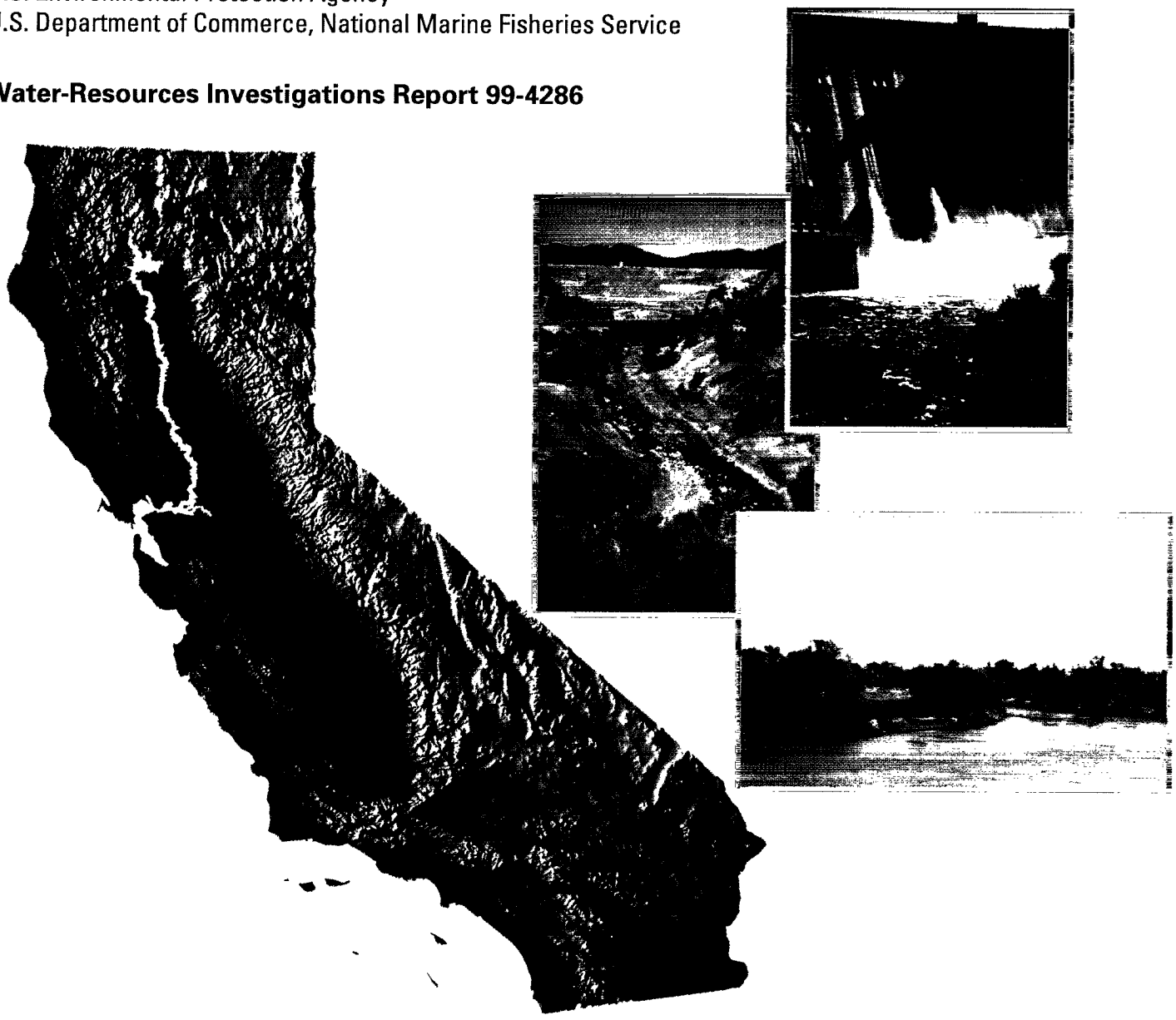
Metals Transport in the Sacramento River, California, 1996–1997

Volume 1: Methods and Data

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
Sacramento Regional County Sanitation District
California State Water Resources Control Board
U.S. Environmental Protection Agency
U.S. Department of Commerce, National Marine Fisheries Service

Water-Resources Investigations Report 99-4286



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Volume 1: Methods and Data

Charles N. Alpers, Howard E. Taylor, *and*
Joseph L. Domagalski, editors

U.S. GEOLOGICAL SURVEY

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U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

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Charles G. Groat, Director

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For additional information write to:

District Chief
U.S. Geological Survey
Water Resources Division
Placer Hall
6000 J Street
Sacramento, California 95819-6129

Copies of this report can be purchased from:

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FOREWORD

The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policymakers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission.

One of the greatest challenges faced by water-resources scientists is acquiring reliable information that will guide the use and protection of the Nation's water resources. That challenge is being addressed by Federal, State, interstate, and local water-resource agencies and by many academic institutions. These organizations are collecting water-quality data for a host of purposes that include: compliance with permits and water-supply standards; development of remediation plans for specific contamination problems; operational decisions on industrial, wastewater, or water-supply facilities; and research on factors that affect water quality. An additional need for water-quality information is to provide a basis on which regional- and national-level policy decisions can be based. Wise decisions must be based on sound information. As a society we need to know whether certain types of water-quality problems are isolated or ubiquitous, whether there are significant differences in conditions among regions, whether the conditions are changing over time, and why these conditions change from place to place and over time. The information can be used to help determine the efficacy of existing water-quality policies and to help analysts determine the need for and likely consequences of new policies.

To address these needs, the U.S. Congress appropriated funds in 1986 for the USGS to begin a pilot program in seven project areas to develop and refine the National Water-Quality Assessment (NAWQA) Program. In 1991, the USGS began full implementation of the program. The NAWQA Program builds upon an existing base of water-quality studies of the USGS, as well as those of other Federal, State, and local agencies. The objectives of the NAWQA Program are to:

- Describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers.
- Describe how water quality is changing over time.
- Improve understanding of the primary natural and human factors that affect water-quality conditions.

This information will help support the development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies to protect, use, and enhance water resources.

The goals of the NAWQA Program are being achieved through ongoing and proposed investigations of 59 of the Nation's most important river basins and aquifer systems, which are referred to as study units. These study units are distributed throughout the Nation and cover a diversity of hydrogeologic settings. More than two-thirds of the Nation's freshwater use occurs within the 59 study units and more than two-thirds of the people served by public water-supply systems live within their boundaries.

National synthesis of data analysis, based on aggregation of comparable information obtained from the study units, is a major component of the program. This effort focuses on selected water-quality topics using nationally consistent information. Comparative studies will explain differences and similarities in observed water-quality conditions among study areas and will identify changes and trends and their causes. The first topics addressed by the national synthesis are pesticides, nutrients, volatile organic compounds, and aquatic biology. Discussions on these and other water-quality topics will be published in periodic summaries of the quality of the Nation's ground and surface water as the information becomes available.

This report is an element of the comprehensive body of information developed as part of the NAWQA Program. The program depends heavily on the advice, cooperation, and information from many Federal, State, interstate, Tribal, and local agencies and the public. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch

Robert M. Hirsch
Chief Hydrologist

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CONVERSION FACTORS, VERTICAL DATUM, ACRONYMS and ABBREVIATIONS, and CHEMICAL NOTATION

Conversion Factors

Multiply	By	To obtain
acre-foot (acre-ft)	1,233	kiloliter
foot per second (ft/s)	0.3048	meter per second
cubic foot per second (ft^3/s)	28.32	cubic liter per second
inch (in.)	2.54	centimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
cubic yard (yd^3)	0.7646	cubic meter

Temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F=1.8(°C)+32.$$

Vertical Datum

Sea level: In this paper, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Acronyms and Abbreviations

(Additional information given in parentheses)

µg, microgram
µg/g, microgram per gram
µg/L, microgram per liter
µm, micrometer
µS/cm, microsiemens per centimeter at 25° Celsius
MΩ-cm, megohm centimeter
σ, sigma

cm, centimeter
cm^2, square centimeter
cP, centipoise
g, gram
g, gravitational constant
g/L, gram per liter
in./yr, inch per year
km, kilometer
km^2, square kilometer
L, liter
L/min, liter per minute
kHz, kilohertz
m, meter
mg, milligram

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mg/g, milligram per gram
mg/L, milligram per liter
mL, milliliter
mm, millimeter
mW, milliwatt
ng, nanogram
ng/L, nanogram per liter
nm, nanometer

Ax, axial
BOR, Bureau of Reclamation
BTD&Q, Branch of Technical Development and Quality Systems
CDEC, California Data Exchange Center
CV–AFS, cold vapor–atomic fluorescence spectrometry
DIFF, diffraction
DL, detection limit
DOC, dissolved organic carbon
EPA, U.S. Environmental Protection Agency
F, fractionation factor
HDPE, high density polyethylene
IC, ion chromatography
ICP–AES, inductively coupled plasma–atomic emission spectrometry
ICP–MS, inductively coupled plasma–mass spectrometry
M, Molar
MPV, most probable value
n, number of observations, number of duplicate samples
N, Normal
NAWQA, National Water-Quality Assessment (Program)
NIST, National Institute of Standards and Technology
NMWL, nominal molecular weight limit
NRP, National Research Program
NWQL, National Water Quality Laboratory
PFA, perfluoroalkoxy
PTFE, polytetrafluoroethylene
PUB, published concentration value for standard reference material
PVC, polyvinyl chloride
QAPP, Quality Assurance Project Plan
QAQC, quality assurance and quality control
REC, percentage recovery
rms, root mean squared
RPD, relative percentage difference
RSD, Relative Standard Deviation
SCDD, Spring Creek Debris Dam
SCPP, Spring Creek Power Plant
SD, standard deviation
SOC, suspended organic carbon
SRM, standard reference material
SRWS, standard reference water sample
TDS, total dissolved solids
USGS, U.S. Geological Survey
UV–vis, ultraviolet–visible spectroscopy
WPPES, Water Pollution Performance Evaluation Study
WSPES, Water Supply Performance Evaluation Study
wt, weight

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Elements

Ag, silver
Al, aluminum
Ar, argon
As, arsenic
Au, gold
B, boron
Ba, barium
Be, beryllium
Bi, bismuth
Br, bromine
C, carbon
Ca, calcium
Cd, cadmium
Ce, cerium
Cl, chlorine
Co, cobalt
Cr, chromium
Cs, cesium
Cu, copper
Dy, dysprosium
Er, erbium
Eu, europium
F, fluorine
Fe, iron
Fe(II), ferrous iron
Fe(III), ferric iron
Gd, gadolinium
H, hydrogen
Hg, mercury
In, indium
Ir, iridium
Ho, holmium
K, potassium
La, lanthanum
Li, lithium
Lu, lutetium
Mg, magnesium
Mn, manganese
Mo, molybdenum
N, nitrogen
Na, sodium
Nd, neodymium
Ni, nickel
O, oxygen
P, phosphorous
Pb, lead
Pr, praseodymium
Rb, rubidium
Re, rhenium
Rh, rhodium

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S, sulfur
Sb, antimony
Se, selenium
Si, silicon
Sm, samarium
Sn, tin
Sr, strontium
Tb, terbium
Te, tellurium
Th, thorium
Ti, titanium
Tl, thallium
Tm, thulium
U, uranium
V, vanadium
W, tungsten
Y, yttrium
Yb, ytterbium
Zn, zinc
Zr, zirconium

Compounds, Ions, and Minerals

Cl^-, chloride
$CaCO_3$, calcium carbonate; calcite (or aragonite)
CO_2, carbon dioxide
$CuFeS_2$, chalcopyrite
F^-, fluoride
FeS_2, pyrite
HBr, hydrobromic acid
HCl, hydrochloric acid
HF, hydrofluoric acid
$HgCl_2$, mercuric chloride
HNO_3, nitric acid
H_2SO_4, sulfuric acid
$K_2Cr_2O_7$, potassium dichromate
MMHg, monomethylmercury (CH_3Hg^+)
N_2, nitrogen gas
NaN_3, sodium azide
$NH_2(CHOH)_3$ HCl, tris hydrochloride
NH_3, ammonia
NO_2^-, nitrite
NO_3^-, nitrate
SiO_2, silica (or quartz)
$SnCl_2$, stannous chloride
SO_4^{2-}, sulfate
(Zn,Fe,Cd)S, sphalerite

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Metals Transport in the Sacramento River, California, 1996–1997. Volume 1: Methods and Data

Charles N. Alpers, Howard E. Taylor, *and* Joseph L. Domagalski, editors

Executive Summary

The overall goal of this study was to determine the significance of contamination from metal sources into the Sacramento River, during a variety of river flow conditions. The main sources investigated were historic mining areas in addition to areas with other land uses including agricultural and urban. Parts of the Sacramento River watershed have been severely affected by historic mining activities. Hard-rock mining of copper, zinc, and lead was done primarily in the vicinity of Shasta Lake, whereas mercury was predominantly mined in the Coast Ranges. Mercury (quicksilver) was used extensively in gold mining and recovery operations, especially at hydraulic placer mines in the Sierra Nevada foothills and the Klamath Mountains but also at mills associated with hardrock mines in both of these areas. This project was funded primarily by the Sacramento Regional County Sanitation District with assistance from a grant administered by the State Water Resources Control Board. Additional funding for the study was made available by the U.S. Environmental Protection Agency, the National Marine Fisheries Service, and the U.S. Geological Survey's Federal–State Cooperative Hydrology Program.

The distribution, fate, and transport of metals in the Sacramento River were studied using a multidisciplinary approach that included water, sediment, and biological sampling. Although the focus of this study was on seven trace metals (aluminum, cadmium, copper, iron, lead, mercury, and zinc), more than 40 additional elements were analyzed in water and sediment samples. Water samples were collected on six occasions during the period July 1996 through June 1997 at up to 19 sites categorized as follows: 11 sites were on the reach of the mainstem Sacramento River between Shasta Dam and Freeport; 7 different tributary sites were sampled; and one distributary site, the Yolo Bypass, was sampled during high-flow conditions. Samples of caddisfly (*Hydropsyche californica*) larvae were collected during October 1996 at 5 mainstem sites between Redding and Tehama, and at 1 tributary stream. Streambed sediment samples were collected during October and November 1996 from 9 sites, including each of the 6 sites where caddisfly larvae samples were taken. Water samples were collected and processed using ultraclean techniques necessary for accurate and precise determination of trace metals with concentrations as low as 0.0004 micrograms per liter. Concentrations of metals from an extremely fine filtering technique called "tangential flow ultrafiltration" (0.005 micrometer equivalent pore size) were compared with concentrations from conventional filtration (0.45- and 0.40-micrometer pore sizes) and unfiltered (whole-water) samples. The tangential-flow filtrates, hereinafter referred to as "ultrafiltrates," are a better approximation of truly dissolved metal concentrations than conventional filtrates because they exclude colloidal particles in the size range of about 0.005 to 0.40 (or 0.45) micrometers that pass through conventional filters.

Colloid concentrates were prepared using the solids that were retained from tangential-flow

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ultrafiltration of large (100 liter) water samples. The water samples were taken during six sampling periods between July 1996 and June 1997 from the following seven sites: below Shasta Dam, below Keswick Dam, at Bend Bridge, at Colusa, at Verona, and at Freeport, all located on the mainstem of the Sacramento River; and the Yolo Bypass at Interstate 80 located near West Sacramento. The Yolo Bypass is part of a flood-control system and carries water only when the channel capacity of the mainstem of the Sacramento River exceeds, or is expected to exceed, its capacity. All colloid concentrates were analyzed for total metals using a complete dissolution procedure. Some colloid concentrates also were subjected to a sequence of partial dissolution steps to determine the concentrations of metals in three operationally defined parts or fractions: (1) reducible (including hydrous iron and manganese oxides), (2) oxidizable (including organic material and sulfides), and (3) residual (remaining after the previous two steps).

Generally, it was found that using the sum of dissolved and colloidal concentrations from ultrafiltrates and retentate (colloid concentrate) samples, rather than using total recoverable analyses of whole-water samples, provided a more definitive way to estimate total water-column concentrations. The total recoverable analyses were affected by more sources of variation than were the analysis of the dissolved plus colloidal concentrations.

Most of the trace metals transported in the Sacramento River between Shasta Dam and Freeport occurred as colloids (operationally defined as particles with grain size between about 0.005 and 1.0 micrometer). In the water column, colloids appeared to be the dominant form of aluminum, iron, lead, and mercury, and are important in the distribution of other trace metals. The percentage of the load that is colloidal compared with the percentage that is dissolved (operationally defined by concentrations in ultrafiltrates as less than about 0.005 micrometer diameter) was higher for copper than it was for zinc and cadmium. This distinction is significant because the relative amounts of colloidal and dissolved metals may influence the rates and mechanisms of metal bioaccumulation (the accumulation of an environmental compound into an organism).

The influence of metal-laden acidic drainage from the Iron Mountain mine site (via Spring Creek and the Spring Creek arm of Keswick Reservoir) is apparent in water samples from the site below Keswick Dam. Historically, California's Basin Plan water-quality standards have been exceeded with respect to copper concentrations at this site (the Basin Plan standard for copper in this area is 5.6 micrograms per liter, which is based on a hardness of 40 milligrams per liter). Occasional exceedances of copper concentration standards in the Basin Plan continued during January 1997 despite the ongoing operation of a lime neutralization plant at Iron Mountain, which has removed about 80 percent of copper loads and about 90 percent of zinc and cadmium loads from Spring Creek since July1994. In mid-December 1996, conventionally filtered samples had copper concentrations that ranged from 4.6 to 5.1 micrograms per liter and zinc concentrations that ranged from 6 to 9 micrograms per liter. During flood conditions in early January 1997, conventionally filtered copper concentrations were 4 to 9 micrograms per liter and zinc concentrations were 9 to 16 micrograms per liter. With regard to transport of the these metals below Keswick Dam, copper concentrations in ultrafiltrates were about 40 to 70 percent lower than conventional filtrates (0.40- and 0.45-micrometer) and zinc concentrations were 10 to 50 percent lower, indicating that both copper and zinc are transported as both colloidal and dissolved forms.

Lead isotope data in colloid concentrates and streambed sediments provide a useful fingerprint or natural tracer for lead contamination from Iron Mountain mine drainage via Spring Creek and Keswick Reservoir. Lead isotope data for streambed sediments and suspended colloid samples taken during 1996 and 1997 indicate that contamination from Iron Mountain was (1) a relatively major component of the total lead found at Sacramento River sites at Rodeo Park (in

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Redding) and above Churn Creek (near Anderson), (2) less of a component of the lead found at Balls Ferry, and (3) a relatively minor component of the lead in colloids and streambed sediment at Bend Bridge (near Red Bluff) and at sites farther downstream.

The geochemical forms of metals in colloid concentrates from the Sacramento River were evaluated using a sequence of partial dissolution steps. During May–June 1997, cadmium was predominantly associated with the reducible (or iron–manganese oxide) fraction at all mainstem sampling sites, whereas copper and zinc were more or less evenly distributed between reducible and residual (or refractory) fractions at all sites with a small amount present in the oxidizable (or organic plus sulfide) fraction. These results are consistent with the data on caddisfly bioaccumulation, which indicate that cadmium is likely more bioavailable on a relative basis than copper or zinc in the Sacramento River between Redding and Tehama.

In addition to water and sediment concentrations, selected trace elements were examined in relation to their bioavailability. Bioaccumulation of metals in caddisfly larvae was assessed at five sites in the Sacramento River between Redding and Tehama and at one site less impacted by mining (Cottonwood Creek near Cottonwood). Samples were taken in October 1996. Cadmium concentrations in caddisfly larvae at Sacramento River sites were 5 to 36 times greater than concentrations at the Cottonwood Creek site. Cadmium concentrations of the whole body ranged from 0.7 to 2.2 micrograms per gram, dry weight. Of this total, approximately 60 percent (0.4 to 1.3 micrograms cadmium per gram, dry weight) was associated with the cell cytosol, an intracellular fraction that is indicative of metal bioavailability. Concentrations of cadmium in caddisfly larvae from the Sacramento River are comparable with other areas severely impacted by mining. Concentrations of copper and zinc also showed some enrichment in caddisfly whole-body samples and cytosol fractions; copper and zinc concentrations at Sacramento River sites were 1.4 to 3.0 times greater than concentrations at Cottonwood Creek near Cottonwood. The caddisfly data indicate that bioavailable forms of cadmium persist in the Sacramento River downstream of Tehama.

Exceedances of levels of mercury—with respect to the U.S. Environmental Protection Agency (EPA) water-quality criterion (12 nanograms per liter)—are common in northern California during the winter and especially following significant rainfall. The concentrations of total mercury in the Sacramento River increased during storm water runoff and were above the EPA water-quality criterion during high flows in December 1996 and January 1997, from the Bend Bridge site (located near Red Bluff) downstream to Freeport. Dissolved mercury concentrations were low and relatively constant under different flow conditions, but combined concentrations of dissolved and colloidal mercury were found to increase with discharge and with suspended sediment transport. This implies that most mercury transported in the Sacramento River is colloidal in form. Using a sequence of dissolution steps with specific chemical reagents, it was shown that most of the colloidal mercury was in the oxidizable and residual fractions, whereas only a minor component was found in the reducible colloid fraction. The implications of the occurrence of mercury in predominantly oxidizable and colloidal forms are currently unknown and warrant further investigation in the context of mercury methylation processes.

Abstract

Metals transport in the Sacramento River, northern California, was evaluated on the basis of samples of water, suspended colloids, streambed sediment, and caddisfly larvae that were collected on one to six occasions at 19 sites in the Sacramento River Basin from July 1996 to June 1997. Four of the sampling periods (July, September, and November 1996; and May–June 1997) took place during relatively low-flow conditions and two sampling periods (December 1996 and January 1997) took place during high-flow and

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flooding conditions; respectively. Tangential-flow ultrafiltration with 10,000 nominal molecular weight limit, or daltons (0.005 micrometer equivalent), pore-size membranes was used to separate metals in streamwater into ultrafiltrate (operationally defined dissolved fraction) and retentate (colloidal fraction) components, respectively. Conventional filtration with capsule filters (0.45 micrometer pore-size) and membrane filters (0.40 micrometer pore-size) and total-recoverable analysis of unfiltered (whole-water) samples were done for comparison at all sites. Because the total-recoverable analysis involves an incomplete digestion of particulate matter, a more reliable measurement of whole-water concentrations is derived from the sum of the dissolved component that is based on the ultrafiltrate plus the suspended component that is based on a total digestion of colloid concentrates from the ultrafiltration retentate. Metals in caddisfly larvae were determined for whole-body samples and cytosol extracts, which are intercellular solutions that provide a more sensitive indication of the metals that have been bioaccumulated.

Trace metals in acidic, metal-rich drainage from abandoned and inactive sulfide mines were observed to enter the Sacramento River system (specifically, into both Shasta Lake and Keswick Reservoir) in predominantly dissolved form, as operationally defined using ultrafiltrates. The predominant source of acid mine drainage to Keswick Reservoir is Spring Creek, which drains the Iron Mountain mine area. Copper concentrations in filtered samples from Spring Creek taken during December 1996, January 1997, and May 1997 ranged from 420 to 560 micrograms per liter. Below Keswick Dam, copper concentrations in conventionally filtered samples ranged from 0.5 micrograms per liter during September 1996 to 9.4 micrograms per liter during January 1997; the latter concentration exceeded the applicable water-quality standard. The proportion of trace metals that was dissolved (versus colloidal) in samples collected at Shasta and Keswick dams decreased in the order cadmium ≈ zinc > copper > aluminum ≈ iron ≈ lead ≈ mercury. At four sampling sites on the Sacramento River at various distances downstream of Keswick Dam (Bend Bridge, 71 kilometers; Colusa, 256 kilometers; Verona, 360 kilometers; and Freeport, 412 kilometers) concentrations of these seven metals were predominantly colloidal during both high- and low-flow conditions.

Because copper compounds are used extensively as algaecides in rice farming, agricultural drainage at the Colusa Basin Drain was sampled in June 1997 during a period shortly after copper applications to newly planted rice fields. Copper concentrations ranged from 1.3 to 3.0 micrograms per liter in filtered samples and from 12 to 13 micrograms per liter in whole-water samples (total recoverable analysis). These results are consistent with earlier work by the U.S. Geological Survey indicating that copper in rice-field drainage likely represents a detectable, but relatively minor source of copper to the Sacramento River.

Lead isotope data from suspended colloids and streambed sediments collected during October and November 1996 indicate that lead from acid mine drainage sources became a relatively minor component of the total lead at the site located 71 kilometers downstream of Keswick Dam and beyond. Cadmium, copper, and zinc concentrations in caddisfly larvae were elevated at several sites downstream of Keswick Dam, but concentrations of aluminum, iron, lead, and mercury were relatively low, especially in the cytosol extracts. Cadmium showed the highest degree of bioaccumulation in whole-body and cytosol analyses, relative to an unmineralized control site (Cottonwood Creek). Cadmium bioaccumulation persisted in samples collected as far as 118 kilometers downstream of Keswick Dam, consistent with transport in a form more bioavailable than lead.

Introduction

Charles N. Alpers

Contamination of surface waters by metals can cause harmful effects to aquatic ecosystems and human health. In the Sacramento River drainage basin

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of northern California (fig. 1), metal contamination is a major concern, yet the sources, transport, and fate of metals in this basin remain poorly known. Water-quality problems with copper (Cu), cadmium (Cd), and zinc (Zn) have been known for many years near Redding, where large amounts of these metals flow into the Sacramento River system from acid mine drainage associated with inactive mines at Iron Mountain and other sources in the area (U.S. Environmental Protection Agency, 1992). Copper, cadmium, and zinc are also of concern in the San Francisco Bay and Sacramento–San Joaquin Delta (herinafter referred to as the Bay–Delta), yet the proportion of metals transported to the Bay–Delta by way of the Sacramento River that comes from Iron Mountain Mine and other mineralized areas in the East Shasta and West Shasta mining districts has not been demonstrated. Mercury (Hg) concentrations in water and biota, particularly fish, are major environmental and human health concerns in the lower reaches of the Sacramento River and in the Bay–Delta, however the sources and chemical forms of mercury transported in the Sacramento River remain largely undetermined.

This report presents the results of a U.S. Geological Survey (USGS) study of metals transport in the reach of the Sacramento River between Shasta Dam and Freeport (fig. 1). The study was designed to complement ongoing studies of water quality in the Sacramento River Basin being carried out by the USGS's National Water-Quality Assessment (NAWQA) Program. The overall goals and conceptual design of the NAWQA Program were described by Hirsch and others (1988). Detailed description of the NAWQA Sacramento River Basin study unit is given in the next section of this report. Results of the NAWQA Sacramento River Basin study will be published separately from this report, which is designed to document the results of additional studies of metals transport that were beyond the original scope of the NAWQA investigation.

Routine protocols for sampling and sample processing in the NAWQA Program, and routine laboratory analysis for trace metals at the USGS's National Water Quality Laboratory (NWQL) are designed for a reporting limit of 1 µg/L for most metals. The advent of the USGS "part per billion" protocol for water sampling (Horowitz and others, 1994) represented a significant improvement over previous approaches; however, it was deemed inadequate in addressing critical trace metal issues in the Sacramento Basin. For this study, a more rigorous set of ultratrace protocols were adopted largely on the basis of methods developed by USGS researchers involved with a comprehensive study of trace metal transport in the Mississippi River (Taylor and Shiller, 1995; Taylor and others, 1995; Meade, 1996). Similar protocols also have been used in USGS studies of metals transport in the Arkansas River (Kimball and others, 1995) and elsewhere. Using triple-distilled acids, double-deionized water, precleaned sampling containers, and other precautions combined with state-of-the-art laboratory equipment such as a new generation of inductively coupled plasma–mass spectrometry (ICP–MS) instruments, reporting limits of less than 0.05 µg/L were achieved for many trace metals.

The overall objectives of the Sacramento River metals transport study were to determine the distribution and fate of metals from a known source, namely base-metal mines in the upper part of the watershed near Keswick Dam, and to determine if other sources such as agricultural and urban runoff were major contributors to base-metal loading under different flow conditions. The approach taken was multidisciplinary, involving collection and analysis of water, sediment, and biota. Water samples were taken at 6 to 11 sites during six sampling periods between July 1996 and June 1997, spanning a range of hydrologic conditions. Sample sites were chosen at or near active gaging stations so that discharge data would be available for calculation of metal loads. Streambed sediment and biota (caddisfly larvae) were sampled once at nine and six sites, respectively. To evaluate the importance of colloidal transport of metals, concentrations and loadings of metals were determined from the total recoverable analysis of whole-water samples and the various filtrates and ultrafiltrates of the water. Colloid concentrates were prepared using ultrafiltration and were analyzed for total metals as well as metal speciation using sequential extraction procedures that differentiated three operationally defined geochemical fractions: reducible (iron–manganese oxides), oxidizable (sulfides and organics), and residual (refractory).

This report is organized into several sections, each of which describes a critical aspect of the study. Following this Introduction, the second section contains a description of the Sacramento River Basin, with an overview of surface hydrology, physiography, and land use, plus a summary of the study unit design of the NAWQA Sacramento River Basin investigation. The third section describes the design of the metals

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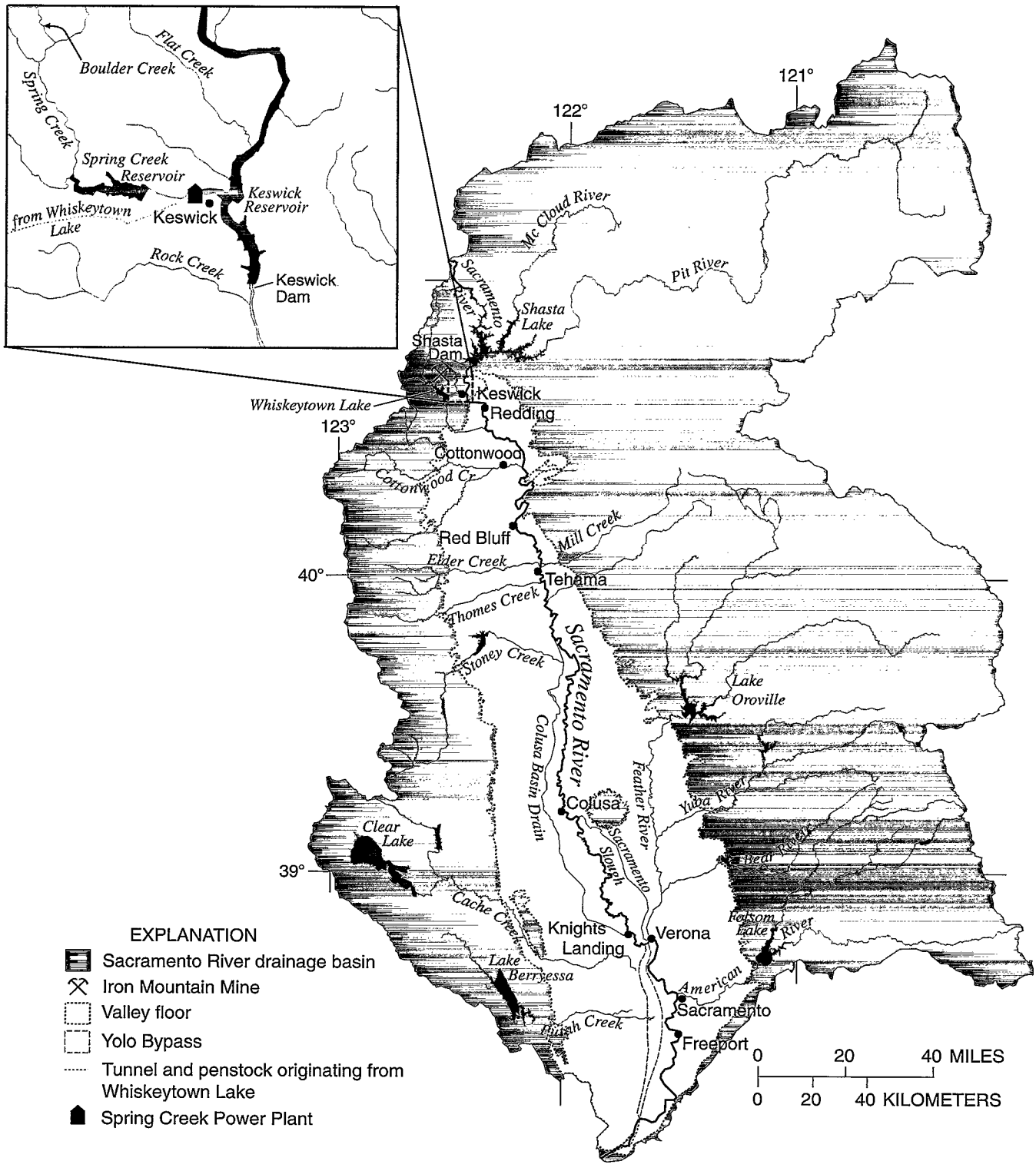

Figure 1. Map of the Sacramento River Basin, California.

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transport study, including descriptions of sampling methods, analytical procedures, quality assurance and quality control procedures, and data analysis techniques. The fourth section presents a summary of the results of quality assurance and quality control procedures with reference to data quality objectives as described in the Quality Assurance Project Plan, which is included as Appendix 1. The fifth section includes a description of the results of the study, divided into analysis of water, sediment, and biological samples, with emphasis on concentrations of the trace metals of principal concern: cadmium, copper, mercury, lead (Pb), and zinc. The final section of the report presents conclusions based on the results of this study. Metal loadings, sources, and implications of the results of this study to future water-quality management in the Sacramento River Basin are discussed in a companion report (Alpers and others, 2000). The distribution, transport, and loads of mercury in the Sacramento River Basin are discussed in a manuscript by David A. Roth and others (U.S. Geological Survey, written commun., 1999). Results from caddisfly sampling and analysis are described in detail by Cain and others (2000).

Other appendixes to this report include extensive tables of data, including analytical results and sup-porting quality assurance information. Appendixes 2 through 7 contain tables with the basic data resulting from this study. Appendix 2 contains tables of data relating to quality assurance and quality control for the chemical analyses in this study, including results of analysis of standard reference materials and blanks. Appendix 3 contains tables of data for unstable water-quality indices measured in the field, plus analytical data for major anions, nutrients, and organic carbon and information on sample site locations. Appendix 4 contains tables of metal concentrations in filtered and unfiltered (whole) water samples collected at study sites from July 1996 to June 1997. Appendix 5 presents tables of metal concentrations in sediment and colloids. Appendix 6 contains tables of data showing particulate size distribution in colloid con-centrates and streambed sediment samples. Appendix 7 presents tables of trace-element data for caddisfly larvae collected in October 1996. Appendix 8 contains plots of dissolved and colloidal metal concentrations.

The authors thank the numerous individuals at USGS and other agencies who made this study possible through their hard work and cooperation. USGS hydrologic technicians and other field personnel included: Steve Gallanthine, Michael Hunerlach, Mark Johnson, Willie Kinsey, Frank Moseanko, Cathy Munday, and Darnella Murphy. We also appreciate several other USGS employees who helped contribute to the project: in Tucson, Arizona, David Graham; in Sacramento, California: D'An Brent, Susan Davis, Yvonne Gobert, Glenn Schwegmann, and David Uyematsu; in Boulder, Colorado: George Aiken, D. Kirk Nordstrom, Dale Peart, and Robert Stallard; in Menlo Park, California: James Carter, Steven Fend, and Samuel Luoma; and in Bethesda, Maryland, Michael Koterba. In the Redding and Shasta areas, several employees of the Bureau of Reclamation provided assistance during sample collection, including Stuart Angerer, Sean Duffy, and Janet Martin. We thank Rosemary Clark, Mary James, Robert Seyfried, Jerry Troyan, and their colleagues at the Sacramento Regional County Sanitation District for help in securing funds for this effort and for useful suggestions during its execution, and Greg Frantz at the California State Water Resources Control Board for his administrative assistance on the 205(j) grant. We also thank Nicolas Iadanza at the National Marine Fisheries Service (Department of Commerce) for his assistance with funding for the caddisfly work, and Richard Sugarek at the U.S. Environmental Protection Agency (EPA) for arranging funding though the EPA Superfund Program to add sampling sites in the Spring Creek area. We also thank the members of the Project's Technical Advisory Committee who provided comments on the report: Ronald Churchill of the California Department of Conservation, Division of Mines and Geology, and Dennis Heiman of the Regional Water Quality Control Board, Central Valley Region.

Description of the Sacramento River Basin and Ongoing Studies

Joseph L. Domagalski, Peter D. Dileanis, Donna L. Knifong, *and* Charles N. Alpers

This section provides an overview of the geographic setting in the Sacramento River Basin and a brief description of other ongoing studies in the area. The geographic setting of the basin is described in

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terms of its surface-water hydrology, physiography, and land use patterns.

Surface-Water Hydrology

The Sacramento River drainage basin (fig. 1) covers approximately 27,000 mi^2 (70,000 km^2) in northern California. The total length of the Sacramento River is 327 mi (526 km). The annual runoff averages 16,960,000 acre-ft/yr (Anderson and others, 1997) making it the largest river in the state of California. The river is of utmost importance to the economy of California, providing irrigation water to farms in the Sacramento and San Joaquin Valleys, drinking water to cities in northern and southern California, and most of the freshwater flow to the San Francisco Bay. The annual discharge of the Sacramento River is partly dependent on the amount of snowpack in the mountainous regions of the basin and stormwater runoff throughout the basin. Because of the variable amounts of snowpack and the destruction caused by floods in low-lying areas, reservoirs have been constructed to store water. These reservoirs were built with the intention of providing a more stable source of water for various uses and for flood control. The largest of these, Shasta Lake (fig. 1), was constructed between 1938 and 1944 by the federal government. The capacity of Shasta Lake is 4,552,000 acre-ft. Lake Oroville (fig. 1) is the second largest reservoir in California with a capacity of 3,537,600 acre-ft. Lake Oroville is on the Feather River and was completed in 1968 by the state of California. Reservoirs have also been constructed on many of the other tributaries to the Sacramento or Feather Rivers, especially within the Sierra Nevada drainage. Nearly all of the major rivers draining the Sierra Nevada and the Coast Ranges on the west side of the basin are regulated by some type of dam or control structure.

Flow on the Sacramento River is affected by reservoir releases, runoff, irrigation drainage, and flood control. Reservoir releases are set by resource managers who need to balance the capacity of reservoirs for flood control and to supply water for irrigation, urban, and environmental needs. The amount of water allocated to irrigation, urban, environmental needs, and other uses is determined in part by reservoir storage. The principal environmental needs involve controlling salinity in the Bay–Delta, meeting temperature requirements for migratory fishes, and controlling metals concentrations below Keswick Dam (fig. 1), which was completed by the federal government in 1950. The principal environmental use of water for wildlife habitat requirements is the discharge of sufficient fresh water to meet salinity criteria within the lower Sacramento River and parts of the San Francisco Bay–Delta estuary. Another important environmental constraint is to provide sufficient water at the proper temperatures for migratory fishes. As an example of the importance of this factor, the Bureau of Reclamation recently completed (in May 1997) construction of a temperature control device on Shasta Dam, at a cost of about $83,000,000, that allows water to be released from different elevations in Shasta Lake (California Department of Water Resources, 1998c).

The principal known input of metals downstream of Shasta Dam is Spring Creek (fig. 1), which receives metal-laden acidic drainage from the inactive copper–zinc mines at Iron Mountain. The Spring Creek Debris Dam (SCDD) was constructed in 1963 by the Bureau of Reclamation for the joint purpose of controlling metal pollution from Spring Creek and to prevent sediment and debris from interfering with the tailrace from the Spring Creek Power Plant (U.S. Environmental Protection Agency, 1992). Water is released from the SCDD in one or two locations depending on the amount of discharge. Discharge less than about 700 ft^3/s is made from gates within the dam; discharge above this amount is made either entirely over the SCDD spillway or in some combination of flow from the gates and over the spillway. The amount of discharge is controlled by the Bureau of Reclamation so that, below Keswick Dam, certain water-quality objectives for metals are met according to a 1980 Memorandum of Understanding between the Bureau of Reclamation (then the U.S. Water and Power Resources Services), the California Department of Fish and Game, and the California State Water Resources Control Board (U.S. Environmental Protection Agency, 1992). When the amount of water in Spring Creek Reservoir exceeds 5,000 acre-ft (or about 86 percent of capacity), there is the potential for an uncontrolled spill. Under those conditions, water may be needed from Shasta Lake or Whiskeytown Lake to dilute metal concentrations. Water from Whiskeytown Lake is supplied through the Spring Creek Power Plant.

The maximum probable impact scenario, insofar as impact on fresh-water resources, is when a wet year follows a dry year. For example, in 1992–1993, dilution water was needed for an early season storm

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that caused an uncontrolled spill from Spring Creek Reservoir at a time when Shasta Lake was relatively empty. During January 1993, approximately 100,000 acre-ft of water was released from Shasta Lake at a time of year when this water could not be recaptured downstream during a year when farmers did not receive their full allotment of irrigation water (Richard Sugarek, U.S. Environmental Protection Agency, oral commun., 1994). Metal-laden, acidic water from Spring Creek mixes with dilute water from Whiskeytown Lake (released from the Spring Creek Power Plant) in the Spring Creek arm of Keswick Reservoir (fig. 1). Neutralization of the acidic water upon dilution in this mixing zone has caused extensive precipitation of hydrous iron and aluminum oxides, some of which flocculate and settle in the Spring Creek arm (Nordstrom and others, 1999) and some of which remain in suspension and are transported into the main channel of Keswick Reservoir. From Keswick Reservoir, these metals may be transported downstream of Keswick Dam in the Sacramento River.

Agricultural use of water is the highest single category of use in the Sacramento River Basin. In 1990, for example, agriculture accounted for 58 percent of the water use in the basin and environmental needs accounted for 32 percent (California Department of Water Resources, 1993). Urban and other uses accounted for the remaining 10 percent of the allocations. Stormwater runoff or snowmelt takes place in late fall through spring in response to rain in the lowland areas and snowmelt in the mountains. Irrigation water is supplied by reservoir releases or ground water pumping from late March to September. Irrigation runoff is an important component of flow in the summertime. Two drains that discharge a considerable volume of irrigation runoff are the Colusa Basin Drain and the Sacramento Slough (fig. 1).

Flood control efforts have significantly changed the channel morphology and flow characteristics of the Sacramento River. Because of recurring flooding, especially in urbanized areas such as Sacramento, the Sacramento River channel has been modified to accommodate high flow or to divert water out of the main channel. Channel modifications include artificial levees. Flow control is partly accomplished by a series of weirs that remove water from the main channel and divert that flow onto agricultural land. The flow is routed to a region called the Yolo Bypass, at a point just upstream of the Sacramento River at Verona (fig. 1). Water discharges to the Fremont Weir when flow exceeds 55,000 ft^3/s on the Sacramento River at Verona. It is necessary to take water out of the river at that location because of decreasing channel capacity downstream. That water is then diverted to the San Francisco Bay–Delta Estuary. Water may also be taken out of the Sacramento River at Sacramento and diverted to the Yolo Bypass.

In the upper part of the basin, the mean annual discharge of the Sacramento River above Bend Bridge near Red Bluff is 12,790 ft^3/s for the period of record from 1964 to 1996 (Anderson and others, 1997). The mean annual discharge of the Sacramento River at Colusa is 11,460 ft^3/s for the period of record from 1946 to 1996 (Anderson and others, 1997). The mean annual discharge for the Sacramento River at Verona increases to 19,620 ft^3/s for the same period of record. The mean annual discharge of the Sacramento River at Freeport, in the lower part of the basin, is 23,410 ft^3/s for the period of record from 1949 to 1996 (Anderson and others, 1997). The Feather River is the largest tributary to the Sacramento River. The mean annual discharge of the Feather River near Gridley, which is located downstream of Lake Oroville, is 4,852 ft^3/s for the period of record from 1969 to 1996 (after the completion of the dam on Lake Oroville). The Yuba River is the largest tributary to the Feather River and has a mean annual discharge of 2,372 ft^3/s for the site at Marysville for the period of record from 1970 to 1996. The other large tributary to the Sacramento River is the American River, which has a mean annual discharge of 3,715 ft^3/s (just below Folsom Lake) for the period of record from 1956 to 1996. The dam on Folsom Lake was completed in 1955.

Hydrographs during the study period (July 1996–June 1997) for several of the sampling sites used in this study are shown in figure 2*A* through 2*I*. The 1996–1997 water year was characterized by a major flooding event in late December 1996 and early January 1997 that severely affected the Central Valley of California, particularly along the Yuba, Feather, Cosumnes, and Mokelumne Rivers, which experienced numerous (approximately 30) failed levees (Hunrichs and others, 1998). Several feet of snowfall in the Sierra Nevada in mid-to-late December was followed by several inches of warm rain that melted the previously accumulated snow, causing torrential runoff in some areas that experienced events in excess of the "100-year flood." In the northern end of the Sacramento Valley, the rainfall and streamflow patterns were less anomalous. For example, during

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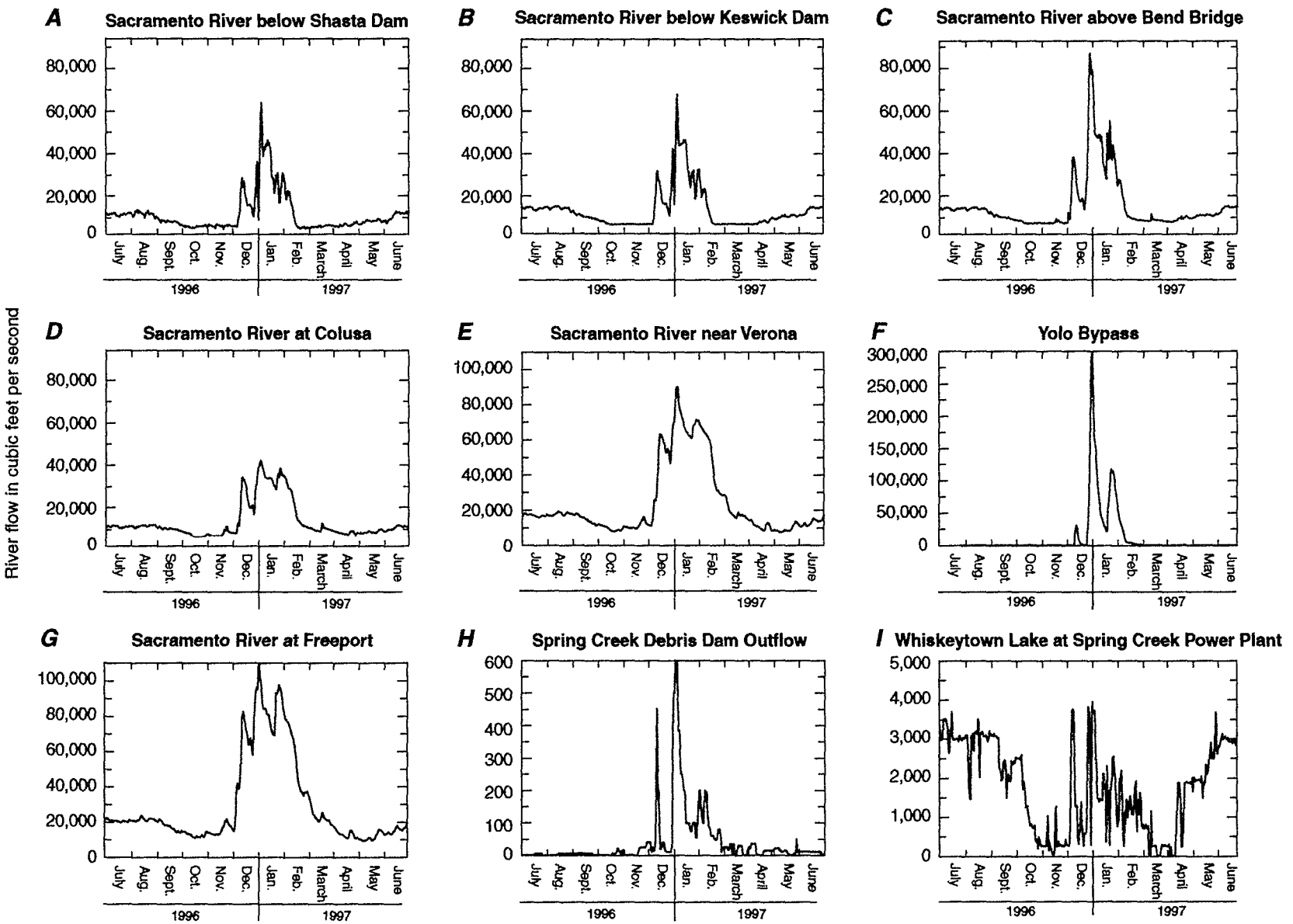

Figure 2. Hydrographs showing daily mean discharge for the period July 1, 1996, to June 30, 1997, for nine sites in the Sacramento River Basin, California. California Department of Water Resources (1998a) for *A*; California Department of Water Resources (1998b) for *B*; U.S. Geological Survey (1998) for *C*, *D*, *E*, *F*, and *G*; and Bureau of Reclamation (1998, written communication) for *H* and *I*.

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early January 1997, peak flows at 17 gaged stations on streams in Shasta County and Tehama County had recurrence intervals ranging from 2 to 61 years with a median of 21 years (Hunrichs and others, 1998). In contrast, numerous streams in the southern part of the study area had peak flows corresponding to 1-in-100 year events or more (Hunrichs and others, 1998). For example, 18 gaged streams in El Dorado County (in the American River watershed) had peak flows with recurrence intervals that ranged from 3 to 270 years with a median of 98 years. Flows from Shasta and Keswick dams were held back markedly in early January to minimize downstream flooding.

Discharge data from several gaging stations and dams in the study area are plotted as daily mean discharges in figure 2. The data from Shasta and Keswick dams are from the Bureau of Reclamation, or BOR (California Department of Water Resources, 1998a,b). Hydrographs for the Sacramento River gaging stations at Bend Bridge, Colusa, Verona, and Freeport, and for the Yolo Bypass are based on published data from the USGS (U.S. Geological Survey, 1998). The data for the Spring Creek Debris Dam outflow and the Whiskeytown Lake discharge through the Spring Creek Power Plant were provided by the BOR (Valerie Ungvari, Bureau of Reclamation, written commun., March 12, 1998).

Monthly rainfall data during 1996–1997 at Shasta Dam, Redding, and Sacramento are compared with long-term monthly average rainfall data in figure 3 (National Oceanic and Atmospheric Administration, 1996, 1997a–f). Despite their proximity, there is generally higher annual rainfall at Shasta Dam (61 in./yr) compared with Redding (33.5 in./yr). This difference was even greater in the data from the 1996–1997 water year. For example, in December 1996, Shasta Dam had about three times as much rainfall as Redding. The rainfall data (fig. 3) show that the 1996–1997 water year was characterized by much higher than normal rainfall in the early part of the wet season (December and January), followed by much lower than normal rainfall during February through April. Despite the extensive flooding in many parts of the Sacramento River Basin, the 1996–1997 water year ended up close to average with regard to total precipitation in many areas because there was very little if any rain from mid-January to May, during what is normally a very wet period.

Physiography

The Sacramento River drainage basin can be divided into seven regions that are based on physiography (fig. 4). These physiographic provinces are largely based on geologic factors, including rock types and tectonic setting. The provinces are the Sacramento Valley, the Klamath Mountains, the Coast Ranges, the Modoc Plateau, the Cascade Mountains, the Sierra Nevada, and the Sacramento–San Joaquin Delta. The Sacramento Valley and the Sacramento–San Joaquin Delta are the low-lying parts of the basin. For a more complete description of the geology of these zones, the reader is referred to reports by Bailey (1966) and by Norris and Webb (1990).

Land Use

The major land uses in the Sacramento River Basin are agriculture, forestry, urban development, and mining. Mining is discussed in greatest detail in this report because of the potential for water quality degradation from acid-mine drainage and the potential for mercury transport from mercury and gold (Au) mines.

Mining

Metals have been mined from locations in the Klamath Mountains, the Sierra Nevada, and the Coast Ranges provinces. The West Shasta mining district, located in the Klamath Mountains near Shasta Lake, contains several massive sulfide copper–zinc deposits with historic production. The massive sulfide deposits consist of millions of tons of the minerals chalcopyrite ($CuFeS_2$), sphalerite [(Zn,Fe,Cd)S], and pyrite (FeS_2) hosted by hydrothermally altered volcanic rocks with minimal capacity for neutralization of sulfuric acid (H_2SO_4) solutions formed during weathering. These metal deposits formed during the Devonian Period (approximately 400 million years ago) when sulfide minerals were deposited from sea-floor vents presumably analogous to active "black smokers" found at mid-ocean ridges and in back-arc basins (Morton and others, 1994; Barrie and Hannington, 1999). Mine wastes and acid discharges from historic mining of these massive sulfide deposits has resulted in acid mine drainage that has caused extreme metal contamination in several northern California streams, including Boulder Creek, Slickrock Creek, Spring

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Creek, Little Backbone Creek, and West Squaw Creek (Nordstrom and others, 1977).

Gold was also mined in the Klamath Mountains; this province is second only to the Sierra Nevada for gold production in California (Norris and Webb, 1990). Placer gold was recovered from modern and ancient stream deposits both in the Klamath Mountains and the Sierra Nevada. "Lode" gold (or hardrock) also was mined both in the Klamath Mountains and in the Sierra Nevada foothills region, known as the Mother Lode. At least 107 million ounces of gold have been recovered from the Mother Lode (Norris and Webb, 1990). From the 1849 gold rush until the early 1900s, the dominant process used for gold recovery was mercury amalgamation (Bradley, 1918). The mercury used for gold processing was mined in the Coast Ranges of California. Residual mercury from gold processing operations has contaminated streambed sediments within the Sierra Nevada and downstream locations (Hunerlach and others, 1999). Elevated mercury concentrations in benthic invertebrates and fish have been shown in some Sierra Nevada streams (Slotton and others, 1997a) and in the Cache Creek watershed, which is heavily impacted by mercury mining and processing activities (Slotton and others, 1997b).

The location of mines in these different physiographic zones relates to the potential for trace metal transport from past or present mining operations, or from natural sources, such as springs, associated with the mineralized areas. The locations of historic copper, lead, and zinc mines are shown in figure 5, and the locations of gold and mercury mines are shown in figure 6.

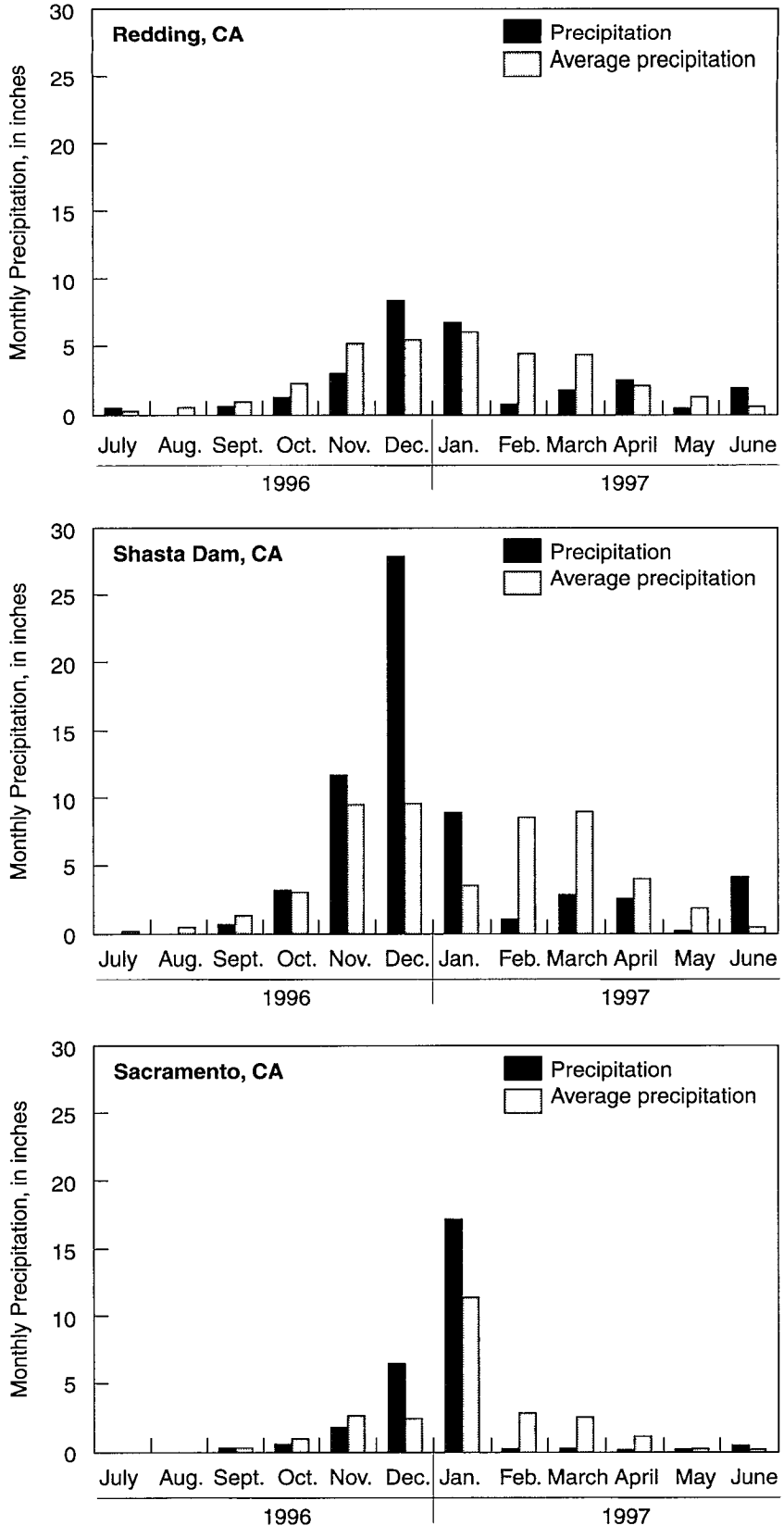

Figure 3. Histograms showing monthly precipitation for the period July 1996 to June 1997 and long-term monthly averages for three sites in the Sacramento River Basin, California.

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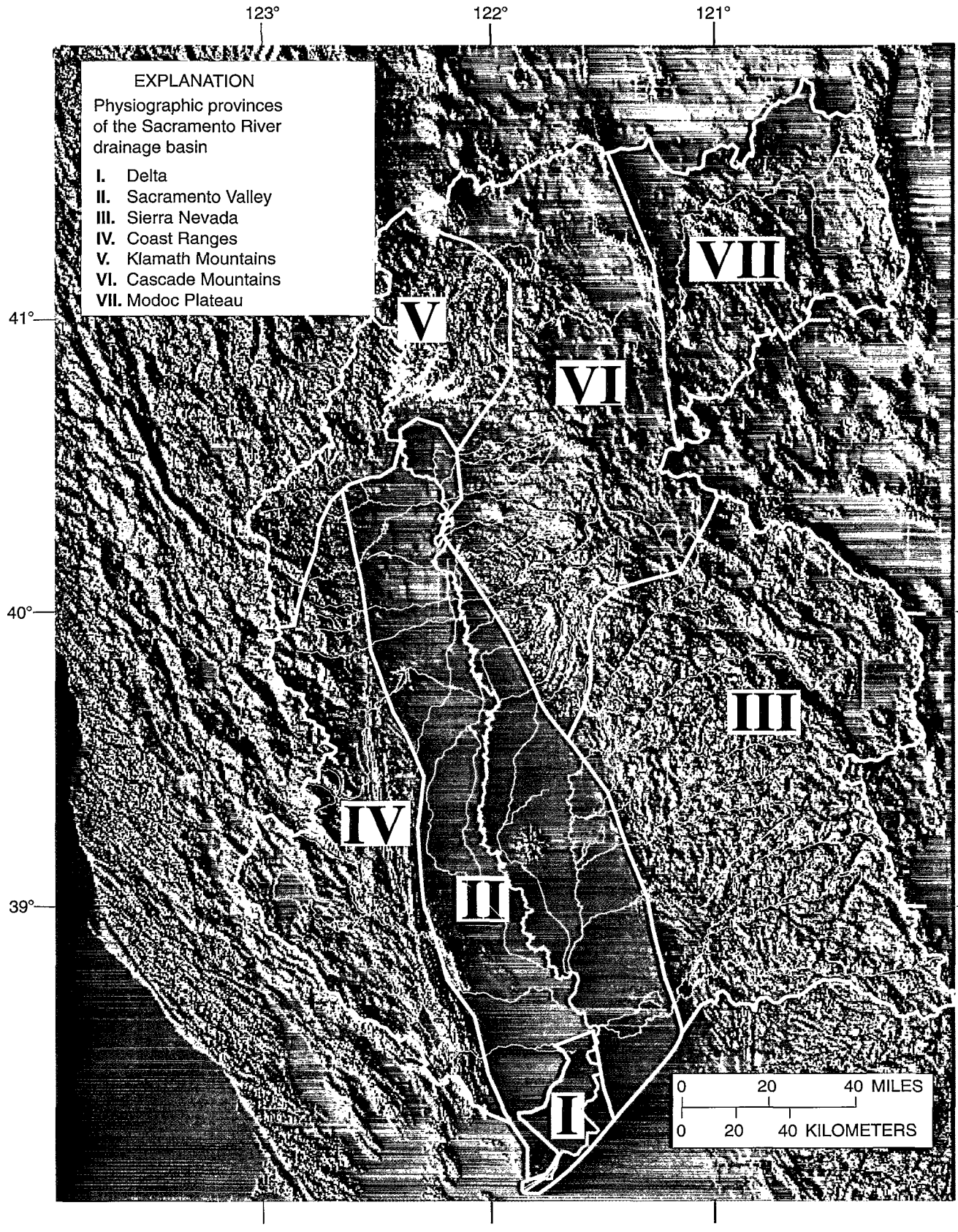

Figure 4. Map of physiographic provinces for the Sacramento River Basin, California.

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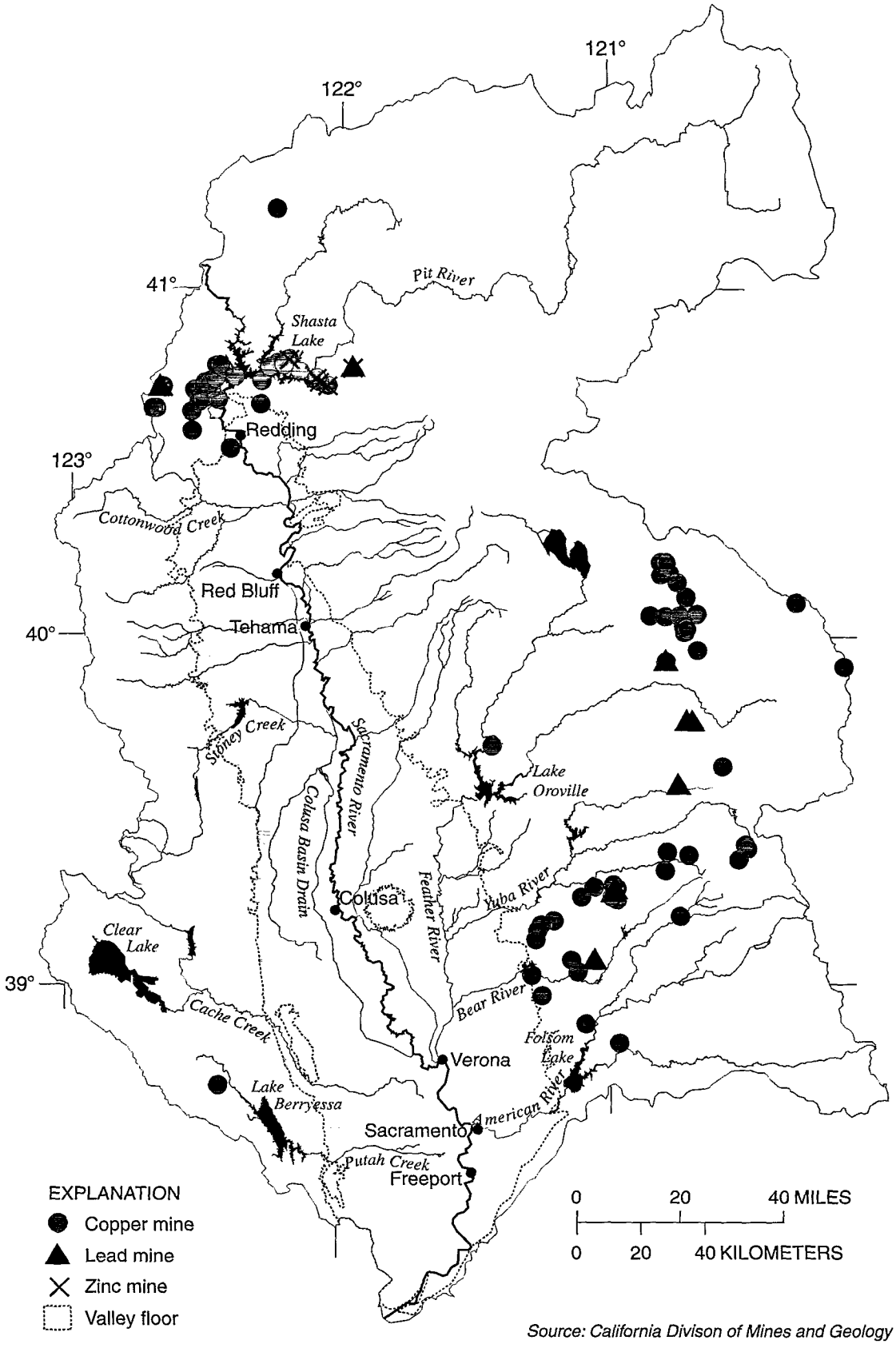

Figure 5. Map showing historic copper, lead, and zinc mines in relation to other selected features in the Sacramento River Basin, California.

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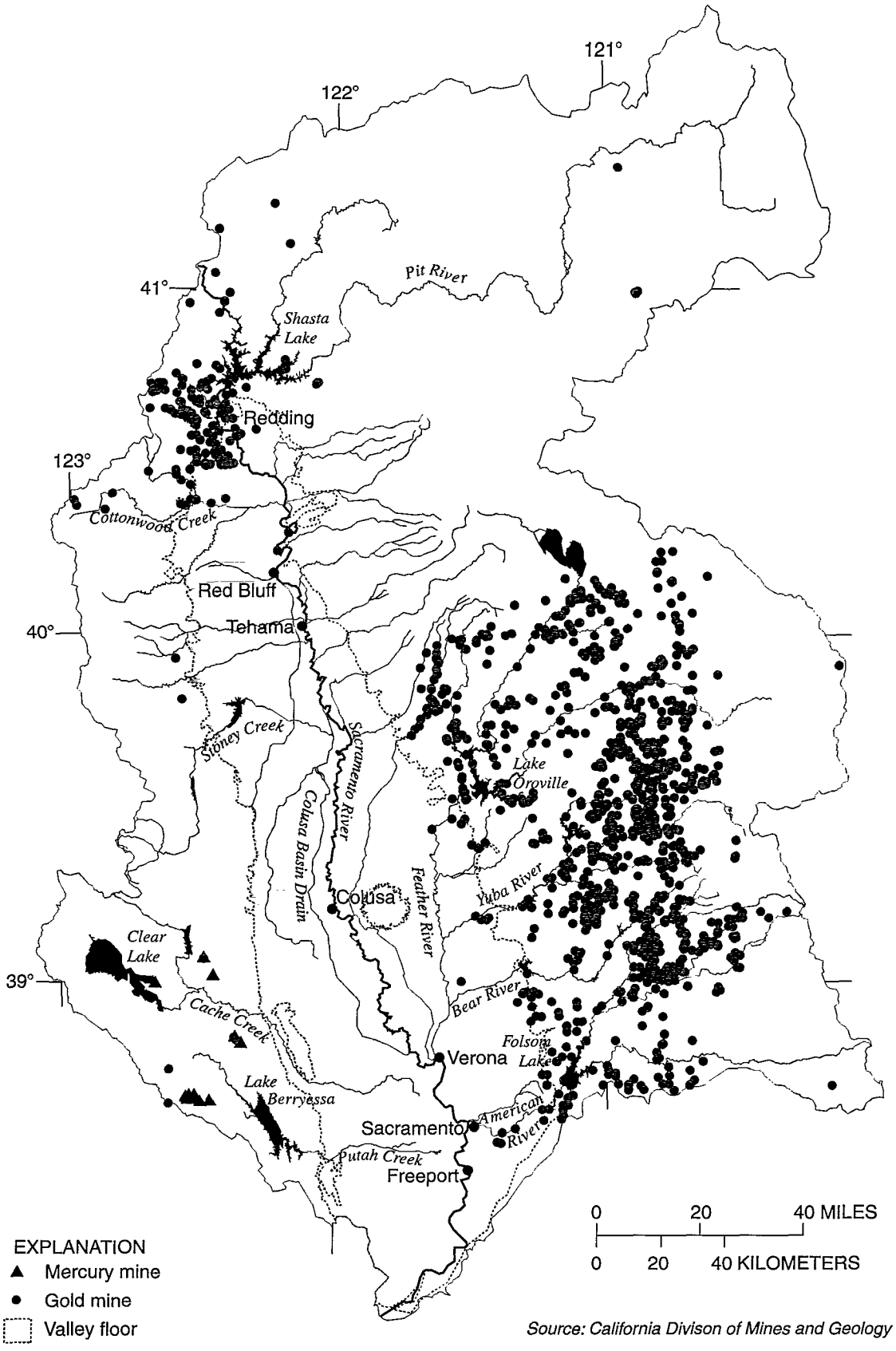

Figure 6. Map of historic gold and mercury mines in relation to other selected features in the Sacramento River Basin, California.

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Other Land Uses

Other (nonmining) land uses of the Sacramento River Basin are shown in figure 7. The Sacramento Valley floor (figs. 1, 4, and 7) is the major agricultural region of the basin. Row crops are predominant in the southern Sacramento Valley and grazing is an important activity in the northern valley. Rice is one of the most important crops of the Sacramento Valley. Rice production involves the creation of temporary wetlands. Pest control in these temporary wetlands includes the use of copper compounds, such as copper sulfate, for the control of algae. Land cover in most of the mountainous areas of the basin is principally forest. The types of forests in the various locations were described in detail by Schoenherr (1992).

