171	Clear Crk below Whiskeytown Res	0.00		0.06	0.01	0.00
172	Spring Crk @ Debris Dam	0.06		0.24	0.06	0.07
173	Sacramento Rvr @ Keswick Dam	0.01		0.00	0.03	0.00
174	Cottonwood Crk @ I-5	0.00		0.00	0.02	0.00
175	Mill Crk @ HWY 99	0.16		0.00	0.00	0.00
176	Sacramento Rvr @ Hamilton City	0.01		0.04	0.03	0.00
177	Big Chico Crk @ River Rd	0.01		0.08	0.01	0.00
178	Feather Rvr @ Gridley (East Gridley Rd)	0.00		0.08	0.01	0.00
179	Yuba Rvr @ Marysville (Ramirez St & Simpson Lane)	0.00		0.04	0.01	0.00
180	Sutter Bypass @ Tarke Rd	0.02		0.06	0.02	0.03
181	Butte Crk @ Butte Slough Rd	0.02		0.06	0.02	0.00
182	Sacramento Rvr @ Grimes	0.01		0.08	0.01	0.00
183	RD 108 Drain @ HWY 45	0.03		0.16	0.27	0.03
184	Colusa Basin Drain @ Road 99E	0.01		0.16	0.02	0.03

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
185	Sacramento Slough @ Karnack	0.02		0.08	0.03	0.03
186	Feather Rvr @ West Catlett Rd	0.00		0.06	0.01	0.00
187	Natomas East Drain @ Del Paso Rd	0.01		0.24	0.01	0.03
188	Salado Crk (2.1 mi west of I-5)	0.00	2.14	0.98	0.17	0.40
189	Kern Canon Crk @ I-5	0.03	12.57	1.30	0.32	0.70
190	Ortigilita Crk west of I-5	0.00	7.57	1.14	0.22	0.40
191	Corral Hollow Crk @ Corral Hollow Rd Brdg	0.01	6.00	0.24	0.18	0.13
192	Pacheco Crk above reservoir	0.00	0.36	0.00	0.06	0.03
193	Garzas Crk @ Sullivan Rd west of I-5		1.13	0.12		
194	Suisun Crk @ Suisun Valley Rd		0.24	0.08		
195	Orestimba Crk upstream of Calif Aqueduct	0.00	0.86	0.36	0.08	0.10
196	Deer Crk @ Deer Valley Rd	0.00	2.00	1.06	0.08	1.40
197	Little Panche Crk below the dam	0.02	15.43	0.08	0.22	0.10
198	Panoche Crk @ USGS Gauge (west of I-5)	0.00	17.86	0.38	0.58	1.30
199	Ingram Crk (west of I-5)	0.01	8.57	0.58	0.16	0.13
200	Kellogg Crk @ Vasco Rd	0.01	5.43	0.66	0.05	0.10
201	Marsh Crk @ Marsh Crk Rd (USGS Gauge)	0.00	3.71	0.14	0.06	0.00
202	South Fork Pacheco Crk @ HWY 152	0.01	0.23	0.08	0.06	0.03
203	Quinto Crk @ Howard Ranch	0.01	2.86	0.20	0.15	0.10
204	Romero Crk @ McCabe Rd	0.01	2.57	0.16	0.12	0.07
205	Del Puerto Crk west of I-5	0.01	1.57	0.10	0.11	0.03
206	Mountain House Crk @ Grant Line Rd	0.01	10.29	1.48	0.37	0.40
207	Little Panoche Crk above Reservoir	0.00	7.00	0.18	0.16	0.07
208	Bennett Valley Crk upstream of I-5	0.19	4.29	2.20	6.11	7.33
209	Silver Crk upstream of Panoche Crk	0.01	14.29	1.08	0.51	0.90
210	Black Gulch Crk @ I-5	0.03	6.86	2.60	0.58	1.93
211	Crow Crk upstream of I-5	0.01	2.86	3.00	0.24	0.90
212	Sand Crk @ Deer Valley Rd		8.86	0.78		
213	Pleasants Crk @ Pleasants Valley Rd			0.40	0.07	0.10
214	Green Valley Crk @ Cordelia Rd			0.06	0.03	0.00
215	Suisun Crk @ Cordelia Rd			0.08	0.03	0.00

Table A-6 (continued) Ratio of the Trace Element Concentrations for Selected Streams in California to Water Quality Criteria for Protection of Freshwater Aquatic Life.

Site ID	Site Description	As	B	Se	Mo	U
216	Alamo Crk @ Pleasants Valley Rd			0.18	0.06	0.03
217	McCune Crk @ Midway Rd			0.28	0.03	0.00
218	Sweany Crk @ Midway Rd			0.06	0.03	0.03
219	Ulatis Crk @ Brown Rd			0.12	0.07	0.07
220	Eticuera Crk @ Knoxville Rd (above Lake Berryessa)		0.14	0.06		0.00
221	Maxwell Crk @ Pope Canyon Rd		0.16	0.12		0.00
222	Pope Crk @ Pope Canyon Rd			0.04		0.00
223	Capell Crk @ HWY 128			0.08		0.00
224	Green Valley Crk @ Green Valley Rd		0.14	0.06		0.00
225	Lone Tree Crk @ Bird Rd		4.43	0.34		0.00
226	Logan Creek at Rd 60		0.34	0.08		0.00