Ongoing Studies—NAWQA Program

One of the goals of the NAWQA Program is to investigate and describe the status of, and trends in, the water quality of the nation's streams and ground water. Conceptual details of the program were given by Hirsch and others (1988). A total of 59 NAWQA study units throughout the United States are assessing water quality in basins representing more than 75 percent of the nation's water use. The environmental setting and study design of the NAWQA study unit in the Sacramento River Basin are described by Domagalski and others (1998). The study design includes a network of basic fixed sites that are monitored monthly for water quality and a network of sites where streambed sediment and biological tissues are sampled on a less frequent, synoptic basis. The sites selected for these monitoring activities are described in more detail below.

The NAWQA Program is designed to provide continuing documentation of the quality of the rivers and ground water in major basins throughout the United States. Investigations at individual basins are designed for a 10-year cycle. As part of the NAWQA Program, rivers are sampled for a period of 2 years during part of that 10-year cycle. The sampling takes place at predetermined monthly intervals and in response to hydrological conditions such as storm-water runoff. Water-quality samples collected at NAWQA sites are analyzed for a suite of constituents, including major cations and anions, nutrients, dissolved organic carbon, and general water-quality parameters such as pH, dissolved oxygen, specific conductance, temperature, and alkalinity. At a subset of sites, samples are collected for pesticide or volatile organic chemical analyses, or both. Additional samples, such as those for trace metals, are collected if additional funding has been appropriated. Data is aggregated at the national level, where attention is currently directed to the concentrations and trends detected in nutrients, pesticides, ecology, volatile organic chemicals, and trace elements. In the NAWQA Program, sampling sites on rivers are selected on the basis of natural features of the environment, such as physiography, and of anthropogenic factors such as land use. Consideration in sampling site selection also is given to the subsequent data interpretation, including the capability to provide a mass balance for various constituents in the watershed and to complete biological assessments at or near the water-quality sampling sites.

Basic Fixed Sites

Twelve river sites were chosen as basic fixed sites in the Sacramento River Basin for the NAWQA project. Four sites were chosen on the Sacramento River: the Sacramento River above Bend Bridge near Red Bluff, the Sacramento River at Colusa, the Sacramento River at Verona, and the Sacramento River at Freeport (fig. 8). The Bend Bridge site was selected because it is the northernmost location, below Shasta Lake, that met applicable national NAWQA criteria. It was suspected that impacts of acid mine drainage from Iron Mountain Mine, via Spring Creek, might be detectable at this site. The Colusa site was chosen because it is centrally located in the basin, it is sufficiently downstream of Spring Creek, such that the effects of acid mine drainage are less likely to be detected, and it is upstream of both drainage from the Sierra Nevada and most of the agricultural drainage of the Sacramento Valley. The Verona site is just downstream of the confluence with the Feather River, one of the major streams draining the Sierra Nevada. The site is also just downstream of the location where much of the agricultural drainage of the Sacramento Valley drains to the Sacramento River. The Freeport site was chosen as a basic fixed site because of its downstream location. Water-quality samples at that site provide an overall indication of multiple sources of constituents to the Sacramento River and also provide an indication of the quality of water entering the San Francisco Bay–Delta Estuary.

Three streams draining the Sierra Nevada were selected as basic fixed sites for the NAWQA study

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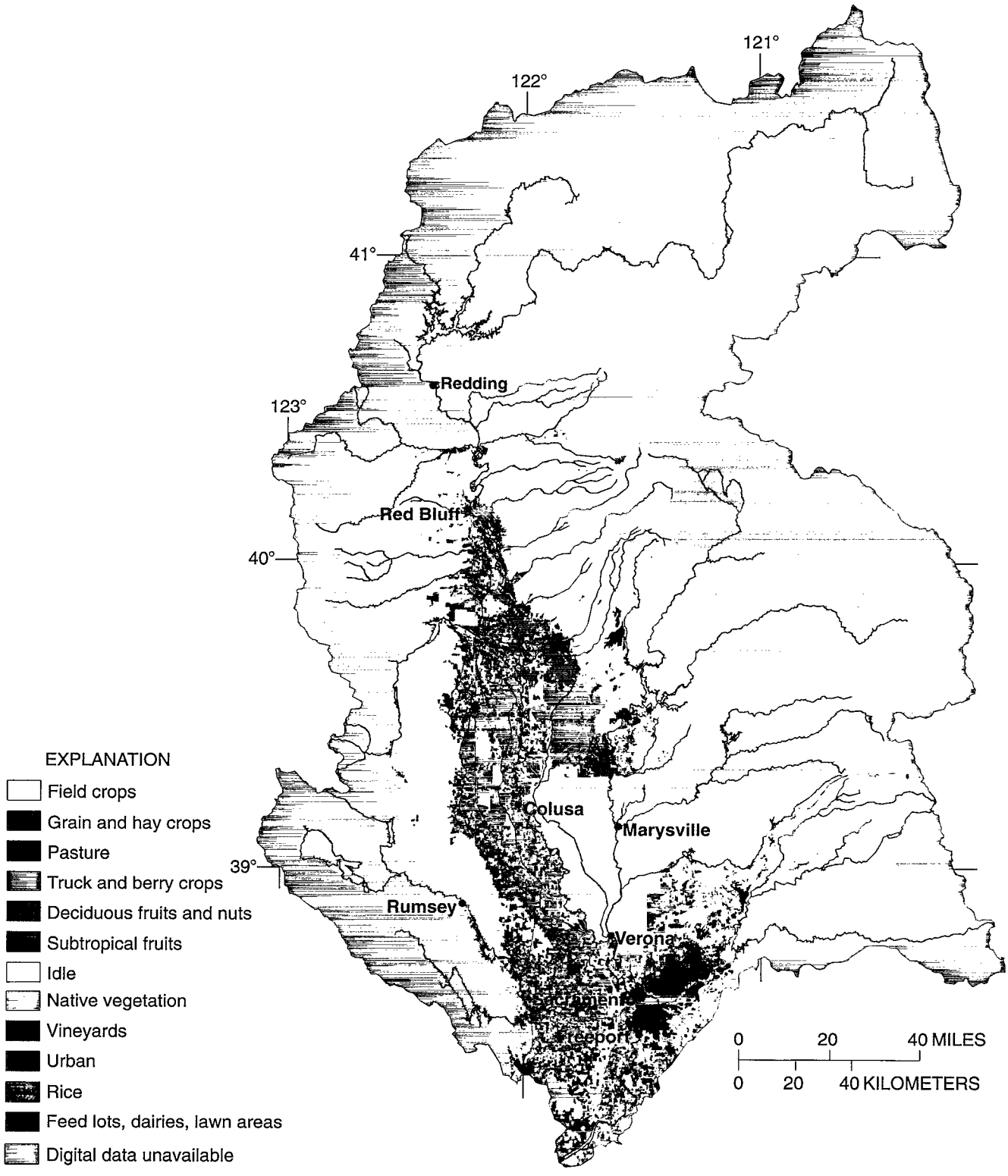

Figure 7. Map showing agricultural and other nonmining land uses in the Sacramento River Basin, California.

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unit: the Feather River near Nicolaus, the Yuba River near Marysville, and the American River in Sacramento (Domagalski and others, 1998). The chosen locations on these streams are either near the confluence with the Sacramento River, or in the case of the Yuba River, near the confluence with the Feather River. Two NAWQA basic fixed sites were chosen on streams draining agricultural regions in the Sacramento Valley: the Colusa Basin Drain and the Sacramento Slough. Two additional streams were

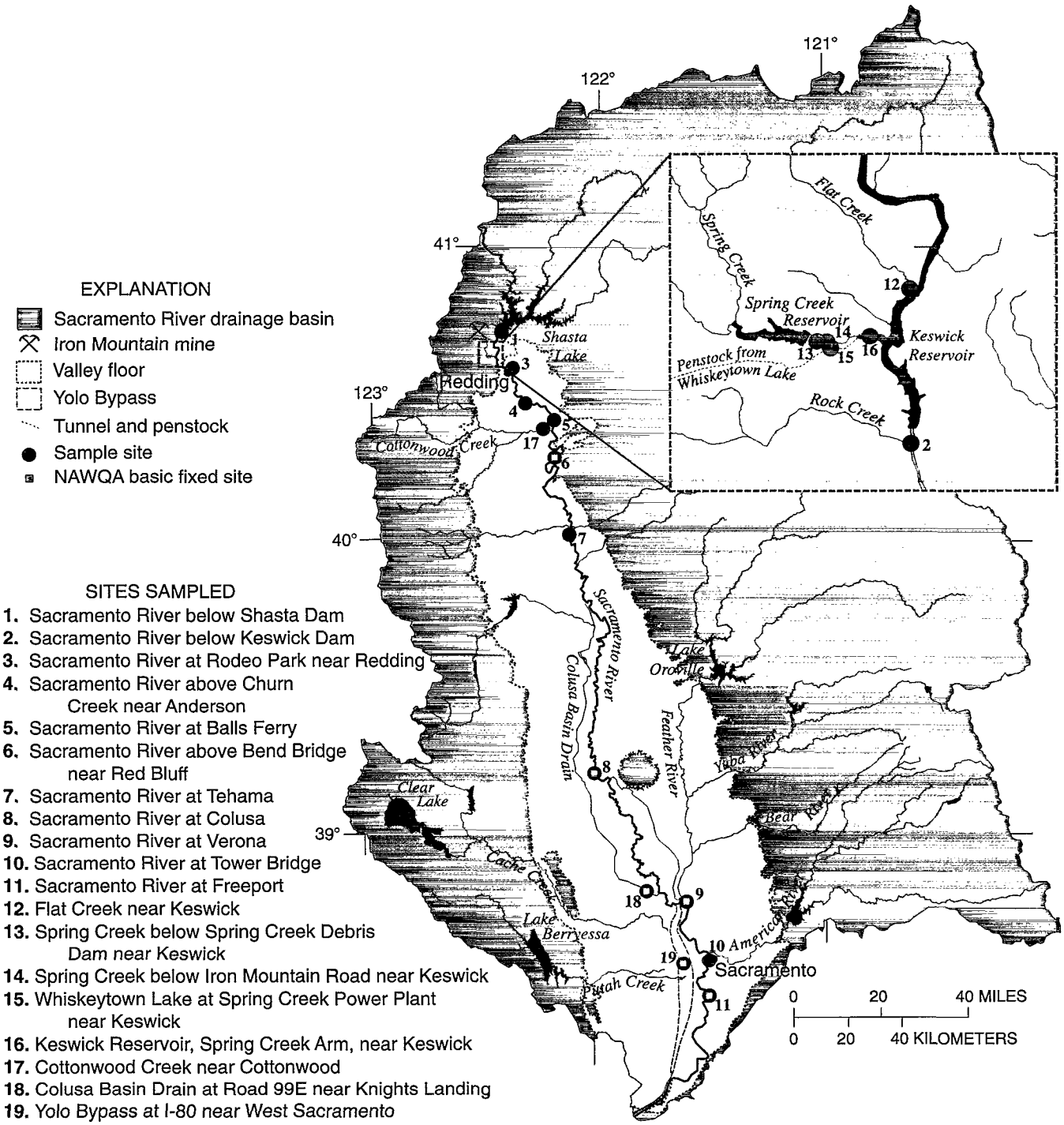

Figure 8. Map showing sampling sites in the Sacramento River Basin, California.

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selected: Cache Creek, which drains a part of the Coast Ranges with considerable mercury mining, and Arcade Creek near Del Paso Heights, an urban stream.

One distributary site, the Yolo Bypass at Interstate 80 near West Sacramento, also was selected. As discussed previously, water flows in the Yolo Bypass only during wet years and primarily during the winter months. It is necessary to sample the Yolo Bypass at Interstate 80 near West Sacramento to understand the transport of metals and other constituents from the Sacramento River to the Bay–Delta.

Streambed Sediment and Tissue Sites

In addition to the twelve basic fixed sites selected for monthly monitoring of water quality, an additional set of six sites was selected for the sampling of streambed sediment and tissue of aquatic organisms as part of the NAWQA Program. The aquatic organisms collected for tissue analyses were the Asian clam, *Corbicula fluminea*, and bottom feeding fish such as the common carp, *Cyprinus carpio*. The Yolo Bypass at Interstate 80 near West Sacramento (a basic fixed site) was not sampled for streambed sediment or tissue of aquatic organisms because it was dry at the time of sampling. The other 11 basic fixed sites were sampled for streambed sediment and tissue, making a total of 17 sites. These additional sites are the McCloud River, the Cottonwood Creek near Cottonwood, the Deer Creek near Vina, the Jack Slough near Jack Slough Road, and the Stony Creek below Black Butte Dam (Domagalski and others, 1998). Samples of streambed sediment and tissue of select aquatic organisms were collected initially in October 1995 for the determination of trace elements and hydrophobic organic contaminants (MacCoy and Domagalski, 1999). Results of follow-up sampling during 1997 and 1998 will be presented in a subsequent report.

Study Design: Field and Laboratory Methods

Charles N. Alpers, Howard E. Taylor, David A. Roth, Daniel J. Cain, James W. Ball, Daniel M. Unruh, and Peter D. Dileanis

This section describes the design of the Sacramento River metals transport study and the field and laboratory methods used. The site selection and sampling schedule are discussed, including methods used for the collection and processing of water, sediment, and biological samples. The analytical procedures that were used in the field and the laboratory are also discussed.

Site Selection and Sampling Schedule

Samples of water, colloids, streambed sediment, and caddisfly larvae were taken at 19 different sites for this study (fig. 8), though each type of sample was not necessarily taken at each site. Table 1 shows the dates of sampling for each type of sample at the various sample sites, along with distance from the river mouth.

Water Sampling

Water sampling sites for this study included six principal sites along the mainstem Sacramento River, plus the Yolo Bypass, a distributary site that receives water from mainstem Sacramento River for flood control during high-flow conditions (fig. 8). On one sampling trip during extreme high-flow conditions, an alternate site was chosen at one of the mainstem locations for logistics reasons. Six tributaries to the Sacramento River also were sampled, focusing on the Spring Creek area near Keswick Reservoir. The individual water sampling sites and the rationale for their selection are discussed in the following sections.

Sacramento River and Yolo Bypass Sites

One of the principal objectives of this study was to assess metal loads along the mainstem of the Sacramento River from Shasta Dam to Freeport (fig. 1). The four mainstem basic fixed sites from the NAWQA study—Sacramento River above Bend Bridge near Red Bluff, at Colusa, at Verona, and at Freeport (fig. 8, table 1, sites 6, 8, 9, and 11, respectively)—were selected for detailed trace-metal analysis. In addition, two other mainstem sites on the Sacramento River upstream from the Bend Bridge site were chosen for detailed sampling of water and colloids: the Sacramento River below Shasta Dam and below Keswick Dam (fig. 8, table 1, sites 1 and 2). All six of these mainstem sites were sampled during five of the six sampling periods (July, September, November, and December 1996, and May–June 1997).

Water samples also were taken from mainstem Sacramento River sites below Keswick Dam, above Bend Bridge, and at Colusa during the sixth (fifth chronologically) sampling period, which corresponded

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Table 1. Sampling sites along the Sacramento River showing distance from river mouth and dates of sampling for various media

[Dist., distance from river mouth. DD, Debris Dam; PP Power Plant; Jan., May, and June samples taken in 1997; all other months in 1996. **Bold** denotes field replicate samples taken and analyzed; *italics* denote sequential extraction analysis for speciation of colloids; blank cells indicate no samples taken]

	Dist. River Mile (kilometer)	Media Sampled			
		Water	Colloids (speciation in italics)	Streambed Sediment	Hydropsyche Larvae
SACRAMENTO RIVER SITES					
1. Sacramento River below Shasta Dam	311 (500)	**July, Sept., Nov., Dec., May**	July, Nov., Dec., *May*		
2. Sacramento River below Keswick Dam	302 (486)	**July, Sept., Nov., Dec., Jan., May**	July, Nov., Dec., *Jan.*, *May*		
3. Sacramento River at Rodeo Park near Redding	298 (479)			Oct.	Oct.
4. Sacramento River above Churn Creek near Anderson	285 (459)			Oct.	Oct.
5. Sacramento River at Balls Ferry	276 (444)			Oct.	Oct.
6. Sacramento River above Bend Bridge near Red Bluff	258 (415)	**July, Sept., Nov., Dec., Jan., May**	July, Sept., Nov., Dec., *Jan.*, *May*	Oct.	Oct.
7. Sacramento River at Tehama	229 (368)			Oct.	Oct.
8. Sacramento River at Colusa	143 (230)	**July, Sept., Nov., Dec., Jan., June**	July, Sept., Nov., Dec., *Jan.*, *June*	Nov.	
9. Sacramento River at Verona	78 (126)	**July, Sept., Nov., Dec., June**	July, Sept., Nov., Dec., *June*	Nov.	
10. Sacramento River at Tower Bridge	59 (95)	**Jan.**	Jan.		
11. Sacramento River at Freeport	46 (74)	**July, Sept., Nov., Dec., June**	July, Sept., Nov., Dec., *June*	Nov.	
TRIBUTARY SITES					
12. Flat Creek near Keswick	304 (489)	**Dec., May**			
13. Spring Creek below Spring Creek DD near Keswick	303 (488)	**Dec., May**	Dec., *May*		
14. Spring Creek below Iron Mountain Road near Keswick	303 (488)	**Jan.**	Jan.		
15. Whiskeytown Lake at Spring Creek PP near Keswick	303 (488)	**Dec., May**			
16. Keswick Reservoir, Spring Creek arm, near Keswick	303 (488)	**July, Sept., Nov., Dec., May**	July, Nov., Dec., *May*		
17. Cottonwood Creek near Cottonwood	273 (439)			Oct., June	Oct.
18. Colusa Basin Drain at Road 99E near Knights Landing	90 (145)	**June**	*June*		
DISTRIBUTARY SITE					
19. Yolo Bypass at I-80 near West Sacramento	83 (134)	**Jan.**	Jan.		

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to extremely high flows associated with the New Year's flood event of early January 1997. No extreme high-flow samples were taken at the sites below Shasta Dam, at Verona, or at Freeport for logistics reasons, such as limited boat access and unsafe river conditions.

During the flood conditions of early January 1997, the flow regime of the Sacramento River near Sacramento was sufficiently different that sampling in the lower part of the river was done at different locations. Because of the magnitude of the flow, a large part of the river flow was diverted to the Yolo Bypass by way of the Fremont weir (fig. 8). Therefore, a composite sample consisting of thirty vertical intervals was collected from the Yolo Bypass at Interstate 80 (fig. 8, table 1, site 19). Also during this extremely high-flow period, the Sacramento River, south of its confluence with the American River, consisted mainly of water from the American River because most of the flow from the mainstem Sacramento River was diverted to the Yolo Bypass. During these conditions, boat access to certain parts of the Sacramento River was limited or deemed unsafe. In lower-flow conditions, the Freeport site is routinely sampled by boat; the nearby bridge has been deemed unsafe for bridge-based sampling because of narrow traffic and pedestrian lanes. In January 1997, boat access at Freeport was not possible; therefore, the mainstem Sacramento River was sampled at Tower Bridge, near downtown Sacramento, located 21 km (13 mi) upstream (fig. 8, table 1, site 10).

Tributary Sites

The tributary best known as a source of metals to the Sacramento River is Spring Creek (figs. 1 and 8). During five of the six sampling periods for this study (all except January 1997), a sample was taken in the Spring Creek arm of Keswick Reservoir (fig. 8, table 1, site 16). The sampling point for site 16 was approximately 100 m downstream of the mixing zone of Spring Creek and the tailrace from the Spring Creek Power Plant (SCPP) (water from Whiskeytown Lake) (figs. 1 and 8). At this site, the flow from these tributaries was relatively well mixed horizontally, in a constricted part of the Spring Creek arm where the influence from water released at Shasta Dam was extremely unlikely. It was assumed that the dissolved and colloidal fractions of the water column were well mixed vertically at this location.

Spring Creek was sampled on three occasions (December 1996, January 1997, and May 1997) between the SCDD and the discharge point to the Spring Creek arm of Keswick Reservoir. The site named "Spring Creek below Spring Creek Debris Dam near Keswick" (fig. 8, table 1, site 13) corresponds to the concrete weir that receives water from the outlet works of SCDD. This was the sampling location in December 1996 and May 1997. During January 1997, the Spring Creek samples were taken at the site named "Spring Creek below Iron Mountain Road near Keswick" (fig. 8, table 1, site 14) so that the discharge from the SCDD spillway and other runoff from areas near the SCDD would be included.

Samples were taken of Whiskeytown Lake water from the SCPP near Keswick in December 1996 and May 1997. Under some conditions, the discharge from the SCPP represents most of the flow in the Spring Creek arm of Keswick Reservoir. The water samples were taken from a spigot off a turbine housing on the lowest level of the power plant. No sample was taken during early January 1997 because discharge through the SCPP was minimal at that time.

The Flat Creek near Keswick site is located near the confluence of Flat Creek and Keswick Reservoir. Flat Creek is a tributary to Keswick Reservoir approximately 1.5 km upstream from the Spring Creek arm of Keswick Reservoir (fig. 8, table 1, site 12). Construction of a diversion of upper Spring Creek into Flat Creek was completed in December 1990 (U.S. Environmental Protection Agency, 1992). This diversion carries up to 600 ft^3/s of relatively uncontaminated water from upper Spring Creek to reduce the flow into Spring Creek Reservoir. It is known that metals contaminate upper Spring Creek because of the Stowell Mine, a copper–zinc mine similar in geology to Iron Mountain; but because the mine is considerably smaller in terms of deposit size and production, the contamination is relatively insignificant (Kinkel and others, 1956).

The Flat Creek drainage also includes the Minnesota Flats site, which was a disposal area for high-pyrite mill tailings from the Minnesota copper flotation mill, which operated from about 1914 to 1942 (U.S. Environmental Protection Agency, 1992). During 1988, the tailings (approximately 28,000 yd^3) were excavated and deposited in the Brick Flat Pit near the top of Iron Mountain, effectively eliminating this source of pollution (U.S. Environmental Protection Agency, 1992). Also, since 1994, a lime neutralization

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plant has been located at the Minnesota Flats site. This plant treats drainage from the Richmond and Lawson portals on the Boulder Creek side of Iron Mountain, as well as water pumped from the Old mine and Number 8 mine workings on the Slickrock Creek side of Iron Mountain. The treated water is discharged to Spring Creek so that, under normal operating conditions, there is no metal loading to Flat Creek associated with operation of the treatment plant. Nevertheless, Flat Creek carries the second largest metal loading to Keswick Reservoir, behind Spring Creek (John Spitzley, CH2M Hill, Redding, California, written commun. to Richard Sugarek, U.S. Environmental Protection Agency, 1997).

Flat Creek was sampled near its confluence with Keswick Reservoir during December 1996 and May 1997 (table 1). During early January 1997, flood conditions had caused scouring of a bridge where Iron Mountain Road crosses Flat Creek. The upper Spring Creek Diversion was temporarily shut down while the bridge was repaired. Although there was some flow in Flat Creek associated with its original watershed, the metal loadings were probably much lower than would have been the case if the diversion had been operating. Therefore, Flat Creek was not sampled during the January 1997 sampling period.

The Colusa Basin Drain was sampled to represent agricultural drainage from an area with active rice production. Substantial amounts of copper sulfate are added to rice fields periodically to suppress algae and other pests. This site was sampled monthly during 1996 as a basic fixed site in the NAWQA Program, and showed elevated copper concentrations during June of that year, a period when the rice fields were draining. The Colusa Basin Drain site was sampled with the additional trace metal protocols for this study in June 1997 to evaluate the potential occurrence of metals and their manner of transport at this location during drainage of the rice fields.

Streambed Sediment and Caddisfly Larvae Sampling

Streambed sediment was sampled (table 1) at each of the four basic fixed sites on the Sacramento River (Bend Bridge, Colusa, Verona, and Freeport). Four additional sites on the mainstem Sacramento River between Redding and Tehama (Rodeo Park, Churn Creek, Balls Ferry, and Tehama; fig. 8, sites 3, 4, 5, and 7) and one tributary (Cottonwood Creek, fig. 8, site 17) also were sampled for streambed sediment in conjunction with sampling for caddisfly larvae (table 1). The purpose of sediment sampling was to investigate possible correlations of trace metal chemistry between sediment, water, and biota at selected sites.

Additional suitable sites for caddisfly larvae collection could not be found between Keswick Dam and Shasta Dam (namely, in Keswick Reservoir) or in the Sacramento River downstream of Tehama because of the lack of a suitable habitat, such as riffle zones. In addition, an attempt to collect additional caddisfly samples in June 1997 was unsuccessful in the mainstem Sacramento River at the sites sampled previously in October 1996 because of relatively high-flow conditions.

Methods for Sample Collection and Field Measurements

This section describes the methods of collection for samples of water, sediment, and caddisfly larvae. Also discussed are methods used for field measurements, including pH, specific conductance, and dissolved oxygen.

Water Sampling

The Sacramento River metals transport study and the concurrent NAWQA study used somewhat different procedures for the collection and processing of water samples. The metals transport study used protocols developed by the USGS's National Research Program (NRP) in water resources, under the direction of Dr. Howard E. Taylor. Both the NAWQA and the NRP procedures are described in this report, although much of the NAWQA data will be reported elsewhere. The water sampling collection methods are described in this section, and the processing methods are described in a later section.

NAWQA Protocols

At the four basic fixed sites on the mainstem Sacramento River (Bend Bridge, Colusa, Verona, and Freeport), the NAWQA Program collected monthly samples using a D-77 depth-integrating sampler (Horowitz and others, 1994) with the equal-width-increment method (Edwards and Glysson, 1988). The D-77 sampler (see sketch in fig. 3 in Appendix 1) is suspended from a boat or bridge using a pulley and winch with hand crank. The sampler consists of a 3-L polytetrafluoroethylene (PTFE, a variety of Teflon)

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bottle with a PTFE nozzle that is designed to transmit water in an isokinetic manner. (Note that two varieties of Teflon were used in this study, PTFE and perfluoroalkoxy, or PFA.) In isokinetic sampling, the water enters the sampler at the same velocity as the water flowing near the sampler to ensure that concentrations of suspended sediment particles are representative of concentrations in the water sampled. The 3-L bottle is housed in the bronze body of the D-77; the bronze is coated with epoxy paint to eliminate potential contamination. The D-77 is considered to be rated as isokinetic to a depth of 15 ft, and to a maximum river velocity of about 4 ft/s (Shelton, 1994).

The D-77 sampler was raised and lowered at a constant rate, sufficiently fast to ensure that the 3-L bottle did not completely fill. Several equally spaced locations were sampled in a cross-section of the river and the volume collected in each vertical pass was recorded. For the purposes of the NAWQA Program, a total volume of about 9 L was generally collected in three separate 3-L PTFE bottles, which were processed using a PTFE cone splitter, as described in the following section on Sample Processing.

The NAWQA project used a grab method for the collection of water samples for mercury, dissolved organic carbon, and suspended organic carbon analyses. A single 3-L PTFE bottle and D-77 nozzle was dedicated to collection of the grab samples, which were taken generally from a single depth-integrated vertical interval located near the center of the river. The mercury grab samples were transferred immediately to acid-cleaned PTFE bottles, preserved with approximately 5 mL of 50 percent hydrochloric acid (HCl), and then closed tightly with a wrench, chilled, and shipped to a USGS laboratory in Madison, Wisconsin for analysis of total mercury. In some cases, water samples for monomethylmercury (MMHg) were taken also. Results for mercury and monomethylmercury from the NAWQA project will be presented in a separate report.

Measurements were made of field water-quality parameters according to NAWQA protocols (Shelton, 1994). Temperature was measured in place using an ASTM-calibrated thermometer (Cole Parmer model number 90201-10) that was placed about 10 cm below the water surface; temperature readings are considered accurate to within 0.2°C. Dissolved oxygen was determined in place using a probe with a thin permeable membrane. The dissolved oxygen meter (YSI model number 57) was calibrated at 100 percent saturation using the air-calibration-in-water method (Shelton, 1994). Barometric pressure was measured with a hand-held barometer at the time of each dissolved oxygen measurement so that the saturation value could be computed. Field values of specific conductance and pH were determined using raw (unfiltered) subsamples from the cone splitter. Specific conductance was determined using a Cole Parmer conductivity meter (model number 1481-60). Field values of pH were measured using an Orion meter (model number 250A) with a liquid-filled Triode electrode. Specific conductance and pH standards in the range of the unknown samples were used to calibrate the meters (Shelton, 1994). Laboratory determinations of specific conductance and pH were also made by similar methods on separate raw subsamples. Alkalinity determinations made on 50-mL subsamples of filtered (0.45-µm capsule filter) water from the cone splitter were based on titrations performed with a digital titrator and 0.16 Normal (*N*) sulfuric acid. In general, two separate alkalinity titrations were done for each sample, each using 50 mL of filtered water. The titration results were computed using the Gran titration method (Butler, 1982).

USGS's NRP Ultratrace Element Protocol

At the four basic fixed NAWQA sites on the Sacramento River, water sample collection for the concurrent metal transport study was also performed using equal-width increment methods. In cases where the D-77 sampler was used, either from a boat or a bridge, the additional samples were taken in a similar manner as in the NAWQA study. During July 1996, a modified D-77 sampler was used, in which a collapsible PTFE bag was inserted into a perforated 3-L polyethylene bottle (Kelly and Taylor, 1996). During the July 1996 sampling period, trace metal samples were composited in acid-washed 8-L PTFE-lined stainless-steel churns. Details of the water (composite water and grab water) and colloid sample collection for each sample taken in this study are given in tables 2–4. For all other sampling periods (September 1996 through May–June 1997), water samples for the metal transport study were collected by using either the standard D-77 sampler or PTFE tubing with a peristaltic pump.

Samples taken from September 1996 to June 1997 generally were composited in an acid-washed 20-L PTFE-lined stainless-steel churn. At the four basic fixed NAWQA sites, the pumping was done at

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the same equal-width stations at which concurrent NAWQA samples were taken. Volumes yielded by the D-77 sampler during the NAWQA sampling were used to determine the volume needed from each station to achieve a width-integrated sample. At the Spring Creek arm site, horizontal integration was achieved by moving the boat from side to side across the full width of the flow channel (about 10 m). Some degree of vertical integration for pumped samples was achieved in the upper 0.2 to 2.5 m of the river by placing the PTFE tubing inside a 3-m length of 5-cm-diameter rigid polyvinyl chloride (PVC) pipe. The PTFE tubing was taped in place using nonmetallic, white duct tape so that it protruded about 30 cm beyond the end of the PVC pipe. The tubing–pipe assembly was moved vertically in the river from the bow of the boat with the tubing pointed upstream, so that the water collected had minimal (if any) contact with the PVC pipe. Field and equipment blanks were performed on these materials; results are described in the section on Quality Assurance and Quality Control.

At most other sites, water samples were also collected by pumping with PTFE tubing. At sites where boat access was not available or deemed unsafe, pumping through PTFE tubing with a peristaltic pump was done from the shoreline. Three such sites were located immediately downstream of dams (Shasta Dam, Keswick Dam, and Spring Creek Debris Dam), where the flow was considered to be well mixed and width-integrated sampling was considered unnecessary.

At the sampling site below Shasta Dam, lateral differences in water quality are possible under certain flow conditions, such as when water is drawn from more than one depth in Shasta Lake and is partly diverted through the turbines and partly through the spillway. During July 1996, a horizontal traverse of the river was performed from a bridge using a Hydrolab instrument to determine lateral heterogeneities with respect to pH, temperature, and specific conductance. No such heterogeneity was found, and samples were taken from the right bank (facing downstream), about 30 m downstream from the bridge (a sampling point used on occasion by other agencies). This shoreline sampling point was also used in September and November 1996; however, the water level was higher in December 1996, and for safety reasons, a width-integrated sample was collected from the bridge using a D-77 sampler. In May 1997, the sample from below Shasta Dam was also taken from the bridge using a D-77 sampler (table 2).

The sampling point for the site below Keswick Dam also was on the right bank at a point about 100 m from the dam, a location that is also used routinely for sample collection by the BOR. During January 1997, the USGS sample was taken concurrently with one by the BOR for comparative purposes.

The sampling from Spring Creek also was accomplished using PTFE tubing from the shoreline. At the site "below SCDD," samples were pumped from a point on the right bank, about 10 m upstream from the concrete V-notch weir. At the Spring Creek site "below Iron Mountain Road," samples were pumped from a point on the right bank about 50 m downstream from the culvert that passes under Iron Mountain Road.

The water sample taken from the Yolo Bypass at Interstate 80 in January 1997 was collected using a D-77 sampler. The extreme width of this water body (about 5 km) and its potential lateral heterogeneity required that 30 separate width increments be taken, spaced at an interval of about 150 m. A composite sample using a 20-L churn was taken concurrently with a NAWQA Program sample that was split with the cone splitter. Flow measurements were taken at each of the sampling stations along the Yolo Bypass to derive an estimate of total discharge.

In addition to the composite (churn) sample taken at all sampling sites in the study, a separate grab sample also was taken at each site (table 3), specifically for the analysis of lead in whole water and various filtrates. A grab sample is defined as a sample taken from a single location in a water body; it is preferred in some studies of ultratrace elements because of lower potential for contamination. A single 3-L PTFE bottle was dedicated to collection of the grab samples. At sites where multiple vertical intervals were sampled, the grab sample was taken from the centermost station, similar to the NAWQA mercury grab samples. At sites where water was pumped from the shoreline, the grab sample represents a replicate sample of the composite; this situation is indicated in tables 2 and 3 as sites with one collection point for both "composite" and grab samples.

Streambed Sediment Sampling

Streambed sediment samples were collected using NAWQA protocols (Shelton and Capel, 1994). Relatively fine-grained sediment from three to six

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Table 2. Sampling methods used for composite water samples

[Site numbers correspond to figure 8 and table 1 (no composite water samples were taken at sites 3, 4, 5, 7, and 17); DD, Debris Dam; PP, Power Plant; NS, no sample taken; initial number in cells (1–30) denotes number of sampling points composited (parentheses denote estimate); *, composited from samples collected continuously while passing boat horizontally across water body; Bo, boat; Br, bridge; Sh, shoreline; Sp, spigot in power plant; D-77M, D-77 sampler modified with Teflon bag; PPTT, peristaltic pump with Teflon tubing; Dip-1L, dipped 1-liter Teflon bottle near surface; Dip-2L, dipped 2-liter Teflon bottle near surface; 8L, 8-liter Teflon-lined churn; 20L, 20-liter Teflon-lined churn; JC, 13-liter Teflon-lined high-density polyethylene jerrican; CS, Teflon cone splitter used to split sample for USGS's National Water-Quality Assessment Program. L, liter]

	Sampling Period					
	July 1996	September 1996	November 1996	December 1996	January 1997	May/June 1997
SACRAMENTO RIVER SITES						
1. Sacramento River below Shasta Dam	1, Sh, PPTT, 8L	1, Sh, PPTT, 20L	1, Sh, PPTT, 20L	3, Br, D-77, 20L	NS	4, Br, D-77, 20L
2. Sacramento River below Keswick Dam	1, Sh, PPTT, 8L	1, Sh, PPTT, 20L	1, Sh, PPTT, 20L	1, Sh, PPTT, 20L	1, Sh, PPTT, 20L	1, Sh, PPTT, 20L
6. Sacramento River above Bend Bridge near Red Bluff	5, Br, D-77M, 8L	5, Bo, PPTT 20L	4, Bo, PPTT, 20L	1, Sh, PPTT, 20L	5, Bo, PPTT, 20L	5, Bo, PPTT, 20L
8. Sacramento River at Colusa	5, Bo, D-77M, 8L	5, Bo, Dip-2L, 20 L	(4), Bo, PPTT, 20L	4, Bo, PPTT, 20L	5, Bo, PPTT, 20L	5, Bo, PPTT, 20L
9. Sacramento River at Verona	6, Bo, D-77M, 8L	6, Bo, PPTT, 20L	(6), Bo, PPTT, 20L	8, Bo, PPTT, 20L	NS	5, Bo, PPTT, 20L
10. Sacramento River at Tower Bridge	NS	NS	NS	NS	(4), Br, D-77, 20L	NS
11. Sacramento River at Freeport	5, Bo, D-77M, 8L	5, Bo, PPTT, 20L	(5), Bo, PPTT, 20L	4, Bo, PPTT, 20L	NS	5, Bo, PPTT, 20L
TRIBUTARY SITES						
12. Flat Creek near Keswick	NS	NS	NS	1, Sh, 20L	NS	1, Sh, Dip-1L, JC
13. Spring Creek below Spring Creek DD near Keswick	NS	NS	NS	1, Sh, PPTT, 20L	NS	1, Sh, PPTT, 20L
14. Spring Creek below Iron Mountain Road near Keswick	NS	NS	NS	NS	1, Sh, PPTT, 20L	NS
15. Whiskeytown Lake at Spring Creek PP near Keswick	NS	NS	NS	1, Sp, 20L	NS	1, Sp, 20L
16. Keswick Reservoir, Spring Creek arm, near Keswick	*, Bo, PPTT, 8L	*, Bo, PPTT	*, Bo, PPTT	*, Bo, PPTT	NS	*, Bo, PPTT
18. Colusa Basin Drain at Road 99E near Knights Landing	NS	NS	NS	NS	NS	Br, 20L
DISTRIBUTARY SITE						
19. Yolo Bypass at I-80 near West Sacramento	NS	NS	NS	NS	30, Br, D-77, CS, 20L	NS

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Table 3. Sampling methods used for grab water samples

[Site numbers correspond to figure 8 and table 1 (no grab water samples were taken at sites 3, 4, 5, 7, and 17); DD, Debris Dam; PP, Power Plant; NS, no sample taken; initial number in cells (1) denotes number of sampling points composited; *, composited from samples collected continuously while passing boat horizontally across water body; Bo, boat; Br, bridge; Sh, shoreline; Sp, spigot in powerplant; D-77M, D-77 sampler modified with Teflon bag; PPTT, peristaltic pump with Teflon tubing; Dip-2L, dipped 2-liter Teflon bottle near surface; Dip-1L, dipped 1-liter Teflon bottle near surface; 3L, 3-liter Teflon bottle. L, liter]

	July 1996	September 1996	November 1996	December 1996	January 1997	May/June 1997
SACRAMENTO RIVER SITES						
1. Sacramento River below Shasta Dam	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Br, D-77, 3L	NS	1, Br, D-77, 3L
2. Sacramento River below Keswick Dam	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L	1, Sh, PPTT, 3L
6. Sacramento River above Bend Bridge near Red Bluff	1, Br, D-77M, 3L	1, Bo, PPTT 3L	1, Bo, PPTT, 3L	1, Sh, PPTT, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L
8. Sacramento River at Colusa	1, Bo, D-77M, 3L	1, Bo, Dip-2L, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L
9. Sacramento River at Verona	1, Bo, D-77M, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	NS	1, Bo, PPTT, 3L
10. Sacramento River at Tower Bridge	NS	NS	NS	NS	1, Bo, PPTT, 3L	NS
11. Sacramento River at Freeport	1, Bo, D-77M, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	1, Bo, PPTT, 3L	NS	1, Bo, PPTT, 3L
TRIBUTARY SITES						
12. Flat Creek near Keswick	NS	NS	NS	1, Sh, 3L	NS	1, Sh, Dip-1L, 3L
13. Spring Creek below Spring Creek DD near Keswick	NS	NS	NS	1, Sh, PPTT, 3L	NS	1, Sh, PPTT, 3L
14. Spring Creek below Iron Mountain Road near Keswick	NS	NS	NS	NS	1, Sh, PPTT, 20L	NS
15. Whiskeytown Lake at Spring Creek PP near Keswick	NS	NS	NS	1, Sp, 3L	NS	1, Sp, 3L
16. Keswick Reservoir, Spring Creek arm, near Keswick	*, Bo, PPTT, 3L	*, Bo, PPTT, 3L	*, Bo, PPTT, 3L	*, Bo, PPTT, 3L	NS	*, Bo, PPTT, 3L
18. Colusa Basin Drain at Road 99E near Knights Landing	NS	NS	NS	NS	NS	Br, 20L
DISTRIBUTARY SITE						
19. Yolo Bypass at I-80 near West Sacramento	NS	NS	NS	NS	1, Br, D-77, 3L	NS

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locations within 100 m of the water sampling site was collected from shallow-water areas with acid-washed, plastic spoons and spatulas, and composited in an acid-cleaned, 8-L glass container. The sediment and associated river water was homogenized, and a split (about 100 mL, or roughly 200 g) of the whole sediment was taken for grain-size analysis. The remaining sample was then screened through a 62-µm nylon mesh; the coarse fraction was discarded. The fine-grained material (clay plus silt size fractions) was placed in acid-washed plastic jars and chilled.

Caddisfly Sampling

Samples of *Hydropsyche* larvae were collected at five stations (fig. 8, table 1, sites 3, 4, 5, 6, and 7) in the Sacramento River between Redding and Tehama during October 21–23, 1996, a period of low-flow conditions. In addition, a sample was collected from Cottonwood Creek (fig. 8, table 1, site 17); this sample was used for comparison with metal levels in samples from the Sacramento River. Caddisfly samples were not collected upstream of Keswick Reservoir, nor downstream of Tehama, nor during other times of the year because of the scarcity of habitat that could be sampled using the methods employed. *Hydropsyche* larvae were collected with large kick nets, and by hand, from a single, wadeable (approximately 0.3-m deep) riffle at each site. Specimens were picked from the net with nylon forceps and placed into plastic trays with stream water (forceps and trays were previously acid washed). Water in the trays was freshened every few minutes. Specimens were transferred from the trays to sealed, plastic bags and then frozen on dry ice in a small volume of river water within 1 hour of collection. The samples were moved to the laboratory where they were stored at –70°C until analysis. Specimens for taxonomic identification were preserved in 10 percent formalin in the field and transferred to 75 percent ethanol in the laboratory.

Sample Processing Methods

This section contains descriptions of methods used for sample processing in this study. The types of samples include water, sediment, and biological samples.

Water Sample Processing

Two approaches for the processing of water samples were used in this study. The "part-per-billion" protocol adopted by the NAWQA Program (Horowitz and others, 1994) was used for subsamples analyzed for anions, nutrients, and organic carbon at the basic fixed sites. For the second approach, subsamples analyzed for cations, trace elements, and iron redox speciation were processed using a protocol for ultra-trace constituents developed by the USGS's NRP in water resources, under the direction of Dr. Howard E. Taylor. Both processing approaches are described in this subsection.

NAWQA Protocols

Water samples collected for the NAWQA study were processed to make subsamples using a Teflon (PTFE) cone splitter (see sketch in fig. 4 in Appendix 1). The use and precision of the cone splitter have been described by Ward and Harr (1990) and Capel and others (1995). Raw subsamples from the cone splitter were collected for analysis of suspended sediment concentration and certain nutrient constituents. A raw subsample was used for measurement of pH and specific conductance. Additional raw subsamples from the cone splitter were used as input to filtration processes. A disposable 0.45-µm capsule filter (Gelman 12175) was used to filter samples for major and trace element analyses. The capsule filters were preconditioned by passing 1 L of deionized water through, prior to any sample. A minimum of 50 mL of sample was passed through the capsule filter prior to rinsing and filling the sample bottles with filtrate.

A raw subsample of 100 mL, taken from the 3-L PTFE bottle used to collect the grab sample for mercury, was processed for dissolved and suspended organic carbon analysis. It was filtered through a 47-mm-diameter silver membrane filter (pore diameter of 0.45-µm, manufactured by the Poretics Products Division of Osmonics). The silver filters were heated to 300°C for 4 hours and then mounted in a multistage PTFE filter holder. A clean amber glass bottle was placed in a sealed PTFE canister. The canister is equipped with a fitting that allows for an airtight connection, using PTFE tubing, between the PTFE filter holder and the amber glass bottle. Water was drawn through the filter under a vacuum, with an oil-free vacuum pump attached to the PTFE canister. The filtrate samples were collected in the precleaned 100-mL amber glass bottles and immediately chilled.

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The silver filters were retained in plastic petri dishes for analysis of suspended organic matter.

Both raw (unfiltered) and filtered water subsamples were taken for analysis of nutrients. Filtration was done using the same 0.45-µm capsule filter (manufactured by Gelman) as used for the major and trace element subsample. The unfiltered subsamples that were used for nutrient analysis were acidified with sulfuric acid, whereas the filtered samples were not preserved other than chilling on ice immediately after collection and processing and keeping refrigerated until analyzed. Samples for analysis of nutrients and organic carbon were shipped on ice within 24 hours of collection to the USGS's NWQL in Arvada, Colorado.

USGS's NRP Ultratrace Element Protocol

After compositing streamwater in PTFE-lined churns, the composite raw water samples were mixed using conventional churn-splitting techniques (Leenheer and others, 1989) and processed as necessary to obtain representative subsamples for whole-water analysis, subsequent filtration, and suspended sediment concentration determinations (see table 5, which has been modified from the Quality Assurance Project Plan, table 4 in Appendix 1). Whole-water and filtered subsamples for analysis of cations and trace metals were collected in acid-soaked, screw-cap 250-mL polyethylene bottles and were immediately preserved with high-purity nitric acid (HNO_3) (table 5). The nitric acid was purified in the laboratory using a distillation procedure described by Kuehner and others (1972).

Whole-water samples intended for analysis of major cations and trace metals were preserved in the field using 2 mL of concentrated, distilled nitric acid per 250-mL subsample, and were then subjected to an in-bottle digestion using 5 mL of concentrated hydrochloric acid per 200 mL of sample in a water bath at near-boiling conditions (see method I-3485-85 in Fishman and Friedman, 1989). Results from this method are considered "total" if greater than 95 percent of a substance is solubilized and are considered "total recoverable" if less than 95 percent of a substance is solubilized (Fishman and Friedman, 1989). The addition of nitric acid in the field was necessary to avoid metal precipitation in iron-bearing samples. The net result was a more rigorous digestion than that which would be obtained using only hydrochloric acid.

The whole-water samples intended for iron redox analysis were preserved in the field using 2 mL of concentrated, distilled hydrochloric acid per 250-mL subsample. Nitric acid, a weak oxidant, was not added to these samples because it likely would have changed the proportion of ferrous iron [Fe(II)] and ferric iron [Fe(III)]. Because bacteria were not excluded from these unfiltered samples, and some iron-oxidizing bacteria are known to survive in extremely acid conditions (Nordstrom and Southam, 1997), some oxidation of Fe(II) to Fe(III) may have occurred after sample preservation. This effect is less likely to have occurred in the filtered subsamples preserved in a similar manner for iron redox determinations.

Filtration for analysis of cations (including trace metals), mercury, anions, iron redox, and nutrients was performed in a mobile laboratory using a 0.45-µm capsule filter (Gelman) and peristaltic pump. Subsamples for replicate analysis, and in-bottle spikes, if required, were taken from the churn and processed in a manner similar to that described earlier. Containers and preservatives were used in accordance with quality assurance protocols (see table 5 and Appendix 1). A diagram showing the procedure for the processing of composite samples is shown in figure 9.

A subsample of the 3-L grab sample was also filtered (in the mobile lab) using a separate 0.45-µm capsule filter (Gelman) for lead analysis (fig. 10). With the exception of PTFE bottles, which were used in place of polyethylene bottles, the handling procedures for the grab samples were the same as those used for the composite samples and related subsamples that were prepared for analysis of cations and trace elements.

Water remaining in the churn and in the grab sample bottle, as well as the 100-L sample for colloid isolation, were transported to a processing laboratory as quickly as logistics permitted (generally within 2 to 24 hours). There, subsamples from the composited sample and the grab sample were filtered using a Nuclepore 0.40-µm membrane in an all-PTFE filter holder, under vacuum (Kelly and Taylor, 1996). Replicate filtered subsamples were obtained in this manner for the analyses of cations and mercury (see second column of table 5; fig. 9).

In the laboratory, another portion (about 3 L) of the composited sample was filtered with a Minitan (Millipore Corporation) tangential-flow ultrafiltration procedure to remove suspended particulate matter,

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Table 4. Sampling methods used for colloid samples

[Site numbers correspond to figure 8 and table 1 (no colloid samples were taken at sites 3, 4, 5, 7, and 17); DD, Debris Dam; PP, Power Plant; NS, no sample taken; initial number in cells (1–30) denotes number of sampling points composited (parentheses denotes estimate); *, composited from samples collected continuously while passing boat horizontally across water body; Bo, boat; Br, bridge; Sh, shoreline; Sp, spigot in power plant; D-77M, D-77 sampler modified with Teflon bag; PPTT, peristaltic pump with Teflon tubing; Dip-1L, dipped 1-liter Teflon bottle near surface; Dip-2L, dipped 2-liter Teflon bottle near surface; volumes (for example, 92.1 L) denote total volume of water processed through Pellicon tangential-flow ultrafilter; samples collected in 25-liter high-density polyethylene carboys; *italics* indicate duplicate sample; CS, Teflon cone splitter used to split sample for USGS's National Water-Quality Assessment Progam.. L, liter]

	July 1996	September 1996	November 1996	December 1996	January 1997	May/June 1997
SACRAMENTO RIVER SITES						
1. Sacramento River below Shasta Dam	1, Sh, PPTT, 92.1 L	1, Sh, PPTT, 99.9 L	1, Sh, PPTT, 98.4 L	3, Br, D-77, 72.7 L	NS	4, Br, D-77, 98.6 L
2. Sacramento River below Keswick Dam	1, Sh, PPTT, 46.8 L	1, Sh, PPTT, 93.8 L	1, Sh, PPTT, 100.5 L	1, Sh, PPTT, 90.8 L	1, Sh, PPTT, 93.2 L	1, Sh, PPTT, 96.9 L
6. Sacramento River above Bend Bridge near Red Bluff	5, Br, D-77M, 46.6 L	5, Bo, PPTT 95.5 L	4, Bo, PPTT, 96.0 L	1, Sh, PPTT, 90.9 L	5, Bo, PPTT, 102.2 L	5, Bo, PPTT, 98.2 L, *98.2 L*
8. Sacramento River at Colusa	5, Bo, D-77M, 94.5 L	5, Bo, Dip-2L, 93.8 L	(4), Bo, PPTT, 104.3 L	4, Bo, PPTT, 93.8 L	5, Bo, PPTT, 45.4 L	5, Bo, PPTT, 98.0 L
9. Sacramento River at Verona	6, Bo, D-77M, 100.5 L	6, Bo, PPTT, 98.3 L	(6), Bo, PPTT, 102.0 L	8, Bo, PPTT, 95.2 L	NS	5, Bo, PPTT, 101.8 L
10. Sacramento River at Tower Bridge	NS	NS	NS	NS	(4), Br, D-77, 49.1 L, 49.1 L	NS
11. Sacramento River at Freeport	5, Bo, D-77M, 101.4 L	5, Bo, PPTT, 98.0 L	(5), Bo, PPTT, 95.3 L	4, Bo, PPTT, 94.5 L	NS	5, Bo, PPTT, 76.8 L, *74.5 L*
TRIBUTARY SITES						
12. Flat Creek near Keswick	NS	NS	NS	NS	NS	NS
13. Spring Creek below Spring Creek DD near Keswick	NS	NS	NS	1, Sh, PPTT, 72.9 L	NS	1, Sh, PPTT, 93.7 L
14. Spring Creek below Iron Mountain Road near Keswick	NS	NS	NS	NS	1, Sh, PPTT, 77.6 L	NS
15. Whiskeytown Lake at Spring Creek PP near Keswick	NS	NS	NS	NS	NS	NS
16. Keswick Reservoir, Spring Creek Arm, near Keswick	*, Bo, PPTT, 95.3 L	*, Bo, PPTT, 97.5 L	*, Bo, PPTT, 99.6 L	*, Bo, PPTT, 96.3 L	NS	*, Bo, PPTT, 95.6 L
18. Colusa Basin Drain at Road 99E near Knights Landing	NS	NS	NS	NS	NS	(4), Br, 80.9 L
DISTRIBUTARY SITE						
19. Yolo Bypass at I-80 near West Sacramento	NS	NS	NS	NS	30, Br, D-77, CS, 49.7 L	NS

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Table 5. Subsamples of water and quality assurance protocols for sample preservation for various analyses

[$K_2Cr_2O_7$, potassium dichromate; HNO_3, nitric acid; HCl, hydrochloric acid. *, triple-distilled HNO_3 for ultratrace element preservation; (a), split sample held for archive purposes; CA, California; CO, Colorado; conc., concentration; poly, polyethylene or polypropylene; PTFE, polytetrafluoroethylene (Teflon); USGS, U.S. Geological Survey. µm, micrometer; mL, milliliter]

Matrix / Filtration	Analysis	Preservation	Bottle Type, Volume	Laboratory
Whole water	Mercury	$K_2Cr_2O_7$, HNO_3*	Glass, 125 mL (a)	USGS–Boulder, CO
	Major & trace elements (cations)	Acidify (HNO_3)*	Poly, 250 mL (a)	USGS–Boulder, CO
	Iron, redox speciation	Acidify (HCl)	Poly, amber, 125 mL	USGS–Boulder, CO
	Nutrients	Chill	Poly, amber, 125 mL	USGS–Arvada, CO
	Suspended sediment conc.	None	Poly, 1,000 mL	USGS–Salinas, CA
0.45 µm filtrate (silver filter)	Organic carbon, dissolved	Chill	Glass, amber, 125 mL	USGS–Arvada, CO
Silver filter retentate	Organic carbon, suspended	Chill	petri dish	USGS–Arvada, CO
0.45 µm filtrate (capsule filter)	Mercury	$K_2Cr_2O_7$, HNO_3*	Glass, 125 mL (a)	USGS–Boulder, CO
	Major & trace elements (cations)	Acidify, (HNO_3)*	Poly, 250 mL (a)	USGS–Boulder, CO
	Major elements (anions)	Chill	Poly, 250 mL (a)	USGS–Arvada, CO
	Iron, redox speciation	Acidify (HCl)	Poly, amber, 125 mL	USGS–Boulder, CO
	Nutrients	Chill	Poly, amber, 125 mL	USGS–Arvada, CO
0.40 µm filtrate (membrane filter)	Mercury	$K_2Cr_2O_7$, HNO_3*	Glass, 125 mL (a)	USGS–Boulder, CO
	Major & trace elements (cations)	Acidify (HNO_3)*	Poly, 250 mL (a)	USGS–Boulder, CO
	Iron, redox speciation	Acidify (HCl)	Poly, amber, 125 mL	USGS–Boulder, CO
10,000 daltons ultrafiltrate (tangential-flow, 0.005 µm equivalent)	Mercury	$K_2Cr_2O_7$, HNO_3*	Glass, 125 mL (a)	USGS–Boulder, CO
	Major & trace elements (cations)	Acidify (HNO_3)*	Poly, 250 mL (a)	USGS–Boulder, CO
	Iron, redox speciation	Acidify (HCl), chill	Poly, 250 mL	USGS–Boulder, CO
Colloid concentrate, 10,000 daltons retentate (tangential-flow, 0.005 µm equivalent)	Major & trace elements (cations) –total digestion and sequential-extractions	Chill, freeze dry	PTFE, 500 mL or 1,000 mL	USGS–Boulder, CO
	Lead isotopes	Chill, freeze dry	PTFE, 30 mL	USGS–Denver, CO
	Particle size distribution (photon correlation spectrometry)	Chill, freeze dry	Poly, 100 mL	USGS–Boulder, CO

including most of the colloidal material, from the water. A separate set of four (in a stack) 10,000 nominal molecular weight limit (NMWL), or daltons, low-binding, regenerated cellulose tangential-flow membranes were used for each sampling site to reduce cross-contamination problems. The 10,000 NMWL regenerated cellulose membranes retain particles in the range of 0.0035 to 0.0055 µm (Millipore Corporation, 1993). In this report, we refer to the pore size of these membranes as "0.005-µm equivalent

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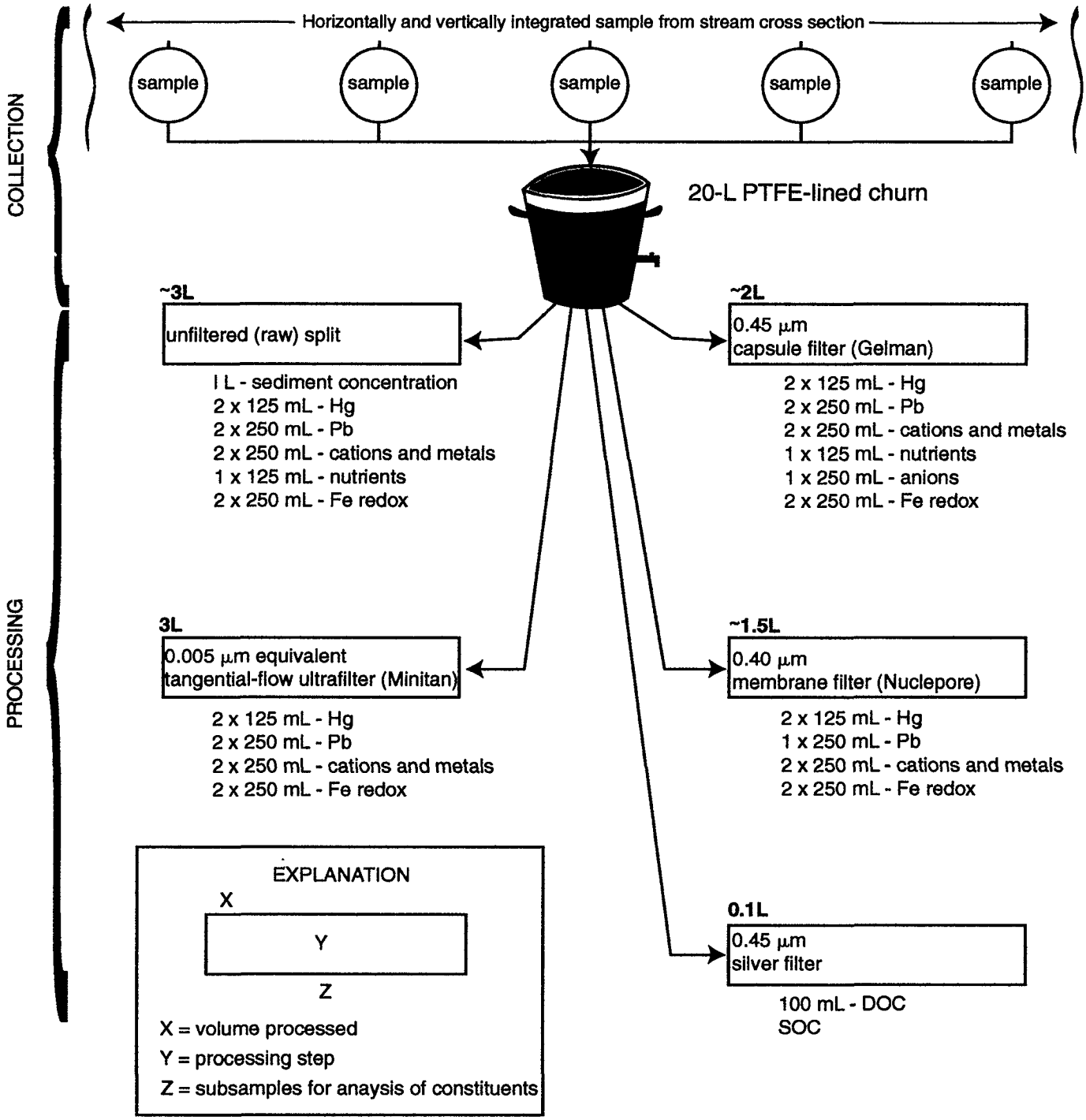

Figure 9. Diagram showing the procedure for the collection and processing of composite water samples in the Sacramento River Basin, California. DOC, dissolved organic carbon; SOC, suspended organic carbon. PTFE, polytetrafluoroethylene; Hg, Mercury; Pb, lead; Fe, iron; ~, approximately; µm, micrometer; mL, milliliter; L, liter.

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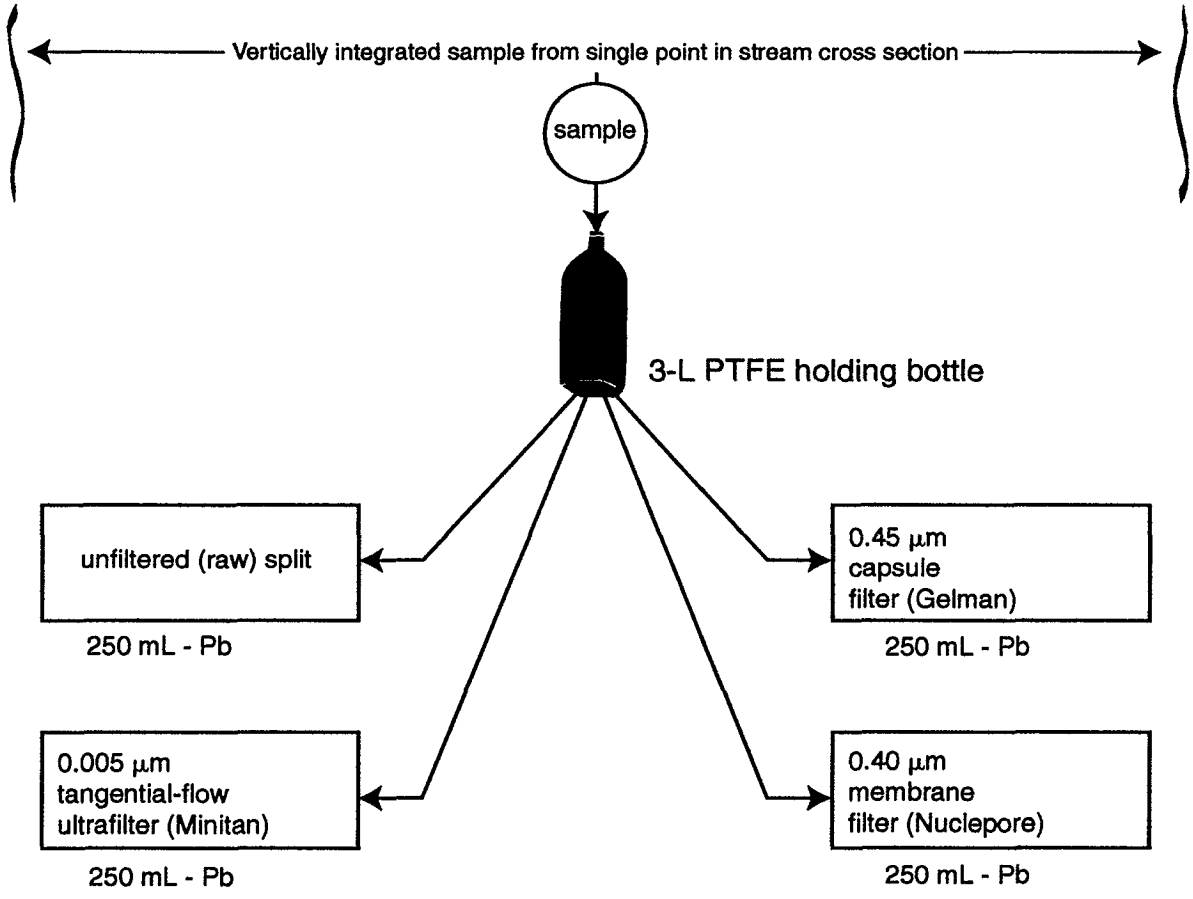

Figure 10. Diagram showing the procedure for the collection and processing of grab water samples in the Sacramento River Basin, California. PTFE, polytetrafluorethylene; Pb, lead; µm, micrometer; mL, milliliter; L, liter.

pore-size diameter." Ultrafiltrates produced by tangential-flow ultrafiltration with 10,000 NMWL membranes are the best available approximation to truly dissolved concentrations. Prior to filtration, the membranes and filter apparatus were acid-rinsed with a 1 percent (by volume) solution of high-purity, distilled nitric acid (Kuehner and others, 1972) to remove potential metal contamination on the filters, followed by a thorough rinsing with deionized water (type 1, 18 MΩ-cm).

Whole-water and filtered subsamples for total mercury analysis were collected in duplicate as 125-mL sample aliquots in acid-cleaned borosilicate glass bottles. All water subsamples for mercury analysis were preserved by the addition of 5 mL of a 1:100 mixture of high-purity potassium dichromate and nitric acid (w:v,g $K_2Cr_2O_7$:mL HNO_3)(table 5).

Large water samples totalling approximately 100 L were collected then split in four acid-cleaned 25-L high density polyethylene (HDPE) carboys for the recovery of suspended colloids (fig. 11). The water contents, undisturbed in the original carboys, were allowed to settle for 1 hour at room temperature to separate the material greater than about 1 µm in diameter. After settling, the supernatant phase was filtered with a Pellicon, model OM-141, tangential-flow ultrafilter (Millipore Corporation) using a stack of 8 individual 10,000 NMWL (0.005-µm equivalent pore-size diameter) regenerated cellulose membrane filters. The Pellicon, rather than the Minitan, was used to isolate a concentrate of colloidal-size particulate material because of the larger surface area of the filters (7,440 cm^2 for the Pellicon as opposed to 240 cm^2 for the Minitan). This larger surface area (30:1) greatly increased the efficiency of processing the 100-L sample. Pellicon filter membranes were rinsed with dilute nitric acid and then rinsed with deionized water prior to filtration as described previously for the Minitan membranes. During sample processing with the Pellicon unit, most of the ultrafiltrate was discarded and the "retentate," or residual solids, were retained. After the original volume of approximately

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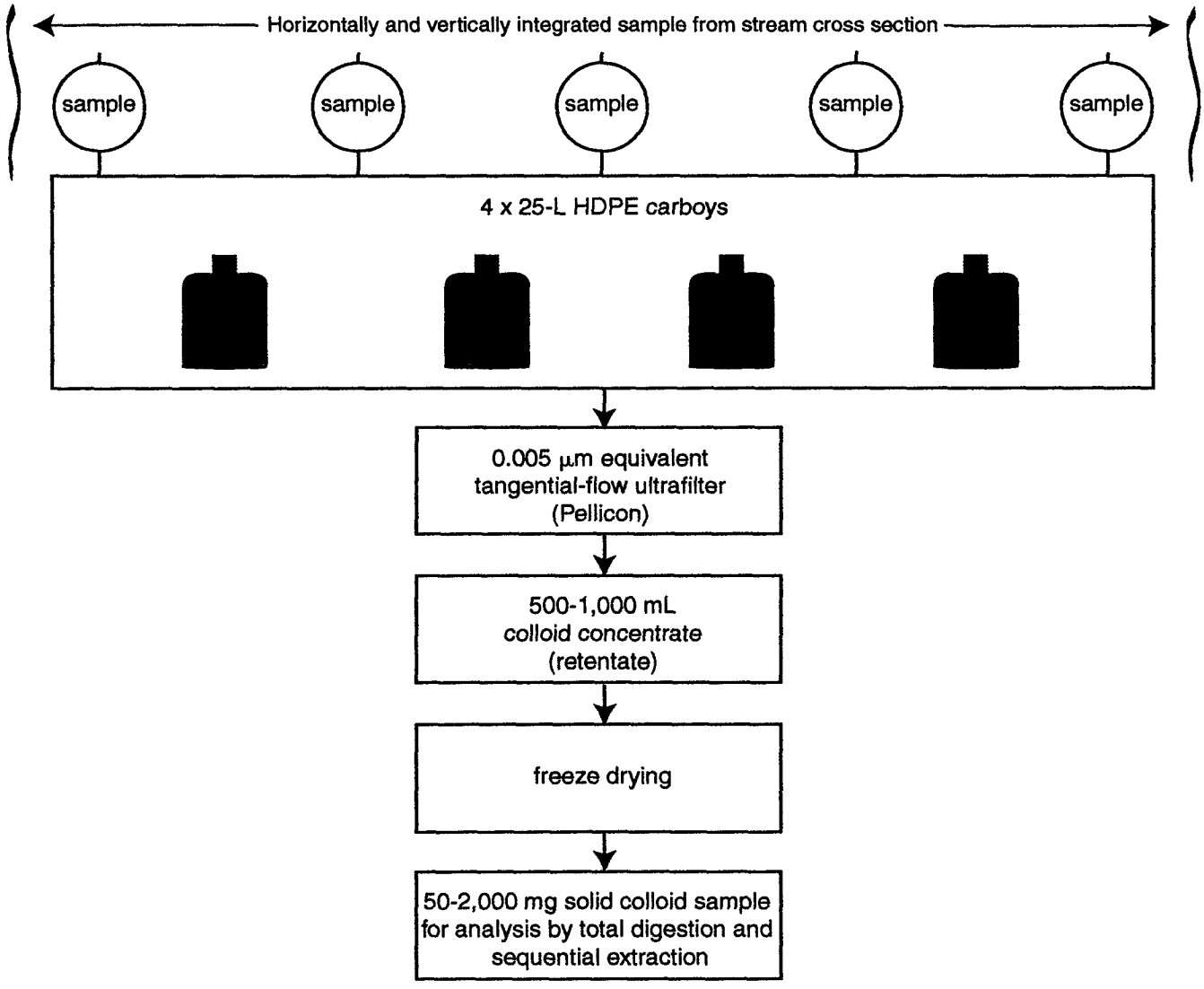

Figure 11. Diagram showing the procedure for the collection and processing of colloid samples in the Sacramento River Basin, California. HDPE, high density polyethylene; µm, micrometer; mL, milliliter; mg, milligram; L, liter.

100 L was reduced to about 0.5 L, the Pellicon filter unit was disassembled and the residual solids on the filter plates were recovered into a Teflon bag using a squeeze bottle filled with ultrafiltrate. The final colloid concentrate was stored in a 1 L PTFE bottle and refrigerated.

The colloid concentrate was dewatered by spinning successive 50-mL quantities in a polycarbonate centrifuge tube at 12,000 revolutions per minute and 10°C using a Sorval model RC-5B refrigerated centrifuge. As each aliquot was centrifuged, the supernatant liquid was carefully decanted to waste. When dewatering by centrifugation was completed, the residue was freeze-dried for 24 hours to remove the residual moisture. Subsamples of the freeze-dried material were microwave digested (Milestone, Model mls 1200 "mega" microwave oven) using a combination of distilled nitric acid, hydrochloric acid, and hydrofluoric acid (HF) in PTFE closed-digestion vessels (Hayes, 1993). Following the digestion and before the analysis, boric acid was added to the solutions to reduce the activity of the excess fluoride, thereby reducing deleterious impact on glassware and plasma torches. The digested samples were diluted to an appropriate concentration and stabilized with the same preservative solutions used for the preservation of similar water samples (table 5); namely, nitric acid was added to subsamples intended for analysis of

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cations and trace metals, and potassium dichromate ($K_2Cr_2O_7$) plus nitric acid were added to subsamples intended for analysis of mercury. Subsamples of freeze-dried colloid solids for particulate size distribution were preserved with sodium azide (NaN_3, to a final concentration of 0.01 percent) to inhibit bacterial growth, then refrigerated until analyzed.

Sequential chemical extractions (Hayes, 1993) were performed on the colloid samples that had a sufficient amount of material, approximately greater than 200 mg. A 100-mg sample was first extracted in a 30-mL PTFE screw-capped tube in a reducing environment with acidified hydroxylamine hydrochloride to remove metals weakly bound to the sediment and those associated with any iron or manganese oxide coatings. This fraction is referred to as the "reducible" phase. The residue from this extraction was treated with a potassium persulfate solution to oxidize any organic coatings or organic and sulfide particles. This fraction is referred to as the "oxidizable" phase. Finally, an $HCl–HNO_3–HF$ acid microwave digestion, identical to that used for total digestions, was performed on the residue from the oxidizable phase extraction. This fraction is termed the "residual" phase. All chemical extractions were carried out in closed containers, and sample aliquots were preserved immediately (as with water samples in table 5) to minimize contamination or loss of volatile constituents such as mercury.

Streambed Sediment Sample Preparation

Streambed sediment samples were chilled on ice immediately after collection and stored at 5°C until further processing. A subsample for particulate size distribution was chilled until analysis. The remaining sediment samples were freeze dried for 24 hours to remove the residual moisture.

Dissolution of subsamples of streambed sediments was performed using a total $HCl–HNO_3–HF$ acid microwave digestion procedure identical to that used for suspended sediments (Hayes, 1993). The digested samples were diluted to an appropriate con-centration range for analysis by inductively coupled plasma methods and stabilized with the same reagents used for the preservation of the water samples (table 5).

Caddisfly Sample Preparation

Specimens were partially thawed in batches, rinsed with cold deionized water (type 1, 18 MΩ-cm) to remove sediment and detritus, and then transferred to a glass sorting dish that was placed on a bed of ice. Individual animals were immersed using tweezers in a small amount of water and viewed under a stereomicroscope for identification and further cleaning. Instars of *Hydropsyche californica* were not sorted, although smaller specimens that could not be clearly identified were discarded. Identified and cleaned specimens then were transferred to a second container and put on ice. When the sample had been sorted and cleaned, the animals were blotted dry with tissue paper, pooled into replicate subsamples of caddisfly larvae of approximately the same wet weight, and temporarily refrigerated.

Cold 0.05 Molar (*M*) Tris-hydrochloride buffer [pH 7.4, previously degassed to remove carbon dioxide (CO_2) with nitrogen gas (N_2)] was added to each subsample at a ratio of 8:1 (mL Tris-hydrochloride:g wet sample). Subsamples were homogenized with a stainless-steel, high-speed tissue homogenizer under a nitrogen (N_2) atmosphere for 1 minute. The homogenate was split into two fractions: one for the whole-body metal analysis and the other for the cytosolic metals. The cytosol was isolated by centrifuging the homogenate at 100,000 *g* for 1 hour at 5°C. The supernatant (cytosol) and pellet were collected and transferred to separate screw-cap glass vials. Samples were kept cold throughout the procedure. Sample fractions were frozen at –20°C as they were prepared. Later, they were freeze dried, weighed, digested by reflux in hot, isopiestically distilled (Kuehner and others, 1972) 16 *N* nitric acid. When the digestion was complete, the sample residues were evaporated to dryness. Before analysis, sample residues were reconstituted by the addition of 10 mL of 1 percent distilled nitric acid. For the trace metal analysis, 5 mL of this solution was diluted to 50 mL.

All plastic and glassware used for the preparation and digestion were cleaned by soaking overnight in a Micro-90 solution (available from International Products Corp., Burlington, New Jersey), rinsed with deionized water, then washed in 5 percent hydrochloric acid and rinsed with deionized water. The tissue homogenizer was cleaned by soaking it overnight in a solution of RBS 35 detergent (available from Pierce, Rockford, Illinois) and rinsing it in deionized water.

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Analytical Procedures

This section presents information on analytical procedures used in this study. In cases where USGS-approved methods are used, such as the determinations made by the USGS's NWQL, relatively little information is given and the reader is referred to published sources. More detailed information is given in this section for research methods that are not officially approved by the USGS as "production methods."

Major Cations and Trace Elements

Inductively Coupled Plasma Spectrometry

Major elements that were present in samples at high concentration levels, including calcium (Ca), magnesium (Mg), sodium (Na), and silica (Si, reported as SiO_2), respectively, were determined by inductively coupled plasma–atomic emission spectrometry (ICP–AES) techniques utilizing a Jarrell–Ash Atomcomp 975, multichannel emission spectrometer. A description of the analysis conditions and procedures was reported by Garbarino and Taylor (1979). Potassium (K) also was determined by ICP–AES using a Varian Liberty 150AX Turbo axial-view sequential spectrometer. A modified flow-injection, pneumatic-nebulization sample introduction technique (Varian SPS5 Sample Prep Station) was employed to perform this determination (Antweiler and Taylor, 1998).

Except for mercury, trace-element determinations were performed by inductively coupled plasma–mass spectrometry (ICP–MS), using a Perkin Elmer Elan Model 5000. Aerosols of acidified aqueous samples were introduced into the spectrometer with a cone-spray pneumatic nebulizer. Multiple internal standards (indium [In], iridium [Ir], rhodium [Rh], and thorium [Th], respectively), which covered the mass range, were used to normalize the system for drift. Details of the specific analysis techniques, procedures, and instrumental settings were described by Garbarino and Taylor (1995).

Multielement instrument calibration standards for ICP–AES determinations were matrix-matched with comparable concentrations of reagents used in the digestion procedure. This was simulated by the composition of the digest, which reduced interelement suppression interference effects. Because of the higher sensitivity of ICP–MS relative to ICP–AES, 10:1 dilutions of the digest solutions were used for ICP–MS determinations to avoid interelement interferences.

Atomic Fluorescence Spectrometry

Mercury stock and standard solutions were made from Puratronic grade (99.9995 percent) mercuric chloride ($HgCl_2$) salt (Johnson Mathey) and preserved in a solution of high-purity nitric acid and primary-standard grade potassium dichromate using the same reagents and concentrations as those used to preserve samples (table 5). Deionized water (type 1, 18 MΩ-cm) was used for preparing all standards and reagent solutions. A 2 percent stannous chloride ($SnCl_2$) solution (wt:volume, stannous chloride:3 percent hydrochloric acid) in 3 percent hydrochloric acid (volume:volume, hydrochloric acid:type 1, 18 MΩ-cm deionized water) was used for the reduction of mercury to its elemental form in the cold vapor reactor.

Trace concentration levels of mercury were measured using an automated, cold vapor–atomic fluorescence spectrometer or CV–AFS (PS Analytical) using methods described previously by Roth (1994) and by David A. Roth and others (U.S. Geological Survey, written commun., 1999). Instrumental parameters for the atomic fluorescence mercury analysis are listed in table 6.

The procedure involves reduction of mercury in the sample with excess stannous chloride to produce elemental mercury vapor. The vapor is transported to the detector with a stream of argon gas. Peak height intensities of unknown samples are compared to a six-point calibration curve prepared from aqueous

Table 6. Operational settings for analysis of mercury with the cold vapor–atomic fluorescence spectrometer

[s, second]

Characteristics	Settings
Cold-vapor reactor timing	
Delay	15 s
Rise	30 s
Analysis	30 s
Memory	60 s
Argon flow rates	
Sample	0.30 liter per minute
Shield	0.25 liter per minute
Backflow	2.7 liter per minute
Fluorescence spectrometer settings	
Coarse gain	1,000
Fine gain	optimized
Integration time	0.25 s
Damping	32 readings (8 s)

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standards ranging in concentration from 0 to 50 ng/L, preserved with potassium dichromate and nitric acid in a similar manner as with the samples.

Iron Redox Speciation

Total iron (Fe) and Fe(II) were determined using a modification of the FerroZine colorimetric technique proposed by Stookey (1970). For Fe(II) determination, an adequate volume of acidified sample (as much as 20 mL) to give 0.1–40 µg iron per 25 mL, was transferred by pipet into a 25-mL volumetric flask. Then, 0.5 mL FerroZine reagent was added and the contents of the flask were mixed. Next, 1.25 mL of an ammonium–acetate buffer solution was added, the flask was shaken, and at least 5 minutes were allowed for full color development. The solution in each flask was then diluted to the mark and shaken well. Absorbance was measured within 2 hours at 562 nm using an ultraviolet–visible (UV–vis) spectrometer.

For total iron, the same procedure was used as for Fe(II), except for the addition of 0.25 mL hydroxylamine hydrochloride, a reducing agent, to the samples before the addition of 0.5 mL of FerroZine reagent. The procedure for all blanks and standards was similar to that described for total iron analysis, including the hydroxylamine hydrochloride step. A linear regression of absorbance versus iron concentration was developed on the basis of at least five standards.

Double-distilled water was used in the preparation of all solutions. Ammonium acetate buffer solution was prepared by mixing appropriate volumes of high-purity acetic acid and ammonium hydroxide. Traces of iron were removed from a solution of reagent grade hydroxylamine hydrochloride by solvent extraction with isoamyl alcohol.

Lead Isotopic Analysis

Isotopic compositions of lead from selected freeze-dried samples of suspended colloids and streambed sediments were determined by chemical separation of lead followed by thermal-ionization mass spectrometry. Samples weighing 3 to 10 mg (containing 80 to 100 ng of lead) were decomposed overnight in a 4:1 mixture of 24*M* hydrofluoric acid and 16*M* nitric acid in screw-cap PFA-Teflon vials at 50°C. Lead was separated using anion exchange with analytical grade Dowex-1 X8 resin in 1.2*M* hydrobromic acid (HBr) medium and was eluted from the anion-exchange columns with 1.0*M* nitric acid, following the procedures of Unruh (1982). The purified lead separate was loaded onto a rhenium filament for mass spectrometry analyses using the conventional phosphoric acid–silica gel method (Cameron and others, 1969). Lead blanks for the chemical procedure were less than 0.1 ng.

Lead isotopic data were initially measured using a VG Elemental model Sector 54 seven-collector mass spectrometer operated in "static" mode. However, during the course of this work, an electrical malfunction in this mass spectrometer made it necessary to complete the analyses using a VG Elemental model 54R single-collector mass spectrometer. Mass fractionation during analyses with both mass spectrometers was monitored by analyses of National Institute of Standards and Technology (NIST) lead isotope standard SRM-981, using the values for this standard reported by Todt and others (1993). Analytical uncertainties in the fractionation-corrected data were calculated in the manner prescribed by Ludwig (1979) and reflect both the internal precision of each individual run, as well as the uncertainties induced by the mass-fractionation corrections.

Anions

The determination of major anions in water, including chloride (Cl^-), fluoride (F^-), and sulfate (SO_4^{2-}), was done on filtered samples by ion-exchange chromatography following procedures described by Fishman and Friedman (1989). The anion determinations were made at the USGS's NWQL in Arvada, Colorado.

Nutrients

A standard suite of nutrient analyses was done for each water sample taken in this study, using both raw (unfiltered) and filtered samples. Samples that required filtration were filtered with a 0.45-µm capsule filter (Gelman) in accordance with standard NAWQA protocols (Shelton, 1994) and analyzed at the USGS's NWQL.

A total of eight nutrient determinations are reported for each water sample—three analyses of phosphorus (P) forms and five analyses of nitrogen (N) forms (table 7). The phosphorus determinations included orthophosphate in filtered water, plus total phosphorus in both raw and filtered water. Orthophosphate was determined using an automated,

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colorimetric, phosphomolybdate blue procedure with antimony (Sb) added to increase the reduction rate (Patton and Truitt, 1992; Fishman, 1993). Total phosphorus was determined colorimetrically as orthophosphate after Kjeldahl digestion (Patton and Truitt, 1992).

Filtered water samples were analyzed for nitrogen in the following forms: (1) nitrite (NO_2^-), (2) nitrite plus nitrate (NO_3^-), (3) ammonia (NH_3), and (4) ammonia plus organic nitrogen. Ammonia plus organic nitrogen was also determined in raw water samples. The method used for nitrite determination was diazotization using sulfanilamide and N-1-naphthylethylenediamine under acidic conditions to form a red compound, the absorbance of which was determined colorimetrically using an automated-segment flow procedure (Fishman, 1993). Nitrite plus nitrate determinations were made by reducing nitrate to nitrite using cadmium metal, followed by nitrite analysis by diazotization (Fishman, 1993). Ammonia determinations were performed using a salicylate-hypochlorite method, in the presence of ferricyanide ions, that produces the salicylic acid analog of indophenol blue, which was analyzed colorimetrically using an automated-segmented flow procedure (Fishman, 1993). The determinations of ammonia plus organic nitrogen in raw and filtered samples were made using the same Kjeldahl digestion as that used for total phosphorus, in which the organic nitrogen is reduced to the ammonium ion, followed by determination of the ammonium ion by the colorimetric salicylate-hypochlorite method (Fishman and Friedman, 1989; Patton and Truitt, 1992).

Organic Carbon

Dissolved organic carbon (DOC) concentrations were determined on 100-mL filtered water samples (0.45-µm silver membrane filter). The filtrates were first acidified to remove dissolved and colloidal carbonates and bicarbonates, then the organic carbon was oxidized to carbon dioxide with persulfate and ultraviolet light. The carbon dioxide was then measured by infrared spectrometry using a Dorhmann carbon analyzer (Brenton and Arnett, 1993).

Suspended organic carbon (SOC) concentrations were determined with the residual material that was collected on the silver membrane filters used to prepare DOC samples. The silver membrane filters were treated with acid to dissolve inorganic forms of carbon, then were reacted with potassium persulfate in glass ampules for 4 hours at 116° to 130°C. The ampules were then broken in the carbon analyzer, releasing carbon dioxide which was measured by infrared spectrometry using an Oceanography International carbon analyzer (Wershaw and others, 1987).

Particulate Size Distribution

Colloids

The size distribution of colloids was determined from subsamples of the residual colloid concentrates collected from tangential-flow ultrafiltration procedure (Pellicon, discussed earlier in this report). Samples for colloid particulate size distribution analysis were subsampled from the colloid concentrate and preserved to inhibit bacterial growth with sodium azide, to a final concentration of 0.01 percent, and refrigerated until analyzed. Before analysis, samples were warmed to room temperature and were shaken to homogenize the contents, and a few milligrams were removed by Pasteur pipette. Three drops of a nonionic surfactant, FL-70 (Fisher Scientific) at a concentration of 2.5 percent (volume:volume, FL-70:type 1

Table 7. Types of nutrient analyses and analytical methods

Nutrient	Sample type		Analytical Method
	Unfiltered	Filtered	
Phosphorous			
Orthophosphate	No	Yes	Phosphomolybdate blue
Total phosphorous	Yes	Yes	Kjeldahl digestion with phosphomolybdate blue
Nitrogen			
Nitrite	No	Yes	Diazotization
Nitrite plus nitrate	No	Yes	Reduction using cadmium with diazotization
Ammonia	No	Yes	Salicylate–hypochlorite
Ammonia plus organic nitrogen	Yes	Yes	Kjeldahl digestion with salicylate–hypochlorite

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deionized water, 18 MΩ-cm) were added to the sample cuvette followed by three drops of sample. The sample-surfactant mixture was diluted (5 mL of type 1 deionized water, 18 MΩ-cm, prefiltered through a 0.45-µm Gelman capsule filter) and mixed, and suspended particulates were dispersed by ultrasonication (with a Horiba Ultrasonic Disrupter, model HA40) at 20 watts and 20 kHz for at least 60 seconds.

Sample transmittance, at 632.8 nm, was measured with a Milton-Roy, Spectronic Mini20 spectrophotometer, to confirm it was in a suitable range for analysis (60 to 90 percent). The sample was placed in the cell holder of a Brookhaven Photon Correlation Spectrometer and particle size determinations were performed at goniometer angles of 45°, 90°, and 120° measured parallel to an incident laser beam. Particle distributions were calculated using an exponential sampling routine. Instrumentation and calculation parameters used in the colloid particulate size distribution analysis are listed in table 8.

The scattering source of the photon correlation spectrometer used a 10 mW helium–neon laser at a wavelength of 632.8 nm. Slit widths ranging from 100 to 200 µm were used with an optical filter designed for 632.8 nm. Voltage bias on the detector was –1,800 volts (direct current). Toluene (98.8 percent, HPLC grade, Sigma Aldrich) was used as the index matching liquid in the cell holding device to reduce scattered light originating from the liquid-glass interfaces. Temperature of the sample and index matching solutions were maintained at 20.0°C with a recirculating cooler.

Streambed Sediments

Particulate size distribution in streambed sediment samples was determined by wet sieve and X-ray adsorption methods. Wet sieve methods were used to determine the percentage of the mass of each sample less than standard sieve openings of 16, 8, 4, 2, 1, 0.5, 0.25, 0.125, and 0.062 mm (Allen, 1990). The SediGraph 5100 X-ray absorption analyzer manufactured by Micrometrics (Syvitski, 1991) was used to determine the percentage of mass finer than the following sizes in millimeters: 0.031, 0.016, 0.008, 0.004, 0.002, 0.001, 0.00050, and 0.00025.

Quality Assurance and Quality Control

Howard E. Taylor, Ronald C. Antweiler, Charles N. Alpers, David A. Roth, Terry I. Brinton, Daniel J. Cain, James W. Ball, Daniel M. Unruh, *and* Peter D. Dileanis

A variety of measurements and analyses were used to determine the quality of the data produced in this study. Precision and accuracy criteria were evaluated by the analysis of numerous field and laboratory blank samples, standard reference materials, spike recoveries, and replicate samples. Data quality objectives, as described in the Quality Assurance Project Plan (QAPP, Appendix 1), were met in nearly all respects for dissolved data (ultrafilter effluent), whole-water data (unfiltered samples), colloids, total sediment, and sequential extraction sediment analyses. Quantitative analysis for data quality was not made for capsule filter and membrane filter effluents because these data were not used in quantitative interpretations outlined in a companion report by Alpers and others (2000).

Data Quality Objectives

Accuracy is defined in this study as the measure of the degree of conformance of values generated by a specific method with the true or expected value of that measurement. The accuracy of field measurements

Table 8. Instrumentation and calculation parameters used in the colloid particulate size-distribution analysis

[cP, centipoise; I_m, imaginary part of the measurement calculation of the refractive index; R_c, real part of the measurement calculation of the refractive index; nm, nanometer; °C, degree Celsius]

Parameter	Setting	Parameter	Setting
Prescale (gain)	0	Viscosity	1.002 cP
Sampling time	30–250 milliseconds (optimized)	Wavelength	632.8 nm
Sample duration	6 seconds	Refractive index	
Acquisition angle	45°, 90°, and 120°C	of liquid	1.4903
First channel used	Channel 2[1]	of particle (R_c)	1.59
Temperature	20°C	of particle (I_m)	0

[1]Channel 1 was omitted because it had excessive errors.

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was established by the use of standard methods of analysis with the appropriate calibration standards. The accuracy of laboratory analytical data for trace metals and major cations was assessed by analyzing standard reference materials (SRM) and the recovery of known concentrations of analytes in spiked samples. For the SRMs, the percentage recovery (REC) was computed as:

$$REC_{SRM} = \frac{\text{measured value}}{\text{certified or most probable value}} \times 100 \quad (1)$$

For the spiked samples, the REC was computed as:

$$REC_{SPIKE} = \frac{\text{measured value}}{\text{expected value}} \times 100 \quad (2)$$

For all analytes discussed in the QAPP, the data quality objective with regard to accuracy was to have REC values equal to 100 ± 25 percent for concentrations greater than 10 times the detection limit, and 100 ± 50 percent for concentrations less than 10 times the detection limit.

Precision (or variability) is defined in this study as the degree of similarity among independent measurements of the same quantity. The precision of laboratory analytical data was evaluated by randomly submitted split samples and evaluated in terms of relative percentage difference (RPD), where

$$RPD = \frac{\text{difference between reported values}}{\text{average reported value}} \times 100 \quad (3)$$

For all analytes discussed in the QAPP, data were considered sufficiently precise when the RPD values were less than 25 percent for concentrations greater than 10 times the detection limit, or less than 50 percent for concentrations less than 10 times the detection limit. Concentrations in water and solid samples were determined for numerous additional elements not specifically mentioned in the QAPP, such as rare earth elements and other trace elements. For these analytes, precision was evaluated using percentage Relative Standard Deviation (RSD), defined in a later section of this report.

Completeness (a term specified by the EPA to conform to their preferred QAPP) was considered in this study as the percentage of analyses meeting the accuracy and precision objectives. In all, 48 water samples were taken at various sites during six sampling periods (table 1). Therefore, to achieve the goal of 90 percent completeness described in the QAPP (Appendix 1), 44 of 48 samples needed to meet the data quality objectives. Colloid concentrates were prepared from 41 water samples of which 37 samples needed to meet the accuracy and precision objectives to satisfy the 90 percent completeness goal. Speciation analysis was carried out on 17 of the colloid concentrates of which 16 needed to meet data quality objectives to exceed 90 percent completeness. Accuracy, precision, and completeness are discussed in turn for each of the analytical procedures, if appropriate, in the remainder of this section.

Major Cations and Trace Elements

Accuracy

The levels of accuracy for the determinations of major cations and trace element concentrations performed in this study were evaluated by three specific techniques: (1) measurement of natural-matrix SRMs, (2) determination of spike recovery information for selected elements, and (3) measurement of blanks, both in the field and in the laboratory. These approaches provide information regarding the proximity of reported analytical results to the best known values of various analytes in the measured samples. This information was used during data interpretation to evaluate bias or systematic error in the measured concentrations of major cations and trace elements in the samples collected during the study.

Standard Reference Materials

Two types of SRMs were used for evaluation in this study: (1) natural-matrix certified SRMs produced by the NIST, and (2) natural-matrix noncertified standard reference water samples (SRWS) produced by the USGS. SRMs were analyzed with each group of water samples analyzed in the laboratory at a frequency of about 30 percent of the total number. For sediment analysis, about 15 percent of the total samples analyzed consisted of reference materials.

The NIST standards used in this study included: SRM 1643a Trace Elements in Water, SRM 1643b Trace Elements in Water, SRM 1643d Trace Elements in Water, SRM 1645 River Sediment, and SRM 2704 Buffalo River Sediment. NIST standards SRM 1643a, b, and d, were also diluted 1:10 to approximate the concentration range anticipated in the samples from this study. USGS standards used in this study included: SRWSs T-99, T-101, T-103, T-105, T-107, T-111, T-113, T-117, T-119, T-125, T-129, T-131,

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T-133, T-135, T-137, T-143, and T-145 for trace elements, and Hg7, Hg10, Hg12, Hg15 and Hg24 (diluted 1:100 to approximate the concentration range for study samples) for trace mercury determinations. Certified values, or "most probable values" (MPV), for selected elements in each of these standards are tabulated elsewhere (Peart and others, 1998). Results of repeated analysis of these standards are tabulated in Appendix 2 of this report.

Summary data obtained from the analysis of dissolved constituent SRMs (table 9), which were processed with every suite of samples throughout the study, demonstrate conformance to the criteria specified in the QAPP (Appendix 1) for the specified "critical" elements. Namely, for each constituent listed, at least 90 percent of the observed values (n) occurred within 25 percent of the certified value or MPV, depending on the SRM (table 1 in Appendix 1). Calculation of REC equals the observed (measured) value divided by either the certified value or MPV (depending on the SRM) multiplied by 100 (to convert to percentage). Table 9 uses a frequency calculation, expressing the percentage of observations at various intervals of various percentage REC levels. Table 9 shows that all determinations of the specified elements for the SRMs were within the stated data quality objective criteria in QAPP (table 1 in Appendix 1). Note that two entries are provided for mercury in table 9: (1) accumulated data for all mercury standards included in the study, and (2) only those standards whose values exceeded the detection limit for mercury by a factor of 10. By definition, when the reported value of the determination approaches the detection limit, the precision deteriorates accordingly (see the section on Precision).

Similar data on accuracy were developed for all other elements that we report (table 10), but that were not specified in the QAPP. For elements that do not have a certified value or MPV in the SRMs, we compare our observations to data reported by NIST as "for informational purposes." These data are provided to assist in the interpretation of other determinations included in this study. Nevertheless, 21 of 24 elements satisfy the criterion that at least 90 percent of analyses are within 25 percent of the certified or most probable values. Only silver (Ag), boron (B), and tellurium (Te) do not meet this criterion.

Several figures summarize the results of the analyses of SRMs and SRWSs. Figures 12 through 16 consist of correlation plots of SRMs for dissolved determinations. Figure 12 shows the correlation between MPV and observed (measured) values for four major elements in the concentration range of 2 mg/L to about 300 mg/L. Figures 13 and 14 show elements in the range of greater than 1.5 µg/L to 3,000 µg/L. Figures 15 and 16 display data for elements with concentrations in the range of 0.6 µg/L to 60 µg/L. Each plot includes a dotted line demonstrating perfect agreement (not a regression line) and lines representing 99 percent confidence bands.

For the establishment of accuracy in sediment analysis, tables are presented showing the data for the determination of NIST SRM 2704–Buffalo River Sediment, which was analyzed with each laboratory analysis group of suspended and streambed sediment samples. A listing of REC data is shown in table 11 for

Table 9. Percentage of determinations for critical elements within the stated percentage recovery for the certified or most probable value for the National Institute of Standards and Technology's standard reference materials (waters) or the U.S. Geological Survey's standard reference water samples

[REC_{SRM}, percentage recovery with respect to standard reference materials; n, number of observations. %, percent]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125[1]	85–115	90–110	95–105
Aluminum	1,917	100	100	99	97	93	72
Cadmium	2,275	99	98	95	88	81	62
Copper	2,275	100	99	97	89	78	59
Iron	881	100	98	90	76	65	41
Lead	1,984	100	100	99	97	92	74
Mercury [2]	605	100	98	81	70	58	38
Mercury [3]	303	100	100	94	88	79	53
Zinc	2,275	100	100	93	89	83	64

[1]Data quality objective was at least 90% completeness in the 75–125% range of REC_{SRM}.
[2]All mercury standards.
[3]Mercury standards with concentrations greater than 10 times the detection limit.

C—034714

C-034715

Table 10. Percentage of determinations of noncritical elements within the stated percentage recovery for the certified or most probable value for the National Institute of Standards and Technology's standard reference materials (waters) or the U.S. Geological Survey's standard reference water samples

[REC_{SRM}, percentage recovery with respect to standard reference material; n, number of observations; *, "for informational purposes" value]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125	85–115	90–110	95–105
Antimony	886	100	100	99	97	85	66
Arsenic	1,187	100	100	98	96	85	56
Barium	1,221	100	100	98	96	92	71
Beryllium	1,087	100	99	98	95	89	65
Bismuth	419	100	99	94	93	90	74
Boron	1,021	100	99	89	78	63	41
Calcium	1,025	100	100	99	91	81	55
Chromium	1,258	100	98	92	84	72	47
Cobalt	1,626	100	100	99	95	90	74
Lithium	1,360	100	99	97	96	90	70
Magnesium	1,025	100	100	99	94	88	68
Manganese	1,655	100	100	98	89	82	64
Molybdenum	1,263	100	100	98	91	80	54
Nickel	1,891	100	100	98	94	84	64
Rubidium*	260	100	97	95	93	93	83
Selenium	1,839	100	98	90	76	64	45
Silica[1]	1,007	100	100	98	92	85	65
Silver	1,183	98	83	69	55	44	30
Sodium	1,025	100	100	96	82	71	51
Strontium	1,222	100	100	98	96	93	79
Tellurium*	235	100	95	73	49	37	18
Thallium	508	100	100	96	95	93	78
Uranium	101	100	100	100	100	97	76
Vanadium	1,243	100	100	98	95	80	66

[1]Silica was the only substance reported as an oxide.

the total determination of elements specified in the QAPP (table 2 in Appendix 1); and table 12 is a tabulation of all other major and trace elements determined on a total basis, but not mentioned specifically in the QAPP. For the elements listed in the QAPP, the REC data in table 11 indicate that accuracy was within the specified data quality objectives. Table 12 includes REC data for 28 elements not listed in the QAPP. For the 16 elements listed in table 12 for which certified values are available for SRM 2704, 11 elements met the criterion of at least 90 percent of SRM analyses in the range of 75–125 percent REC. Three of the other elements (magnesium, nickel [Ni], and silica [SiO_2]) had 89 percent of REC values in this range and 2 of the 16 elements (sodium and potassium) had only 58 percent of REC values in the 75–125 percent range.

Figures 17 through 21 show correlation plots for the analysis of NIST SRM 2704 with regard to total digestions and the sum of sequential digestions. Figure 17 is for five major elements at concentrations within the range from about 2 to 32 percent by weight (wt percent). Figure 18 shows five elements at concentrations within the range of 100 to 30,000 µg/g. Figures 19 and 20 show elements in the range of 3 to 800 µg/g. Finally, figure 21 shows concentration data for trace element standards that range from about 1 to 3 µg/g. On figures 17 through 21, dotted lines represent perfect agreement between observed and certified, or MPV, concentrations, and lines represent 95 percent confidence bands. Because no SRMs are available for sequential extraction data, the sum of the three components (oxidizable, reducible, and residual) are compared with the total values certified in the respective SRM. The data points for these determinations are noted in the legends. Figure 21 shows that the mercury value for NIST SRM 2704 falls at the edge of the 95 percent confidence band on the low side. This is expected, because the procedure for sequential extraction involves several steps that could result in loss of mercury because of its volatility.

C—0 3 4 7 1 5

C-034716

Spike Addition Recovery

Selected water samples ($36 \leq n \leq 50$) were spiked in the field, immediately after processing, for elements: Ag, arsenic (As), Cd, cobalt (Co), chromium (Cr), Cu, Hg, Ni, Pb, selenium (Se), uranium (U), and Zn. For each of these elements in each sample, the REC_{SPIKE} was calculated, as indicated earlier in this report, using the theoretical value (calculated from known amount of spike added) as the basis for recovery. The expected concentration for each spiked element is listed along with the number of spiked samples and a frequency distribution (percentage of observations within a range of percentage recoveries) of REC_{SPIKE} in table 13. Specific quantities of the spike addition will vary slightly from sample to sample depending on its final volume; however, this variation is well within the experimental error of the measurements. Similar to the SRMs, REC_{SPIKE} is calculated by dividing the measured value of the spike by the expected recovered value, multiplied by 100 to convert to percentage recovery. Beryllium was added to the spike solution to serve as an internal standard to compensate for volume variations in samples. All trace elements listed in table 13 that are specified in the QAPP (table 1 in Appendix 1) are within the listed data quality objectives. No spiked additions were performed on sediment samples.

Figure 22 shows a distribution diagram of the REC_{SPIKE} of spiked additions for cadmium, copper, mercury, lead, and zinc versus the percentage of

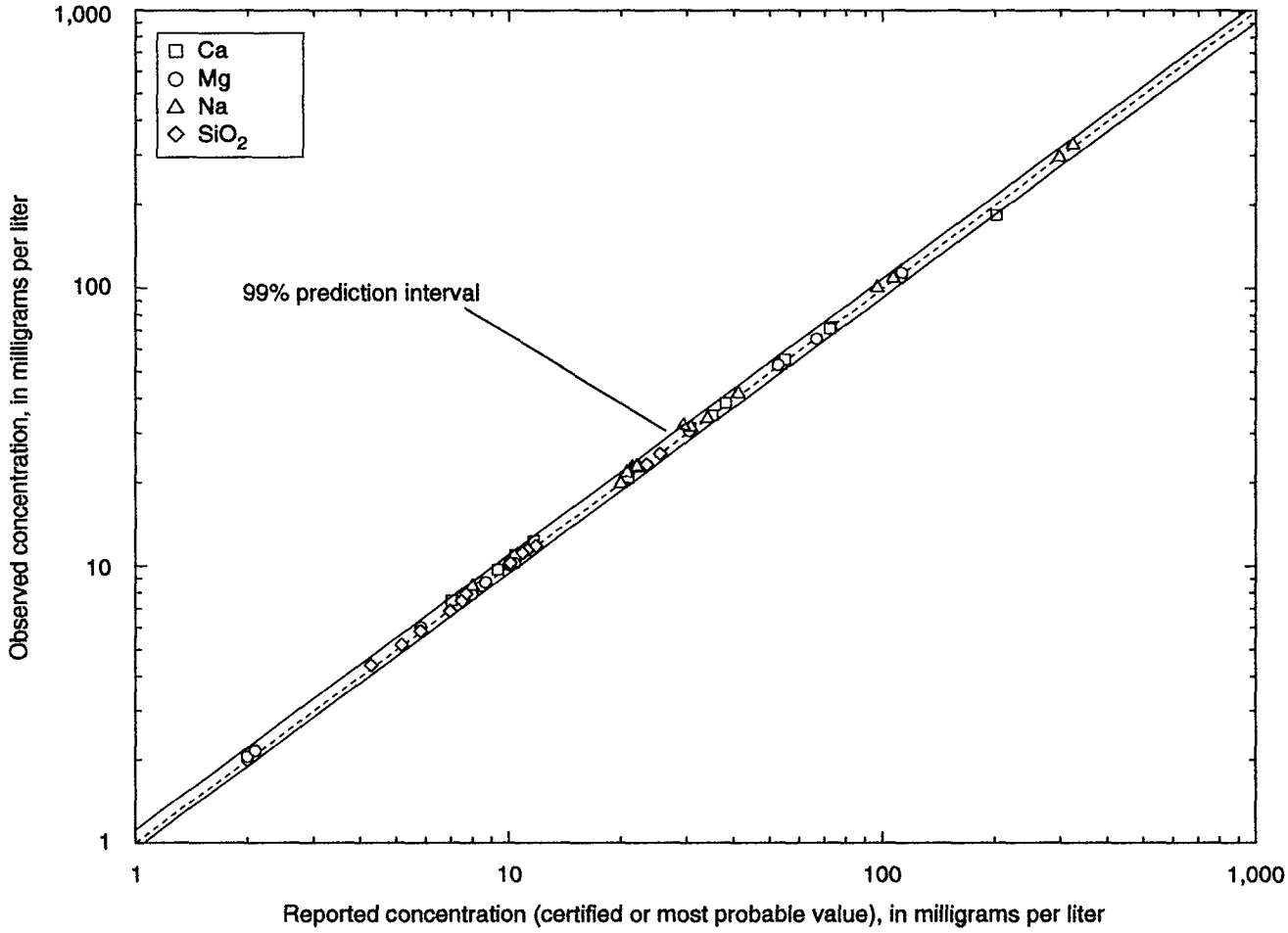

Figure 12. Correlation plot of observed versus reported (certified or most probable value) dissolved concentration values of calcium (Ca), magnesium (Mg), sodium (Na), and silica (SiO_2) in standard reference materials. Standard reference materials tested were National Institute of Standards and Technology's standard reference material 1643b and U.S. Geological Survey's standard reference water samples T99, T101, T103, T105, T107, T117, T125, T131, T133, T135, T137, T143, and T145. Error band represents the 99 percent (%) prediction interval.

C—0 3 4 7 1 6

C-034717

samples observed. Dashed lines specifying limits of compliance (from the QAPP) are shown on the diagram.

Because no SRMs are available for the evaluation of sequential chemical extraction of sediments, the only determination of accuracy is the comparison of the sum of each phase of the extraction to the total certified values for a sediment reference material. This approach provides indirect information regarding the confidence in the sequential extraction process. Table 14 shows the REC_{SRM} values for the sum of the sequential extraction of multiple aliquots of NIST SRM 2704–Buffalo River Sediment, for all elements specified in the QAPP (table 2 in Appendix 1). Similarly, table 15 shows the REC_{SRM} sediment data for all other elements not mentioned in the QAPP that were determined in the sequential extraction of multiple aliquots of NIST SRM 2704–Buffalo River Sediment, compared with the total certified or "informational purposes" values in the reference material. The data in table 15 shows good conformance to the QAPP criteria for all elements except aluminum (Al).

Blanks

Analytical laboratory reagent blank and deionized water blank data were used to correct analyte determinations in concurrently measured samples. Reagent blanks were analyzed at a minimum

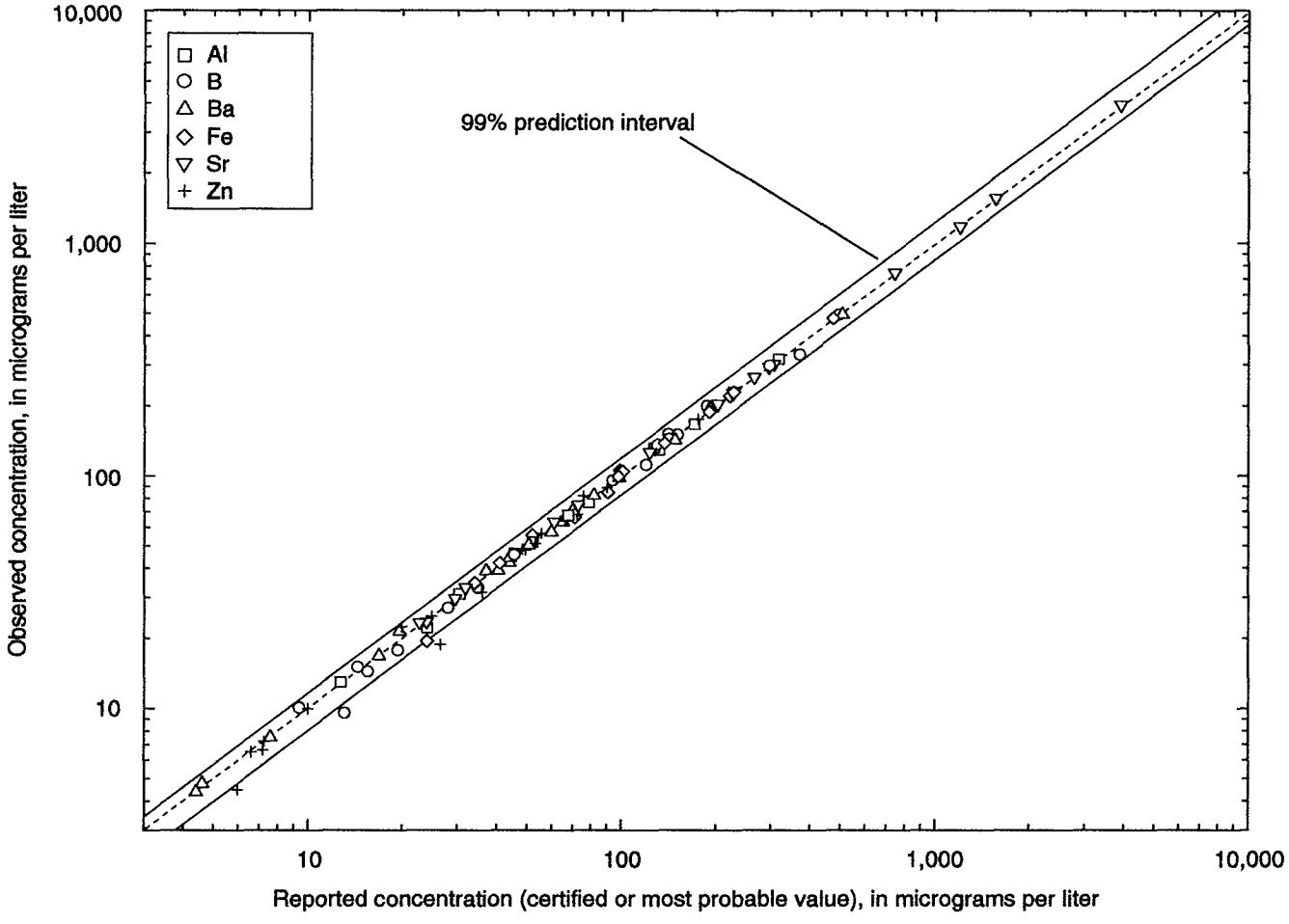

Figure 13. Correlation plot of observed versus reported (certified or most probable value) dissolved concentration values of aluminum (Al), boron (B), barium (Ba), iron (Fe), strontium (Sr), and zinc (Zn) in standard reference materials. Standard reference materials tested were National Institute of Standards and Technology's standard reference materials 1643a, 1643b, and 1643d; and U.S. Geological Survey's standard reference water samples T99, T101, T103, T105, T107, T113, T117, T119, T125, T131, T133, T135, T137, T143, and T145. Error band represents the 99 percent (%) prediction interval.

C—0 3 4 7 1 7

C-034718

of 10 percent frequency of total samples with each group of laboratory analyses performed. Field process blanks for each step of sampling and processing of samples were analyzed at a minimum of 10 percent frequency of all samples collected (dissolved and sediment analyses). The purpose of the field and process blanks was to monitor potential contamination of sample collection and handling processes. No analytical data corrections were made for positive concentration values observed for field or process blanks. Because the dissolved concentrations of trace metals, for interpretation purposes, was focused on data collected by tangential-flow filtration, only blank data related to this process were evaluated. These included tangential-flow filter blanks, deionized water blanks, and churn blanks.

Analytical results of all blank determinations (with appropriate error terms) are tabulated in Appendix 2 (table A2-2). Blank data obtained to evaluate contamination problems are element specific and are focused on the trace elements of primary interest (critical elements) in this study. Results of blank data for these elements are evaluated individually.

Figures 23 through 28 show box plots comparing different types of blank sample concentration data with Sacramento River mainstem dissolved (ultrafiltrate) concentration data for the elements Al, Cd, Cu, Fe, Pb and Zn, respectively. No apparent significant blank problems for the elements aluminum, cadmium, and copper are shown in figures 23–25, respectively. With the exception of an occasional

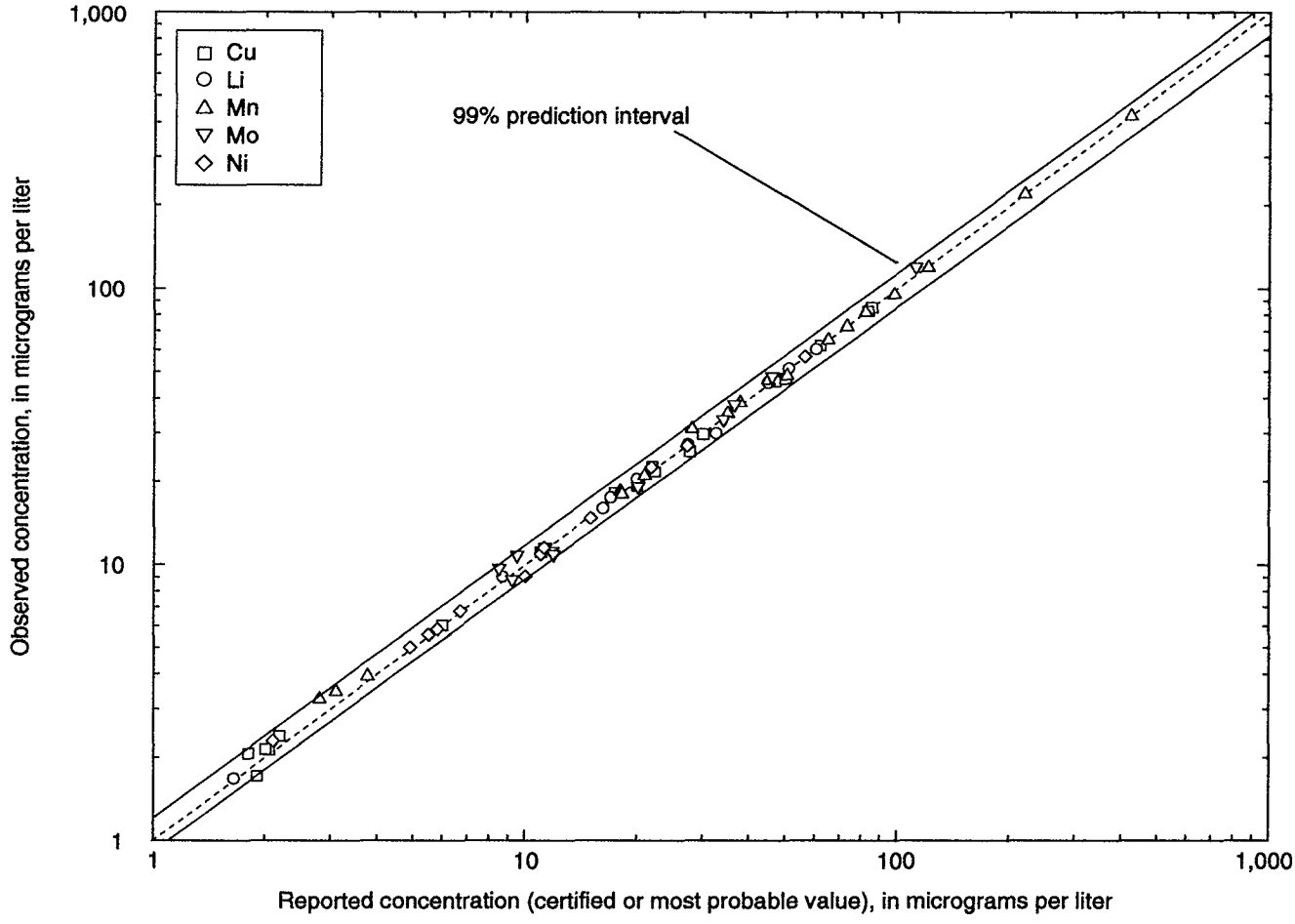

Figure 14. Correlation plot of observed versus reported (certified or most probable value) dissolved concentration values of copper (Cu), lithium (Li), manganese (Mn), molybdenum (Mo), and nickel (Ni) in standard reference materials. Standard reference materials tested were National Institute of Standards and Technology's standard reference materials 1643a, 1643b, and 1643d; and U.S. Geological Survey's standard reference water samples T101, T103, T105, T107, T113, T117, T119, T125, T131, T133, T135, T137, T143, T144, and T145. Error band represents the 99 percent (%) prediction interval.

C—0 3 4 7 1 8

C-034719

outlier, the mean and median of the blanks for these three elements are significantly smaller than the values observed in the mainstem of the river, which are used for the study and interpretation of the distribution of these elements in the hydrologic system.

Blank concentration data for zinc may demonstrate a minor problem on the basis of the apparent marginal overlap of box plots with concentration data shown for the mainstem of the Sacramento River (fig. 28). Two specific deionized water blank outliers, which were known to be contaminated (independently from the deionized water system), were removed from the data set. From this plot it is clear that the source of the overlap is most prevalent from blank samples taken from the churns. In evaluating these data, one must consider the procedure that was used to collect and process the blank samples—namely, the deionized water from the deionizer column was sampled (without filtration) and immediately transferred to the precleaned churn. A subsample from the churn was collected (without filtration) and the remainder was processed through the tangential-flow filtration system, where (after ultrafiltration) a sample was taken for blank analysis ("filter" blank). The only logical explanation for churn blank samples being higher in trace element concentration than either the original deionized water or the tangential flow ultrafiltrate is that particulate matter containing trace elements, from a poorly cleaned churn, was analyzed in these churn blank samples. These constituents would necessarily be removed from the filter blank samples by the nature of the filtration process. In summary, this situation

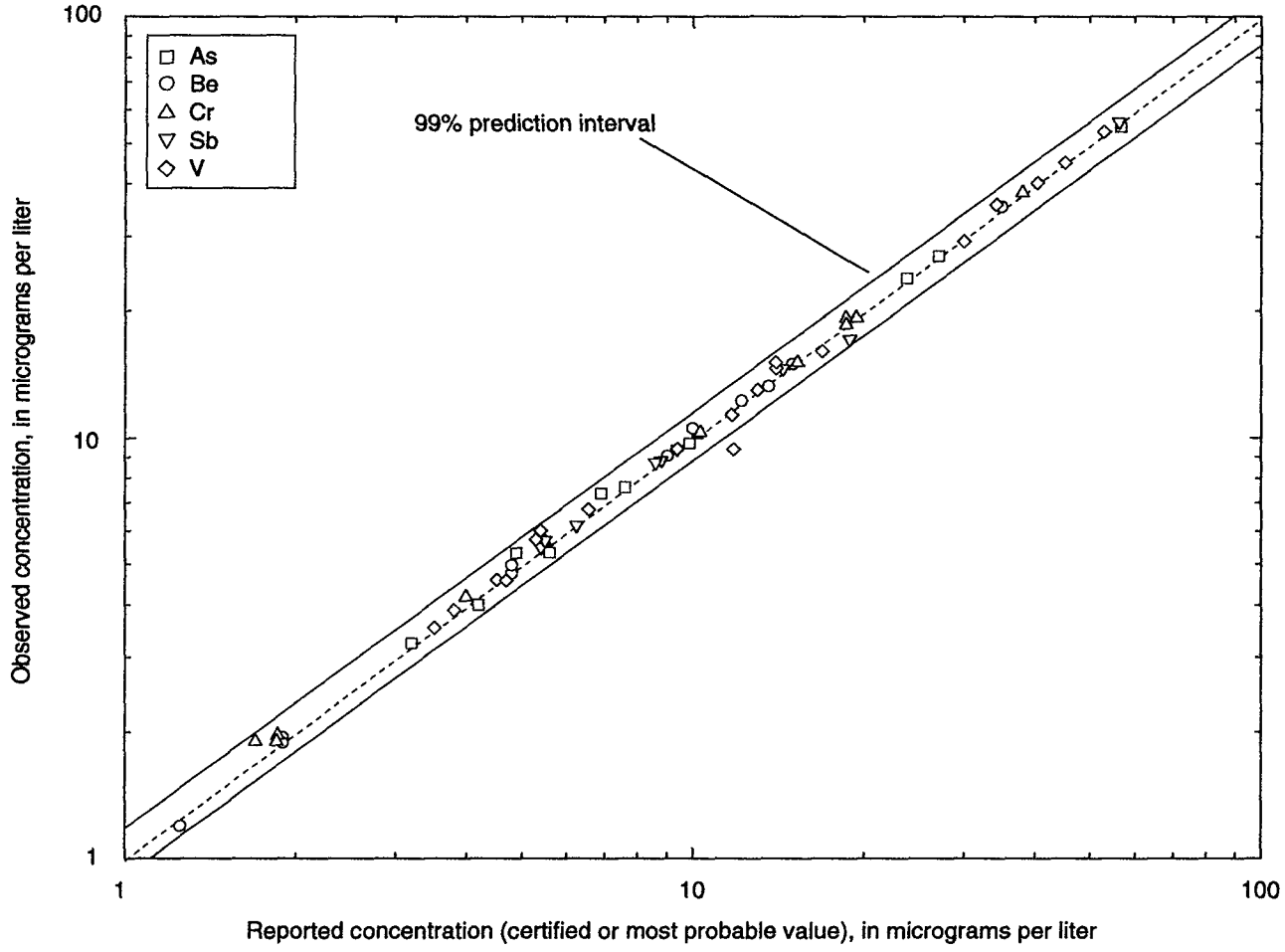

Figure 15. Correlation plot of observed versus reported (certified or most probable value) dissolved concentration values of arsenic (As), beryllium (Be), chromium (Cr), antimony (Sb), and vanadium (V) in standard reference materials. Standard reference materials tested were National Institute of Standards and Technology's standard reference materials 1643a, 1643b, and 1643d; and U.S. Geological Survey's standard reference water samples T99, T101, T103, T105, T107, T113, T117, T119, T125, T131, T133, T135, T137, T143, and T145. Error bands represent the 99 percent (%) prediction interval.

C—0 3 4 7 1 9

C-034720

does not reflect a problem that will impact sample determinations for zinc in ultrafiltrates or hinder the interpretation of such data for zinc.

The filter blanks from Minitan ultrafilters (U1 and U2 in table A2-2, Appendix 2) have zinc concentration values ranging from the detection limit (usually <0.03 µg/L) to 0.57 µg/L. The highest filter blanks for zinc were collected during the first sampling trip. Remedial action was taken (field processing facilities were moved to a more suitable location) to ameliorate these high blanks. The mainstem river samples have a median dissolved zinc value of 0.8 µg/L, and less than 25 percent of the mainstem river samples have concentrations less than 0.4 µg/L; indeed less than 5 percent of the mainstem river samples have lower concentrations than that of the median filter blank samples. These considerations lead to the conclusion that in the samples, zinc data are at most only marginally affected by contamination, and contamination is insignificant in the interpretation of dissolved zinc concentrations in river water samples.

The data for lead concentrations in blank samples show some overlap with ultrafiltrate concentrations in mainstem Sacramento River samples (fig. 27). As with zinc, the most commonly observed blanks with elevated lead concentrations were the churn blanks, which had a mean value of 5 ng/L. The mean and median concentration values of the mainstem

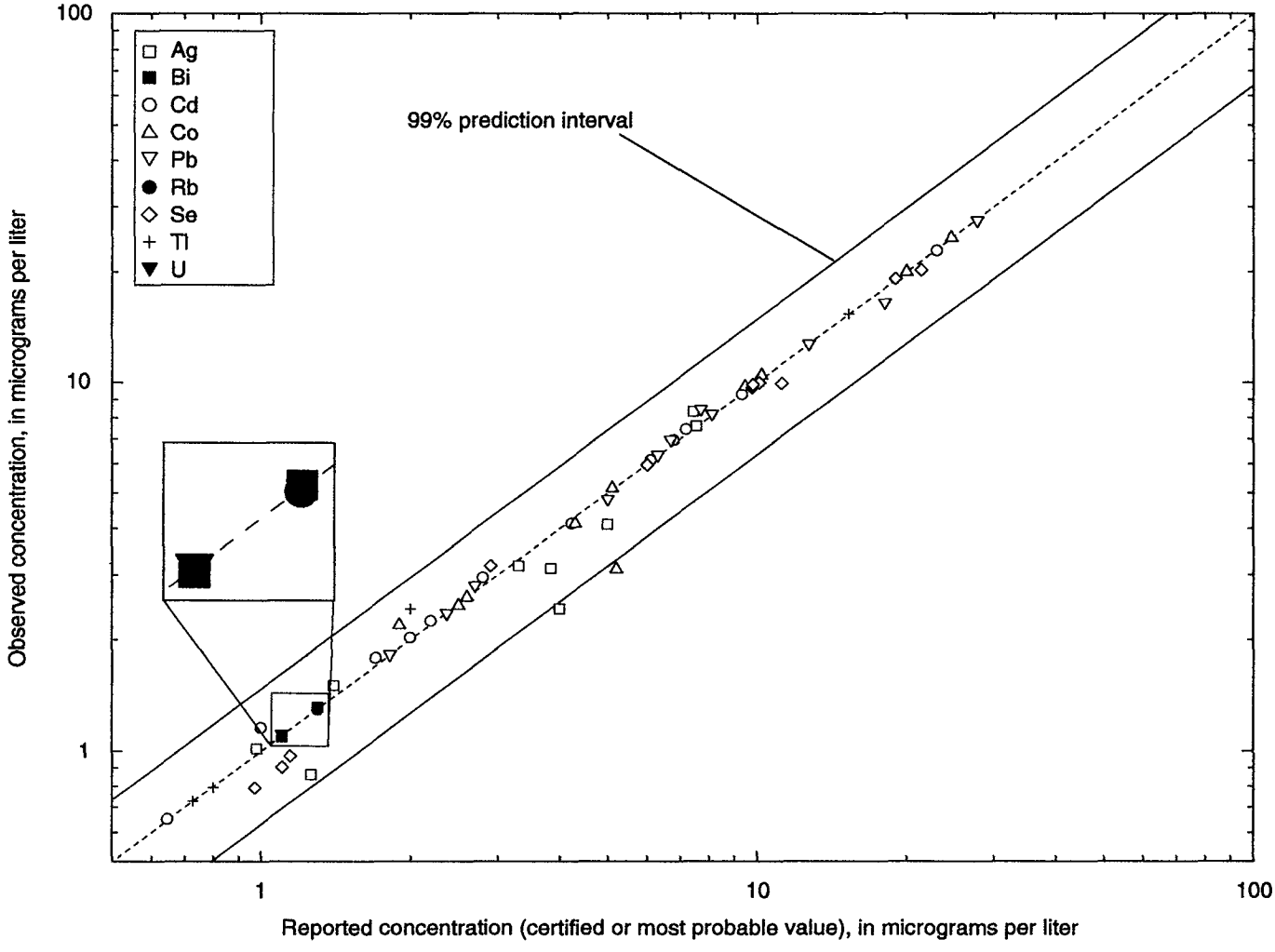

Figure 16. Correlation plot of observed versus reported (certified or most probable value) dissolved concentration values of silver (Ag), bismuth (Bi), cadmium (Cd), cobalt (Co), lead (Pb), rubidium (Rb), selenium (Se), thallium (Tl), and uranium (U) in standard reference materials. Standard reference materials tested were National Institute of Standards and Technology's standard reference material 1643a, 1643b, and 1643d; and U.S. Geological Survey's standard reference water samples T103, T113, T117, T119, T125, T131, T133, T137, and T145. Error band represents the 99 percent (%) prediction interval.

C—0 3 4 7 2 0

C-034721

samples are also about 5 ng/L. In addition, a few concentration values greater than 5 ng/L were observed for deionized water and the filter blanks, suggesting that 5 ng/L is a reasonable reporting limit for dissolved lead for this study.

The data for iron concentrations in blanks show significant overlap with the iron data obtained for the Sacramento River mainstem samples (fig. 26). Therefore, the dissolved iron data for the Sacramento River samples cannot be distinguished from the blank

Table 11. Percentage of determinations for critical elements within the stated percentage recovery for the certified value for the National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment

[REC_{SRM}, percentage recovery with respect to standard reference materials; n, number of observations; %, percent]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125[1]	85–115	90–110	95–105
Aluminum	19	100	100	100	95	68	32
Cadmium	19	100	100	100	95	84	42
Copper	19	100	100	95	89	68	37
Iron	19	100	100	100	100	100	89
Lead	19	100	100	100	100	100	26
Mercury	18	100	100	100	83	83	39
Zinc	19	100	100	100	100	100	89

[1]Data quality objective was at least 90% completeness in 75–125% range of REC_{SRM}.

Table 12. Percentage of determinations of noncritical elements within the stated relative percentage recovery for the certified or "informational purposes" value for the National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment

[REC_{SRM}, percentage recovery with respect to standard reference materials; n, number of observations; *, "informational purposes" value]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125	85–115	90–110	95–105
Antimony	19	100	100	100	89	84	74
Barium	19	100	100	100	79	63	53
Calcium	19	100	100	100	100	100	89
Cerium*	19	100	100	53	26	11	0
Cesium*	19	100	100	100	84	68	53
Chromium	19	100	100	100	100	79	79
Cobalt	19	100	100	100	100	100	37
Dysprosium*	19	100	100	58	0	0	0
Europium*	19	100	100	84	26	26	11
Lanthanum*	19	100	100	58	42	21	5
Lithium	19	100	100	100	100	89	11
Lutetium*	19	100	100	11	0	0	0
Magnesium	19	100	100	89	63	63	32
Manganese	19	100	100	100	100	100	79
Nickel	19	100	100	89	84	58	37
Potassium	19	100	100	58	5	0	0
Rubidium*	19	100	58	5	5	5	5
Samarium*	19	100	100	79	58	37	5
Silica[1]	19	100	100	89	84	74	47
Sodium	19	89	89	58	53	42	21
Strontium*	19	100	100	100	74	74	32
Thallium	19	100	100	100	100	89	16
Thulium*	19	100	100	84	58	47	16
Titanium	19	100	100	100	100	100	100
Uranium	19	100	100	100	100	100	68
Vanadium	19	100	100	100	100	89	32
Ytterbium*	19	100	100	100	95	58	47
Zirconium*	19	100	95	79	42	37	21

[1]Silica was the only substance reported as an oxide.

C—0 3 4 7 2 1

C-034722

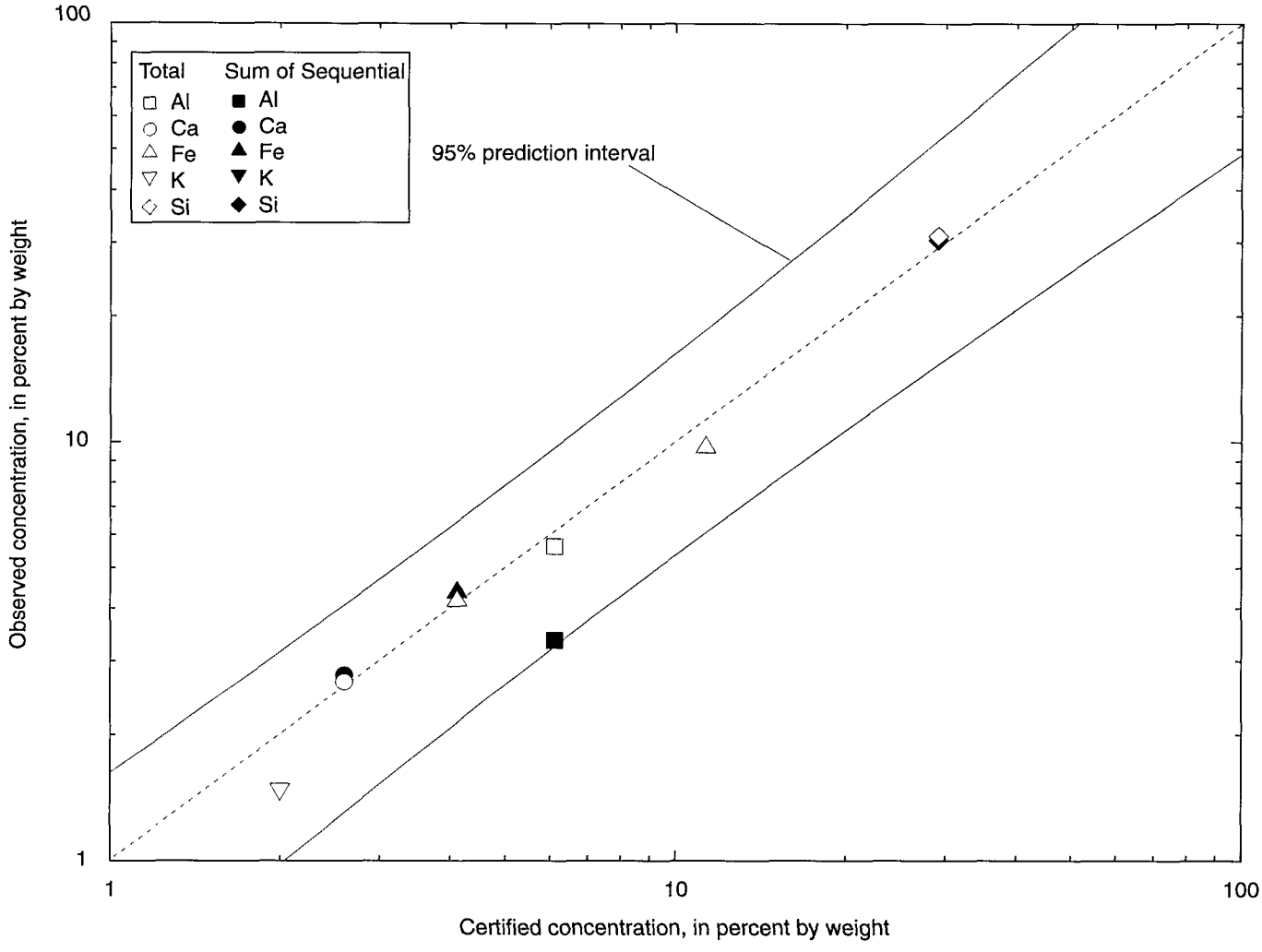

Figure 17. Correlation plot of observed concentration values in total digestions and in the sum of sequential digestions versus certified concentrations of aluminum (Al), calcium (Ca), iron (Fe), potassium (K), and silicon (Si) in standard reference material. The standard reference material tested was National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment. Error and represents the 95 percent (%) prediction interval.

data resulting in an inability to interpret low level, dissolved iron concentrations.

Precision

Each duplicate sample for dissolved constituents (ultrafilter effluent) was analyzed three times. Because of the limited quantities of the freeze-dried colloidal material that were available, single digestions were performed. The solutions from the colloid total digestions, however, were also analyzed in triplicate. Results (for the trace elements listed in table 1 of the QAPP, Appendix 1) for the analyses of field duplicate dissolved samples, expressed as the percentage of sample values whose RPD was below the specified value, are shown in table 16. This table uses the calculation of RPD as specified in the QAPP, which is the difference between the measured value (mean of triplicate determinations) of each of the field duplicates, divided by the mean value of the two duplicates, multiplied by 100 to convert to percentage (as follows):

$$\mathrm{RPD} = \frac{X_{D1} - X_{D2}}{X(D_1 + D_2)} \times 100 \qquad (4)$$

where, X_{D1} and X_{D2} are the mean values of the triplicate laboratory analysis of each of the field duplicates and $X_{(D1+D2)}$ is the mean of X_{D1} and X_{D2}.

C—0 3 4 7 2 2

C-034723

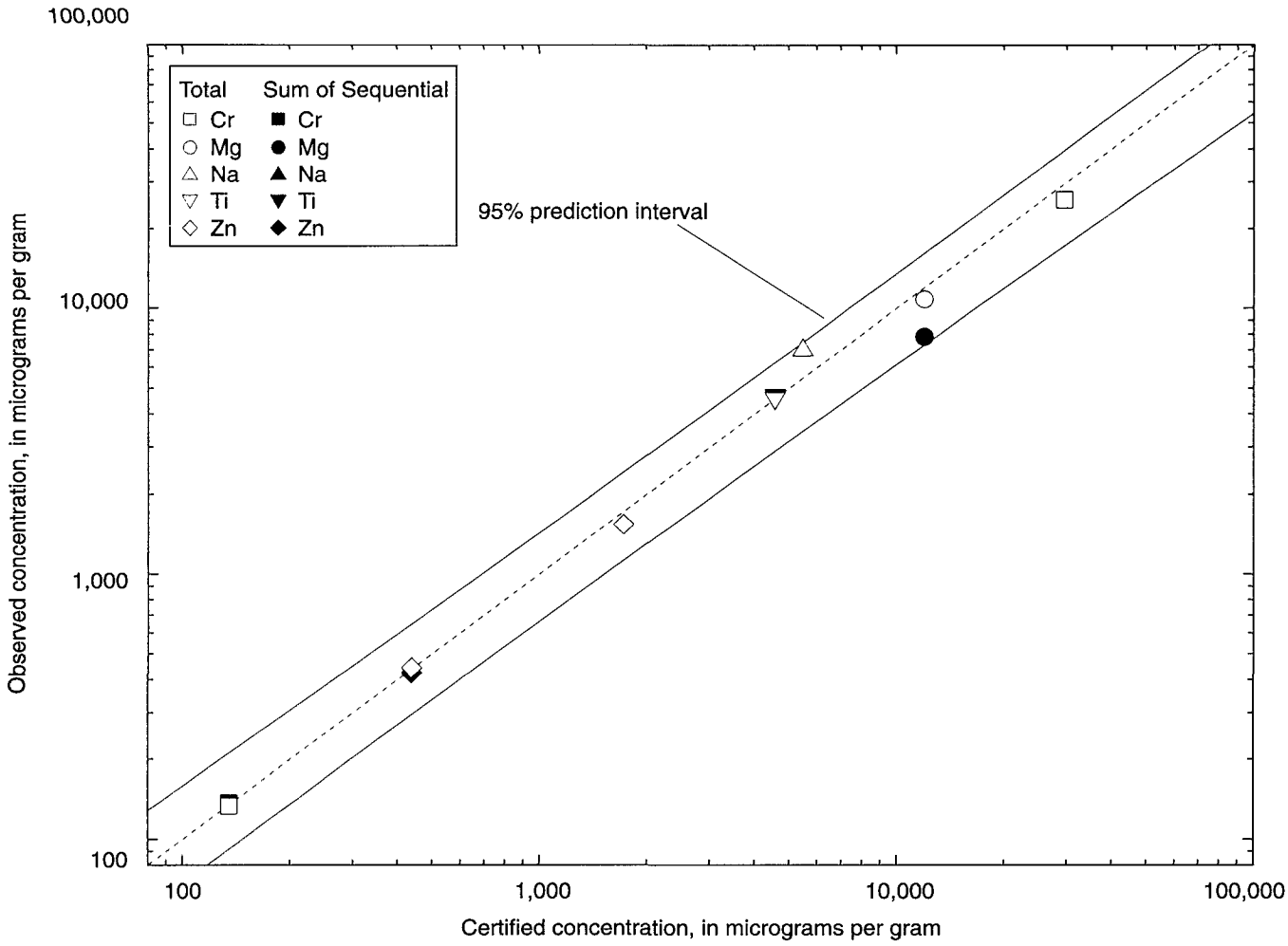

Figure 18. Correlation plot of observed concentration values in total digestions and in the sum of sequential digestions versus certified concentrations of chromium (Cr), magnesium (Mg), sodium (Na), titanium (Ti), and zinc (Zn) in standard reference material. The standard reference material tested was National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment). Error band represents the 95 percent (%) prediction interval.

Field duplicate agreement specifies the worst-case situation for repeatability of determinations because it incorporates all sources of variance, including sampling precision, processing precision, and laboratory analysis precision. Figure 29 provides correlation plots between field replicate samples for six elements: Al, Cd, Cu, Fe, Pb, and Zn. Error bars on the correlation plots represent the standard deviation of multiple laboratory determinations on each of the replicates. The range of concentration varies significantly from element to element on the plots. The dotted lines are not regression fits, but the theoretical lines of perfect agreement.

As observed concentrations approach the detection limit for specific elements, the precision of determination decreases. Figures 30 through 33 show how the percentage relative standard deviation increases as dissolved (ultrafiltrate) concentrations decrease for aluminum, cadmium, copper, and mercury, respectively. The RSD is calculated as follows: (1) the overall standard deviation is calculated by pooling the standard deviations of the individual determinations (analysis precisions); (2) the mean of the individual determinations is computed; and finally, (3) the RSD is calculated by dividing the standard deviation by the mean value and multiplying by 100.

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C-034724

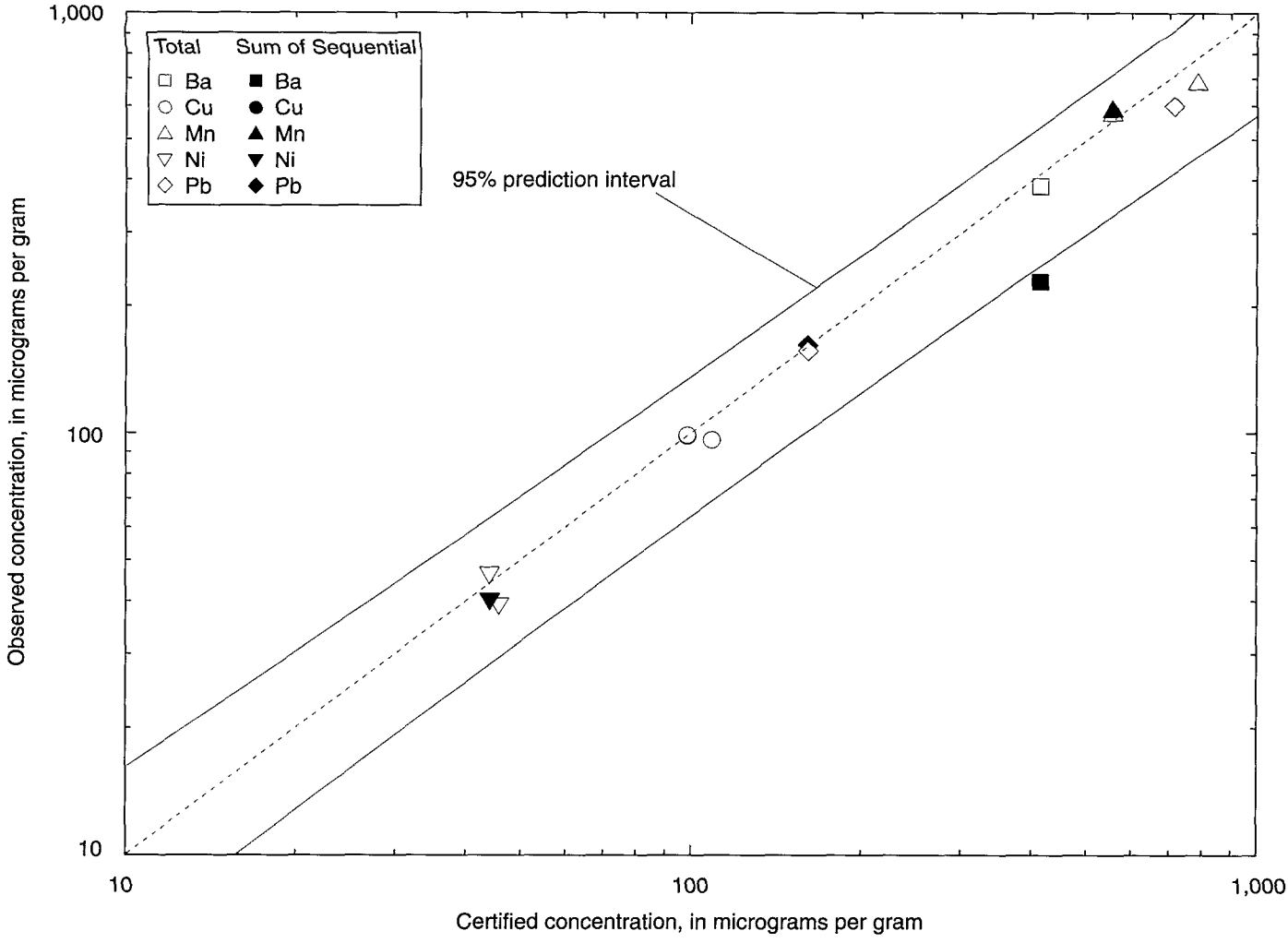

Figure 19. Correlation plot of observed concentration values in total digestions and in the sum of sequential digestions versus certified concentrations of barium (Ba), copper (Cu), manganese (Mn), nickel (Ni), and lead (Pb) in standard reference material. The standard reference material tested was National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment. Error band represents the 95 percent (%) prediction interval.

This calculation provides a more definitive evaluation of the overall precision than the RPD specified in the QAPP. Figures 30 through 33 show vertical lines that represent both the detection limit and 10 times the detection limit. For aluminum and cadmium (figs. 30 and 31), the RSD increases exponentially with the decrease in concentration. For copper (fig. 32), an exponential relationship is suggested for the data in the range of 0.3 to 9 µg/L, although somewhat higher values of RSD were observed for two of three samples from Spring Creek, with copper concentrations in the range of 429 to 535 µg/L. A similar relationship is not clear in figure 33 for mercury, probably because all observed values are very low compared with a value of 10 times the detection limit.

Table 16 provides a summary of the precision of field duplicate dissolved samples. The information is presented in terms of the percentage of samples for which the RPD was less than specified values. Data quality objectives for this study (QAPP, Appendix 1) were that RPD values for at least 90 percent of the samples should be less than 25 percent. The data in table 16 indicate that this objective was achieved for all of the critical elements in this study with the exception of mercury (74 percent completeness at RPD less than 25 percent) and zinc (78 percent completeness at RPD less than 25 percent).

Table 17 summarizes the percentage of replicate dissolved samples whose percentage RSD occurred below the specified values listed. Table 17 presents

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C-034725

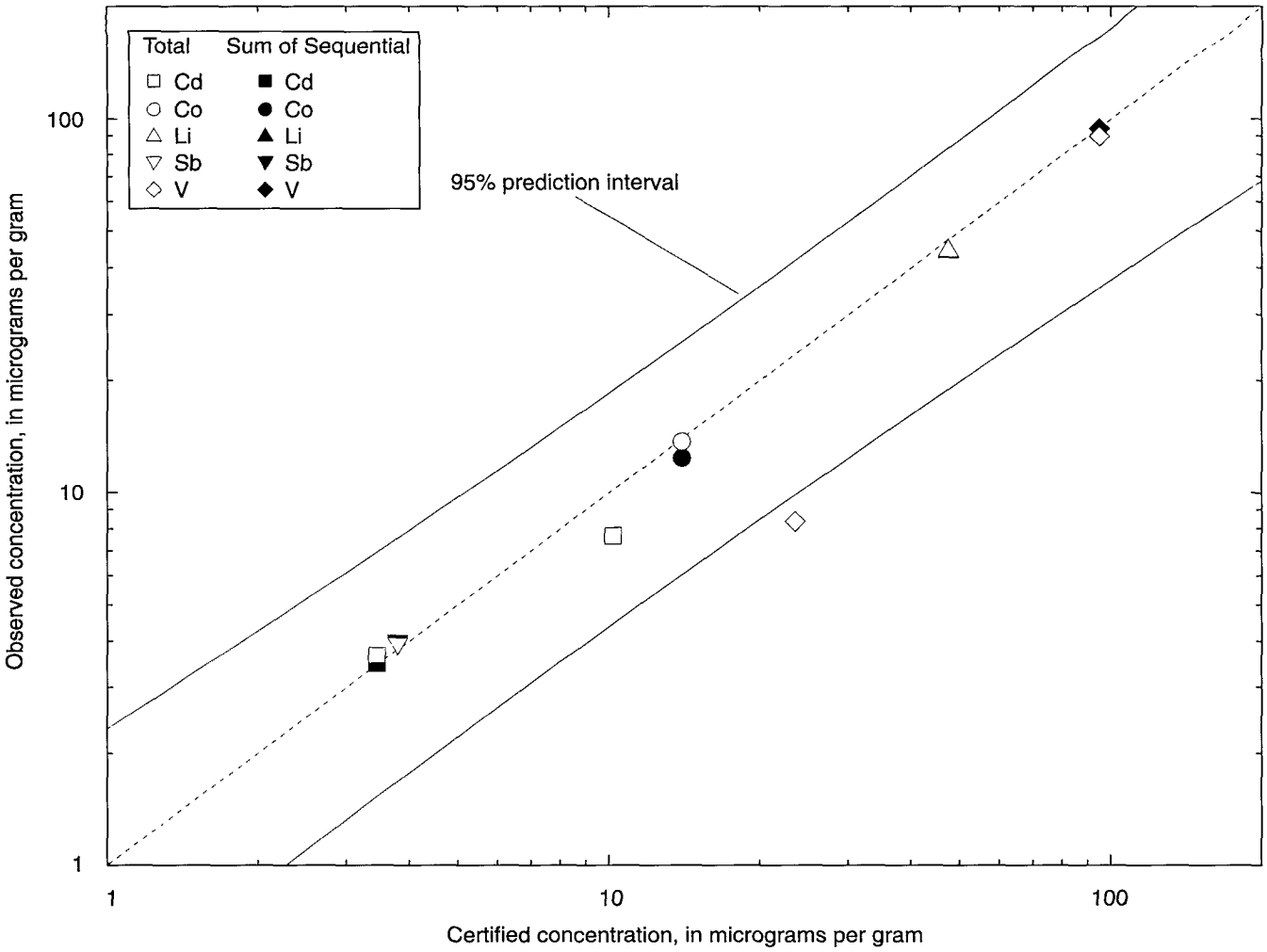

Figure 20. Correlation plot of observed concentration values in total digestions and in the sum of sequential digestions versus certified concentrations of cadmium (Cd), cobalt (Co), lithium (Li), antimony (Sb), and vanadium (V) in standard reference material. The standard reference material tested was National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment. Error band represents the 95 percent (%) prediction interval.

data for all elements determined in this study. Also, table 17 provides average detection limit data computed from the actual analytical determinations, rather than the estimated values presented in the QAPP (tables 1 and 2 in Appendix 1).

For colloid samples, table 18 summarizes the RPD of the elements listed in the QAPP (table 2 in Appendix 1). The table shows the percentage of field duplicate samples for which the RPD value was below the designated levels for each of the critical elements. Field duplicate agreement specifies the worst case situation for repeatability of determinations because it incorporates all sources of variance, including sampling precision, processing precision, and laboratory analysis precision. Since limited field duplicate samples were analyzed because of the limited amount of colloid material recovered, the samples (n=4) for tables 18 and 19 are relatively low.

Table 19 summarizes the percentage of replicate colloid sediment samples whose percentage RSDs (see section on dissolved constituents) are below the specified values listed. This table presents data for all elements determined in this study.

Data for the RPD of sequential extraction determinations on colloidal suspended sediments for the critical elements are presented in table 20. Finally, table 21 summarizes the percentage of duplicate sequential extraction determinations on colloid sediment samples whose RSDs are below the specified

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C-034726

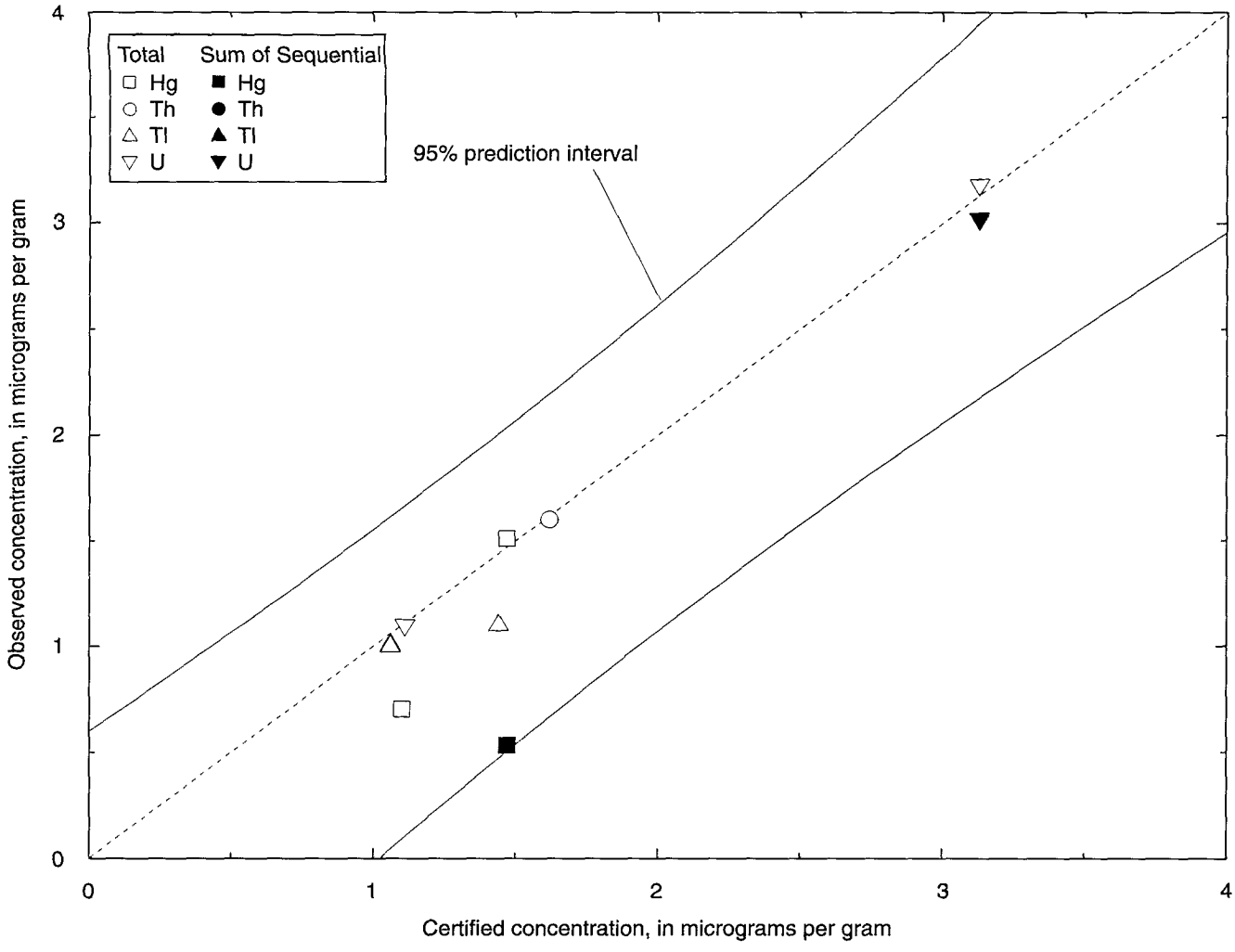

Figure 21. Correlation plot of observed concentration values in total digestions and in the sum of sequential digestions versus certified concentrations of mercury (Hg), thorium (Th), thallium (Tl), and uranium (U) in standard reference material. The standard reference material tested was National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment. Error band represents the 95 percent (%) prediction interval.

values listed. This table presents data for all elements determined in this study.

Trace Elements in Caddisfly Larvae

Standard Reference Materials

Two SRMs were digested along with caddisfly larvae: NIST SRM 1566a oyster tissue, and SRM 50 albacore tuna. No certified values for aluminum, cadmium, copper, or iron were available for SRM 50; only lead and zinc are reported (table 22). With the exception of aluminum, observed values are within 10 percent of certified values.

Spike Addition Recovery

Spike additions on caddisfly larvae extracts were done on 14 subsamples from 4 sampling sites. Spike recovery percentages for cadmium, copper, lead, and zinc are shown in table 23. The overall range for cadmium was 95–102 percent, for copper was 82–100 percent, for lead was 87–98 percent, and for zinc was 93–108 percent.

Iron Redox

No SRMs exist for iron redox species because of the poor long-term stability of Fe(II) and Fe(III) in

C—0 3 4 7 2 6

C-034727

Table 13. Percentage of determinations for each selected element that fell within the specified range of the percentage recovery for the calculated theoretical value of the spike addition in water samples

[REC_{SPIKE}, percentage recovery with respect to spiked samples; n, number of observations; Conc., spiked concentration; QAPP, Quality Assurance Project Plan. %, percent; µg/L, microgram per liter]

REC_{SPIKE} Range (%)	Percentage of spiked samples within the specified REC_{SPIKE} range											
	Arsenic	Cadmium[1]	Chromium	Cobalt	Copper[1]	Lead[1]	Mercury[1]	Nickel	Selenium	Silver	Uranium	Zinc[1]
0–200	100	100	100	100	100	100	100	100	100	98	100	100
50–150	100	100	100	100	100	98	100	100	100	92	100	98
75–125	98	100	98	100	98	98	100	100	100	78	98	98
85–115	92	94	98	100	98	96	89	100	98	58	80	91
90–110	78	88	88	98	85	82	69	96	94	44	62	83
95–105	58	69	52	69	60	56	44	70	70	16	42	55
n	50	48	50	49	47	50	36	50	50	50	50	47
Conc. (µg/L)	10	1	50	5	10	50	0.004	10	20	10	10	10

[1]Data quality objective was at least 90 percent completeness in the 75–125 range of REC_{SPIKE} for indicated elements listed in the QAPP (Appendix 1).

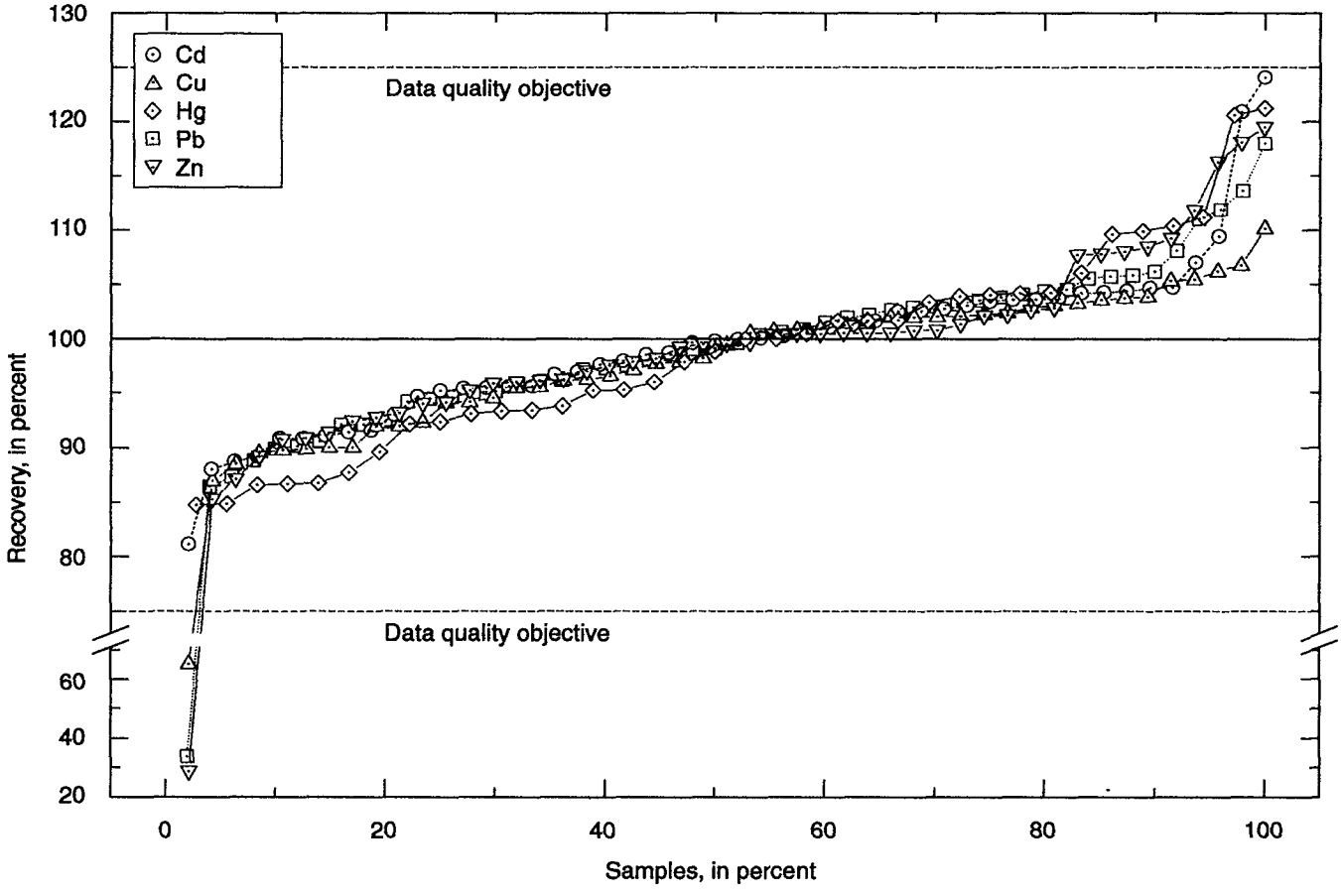

Figure 22. Distribution diagram of the percentage recovery of dissolved spike addition determinations for cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), and zinc (Zn) versus the percentage of samples observed in the Sacramento River Basin, California, including the data quality objective (represented by horizontal lines).

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Table 14. Percentage of determinations of critical elements within the stated percentage recovery for the certified or critical value compared with the sum of the sequential extraction phases of the National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment

[REC_{SRM}, percentage recovery with respect to standard reference materials; n, number of observations]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125	85–115	90–110	95–105
Aluminum	5	100	80	0	0	0	0
Cadmium	5	100	100	100	100	80	60
Copper	5	100	100	100	80	60	40
Iron	5	100	100	100	100	80	40
Lead	5	100	100	100	100	80	80
Mercury	5	100	100	100	100	100	80
Zinc	5	100	100	100	100	100	40

Table 15. Percentage determinations of noncritical elements within the stated percentage recovery for the certified or "informational purposes" value compared with the sum of the sequential extraction phases of the National Institute of Standards and Technology's standard reference material SRM 2704–Buffalo River Sediment

[REC_{SRM}, percentage recovery with respect to standard reference materials; n, number of observations; *, "informational purposes" value]

Element	n	Range REC_{SRM} (percent)					
		0–200	50–150	75–125	85–115	90–110	95–105
Antimony	5	100	100	100	80	80	60
Barium	5	100	80	20	0	0	0
Calcium	5	100	100	100	80	80	40
Cerium*	5	100	0	0	0	0	0
Cesium*	5	100	100	100	80	60	40
Chromium	5	100	100	100	100	60	40
Cobalt	5	100	100	100	60	40	20
Dysprosium*	5	100	40	0	0	0	0
Europium*	5	100	80	0	0	0	0
Lanthanum*	5	100	0	0	0	0	0
Lithium	5	100	100	100	80	80	40
Lutetium*	5	100	0	0	0	0	0
Magnesium	5	100	100	0	0	0	0
Manganese	5	100	100	100	100	80	60
Nickel	5	100	100	80	20	20	20
Rubidium*	5	100	0	0	0	0	0
Samarium	5	100	60	0	0	0	0
Silica[1]	5	100	100	100	100	80	20
Strontium*	5	100	100	20	20	0	0
Titanium	5	100	100	100	100	80	80
Thallium	5	100	100	100	80	80	60
Thorium*	5	100	40	0	0	0	0
Uranium	5	100	100	100	100	100	40
Vanadium	5	100	100	100	100	100	100
Ytterbium*	5	100	40	0	0	0	0
Zirconium*	5	100	100	80	80	80	60

[1]Silica was the only substance reported as an oxide.

aqueous solution. Therefore, the quality of analytical results for iron redox determinations by ultraviolet–visible (UV–vis) spectroscopy using FerroZine as the complexing agent were evaluated by replicate analysis, by comparison of total iron determinations to those made by another method (ICP–AES), and by comparing the proximity of a given analytical result with the method detection limit. At the method detection limit, by definition the precision of the analytical result is ± 100 percent. Precision improves exponentially with increasing concentration until it is ± 5 percent or less at about

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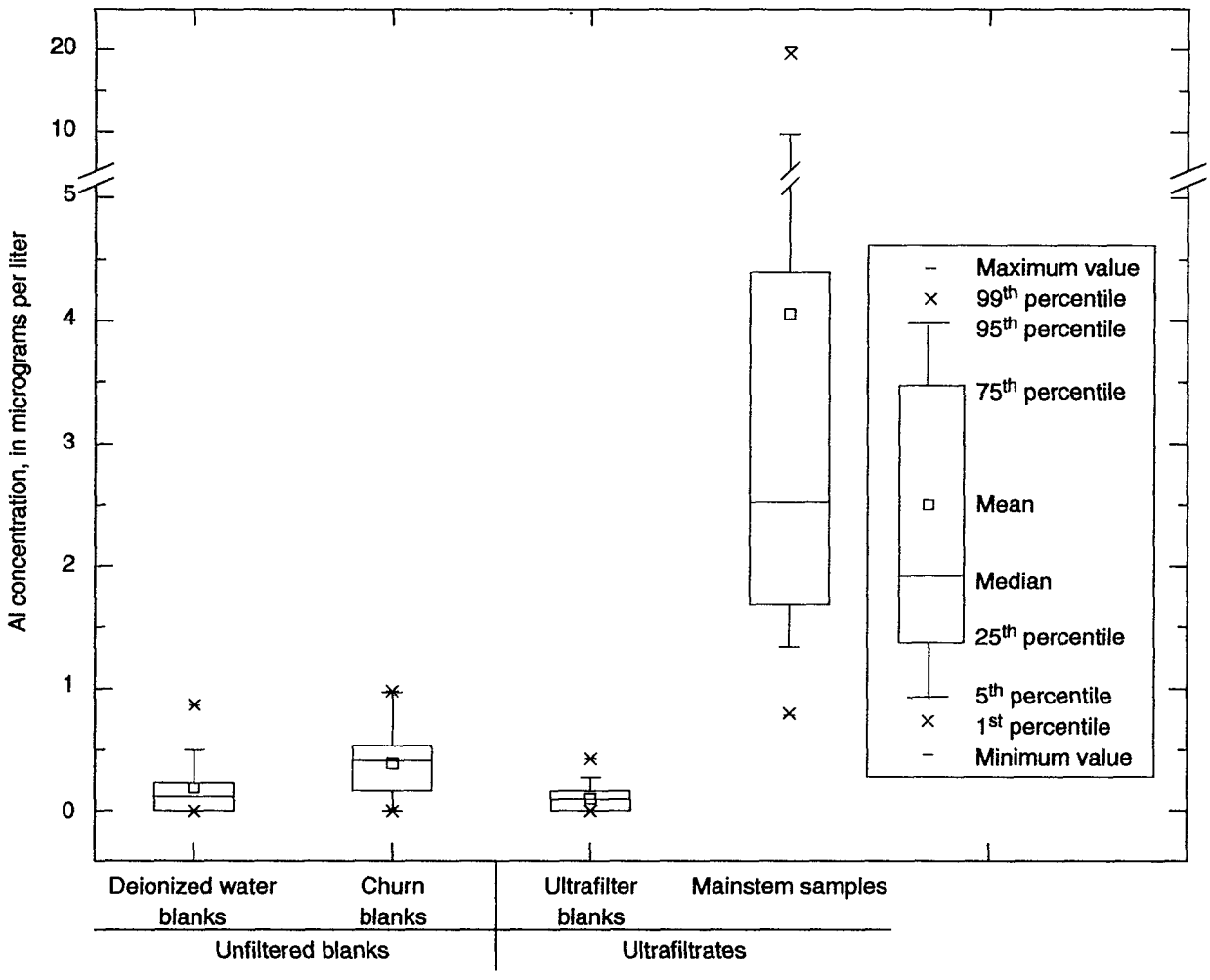

Figure 23. Box plots showing concentration ranges for aluminum (Al) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

10 to 20 times the detection limit. Iron redox samples were analyzed routinely in duplicate, with additional analyses performed for instances where precision between replicates was judged poorer than that expected for the concentration range represented by the analyses.

Concentrations of total iron in filtered water samples determined by UV–vis spectroscopy can be compared with total iron determined by ICP–AES on split subsamples. Comparing results from all six sampling events (table A4-1) indicates a slight bias toward higher iron concentrations with UV–vis spectroscopy than with ICP–AES, especially in the concentration range of about 8 to 80 µg/L. Blanks for the iron redox subsplits for the July and September 1996 sampling trips showed elevated iron in this approximate concentration range (table A2-2), indicating a probable laboratory contamination problem. The source of the iron contamination could have been the bottle washing procedure, the hydrochloric acid used for sample preservation, the pipette used to transfer the acid, or perhaps the environmental conditions in the laboratory used to process and preserve these samples. Sample processing was relocated from the BOR laboratory near Keswick Dam to the USGS laboratory in Sacramento beginning in November 1996. Significantly lower blank levels were observed beginning in November 1996, and the agreement between the data from the two methods of iron determination was also improved beginning with samples from that time. The agreement between the two methods for total iron is especially good above concentrations of 10 µg/L, a value less than 10 times the detection limit of both methods.

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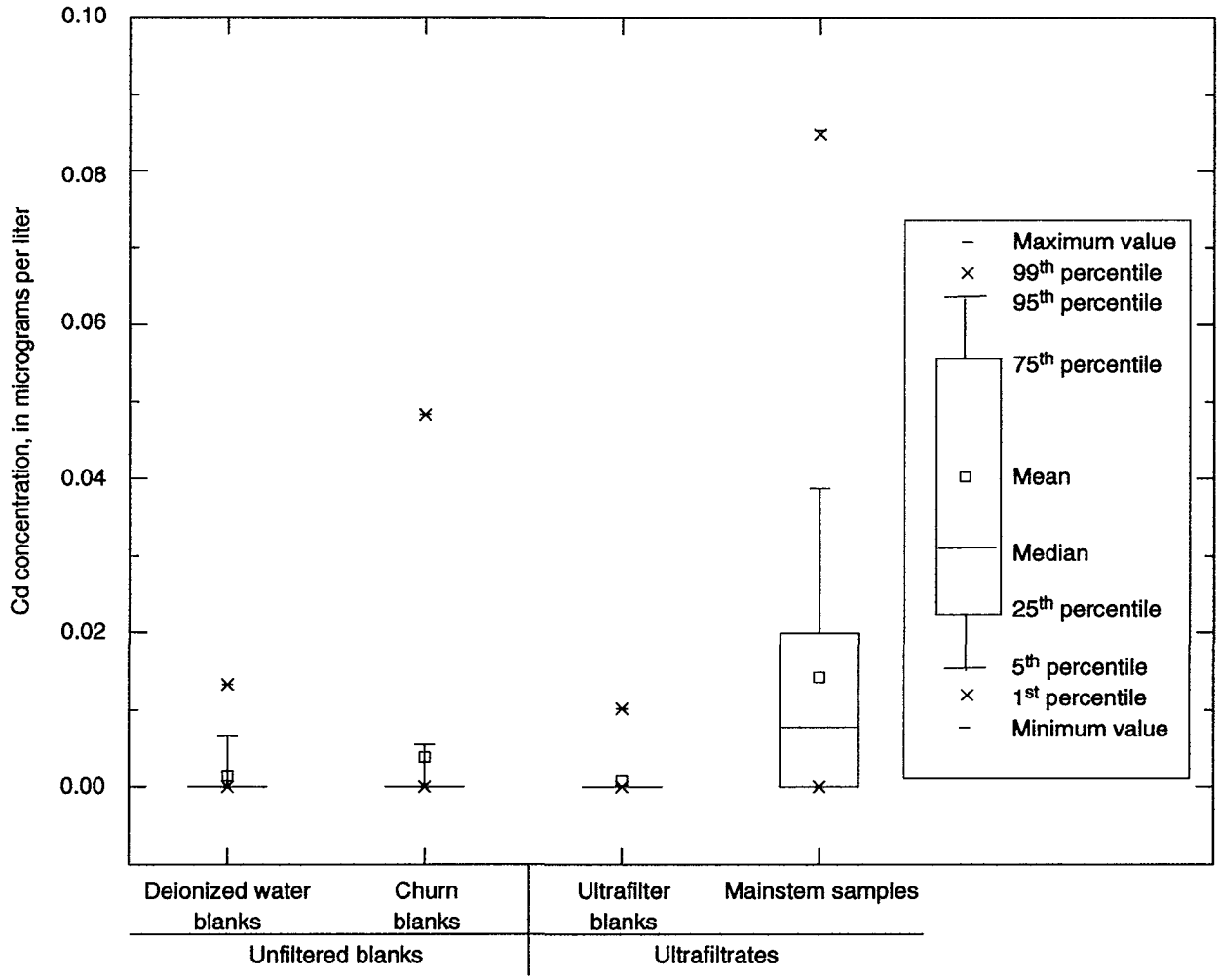

Figure 24. Box plots showing concentration ranges for cadmium (Cd) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

Lead Isotopes

The total chemistry lead blank for the lead procedure is approximately 0.1 ng. In the worst case scenario (83 ng of lead in the sample) the blank contributes 0.12 percent of the total lead. However, because the isotopic composition of the lead blank ($^{206}Pb/^{204}Pb = 18.9$) is similar to that of the samples ($^{206}Pb/^{204}Pb = 18.1–19.1$), the blank effect on the isotopic composition of the sample is less than 0.006 percent. This contribution is insignificant relative to the precision of the mass spectrometric analyses (0.05–0.1 percent).

Mass spectrometric data for lead were collected from at least three blocks of 10 ratio sets. When the VG Sector 54 seven-collector mass spectrometer was used in static mode, all lead isotopes were measured simultaneously. Differences in collector efficiencies were routinely measured and corrected mathematically as a part of the general operating software. When lead was measured on the VG 54R single-collector mass spectrometer, data were measured as pairs using peak switching and ^{206}Pb as the reference isotope. Data are considered to be of acceptable quality if the internal precision for a given run is better than 0.1 percent for $^{206}Pb/^{204}Pb$ and better than 0.05 percent for $^{207}Pb/^{206}Pb$ and $^{207}Pb/^{208}Pb$.

The principal cause of uncertainty in mass spectrometric analyses for lead is mass-dependent fractionation induced during thermal ionization of the sample. The level of accuracy for the mass spectrometric determinations performed in this study was

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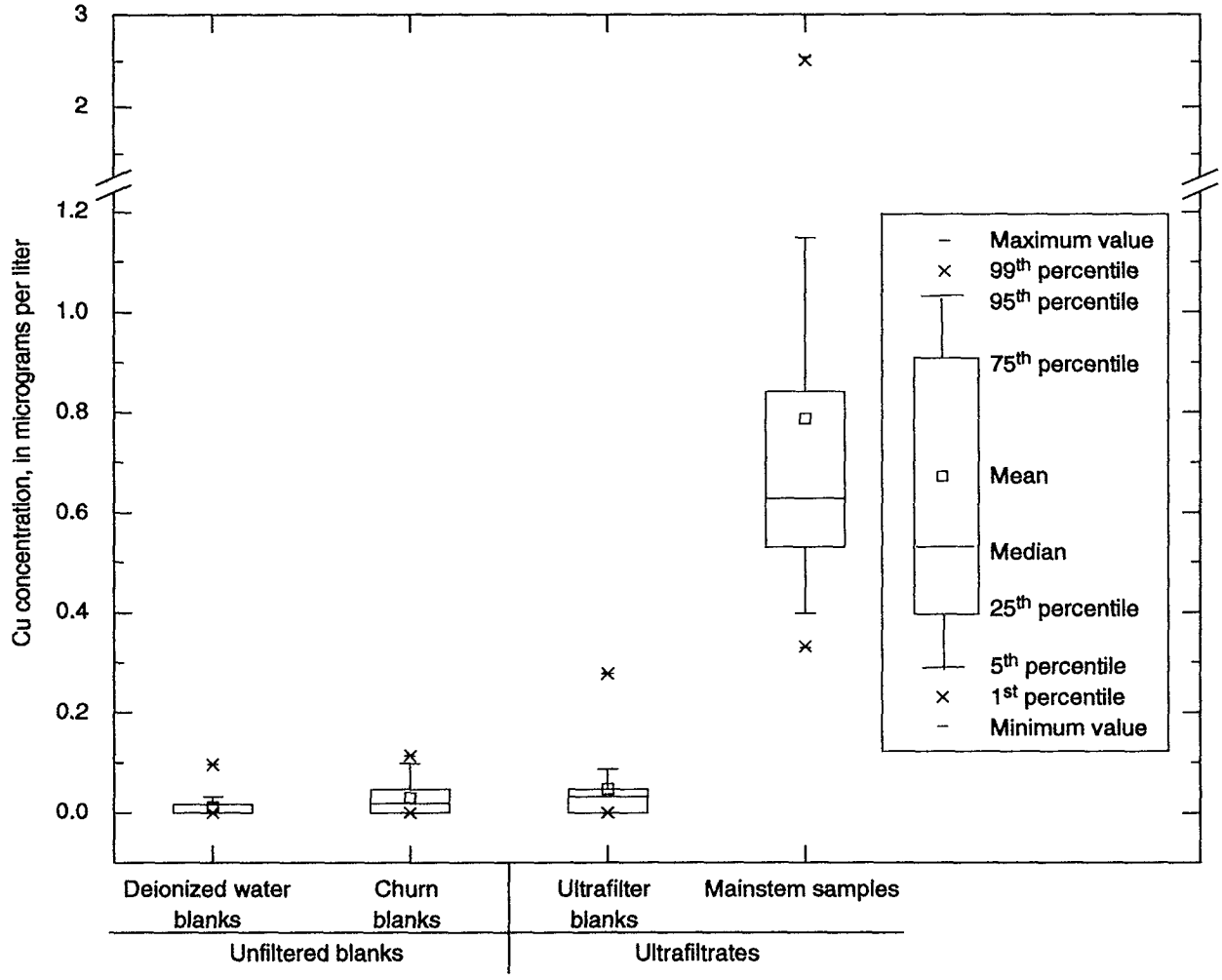

Figure 25. Box plots showing concentration ranges for copper (Cu) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

evaluated by performing concurrent analyses of NIST lead isotopic standard SRM-981 (Todt and others, 1993). One standard analysis was performed for every 10 or fewer sample analyses. A fractionation factor (F) that is calculated from the standard data represents the correction in percentage per atomic mass unit that must be applied to a given isotopic ratio as follows:

$$\frac{^{206}Pb}{^{204}Pb_C} = \frac{^{206}Pb}{^{204}Pb_M}(1 + 0.02F) \quad (5)$$

$$\frac{^{207}Pb}{^{206}Pb_C} = \frac{^{207}Pb}{^{206}Pb_M}(1 + 0.01F) \quad (6)$$

$$\frac{^{208}Pb}{^{206}Pb_C} = \frac{^{208}Pb}{^{206}Pb_M}(1 + 0.02F) \quad (7)$$

$$\frac{^{207}Pb}{^{204}Pb_C} = \frac{^{207}Pb}{^{204}Pb_M}(1 + 0.03F) \quad (8)$$

$$\frac{^{208}Pb}{^{204}Pb_C} = \frac{^{208}Pb}{^{204}Pb_M}(1 + 0.04F) \quad (9)$$

where the subscripts C and M refer to the corrected and measured isotopic ratios, respectively.

Lead isotopic data were measured at filament temperatures ranging from approximately 1,200° to 1,300°C. There is a small but measurable effect of filament temperature on mass fractionation as outlined in table 24. Fractionation corrections were applied to the data for individual samples on the basis of the mass spectrometer used and the filament temperature. The uncertainties are calculated after the manner in

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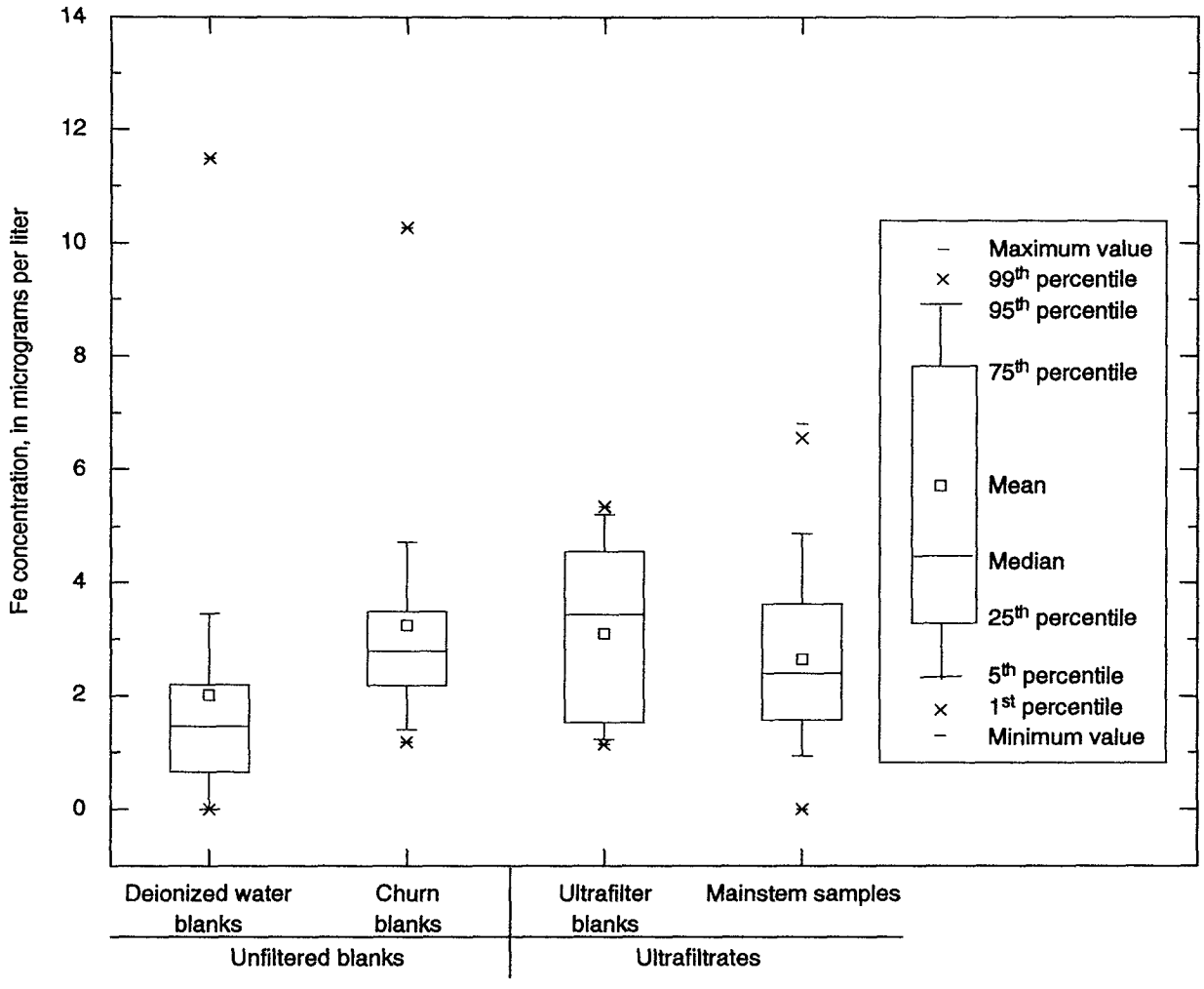

Figure 26. Box plots showing concentration ranges for iron (Fe) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

Ludwig (1979) and are at the 95 percent confidence interval, or 2 sigma (2σ).

As an independent check of the mass spectrometric procedures used in this study, one of the colloid samples (below Shasta Dam) was analyzed on both mass spectrometers. The fractionation-corrected data on this comparison are presented in table 25, showing essentially identical agreement between both mass spectrometers.

Anions, Nutrients, and Organic Carbon

Analyses of anions, nutrients, and organic carbon were done by USGS personnel at the NWQL in Arvada, Colorado. Quality assurance and quality control (QAQC) activities at the NWQL are documented in reports by Friedman and Erdmann (1982) and by Pritt and Raese (1995). Method performance evaluations were based on the analysis of SRMs, laboratory replicates, and analysis of blank samples. A minimum of 10 percent of analyzed samples were reference materials.

In addition to internal QAQC assessments, NWQL participates in numerous external performance evaluation programs, including the EPA's Water Pollution Performance Evaluation Study (WPPES) and its Water Supply Performance Evaluation Study (WSPES). These studies are made by the EPA's Environmental Monitoring Systems Laboratory and are used to evaluate the performances of EPA, state, and other selected laboratories for 80 water pollution constituents. The NWQL also participates in the

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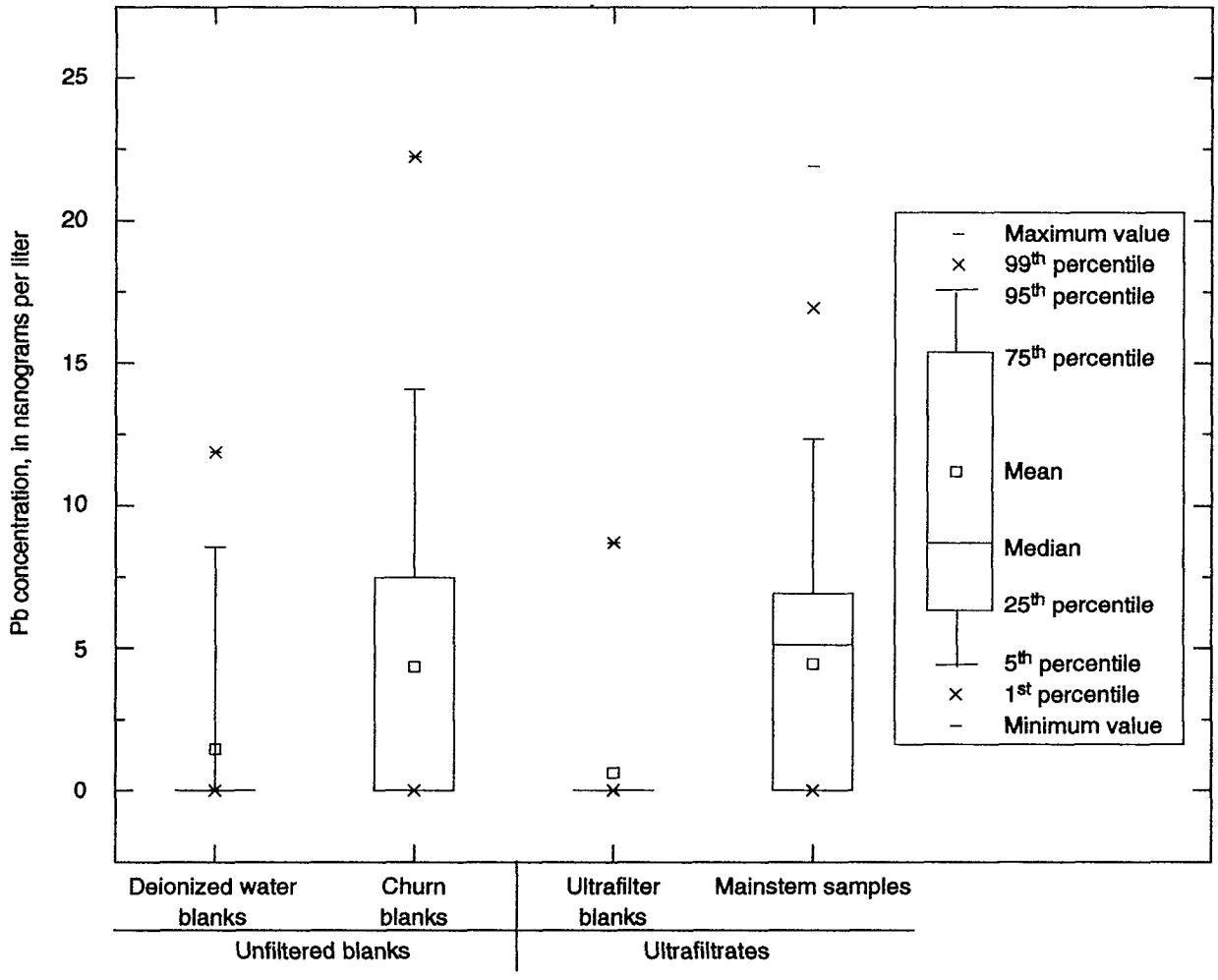

Figure 27. Box plots showing concentration ranges for lead (Pb) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

spring Canadian Federal–Provincial water performance evaluation study. This study includes low-ionic strength, trace metals, and major ion determinations. Additionally, the NWQL participates in the USGS Water Resources Division, Branch of Technical Development and Quality Systems (BTD&QS) round-robin performance evaluation program, which biannually sends standard reference water samples to more than 150 laboratories for comparative analysis. The NWQL also takes part in the BTD&QS blind sample program on an ongoing basis.

Satisfactory results of the three WPPES evaluations (WP036, WP037, and WP038) that were completed during the time period of this study are included in Appendix 2 (tables A2-1a, A2-1b, and A2-1c). The acceptance limits defined by the EPA (Appendix 2) are the 99 percent confidence interval or, effectively, ± 3 standard deviations (3σ). Warning limits are defined as the 95 percent confidence interval, or ± 2σ. The number of decimal places reported in the EPA performance evaluations (Appendix 2) is not necessarily reflective of the precision of the analytical method.

Particulate Size Determinations

Replicate split samples were analyzed for size distribution of both suspended colloid and streambed sediment but are not reported. Similar size distributions were observed in replicate samples analyzed by either of the methods described earlier in this report;

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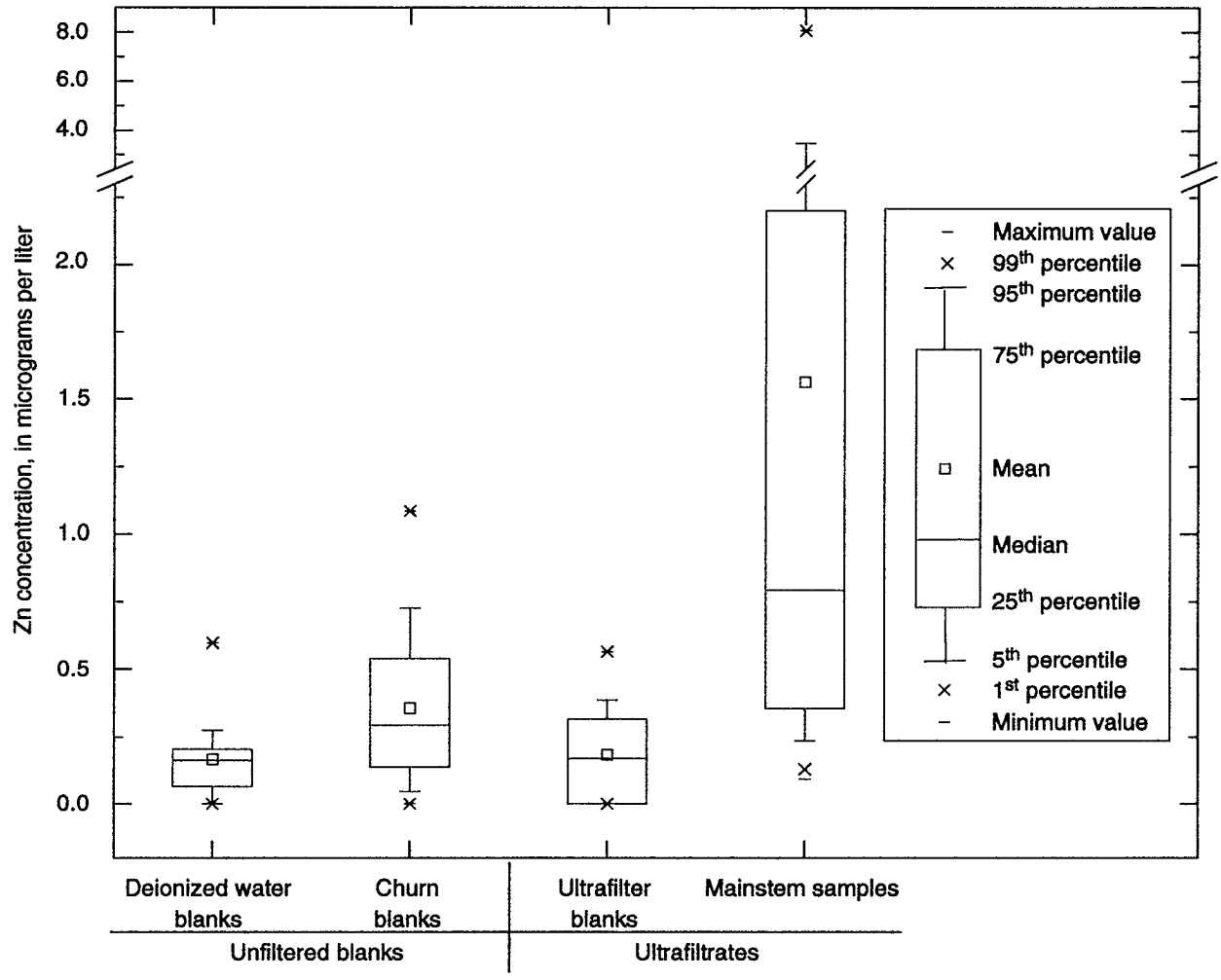

Figure 28. Box plots showing concentration ranges for zinc (Zn) in selected blank water samples and dissolved (ultrafiltrate) subsamples from the mainstem Sacramento River, California.

Table 16. Percentage of field duplicate dissolved samples whose relative percentage difference was below specified values for critical elements

[RPD, relative percentage difference; DL, detection limit; values in table represent the total of those less than detection limit and those which meet the criteria; n, number of duplicate samples. %, percent; <, less than; >, greater than]

RPD	Percentage of duplicate sample results whose RPD fell below the given value						
	Aluminum	Cadmium	Copper	Iron	Lead	Mercury	Zinc
% < 100%	100	100	98	100	100	100	98
% < 50%	100	100	98	100	100	100	96
% < 25%[1]	98	100	98	91	100	74	78
% < 15%	96	100	96	91	100	57	57
% < 10%	85	96	85	91	100	49	46
% < 5%	63	96	59	89	100	28	30
n > DL	46	9	46	8	3	37	46
Total n	46	46	46	46	46	47	46

[1]Data quality objective was at least 90% completeness for RPD values < 25%.

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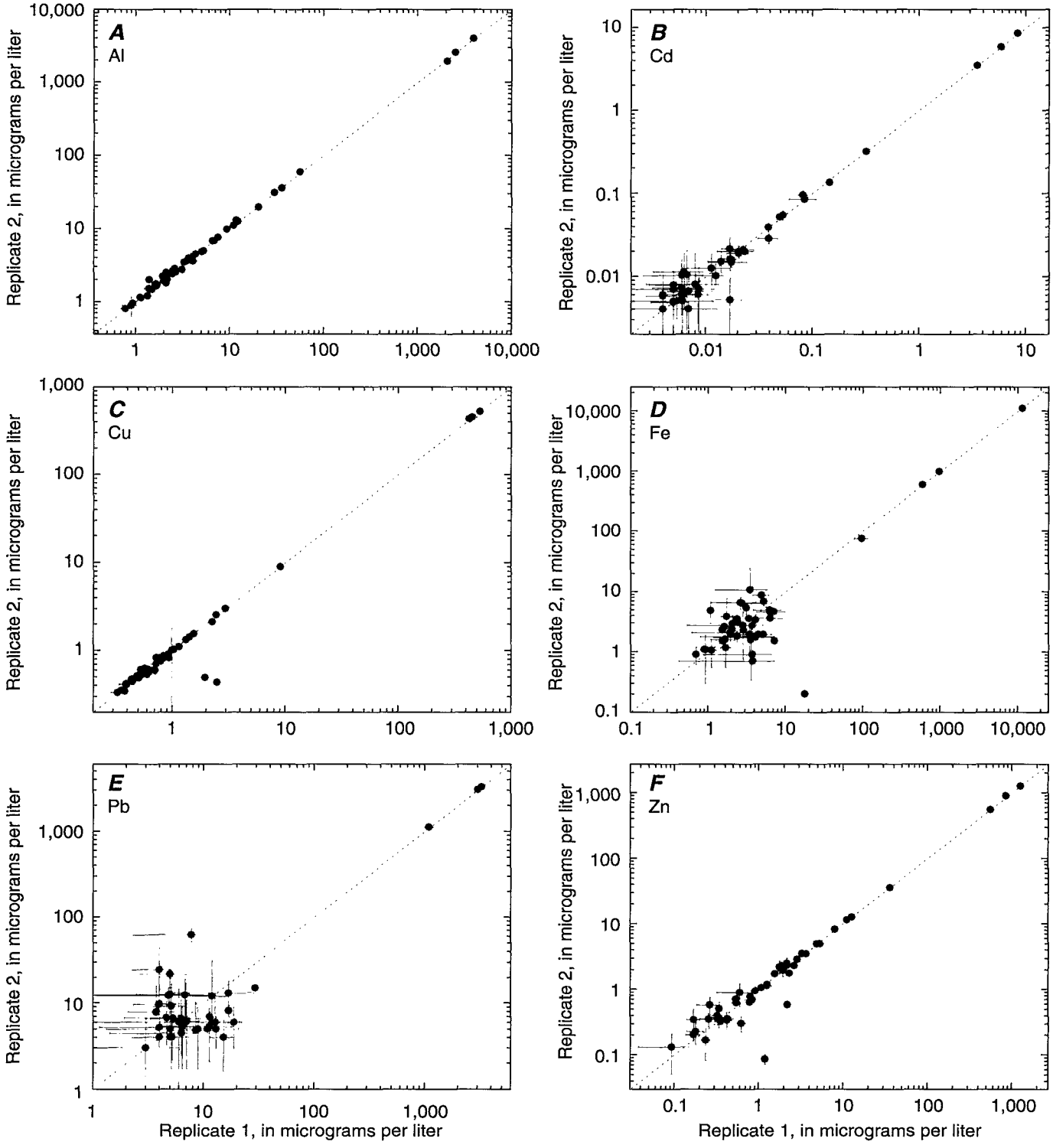

Figure 29. Correlation plots of field replicates for dissolved *A.* aluminum (Al), *B.* cadmium (Cd), *C.* copper (Cu), *D.* iron (Fe), *E.* lead (Pb), and *F.* zinc (Zn) in the Sacramento River Basin, California, with error bars representing laboratory analytical precision.

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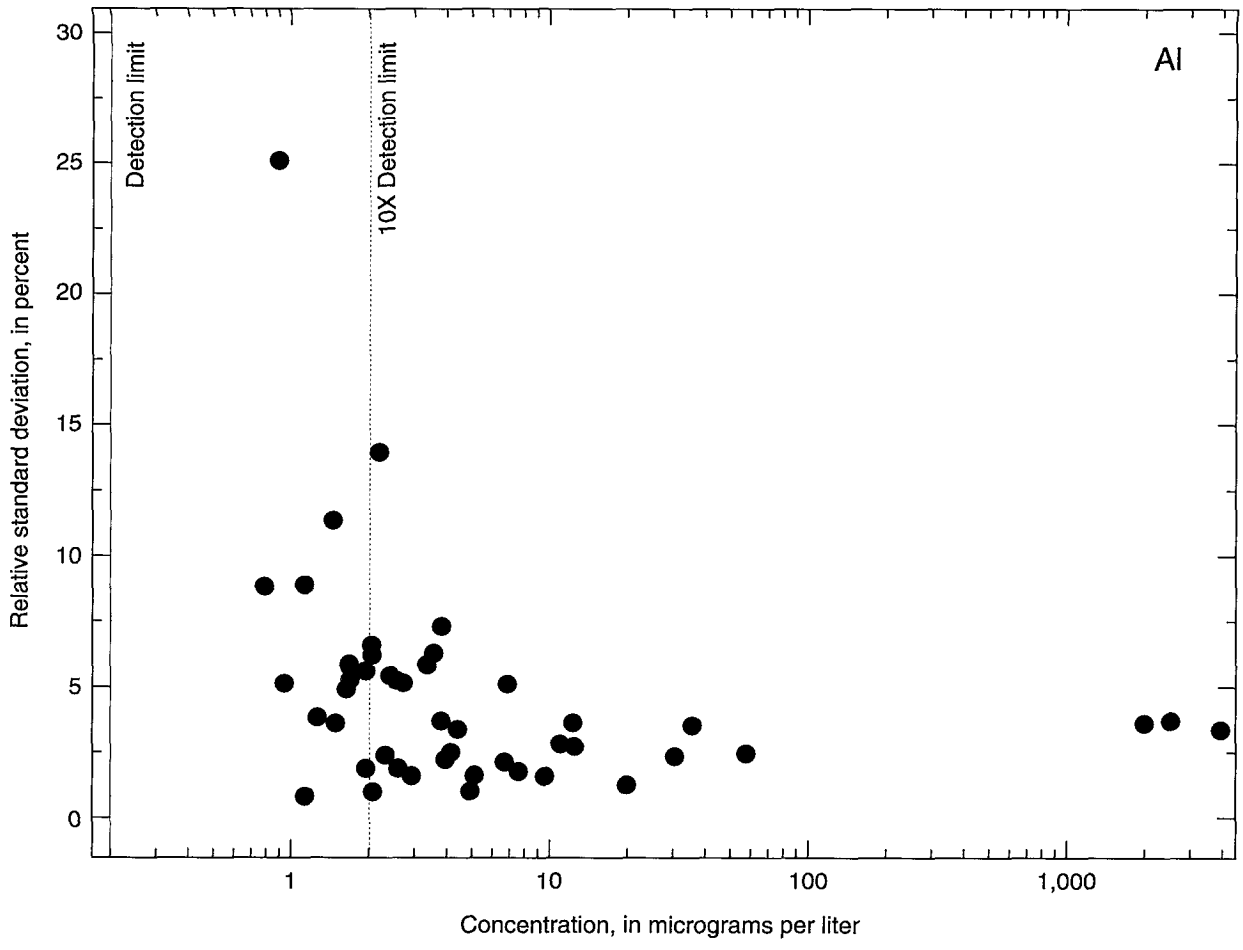

Figure 30. Plot of relative standard deviation for replicate determinations of aluminum (Al) versus dissolved (ultrafiltrate) concentration in the Sacramento River Basin, California, including solid and dashed vertical lines that represent the reported detection limit and 10 times the detection limit, respectively.

however, no quantitative comparative size determinations were performed.

Results

Ronald C. Antweiler, Peter D. Dileanis, Charles N. Alpers, Howard E. Taylor, *and* Joseph L. Domagalski

Metal Concentrations in Water

Raw data for metal analyses in water samples are provided in Appendix 4 (tables A4-1 and A4-2) in the following order: (1) by sampling site in downriver order with tributaries following mainstem sites, (2) within a site by sampling date, and (3) within a date by filter type. Concentration data for various filtrates includes the 0.45-µm pore-size capsule filtrate, the 0.40-µm pore-size membrane filtrate, and the 10,000 NMWL (0.005-µm equivalent pore size) tangential-flow ultrafiltrate (table A4-1). Data are also provided on unfiltered (whole water) samples (table A4-2).

Dissolved Constituents from Tangential-Flow Ultrafiltration

Box plots (figs. 34 and 35) demonstrate average dissolved (from the tangential-flow ultrafiltrates) concentrations (Al, Cd, cerium [Ce], Cu, Fe, manganese [Mn], Pb, and Zn) at various sites along the Sacramento River and for some tributaries in the Keswick Reservoir area. They also provide a direct comparison of the range and median concentrations.

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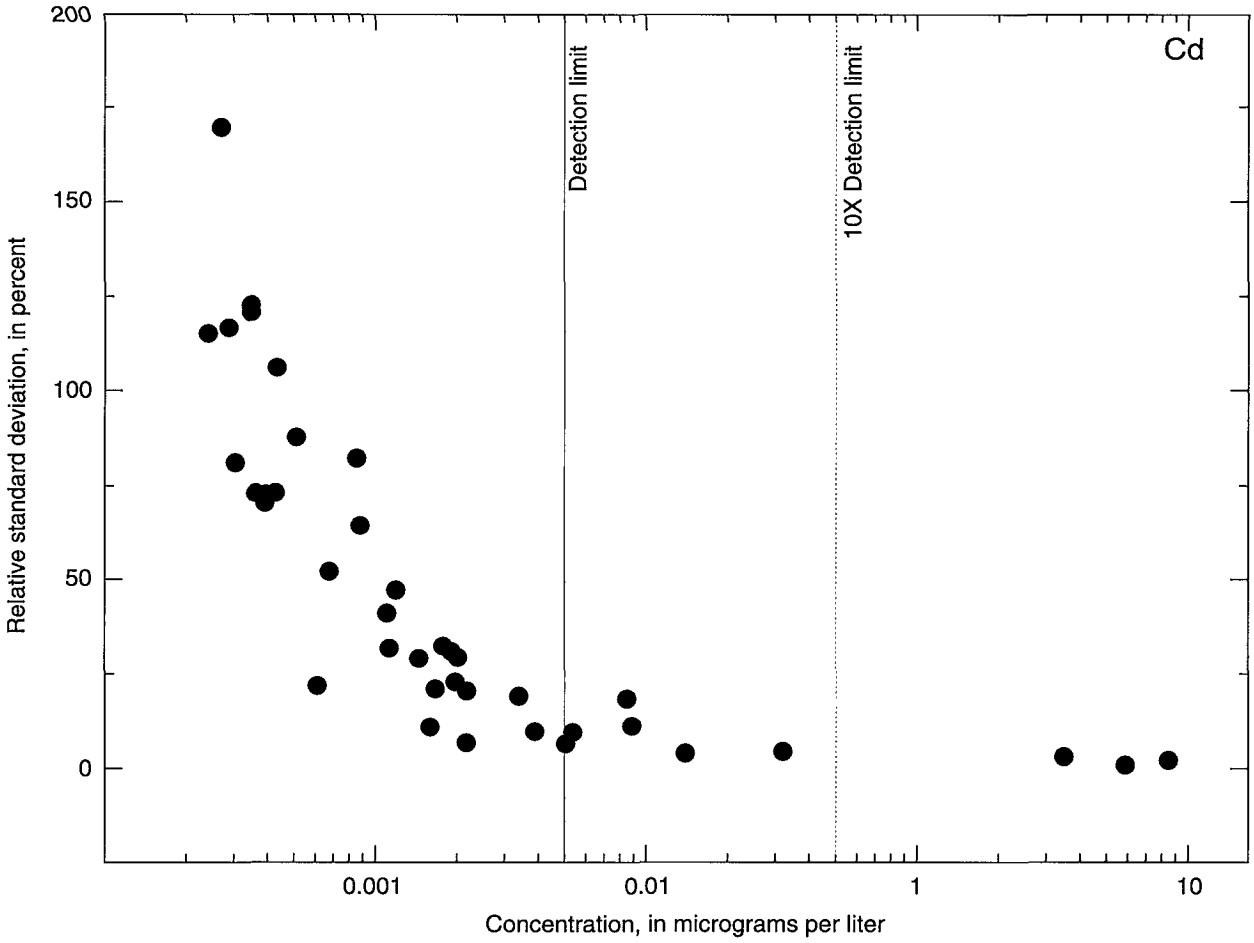

Figure 31. Plot of relative standard deviation for replicate determinations of cadmium (Cd) versus dissolved (ultrafiltrate) concentration in the Sacramento River Basin, California, including solid and dashed vertical lines that represent the reported detection limit and 10 times the detection limit, respectively.

Values in Spring Creek, a tributary, are commonly more than 1,000 times higher than at any other site studied along the Sacramento River.

Concentration data from the mainstem sites on the Sacramento River from tangential-flow ultrafiltration subsamples for selected elements (Al, Cd, Cu, Fe, Pb, and Zn) are plotted as a function of distance in figures 36 through 41, respectively. Similar plots for 14 additional elements are shown in Appendix 8 (figs. A8-1 through A8-14). On each of these graphs, the vertical axis represents the dissolved concentration of the analyte in question, and the horizontal axis represents distance in kilometers from the mouth of the Sacramento River (table 1; U.S. Army Corps of Engineers, 1991). Because several sampling sites are near Redding and Keswick Dam (near river kilometer 480), and sites are more widely spaced in the lower reaches of the river, the horizontal axis is divided into two parts with different scales that provide the reader with a way to discriminate between the various upriver sites. For most trace metals, the dissolved concentration was fairly uniform in the lower 250 km of the river and varied little from season to season. In the upstream part of the study area, several elements are at higher concentrations in the Spring Creek arm of Keswick Reservoir and below Keswick Dam, including aluminum, cadmium, copper, zinc, nickel, and some rare-earth elements, such as cerium. Dissolved concentrations for these same elements also appear to have varied seasonally, with the highest concentrations having occurred generally in December 1996 or January 1997.

A comparison was made between the analysis of composite-collected lead samples and separate

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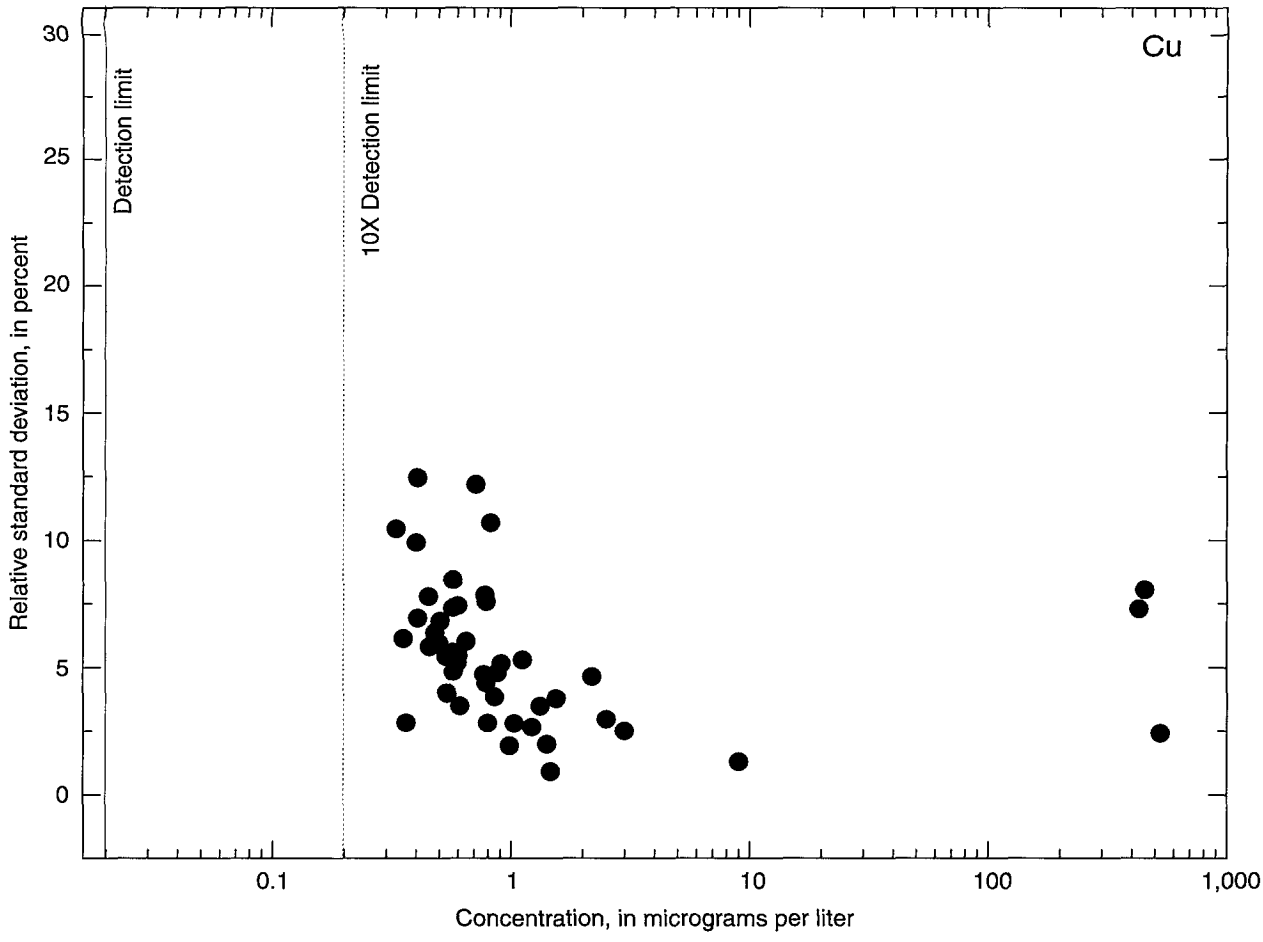

Figure 32. Plot of relative standard deviation for replicate determinations of copper (Cu) versus dissolved (ultrafiltrate) concentration in the Sacramento River Basin, California, including solid and dashed vertical lines that represent the reported detection limit and 10 times the detection limit, respectively.

grab-collected lead samples concurrently collected (fig. 42; tables A4-3 and A4-4 in Appendix 4 contain the corresponding data). Most dissolved lead concentrations were less than 10 times the analytical detection limit, indicating there was practically no dissolved lead present. Composite samples, however, did tend to have lower dissolved lead concentrations than their grab sample counterparts; also, three outlying data points indicate that probable contaminants of unknown origin were present in these grab samples. These results would tend to imply that there is no benefit to the collection of grab samples for dissolved lead from the standpoint of contamination for the methods employed in this study.

Isolated Colloidal Material

Suspended colloids were subjected to two types of analysis: a total digestion in which all colloid material was dissolved and analyzed, and a sequential extraction in which the colloids were subjected sequentially to three distinct digestions. The details of these digestions are described earlier in this report.

Total Digestions

The analytical results from the total digestion of the colloids are presented in Appendix 5, table A5-2. These data—called the "elemental concentrations of the colloids"—are presented as micrograms of analyte per gram of freeze-dried colloid (micrograms per gram), and therefore represent the variation in the suspended sediment chemistry. The product of this quantity (in micrograms per gram), and the concentration of the colloid in the river at the time the sample was collected (in grams per liter) is defined as the "equivalent concentration" in micrograms per liter of the analyte in the river associated with the colloid.

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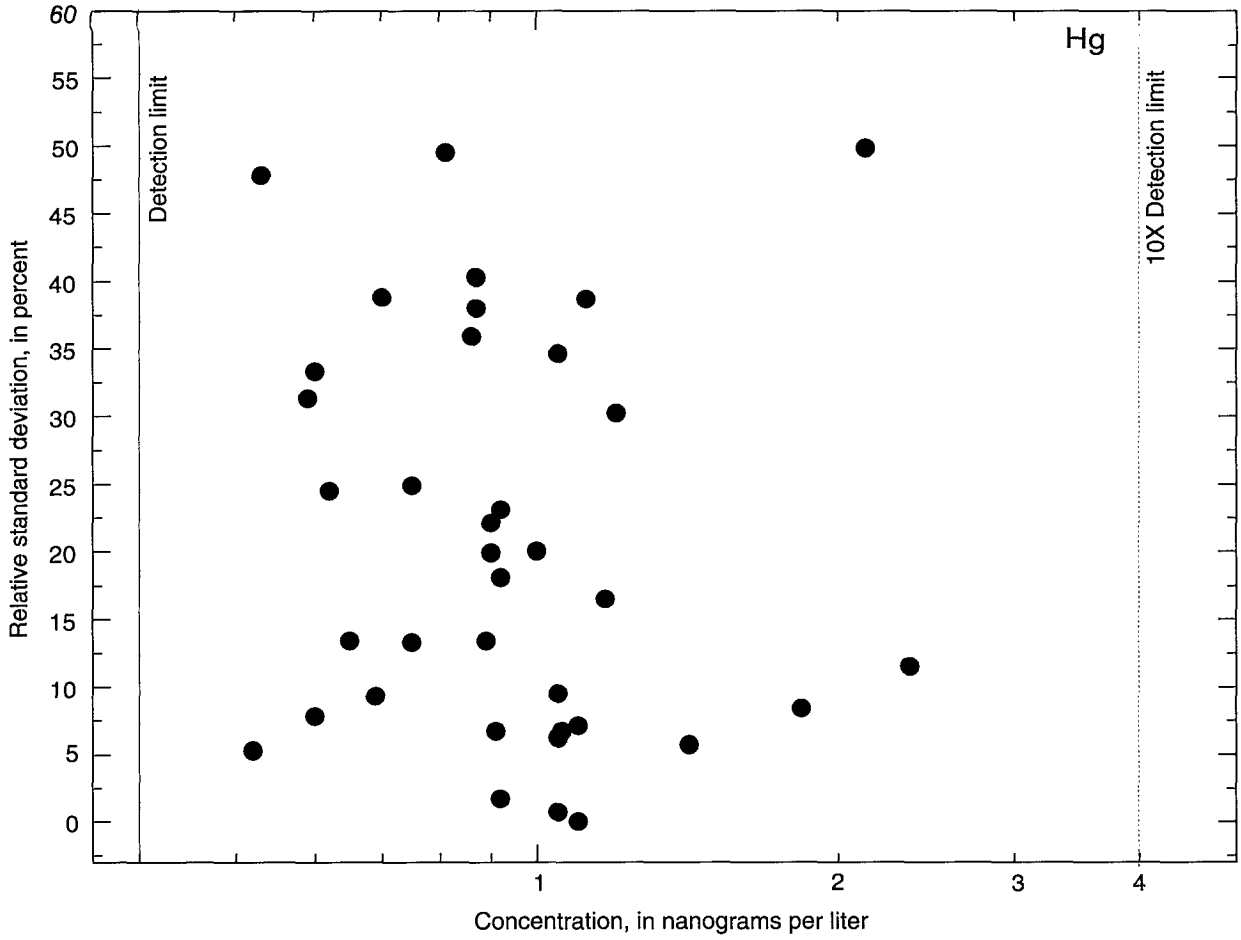

Figure 33. Plot of relative standard deviation for replicate determinations of mercury (Hg) versus dissolved (ultrafiltrate) concentration in the Sacramento River Basin, California, including solid and dashed vertical lines that represent the reported detection limit and 10 times the detection limit, respectively.

Expressed another way, the equivalent concentration of element X represents the amount of X being carried with colloids in the river per liter of river water, and is, therefore, the analogue of the dissolved concentration, with which it can be directly compared. The top figure *A* of figures 36 to 41 are plots of the equivalent concentrations of selected elements (Al, Cd, Cu, Fe, Pb, and Zn, respectively) in the Sacramento River, just as the lower figure *B* of figures 36 to 41 contain the dissolved concentrations of these same elements. Appendix 8 contains similar plots for an additional 14 elements. By comparing the vertical axes on the A panel with those of the B panel on figures 36 through 41 and A8-1 through A8-14, the relative amount of each element that is being carried on colloids can be compared with the relative amount being carried in solution. On all of these figures, the horizontal axis is broken to provide the reader with a way to discriminate between the various upriver sites. For example, in the case of aluminum (fig. 36), roughly 1,000 times more of this element is carried colloidally than in solution. Cadmium, on the other hand (fig. 37), exists in roughly equal amounts in colloidal form and in solution. As noted previously with dissolved (ultrafiltrate) data, the equivalent concentration of most analytes is more or less constant in the lower 250 km of the river. There is, however, a distinct difference in effective concentration seasonally; high-flow periods (December 1996 and January 1997) showed much higher equivalent concentrations than did low-flow periods.

Sequential Extractions

Results from sequential extractions (reducible, oxidizable, and residual) from selected samples

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Table 17. Percentage of replicate dissolved samples whose relative standard deviation fell below the specified values for all elements analyzed

[DL, detection limit; µg/L, microgram per liter; RSD, relative standard deviation; n, number of duplicate samples. The range values in the table represent the total of those less than the detection limit and those that meet the criteria. %, percent; <, less than]

Element	Avg. DL (µg/L)	n	Range (%RSD)						
			% < DL	% < 100%	% < 50%	% < 25%	% < 15%	% < 10%	% < 5%
Aluminum	0.05	46	0	100	100	100	98	89	76
Antimony	0.02	46	9	100	100	91	80	72	46
Arsenic	0.04	46	0	100	100	98	93	89	72
Barium	0.01	46	0	100	100	100	100	98	89
Beryllium	0.02	46	93	100	100	100	96	93	93
Bismuth	0.01	46	100	100	100	100	100	100	100
Boron	4	46	4	100	100	98	98	91	76
Cadmium	0.006	46	41	100	98	93	89	80	70
Calcium	20	46	0	100	100	100	100	98	93
Cerium	0.001	46	2	100	98	85	67	54	37
Cesium	0.06	46	67	96	93	91	85	76	67
Cesium	0.06	46	67	96	93	91	85	76	67
Chromium	0.2	46	26	100	100	93	80	65	43
Cobalt	0.01	46	52	100	100	96	91	89	83
Copper	0.02	46	0	100	98	98	98	96	74
Dysprosium	0.002	46	59	100	100	91	89	85	72
Erbium	0.002	46	59	100	98	96	87	85	70
Europium	0.001	46	72	98	96	89	85	80	76
Gadolinium	0.003	46	43	100	100	91	74	65	61
Holmium	0.0005	46	52	102	100	91	85	78	70
Iron	0.7	46	11	100	74	57	41	35	33
Lanthanum	0.0005	46	0	100	98	93	70	61	35
Lead	0.006	46	57	98	89	74	70	67	65
Lithium	0.1	46	4	100	100	100	100	100	80
Lutetium	0.0005	46	74	100	96	91	85	83	80
Magnesium	15	46	0	100	100	100	100	98	91
Manganese	0.02	46	0	100	100	98	98	96	89
Mercury	0.0004	47	19	100	100	74	60	55	36
Molybdenum	0.03	46	7	100	100	98	85	72	50
Neodymium	0.003	46	26	100	96	87	74	61	48
Nickel	0.02	46	0	100	100	98	93	87	70
Potassium	10	46	0	100	100	98	98	96	93
Praseodymium	0.0005	46	17	100	100	87	74	65	52
Rhenium	0.0013	46	83	100	100	93	91	91	87
Rubidium	0.002	46	0	100	100	100	98	98	80
Samarium	0.003	46	74	100	100	96	93	89	85
Selenium	0.2	46	80	100	100	98	98	96	89
Silica[1]	50	46	0	100	100	100	100	98	93
Silver	0.05	46	100	100	100	100	100	100	100
Sodium	70	46	0	100	100	100	96	93	74
Strontium	0.02	46	0	100	100	100	98	98	96
Terbium	0.0007	46	63	100	98	89	78	74	72
Thallium	0.005	46	85	100	100	100	98	98	96
Thulium	0.0005	46	74	100	98	91	89	85	80
Tungsten	0.004	46	2	100	100	93	74	63	37
Uranium	0.002	46	7	100	100	98	96	87	70
Vanadium	0.05	46	4	100	100	100	100	98	93
Ytterbium	0.0014	46	48	100	96	87	74	67	63
Yttrium	0.0004	46	0	100	100	93	85	74	46
Zinc	0.08	46	0	98	98	91	67	59	33
Zirconium	0.01	46	67	100	100	91	83	80	78

[1]Silica was the only substance reported as an oxide.

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C-034741

Table 18. Percentage of duplicate colloid samples whose relative percentage difference of total elemental analysis was below specified values for critical elements

[RPD, relative percentage difference; n, number of duplicate samples. %, percent; <, less than; >, greater than]

RPD	Aluminum	Cadmium	Copper	Iron	Lead	Mercury[1]	Zinc
% < 100%	100	100	100	100	100	100	100
% < 50%	100	100	100	100	100	100	100
% < 25%	100	100	100	100	100	50	100
% < 15%	100	100	100	100	100	50	100
% < 10%	100	100	75	100	75	50	100
% < 5%	25	75	0	75	25	25	75
n > DL	4	4	4	4	4	4	4
Total n	4	4	4	4	4	4	4

[1]Those values of RPD above 25% were less than 10 times the detection limit.

(Appendix 5, table A5-3) indicate that elements such as aluminum, chromium, titanium (Ti), and thallium (Tl) occur mainly in the residual phase, and therefore are interpreted as being not readily bioavailable, despite the fact they are present in colloids in substantial quantities. Other elements, such as cadmium, copper, and zinc, tend to occur primarily in the oxidizable and(or) reducible phases, and are considered likely to be bioavailable, and hence, may possibly be affecting the local aquatic ecology.

Equivalent Colloid Concentrations in Water

To estimate colloid concentrations for use in loading calculations, a technique was devised on the basis of chemical measurements. Although conventional techniques were used to measure suspended sediment concentrations (the results are in Appendix 5, table A5-2), these data are not appropriate for colloidal size material (< 2 µm diameter). Special procedures that require separation of coarser material followed by coagulation and a subsequent gravimetric determination (Guy, 1969) are very complex and generally do not work well for the low concentrations of suspended sediment that were often found during this study. The validity of the procedure that was developed to estimate the colloid concentrations is predicated on several assumptions:

1. A major elemental constituent in the colloidal material, which can serve as an indicator element, can be measured accurately at low concentration in the dissolved phase.
2. The indigenous concentration of this element is relatively low in the dissolved phase.
3. A conventional total recoverable analysis using a partial digestion procedure on a whole-water (unfiltered) sample will dissolve a major fraction of the element from the colloidal suspended material, or preferentially dissolve colloid-size suspended matter, because of the high degree of reactivity and significantly large surface area of colloid material.
4. Colloid-size material is the primary form of suspended matter present at the site, which implies that the silt-size and sand-size material concentrations are small or negligible compared to colloid-size suspended matter, or, if not, a preliminary separation of the coarser suspended matter is performed.

On the basis of these assumptions, the procedure involves the determination of the concentration of an indicator element in the ultrafiltrate of the sample at the site where suspended colloid concentration is to be measured. This ultrafiltrate concentration represents the natural dissolved concentration of the indicator element under the prevailing water chemistry conditions. The concentration of this element also is determined by total recoverable analysis by partial digestion of a representative whole-water (unfiltered) sample taken from the same site at the same time as the ultrafiltrate sample. By subtracting the dissolved concentration from the total recoverable analysis (whole-water digestion) concentration, a concentration of the indicator element attributed to the suspended colloidal material is obtained. By knowing the concentration of the indicator element in the colloidal suspended matter, obtained from independent measurements on a total digestion of the isolated

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C-034742

Table 19. Percentage of replicate colloid samples whose relative standard deviation fell below the specified values for all elements analyzed

[DL, detection limit; µg/L, microgram per liter; RSD, relative standard deviation; n, number of duplicate samples; the values in the table represent the total of those less than the detection limit and those that meet the criteria. %, percent; <, less than]

Element	Range (%RSD)							
	n	% < DL	% < 100%	% < 50%	% < 25%	% < 15%	% < 10%	% < 5%
Aluminum	4	0	100	100	100	100	100	50
Antimony	4	0	100	100	100	75	75	25
Barium	4	0	100	100	100	100	50	25
Beryllium	4	0	100	100	100	100	75	50
Bismuth	4	3	100	100	75	75	75	75
Cadmium	4	0	100	100	100	100	100	75
Calcium	4	0	100	100	100	100	75	75
Cerium	4	0	100	100	75	25	25	0
Cesium	4	0	100	100	75	50	25	0
Chromium	4	0	100	100	100	100	100	75
Cobalt	4	0	100	100	100	100	100	75
Copper	4	0	100	100	100	100	75	25
Dysprosium	4	0	100	100	100	75	75	25
Erbium	4	0	100	100	100	100	75	0
Europium	4	0	100	100	100	50	25	25
Gadolinium	4	0	100	100	100	50	50	25
Holmium	4	0	100	100	100	100	50	0
Iron	4	0	100	100	100	100	100	100
Lanthanum	4	0	100	100	75	25	0	0
Lead	4	0	100	100	100	100	100	50
Lithium	4	0	100	100	100	100	100	100
Lutetium	4	0	100	100	100	75	75	25
Magnesium	4	0	100	100	100	75	50	50
Manganese	4	0	100	100	100	100	100	50
Mercury	4	0	100	100	100	50	50	25
Molybdenum	4	3	100	100	100	100	100	75
Neodymium	4	0	100	100	75	50	25	25
Nickel	4	0	100	100	100	75	75	50
Potassium	4	0	100	100	100	75	50	25
Praseodymium	4	0	100	100	75	75	25	0
Rubidium	4	0	100	50	25	0	0	0
Samarium	4	0	100	100	100	50	0	0
Silica[1]	4	0	100	100	100	100	50	25
Sodium	4	0	100	100	75	75	50	25
Strontium	4	0	100	100	100	100	100	75
Terbium	4	0	100	100	100	75	25	0
Titanium	4	0	100	100	100	100	100	100
Thallium	4	0	100	100	100	100	100	75
Thorium	4	0	100	100	100	75	0	0
Thulium	4	0	100	100	100	75	25	0
Tungsten	4	0	100	100	100	100	25	0
Uranium	4	0	100	100	100	100	100	75
Vanadium	4	0	100	100	100	100	100	100
Yttrium	4	0	100	100	100	50	50	0
Ytterbium	4	0	100	100	100	75	75	25
Zinc	4	0	100	100	100	100	100	75
Zirconium	4	0	100	100	100	100	75	50

[1]Silica was the only substance reported as an oxide.

C—0 3 4 7 4 2

C-034743

Table 20. Percentage of duplicate colloid samples whose relative percentage difference for the sum of sequential elemental analysis was below specified values for critical elements

[RPD, relative percentage difference; values in the table represent the total of those less than the detection limit and those that meet the criteria; n, number of duplicate samples; DL, detection limit. %, percent]

RPD	Aluminum	Cadmium	Copper	Iron	Lead	Mercury	Zinc
% < 100%	100	100	100	100	100	100	100
% < 50%	100	100	100	100	100	100	100
% < 25%	75	100	100	100	100	100	100
% < 15%	50	75	75	100	100	100	75
% < 10%	50	75	25	50	75	100	75
% < 5%	25	50	0	50	0	75	0
% < 3%	25	25	0	0	0	50	0
% < 1%	25	0	0	0	0	50	0
n > DL	4	4	4	4	4	2	4
Total n	4	4	4	4	4	4	4

colloidal material, the concentration of the colloidal suspended matter can be calculated. This approach was tested and calibrated empirically by creating artificial colloid suspensions from each of the sampling sites where sufficient isolated colloidal material was available (after the other digestions and measurements were completed). These suspensions, which were derived from freeze-dried ultrafilter retentate, were prepared gravimetrically and resuspended in deionized water using ultrasonic agitation and the addition of a surfactant. The artificial colloid suspensions were processed by total recoverable analysis (whole-water digestion) in the same manner as the unfiltered water samples previously described. The recovery of the indicator elements from these total recoverable analyses (whole-water digestions) of the artificial colloid suspensions relative to the known amount of these indicator elements (because a known amount of the isolated colloids were artificially added to deionized water) was computed and used to adjust the sample calculations from the same sites. This calibration approach effectively compensated for any deviations in the chemistry of the colloids or the efficiency of the total recoverable (whole water) extraction process.

Several elements were used to perform the calculations of equivalent colloid concentrations. Aluminum, iron, and several rare earth elements proved to be suitable indicators for these calculations. A correlation diagram is shown in figure 43, which plots colloid concentrations determined using aluminum as the indicator element versus concentrations determined using iron as the indicator element. The linearity of this correlation plot ($R^2 = 0.98$) shows implicitly that concentrations calculated by using either element would yield comparable results. To simplify the presentation of effective colloid concentration data, further discussion of concentrations calculated by this procedure are restricted to results using aluminum as the indicator element.

Total Recoverable Analyses of Whole-Water (Unfiltered) Samples

In addition to dissolved and colloid samples, unfiltered (whole-water) samples were collected, partially digested and analyzed, as described earlier in this report. The results of these analyses are presented in Appendix 4 (table A4-2). As a general rule, total recoverable analysis of whole-water samples usually do not provide as complete and reproducible information as do the sum of dissolved and colloidal samples, mainly because total recoverable analysis is not a complete chemical digestion. For this particular study, however, total recoverable concentrations from whole-water samples tend to agree well with the sum of dissolved and equivalent colloid concentrations (fig. 44) for Cd, Cu, Pb, Mg, Hg, and Zn. The sum of dissolved and equivalent colloid concentrations are referred to as "effective concentration."

Conventional Membrane and Capsule Filtration

As discussed in an earlier section of this report, in addition to the tangential-flow ultrafiltration samples, two other types of dissolved samples were processed. Filtrate data from a 0.40-µm membrane-filtered (Nuclepore) subsample and a 0.45-µm tortuous-path capsule-filtered (Gelman) subsample were collected to allow a rigorous comparison

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C-034744

Table 21. Percentage of duplicate colloid samples whose relative standard deviation for the sum of sequential elemental analysis was below specified values for all elements analyzed

[Values in the table represent the total of those less than the detection limit and those that meet the criteria. DL, detection limit; n, number of duplicate samples; RSD, relative standard deviation; %, percent; <, less than; >, greater than]

Element	n > DL	Range (%RSD)						
		% < DL	% < 100%	% < 50%	% < 25%	% < 15%	% < 10%	% < 5%
Aluminum	4	4	100	100	100	50	50	25
Antimony	4	4	100	100	100	75	75	0
Barium	4	4	100	100	100	50	50	0
Beryllium	4	4	100	100	100	25	0	0
Bismuth	4	2	100	100	100	100	100	50
Cadmium	4	4	100	100	100	75	75	50
Calcium	4	4	100	100	100	75	75	0
Cerium	4	4	100	100	75	75	75	25
Cesium	4	4	100	100	75	50	25	0
Chromium	4	4	100	100	100	100	100	0
Cobalt	4	4	100	100	100	100	100	0
Copper	4	4	100	100	100	100	50	0
Dysprosium	4	4	100	100	100	100	75	50
Erbium	4	4	100	100	100	50	50	50
Europium	4	4	100	100	100	75	75	50
Gadolinium	4	4	100	100	100	100	75	25
Holmium	4	4	100	100	100	75	50	0
Iron	4	4	100	100	100	100	75	25
Lanthanum	4	4	100	100	75	75	50	25
Lead	4	4	100	100	100	100	100	25
Lithium	4	4	100	100	100	100	25	0
Lutetium	4	4	100	100	100	50	25	0
Magnesium	4	4	100	100	100	75	50	25
Manganese	4	4	100	100	100	100	100	25
Mercury	4	2	100	100	100	100	100	50
Molybdenum	4	2	100	100	100	75	75	50
Neodymium	4	4	100	100	100	75	75	25
Nickel	4	4	100	100	100	75	50	0
Praseodymium	4	4	100	100	75	75	50	0
Rubidium	4	4	100	100	75	50	50	25
Samarium	4	4	100	100	100	75	75	25
Silica[1]	4	4	100	100	100	100	50	0
Strontium	4	4	100	100	100	50	25	0
Terbium	4	4	100	100	100	100	50	0
Thallium	4	4	100	100	100	100	100	0
Thorium	4	4	100	100	100	75	75	0
Thulium	4	4	100	100	100	75	25	0
Titanium	4	4	100	100	100	100	75	25
Tungsten	4	4	100	100	100	100	75	25
Uranium	4	4	100	100	100	75	75	0
Vanadium	4	4	100	100	100	100	50	25
Ytterbium	4	4	100	100	100	75	75	50
Yttrium	4	4	100	100	100	75	75	25
Zinc	4	4	100	100	100	100	75	0
Zirconium	4	4	100	100	75	75	25	0

[1]Silica was the only substance reported as an oxide.

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C-034745

Table 22. Comparison of metal concentrations determined in the study with certified values reported by the National Institute of Standards and Technology for standard reference materials SRM 1566a–Oyster tissue and SRM 50–Albacore tuna

[Mean ± 95 percent CI (confidance interval) for n = 5 (n refers to the number of analyses of the individual SRMs); NIST, National Institute of Standards and Technology; SRM, Standard Reference Material. Units are micrograms per gram dry weight. %, percent; —, not reported]

Metal	NIST SRM 1566a				NIST SRM 50			
	Certified		Observed		Certified		Observed	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Aluminum	202.5	13	136	9	—	—	6.28	1.7
Cadmium	4.15	0.4	4.38	0.17	—	—	0.06	0.03
Copper	66.3	4.3	61.8	3.8	—	—	3.08	0.2
Iron	539	15	518	24	—	—	53	2
Lead	0.371	0.01	0.37	0.07	0.46	—	0.52	0.16
Zinc	830	57	824	26	13.6	1	13.8	0.9

Table 23. Percentage of metal recovered from representative caddisfly samples spiked with a known quantity of metal

[wb, whole body sample; s, spiked sample; c, cytosol sample; p, pellet sample]

Station	Sample Number	Cadmium	Copper	Lead	Zinc
Sacramento River above Churn Creek near Anderson	SRAH1wb/s	100	99	89	101
Sacramento River at Bend Bridge near Red Bluff	SRBH1wb/s	98	90	98	93
	SRBH2wb/s	96	82	90	97
	SRBH1c/s	98	96	97	98
	SRBH2c/s	102	93	94	99
	SRBH1p/s	99	100	97	108
	SRBH2p/s	96	97	96	96
Sacramento River at Tehama	SRTBLK1wb/s	95	93	92	96
	SRTH1wb/s	97	93	87	96
	SRTH2wb/s	99	92	88	99
	SRTH3wb/s	99	94	97	96
	SRTH4wb/s	99	94	88	95
Cottonwood Creek near Cottonwood	SRCCH1wb/s	101	95	87	95
	SRCCH2wb/s	95	85	93	96

between these and ultrafiltrate samples (Appendix 4, table A4-1). Concentration differences for some representative elements (cerium, copper, and iron shown in fig. 45) among the three filter types for three sampling sites in the upper part of the Sacramento River Basin indicate that the commonly used filtration techniques (the capsule and membrane filters) tend to overestimate the amount of dissolved material present, especially at the Sacramento River below Keswick Dam. A more complete discussion of comparisons among the different filtrates is planned as part of subsequent reports.

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C-034746

Table 24. Lead isotopic data for the National Institute of Standards and Technology's standard reference material SRM-981 for filament temperatures of 1,191° to 1,300°C for the VG Sector 54 and VG 54R mass spectrometers

[The "true values" are the commonly accepted corrected values from Todt and other (1993). AMU, atomic mass units; *F*, fractionation factor, in units of percent per AMU; Pb, lead; NIST, National Institute of Standards and Technology; SRM, Standard Reference Material; T, temperature; Uncert., uncertainty. °C, degrees Celsius; %, percent]

Sample	T (°C)	$^{206}Pb/^{204}Pb$	Uncert. (%)	$^{207}Pb/^{206}Pb$	Uncert. (%)	$^{208}Pb/^{206}Pb$	Uncert. (%)	Mean *F* (%/AMU)	Uncert.
True Values		16.9322	0.005	0.914561	0.0044	2.16662	0.006		
Sector 54-Low T									
SRM 981a	1,208	16.884	0.052	0.91325	0.0048	2.1606	0.0042		
SRM 981b	1,191	16.883	0.029	0.91325	0.0045	2.1605	0.0039		
Mean		16.884	0.025	0.91325	0.0032	2.1606	0.0420		
F		0.144	0.013	0.143	0.003	0.140	0.021	0.143	0.003
Sector 54-High T									
SRM 981a	1,299	16.890	0.0264	0.91335	0.0042	2.1613	0.0063		
SRM 981b	1,276	16.888	0.012	0.91335	0.0036	2.1613	0.0054		
Mean		16.888	0.011	0.91335	0.0027	2.1613	0.004		
F		0.130	0.006	0.132	0.003	0.124	0.002	0.128	0.011
54R-Low T									
SRM 981c	1,220	16.885	0.071	0.91343	0.0071	2.1608	0.014		
SRM 981d	1,200	16.889	0.021	0.91347	0.0050	2.1610	0.008		
SRM 981e	1,200	16.887	0.03	0.91331	0.0057	2.1607	0.056		
Mean		16.888	0.016	0.91340	0.022	2.1610	0.007		
F		0.131	0.008	0.127	0.022	0.131	0.004	0.130	0.004
54R-High T									
SRM 981d	1,280	16.894	0.027	0.91352	0.0050	2.1615	0.019		
SRM 981e	1,300	16.897	0.051	0.91355	0.0151	2.1620	0.026		
Mean		16.895	0.023	0.91352	0.0046	2.1617	0.015		
F		0.110	0.012	0.114	0.005	0.114	0.008	0.114	0.004

Table 25. Comparison of lead isotopic data obtained from the VG Sector 54 and VG 54R mass spectrometers for a Shasta Dam colloid sample (collected in December 1996)

[T, temperature; °C, degrees Celsius; Uncert., uncertainty; *F*, fractionation factor; Pb, lead. Data are corrected for mass fractionation based on the *F*-values given; uncertainties are absolute values at the 95 percent confidence interval]

Mass Spectrometer	T (°C)	F	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
Sector 54	1,360	0.128	18.661 ± 0.015	0.83561± 0.00018	2.0426 ± 0.0008
54R	1,285	0.114	18.663 ± 0.014	0.83598± 0.00039	2.0432 ± 0.0016

Metal Concentrations in Streambed Sediments

Samples of streambed sediments were collected during the study according to the protocols described in the previous section of this report. The results of these analyses are presented in Appendix 5 (table A5-1). Figures 46 through 51 are plots for six trace metals (Cd, Cu, Fe, Hg, Pb, and Zn), which compare concentrations in streambed sediment with those in suspended colloidal sediment in relation to downriver distance. As in figures showing concentrations in water versus distance (figs. 36 through 41 and A8-1 through A8-14), the horizontal axis in figures 46–51 has been broken into two sections at different scales to emphasize the upper river sites. Streambed sediments and suspended colloidal sediments near Keswick Reservoir are elevated in certain trace elements (cadmium, copper, lead, and zinc) associated with massive sulfide mineralization, relative to the downriver sites. Other elements, such as iron, have elevated concentrations in suspended colloidal sediment near Keswick Reservoir, but do not have particularly

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C-034747

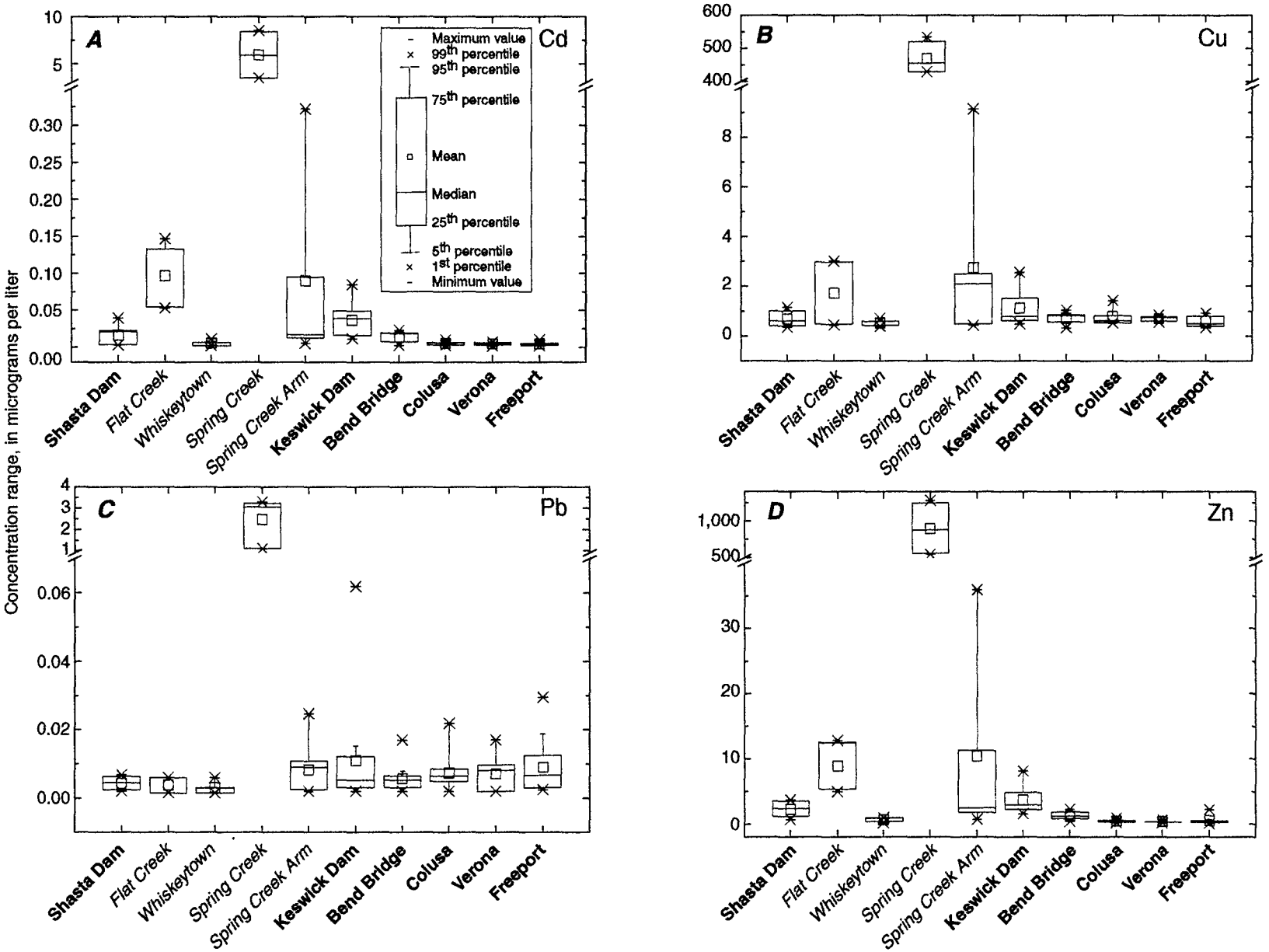

Figure 34. Box plots showing range, mean, and median of dissolved (ultrafiltrate) concentrations in the Sacramento River Basin, California, for *A*. Cadmium, *B*. Copper, *C*. Lead, *D*. Zinc. Site names in bold are mainstem sites and those in italics are tributary sites.

C-034747
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C-03749

C — 0 3 4 7 4 8

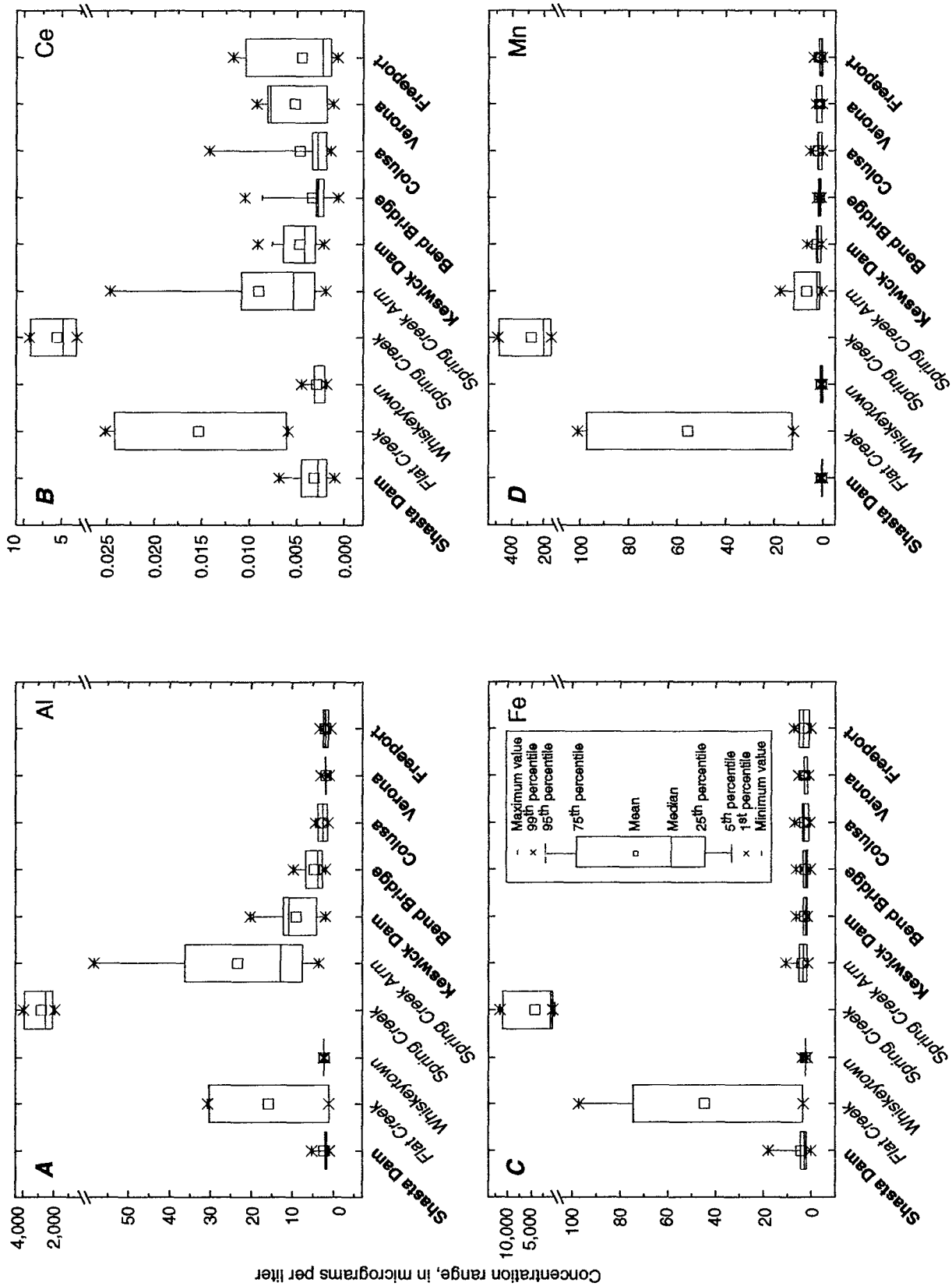

Figure 35. Box plots showing range, mean, and median of dissolved (ultrafiltrate) concentrations in the Sacramento River Basin, California, for *A.* Aluminum, *B.* Cerium, *C.* Iron, *D.* Manganese. Site names in bold are mainstem sites and those in italics are tributary sites.

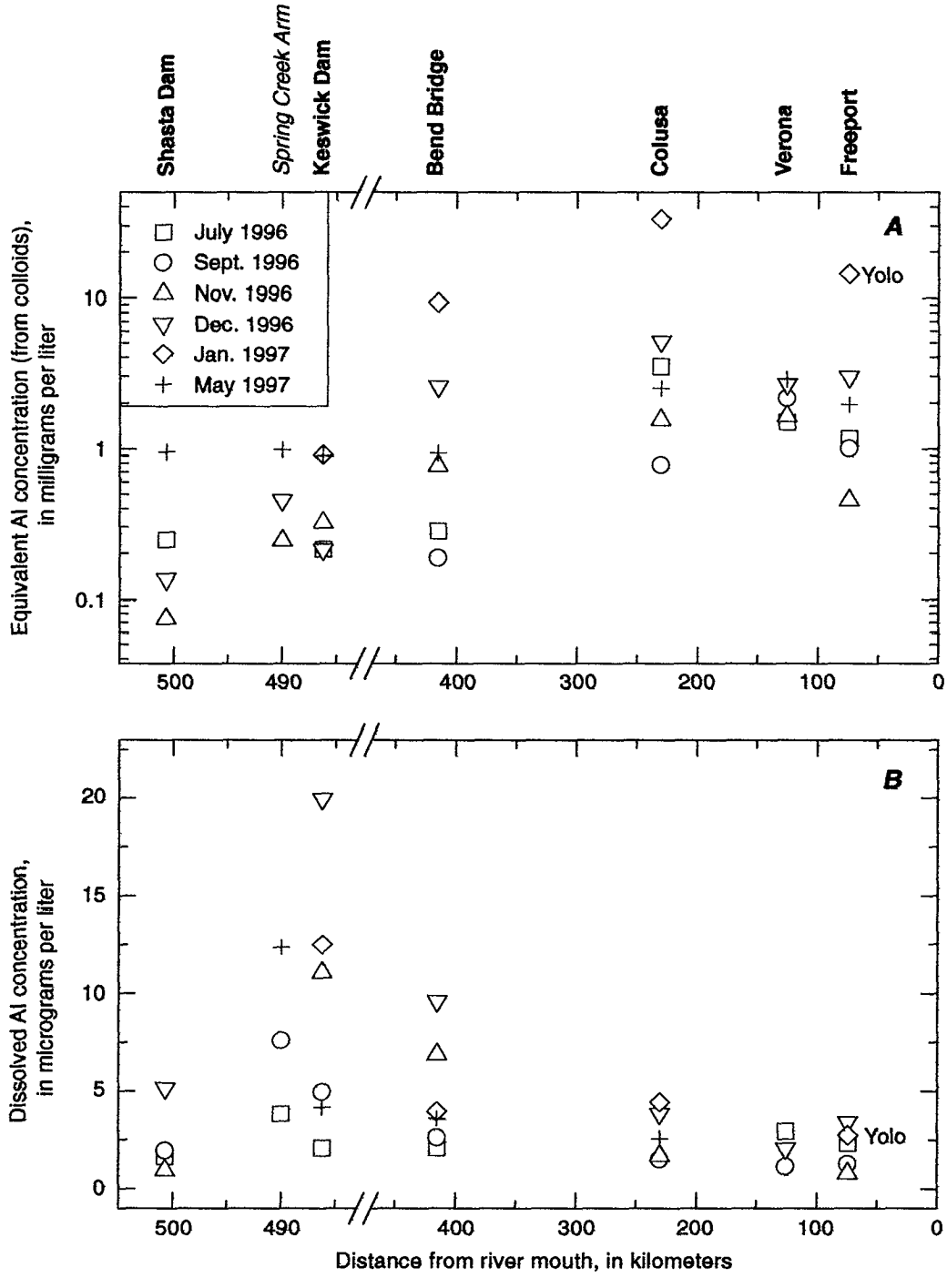

Figure 36. Plots of aluminum (Al) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

C —0 3 4 7 4 9

C-034750

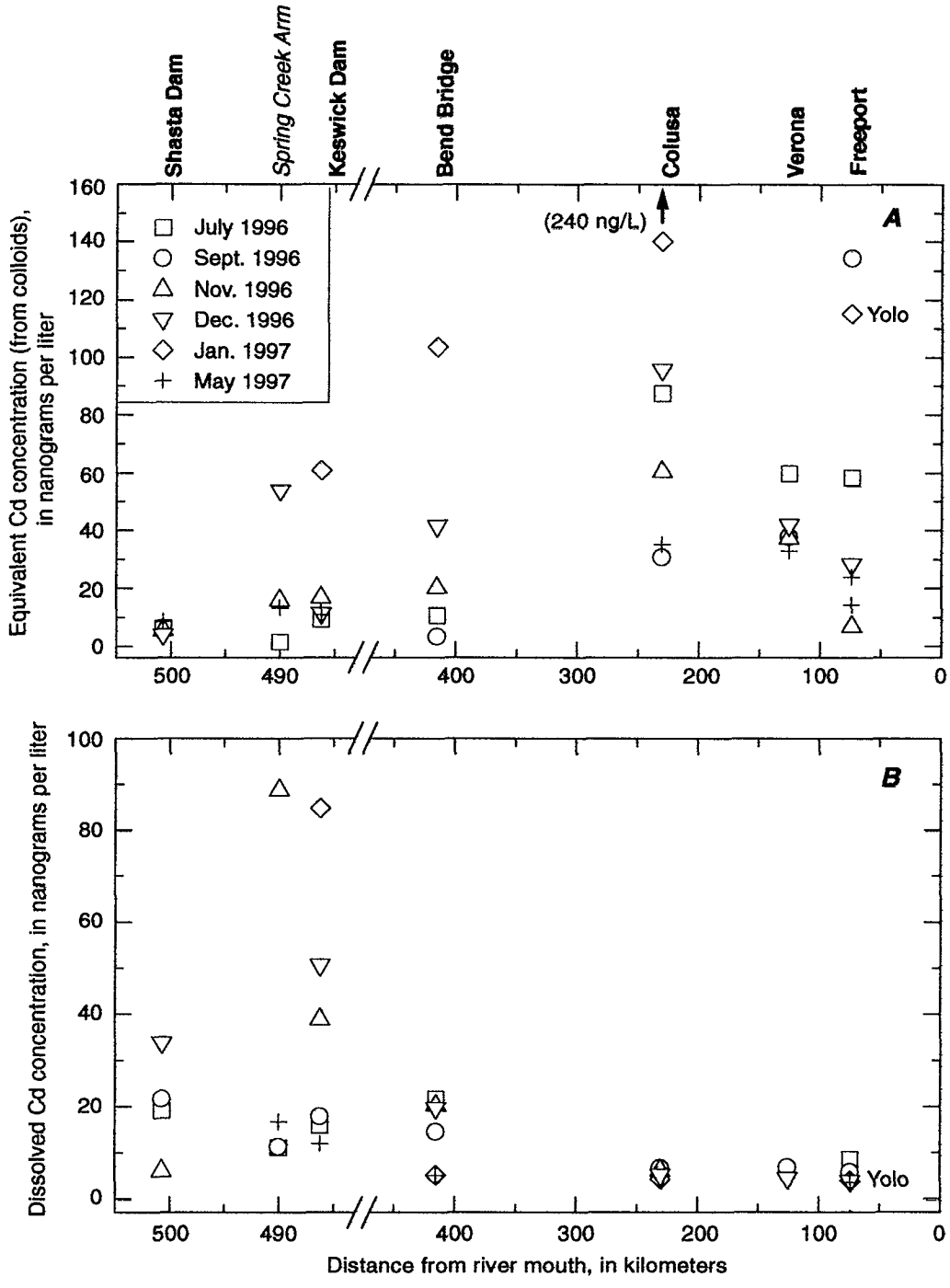

Figure 37. Plots of cadmium (Cd) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

C—0 3 4 7 5 0

C-034751

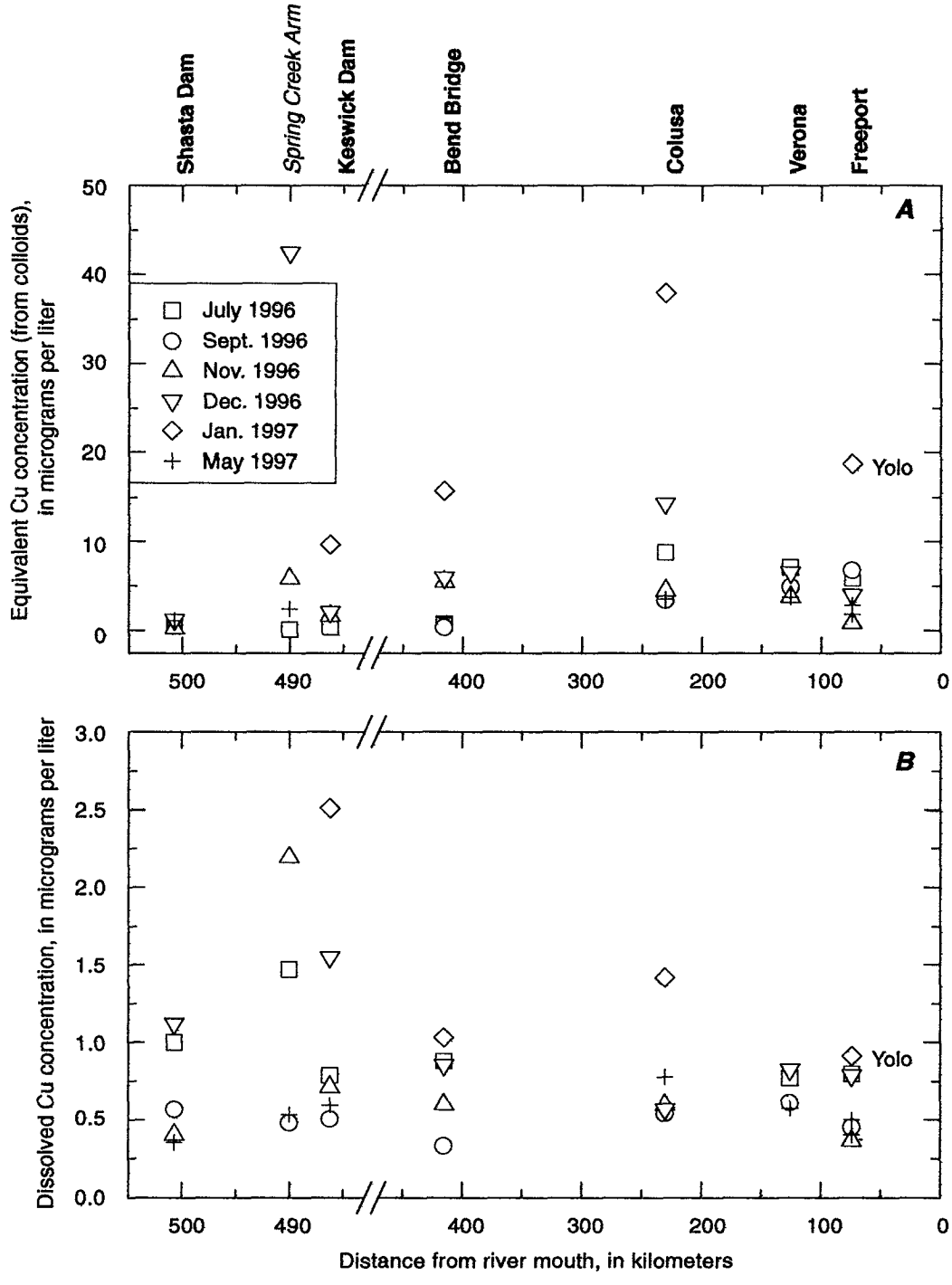

Figure 38. Plots of copper (Cu) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

C—0 3 4 7 5 1

C-034752

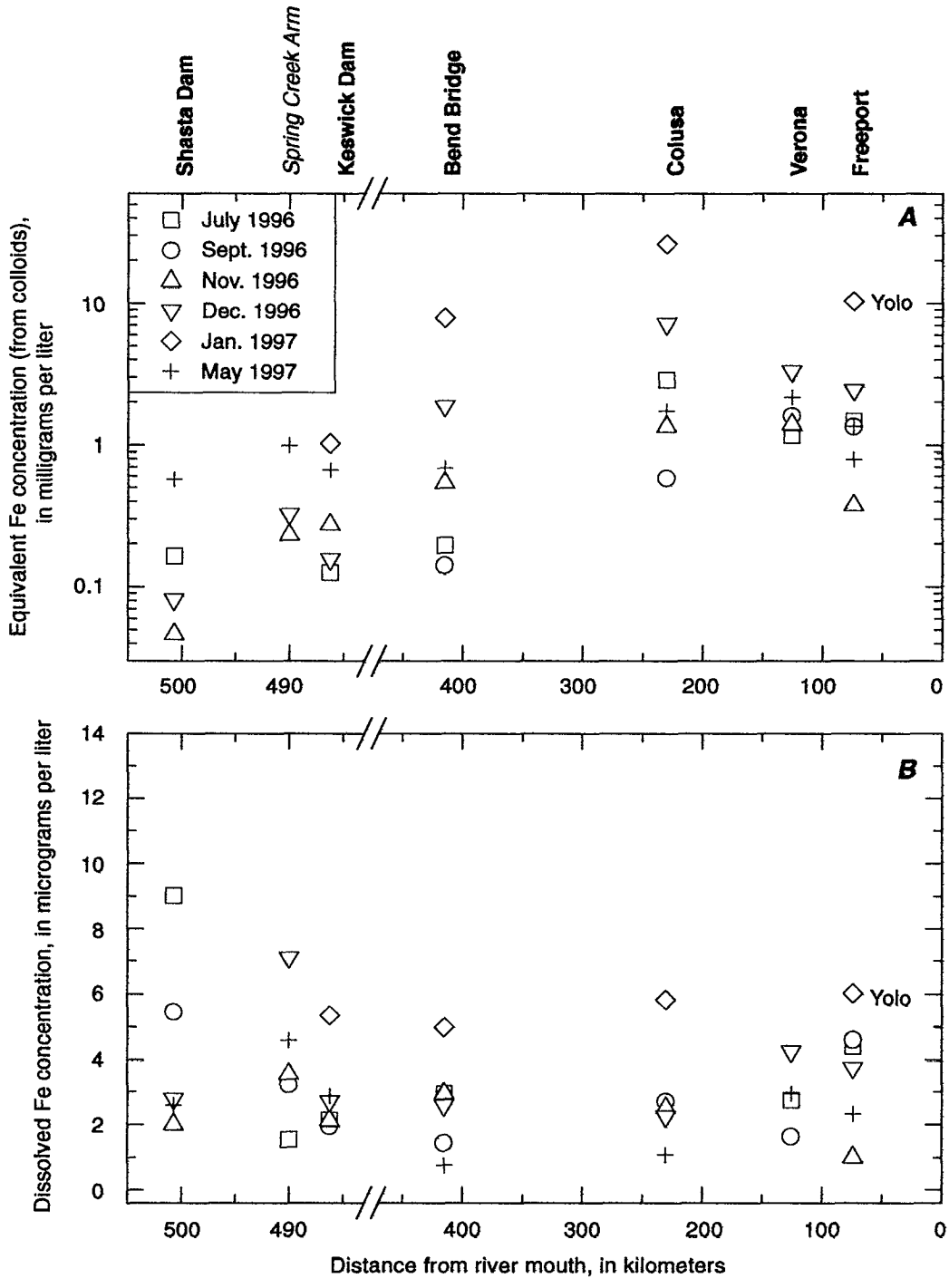

Figure 39. Plots of iron (Fe) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

C — 0 3 4 7 5 2

C-034753

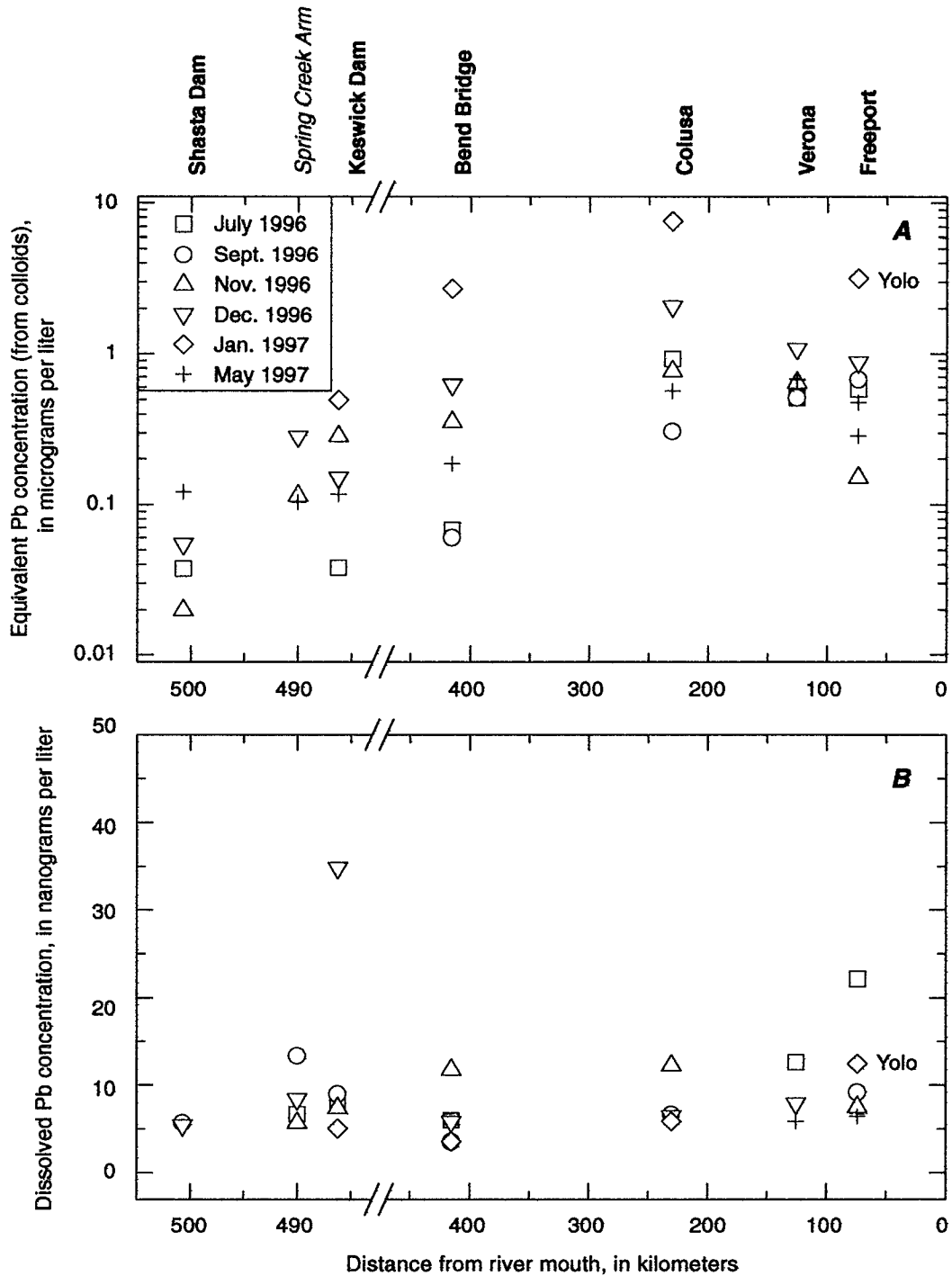

Figure 40. Plots of lead (Pb) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

C —0 3 4 7 5 3

C-034754

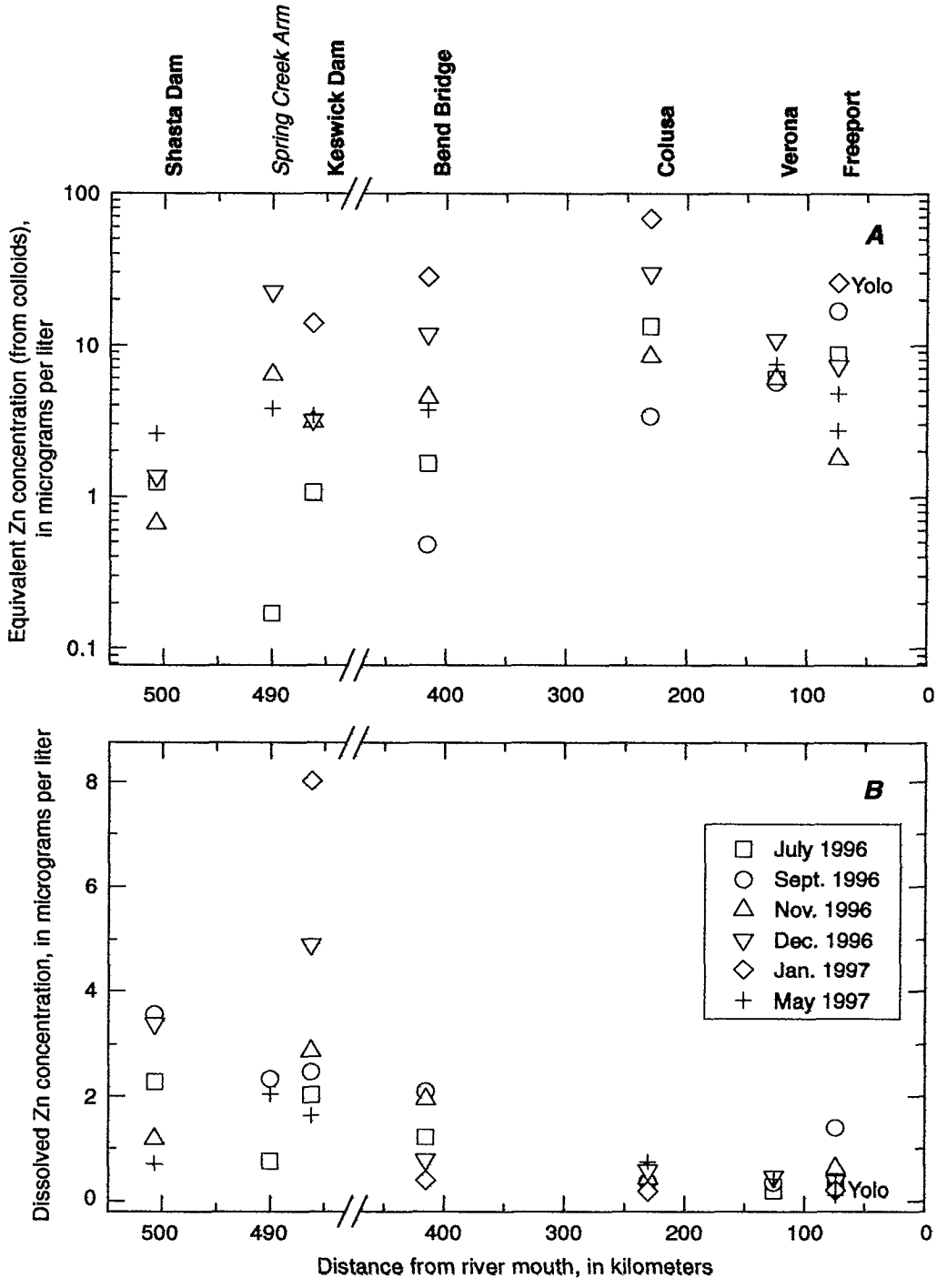

Figure 41. Plots of zinc (Zn) concentration in relation to distance (broken scale) from Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997. Site names in bold are mainstem sites and those in italics are tributary sites.

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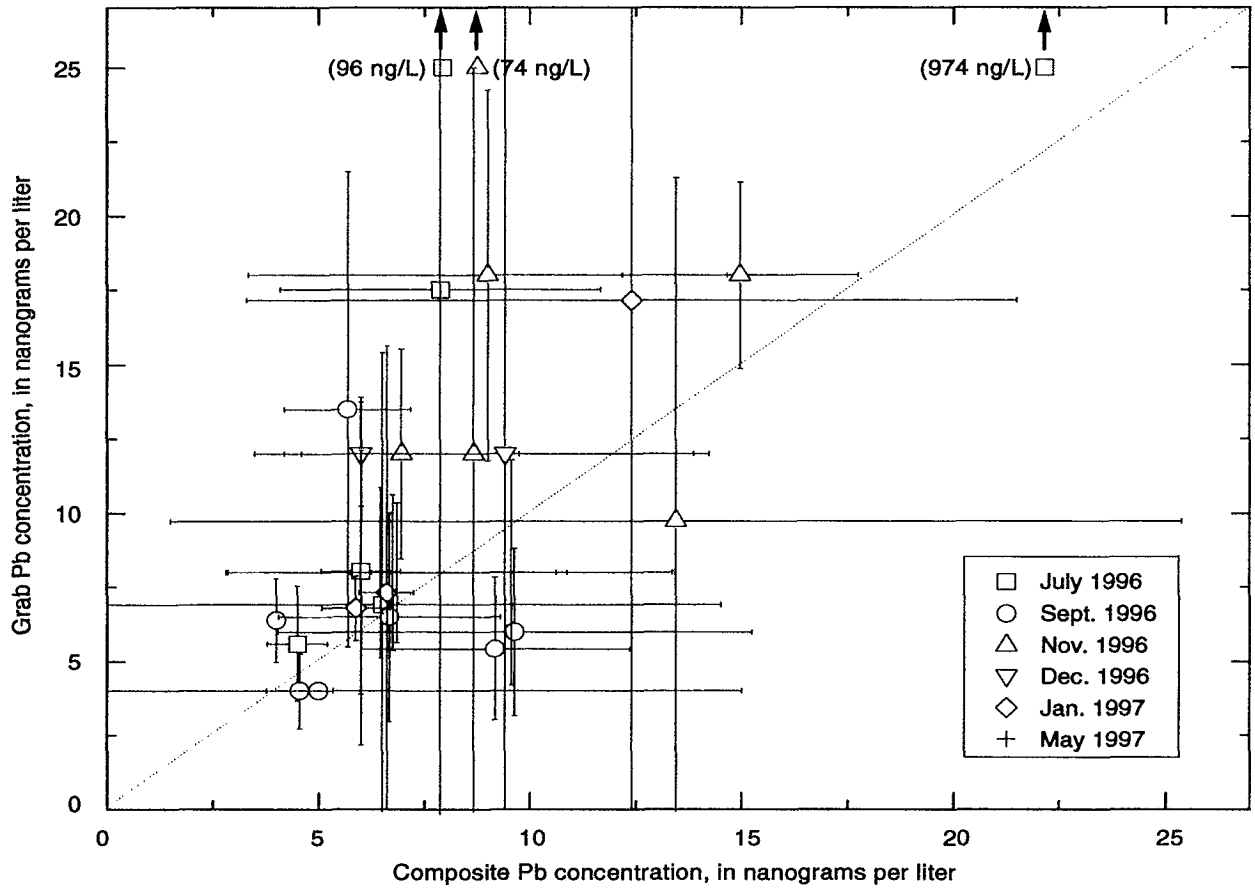

Figure 42. Plot of dissolved (ultrafiltrate) lead (Pb) concentration in composite water samples compared with dissolved (ultrafiltrate) lead concentration in concurrent grab water samples in the Sacramento River Basin, California. Vertical and horizontal lines represent standard deviation based on three to six determinations. Dotted line represents theoretical line of perfect agreement; error bars represent precision based on triplicate (or hextuplicate) analyses. ng/L, nanogram per liter.

elevated concentrations in the streambed sediment at sites downstream of Keswick Reservoir. For many trace elements, higher absolute concentrations are associated with the suspended colloids than with the bed sediments. This effect could possibly be related to the generally smaller grain size and larger surface area of the suspended colloidal sediment, resulting in a greater adsorption of metals.

Metal Concentrations in Caddisfly Larvae

Caddisfly (*H. californica*) larvae samples were collected as described in the previous section of this report. The results of the analyses of these samples are presented in Appendix 7 (tables A7-1 and A7-2) and indicate that *H. californica* in the Sacramento River were exposed to elevated concentrations of bioavailable cadmium, copper, lead, and zinc, with cadmium showing the greatest enrichment. Distribution patterns of cadmium, copper, and lead were consistent with an upstream source at or upstream of Redding. Although all metals were attenuated downstream, the transport of bioavailable metals appears to extend downstream of Tehama (fig. 8). A detailed discussion of the caddisfly data is presented separately (Cain and others, 2000).

Lead Isotopes in Colloid Concentrates and Streambed Sediments

Table 26 contains the lead isotope data for both colloid concentrates and streambed sediment samples

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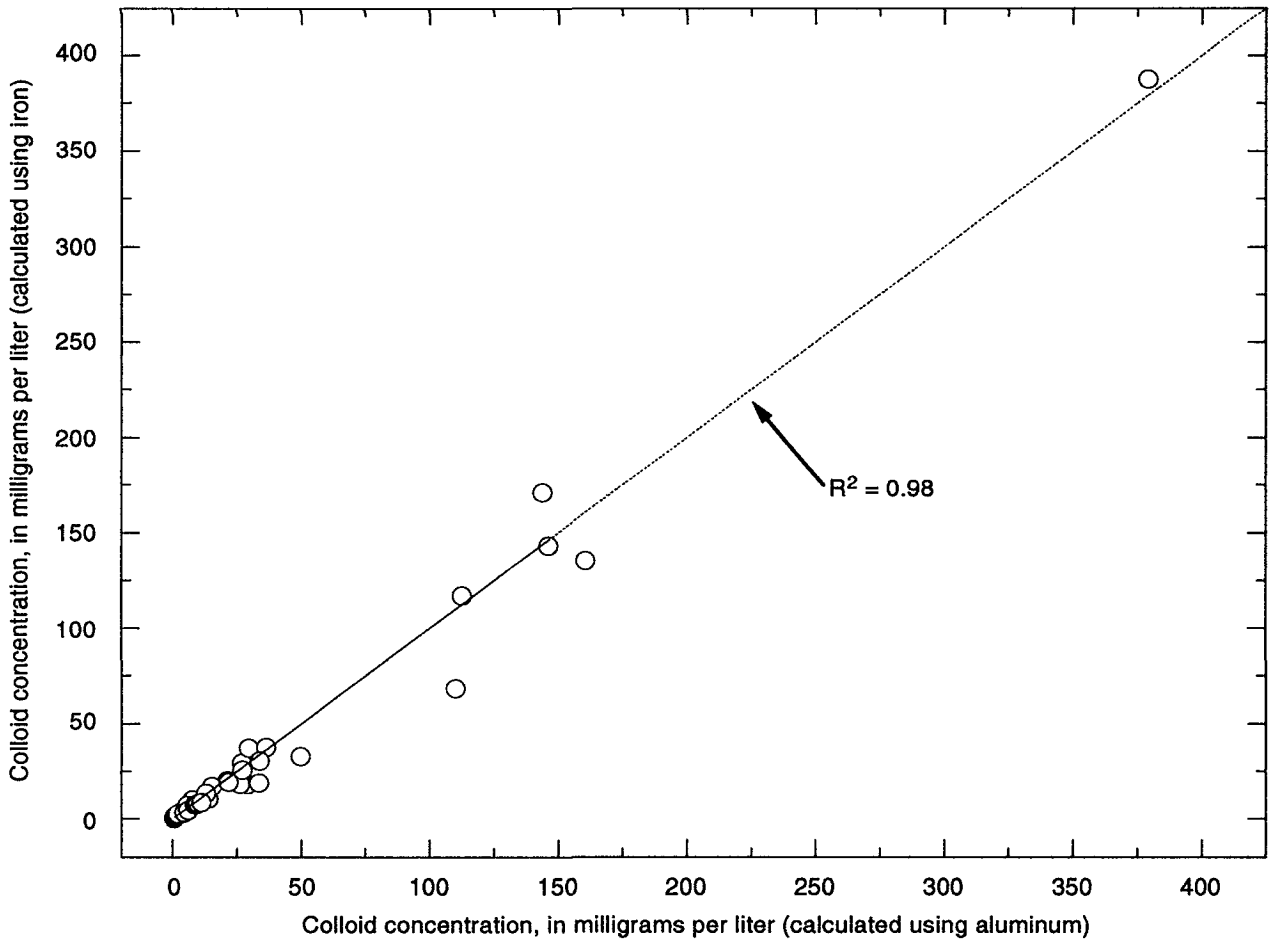

Figure 43. Plot of equivalent colloid concentration in river water computed using aluminum data compared with colloid concentration in river water computed using iron data in the Sacramento River Basin, California. R^2 value is based on linear least-squared regression.

for selected sites in the Sacramento River Basin. Lead isotope data can be used as a tracer to elucidate the possible sources of sediment and are particularly well suited to trace lead from massive sulfide deposits (Church and others, 1993, 1997). Figure 52 is a three-paneled plot of $^{206}Pb/^{204}Pb$, $^{207}Pb/^{206}Pb$, and $^{208}Pb/^{206}Pb$ versus distance from river mouth (broken scale). These plots show the influence of the massive sulfides at Iron Mountain as a source of lead to down-river sites, both in the suspended colloid sediments and in the streambed sediments. At the Bend Bridge site, 71 km downstream of Keswick Dam, the lead isotope signature from the Iron Mountain massive sulfide deposits seems to have been attenuated by more radiogenic lead from other sources such as the granitic rocks of the northern Sierra Nevada.

Figure 53 is another plot of $^{206}Pb/^{204}Pb$ versus river kilometer (continuous distance scale) that shows consistently higher values of $^{206}Pb/^{204}Pb$ in suspended colloids collected in January 1997 compared with those collected in December 1996. Values of $^{206}Pb/^{204}Pb$ in streambed sediments tend to fall between the December 1996 and January 1997 colloid values. These differences could be caused by a shift to more radiogenic (that is, granitic) source rocks from the eastern side of the Sacramento Valley during extreme flooding that took place in January 1997.

The distinctly nonradiogenic lead isotope signature of the massive sulfide deposits at Iron Mountain (Doe and others, 1985) is shown clearly on a plot of $^{206}Pb/^{204}Pb$ versus $^{208}Pb/^{207}Pb$ (fig. 54). Lead isotope ratios in the colloid samples collected below Shasta Dam and Keswick Dam plot on a linear trend with the

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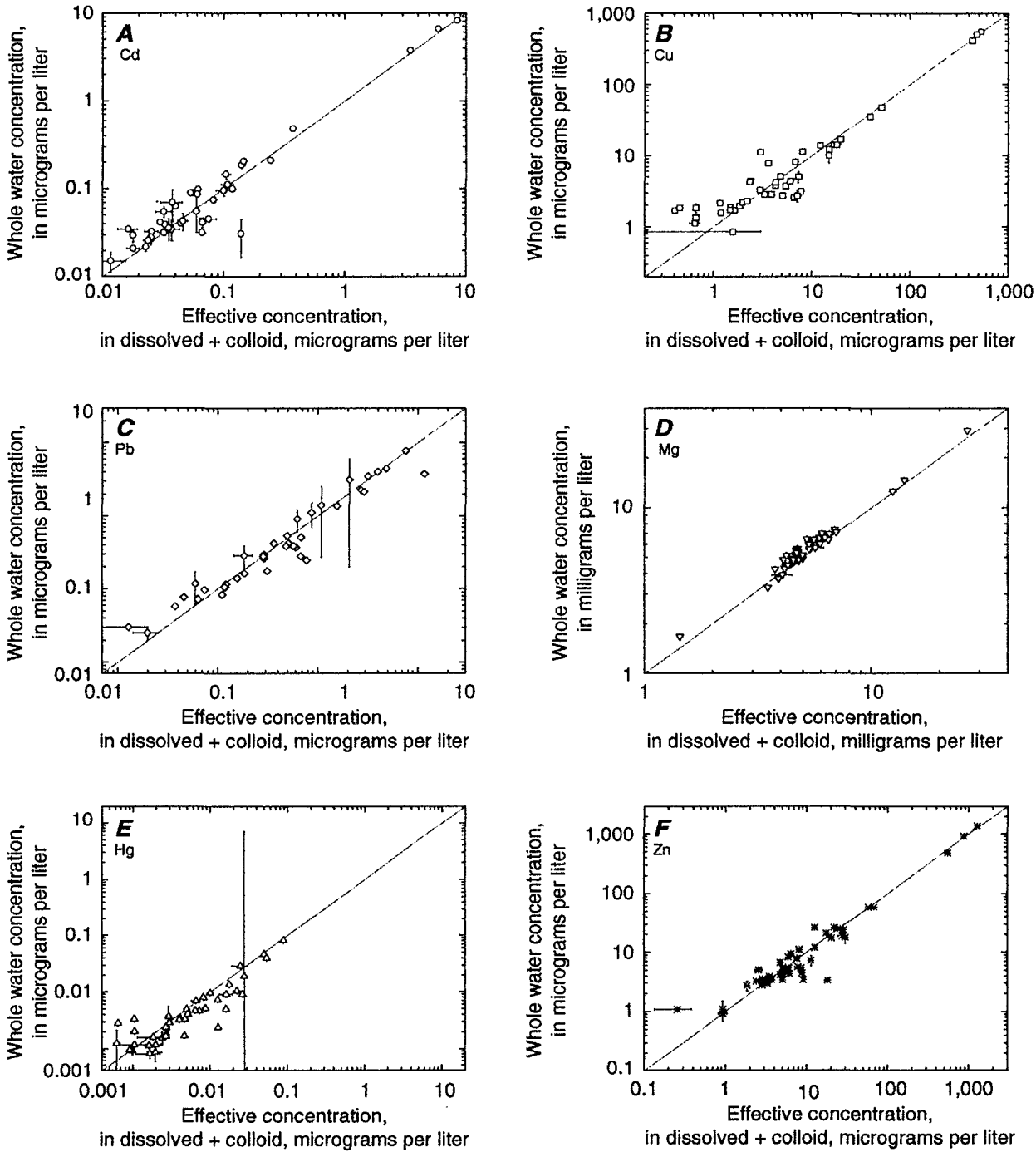

Figure 44. Plots of effective concentration (dissolved plus colloid) compared with total recoverable (whole water) concentration in the Sacramento River Basin, California, for *A.* Cadmium (Cd), *B.* Copper (Cu), *C.* Lead (Pb), *D.* Magnesium (Mg), *E.* Mercury (Hg), *F.* Zinc (Zn). Dotted line represents theoretical line of perfect agreement; error bars represent precision based on triplicate (or hextuplicate) analyses.

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C-034758

data from the Iron Mountain massive sulfide deposit (fig. 54). This linear pattern is consistent with an interpretation that the lead in suspended colloids at Keswick Dam represents a mixture of lead from tributaries to Shasta Lake with lead from Iron Mountain mine and Spring Creek. Mainstem Sacramento River sites downstream from Keswick Dam plot on a different linear trend in figure 54, indicating a different mix of source rocks and(or) other possible contaminant sources such as urban runoff or soils with lead from historic automobile emissions. The suspended colloid sample collected at Tower Bridge during January 1997 represents primarily the American River watershed because of the hydrology of the river during flood conditions and the operation of the Yolo Bypass (as discussed earlier in this report). Therefore, it is not surprising that this point has a much more radiogenic lead signature than other samples from this study, reflecting sources of lead in the Sierra Nevada granitic rocks and other source rocks dominated by continental crust.

The distribution of lead concentrations in streambed sediment and suspended colloids for different sites along the Sacramento River (fig. 55) illustrates the input of lead to the Sacramento River system from Spring Creek. Lead concentrations in both streambed sediment and suspended colloids reach minimum values in the samples collected from the Sacramento River at Colusa. Downstream from Colusa, lead concentrations increase in both sediment and colloids, indicating additional sources of lead either from tributary streams or, more likely, from urban runoff as the more densely populated Sacramento metropolitan area is approached. The ratio $^{206}Pb/^{204}Pb$ versus lead concentration in sediments and colloids (fig. 56) indicates a fairly strong correlation between elevated lead concentrations and non-radiogenic lead. This trend helps to confirm that the source of lead in the upper part of the watershed is most likely from the massive sulfide deposits hosted in oceanic crust (igneous rocks that originally formed in an oceanic environment, with relatively nonradiogenic lead). Also the colloid sample from the Tower Bridge in January 1997 falls off the aforementioned trend (fig. 56), which is consistent with more radiogenic sources of lead in drainage from the American River watershed.

Anions, Nutrients, Organic Carbon, and Field Parameters

Data for anions, nutrients, organic carbon, and field parameters collected during the study are contained in Appendix 3 (table A3-1). Anions included in this report are chloride, sulfate, and fluoride analyzed in filtered (0.45-µm capsule filter) water samples split from composite samples collected for metal analysis or collected as part of the NAWQA Program. Chloride concentrations ranged from 0.14 mg/L to 5.9 mg/L, with a median value of 2.2 mg/L in the Sacramento River sites. The highest chloride concentration measured was 37 mg/L in a sample from the Colusa Basin Drain, a channel containing mostly agricultural return flows at the time the sample was collected. Sulfate concentrations ranged from 1.7 to 6.0 mg/L in the Sacramento River sites. Higher concentrations were detected in Spring Creek (15–230 mg/L), Flat Creek (9.2–55 mg/L), and the Colusa Basin Drain (92 mg/L). Despite the high sulfate concentrations in these streams, their contribution to the total sulfate load of the Sacramento River is small, and concentrations downstream of these inputs did nor appear significantly elevated with respect to other sites on the Sacramento River. Fluoride concentrations were very near or below the reporting limit of 0.10 mg/L at all sites except for the Colusa Basin Drain (0.4 mg/L).

Nitrogen in the form of nitrite plus nitrate ranged from below reporting limits of 0.05 mg/L to a high of 0.25 mg/L in the Sacramento River. The highest ammonia concentration was 0.11 mg/L and the highest combined, unfiltered organic plus ammonia nitrogen concentration was 0.5 mg/L. Thirty-eight of the 41 samples analyzed for organic plus ammonia forms of nitrogen were less than the reporting limit of 0.02 mg/L as nitrogen. Organic carbon concentrations in filtered water samples from all sites ranged from 0.4 to 4.8 mg/L as carbon with a median value of 1.4. The highest value was detected in a sample from the Colusa Basin Drain. Suspended organic carbon concentrations had a median value of 0.30 mg/L and tended to be less than corresponding dissolved organic carbon concentrations.

Water temperatures, specific conductance, and pH values varied in the Sacramento River system both temporally and spatially (table A3-1). Water temperatures changes seasonally from a wintertime low of 8.5°C to a summertime high of 25.5°C. Specific conductance in the Sacramento River ranged from

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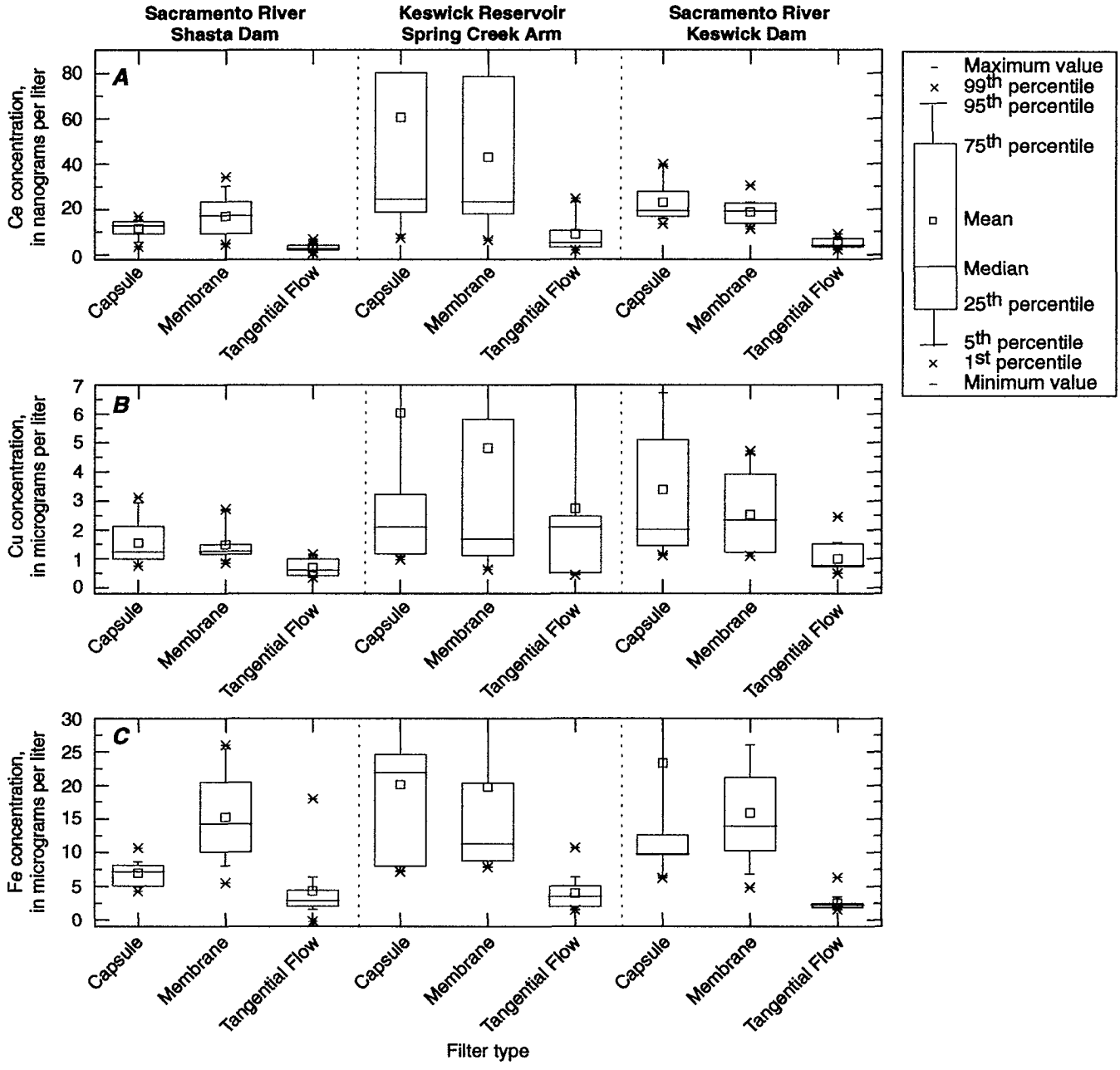

Figure 45. Box plots showing comparison of concentrations from three types of filtered samples at three sites in the upper Sacramento River Basin, California, for *A.* Cerium (Ce), *B.* Copper (Cu), *C.* Iron (Fe).

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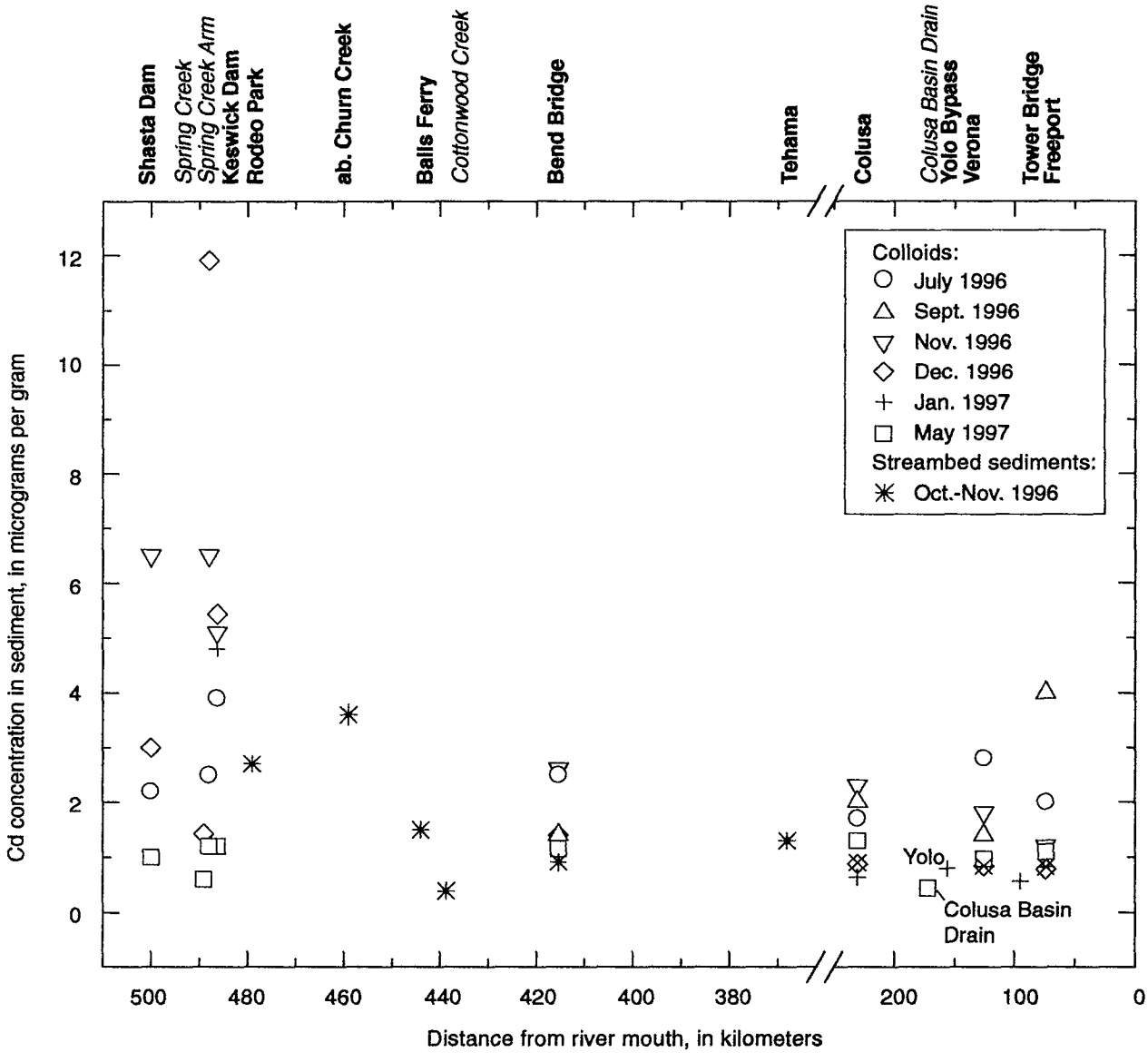

Figure 46. Plot of cadmium (Cd) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

51 to 149 µS/cm, but some tributaries were notably higher. Spring Creek ranged from 129 to 495 µS/cm and the measurement at Colusa Basin Drain on June 6, 1997, was 712 µS/cm. Measurements of pH at mainstem Sacramento River sites ranged from 7.0 to 8.1. The lowest pH measured was 3.7 at the Spring Creek site. Immediately downstream of Spring Creek, in the Spring Creek arm of Keswick Reservoir, the pH ranged from 7.3 to 7.6, which was similar to pH values (7.3 to 7.8) measured in the Sacramento River below Shasta Dam.

Particulate Size Distribution

Suspended Colloids

As discussed in a previous section of this report, all of the colloidal samples were subjected to a

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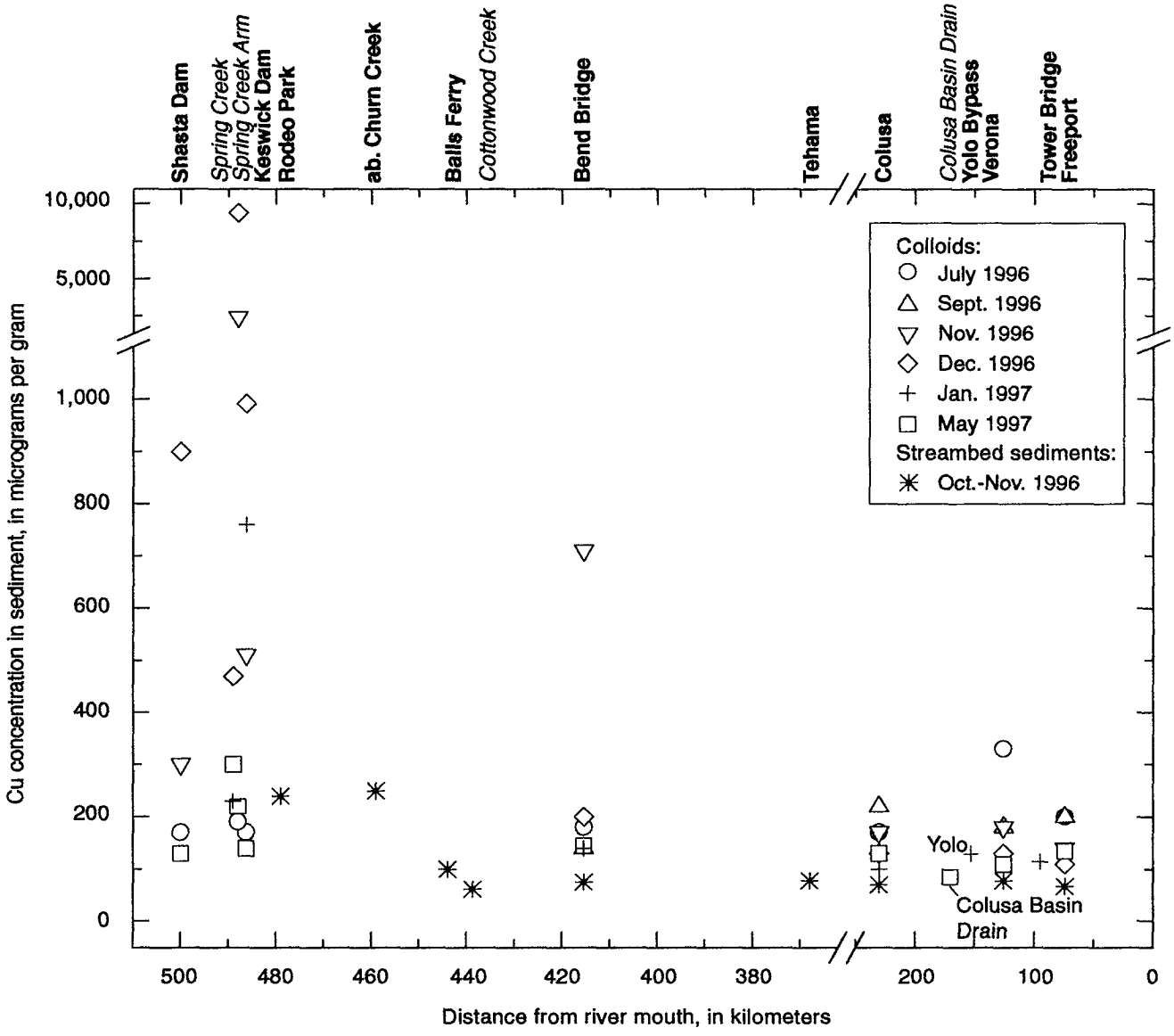

Figure 47. Plot of copper (Cu) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

particulate size distribution analysis. The results of these analyses are presented in Appendix 6 (table A6-1). Figure 57 shows a selected sample of those data, the particle size distribution for colloids collected during September 1996. The particulate size distribution from below Shasta Dam, Keswick Reservoir in Spring Creek arm and below Keswick Dam seem to be unimodal, whereas the three most downstream sampling sites (Colusa, Verona, and Freeport) show definite traces of bimodal distributions. Similar patterns were obtained for sampling periods other than September 1996 as well.

Streambed Sediments

The particulate size distributions for eight streambed sediment samples from the mainstem Sacramento River and for one sample from a tributary

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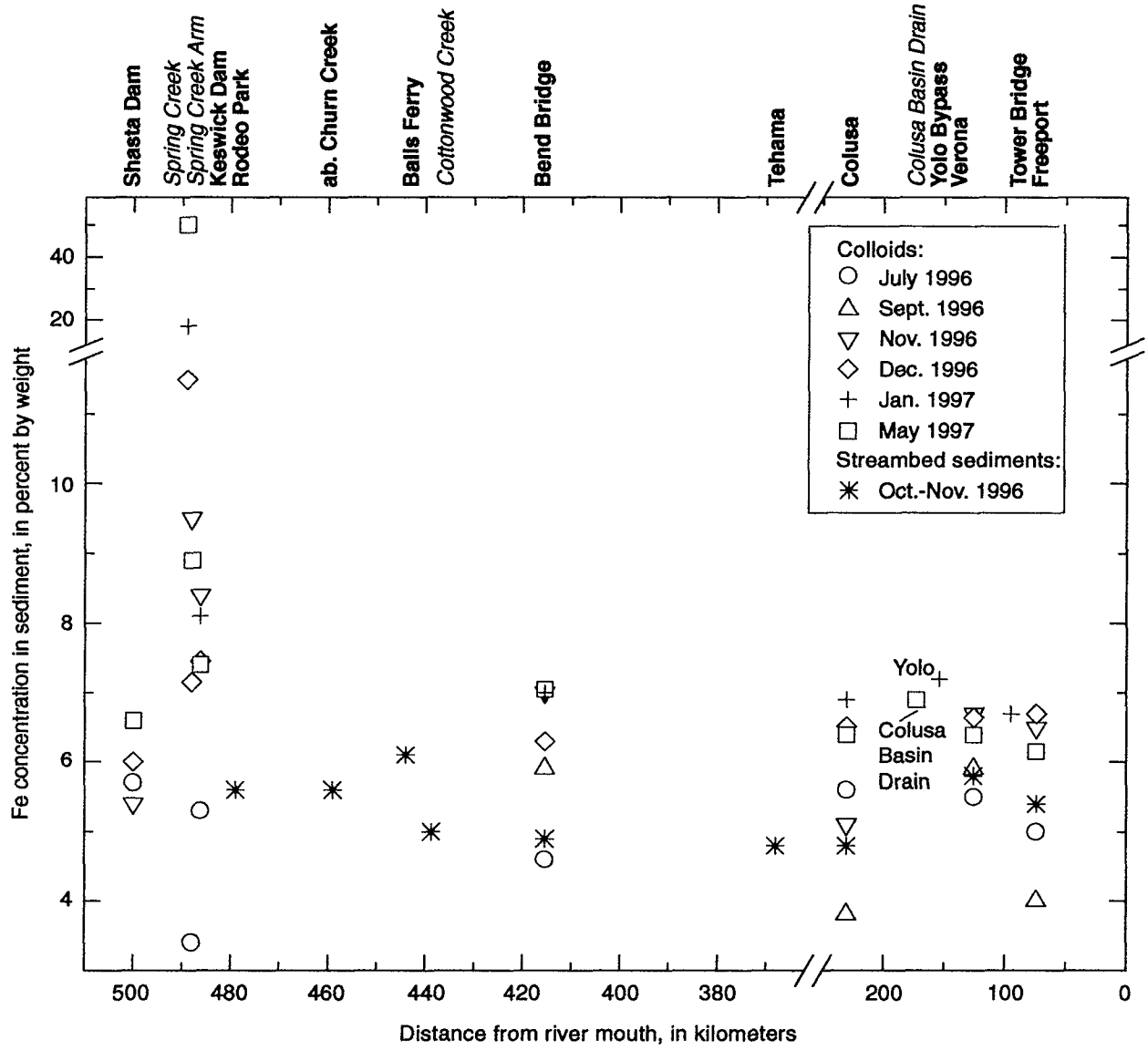

Figure 48. Plot of iron (Fe) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

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C-034763

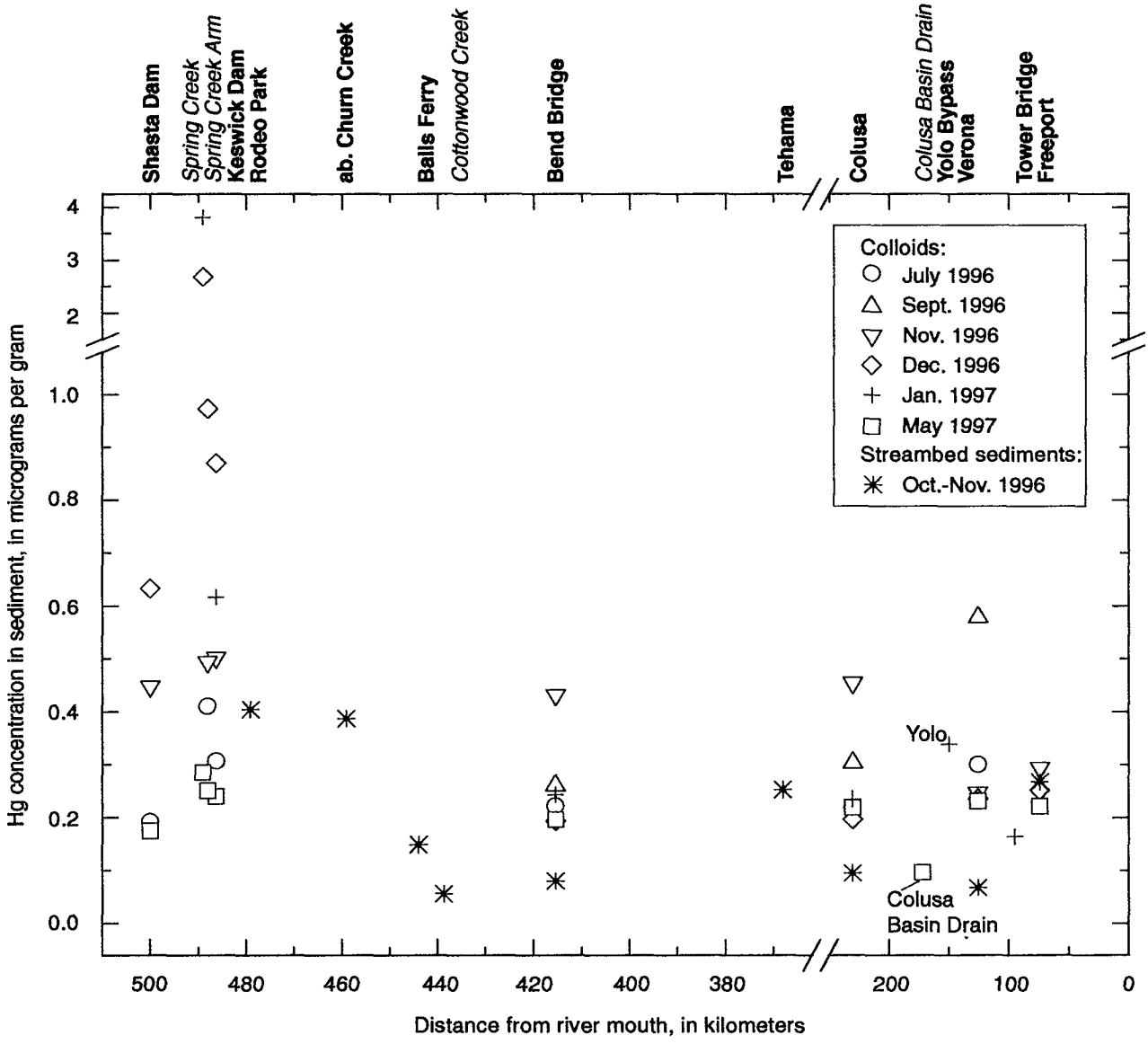

Figure 49. Plot of mercury (Hg) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

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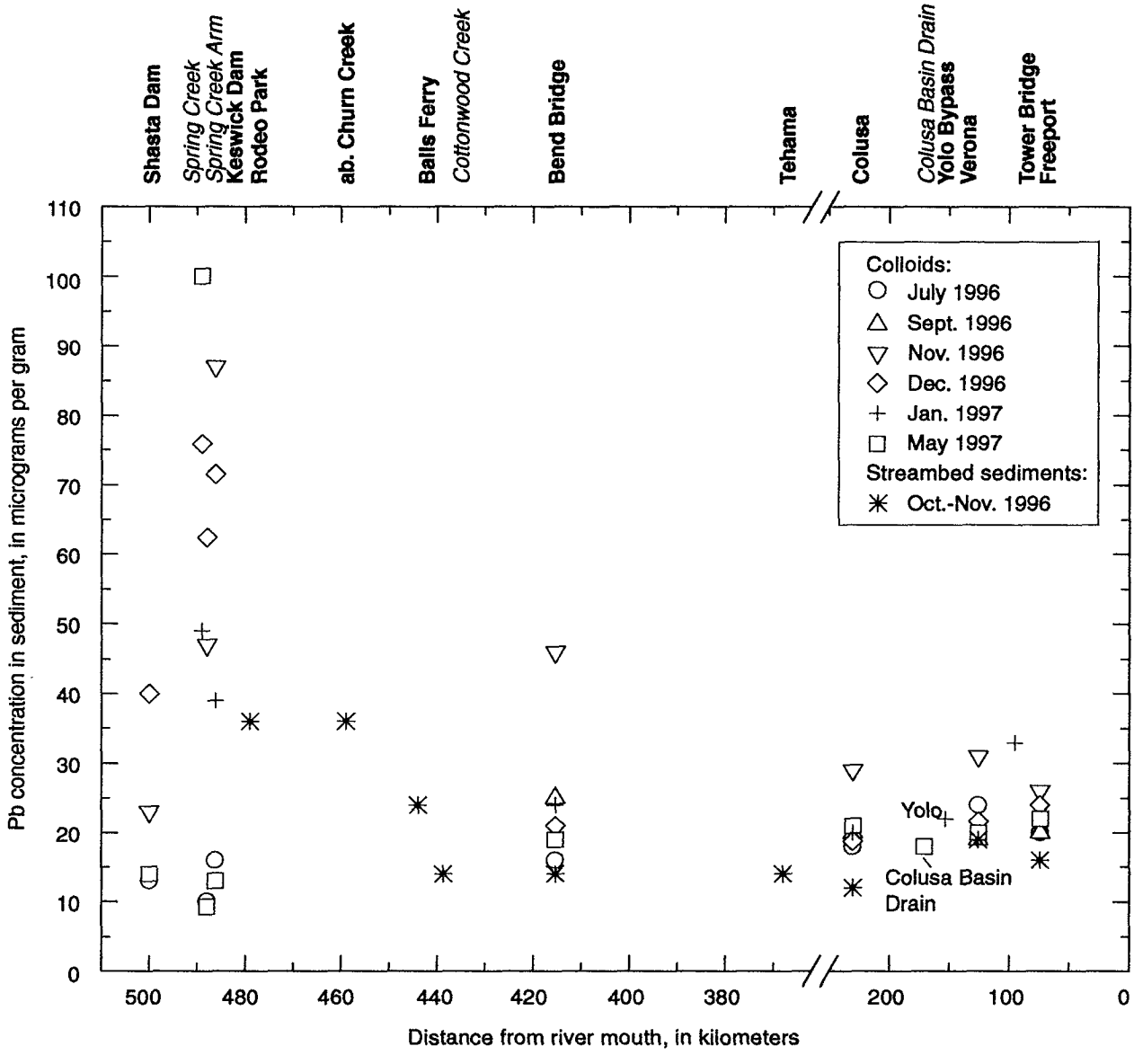

Figure 50. Plot of lead (Pb) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

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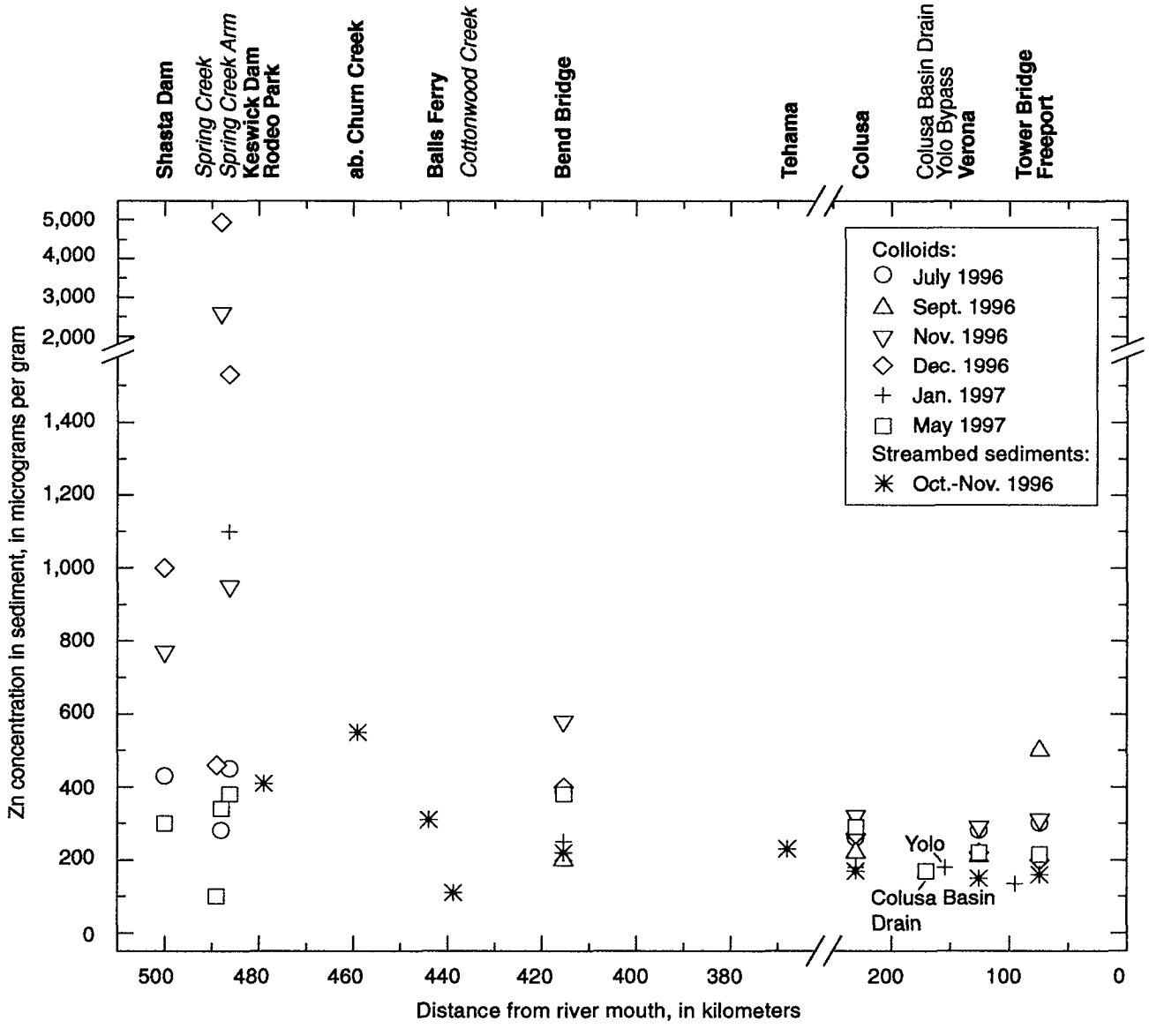

Figure 51. Plot of zinc (Zn) concentrations in suspended colloids and streambed sediment in relation to distance (broken scale) from Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

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C-034766

Table 26. Lead isotopic data for suspended colloids and streambed sediments from the Sacramento River and some of its tributaries

[Data are corrected for mass fractionation during mass spectrometry of 0.11% ± 0.03% to 0.14% ± 0.02% per atomic mass unit based on analyses of NIST's standard reference material SRM-981. Uncertainties are absolute values at the 95% confidence interval; NIST, National Institute of Standards and Technology; Pb, lead; mm/dd/yy, month/day/year; %, percent]

Location	Date (mm/dd/yy)	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
Suspended Colloid Samples						
Sacramento River Sites						
Sacramento River below Shasta Dam	12/12/96	18.661 ± .015	15.593 ± .014	38.117 ± .040	0.83561 ± .00018	2.0426 ± .0008
Sacramento River below Keswick Dam	12/11/96	18.185 ± .017	15.506 ± .016	37.697 ± .045	0.85269 ± .00019	2.0731 ± .0009
Sacramento River below Keswick Dam	1/02/97	18.344 ± .014	15.521 ± .014	37.791 ± .039	0.84609 ± .00018	2.0602 ± .0008
Sacramento River above Bend Bridge	12/12/96	18.785 ± .014	15.602 ± .013	38.452 ± .039	0.83053 ± .00017	2.0469 ± .0008
Sacramento River above Bend Bridge	1/03/97	18.866 ± .009	15.620 ± .010	38.554 ± .032	0.82799 ± .00017	2.0436 ± .0008
Sacramento River at Colusa	12/16/97	18.792 ± .011	15.605 ± .012	38.474 ± .035	0.83040 ± .00017	2.0473 ± .0008
Sacramento River at Colusa	1/04/97	18.905 ± .008	15.629 ± .010	38.631 ± .032	0.82668 ± .00017	2.0434 ± .0008
Sacramento River at Verona	12/18/96	18.808 ± .012	15.619 ± .012	38.536 ± .036	0.83043 ± .00017	2.0489 ± .0008
Sacramento River at Freeport	12/17/97	18.844 ± .011	15.639 ± .011	38.629 ± .034	0.82993 ± .00017	2.0499 ± .0008
Sacramento River at Tower Bridge	1/06/97	19.115 ± .011	15.699 ± .011	39.223 ± .035	0.82130 ± .00017	2.0520 ± .0008
Tributary Sites						
Spring Creek below Debris Dam near Keswick	12/11/96	18.103 ± .010	15.493 ± .011	37.620 ± .034	0.85586 ± .00018	2.0782 ± .0008
Spring Creek below Iron Mountain Road	1/02/97	18.079 ± .009	15.508 ± .010	37.649 ± .032	0.85782 ± .00017	2.0825 ± .0009
Keswick Reservoir, Spring Creek arm, near Keswick	12/11/96	18.135 ± .008	15.511 ± .010	37.697 ± .031	0.85532 ± .00018	2.0788 ± .0009
Distributary Site						
Yolo Bypass at I-80 near West Sacramento	01/07/97	18.896 ± .010	15.625 ± .011	38.620 ± .034	0.82688 ± .00017	2.0438 ± .0008
Streambed Sediment Samples						
Sacramento River Sites						
Sacramento River at Rodeo Park	10/23/96	18.234 ± .013	15.542 ±. 015	37.835 ±. 048	0.85236 ± .00030	2.0750 ±. 0013
Sacramento River above Churn Creek	10/22/96	18.354 ± .016	15.515 ± .017	37.964 ± .047	0.84532 ± .00048	2.0685 ± .0014
Sacramento River at Balls Ferry	10/22/96	18.704 ± .008	15.600 ± .010	38.389 ± .032	0.83404 ± .00017	2.0524 ± .0008
Sacramento River above Bend Bridge	10/22/96	18.819 ± .012	15.601 ± .012	38.482 ± .038	0.82901 ± .00021	2.0449 ± .0010
Sacramento River at Tehama	10/23/96	18.823 ± .019	15.591 ± .021	38.442 ± .059	0.82829 ± .00050	2.0423 ±. 0016
Sacramento River at Colusa	11/14/96	18.871 ± .013	15.601 ± .014	38.520 ± .041	0.82672 ± .00030	2.0413 ± .0011
Sacramento River at Verona	11/13/96	18.874 ± .010	15.625 ± .011	38.590 ± .034	0.82788 ± .00019	2.0446 ± .0009
Sacramento River at Freeport	11/15/96	18.877 ± .008	15.632 ± .010	38.597 ± .032	0.82812 ± .00017	2.0447 ± .0008
Tributary Site						
Cottonwood Creek near Cottonwood	10/23/96	18.921 ± .010	15.638 ± .012	38.646 ± .035	0.82646 ± .00033	2.0425 ± .0010

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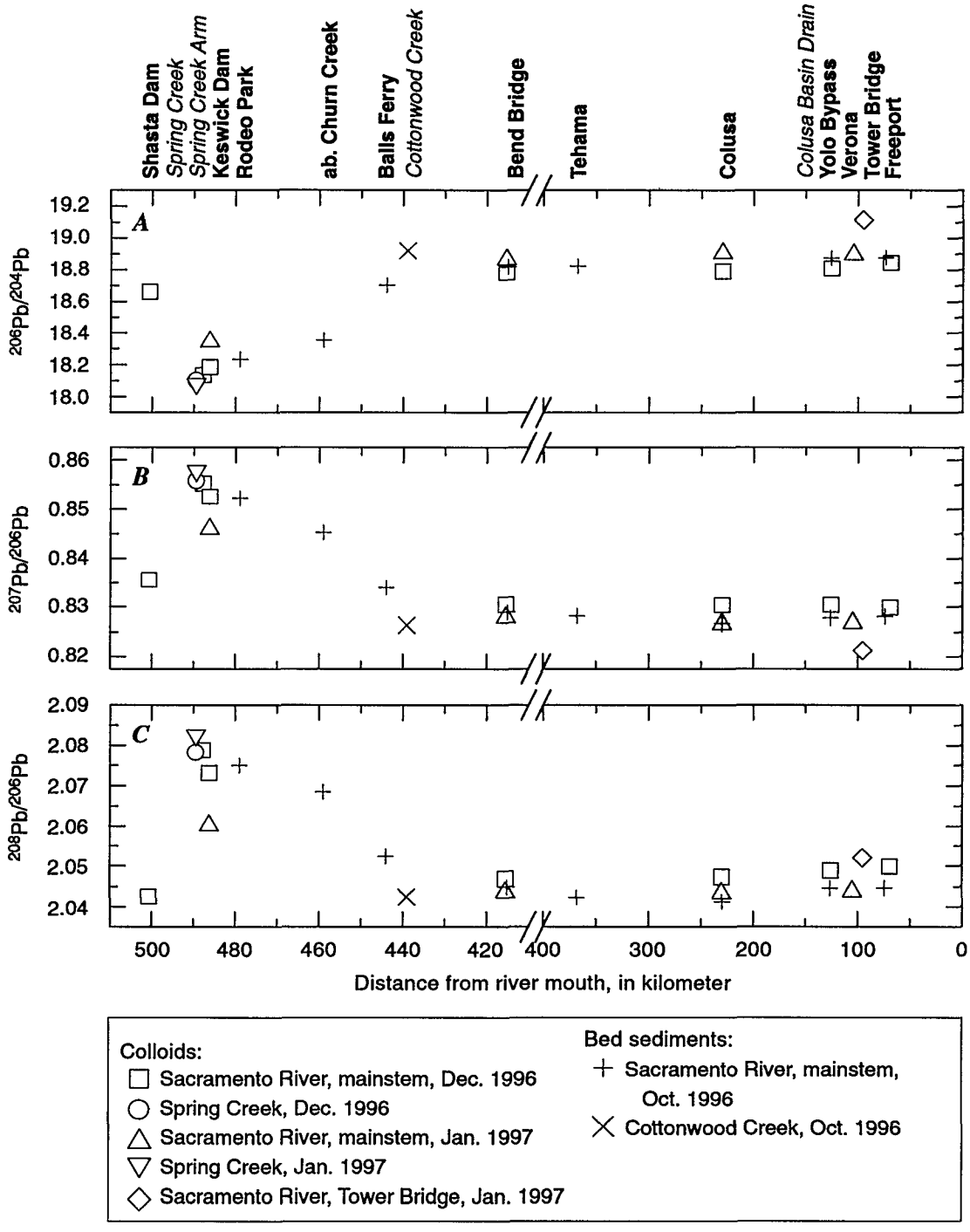

Figure 52. Plots of lead (Pb) isotope ratios in relation to distance (broken scale) from the Sacramento River mouth, California, for streambed sediments and suspended colloids. *A.* $^{206}Pb/^{204}Pb$, *B.* $^{207}Pb/^{206}Pb$, *C.* $^{208}Pb/^{206}Pb$. Site names in bold are mainstem sites and those in italics are tributary sites.

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C-034768

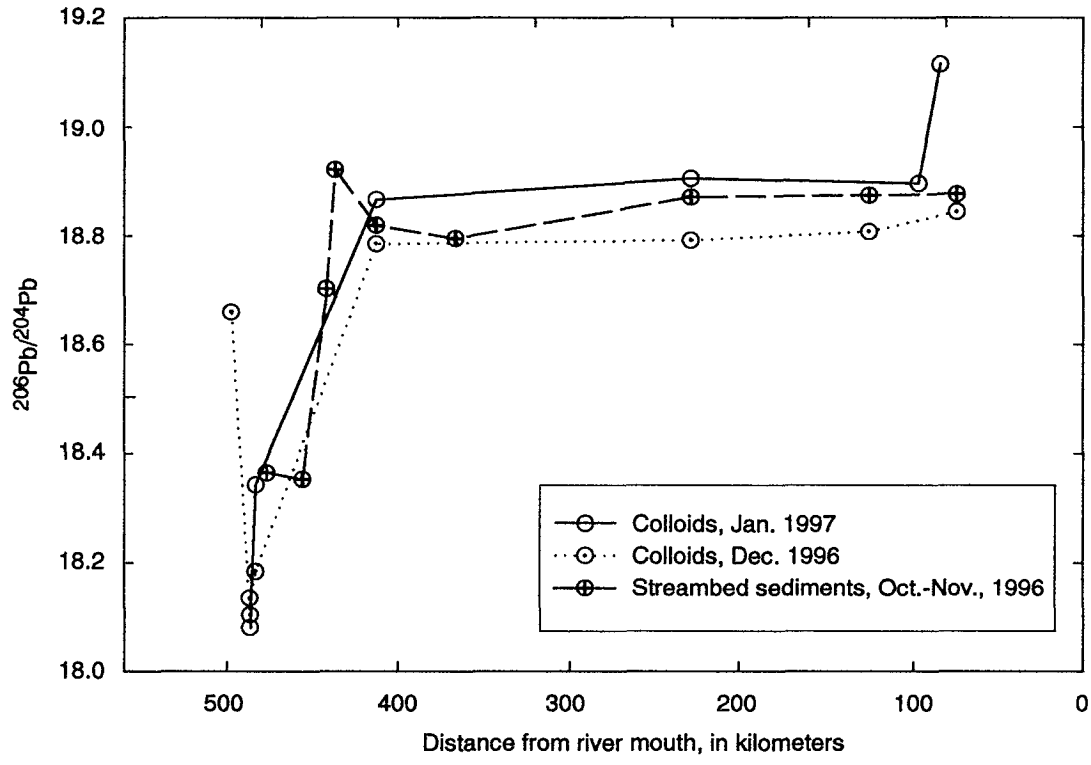

Figure 53. Plot of $^{206}Pb/^{204}Pb$ in relation to distance (continuous scale) from the Sacramento River mouth, California, for streambed sediments and suspended colloids.

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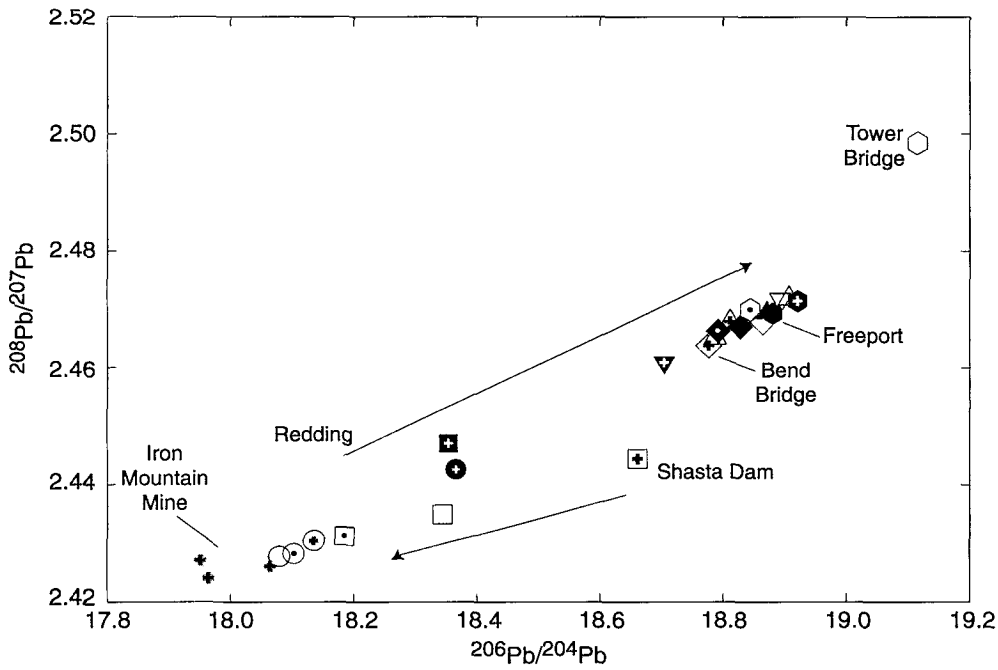


EXPLANATION

Colloids:

- Sacramento River below Shasta Dam, Dec. 1996
- Sacramento River below Keswick Dam, Dec. 1996
- Sacramento River below Keswick Dam, Jan. 1997
- Sacramento River above Bend Bridge near Red Bluff, Dec. 1996
- Sacramento River above Bend Bridge near Red Bluff, Jan. 1997
- Sacramento River at Colusa, Dec. 1996
- Sacramento River at Colusa, Jan. 1997
- Sacramento River at Verona, Dec. 1996
- Sacramento River at Tower Bridge, Jan. 1997
- Sacramento River at Freeport, Dec. 1996
- Spring Creek below Spring Creek Debris Dam near Keswick, Dec. 1996
- Spring Creek below Iron Mountain Road near Keswick, Jan. 1997
- Keswick Reservoir, Spring Creek arm, Dec. 1996
- Yolo Bypass at I-80 near West Sacramento, Jan. 1997

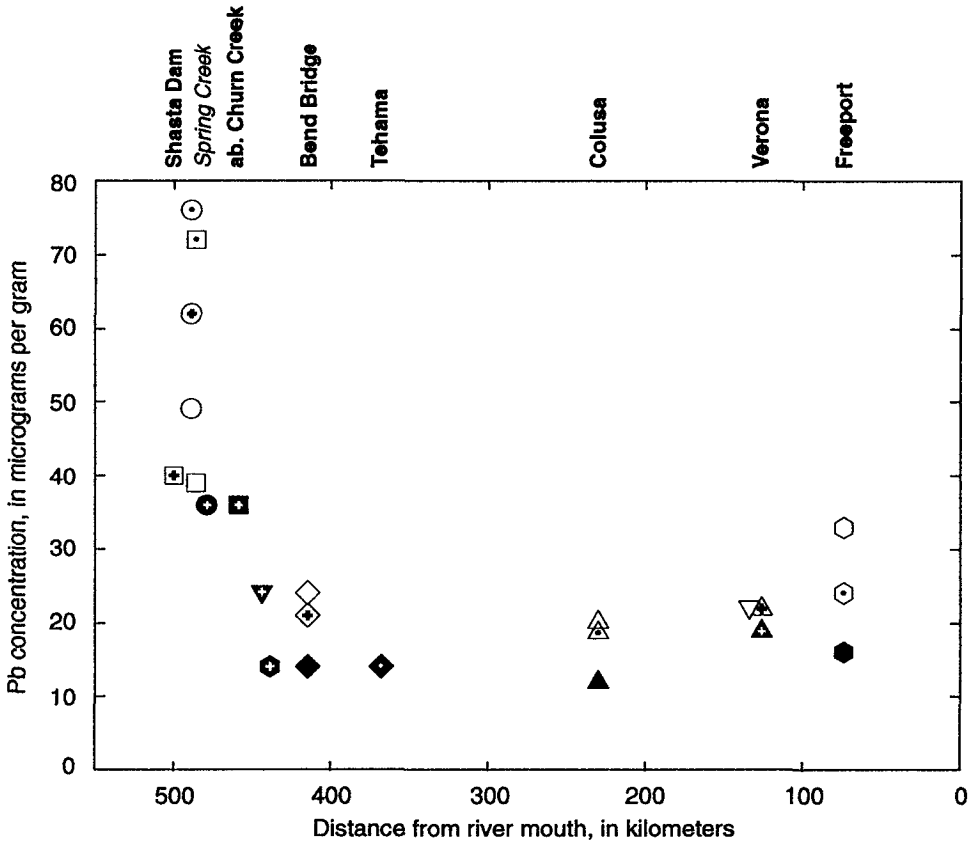
Streambed sediments:

- Sacramento River at Rodeo Park near Redding, Oct. 1996
- Sacramento River above Churn Creek near Anderson, Oct. 1996
- Sacramento River at Balls Ferry, Oct. 1996
- Sacramento River above Bend Bridge, Oct. 1996
- Sacramento River at Tehama, Oct. 1996
- Sacramento River at Colusa, Nov. 1997
- Sacramento River at Verona, Nov. 1996
- Sacramento River at Freeport, Nov. 1996
- Cottonwood Creek near Cottonwood, Oct. 1996
- Iron Mountain Mine area (Doe and others, 1985)

Figure 54. Plot of $^{206}Pb/^{204}Pb$ versus $^{208}Pb/^{207}Pb$ for streambed sediments and suspended colloids in the Sacramento River Basin, California.

C —0 3 4 7 6 9

C-034770



EXPLANATION

Colloids

- Sacramento River below Shasta Dam, Dec. 1996
- Sacramento River below Keswick Dam, Dec. 1996
- Sacramento River below Keswick Dam, Jan. 1997
- Sacramento River above Bend Bridge near Red Bluff, Dec. 1996
- Sacramento River above Bend Bridge near Red Bluff, Jan. 1997
- Sacramento River at Colusa, Dec. 1996
- Sacramento River at Colusa, Jan. 1997
- Sacramento River at Verona, Dec. 1996
- Sacramento River at Tower Bridge, Jan. 1997
- Sacramento River at Freeport, Dec. 1996
- Spring Creek below Spring Creek Debris Dam near Keswick, Dec. 1996
- Spring Creek below Iron Mountain Road near Keswick, Jan. 1997
- Sacramento River near Spring Creek Arm, Dec. 1996
- Yolo Bypass at I-80 near West Sacramento, Jan. 1997

Streambed sediments

- Sacramento River at Rodeo Park near Redding, Oct. 1996
- Sacramento River above Chum Creek near Anderson. Oct. 1996
- Sacramento River at Balls Ferry, Oct. 1996
- Sacramento River above Bend Bridge, Oct. 1996
- Sacramento River at Tehama, Oct. 1996
- Sacramento River at Colusa, Nov. 1997
- Sacramento River at Verona, Nov. 1996
- Sacramento River at Freeport, Nov. 1996
- Cottonwood Creek near Cottonwood, Oct. 1996

Figure 55. Plot of lead (Pb) concentration in streambed sediments and suspended colloids versus distance (continuous scale) from the Sacramento River mouth, California. Site names in bold are mainstem sites and those in italics are tributary sites.

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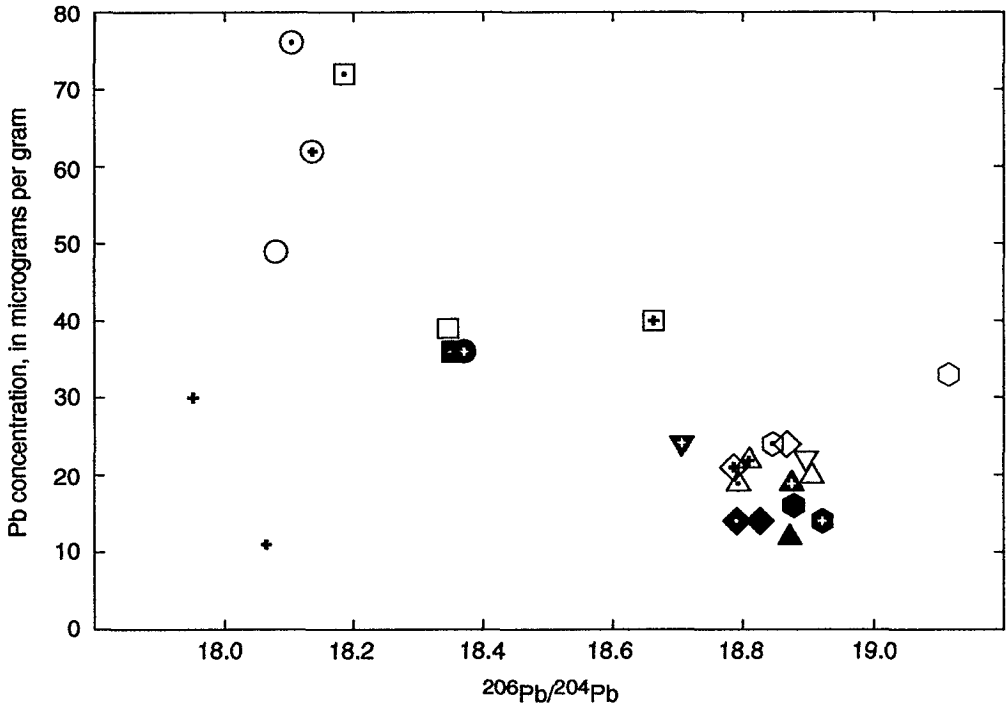
C-034771



EXPLANATION

Colloids:

- Sacramento River below Shasta Dam, Dec. 1996
- Sacramento River below Keswick Dam, Dec. 1996
- Sacramento River below Keswick Dam, Jan. 1997
- Sacramento River above Bend Bridge near Red Bluff, Dec. 1996
- Sacramento River above Bend Bridge near Red Bluff, Jan. 1997
- Sacramento River at Colusa, Dec. 1996
- Sacramento River at Colusa, Jan. 1997
- Sacramento River at Verona, Dec. 1996
- Sacramento River at Tower Bridge, Jan. 1997
- Sacramento River at Freeport, Dec. 1996
- Spring Creek below Spring Creek Debris Dam near Keswick, Dec. 1996
- Spring Creek below Iron Mountain Road near Keswick, Jan. 1997
- Sacramento River near Spring Creek Arm, Dec. 1996
- Yolo Bypass at I-80 near West Sacramento, Jan. 1997

Streambed sediments:

- Sacramento River at Rodeo Park near Redding, Oct. 1996
- Sacramento River above Churn Creek near Anderson, Oct. 1996
- Sacramento River at Balls Ferry, Oct. 1996
- Sacramento River above Bend Bridge, Oct. 1996
- Sacramento River at Tehama, Oct. 1996
- Sacramento River at Colusa, Nov. 1997
- Sacramento River at Verona, Nov. 1996
- Sacramento River at Freeport, Nov. 1996
- Cottonwood Creek near Cottonwood, Oct. 1996
- Iron Mountain Mine area (Doe and others, 1985)

Figure 56. Plot of $^{206}Pb/^{204}Pb$ versus lead concentration for streambed sediments and suspended colloids in the Sacramento River Basin, California. Pb, lead.

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C-034772

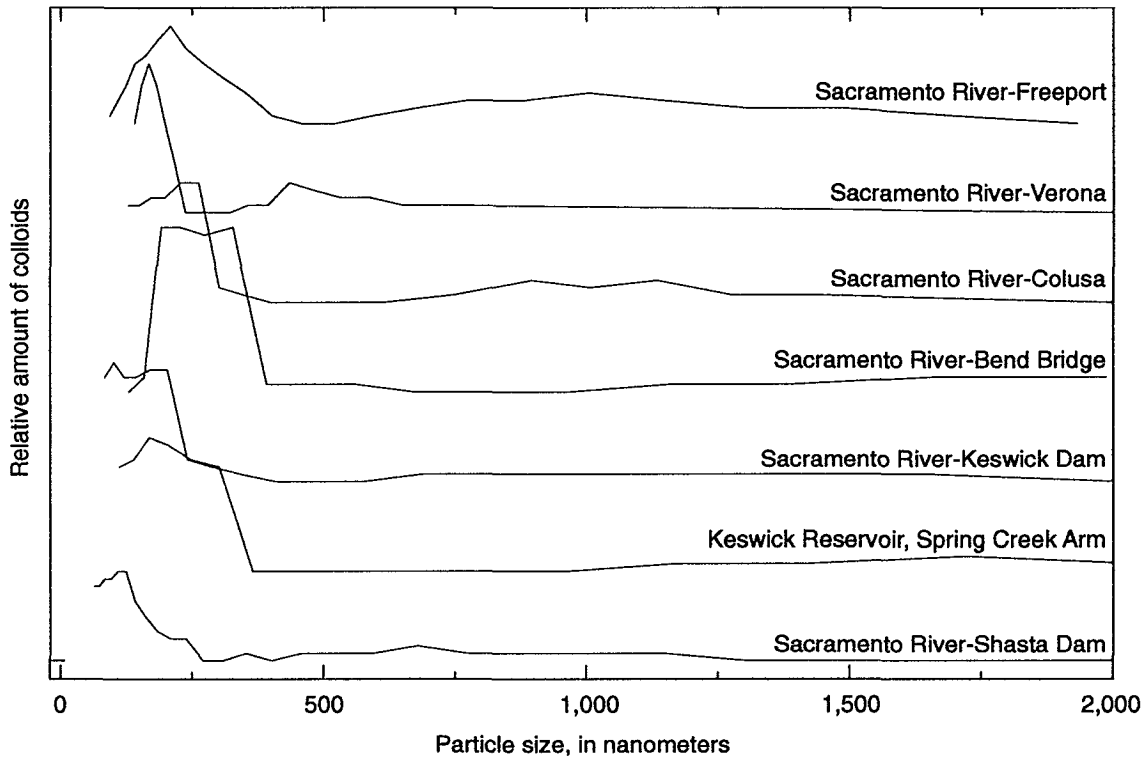

Figure 57. Plot of particulate size distributions for colloid samples collected during September 1996 along the Sacramento River, California.

(Cottonwood Creek) are also given in Appendix 6 (table A6-2). These distributions were determined using whole sediment samples, whereas the fraction of the sediment that was analyzed chemically was the part that passed through a 62-µm screen, as described earlier. The proportion of the whole sediment that passed through the 62-µm screen ranged from 3 to 44 percent, by weight, with a median value of 11 percent, by weight. The sand-sized fraction (62 µm to 2.0 mm) comprises more than 50 percent, by weight, of eight of the nine samples analyzed; the only exception was the sample from Bend Bridge, which had 63 percent, by weight, larger than 2.0 mm (table A6-2).

Summary and Conclusions

Charles N. Alpers, Howard E. Taylor, *and* Joseph L. Domagalski

Results from this study represent some of the first available data of high quality for dissolved and colloidal concentrations of trace elements in the reach of the Sacramento River from Shasta Dam to Freeport. The primary purposes of this report are to document the methods and quality assurance and quality control procedures used in this study and to provide the resulting data in accessible format.

This study used a multidisciplinary approach to improving the understanding of metal distribution, fate, and transport in the Sacramento River. Samples of water, streambed sediment and(or) caddisfly larvae were collected on one or more occasions during the period between June 1996 and July 1997 at 11 sites along the reach of the Sacramento River between Shasta Dam and Freeport; at 7 different tributary sites; and at 1 distributary site, the Yolo Bypass. Water samples were collected and processed using ultraclean techniques necessary for accurate and precise determination of trace and ultratrace constituents. Tangential-flow ultrafiltration (0.005-µm equivalent pore size) was used to determine "dissolved" concentrations that were compared with results from conventional filtration (0.45- and 0.40-µm pore size). The ultrafiltrates give a better approximation to truly

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dissolved metal concentrations and allow the extent of colloidal transport to be assessed.

During six sampling periods between July 1996 and June 1997, colloid concentrates were prepared using the retentate from tangential-flow ultrafiltration of large (approximately 100 L) water samples from six mainstem Sacramento River sites (below Shasta Dam, below Keswick Dam, at Bend Bridge, at Colusa, at Verona, and at Freeport), and the Yolo Bypass at Interstate 80 during high flow. The colloid concentrates were analyzed for total metals and some were also subjected to sequential extractions to determine forms of metals in operationally defined fractions: reducible (including hydrous iron and manganese oxides), oxidizable (including organic material and sulfides), and residual (surviving both of the previous extractions).

It was generally found that the sum of dissolved and colloidal concentrations using ultrafiltrate and retentate (colloid concentrate) samples was a more reliable way to estimate total water-column loadings rather than conventional whole-water analyses.

Some other key results of this study are as follows:

1. A significant proportion of the trace metals transported in the Sacramento River between Shasta Dam and Freeport occurs in colloidal form (operationally defined as grain size between about 0.005- and 1.0-µm diameter). Colloids represent the dominant form of aluminum, iron, lead, and mercury in the water column and are an important factor in the distribution of other trace metals. The proportion of loading that is colloidal as opposed to "dissolved" (less than about 0.005-µm diameter) generally decreases in the order copper greater than zinc and cadmium.
2. The influence of metal-laden acidic drainage from the Iron Mountain mine site (by way of Spring Creek and the Spring Creek arm of Keswick Reservoir) can be seen in data from water samples from the site below Keswick Dam, where historically, the Basin Plan water-quality standards for copper have been exceeded. (The Basin Plan standard for copper in this area is 5.6 µg/L, which is based on a hardness of 40 mg/L and filtration using a 0.45-µm filter.) Some water-quality standard exceedances occurred in January 1997, despite ongoing operation of the lime neutralization plant at Iron Mountain, which reportedly removes about 80 percent of copper loads and about 90 percent of zinc and cadmium loads from Spring Creek. In mid-December 1996, conventionally filtered copper concentrations were 4.6 to 5.1 µg/L and zinc ranged from 6 to 9 µg/L. During flood conditions in early January 1997, conventionally filtered copper concentrations were 4 to 9 µg/L and zinc ranged from 9 to 16 µg/L. Ultrafiltrates (0.005-µm equivalent pore size) of water samples from below Keswick Dam in December 1996 and January 1997 had copper concentrations about 40 to 70 percent lower than the conentional (0.40- and 0.45-µm) filtrates and zinc concentrations were 10 to 50 percent lower, indicating significant colloidal transport of copper and to a lesser extent, zinc.
3. Lead isotope data in colloid concentrates and streambed sediments provide a useful fingerprint or natural tracer for lead contamination from Iron Mountain mine drainage by way of Spring Creek and Keswick Reservoir. In streambed sediment and suspended colloid samples taken during 1996 and 1997, lead contamination from Iron Mountain is a relatively significant component of the total lead found at Sacramento River sampling sites at Rodeo Park (in Redding) and above Churn Creek (near Anderson), is a much lesser component at Balls Ferry, and is a relatively minor component of the lead in colloids and streambed sediment at Bend Bridge (near Red Bluff) and at sites further downstream.
4. Bioaccumulation of metals in caddisfly larvae was assessed at five sites in the Sacramento River between Redding and Tehama and at one reference site (Cottonwood Creek, near Redding). Samples were taken in October 1996. Cadmium concentrations in caddisfly larvae from Sacramento River sites were enriched 5 to 36 times than those from the reference site. Cadmium concentrations of the whole body ranged from 0.7 to 2.2 µg/g, dry weight. Of this total, approximately 60 percent (0.4 to 1.3 µg cadmium per gram, dry weight) was

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associated with the cell cytosol, an intracellular fraction that is indicative of metal bioavailability. Concentrations in the Sacramento River are comparable with other areas severely impacted by mining, such as the Clark Fork River downstream of Butte, Montana (Cain and others, 2000). Concentrations of copper and zinc also showed some enrichment in caddisfly whole bodies and cytosol fractions, which were enriched 1.4 to 3.0 times. The caddisfly data indicate that bioavailable forms of cadmium persist in the Sacramento River downstream of Tehama.

5. The geochemical forms of metals in colloid concentrates from the Sacramento River were evaluated using sequential extraction techniques. During May and June 1997, cadmium was dominantly associated with the reducible (iron–manganese oxide) fraction at all mainstem sampling sites, whereas copper and zinc were more or less evenly distributed between reducible and residual (refractory) fractions at all sites, with a small amount present in the oxidizable (organic plus sulfide) fraction. These results are consistent with the caddisfly bioaccumulation data that indicate that cadmium is relatively more bioavailable than copper or zinc in the river reach between Redding and Tehama.
6. The concentrations of total inorganic mercury in the Sacramento River increased during storm water runoff and were above the EPA water-quality criterion for aquatic life (12 ng/L) during high flows in December 1996 and January 1997, from the Bend Bridge site located near Red Bluff, downstream to Freeport. Dissolved inorganic mercury concentrations (based on 0.005-µm equivalent pore-size ultrafiltration) were found to be very low and relatively constant under a variety of flow conditions, but dissolved plus colloidal concentrations were found to increase with increasing discharge and suspended sediment transport. The concentrations of colloidal mercury were found to be similar to those measured in whole-water samples. Therefore, much of the mercury transported in the Sacramento River is in the colloidal size fraction. Sequential extraction of mercury from the colloid fraction, using specific chemical reagents, showed that most of the mercury is in operationally defined oxidizable and residual fractions with only a minor component in the reducible fraction. The implications for the bioavailability of mercury from these colloidal forms of mercury are currently unknown and represent a logical extension of this research.

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Glossary

Accuracy The measure of the degree of conformance of values generated by a specific analytical method with the true or expected value of that measurement. In this study, accuracy is evaluated by measurement of standard reference materials, spike recoveries, and blanks, and is quantified by the value of REC (Percentage Recovery).

Anion Negatively charged aqueous ion. Examples of common anions in natural waters are chloride (Cl^-) and sulfate (SO_4^{2-}).

Bias Systematic error in laboratory measurements.

Capsule filter A sealed, disposable filtration device through which raw water is pumped to remove particulates. In this study, the term refers to a tortuous-path filter (manufactured by Gelman), with nominal pore diameter of 0.45 micrometers, that is used routinely by the USGS's NAWQA Program.

Cation Positively charged aqueous ion. Examples of common cations in natural waters are sodium (Na^+) and calcium (Ca^{2+}).

Certified value Concentration of a substance in a standard reference material that is certified as correct by an official agency or organization, such as the National Institute of Standards and Technology.

Colloids Fine particles suspended in water. In this study, the lower size limit of colloid particles is operationally defined by passage through a tangential-flow ultrafilter with pore size of 10,000 nominal molecular weight limit (NMWL), or daltons, approximately equivalent to 0.005 micrometers. The upper limit of grain size for colloids in this study is operationally defined by settling for one hour (approximately 1 micrometer).

Colloid concentrate Sample of suspended colloids derived from raw water using ultrafiltration methods. In this study, typically 100 liters of raw water were processed to generate a concentrate of about 0.5 liters in volume that contained a mass of colloidal solids in the range of 0.02 to 2 grams. The concentrate was freeze-dried and then analyzed in a manner similar to that of streambed sediment samples.

Completeness Percentage of analyses meeting the data quality objectives for accuracy and precision in the Quality Assurance Project Plan (see Appendix 1).

Critical elements The elements of most interest to stakeholders in the Sacramento River watershed; operationally defined to include cadmium, copper, lead, mercury, and zinc. Iron and aluminum are included in some discussions of critical elements because of the importance of these major elements to trace element transport.

Detection limit The minimum concentration of a substance that can be measured and reported with 95 percent confidence that the analyte concentration is greater than zero.

Dissolved concentration The concentration of a substance that is present in water, exclusive of suspended particles. For this study, the ultrafiltrate is assumed to be the best approximation to truly dissolved concentrations.

Duplicate sample A split sample of any matrix (water, sediment, or tissue) taken for quality assurance purposes to assess the variability of either field conditions or laboratory methods.

Effective concentration A calculated quantity that represents the sum of the equivalent colloid concentation in water and the dissolved concentration, based on ultrafiltrates for this study.

Equipment blank A water sample taken for quality assurance purposes. The sample consists of deionized water that is put in contact with an individual piece of water-sample processing equipment. The blank is designed to detect contamination problems associated with specific pieces of equipment.

Equivalent colloid concentration in water A calculated quantity that represents the concentration in water of a constituent based only on the colloid-sized particles. The quantity is calculated in this study using chemical data from the colloid concentrates and whole-water (unfiltered) concentrations of aluminum, with the assumption that essentially all aluminum in the whole-water samples is in colloidal form and that the dissolved aluminum concentrations are negligible.

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Field blank A water sample taken for quality assurance purposes that consists of deionized water processed in a similar manner to unknown water samples. The blank is designed to detect contamination problems, such as airborne dust, associated with specific field sites.

Laboratory blank A water sample taken for quality assurance purposes that consists of deionized water put through the analysis procedure in a manner identical to unknown samples. The blank is designed to determine detection limits and baseline shifts for analytical methods.

Major elements Elements that are in greatest abundance in a water or solid sample includes major cations and major anions. Major cations in water generally include calcium, magnesium, manganese, potassium, silicon (Si), and sodium.

Membrane filter A wafer-thin, disposable filtration device that is placed inside a holder for each use. In this study, the term refers to a polycarbonate membrane (manufactured by Nuclepore) with uniform holes of 0.40 micrometers in diameter.

MPV Most probable value. Concentration of a substance in a noncertified standard reference material that is provided on the basis of analysis by numerous laboratories, usually as the median value. (Compare with certified value.)

Oxidizable Fraction of sequential extraction that is liberated by digestion of a sediment or colloid sample with an oxidizing solution. In this study, a persulfate solution is used to extract metals associated with organic and sulfide components.

Precision The degree of similarity among independent measurements of the same quantity. For this study, precision is quantified by the values of Relative Percentage Difference (RPD) and Relative Standard Deviation (RSD).

REC Percentage Recovery. Quantity computed for the evaluation of accuracy of laboratory analytical data using standard reference materials or recovery of known concentrations of analytes in spiked samples.

For standard reference materials:

$$REC_{SRM} = \frac{\text{measured value}}{\text{certified or most probable value}} \times 100$$

For spike recoveries:

$$REC_{SPIKE} = \frac{\text{measured value}}{\text{expected value}} \times 100$$

where the expected value is the original measured concentration in the sample plus the known concentration of the spike.

RPD Relative Percentage Difference. Quantity computed for the evaluation of precision (or variability) of laboratory analytical data using randomly submitted split samples.

$$RPD = \frac{\text{difference between reported values}}{\text{average reported value}} \times 100$$

RSD Relative Standard Deviation. A quantity computed for the evaluation of precision (or variability) of data. Relative standard deviation is the standard deviation of a series of measurements divided by the average of those measurements times 100:

$$RSD = \frac{\text{standard deviation}}{\text{average reported value}} \times 100$$

Rare earth elements The chemical elements between atomic numbers 57 and 71, inclusive. These elements are lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. The chemical characteristics of these elements are generally very similar.

Redox Oxidation-reduction. Certain elements can exist at more than one valence state, such as iron(II) and iron(III); the redox state refers to the relative abundance or chemical activity of the various valences of such elements.

Reducible Fraction of sequential extraction that is liberated by digestion of a sediment or colloid sample with a reducing solution. In this study, a hydroxylamine hydrochloride solution is used to extract metals associated with iron and manganese oxide components.

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Replicate sample A split sample of any matrix (water, sediment, or tissue) taken for quality assurance purposes to assess the variability of either field conditions or laboratory methods; similar to a duplicate sample, but not limited to two splits.

Residual Fraction of sequential extraction that is remaining after step-wise digestion of a sediment or colloid sample with both reducing and oxidizing solutions. In this study, a complete digestion using hydrofluoric acid, nitric acid, and hydrochloric acid was used dissolve the residual fraction.

Retentate During the tangential-flow ultrafiltration process, the stream retaining the colloidal material, that does not pass through the filters.

Sequential extraction A process that is designed to determine the concentrations of metals associated with different chemical forms in a solid sample of streambed sediment or colloid concentrate. The sequence of extractions used in this study was: (1) reducible (hydroxylamine hydrochloride), (2) oxidizable (persulfate), and (3) residual (complete digestion using hydrofluoric acid, nitric acid, and hydrochloric acid).

SRM Standard Reference Material. Standard used to evaluate accuracy and precision of laboratory measurements in various matrices including water, solids, and biological tissues. SRMs used in this study are distributed by the National Institute of Standards and Technology (NIST) and by the U.S. Geological Survey (USGS). NIST provides certified values for certain constituents in its SRMs and often provides noncertified, "for informational purposes" values for other constituents. The USGS provides "most probable value" concentrations for constituents in its noncertified Standard Reference Water Samples.

Tangential-flow ultrafiltration A filtration process that results in separation of extremely fine particles from water by passing the water repeatedly along the surfaces of a stack of filter membranes; only a small proportion of the water passes through the filters on a given pass; the water is recirculated until the desired volume of ultrafiltrate is attained, or the desired concentration of colloids; in this study, filters with a nominal pore size of 10,000 NMWL or daltons (equivalent to approximately 0.005 micrometers) were used with Minitan and Pellicon units (manufactured by Millipore Corp.).

Total digestion For streambed sediments and colloid concentrates, a chemical procedure that results in complete dissolution of the samples so that the chemical composition can be determined; in this study, complete digestion was achieved using hydrofluoric acid, nitric acid, and hydrochloric acid.

Total recoverable analysis For unfiltered water samples, a procedure that results in partial extraction of metals from suspended solids; in this study, nitric acid was added in the field to prevent precipitation of iron oxides, then hydrochloric acid was added in the laboratory.

Trace elements Elements that are generally present in very low concentrations in water or solid samples.

Ultrafiltrate The water that passes through a tangential-flow ultrafilter; operationally the best approximation to truly dissolved component of water; in this study, an ultrafilter pore size of 10,000 NMWL (equivalent to approximately 0.005 micrometers) was used.

Ultrafiltration see Tangential-flow ultrafiltration.

Whole-water sample An unfiltered (raw) water sample.

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Appendix 1. QUALITY ASSURANCE PROJECT PLAN FOR THE DATA COLLECTION ACTIVITIES OF THE SACRAMENTO RIVER METALS TRANSPORT STUDY

Editors' Note:

The Quality Assurance Project Plan (QAPP) given in Appendix 1 has been edited slightly from its original version. The Plan has been verified against the main report with clarification of some notation. Other areas remain unchanged, though they may differ in the main report; for example, "REC" in the original version of the QAPP remains unchanged but has been changed to "REC_{SPIKE}" and "REC_{SRM}" in the main report. Tables and figures have been reformatted for clarity, typographical errors have been corrected, and references cited in the text but inadvertently left off the references list have been added. No major revisions have been made.

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QUALITY ASSURANCE PROJECT PLAN FOR THE DATA COLLECTION ACTIVITIES OF THE SACRAMENTO RIVER METALS TRANSPORT STUDY

November 1996

Prepared by the U.S. Geological Survey for the
Sacramento Regional County Sanitation District

The use of firm, trade, and brand names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

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1. Title Page and Approvals

REVISED DRAFT QUALITY ASSURANCE PROJECT PLAN FOR THE DATA COLLECTION ACTIVITIES OF THE SACRAMENTO RIVER METALS TRANSPORT STUDY

Implemented by the Sacramento Regional County Sanitation District

Approvals:

Project Manager	Cheryl Creson, Water Quality Division Chief, SRCSD	12/12/96 Date
QA Manager	Charles N. Alpers, Research Chemist, U.S. Geological Survey	12/4/96 Date
QA Officer	Dr. Howard E. Taylor, Research Chemist, U.S. Geological Survey	12/9/96 Date
State Board Contract Manager	Greg Frantz, California State Water Resources Control Board	12/15/96 Date

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2. Distribution List

Cheryl Creson, Sacramento Regional County Sanitation District
Rosemary Clark, Sacramento Regional County Sanitation District

Greg Frantz, State Water Resources Control Board

Technical Advisory Committee:

Jerry Boles, Department of Water Resources, State of California
Jim Bybee, National Marine Fisheries Service
Ron Churchill, Department of Mines and Geology, State of California
Val Connor, Regional Water Quality Control Board–Central Valley Region
Bill Croyle, Regional Water Quality Control Board–Central Valley Region
Lee Erickson, Stauffer Management Co.
John Fields, Bureau of Reclamation
Brian Finlayson, Department of Fish and Game, State of California
Russ Flegal, University of California–Santa Cruz
Dean Heckathorn, U.S. Fish and Wildlife Service
Dennis Heiman, Regional Water Quality Control Board–Central Valley Region
Rick Humphreys, State Water Resources Control Board
Nick Iadanza, National Marine Fisheries Service
Bill Jennings, Delta Keeper
Ray Krauss, Homestake Mining Co.
Stefan Lorenzato, State Water Resources Control Board
Paul Meyer, Bureau of Land Management
Michael Pickering, Brush Creek Mining and Development Co.
Kerry Rae, Bureau of Reclamation
Mike Saiki, U.S. Geological Survey, Biological Resources Division
Darell Slotton, University of California–Davis
Chris Stathos, Suction Dredgers Ad-Hoc Committee
Rick Sugarek, U.S. Environmental Protection Agency
Claus Suverkropp, Larry Walker Associates
Jane Vorpagel, Department of Fish and Game, State of California
Dan Welsh, U.S. Fish and Wildlife Service
Ray Zimny, U.S. Army Corps of Engineers

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3. Project Organization and Responsibility

This project will be managed by the Sacramento Regional County Sanitation District (SRCSD). The project manager is Ms. Cheryl Creson, Chief of the Water Quality Division of the SRCSD.

The project quality assurance manager is Dr. Charles N. Alpers, Research Chemist with the U.S. Geological Survey (USGS) in Sacramento. Sample collection and most data acquisition work will be conducted by the USGS.

Analysis of water samples for trace and ultratrace elements (including mercury), and major cations in water, in colloid concentrates, and in sediment extracts will be done by the USGS laboratory in Boulder, Colorado, under the supervision of Dr. Howard E. Taylor, who is the Quality Assurance officer for this work. Dr. Taylor will also assist in training USGS field personnel in sampling and equipment cleaning procedures.

Analysis of nutrients, organic carbon, and major anions in water samples will be done by the USGS National Water Quality Laboratory in Arvada, Colorado. The Quality Assurance officer for this portion of the work is Dr. Peter Rogerson, who is Director of the USGS National Water Quality Laboratory (NWQL).

Analysis of iron redox species in water samples will be done by the USGS in Sacramento, under the direction of Dr. Charles Alpers. Grain size distribution of suspended sediment will be done by the USGS laboratory in Vancouver, Washington. Grain size distribution in colloid concentrates will be done at the USGS laboratory in Boulder, Colorado.

Mössbauer spectroscopy will be done at the Technical University in Munich, Germany under the direction of Dr. Udo Schwertmann. Flow measurements will be provided by the USGS, the California Department of Water Resources, the Bureau of Reclamation, and other water agencies responsible for recording stream flow in the study area.

A technical advisory committee (TAC) will serve as technical reviewers for the project. The TAC consists of staff from the SRCSD, Larry Walker Associates (contractor to the SRCSD), the California State Water Resources Control Board (SWRCB), the Regional Water Quality Control Board - Central Valley Region, the California Department of Conservation (Division of Mines and Geology), the California Dept. of Fish and Game, the U.S. Environmental Protection Agency (EPA) Region IX, CH2M-Hill (contractor to the U.S. EPA), the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the Bureau of Reclamation, the Bureau of Land Management, the U.S. Forest Service, the U.S. Army Corps of Engineers, the National Marine Fisheries Service, the University of California at Davis, the University of California at Santa Cruz, and commercial and recreational mining interests.

4. Project Description

4.1 Problem Definition

Metals from abandoned and inactive mines represent a major source of potentially toxic contamination to fish populations of the Sacramento River in northern California. Concentrations of copper (Cu), zinc (Zn), cadmium (Cd), lead (Pb), and mercury (Hg) are of concern regarding aquatic life at several points in the Sacramento River. The winter-run Chinook salmon, a federally listed endangered species, has critical habitat in the Sacramento River, as do other threatened aquatic species.

In the lower part of the Sacramento Basin, agricultural activities may be an important source of copper to the river because of the widespread application of compounds such as copper sulfate for control of algae in rice fields. Urban runoff represents a third potential source of metals to the river.

Mercury contamination is a well documented problem in several streams tributary to the Sacramento River. Mercury may be transported to the river from natural geological sources in

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the Coast Ranges, from abandoned mercury mines, from base metal mines, and from mercury which was transported into the Sierra Nevada and foothill regions for use in historical gold mining operations. Non-point sources associated with urban land use may also contribute mercury to the river environment.

4.2 Project Objectives and Approach

The overall objective of the study is to quantify the speciation and transport of copper, zinc, lead, cadmium, and mercury in the Sacramento River below Shasta Dam and to identify sources of trace metals to the Sacramento River, including mines, agriculture, and urban runoff. The geochemical studies are designed to determine the processes affecting the transport mechanisms of dissolved metals and metals associated with fine-grained sediments. Improved knowledge of these issues will provide an understanding of how the river responds chemically to introduced metals. This understanding is critical to determining the benefits throughout the watershed of ongoing and proposed remediation at the Iron Mountain Mines Superfund site and at other mines in the vicinity of Shasta Lake and to determining the likelihood that such remediation may or may not lead to the reduction of metal loadings in the Sacramento River.

Three critical unanswered questions with regard to metals in the Sacramento River will be addressed: (1) What is the distribution and speciation of metals in the dissolved, colloidal, and suspended phases? (2) How do metal concentration and speciation change as a function of distance down-river? and (3) What is the relative magnitude of metal sources, including mine drainage, agricultural drainage, and urban runoff?

Water samples will be collected and analyzed at selected locations to characterize the grain size of suspended particles having elevated concentrations of metals and to determine concentrations of dissolved metals. Tangential-flow ultrafiltration using filter membranes rated at 10,000 Nominal Molecular Weight Units (NMWU, or daltons), equivalent to 0.005 μm pore diameter, will be used to process large volumes of river water so that suitable amounts of colloidal material can be concentrated for analysis. Water samples also will be filtered with conventional 0.45 micrometer pore-diameter membranes for comparison with data collected by

the National Water Quality Assessment Program (NAWQA) of the U.S. Geological Survey and other agencies collecting water-quality data in the Sacramento River Basin. However, the tangential-flow system is expected to provide a more reliable separation of solids because partial clogging of membrane pores is avoided (e.g. Horowitz and others, 1994).

Filtrates from 0.005 equivalent and 0.45 micrometer pore-diameter membranes and colloids concentrated during ultrafiltration will be analyzed chemically to determine the distribution of metals and major elements in different suspended size fractions and in the operationally defined "dissolved" phase. Trace elements and major cations will be determined by inductively coupled plasma/atomic ernission spectrometry (ICP–AES) initially, followed by inductively coupled plasma/mass spectrometry (ICP–MS) for all elements with concentrations less than about 500 μg/L. The methodology that will be used was developed by the USGS National Research Program (Garbarino and Taylor, 1995) to achieve state-of-the-art detection limits for trace metals. Concentrations of mercury will be determined by cold vapor atomic fluorescence spectrometry (CV–AFS). Major anions will be determined by ion chromatography (IC). Ferrous and total iron will be determined by using ultraviolet (UV) spectroscopy with ferrozine as the complexing agent (Stookey, 1970). Aqueous speciation and ion-paring analysis will be carried out using the computer program WATEQ4F (Ball and Nordstrom, 1991) or the equivalent update. Light-scattering spectrometry and X-ray sedimentation analysis will be used to characterize the grain size distribution of the colloidal concentrates.

Mineralogy of suspended and colloidal material will be assessed using X-ray diffraction (XRD) and low-temperature Mössbauer spectroscopy, techniques required to determine the crystallinity and structure of poorly crystalline forms of hydrous iron and aluminum oxides and hydroxy-sulfates (Murad and others, 1994). Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy and related methods will be investigated in an attempt to determine the nature of chemical bonds between trace metals and hydrous iron and aluminum oxide particles, and in particular to distinguish between metal adsorption and co-precipitation (e.g. Waychunas and others, 1993). This distinction is important for determining geochemical mechanisms that could lead to bioavailability via release of trace metals from suspended solids, for example: (a) desorption of metals from Fe-Al-hydroxy-sulfate mineral surfaces in response to pH change, (b) release of metals associated with Fe-Al hydroxy-sulfate minerals by mineral dissolution driven by iron photoreduction or pH change, and (c) oxidative dissolution of mono-sulfide minerals.

Temperature, specific conductance, pH and alkalinity will be measured In the field.

Bed sediment samples will be collected at all the sampling sites. Sediment samples will be screened using river water to exclude material coarser than 63 μm, consistent with protocols used elsewhere in the Sacramento Basin by USGS as part of the NAWQA program. Sequential extractions will be carried out on bed-sediment samples and colloidal concentrates using a series of increasingly strong acids and oxidizing (or reducing) agents (Chao and Zhou, 1983) to determine the likely mineral or metal-organic hosts for different trace metals (Cu, Zn, Cd, Pb, Hg, Fe, and Al). The extracted solutions will be analyzed by ICP–AES, ICP–MS, and CV–AFS. Mineralogy and trace-metal bonding characteristics will be evaluated using the techniques previously described (XRD, Mössbauer spectroscopy, and EXAFS).

Sediment pore water will be extracted and analyzed for metal concentrations at sites where suitably fine grained sediment deposits exist, to aid in the evaluation of water-sediment interactions. Aqueous speciation and ion-paring analysis will be carried out on sediment pore water using the computer program WATEQ4F (Ball and Nordstrom, 1991), or updated equivalent, for the sediment environments.

4.3 Sampling Site Locations

Sample site locations for both water and sediment sampling are shown in Figures 1 and 2. The effect of metal concentrations in Spring Creek will be assessed by taking one sample in Keswick Reservoir below Shasta Dam, another sample in the Spring Creek arm of Keswick Reservoir, and a third sample below Keswick Dam. The four other sampling sites for both water and sediment are located on the Sacramento River farther downstream of Keswick Dam. Data from these sites will be used to assess changes in concentration, loading, and partitioning of metals as they are transported downstream and also to identify and characterize any additional contaminant sources from agricultural and urban land use in the lower areas of the basin. In addition, sediment samples will be taken from five to eight sites along the Sacramento River between Keswick Dam and Red Bluff, plus from one tributary creek near Redding. These additional sediment samples will be taken at sites where caddis fly larvae will be collected for a complementary study of metal bioaccumulation.

Currently identified sampling sites:

Site name	USGS Site number
1) Keswick Reservoir below Shasta Dam	404259122252501
2) Keswick Reservoir, Spring Creek Arm	403750122272301
3) Sacramento River below Keswick Dam	403633122264301
4) Sacramento River near Bend Bridge	11377100
5) Sacramento River at Colusa	11389500
6) Sacramento River near Verona	11425500
7) Sacramento River at Freeport	1144765

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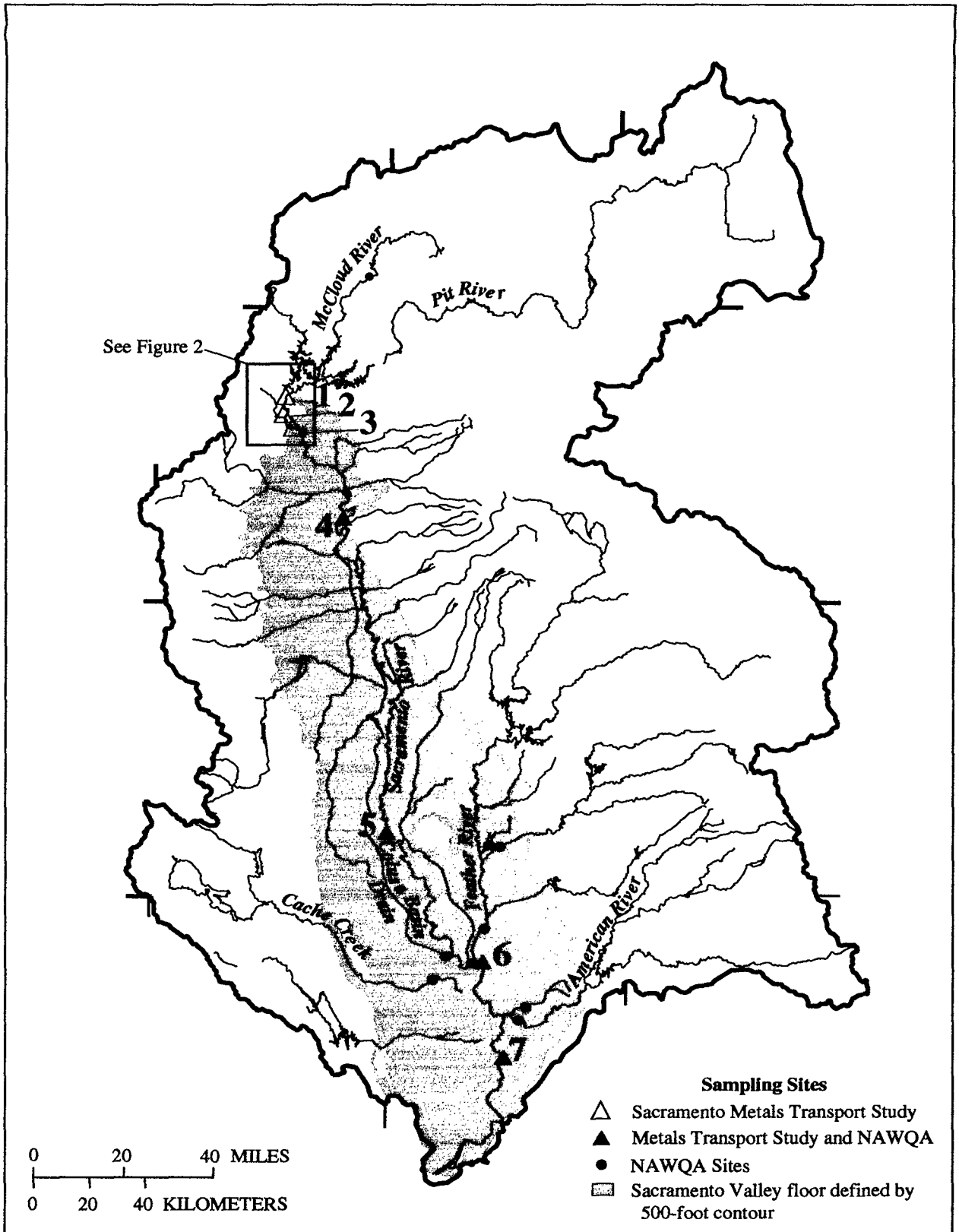

Figure 1. Location of sampling sites and site numbers.

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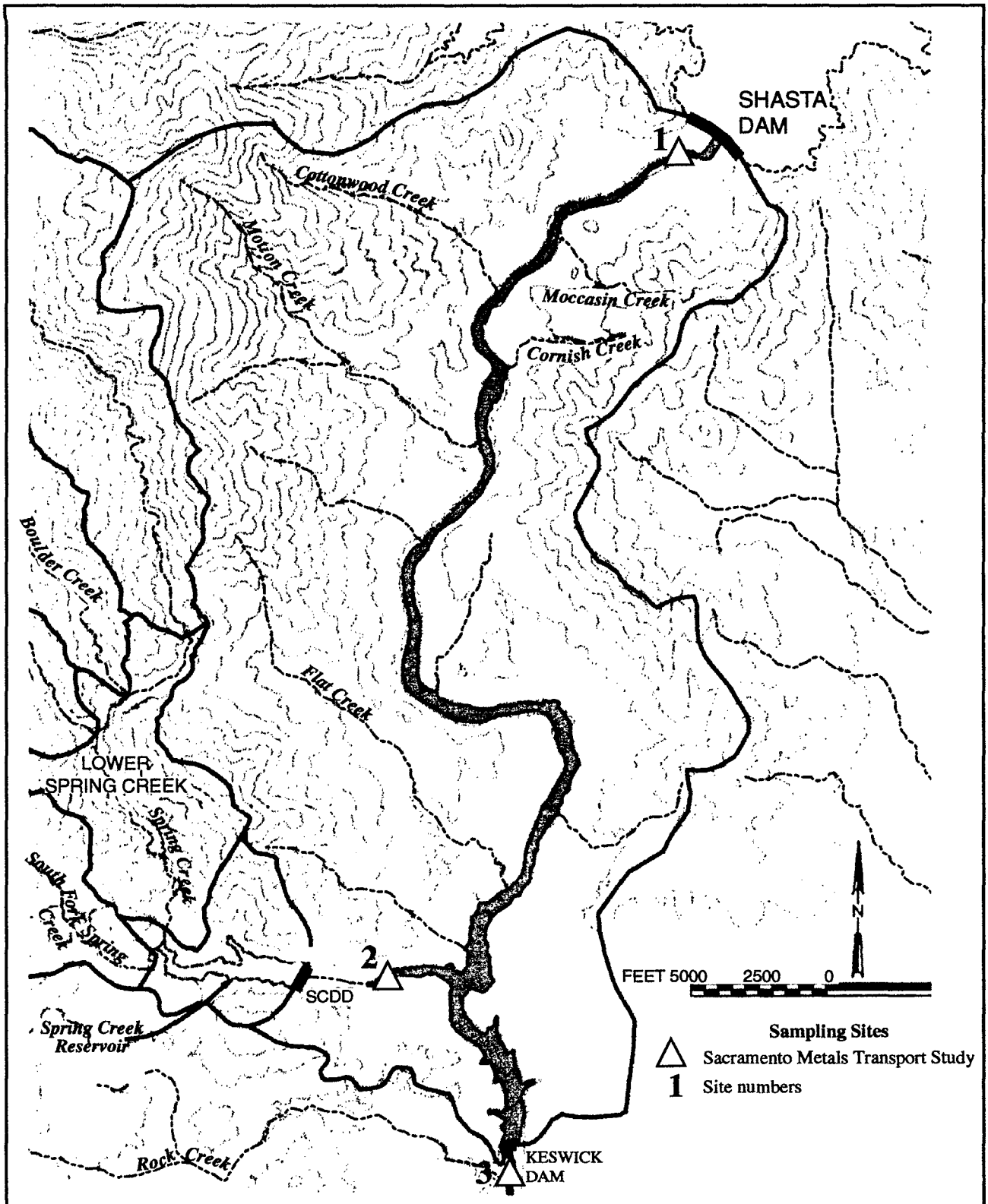

Figure 2. Sites in and below Keswick Reservoir.

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4.4 Sampling Schedule

Sample collection is expected to be done between July 1996 and June 1997. Samples will be collected periodically throughout the year to assess effects of seasonal changes and also during high flows associated with winter storms to assess the effect of these events on the loading and partitioning of metals in the river. A minimum of six water samples and one bed sediment sample will be collected at each site.

1996	July	Water samples
	Aug.	Bottom sediment samples
	Sept.	Water samples
	Nov.	Water samples collected at predicted lowest flows of the year
1997	Dec./Jan.	Water samples collected during storm events
	Feb./Mar	Water samples collected during storm events
	May/June	Water samples collected during the period of rice field drainage
	July	Water samples (if funding is sufficient)

5. Quality Assurance Objectives for Field and Laboratory Measurements

The objective for data collection in this project is to produce data that represent, as closely as possible, in situ conditions of the sampled water body. This objective will be achieved by using accepted methods to collect and analyze water and sediment samples and by evaluating field and laboratory measurements in terms of detection limits, precision, accuracy, and completeness as summarized in Table 1 through 3. The detection limits in Tables 1 and 2 are based on previous work done by the analytical laboratory (under the direction of Dr. Howard Taylor) that will conduct the analyses for this study. Actual limits of detection and quantitation for this study will be determined using data analysis techniques described by Garbarino and Taylor (1995).

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Table 1. Quality assurance data objectives for chemical analyses of water samples

[concs., concentrations; CV–AFS, cold-vapor/atomic fluorescence spectrometry; IC, ion chromatography; ICP–AES, inductively coupled plasma/atomic emission spectrometry; ICP–MS, inductively coupled plasma/mass spectrometry; IRS, infrared spectrometry; REC, percentage recovery; ROE, residual on evaporation; RPD, relative percentage difference; SRM, Standard Reference Material; UV, ultraviolet spectroscopy. µg/L, microgram per liter; %, percent]

Constituent	Method	Detection Limit	Precision	Accuracy	Completeness
Copper	ICP–MS	0.02 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Zinc	ICP–MS	0.08 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Lead	ICP–MS	0.06 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Cadmium	ICP–MS	0.05 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Mercury	CV–AFS	0.0004 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Iron	ICP–AES	5 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Iron (II) and total (III by difference)	UV	10 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Aluminum	ICP–MS	0.2 µg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Sulfate	IC	0.1 mg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Chloride	IC	0.1 mg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%

Table 1. "continued"

Constituent	Method	Detection Limit	Precision	Accuracy	Completeness
Fluoride	IC	0.1 mg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Total dissolved solids	Gravimetric (ROE)	1 mg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Nitrite	IC	0.01 mg/L as nitrogen	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Nitrate + nitrite	Colorimetric (cadmium reduction-diazotization)	0.05 mg/L as nitrogen	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Ammonia	Colorimetric (salicylate-hypochlorite)	0.01 mg/L as nitrogen	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Ammonia + organic nitrogen	Colorimetric (salicylate-hypochlorite)	0.20 mg/L as nitrogen	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Phosphorus (total)	Colorimetric (phosphomolybdate)	0.01 mg/L as phosphorus	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Phosphorus (orthophosphate)	Colorimetric (phosphomolybdate)	0.01 mg/L as phosphorus	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
Organic carbon	Wet oxidation, IRS	0.1 mg/L	Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%

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Table 2. Quality assurance data objectives for chemical analyses of bed-sediment samples and colloid concentrates, *including sequential extractions*

[concs., concentrations; ICP–MS, inductively coupled plasma/mass spectrometry; CV–AFS, cold-vapor/atomic fluorescence spectrometry; ICP–AES, inductively coupled plasma/atomic emission spectrometry; REC, percent recovery; ROE, residual on evaporation; RPD, relative percentage difference; SRM, Standard Reference Material. %, percent. µg/g, microgram per gram]

Constituent	Method	Detection Limit units= µg/g	Precision	Accuracy	Complete-ness
Copper	ICP–MS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		0.3			
oxidation		0.4			
residual		2			
Zinc	ICP–MS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		0.1			
oxidation		4			
residual		5			
Lead	ICP–MS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		0.3			
oxidation		1.5			
residual		2			
Cadmium	ICP–MS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		0.3			
oxidation		1.5			
residual		3			
Mercury	CV–AFS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		0.004			
oxidation		0.02			
residual		0.06			
Iron (total)	ICP–AES		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		1			
oxidation		5			
residual		10			
Aluminum	ICP–MS		Duplicate RPD ≤25% or ±50% at concs. <10 times the detection limit	SRM REC or Lab Spike = 100% ±25% or ±50% at concs. <10 times the detection limit	90%
reduction		2			
oxidation		10			
Residual		20			

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Table 3. Quality assurance data objectives for field measurements of water quality

[DIFF, diffraction; REC, percentage recovery. °C, degree Celsius. %, percent. mg/L, milligram per liter]

Measurement	Method	Accuracy	Completeness
Alkalinity	Gran titration	REC = 100% ±25%	90%
pH	Electrochemical	DIFF < 0.1 unit	90%
Temperature	Thermistor	DIFF <1°C	90%
Dissolved oxygen	Electrochemical	DIFF <0.2 mg/L	90%
Specific conductance	Electrical resistance	DIFF ±3%	90%

6. Specific Routine Procedures Used to Assess Data

Detection limits used in this study are the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. Detection limits must be low enough to evaluate the presence of a substance at the concentrations of interest.

Precision (or variability) is the degree of similarity among independent measurements of the same quantity. The precision of laboratory analytical data is evaluated by randomly submitted split samples and evaluated in terms of relative percentage difference (RPD).

$$\text{RPD} = \frac{\text{difference between reported values}}{\text{average reported value}} \times 100$$

Accuracy (bias or systematic error) is defined in this study as the measure of the degree of conformance of values generated by a specific method with the true or expected value of that measurement. The accuracy of field measurements is evaluated by the use of standard methods of analysis with the appropriate calibration standards. The accuracy of laboratory analytical data is assessed by analyzing standard reference materials (SRM) or the recovery of known concentrations of analytes in spiked samples and calculating the percent recovery (REC) where:

$$\text{REC} = \frac{\text{measured value}}{\text{expected value}} \times 100$$

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Both precision and accuracy will be enhanced by the use of standardized methods for sample collection, handling and preservation and the analysis of field and laboratory blank samples.

Completeness is measured as the percent of valid analyses (those meeting the accuracy and precision objectives). Water samples will be taken at seven sites on at least six occasions for a total of at least 42 samples. Therefore, to achieve 90 percent completeness, 38 of 42 samples must meet the quality assurance data objectives.

7. Sample Collection

Sampling procedures and many of the analytical methods used in this study are identical to those used in the USGS NAWQA project currently underway in the Sacramento River Basin. Data produced by the two studies will be directly comparable to one another.

Representative water samples for total and dissolved constituent analysis will be collected concurrently with samples for colloidal analysis at each site.

7.1 Surface Water Sampling Procedures

Samples from sites accessible by bridge only (Sacramento River below Shasta Dam and Sacramento River at Bend Bridge, during high flow) will be collected using a USGS D77 sampler (Horowitz and others, 1994) shown in Figure 3. The bronze body of the sampler has been epoxy coated to eliminate potential contamination from the sampler itself. The 3-L sample bottle and all parts of the equipment that contact the sample are made of Teflon. The sampler will be suspended from a boat at other sites where it is used. The D-77 sampler is designed to fill the sample bottle in an isokinetic manner (the water enters the sampler at the same velocity as the

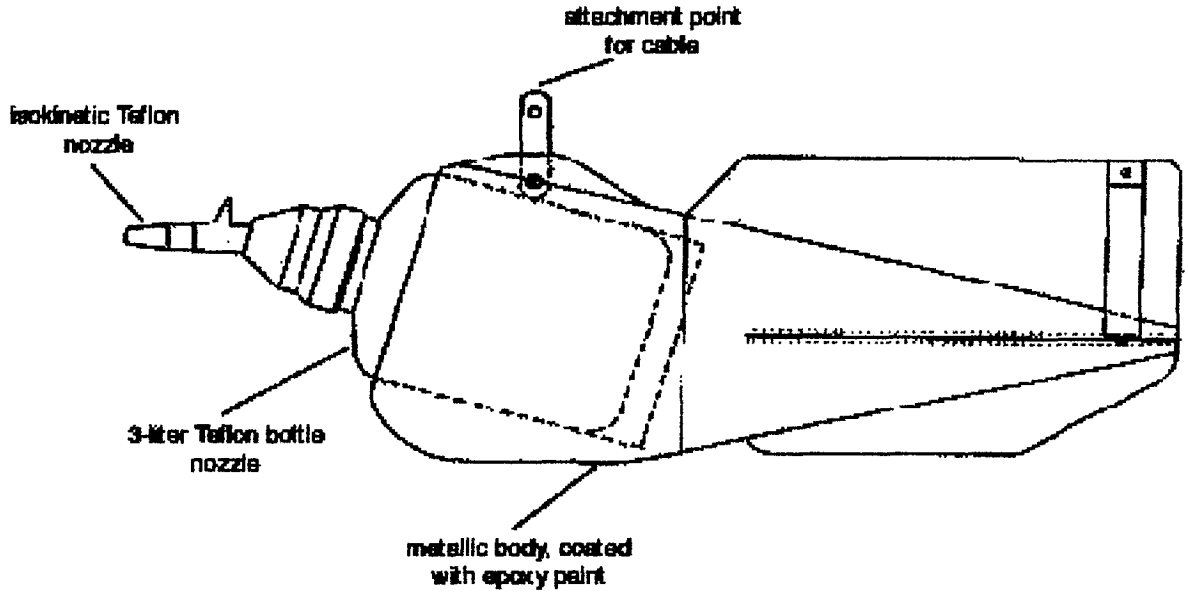

Figure 3. Depth-integrating sampler, D-77.

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water near the sampler) to ensure that concentrations of suspended sediment particles are representative of concentrations in the water sampled. This equipment is capable of collecting an isokinetic sample to a depth of about 15 feet. If this depth is exceeded at a sampling station, a modification of the sampler will be made to extend its depth range. This modification consists of using a perforated polyethylene bottle with a Teflon bag liner in place of a standard 3-L bottle. A set of Teflon bags will be dedicated to each sampling site to minimize potential for contamination between sites.

Samples from the Sacramento River below Keswick Dam will be collected with Teflon tubing using a peristaltic pump from near shore directly into Teflon bottles and polyethylene carboys. The narrow and turbulent channel at this location appears very well mixed and boat access is not feasible. The same approach will be used to sample the Sacramento River below Shasta Dam at low flows. The sites accessible by boat (Spring Creek arm of Keswick Reservoir, and the Sacramento River at Colusa, Verona, and Freeport) also will be sampled using Teflon tubing and a peristaltic pump. The tubing will be secured in 10-feet of polyvinyl chloride (PVC) pipe and suspended into the water column from the bow of the boat to minimize potential contamination. During sample collection, the depth of the tubing intake will be varied between 1 and 9 feet below the river surface.

Mercury and lead will be sampled from a single vertical traverse near the middle of the river. Composite samples for other trace metals, major ions, and other constituents will be collected using equal-discharge-increment methods (Edwards and Glysson, 1988) which provide a cross-section transect sample whose concentration is discharge weighted, both vertically and laterally. Between 5 and 15 lateral points will be sampled on each cross-section. Because of the size of the river and the minimum fill rates of the D77 sampler, sample volume is expected to be between 6 to 20 L and will require multiple sample bottles. Samples for total and dissolved constituents will remain in the 3-L Teflon bottle in which they were collected until processing, or will be composited in a Teflon-lined churn. Because a large volume of water is needed to recover an adequate mass of colloidal material, samples collected for colloid analysis from the vertical stations on a cross-section transect will be composited in one or more 25-L polyethylene carboys. Concentrations of metals in the colloidal fractions are expected to be high enough that any slight

contamination or adsorption resulting from the use of polyethylene rather than Teflon containers should not be significant. Each site will have a dedicated set of carboys that will be used only at that site in order to minimize the potential for contamination between sites.

Samples for mercury and lead analyses will be collected from just one sampling point located at the center of flow using a specially cleaned sample bottle and nozzle. While a width integrated sample provides more confidence that the sample is truly representative of the river at the time of sampling, it also exposes the sample to the atmosphere and potential contamination for a longer period of time. Because concentrations of dissolved mercury and lead are expected to be low, it will be critical to achieve minimal levels of contamination.

7.1.1 Subsample requirements

Once a representative sample of the river water has been collected, a variety of subsamples will be split and processed before shipping to laboratories. Processing will take place. in a mobile laboratory that was built for use in the USGS NAWQA program. The mobile lab allows for efficient sample preparation in a clean environment. Subsample requirements for the project are listed in Table 4.

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Table 4. Subsamples of water required for scheduled analyses

[*, triple-distilled HNO_3 for ultratrace element preservation; (a), a split sample will be held for archive purposes. conc., concentration; CA, California; CO, Colorado; EXAFS, extended X-ray absorption fine structure; NMWL, nominal molecular weight limit; Poly, polyethylene; USGS, U.S. Geological Survey; XRD, X-ray diffraction. µm, micrometer]

Matrix/filtration	Analysis	Preservation	Bottle type, volume	Laboratory
Whole water	Mercury	Oxidize ($K_2Cr_2O_7$) Acidify (HNO_3*)	Glass, 125 mL (a)	USGS–Boulder, CO
	Lead	Acidify (HNO_3*)	Teflon, 250 mL	USGS–Boulder, CO
	Major/ trace elements (cations)	Acidify (HNO_3*)	Poly, 125 mL (a)	USGS–Boulder, CO
	Major elements (anions)	None	Poly, 125 mL (a)	USGS–Arvada, CO
	Suspended sediment conc.	None	Poly, 1,000 mL	USGS–Salinas, CA
0.45 µm filtrate (silver filter)	Organic carbon, dissolved	None	Glass, baked, 125 mL	USGS–Arvada, CO
Silver filter retentate	Organic carbon suspended	None	Petri dish	USGS–Arvada, CO
0.45 µm filtrate (capsule filter)	Mercury	Oxidize ($K_2Cr_2O_7$) Acidify (HNO_3*)	Glass, 125 mL (a)	USGS–Boulder, CO
	Lead	Acidify (HNO_3*)	Teflon, 250 mL	USGS–Boulder, CO
	Major/trace elements (cations)	Acidify	Poly, 125 mL (a)	USGS–Boulder, CO
	Major elements (anions)	None	Poly, 125 mL	USGS–Arvada, CO
	Iron, redox speciation	Acidify (HCl), chill	Poly, amber, 125 mL	USGS–Sacramento, CA
	Nutrients	Chill	Poly, amber, 125 mL	USGS–Arvada, CO
10,000 NMWL filtrate 0.005 µm equivalent	Mercury	Oxidize ($K_2Cr_2O_7$) Acidify (HNO_3*)	Glass, 125 mL (a)	USGS–Boulder, CO
	Lead	Acidify (HNO_3*)	Teflon, 250 mL	USGS–Boulder, CO
	Lead isotopes	Acidify (HNO_3*)	Teflon, 1 L	USGS–Denver, CO
	Major /trace elements (cations)	Acidify (HNO_3*)	Poly, 125 mL (a)	USGS–Boulder, CO
	Major elements (anions)	None	Poly, 125 mL (a)	USGS–Arvada, CO
	Iron redox speciation	Acidify (HCl), chill	Poly, amber, 125 mL	USGS–Sacramento, CA

Table 4. *"continued"*

Matrix/filtration	Analysis	Preservation	Bottle type, volume	Laboratory
Colloidal concentrate	Major/trace elements (cations) total and sequential extractions	Chill	Teflon, 500–1,000 mL	USGS–Boulder, CO
	Lead, total and isotopes	Acidify (HNO_3*)	Teflon, 250 mL	USGS–Denver, CO
	XRD	Chill	Poly, 100 mL	USGS–Sacramento, CA
	EXAFS	Chill	Poly, 100 mL	USGS–Menlo Park, CA Stanford University
	Mössbauer spectroscopy	Freeze dry	Poly, wide-mouth, 200 mL	Technical University, Munich, Germany
	Particle size distribution (light scattering spectometry)	Chill	Poly, 100 mL	USGS–Boulder, CO

7.1.2 Sample processing and Preservation

7.1.2.1 Splitting

The cone splitter (Figure 4) is used by the USGS NAWQA program as the primary splitter to divide the collected sample into subsamples for inorganic-constituent, and suspended-sediment analyses (Ward and Harr, 1990; Capel and others, 1995). Subsamples for filtered inorganic-constituent, suspended-sediment, and field analyses will be collected from the first set of split samples from the cone splitter. Subsequent splits will be used to collect subsamples for raw (unfiltered) inorganic-constituent analyses. Samples for tangential-flow filtration will be composited in a Teflon-lined churn, from which water will be pumped using Teflon tubing.

Samples from the D-77 sampler will be collected in several (two to five) 3-L Teflon bottles

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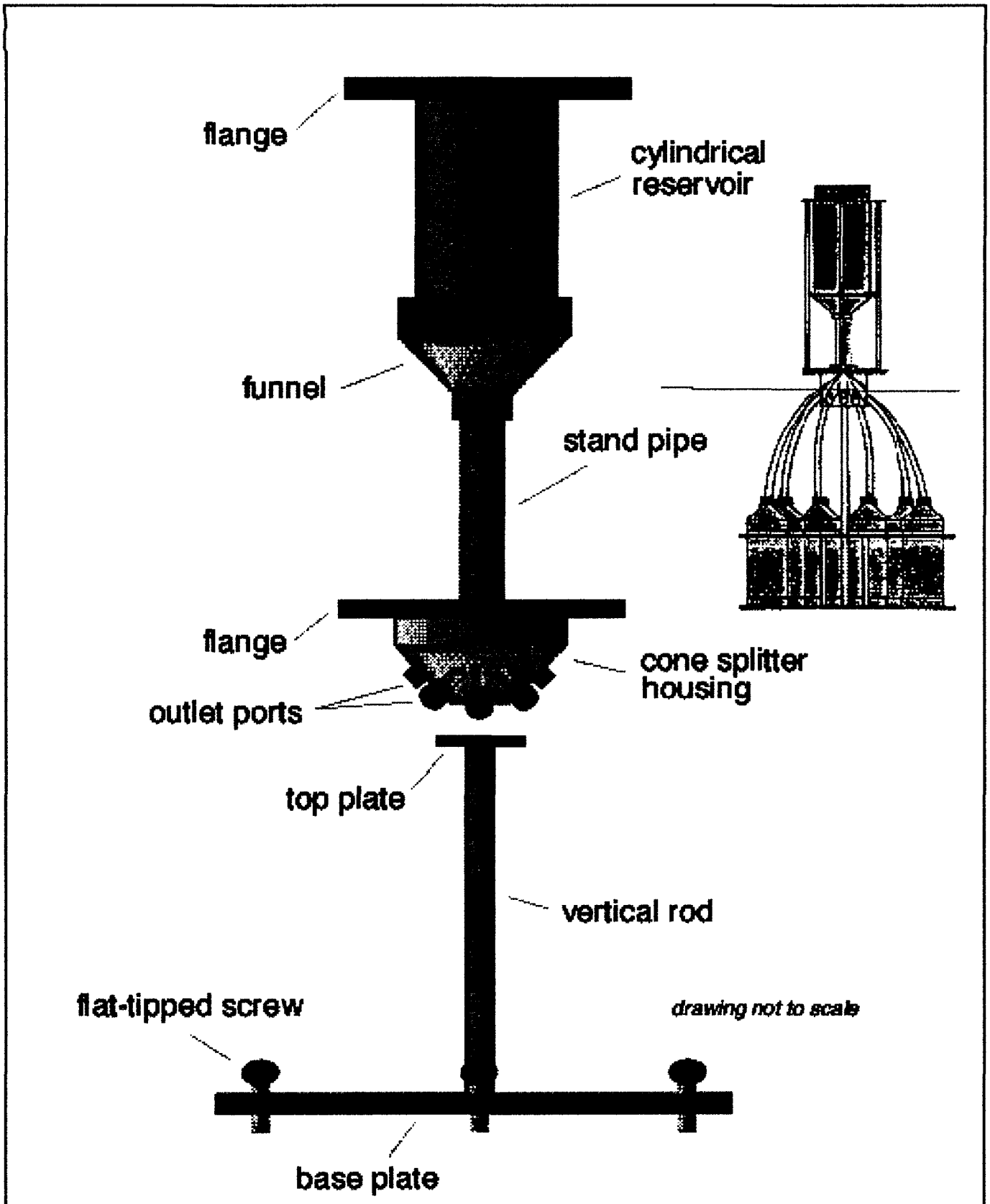

Figure 4. The all-Teflon cone splitter and stand.

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and later poured into the cone splitter. This method allows the cone splitter to function as both a splitter and compositor.

The splitting process is as follows:

1. Set up the cone splitter on a flat, open area. A level splitter is critical to performance. All Teflon tubes should be approximately the same length and the entire apparatus including subsample containers is tented in a plastic bag. Water is poured directly into the splitter reservoir through a hole in the plastic tent, which is covered between pours.

2. Field rinse all sample-collection and splitting equipment with native water. Collect the rinse water near the shore to avoid heavy suspended sediments. Pour rinse water from the D-77 sample bottle through the Teflon cap and nozzle and into the cone splitter. Three 1-L rinses are more effective then one 3-L rinse.

3. Place subsample containers under each outlet tube. The tubes need only extend into the receiving containers far enough to prevent spillage.

4. Agitate the sample (10 to 15 seconds) in the D-77 bottle to resuspend the sediments. Invert the bottle over the cone splitter reservoir. Sample transfer should be rapid. Maintain a head of water above the standpipe to prevent air from entering the splitting block.

5. Remove subsample containers from cone splitter and cap immediately.

6. An additional split is necessary to obtain the smaller volumes of some required subsamples. Reload splitter ports with the required bottles and pour a subsample from the first set of split samples.

7. Disassemble the cone splitter after completing the sample processing and clean before reuse or storing.

7.1.2.2 Filtration–0.45 µm filter, organic carbon

The filtration procedure for dissolved and suspended organic carbon analyses uses a stainless-steel or Teflon-pressure filter assembly fitted with a 47-mm diameter, silver, 0.45-µm

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pore-size filter and a peristaltic pump that has been fitted with Tygon tubing to filter the sample. Filtering and processing methods follow NAWQA protocol (Shelton, 1994).

7.1.2.3 Filtration–0.45 μm, inorganic constituents

A disposable 0.45 μm capsule filter (Gelman 12175) will be used to filter samples for major and trace element analyses. This filter is currently being used by the NAWQA program in the Sacramento Basin and the 0.45 μm pore size is used to define the dissolved phase in most water-quality studies. The use of this filter will facilitate comparison of results obtained by this study with results from NAWQA and other studies in the basin. Data obtained with the 0.45 μm filter will also be used to compare the results from standard versus ultrafiltration methods.

A peristaltic pump head with Tygon tubing or a Teflon diaphragm pump head with corrugated Teflon tubing will be used to create the pressure required to force samples through the filter units. The detailed procedures follow NAWQA protocols (Shelton, 1994).

7.1.2.4 Filtration–10,000 NMWU (0,005 μm equivalent)

A Minitan tangential-flow filter apparatus will be used to obtain a filtered sample for analysis of dissolved constituents defined by the less than 0.005 μm equivalent particle size. A Pellicon tangential-flow filter apparatus will be used to obtain a concentrate of colloidal material. Cleaning procedures will be the same as for other equipment that contacts the water sample. To further minimize contamination, a dedicated set of filter membranes and tubing for both Minitan and Pellicon filters will be used at each sampling site. The carboy(s) containing the sample collected for colloid processing will be allowed to sit quietly for an hour before filtration to let the coarser grained suspended sediment settle to the bottom of the container. Water will be pumped from a fixed distance above the sediment layer in order to eliminate the larger size fractions from the colloidal concentrate.

7.1.2.5 Preservation

Samples for trace metal analyses and major cations will be stabilized by acidifying to a pH of 2 or less with ultrapure (distilled) concentrated nitric acid. In addition, potassium dichromate will be added to samples for mercury analysis. Samples for redox speciation will be stabilized by acidifying to a pH of 2 or less with ultrapure (distilled) hydrochloric acid, then chilled on ice. Samples collected for organic carbon and nutrient analysis will be chilled on ice during storage and transportation to the lab. Preservation of all samples to be collected is summarized in Table 4. Samples will be processed inside a plastic tent set up on a counter of the mobile laboratory to minimize atmospheric contamination during handling.

7.2 Bed Sediment Sampling Procedures

Sediment samples will be collected using either a coring device for deep-water sites or large plastic spoons for shallow-water sites. Sediment cores will be collected in pre-washed, acid-cleaned 10.2-cm diameter, acrylic butyrate core liners placed in a gravity corer. The gravity corer will be slowly lowered into the sediment to avoid disturbance of the sediment-water interface. The cores will be kept upright and carefully transported to a field-based laboratory. Shallow-water sampling will be carried out according to USGS NAWQA protocols (Shelton and Capel, 1994). For samples for which it is determined that extraction of pore waters will not be needed, samples will be screened with a nylon screen and river water to exclude material greater than 63 μm.

7.2.1 Subsample requirements

Once a sample of the bed sediment has been collected, a variety of subsamples will be split and

processed before shipping to laboratories. Subsample requirements are listed in Table 5.

Table 5. Subsamples of bed sediment required for scheduled analyses

[EXAFS, extended X-ray absorption fine structure; NMWL, nominal molecular weight limit; Poly, polyethylene; USGS, U.S. Geological Survey; XRD, X-ray diffraction. mL, millimeter]

Matrix	Analysis	Preservation	Bottle type, volume
Pore water	Major/trace elements (cations)	Acidify	Poly, 125 mL
	Major elements (anions)	None	Poly, 125 mL
Bed sediment	Trace elements, sequential extractions	Chill	Poly, wide-mouth 100 mL
	Sulfur speciation	Chill	Poly, wide-mouth 100 mL
	XRD	Chill	Poly, wide-mouth 100 mL
	EXAFS	Chill	Poly, wide-mouth 100 mL
	Mössbauer spectroscopy	Freeze-dry	Poly, wide-mouth 100 mL
	Particle size distribution (sieve, sedigraph)	Chill	Poly, wide-mouth 100 mL

7.2.2 Sample Processing and Preservation

Cores selected for pore water extraction will be sectioned for sediment and associated porewater within 8 to 24 hours of collection. The water overlying the sediment will first be siphoned off to within 1 to 10 cm of the interface using Tygon tubing. A sample of this overlying water will then be taken with a 10- to 30-mL plastic syringe. The cores will be extruded and sectioned into appropriate depth intervals in a nitrogen-filled glove bag, to minimize oxidation of the pore water. The individual core sections will then be placed in nitrogen-filled 50-mL centrifuge tubes. Subsamples of whole sediment will also be taken for determination of water content and grain-size distribution. The centrifuge tubes will be removed from the glove box and centrifuged at 1500 rpm for 20 minutes to separate porewater and sediment. The tubes will then be returned to the glove box and the supernatant extracted with pre-cleaned 20-mL plastic syringes and filtered through 0.2-μm cartridge filters. Filtered portions will be placed into acid-cleaned 30-mL polyethylene bottles for metal determinations. If there is sufficient volume, portions of pore water will also be taken for alkalinity and anion determinations. The pore water, samples for metal analysis will be acidified to pH < 2 with ultrapure, concentrated nitric acid. Sediment samples will be placed in acid washed containers and packed in ice for transport to the analytical laboratories.

7.3 Equipment cleaning

The sample collecting and processing equipment is soaked in dilute phosphate-free detergent solution, rinsed with tap water, soaked in 5.0 percent hydrochloric acid (HCI), and rinsed extensively with deionized water prior to each field trip and between sites. Detergents and acids will be used with care to avoid possible contamination of the sample by their residue. A thorough native-water rinse is required at each field site before sampling to remove any remaining cleaning agents and equilibrate the equipment to the sampling conditions. Details on procedures are outlined below.

The sampler bottle, cap and nozzle, cone splitter, churn splitter, filter support, pumphead,

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tubing, and any other equipment that will contact the sample are cleaned prior to each field trip and between sites as follows:

1. Disassemble (if necessary) wearing vinyl gloves.
2. Soak for 30 minutes in a 0.2-percent solution of phosphate-free detergent and scrub with a nonmetallic brush. Use a small bottle brush for the cone-splitter parts.
3. Change gloves and rinse thoroughly with warm tap water to remove all soap residue.
4. Soak for 30 minutes in a solution of 5.0-percent hydrochloric acid. Swirling the equipment in the acid solution will adequately desorb any metals not removed during the washing process. The used acid/ water solution should be placed in a waste container for proper disposal.
5. Change gloves and rinse three times with deionized water.
6. Protect areas of the equipment that will contact the sample with Teflon tape and place in a sealable plastic bag for storage and transport.
7. Rinse sampling and splitting equipment at the site with 2- to 3-L of native water before sampling.
8. Rinse sampling and splitting equipment with deionized water immediately after each use.

Equipment used for filtering the organic-carbon samples will be baked at 450°C for 2 hours or cleaned using organic-free deionized water and aggressive scrubbing. Equipment will be isolated from any procedure using methanol.

8. Sample Custody

All bottles will be clearly labeled with a waterproof marker or preprinted labels so the laboratories can identify the samples. The minimum information required is the project name, site identification number, date and time, and type of analysis requested.

An analytical services request form with the same information as the bottle labels will be included with each sample. Copies of the forms will be retained by data management personnel.

Samples will be shipped to laboratories by Federal Express overnight service from Sacramento or Redding, California, within 24 hours of collection and processing. Laboratories will notify data management personnel by electronic mail or standard mail service upon the arrival of samples.

9. Field Measurements

Specific conductance, dissolved oxygen, temperature, and pH, will be determined using the detailed procedures in the NAWQA field guide (Shelton, 1994). Alkalinity will be determined by Gran titration (Stumm and Morgan, 1981) using 0.16 N hydrochloric acid with a Hach digital titrator. Specific conductance, pH, and alkalinity will be determined from a split of the unfiltered water sample. Dissolved oxygen and temperature will be measured instream at the center of flow when feasible, otherwise from near shore. Stream discharge will be determined at all river sites. Sites 4 through 7 are located at USGS gaging stations and discharge will be estimated using current stage-discharge ratings from measurements of stage at the time of sampling (Rantz and others, 1982). Discharge at site 3 (below Keswick Dam) will be determined from BOR flow release records at Keswick Dam. Flow into the Spring Creek arm of Keswick Reservoir will be determined from Spring Creek Reservoir and power plant release records.

10. Calibration Procedures and Frequency

All laboratory apparatuses (analytical balances, volumetric equipment, deionized water systems, etc. are calibrated on at least an annual basis. Laboratory instruments (ICP–AES, ICP–MS, etc.) are recalibrated with each batch of samples that are analyzed. Calibration standards are rerun (as samples) at a 10 percent frequency (I out of 10 samples analyzed) to check for instrument drift. If drift exceeds predetermined limits (variable for instrument, element, and concentration level), the instrument is recalibrated prior to analysis of additional samples.

Usually five, and a minimum of three calibration standards (matrix matched), are used to establish calibration curves, bracketing the concentration range expected for the samples.

Field instruments (electrical conductance, pH, and dissolved oxygen) are calibrated prior to each measurement following standard USGS procedures (Ward and Harr, 1990; Shelton 1994). Certified and dated conductance and pH standards are supplied by the USGS National Water Quality Laboratory. Dissolved oxygen meters are calibrated from the theoretical oxygen saturation of a humid atmosphere at a given temperature and pressure.

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11. Analytical Procedures

11.1 Concentration of dissolved major and trace elements:

The analytes are determined sequentially according to mass, on a single aliquot utilizing argon plasma ionization, mass spectrometric separation, and electron multiplier detection. Each analysis is based on the mean of three replicate determinations. Trace metals and major cations are analyzed using a Perkin Elmer-Sciex, Model 5000, modified inductively coupled plasma–mass spectrometer (ICP–MS). Major cations are analyzed using a Jarrell-Ash, Model 975, inductively coupled plasma–atomic emission spectrometer (ICP–AES). Calibration is performed using a reagent blank and three multi-element calibration standards. Linear regression analysis, through zero and based on 3 points, is employed to generate the calibration equation. All standards and samples are blank subtracted to insure correction for contamination as well as background correction. The methodology has been previously described (Taylor and others, 1990; Taylor and Garbarino, 1991; Garbarino and Taylor, 1995). Mercury is analyzed by cold vapor–atomic fluorescence spectroscopy using methods described by Roth (1994). Major anions will be analyzed using an ion chromatograph calibrated with at least 3 standards.

11.2 Redox speciation of iron:

Iron redox species will be determined with a colorimetric method using ferrozine as the color producing reagent (Stookey, 1970). For the determination of Fe(II), the 562-nm absorbance of the acidified and buffered sample will be measured with a Perkin Elmer Model Lambda 3b UV/VIS spectrophotometer equipped with 1-cm cells for the 10–40 µg range and 5-cm cells for the 2–10 µg range. For the determination of total Fe, a hydroxylamine hydrochloride reductant will be added. Ferric iron will be calculated from the difference between total Fe and Fe(II).

11.3 Sequential extractions of bed sediment and colloidal material:

Three individual extractions will be done to each bed-sediment or colloidal concentrate sample, following the methods described by Hayes (1993). Hydroxylamine-HCI (0.25 M) will be used to dissolve the inorganic fraction of exchangeable metal ions in the sample. Potassium persulfate (0.17M) in 2 percent (volume/volume) sulfuric acid will be used to oxidize organic material. Dissolution of the silicates and other refractory material will be done in strong acids (hydrofluoric, nitric, and hydrochloric acids).

Each extraction will be analyzed by ICP–MS, ICP–AES, CV–AFS, and IC using methods described above for the analysis of major and trace elements in water samples.

11.4 Analysis of sulfur speciation and mineralogy in colloid concentrates and bed sediment:

The forms of sulfur in colloidal concentrates and bed sediment is determined from the chemical analysis of a series of extractions (Rice and others, 1993). An initial extraction with acetone is done to remove elemental sulfur. This extraction is followed by treatment with hot 6 *N* HCI to dissolve acid-volatile sulfides (AVS, assumed to be monosulfides). The sulfide is purged from the sample with nitrogen gas and precipitated as silver sulfide. The hot-acid-treated sample is then filtered and soluble inorganic sulfates are determined by analyzing barium sulfate precipitated from the filtrate following the addition of barium chloride. The retentate is again extracted with acetone to recover AVS oxidized to sulfur during the acid treatment. Disulfide remaining in the retentate are determined following Cr^{2+} reduction/distillation and precipitation as silver sulfide. Organically bound sulfur is determined from the residue of the disulfide sulfur determination by using an Eschka fusion to form SO_4^{2-} followed by precipitation as barium sulfate. Modifications to the above procedure, such as the addition of stannous chloride to the hot acid treatment, will be done to evaluate the effect of ferric iron (especially diagenetic ferric oxides) on the recovery of acid-volatile sulfides. To evaluate the significance of any recovery of pyritic sulfur as AVS, the analyses will be followed by determination of sulfur isotopy ($\delta^{34}S$-values) and mass-balance calculations.

11.5 Mineralogy of colloidal material and bed sediment using X-ray diffraction

X-ray Diffraction (XRD) can provide a qualitative determination of the mineral phases present in the sediment and the suspended sediments. The data will be collected on a Scintag Pad V Automated Diffractometer, which is equipped with a scitillation detector and a graphite monochromator. Computer control of data collection and of data processing will enhance mineral identification and characterization. When concentration in a sample is less than approximately 5 percent or if the mineral is poorly crystalline, the phase in question often must be concentrated by physical differences (density, shape, size, or magnetic susceptibility) or by chemical means (chemical etching of specific phases usually called selective extractions). This equipment is available in the USGS California District laboratory. Emphasis will be placed on characterizing those mineral phases involved with metal transport.

11.6 Mineralogy using Mössbauer spectroscopy:

Information from ^{57}Fe Mössbauer spectroscopy will be combined with X-ray diffraction techniques to evaluate poorly crystallized minerals produced by the oxidation of sulfides. This has proven useful for identification of iron bearing minerals of small particle size and low concentration. A ^{57}Co source of λ-ray is used to generate the Mössbauer spectra which are characteristic of specific iron minerals.

11.7 Bonding of metals using EXAFS:

Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy will be used to determine the local molecular structure about the average Fe ion in poorly crystallized ferrihydrite polymers. EXAFS spectra will be recorded in both transmission and fluorescence modes at the Stanford Synchrotron Radiation Laboratory using methods described by Waychunas and others (1993).

11.8 Particle size distribution:

Particle size distributions of suspended sediment samples wet sieve and sedigraph methods. Particle size distributions of colloidal material will be determined using light scattering spectrometry.

11.9 Lead-isotope methods:

An appropriate weight of sediment sample or colloid material is digested in 2*M* HCl + H_2O_2 to provide a minimum amount of Pb for isotopic analysis (generally 50 ng or more). Digestions are done in FEP Teflon ware under laminar flow conditions using ultra-pure reagents, as described by Church and others (1993). Lead is separated in the bromide medium on Dowex lx8 anion exchange using micro-columns. Analysis of the lead is performed on a multi-collector mass spectrometer; precision for the isotopic ratios is better than 1/1000. Analyses of blind duplicates, standards, and SRM 981 are used to monitor reproducibility and correct for isotopic fractionation, as described by Church and others (1993). Blanks are generally less than 1 ng for samples of this size. All analytical procedures are done under chain-of-custody protocol, under the direction of Dr. Stan Church, who is Quality Assurance officer for the lead isotope analyses.

12. Data Reduction, Validation, and Reporting

Data from field measurements will be entered into the USGS National Water Information Database (NWIS) after each field run. Laboratory data will be transmitted to the USGS project leader on laboratory analysis sheets from each participating laboratory and will include laboratory QA/QC data. Data from all laboratories will be entered into a single spreadsheet database maintained in the USGS Sacramento District office. QA/QC data will be reviewed as it is received and compared to the project Quality Assurance Objectives. Data not meeting objectives will be flagged and included in a report summarizing the activities and results of each sampling run.

13. Quality Control Checks

The purposes of QC samples are to ensure that reported data represent actual values and that the data are reproducible and precise. The QC samples described below are used to evaluate field techniques, equipment, and laboratory methods.

13.1 Laboratory Analysis

Laboratory analysis of major and trace elements in water samples, colloid concentrates, and bed-sediment extracts will be done by the USGS lab in Boulder, Colorado (under the direction of Dr. Howard Taylor). All sample determinations will be performed in triplicate, with the mean value of the triplicate analysis being reported as the most probable value of concentration. Outliers are evaluated and rejected when statistically valid.

Standard Reference Materials (National Institute of Standards, USGS, and other sources) similar in composition (both matrix and analyte concentration) to the samples being analyzed, are processed and analyzed at a frequency of at least 10 percent of the samples determined. Control charts are maintained to assure that interference corrections (where necessary) or calibration procedures are within predetermined specifications.

Laboratory blanks are used to evaluate bias from deionized water and laboratory reagents used during the sample analysis.

When necessary and where appropriate, spike additions are made to samples, prior to analysis, to evaluate spike recovery. This is particularly important when preconcentration, matrix separation, or speciation considerations are implemented.

All samples in a given batch are analyzed in random order to minimize errors associated with sample composition.

Split samples for metals other than mercury will be sent periodically to both Dr. Howard Taylor's lab and the USGS National Water Quality Laboratory (NWQL) to evaluate any differences in the analytic results from the two labs. The NAWQA program uses the NWQL for its routine inorganic chemical analysis (Stanley and others, 1992), and comparison of the two labs is necessary to ensure comparability between data sets created by the two projects. Splits of mercury samples will be sent to the USGS lab in Madison, Wisconsin (under the direction of Dr. David Krabbenhoft). The Madison lab is also analyzing mercury for the Sacramento NAWQA project.

13.2 Field procedures

Equipment blanks will be done prior to or during the first field run to ensure that contaminants are not being introduced by any apparatus or procedure. During the sample collection phase of the project, field blanks will be processed through each stage of sample collection and processing to evaluate potential field contamination problems. Field blanks will be collected between samples at least once during each field run to check the efficacy of equipment cleaning procedures between sites. Additional field blanks will be collected at sites deemed critical to the successful completion of the study objectives.

Triplicate field samples will be collected at all locations at least once during the study to establish field sampling and processing variance. The triplicate samples will be treated as separate unknowns as they are submitted to the laboratories.

14. Performance and System Audits

All field personnel participate in the annual USGS National Field Quality Program. Reference samples for pH, specific conductance, and alkalinity are analyzed with the equipment used in field determinations. Satisfactory determinations are based on deviation from the most probable value

for each coded reference sample: pH, ±0.1 unit; specific conductance, ±4%; and alkalinity, ±1.5 standard deviations.

15. Preventative Maintenance

Field meters and other equipment are inspected and tested before field runs and worn or defective parts replaced. New batteries are installed at least annually or when meters have been inactive for an unknown length of time. Backup meters, spare parts (electrodes, membranes, filling solutions, etc.), and batteries are taken into the field for unscheduled replacement or repair.

16. Corrective Action

Corrective action will be taken before completion of any further field work if instrument malfunction is observed. Corrective action will also be taken whenever data are determined to be outside acceptable limits, as defined by the Quality Assurance Objectives.

Corrective action shall include reanalysis of samples after problems have been remedied. The method of standard additions may be used if spike recoveries are found to be outside acceptable limits. Any data not meeting Quality Assurance Objectives, but judged of potential usefulness, will be flagged and its deficiencies with regard to quality criteria described.

17. Quality Assurance Reports to Management

Following the review of field and laboratory results from each sampling run, the USGS project leader will compile a Quality Assurance Report summarizing the work completed, results of performance evaluations, results of data quality assessments, significant problems and recommended solutions. Summaries of this information will be included in quarterly project status reports.

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Appendix 2. Quality Assurance and Quality Control Data for Chemical Analyses

Table A2-1. Results of EPA's Performance Evaluations WP036 (table 2-1a), WP037 (table 2-1b), and WP038 (table A2-1c) for the USGS's National Water Quality Laboratory.

Table A2-2. Results of laboratory and field blanks for water sample processing.

Table A2-3. Observed metal concentrations and percentage recovery in biological reference materials processed using the same methods as caddisfly samples .

Table A2-4. Procedural blanks for caddisfly samples collected from the Sacramento River and Cottonwood Creek, October 21–23, 1996.

Table A2-5. Concentration data for standard reference materials.

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Table A2-1a. Results of EPA's Performance Evaluation WP036 for the USGS's National Water Quality Laboratory

[*, Based on gravimetric calculations or a reference value when necessary; TDS, total dissolved solids. °C, degree Celsius]

Constituent	Reported value	True value*	Acceptance limits	Warning limits	Performance evaluation
Trace metals (micrograms/liter)					
Aluminum	3,602	3,609	3,130–4,040	3,250–3,920	Acceptable
Cadmium	130	131	113–148	117–144	Acceptable
Copper	564	552	515–618	528–605	Acceptable
Iron	831	790	715–934	742–906	Acceptable
Mercury	4.58	4.7	3.53–5.91	3.83–5.61	Acceptable
Lead	371	375	332–429	344–417	Acceptable
Zinc	1,187	1,203	1,100–1,370	1,140–1,340	Acceptable
Major ions (milligrams/liter)					
TDS at 180°C	142	148	104–187	114–177	Acceptable
Calcium	16.6	17	14.8–19.5	15.4–18.9	Acceptable
Magnesium	1.17	1.2	0.983–1.42	1.04–1.37	Acceptable
Sodium	7.47	7.46	6.55–9.17	6.88–8.85	Acceptable
Potassium	34.5	33.1	30.5–37.5	31.4–36.6	Acceptable
Alkalinity (as $CaCO_3$)	13.6	13	9.69–16.8	10.6–15.9	Acceptable
Chloride	34.6	34.8	30.8–38.4	31.8–37.4	Acceptable
Fluoride	0.21	0.21	0.153–0.27	0.168–0.255	Acceptable
Sulfate	43.4	44	36.4–49.1	37.9–47.5	Acceptable
Nutrients (milligrams/liter)					
Ammonia–nitrogen	10.2	10	8.05–12	8.52–11.5	Acceptable
Nitrate–nitrogen	2.32	2.1	1.73–2.48	1.82–2.39	Acceptable
Orthophosphate	0.993	0.88	0.768–1.02	0.798–0.988	Warning[1]
Kjeldahl–nitrogen	8.78	8.9	6.62–10.9	7.13–10.4	Acceptable
Total Phosphorus	3.06	2.9	2.46–3.43	2.58–3.31	Acceptable

[1]The orthophosphate quality control samples were within range, but the test sample was diluted 1 to 10. This dilution was too large, resulting in the values being at the low end of the reporting range. This added variability to the results. Analysts were cautioned that the measured results should be at mid-range or higher.

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Table A2-1b. Results of EPA's Performance Evaluation WP037 for the USGS's National Water Quality Laboratory

[*, Based on gravimetric calculations, or a reference value when necessary; TDS, total dissolved solids. °C, degree Celsius]

Constituent	Reported value	True value*	Acceptance limits	Warning limits	Performance evaluation
Trace metals (micrograms/liter)					
Aluminum	1,160	1,203	1,030–1,360	1,070–1,310	Acceptable
Cadmium	21.5	22.2	18.3–26.4	19.4–25.4	Acceptable
Copper	112	115	102–128	105–124	Acceptable
Iron	399	393	350–445	362–433	Acceptable
Mercury	0.45	0.494	0.266–0.729	0.324–0.671	Acceptable
Lead	128	130	109–147	114–143	Acceptable
Zinc	290	296	263–332	272–323	Acceptable
Major ions (milligrams/liter)					
TDS at 180°C	607	685	461–932	521–872	Acceptable
Calcium	67.4	66	61–73.2	62.5–71.6	Acceptable
Magnesium	36.4	37	33.7–40	34.5–39.2	Acceptable
Sodium	90.5	92.2	85.1–101	87.1–98.6	Acceptable
Potassium	16.7	17	14.6–19.8	15.3–19.2	Acceptable
Total alkali	92	91	82.2–99	84.3–96.9	Acceptable
Chloride	228	226	207–250	212–244	Acceptable
Fluoride	2.59	2.6	2.25–2.92	2.34–2.84	Acceptable
Sulfate	118	118	99.9–138	105–133	Acceptable
Nutrients (milligrams/liter)					
Ammonia–nitrogen	0.277	0.261	0.12–0.444	0.159–0.405	Acceptable
Nitrate–nitrogen	0.608	0.62	0.47–0.756	0.504–0.722	Acceptable
Orthophosphate	5.94	5.5	4.84–6.25	5.01–6.09	Acceptable
Kjeldahl–nitrogen	2.82	2.6	1.72–3.53	1.94–3.31	Acceptable
Total Phosphorus	7.95	7	5.99–8.24	6.26–7.97	Acceptable

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Table A2-1c. Results of EPA's Performance Evaluation WP038 for the USGS's National Water Quality Laboratory

[*, Based on gravimetric calculations, or a reference value when necessary. $NO_2 + NO_3$, nitrite plus nitrate; NWQL, National Water Quality Laboratory. mg/L, milligram per liter]

Constituent	Reported Value	True Value*	Acceptance Limits	Performance Evaluation
Trace metals (micrograms/liter)				
Cadmium	29.7	28.5	22.8–34.2	Acceptable
Copper	510	490	441–539	Acceptable
Lead	17.4	16	11.2–20.8	Acceptable
Mercury	3.3	3.8	2.66–4.94	Acceptable
Zinc	781	760	706–824	Acceptable
Nutrients/fluoride (milligrams/liter)				
Nitrate as nitrogen	9.52	9.5	8.55–10.5	Acceptable
Fluoride	2.78	2.9	2.61–3.19	Acceptable
Nitrite as nitrogen	0.68	0.82	0.697–0.943	Not Acceptable[1]
Orthophosphate as phosphorus	1.66	1.6	1.43–1.77	Acceptable

[1]The reported value was 0.68 mg/L; the true value was reported to be 0.820 mg/L and the acceptance range was 0.697–0.943 mg/L. At the NWQL, nitrite is analyzed simultaneously with the nitrate + nitrite analysis, and for WS039, the $NO_2 + NO_3$ sample had to be diluted. This diluted value was reported instead of the nondiluted value. The operator and future operators will be instructed that the value of the nondiluted sample or smallest dilution is to be used.

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Table A2-2. Results of laboratory and field blanks for water sample processing

[Explanation:
Source water for all blanks was double deionized Type 1 [18 MΩ-cm (megohm-centimeters)] water generated with a Milli-Q system. All analyses were done by ICP–MS (inductively coupled plasma–mass spectrometry) unless indicated otherwise. Water used to generate field blanks was double deionized water generated in the laboratory (same Type 1) and carried into the field in acid-cleaned, high-density polyethylene (HDPE) jerrycans. Labels under the heading 'Blank Type' indicate whether the blank sample was generated and processed in the laboratory (Lab Blank) or if the blank sample was generated at a field sampling site (Field Blank) and then processed either in the field or in the laboratory. The 'Process Type' heading indicates the type of processing or processing step to which the blank was subjected. A key to the abbreviations is listed below:

DIW	deionized water; blanks preserved in the same ultrahigh purity 1 percent nitric acid (HNO_3) (Kuehner and others, 1972) used to preserve the samples
8LCh	8-L polytetrafluoroethylene (PTFE, or Teflon)-coated churn used for compositing, subsampling, and transporting the sample from field to laboratory during the specified sampling period
MemF	0.40 µm pore-size polycarbonate membrane filter process (Nuclepore)
CapF	0.45 µm pore-size polyethersulfone capsule filter process (Gelman)
UF1	0.005 µm equivalent pore-size tangential-flow ultrafilter (Minitan) with a low-binding regenerated cellulose membrane of 240 cm^2 [Millipore Corp. model PLGCOMP04, 10,000 daltons, or nominal molecular weight limit (NMWL)] used only to process samples from expected low concentration sites
UF2	0.005 µm equivalent pore-size tangential-flow ultrafilter (Minitan) with a low-binding regenerated cellulose membrane of 240 cm^2 (Millipore model PLGCOMP04, 10,000 NMWL), used to process samples from expected high concentration sites
UF3	0.005 µm equivalent pore-size tangential-flow ultrafilter (Pellicon) with a regenerated cellulose membrane of 7,440 cm^2 (Millipore Corp. model PLGC, 10,000 NMWL) used only to isolate suspended sediment samples
HgP	deionized water preserved in the same potassium dichromate/nitric acid ($K_2Cr_2O_7/HNO_3$) solution used to preserve the mercury samples
20LCh	20-L PTFE-coated churn used for compositing, subsampling, and transporting the sample from field to laboratory during the specified sampling period
THB	PTFE holding bottle blank used to hold subsample from churn for samples filtered through the 0.40 µm pore-size polycarbonate membrane filter
20LCh-1	20-L PTFE-coated churn (1 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
20LCh-2	20-L PTFE-coated churn (2 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
20LCh-3	20-L PTFE-coated churn (3 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
20LCh-4	20-L PTFE-coated churn (4 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
20LCh-5	20-L PTFE-coated churn (5 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
20LCh-6	20-L PTFE-coated churn (6 of 6) used for compositing, subsampling, and transporting the sample from field to laboratory
25LCb	25-L HDPE carboy used to transport sample water from the field to the laboratory for the suspended sediment (colloid) sample
UFVP	0.005 µm equivalent pore-size tangential-flow ultrafilter (240 cm^2); collected only during the May/June sampling event to determine if carryover from the "Sacramento River at Verona" sample affected the "Yolo Bypass at I-80 near West Sacramento" sample
JyCn	12-L PTFE-coated HDPE jerrycan used to transport sample water from field to the laboratory
SCDI	deionized water that was carried into the field to the "Spring Creek below Spring Creek Debris Dam near Keswick" site, preserved in the same high purity 1 percent HNO_3 used to preserve the samples
SCADI	deionized water that was carried into the field to the "Keswick Reservoir, Spring Creek arm, near Keswick" site, preserved in the same high purity 1 percent HNO_3 used to preserve the samples
TfTb	PTFE tubing used to collect sample water at selected sites; the length of tubing contained a 25-cm section of either silicone or neoprene tubing through the pump head of the peristaltic pump
Grab	3-L PTFE bottle used to collect a grab sample from the center of the stream channel.

Numbers in parentheses in the column "Process Type" (for example, 1/1) indicate whether multiple samples were collected for that sampling period (second number) and which replicate they represent (first number). mm/dd/yy, month;day/year; ICP–AES, inductively coupled plasma–atomic emission spectrometry; NMWL, nominal molecular weight limit; PTFE, polytetrafluoroethylene; UV–vis, ultraviolet visible spectroscopy. —, no sample collected for specified analysis; comp., composite sample; na, no data available; <, less than indicated detection limit. cm, centimeter; cm^2, square centimeter; L, liter; mm, millimeter; µg/L, microgram per liter; µm, micrometer]

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.11 ± 0.04	< 0.012 ± 0.001	< 0.03 ± 0.01	< 0.011 ± 0.006
Lab Blank	8LCh (1/1)	07/10/96	0.80 ± 0.02	< 0.012 ± 0.002	< 0.03 ± 0.01	0.050 ± 0.042
Lab Blank	MemF (1/1)	07/10/96	0.70 ± 0.08	< 0.012 ± 0.004	< 0.03 ± 0.01	< 0.011 ± 0.008
Lab Blank	CapF (1/1)	07/10/96	< 0.11 ± 0.01	< 0.012 ± 0.004	< 0.03 ± 0.01	< 0.011 ± 0.003
Lab Blank	UF1 (1/1)	07/10/96	0.43 ± 0.05	< 0.007 ± 0.004	< 0.02 ± 0.00	0.050 ± 0.003
Lab Blank	UF2 (1/1)	07/10/96	< 0.11 ± 0.08	< 0.012 ± 0.000	< 0.03 ± 0.01	0.026 ± 0.005
Lab Blank	UF3 (1/1)	07/12/96	0.47 ± 0.11	< 0.007 ± 0.001	< 0.02 ± 0.01	0.051 ± 0.001
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.11 ± 0.07	< 0.012 ± 0.002	< 0.03 ± 0.00	< 0.011 ± 0.002
Field Blank	8LCh (1/1)	07/17/96	0.53 ± 0.07	< 0.007 ± 0.002	< 0.02 ± 0.01	0.022 ± 0.800
Field Blank	MemF (1/1)	07/17/96	0.38 ± 0.16	< 0.007 ± 0.001	< 0.02 ± 0.02	< 0.011 ± 0.166
Field Blank	CapF (1/1)	07/17/96	0.11 ± 0.09	< 0.012 ± 0.003	< 0.03 ± 0.01	0.034 ± 0.003
Field Blank	UF2 (1/1)	07/17/96	< 0.11 ± 0.01	< 0.012 ± 0.002	< 0.03 ± 0.01	0.052 ± 0.005
Field Blank	UF3 (1/1)	07/17/96	0.13 ± 0.11	< 0.012 ± 0.000	< 0.03 ± 0.01	< 0.011 ± 0.001
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	0.11 ± 0.04	< 0.006 ± 0.008	< 0.06 ± 0.01	< 0.005 ± 0.007
Lab Blank	20LCh (1/1)	09/18/96	0.41 ± 0.02	0.019 ± 0.002	< 0.05 ± 0.02	0.017 ± 0.004
Lab Blank	MemF (1/1)	09/18/96	0.83 ± 0.06	< 0.014 ± 0.001	< 0.03 ± 0.04	0.014 ± 0.005
Lab Blank	CapF (1/1)	09/18/96	0.13 ± 0.02	< 0.014 ± 0.002	< 0.03 ± 0.02	0.037 ± 0.004
Lab Blank	UF2 (1/1)	09/18/96	0.15 ± 0.04	0.019 ± 0.005	< 0.05 ± 0.05	0.029 ± 0.006
Lab Blank	UF3 (1/1)	09/18/96	0.26 ± 0.04	< 0.006 ± 0.001	< 0.06 ± 0.01	0.008 ± 0.002
Lab Blank	THB (1/1)	09/18/96	0.31 ± 0.03	< 0.014 ± 0.001	< 0.03 ± 0.02	0.015 ± 0.003
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	0.12 ± 0.02	< 0.006 ± 0.006	< 0.06 ± 0.01	0.011 ± 0.002
Field Blank	20LCh (1/1)	09/18/96	0.23 ± 0.02	< 0.014 ± 0.003	< 0.03 ± 0.04	0.008 ± 0.002
Field Blank	MemF (1/1)	09/18/96	0.17 ± 0.03	< 0.006 ± 0.005	< 0.06 ± 0.03	0.007 ± 0.001
Field Blank	CapF (1/1)	09/18/96	0.06 ± 0.03	< 0.014 ± 0.007	< 0.03 ± 0.04	0.007 ± 0.002
Field Blank	UF2 (1/1)	09/18/96	0.28 ± 0.04	< 0.006 ± 0.004	< 0.06 ± 0.03	0.009 ± 0.002
Field Blank	UF3 (1/1)	09/18/96	1.2 ± 0.1	< 0.014 ± 0.005	< 0.03 ± 0.00	0.016 ± 0.001
Field Blank	THB (1/1)	09/18/96	0.15 ± 0.05	< 0.014 ± 0.007	< 0.03 ± 0.02	0.009 ± 0.007
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	0.20 ± 0.08	< 0.03 ± 0.01	< 0.09 ± 0.03	< 0.05 ± 0.02
Lab Blank	8LCh (1/1)	11/13/96	0.97 ± 0.06	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.02
Lab Blank	MemF (1/1)	11/13/96	0.73 ± 0.18	< 0.03 ± 0.00	< 0.09 ± 0.03	< 0.05 ± 0.01

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	0.28 ± 0.07	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.00
Lab Blank	UF2 (1/1)	11/13/96	0.19 ± 0.02	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.02
Lab Blank	UF3 (1/1)	11/13/96	0.58 ± 0.01	< 0.03 ± 0.02	< 0.09 ± 0.01	< 0.05 ± 0.01
Lab Blank	THB (1/1)	11/13/96	0.40 ± 0.15	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.00
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.11 ± 0.01	< 0.03 ± 0.01	< 0.09 ± 0.04	< 0.05 ± 0.01
Field Blank	8LCh (1/1)	11/20/96	< 0.11 ± 0.00	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.01
Field Blank	MemF (1/1)	11/20/96	0.11 ± 0.06	< 0.03 ± 0.00	< 0.09 ± 0.03	< 0.05 ± 0.02
Field Blank	CapF (1/1)	11/20/96	< 0.05 ± 0.00	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.00
Field Blank	UF1 (1/1)	11/20/96	< 0.05 ± 0.05	< 0.03 ± 0.01	< 0.09 ± 0.04	< 0.05 ± 0.01
Field Blank	UF3 (1/1)	11/20/96	< 0.11 ± 0.11	< 0.03 ± 0.00	< 0.09 ± 0.02	< 0.05 ± 0.00
Field Blank	THB (1/1)	11/20/96	0.98 ± 0.04	< 0.03 ± 0.01	< 0.09 ± 0.02	< 0.05 ± 0.03
Field Blank	CapF (1/1)	11/20/96	0.07 ± 0.03	< 0.03 ± 0.00	< 0.09 ± 0.01	< 0.05 ± 0.02
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.05 ± 0.03	< 0.015 ± 0.002	< 0.04 ± 0.00	< 0.007 ± 0.008
Lab Blank	MemF (1/1)	12/16/96	0.11 ± 0.02	< 0.015 ± 0.009	< 0.04 ± 0.04	0.011 ± 0.016
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	0.16 ± 0.19	< 0.015 ± 0.002	0.06 ± 0.01	0.013 ± 0.005
Lab Blank	UF3 (1/1)	12/16/96	0.15 ± 0.04	< 0.015 ± 0.003	< 0.04 ± 0.01	< 0.007 ± 0.002
Lab Blank	THB (1/1)	12/16/96	0.17 ± 0.08	< 0.015 ± 0.007	< 0.04 ± 0.01	< 0.007 ± 0.005
Lab Blank	20LCh-1 (1/1)	12/16/96	0.17 ± 0.06	< 0.015 ± 0.002	< 0.04 ± 0.00	< 0.007 ± 0.003
Lab Blank	20LCh-2 (1/1)	12/16/96	0.19 ± 0.12	0.021 ± 0.002	< 0.04 ± 0.00	< 0.007 ± 0.003
Lab Blank	20LCh-3 (1/1)	12/16/96	0.98 ± 0.12	< 0.015 ± 0.000	< 0.04 ± 0.01	0.026 ± 0.005
Lab Blank	20LCh-4 (1/1)	12/16/96	0.09 ± 0.02	< 0.015 ± 0.001	< 0.04 ± 0.00	< 0.007 ± 0.003
Lab Blank	20LCh-5 (1/1)	12/16/96	0.43 ± 0.18	< 0.015 ± 0.001	< 0.04 ± 0.01	0.024 ± 0.011
Lab Blank	20LCh-6 (1/1)	12/16/96	0.17 ± 0.08	< 0.015 ± 0.004	< 0.04 ± 0.01	0.007 ± 0.006
Lab Blank	UF1 (1/1)	12/16/96	< 0.05 ± 0.03	< 0.015 ± 0.004	< 0.04 ± 0.01	< 0.007 ± 0.005
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	0.42 ± 0.01	< 0.015 ± 0.000	< 0.04 ± 0.02	0.007 ± 0.017
Field Blank	8LCh (1/1)	12/17/96	0.54 ± 0.01	< 0.015 ± 0.003	< 0.04 ± 0.00	0.015 ± 0.003
Field Blank	MemF (1/1)	12/17/96	0.23 ± 0.03	< 0.015 ± 0.003	< 0.04 ± 0.01	0.040 ± 0.013
Field Blank	CapF (1/1)	12/17/96	0.23 ± 0.20	< 0.015 ± 0.004	< 0.04 ± 0.01	0.018 ± 0.009
Field Blank	UF2 (1/1)	12/17/96	0.09 ± 0.03	< 0.015 ± 0.014	0.20 ± 0.01	0.073 ± 0.016
Field Blank	THB (1/1)	12/17/96	2.14 ± 0.34	< 0.015 ± 0.011	< 0.04 ± 0.01	0.075 ± 0.019
Lab Blank	DIW (1/1)	01/06/97	< 0.04 ± 0.02	< 0.015 ± 0.002	< 0.04 ± 0.01	< 0.02 ± 0.00

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.05 ± 0.01	< 0.015 ± 0.005	0.06 ± 0.02	< 0.02 ± 0.01
Lab Blank	MemF (1/1)	01/06/97	0.07 ± 0.01	< 0.015 ± 0.003	< 0.03 ± 0.00	< 0.02 ± 0.00
Lab Blank	CapF (1/1)	01/06/97	0.1 ± 0.0	< 0.008 ± 0.005	< 0.04 ± 0.01	0.027 ± 0.009
Lab Blank	UF2 (1/2)	01/06/97	< 0.05 ± 0.01	< 0.015 ± 0.003	0.11 ± 0.03	< 0.02 ± 0.00
Lab Blank	UF2 (2/2)	01/06/97	0.11 ± 0.02	< 0.02 ± 0.00	0.09 ± 0.04	< 0.03 ± 0.01
Lab Blank	UF3 (1/1)	01/06/97	66 ± 1	< 0.015 ± 0.002	0.08 ± 0.01	0.54 ± 0.00
Lab Blank	THB (1/1)	01/06/97	0.09 ± 0.07	< 0.015 ± 0.004	< 0.03 ± 0.01	< 0.02 ± 0.00
Lab Blank	25LCb (1/1)	01/06/97	< 0.05 ± 0.01	< 0.015 ± 0.003	< 0.03 ± 0.02	< 0.02 ± 0.00
Lab Blank	DIW (1/1)	01/06/97	1.27 ± 0.01	< 0.015 ± 0.005	< 0.03 ± 0.01	< 0.02 ± 0.00
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	0.09 ± 0.01	< 0.015 ± 0.003	< 0.03 ± 0.01	< 0.02 ± 0.00
Lab Blank	UF2 (1/1)	05/28/97	< 0.1 ± 0.1	< 0.008 ± 0.005	< 0.04 ± 0.01	0.025 ± 0.007
Lab Blank	UF3 (1/1)	05/28/97	5.3 ± 0.2	< 0.008 ± 0.006	< 0.04 ± 0.04	0.053 ± 0.007
Lab Blank	THB (1/1)	05/28/97	0.5 ± 0.0	< 0.008 ± 0.004	< 0.04 ± 0.01	0.026 ± 0.004
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	0.5 ± 0.0	< 0.008 ± 0.004	< 0.04 ± 0.02	0.014 ± 0.002
Field Blank	DIW (2/2)	06/05/97	0.9 ± 0.0	< 0.008 ± 0.010	< 0.04 ± 0.02	0.019 ± 0.006
Field Blank	CapF (1/3)	06/05/97	< 0.1 ± 0.0	< 0.008 ± 0.006	< 0.04 ± 0.03	< 0.008 ± 0.002
Field Blank	UFVP (1/1)	06/05/97	< 0.1 ± 0.0	< 0.008 ± 0.002	< 0.04 ± 0.01	0.018 ± 0.004
Field Blank	JyCn (1/1)	06/05/97	1.9 ± 0.0	< 0.008 ± 0.010	< 0.04 ± 0.01	0.034 ± 0.007
Field Blank	CapF (2/3)	06/05/97	0.11 ± 0.06	< 0.01 ± 0.00	< 0.03 ± 0.01	0.02 ± 0.01
Field Blank	CapF (3/3)	06/05/97	0.09 ± 0.03	< 0.01 ± 0.00	< 0.03 ± 0.00	0.03 ± 0.01
Field Blank	SCDI (1/1)	06/05/97	0.23 ± 0.09	< 0.01 ± 0.01	< 0.03 ± 0.01	< 0.01 ± 0.01
Field Blank	SCADI (1/1)	06/05/97	0.24 ± 0.06	< 0.01 ± 0.01	< 0.03 ± 0.02	0.01 ± 0.00
Field Blank	TfTb (1/1)	06/05/97	< 0.06 ± 0.06	< 0.01 ± 0.01	< 0.03 ± 0.01	0.02 ± 0.03
Lab Blank	DIW (1/1)	05/28/97	< 0.1 ± 0.0	< 0.008 ± 0.001	< 0.04 ± 0.02	< 0.008 ± 0.000
Lab Blank	MemF (1/1)	05/28/97	0.1 ± 0.0	< 0.008 ± 0.005	< 0.04 ± 0.02	0.015 ± 0.003
Lab Blank	CapF (1/1)	05/28/97	< 0.1 ± 0.0	< 0.008 ± 0.005	< 0.04 ± 0.03	< 0.008 ± 0.000

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Beryllium (µg/L)	Bismuth (µg/L)	Boron (µg/L)	Cadmium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.01 ± 0.002	< 0.005 ± 0.001	1.9 ± 0.2	< 0.004 ± 0.003
Lab Blank	8LCh (1/1)	07/10/96	< 0.01 ± 0.003	< 0.005 ± 0.000	1.7 ± 0.2	0.006 ± 0.001
Lab Blank	MemF (1/1)	07/10/96	< 0.01 ± 0.001	< 0.005 ± 0.000	1.8 ± 0.8	0.006 ± 0.001
Lab Blank	CapF (1/1)	07/10/96	< 0.01 ± 0.004	< 0.005 ± 0.000	1.7 ± 0.4	< 0.004 ± 0.003
Lab Blank	UF1 (1/1)	07/10/96	< 0.018 ± 0.002	< 0.005 ± 0.002	1.8 ± 0.2	0.010 ± 0.001
Lab Blank	UF2 (1/1)	07/10/96	< 0.01 ± 0.003	< 0.005 ± 0.000	2.1 ± 0.8	< 0.004 ± 0.005
Lab Blank	UF3 (1/1)	07/12/96	< 0.018 ± 0.007	< 0.005 ± 0.002	2.7 ± 0.3	0.009 ± 0.002
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.01 ± 0.003	< 0.005 ± 0.000	1.7 ± 0.3	< 0.004 ± 0.002
Field Blank	8LCh (1/1)	07/17/96	< 0.018 ± 0.005	< 0.005 ± 0.002	1.8 ± 0.6	0.048 ± 0.003
Field Blank	MemF (1/1)	07/17/96	< 0.018 ± 0.004	< 0.005 ± 0.003	2.0 ± 0.6	< 0.006 ± 0.003
Field Blank	CapF (1/1)	07/17/96	< 0.01 ± 0.003	< 0.005 ± 0.001	1.6 ± 0.2	0.005 ± 0.002
Field Blank	UF2 (1/1)	07/17/96	< 0.01 ± 0.001	< 0.005 ± 0.002	1.7 ± 0.6	< 0.004 ± 0.000
Field Blank	UF3 (1/1)	07/17/96	< 0.01 ± 0.004	< 0.005 ± 0.000	2.5 ± 0.6	< 0.004 ± 0.001
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.03 ± 0.02	< 0.006 ± 0.002	2.2 ± 0.7	< 0.007 ± 0.004
Lab Blank	20LCh (1/1)	09/18/96	< 0.013 ± 0.010	< 0.01 ± 0.002	1.6 ± 0.3	< 0.007 ± 0.004
Lab Blank	MemF (1/1)	09/18/96	< 0.017 ± 0.021	< 0.006 ± 0.000	3 ± 3	< 0.007 ± 0.003
Lab Blank	CapF (1/1)	09/18/96	< 0.017 ± 0.010	< 0.006 ± 0.001	3 ± 1	< 0.007 ± 0.005
Lab Blank	UF2 (1/1)	09/18/96	< 0.013 ± 0.010	< 0.01 ± 0.001	4.5 ± 2.2	< 0.007 ± 0.005
Lab Blank	UF3 (1/1)	09/18/96	< 0.03 ± 0.00	< 0.006 ± 0.002	2.1 ± 0.3	< 0.007 ± 0.002
Lab Blank	THB (1/1)	09/18/96	< 0.017 ± 0.006	< 0.006 ± 0.000	3 ± 3	< 0.007 ± 0.005
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.03 ± 0.01	< 0.006 ± 0.002	2.6 ± 1.0	< 0.007 ± 0.005
Field Blank	20LCh (1/1)	09/18/96	< 0.017 ± 0.008	< 0.006 ± 0.001	< 2 ± 0	< 0.007 ± 0.005
Field Blank	MemF (1/1)	09/18/96	< 0.03 ± 0.00	< 0.006 ± 0.001	1.2 ± 0.2	< 0.007 ± 0.005
Field Blank	CapF (1/1)	09/18/96	< 0.017 ± 0.014	< 0.006 ± 0.000	4 ± 3	0.008 ± 0.002
Field Blank	UF2 (1/1)	09/18/96	< 0.03 ± 0.03	< 0.006 ± 0.002	2.3 ± 0.7	< 0.007 ± 0.005
Field Blank	UF3 (1/1)	09/18/96	0.018 ± 0.002	< 0.006 ± 0.001	3 ± 1	< 0.007 ± 0.004
Field Blank	THB (1/1)	09/18/96	< 0.017 ± 0.013	< 0.006 ± 0.002	5 ± 4	< 0.007 ± 0.003
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.03 ± 0.00	< 0.008 ± 0.001	2 ± 0	< 0.012 ± 0.001
Lab Blank	8LCh (1/1)	11/13/96	< 0.03 ± 0.03	< 0.008 ± 0.001	< 2 ± 0	< 0.012 ± 0.006
Lab Blank	MemF (1/1)	11/13/96	< 0.03 ± 0.02	< 0.008 ± 0.002	< 2 ± 1	< 0.012 ± 0.004

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Beryllium (µg/L)	Bismuth (µg/L)	Boron (µg/L)	Cadmium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.03 ± 0.02	< 0.008 ± 0.001	< 2 ± 0	< 0.012 ± 0.002
Lab Blank	UF2 (1/1)	11/13/96	< 0.03 ± 0.02	< 0.008 ± 0.000	< 2 ± 0	< 0.012 ± 0.001
Lab Blank	UF3 (1/1)	11/13/96	< 0.03 ± 0.03	< 0.008 ± 0.001	< 2 ± 1	< 0.012 ± 0.001
Lab Blank	THB (1/1)	11/13/96	< 0.03 ± 0.02	< 0.008 ± 0.001	< 2 ± 1	< 0.012 ± 0.001
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.000	< 2 ± 0	< 0.012 ± 0.002
Field Blank	8LCh (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.000	< 2 ± 0	< 0.012 ± 0.002
Field Blank	MemF (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.001	< 2 ± 1	< 0.012 ± 0.003
Field Blank	CapF (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.000	< 2 ± 0	< 0.012 ± 0.006
Field Blank	UF1 (1/1)	11/20/96	< 0.03 ± 0.01	< 0.008 ± 0.001	< 2 ± 1	< 0.012 ± 0.008
Field Blank	UF3 (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.000	< 2 ± 1	< 0.012 ± 0.003
Field Blank	THB (1/1)	11/20/96	< 0.03 ± 0.01	< 0.008 ± 0.001	< 2 ± 0	< 0.012 ± 0.003
Field Blank	CapF (1/1)	11/20/96	< 0.03 ± 0.02	< 0.008 ± 0.001	< 2 ± 1	< 0.012 ± 0.010
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.014 ± 0.007	< 0.011 ± 0.000	< 4 ± 2	0.007 ± 0.002
Lab Blank	MemF (1/1)	12/16/96	< 0.014 ± 0.000	< 0.011 ± 0.001	< 4 ± 2	< 0.005 ± 0.002
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.014 ± 0.004	< 0.011 ± 0.000	< 4 ± 3	< 0.005 ± 0.004
Lab Blank	UF3 (1/1)	12/16/96	< 0.014 ± 0.006	< 0.011 ± 0.001	< 4 ± 2	< 0.005 ± 0.005
Lab Blank	THB (1/1)	12/16/96	< 0.014 ± 0.002	< 0.011 ± 0.001	< 4 ± 2	< 0.005 ± 0.005
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.014 ± 0.007	< 0.011 ± 0.001	< 4 ± 2	< 0.005 ± 0.003
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.014 ± 0.005	< 0.011 ± 0.000	< 4 ± 1	< 0.005 ± 0.004
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.014 ± 0.001	< 0.011 ± 0.001	< 4 ± 2	< 0.005 ± 0.002
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.014 ± 0.007	< 0.011 ± 0.000	< 4 ± 2	< 0.005 ± 0.002
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.014 ± 0.004	< 0.011 ± 0.000	< 1 ± 1	< 0.005 ± 0.005
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.014 ± 0.002	< 0.011 ± 0.002	< 4 ± 3	< 0.005 ± 0.002
Lab Blank	UF1 (1/1)	12/16/96	< 0.014 ± 0.002	< 0.011 ± 0.001	< 4 ± 3	< 0.005 ± 0.001
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.014 ± 0.003	< 0.011 ± 0.000	< 4 ± 2	< 0.005 ± 0.002
Field Blank	8LCh (1/1)	12/17/96	< 0.014 ± 0.005	< 0.011 ± 0.001	< 4 ± 3	< 0.005 ± 0.003
Field Blank	MemF (1/1)	12/17/96	< 0.014 ± 0.003	< 0.011 ± 0.002	< 4 ± 4	< 0.005 ± 0.005
Field Blank	CapF (1/1)	12/17/96	< 0.014 ± 0.005	< 0.011 ± 0.001	< 3 ± 2	< 0.013 ± 0.007
Field Blank	UF2 (1/1)	12/17/96	< 0.014 ± 0.004	< 0.011 ± 0.000	< 4 ± 1	< 0.005 ± 0.002
Field Blank	THB (1/1)	12/17/96	< 0.014 ± 0.006	< 0.011 ± 0.001	< 4 ± 0	< 0.005 ± 0.003
Lab Blank	DIW (1/1)	01/06/97	< 0.015 ± 0.006	< 0.01 ± 0.001	< 3 ± 0	0.013 ± 0.009

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Beryllium (µg/L)	Bismuth (µg/L)	Boron (µg/L)	Cadmium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.015 ± 0.004	< 0.01 ± 0.001	< 3 ± 1	< 0.006 ± 0.004
Lab Blank	MemF (1/1)	01/06/97	< 0.015 ± 0.006	< 0.01 ± 0.001	< 3 ± 1	< 0.006 ± 0.005
Lab Blank	CapF (1/1)	01/06/97	< 0.04 ± 0.03	< 0.0009 ± 0.0001	< 1 ± 1	< 0.02 ± 0.00
Lab Blank	UF2 (1/2)	01/06/97	< 0.015 ± 0.007	< 0.01 ± 0.002	< 3 ± 0	< 0.006 ± 0.002
Lab Blank	UF2 (2/2)	01/06/97	< 0.015 ± 0.015	< 0.014 ± 0.001	< 4 ± 1	< 0.011 ± 0.002
Lab Blank	UF3 (1/1)	01/06/97	< 0.015 ± 0.000	< 0.01 ± 0.001	< 3 ± 0	< 0.006 ± 0.002
Lab Blank	THB (1/1)	01/06/97	< 0.015 ± 0.003	< 0.01 ± 0.001	< 3 ± 1	< 0.006 ± 0.001
Lab Blank	25LCb (1/1)	01/06/97	< 0.015 ± 0.005	< 0.01 ± 0.000	< 3 ± 0	< 0.006 ± 0.002
Lab Blank	DIW (1/1)	01/06/97	< 0.015 ± 0.008	< 0.01 ± 0.001	< 3 ± 0	< 0.006 ± 0.004
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.015 ± 0.008	< 0.01 ± 0.001	< 3 ± 2	< 0.006 ± 0.003
Lab Blank	UF2 (1/1)	05/28/97	< 0.04 ± 0.01	< 0.0009 ± 0.0003	< 1 ± 0	< 0.02 ± 0.01
Lab Blank	UF3 (1/1)	05/28/97	< 0.04 ± 0.01	< 0.0009 ± 0.0013	< 1 ± 0	< 0.02 ± 0.01
Lab Blank	THB (1/1)	05/28/97	< 0.04 ± 0.02	< 0.0009 ± 0.0002	< 1 ± 0	< 0.02 ± 0.00
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.04 ± 0.02	< 0.0009 ± 0.0004	< 1 ± 0	< 0.02 ± 0.01
Field Blank	DIW (2/2)	06/05/97	< 0.04 ± 0.01	< 0.0009 ± 0.0005	< 1 ± 1	< 0.004 ± 0.004
Field Blank	CapF (1/3)	06/05/97	< 0.04 ± 0.01	< 0.0009 ± 0.0004	< 1 ± 0	< 0.02 ± 0.01
Field Blank	UFVP (1/1)	06/05/97	< 0.04 ± 0.01	< 0.0009 ± 0.0004	< 1 ± 1	< 0.004 ± 0.001
Field Blank	JyCn (1/1)	06/05/97	< 0.04 ± 0.01	< 0.0009 ± 0.0004	< 1 ± 0	< 0.02 ± 0.01
Field Blank	CapF (2/3)	06/05/97	< 0.04 ± 0.01	< 0.001 ± 0.000	< 0.8 ± 1.6	0.007 ± 0.002
Field Blank	CapF (3/3)	06/05/97	< 0.04 ± 0.04	< 0.001 ± 0.000	< 0.8 ± 0.5	0.005 ± 0.004
Field Blank	SCDI (1/1)	06/05/97	< 0.04 ± 0.01	< 0.001 ± 0.001	0.9 ± 1.3	< 0.01 ± 0.00
Field Blank	SCADI (1/1)	06/05/97	< 0.04 ± 0.03	< 0.001 ± 0.002	< 0.8 ± 0.1	< 0.01 ± 0.01
Field Blank	TfTb (1/1)	06/05/97	< 0.04 ± 0.01	< 0.001 ± 0.001	< 0.8 ± 0.6	< 0.01 ± 0.01
Lab Blank	DIW (1/1)	05/28/97	< 0.04 ± 0.01	< 0.0009 ± 0.0004	< 1 ± 0	< 0.02 ± 0.00
Lab Blank	MemF (1/1)	05/28/97	< 0.04 ± 0.01	< 0.0009 ± 0.0003	< 1 ± 0	0.005 ± 0.002
Lab Blank	CapF (1/1)	05/28/97	< 0.04 ± 0.01	< 0.0009 ± 0.0004	< 1 ± 0	< 0.004 ± 0.003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Calcium (mg/L)	Cerium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.001 ± 0.000	< 0.0005 ± 0.0003	< 0.12 ± 0.03	< 0.004 ± 0.000
Lab Blank	8LCh (1/1)	07/10/96	0.040 ± 0.001	0.0023 ± 0.0003	< 0.12 ± 0.06	< 0.004 ± 0.003
Lab Blank	MemF (1/1)	07/10/96	< 0.001 ± 0.000	0.0007 ± 0.0005	< 0.12 ± 0.04	< 0.004 ± 0.002
Lab Blank	CapF (1/1)	07/10/96	< 0.001 ± 0.000	< 0.0005 ± 0.0001	< 0.12 ± 0.02	< 0.004 ± 0.002
Lab Blank	UF1 (1/1)	07/10/96	< 0.001 ± 0.000	< 0.0007 ± 0.0006	< 0.2 ± 0.4	< 0.005 ± 0.004
Lab Blank	UF2 (1/1)	07/10/96	< 0.001 ± 0.000	< 0.0005 ± 0.0001	< 0.12 ± 0.16	< 0.004 ± 0.001
Lab Blank	UF3 (1/1)	07/12/96	< 0.001 ± 0.000	0.0007 ± 0.0005	< 0.2 ± 0.2	< 0.005 ± 0.002
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.002 ± 0.000	< 0.0005 ± 0.0002	< 0.12 ± 0.01	< 0.004 ± 0.002
Field Blank	8LCh (1/1)	07/17/96	0.016 ± 0.009	0.0055 ± 0.0009	< 0.2 ± 0.1	< 0.005 ± 0.003
Field Blank	MemF (1/1)	07/17/96	0.03 ± 0.05	< 0.0007 ± 0.0015	< 0.2 ± 0.0	< 0.005 ± 0.004
Field Blank	CapF (1/1)	07/17/96	0.010 ± 0.000	0.0009 ± 0.0002	< 0.12 ± 0.11	< 0.004 ± 0.002
Field Blank	UF2 (1/1)	07/17/96	< 0.01 ± 0.01	< 0.0005 ± 0.0002	< 0.12 ± 0.01	< 0.004 ± 0.001
Field Blank	UF3 (1/1)	07/17/96	< 0.002 ± 0.001	< 0.0005 ± 0.0003	< 0.12 ± 0.03	< 0.004 ± 0.000
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.02 ± 0.01	< 0.0011 ± 0.0008	< 0.3 ± 0.0	< 0.008 ± 0.003
Lab Blank	20LCh (1/1)	09/18/96	< 0.009 ± 0.005	< 0.0011 ± 0.0005	0.15 ± 0.12	< 0.011 ± 0.003
Lab Blank	MemF (1/1)	09/18/96	< 0.012 ± 0.004	< 0.0005 ± 0.0003	< 0.17 ± 0.21	< 0.006 ± 0.012
Lab Blank	CapF (1/1)	09/18/96	< 0.009 ± 0.006	< 0.0005 ± 0.0005	< 0.17 ± 0.02	< 0.006 ± 0.008
Lab Blank	UF2 (1/1)	09/18/96	< 0.011 ± 0.000	< 0.0011 ± 0.0005	< 0.12 ± 0.05	< 0.011 ± 0.007
Lab Blank	UF3 (1/1)	09/18/96	< 0.02 ± 0.00	< 0.0011 ± 0.0009	< 0.3 ± 0.0	< 0.008 ± 0.003
Lab Blank	THB (1/1)	09/18/96	< 0.009 ± 0.002	0.0006 ± 0.0004	0.26 ± 0.11	< 0.006 ± 0.007
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.012 ± 0.017	< 0.0011 ± 0.0002	< 0.3 ± 0.1	< 0.008 ± 0.002
Field Blank	20LCh (1/1)	09/18/96	< 0.012 ± 0.001	< 0.0005 ± 0.0005	< 0.17 ± 0.03	< 0.006 ± 0.004
Field Blank	MemF (1/1)	09/18/96	< 0.012 ± 0.001	< 0.0011 ± 0.0002	< 0.3 ± 0.2	< 0.008 ± 0.008
Field Blank	CapF (1/1)	09/18/96	< 0.012 ± 0.000	< 0.0005 ± 0.0003	< 0.17 ± 0.07	< 0.006 ± 0.007
Field Blank	UF2 (1/1)	09/18/96	< 0.012 ± 0.001	< 0.0011 ± 0.0005	< 0.3 ± 0.0	< 0.008 ± 0.004
Field Blank	UF3 (1/1)	09/18/96	< 0.012 ± 0.000	0.0015 ± 0.0005	< 0.17 ± 0.06	< 0.006 ± 0.004
Field Blank	THB (1/1)	09/18/96	< 0.012 ± 0.002	< 0.0005 ± 0.0002	< 0.17 ± 0.06	< 0.006 ± 0.002
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.011 ± 0.001	< 0.0009 ± 0.0003	< 0.12 ± 0.00	< 0.005 ± 0.002
Lab Blank	8LCh (1/1)	11/13/96	< 0.011 ± 0.001	< 0.0009 ± 0.0001	< 0.12 ± 0.06	< 0.005 ± 0.003
Lab Blank	MemF (1/1)	11/13/96	< 0.011 ± 0.001	0.0026 ± 0.0010	< 0.12 ± 0.04	< 0.005 ± 0.002

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Calcium (mg/L)	Cerium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.011 ± 0.005	< 0.0009 ± 0.0002	< 0.12 ± 0.03	< 0.005 ± 0.000
Lab Blank	UF2 (1/1)	11/13/96	< 0.011 ± 0.001	< 0.0009 ± 0.0004	< 0.12 ± 0.08	< 0.005 ± 0.005
Lab Blank	UF3 (1/1)	11/13/96	< 0.011 ± 0.001	0.0020 ± 0.0008	< 0.12 ± 0.02	< 0.005 ± 0.003
Lab Blank	THB (1/1)	11/13/96	< 0.011 ± 0.002	< 0.0009 ± 0.0004	< 0.12 ± 0.01	< 0.005 ± 0.000
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.011 ± 0.001	< 0.0009 ± 0.0003	< 0.12 ± 0.05	< 0.005 ± 0.000
Field Blank	8LCh (1/1)	11/20/96	< 0.011 ± 0.000	< 0.0009 ± 0.0004	< 0.12 ± 0.03	< 0.005 ± 0.003
Field Blank	MemF (1/1)	11/20/96	< 0.011 ± 0.001	< 0.0009 ± 0.0007	< 0.12 ± 0.01	< 0.005 ± 0.003
Field Blank	CapF (1/1)	11/20/96	< 0.011 ± 0.002	< 0.0009 ± 0.0008	< 0.12 ± 0.06	< 0.005 ± 0.000
Field Blank	UF1 (1/1)	11/20/96	< 0.002 ± 0.001	< 0.0009 ± 0.0004	< 0.12 ± 0.01	< 0.005 ± 0.004
Field Blank	UF3 (1/1)	11/20/96	< 0.002 ± 0.003	0.0012 ± 0.0004	< 0.12 ± 0.08	< 0.005 ± 0.002
Field Blank	THB (1/1)	11/20/96	0.011 ± 0.020	0.0023 ± 0.0002	< 0.12 ± 0.05	< 0.005 ± 0.000
Field Blank	CapF (1/1)	11/20/96	< 0.003 ± 0.002	< 0.0009 ± 0.0005	< 0.12 ± 0.04	< 0.005 ± 0.001
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.02 ± 0.00	< 0.0004 ± 0.0001	< 0.06 ± 0.03	< 0.009 ± 0.002
Lab Blank	MemF (1/1)	12/16/96	< 0.02 ± 0.00	0.0005 ± 0.0003	< 0.06 ± 0.03	< 0.009 ± 0.001
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.02 ± 0.00	< 0.0004 ± 0.0002	< 0.06 ± 0.06	< 0.009 ± 0.001
Lab Blank	UF3 (1/1)	12/16/96	< 0.02 ± 0.00	0.0005 ± 0.0004	< 0.06 ± 0.02	< 0.009 ± 0.003
Lab Blank	THB (1/1)	12/16/96	< 0.02 ± 0.00	< 0.0004 ± 0.0001	< 0.06 ± 0.02	< 0.009 ± 0.001
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.02 ± 0.01	< 0.0004 ± 0.0002	< 0.06 ± 0.03	< 0.009 ± 0.002
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.02 ± 0.01	< 0.0004 ± 0.0004	< 0.06 ± 0.05	< 0.009 ± 0.001
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.02 ± 0.00	< 0.0004 ± 0.0000	< 0.06 ± 0.03	< 0.009 ± 0.002
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.02 ± 0.00	< 0.0004 ± 0.0003	< 0.06 ± 0.02	< 0.009 ± 0.004
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.02 ± 0.01	0.0012 ± 0.0003	< 0.05 ± 0.04	< 0.009 ± 0.002
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.02 ± 0.00	0.0004 ± 0.0004	< 0.06 ± 0.07	< 0.009 ± 0.002
Lab Blank	UF1 (1/1)	12/16/96	< 0.008 ± 0.004	< 0.0004 ± 0.0002	< 0.06 ± 0.04	< 0.009 ± 0.001
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.008 ± 0.001	0.0008 ± 0.0002	< 0.06 ± 0.04	< 0.009 ± 0.003
Field Blank	8LCh (1/1)	12/17/96	< 0.008 ± 0.001	0.0017 ± 0.0003	< 0.06 ± 0.03	< 0.009 ± 0.001
Field Blank	MemF (1/1)	12/17/96	< 0.02 ± 0.00	0.0007 ± 0.0003	< 0.06 ± 0.07	< 0.009 ± 0.001
Field Blank	CapF (1/1)	12/17/96	< 0.008 ± 0.003	< 0.0004 ± 0.0002	< 0.06 ± 0.00	< 0.007 ± 0.005
Field Blank	UF2 (1/1)	12/17/96	< 0.02 ± 0.00	< 0.0004 ± 0.0002	< 0.06 ± 0.04	< 0.009 ± 0.002
Field Blank	THB (1/1)	12/17/96	< 0.02 ± 0.00	0.0024 ± 0.0001	< 0.06 ± 0.01	< 0.009 ± 0.002
Lab Blank	DIW (1/1)	01/06/97	< 0.008 ± 0.002	< 0.0004 ± 0.0001	< 0.04 ± 0.05	< 0.009 ± 0.003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Calcium (mg/L)	Cerium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.008 ± 0.001	< 0.0004 ± 0.0002	< 0.04 ± 0.04	< 0.009 ± 0.003
Lab Blank	MemF (1/1)	01/06/97	< 0.008 ± 0.002	< 0.0004 ± 0.0002	< 0.04 ± 0.02	< 0.009 ± 0.003
Lab Blank	CapF (1/1)	01/06/97	< 0.1 ± 0.0	< 0.0005 ± 0.0003	< 0.08 ± 0.06	0.004 ± 0.002
Lab Blank	UF2 (1/2)	01/06/97	< 0.008 ± 0.001	< 0.0004 ± 0.0003	< 0.04 ± 0.04	< 0.009 ± 0.003
Lab Blank	UF2 (2/2)	01/06/97	< 0.007 ± 0.001	< 0.0009 ± 0.0003	< 0.08 ± 0.02	< 0.005 ± 0.001
Lab Blank	UF3 (1/1)	01/06/97	< 0.008 ± 0.001	0.050 ± 0.002	0.15 ± 0.02	0.030 ± 0.001
Lab Blank	THB (1/1)	01/06/97	< 0.008 ± 0.007	< 0.0004 ± 0.0001	< 0.04 ± 0.04	< 0.009 ± 0.002
Lab Blank	25LCb (1/1)	01/06/97	< 0.008 ± 0.001	< 0.0004 ± 0.0003	< 0.04 ± 0.03	< 0.009 ± 0.003
Lab Blank	DIW (1/1)	01/06/97	< 0.008 ± 0.003	< 0.0004 ± 0.0003	< 0.04 ± 0.01	< 0.009 ± 0.001
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	0.008 ± 0.004	< 0.0004 ± 0.0001	< 0.04 ± 0.01	< 0.009 ± 0.003
Lab Blank	UF2 (1/1)	05/28/97	< 0.01 ± 0.00	< 0.0005 ± 0.0001	< 0.08 ± 0.06	< 0.003 ± 0.001
Lab Blank	UF3 (1/1)	05/28/97	< 0.01 ± 0.00	0.0040 ± 0.0001	< 0.08 ± 0.08	0.004 ± 0.003
Lab Blank	THB (1/1)	05/28/97	< 0.01 ± 0.00	< 0.0005 ± 0.0002	< 0.08 ± 0.07	< 0.003 ± 0.001
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.01 ± 0.00	0.0007 ± 0.0002	< 0.08 ± 0.04	< 0.003 ± 0.002
Field Blank	DIW (2/2)	06/05/97	< 0.01 ± 0.00	0.0006 ± 0.0002	< 0.08 ± 0.05	< 0.003 ± 0.002
Field Blank	CapF (1/3)	06/05/97	< 0.01 ± 0.00	< 0.0005 ± 0.0002	< 0.08 ± 0.05	0.003 ± 0.002
Field Blank	UFVP (1/1)	06/05/97	< 0.01 ± 0.00	< 0.0005 ± 0.0002	< 0.08 ± 0.03	< 0.003 ± 0.001
Field Blank	JyCn (1/1)	06/05/97	< 0.01 ± 0.00	0.0016 ± 0.0005	< 0.08 ± 0.08	< 0.003 ± 0.001
Field Blank	CapF (2/3)	06/05/97	< 0.01 ± 0.00	< 0.0004 ± 0.0001	< 0.1 ± 0.1	< 0.003 ± 0.001
Field Blank	CapF (3/3)	06/05/97	< 0.02 ± 0.00	< 0.0004 ± 0.0002	< 0.1 ± 0.1	< 0.003 ± 0.002
Field Blank	SCDI (1/1)	06/05/97	< 0.02 ± 0.00	< 0.0004 ± 0.0003	< 0.1 ± 0.0	< 0.003 ± 0.004
Field Blank	SCADI (1/1)	06/05/97	< 0.02 ± 0.00	0.0005 ± 0.0008	< 0.1 ± 0.1	0.011 ± 0.006
Field Blank	TfTb (1/1)	06/05/97	< 0.02 ± 0.00	< 0.0004 ± 0.0008	< 0.1 ± 0.0	< 0.003 ± 0.000
Lab Blank	DIW (1/1)	05/28/97	< 0.01 ± 0.00	< 0.0005 ± 0.0002	< 0.08 ± 0.02	< 0.003 ± 0.002
Lab Blank	MemF (1/1)	05/28/97	< 0.01 ± 0.00	< 0.0005 ± 0.0002	< 0.08 ± 0.06	< 0.003 ± 0.000
Lab Blank	CapF (1/1)	05/28/97	< 0.01 ± 0.00	< 0.0005 ± 0.0001	< 0.08 ± 0.05	< 0.003 ± 0.001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.03 ± 0.00	< 0.0007 ± 0.0002	< 0.0011 ± 0.0004	< 0.0003 ± 0.0002
Lab Blank	8LCh (1/1)	07/10/96	0.03 ± 0.01	< 0.0007 ± 0.0002	< 0.0011 ± 0.0007	< 0.0003 ± 0.0001
Lab Blank	MemF (1/1)	07/10/96	< 0.03 ± 0.01	< 0.0007 ± 0.0006	< 0.0011 ± 0.0006	< 0.0003 ± 0.0001
Lab Blank	CapF (1/1)	07/10/96	0.03 ± 0.03	< 0.0007 ± 0.0002	< 0.0011 ± 0.0005	< 0.0003 ± 0.0001
Lab Blank	UF1 (1/1)	07/10/96	0.03 ± 0.02	< 0.0017 ± 0.0000	< 0.002 ± 0.001	< 0.001 ± 0.0003
Lab Blank	UF2 (1/1)	07/10/96	< 0.03 ± 0.02	< 0.0007 ± 0.0005	< 0.0011 ± 0.0006	< 0.0003 ± 0.0002
Lab Blank	UF3 (1/1)	07/12/96	0.07 ± 0.01	< 0.0017 ± 0.0010	< 0.002 ± 0.001	< 0.001 ± 0.0005
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.03 ± 0.02	< 0.0007 ± 0.0000	< 0.0011 ± 0.0007	< 0.0003 ± 0.0002
Field Blank	8LCh (1/1)	07/17/96	< 0.03 ± 0.01	< 0.0017 ± 0.0011	< 0.002 ± 0.001	< 0.001 ± 0.0008
Field Blank	MemF (1/1)	07/17/96	< 0.03 ± 0.11	< 0.0017 ± 0.0026	< 0.002 ± 0.001	< 0.001 ± 0.0008
Field Blank	CapF (1/1)	07/17/96	0.82 ± 0.01	< 0.0007 ± 0.0004	< 0.0011 ± 0.0002	< 0.0003 ± 0.0003
Field Blank	UF2 (1/1)	07/17/96	0.04 ± 0.02	< 0.0007 ± 0.0003	< 0.0011 ± 0.0002	0.0003 ± 0.0002
Field Blank	UF3 (1/1)	07/17/96	< 0.03 ± 0.01	< 0.0007 ± 0.0003	< 0.0011 ± 0.0000	< 0.0003 ± 0.0002
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.02 ± 0.02	< 0.003 ± 0.002	< 0.003 ± 0.003	< 0.001 ± 0.001
Lab Blank	20LCh (1/1)	09/18/96	0.05 ± 0.01	< 0.0018 ± 0.0001	< 0.0018 ± 0.0010	< 0.001 ± 0.000
Lab Blank	MemF (1/1)	09/18/96	0.11 ± 0.04	< 0.0018 ± 0.0009	< 0.0015 ± 0.0009	< 0.001 ± 0.000
Lab Blank	CapF (1/1)	09/18/96	0.30 ± 0.05	< 0.0018 ± 0.0011	< 0.0015 ± 0.0007	< 0.001 ± 0.000
Lab Blank	UF2 (1/1)	09/18/96	0.06 ± 0.02	< 0.0018 ± 0.0006	< 0.0018 ± 0.0006	< 0.001 ± 0.000
Lab Blank	UF3 (1/1)	09/18/96	< 0.03 ± 0.02	< 0.003 ± 0.001	< 0.003 ± 0.000	< 0.001 ± 0.001
Lab Blank	THB (1/1)	09/18/96	0.06 ± 0.03	< 0.0018 ± 0.0006	< 0.0015 ± 0.0005	< 0.001 ± 0.000
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	0.02 ± 0.01	< 0.003 ± 0.001	< 0.003 ± 0.001	< 0.001 ± 0.000
Field Blank	20LCh (1/1)	09/18/96	< 0.02 ± 0.02	< 0.0018 ± 0.0014	< 0.0015 ± 0.0011	< 0.001 ± 0.000
Field Blank	MemF (1/1)	09/18/96	0.03 ± 0.01	< 0.003 ± 0.002	< 0.003 ± 0.000	< 0.001 ± 0.000
Field Blank	CapF (1/1)	09/18/96	0.12 ± 0.02	< 0.0018 ± 0.0017	< 0.0015 ± 0.0018	< 0.001 ± 0.001
Field Blank	UF2 (1/1)	09/18/96	0.03 ± 0.01	< 0.003 ± 0.001	< 0.003 ± 0.001	< 0.001 ± 0.000
Field Blank	UF3 (1/1)	09/18/96	0.03 ± 0.01	< 0.0018 ± 0.0005	< 0.0015 ± 0.0015	< 0.001 ± 0.000
Field Blank	THB (1/1)	09/18/96	< 0.02 ± 0.01	< 0.0018 ± 0.0011	< 0.0015 ± 0.0001	< 0.001 ± 0.000
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.02 ± 0.01	< 0.0017 ± 0.0020	< 0.003 ± 0.002	< 0.001 ± 0.0004
Lab Blank	8LCh (1/1)	11/13/96	< 0.02 ± 0.01	< 0.0017 ± 0.0015	< 0.003 ± 0.000	< 0.001 ± 0.0007
Lab Blank	MemF (1/1)	11/13/96	0.03 ± 0.01	< 0.0017 ± 0.0012	< 0.003 ± 0.002	< 0.001 ± 0.0003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.02 ± 0.02	< 0.0017 ± 0.0005	< 0.003 ± 0.001	< 0.001 ± 0.0000
Lab Blank	UF2 (1/1)	11/13/96	0.09 ± 0.02	< 0.0017 ± 0.0009	< 0.003 ± 0.001	< 0.001 ± 0.0003
Lab Blank	UF3 (1/1)	11/13/96	0.09 ± 0.02	< 0.0017 ± 0.0006	< 0.003 ± 0.003	< 0.001 ± 0.0004
Lab Blank	THB (1/1)	11/13/96	0.02 ± 0.01	< 0.0017 ± 0.0001	< 0.003 ± 0.001	< 0.001 ± 0.0002
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.02 ± 0.00	< 0.0017 ± 0.0006	< 0.003 ± 0.001	< 0.001 ± 0.0002
Field Blank	8LCh (1/1)	11/20/96	< 0.02 ± 0.01	< 0.0017 ± 0.0010	< 0.003 ± 0.002	< 0.001 ± 0.0003
Field Blank	MemF (1/1)	11/20/96	< 0.02 ± 0.00	< 0.0017 ± 0.0016	< 0.003 ± 0.003	< 0.001 ± 0.0002
Field Blank	CapF (1/1)	11/20/96	< 0.02 ± 0.03	< 0.0017 ± 0.0008	< 0.003 ± 0.001	< 0.001 ± 0.0004
Field Blank	UF1 (1/1)	11/20/96	< 0.02 ± 0.01	< 0.0017 ± 0.0007	< 0.003 ± 0.001	< 0.001 ± 0.0007
Field Blank	UF3 (1/1)	11/20/96	0.02 ± 0.01	< 0.0017 ± 0.0010	< 0.003 ± 0.002	< 0.001 ± 0.0006
Field Blank	THB (1/1)	11/20/96	< 0.02 ± 0.01	< 0.0017 ± 0.0003	< 0.003 ± 0.001	< 0.001 ± 0.0003
Field Blank	CapF (1/1)	11/20/96	< 0.02 ± 0.02	< 0.0017 ± 0.0001	< 0.003 ± 0.001	< 0.001 ± 0.0005
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	0.03 ± 0.05	< 0.0015 ± 0.0009	< 0.002 ± 0.0013	< 0.001 ± 0.000
Lab Blank	MemF (1/1)	12/16/96	0.03 ± 0.01	< 0.0015 ± 0.0007	< 0.002 ± 0.0005	< 0.001 ± 0.000
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	0.03 ± 0.02	< 0.0015 ± 0.0007	< 0.002 ± 0.0002	< 0.001 ± 0.000
Lab Blank	UF3 (1/1)	12/16/96	0.16 ± 0.02	< 0.0015 ± 0.0008	< 0.002 ± 0.0007	< 0.001 ± 0.000
Lab Blank	THB (1/1)	12/16/96	0.02 ± 0.02	< 0.0015 ± 0.0002	< 0.002 ± 0.0006	< 0.001 ± 0.000
Lab Blank	20LCh-1 (1/1)	12/16/96	0.02 ± 0.02	< 0.0015 ± 0.0003	< 0.002 ± 0.0003	< 0.001 ± 0.000
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.011 ± 0.00	< 0.0015 ± 0.0005	< 0.002 ± 0.0010	< 0.001 ± 0.000
Lab Blank	20LCh-3 (1/1)	12/16/96	0.05 ± 0.01	< 0.0015 ± 0.0011	< 0.002 ± 0.0010	< 0.001 ± 0.000
Lab Blank	20LCh-4 (1/1)	12/16/96	0.02 ± 0.01	< 0.0015 ± 0.0010	< 0.002 ± 0.0007	< 0.001 ± 0.000
Lab Blank	20LCh-5 (1/1)	12/16/96	0.10 ± 0.06	< 0.0015 ± 0.0007	< 0.002 ± 0.0004	< 0.001 ± 0.000
Lab Blank	20LCh-6 (1/1)	12/16/96	0.11 ± 0.04	< 0.0015 ± 0.0004	< 0.002 ± 0.0004	< 0.001 ± 0.000
Lab Blank	UF1 (1/1)	12/16/96	0.05 ± 0.02	< 0.0015 ± 0.0008	< 0.002 ± 0.0005	< 0.001 ± 0.000
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	0.10 ± 0.04	< 0.0015 ± 0.0002	< 0.002 ± 0.0003	< 0.001 ± 0.000
Field Blank	8LCh (1/1)	12/17/96	0.06 ± 0.01	< 0.0015 ± 0.0007	< 0.002 ± 0.0001	< 0.001 ± 0.000
Field Blank	MemF (1/1)	12/17/96	0.07 ± 0.00	< 0.0015 ± 0.0005	< 0.002 ± 0.0005	< 0.001 ± 0.000
Field Blank	CapF (1/1)	12/17/96	0.17 ± 0.04	< 0.0015 ± 0.0004	< 0.002 ± 0.0002	< 0.001 ± 0.000
Field Blank	UF2 (1/1)	12/17/96	0.02 ± 0.01	< 0.0015 ± 0.0002	< 0.002 ± 0.0004	< 0.001 ± 0.000
Field Blank	THB (1/1)	12/17/96	0.05 ± 0.02	< 0.0015 ± 0.0007	< 0.002 ± 0.0006	< 0.001 ± 0.000
Lab Blank	DIW (1/1)	01/06/97	< 0.018 ± 0.021	< 0.0014 ± 0.0004	< 0.0013 ± 0.0002	< 0.001 ± 0.000

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.03 ± 0.01	< 0.0014 ± 0.0006	< 0.0013 ± 0.0007	< 0.001 ± 0.000
Lab Blank	MemF (1/1)	01/06/97	< 0.03 ± 0.00	< 0.0014 ± 0.0010	< 0.0013 ± 0.0003	< 0.001 ± 0.000
Lab Blank	CapF (1/1)	01/06/97	0.44 ± 0.00	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.0008 ± 0.0003
Lab Blank	UF2 (1/2)	01/06/97	< 0.03 ± 0.01	< 0.0014 ± 0.0002	< 0.0013 ± 0.0008	< 0.001 ± 0.000
Lab Blank	UF2 (2/2)	01/06/97	< 0.018 ± 0.017	< 0.0018 ± 0.0021	< 0.0018 ± 0.0016	< 0.001 ± 0.000
Lab Blank	UF3 (1/1)	01/06/97	0.29 ± 0.03	0.0039 ± 0.0003	0.0033 ± 0.0025	0.001 ± 0.000
Lab Blank	THB (1/1)	01/06/97	< 0.03 ± 0.00	< 0.0014 ± 0.0002	< 0.0013 ± 0.0010	< 0.001 ± 0.000
Lab Blank	25LCb (1/1)	01/06/97	< 0.03 ± 0.00	< 0.0014 ± 0.0000	< 0.0013 ± 0.0004	< 0.001 ± 0.000
Lab Blank	DIW (1/1)	01/06/97	0.18 ± 0.01	< 0.0014 ± 0.0007	< 0.0013 ± 0.0008	< 0.001 ± 0.000
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	0.05 ± 0.02	< 0.0014 ± 0.0002	< 0.0013 ± 0.0005	< 0.001 ± 0.000
Lab Blank	UF2 (1/1)	05/28/97	0.05 ± 0.01	< 0.002 ± 0.001	< 0.002 ± 0.000	< 0.0008 ± 0.0002
Lab Blank	UF3 (1/1)	05/28/97	0.19 ± 0.08	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.0008 ± 0.0002
Lab Blank	THB (1/1)	05/28/97	0.04 ± 0.01	< 0.002 ± 0.000	< 0.002 ± 0.000	< 0.0008 ± 0.0004
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	0.02 ± 0.01	< 0.002 ± 0.000	< 0.002 ± 0.000	< 0.0008 ± 0.0005
Field Blank	DIW (2/2)	06/05/97	< 0.04 ± 0.00	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.0008 ± 0.0001
Field Blank	CapF (1/3)	06/05/97	0.10 ± 0.01	< 0.002 ± 0.000	< 0.002 ± 0.000	< 0.0008 ± 0.0001
Field Blank	UFVP (1/1)	06/05/97	0.28 ± 0.03	< 0.002 ± 0.001	< 0.002 ± 0.000	< 0.0008 ± 0.0005
Field Blank	JyCn (1/1)	06/05/97	0.03 ± 0.03	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.0008 ± 0.0001
Field Blank	CapF (2/3)	06/05/97	0.24 ± 0.06	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.001 ± 0.000
Field Blank	CapF (3/3)	06/05/97	0.31 ± 0.00	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.001 ± 0.000
Field Blank	SCDI (1/1)	06/05/97	< 0.02 ± 0.01	< 0.002 ± 0.002	< 0.002 ± 0.000	< 0.001 ± 0.001
Field Blank	SCADI (1/1)	06/05/97	< 0.02 ± 0.02	< 0.002 ± 0.002	< 0.002 ± 0.000	< 0.001 ± 0.001
Field Blank	TfTb (1/1)	06/05/97	0.05 ± 0.03	< 0.002 ± 0.002	< 0.002 ± 0.000	< 0.001 ± 0.001
Lab Blank	DIW (1/1)	05/28/97	< 0.02 ± 0.01	< 0.002 ± 0.001	< 0.002 ± 0.001	< 0.0008 ± 0.0002
Lab Blank	MemF (1/1)	05/28/97	0.02 ± 0.01	< 0.002 ± 0.001	< 0.002 ± 0.000	< 0.0008 ± 0.0003
Lab Blank	CapF (1/1)	05/28/97	0.25 ± 0.01	< 0.002 ± 0.000	< 0.002 ± 0.000	< 0.0008 ± 0.0003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Gadolinium (µg/L)	Holmium (µg/L)	Iron (ICP-AES) (µg/L)	Iron (UV-vis) (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.0009 ± 0.0003	< 0.0001 ± 0.0000	0.7 ± na	11 ± na
Lab Blank	8LCh (1/1)	07/10/96	< 0.0009 ± 0.0003	< 0.0001 ± 0.0001	2.5 ± na	11 ± na
Lab Blank	MemF (1/1)	07/10/96	< 0.0009 ± 0.0007	< 0.0001 ± 0.0001	1.7 ± na	20 ± na
Lab Blank	CapF (1/1)	07/10/96	< 0.0009 ± 0.0002	< 0.0001 ± 0.0001	0.9 ± na	24 ± na
Lab Blank	UF1 (1/1)	07/10/96	< 0.0017 ± 0.0013	0.0006 ± 0.0000	1.5 ± na	10 ± na
Lab Blank	UF2 (1/1)	07/10/96	< 0.0009 ± 0.0005	< 0.0001 ± 0.0001	2.2 ± na	25 ± na
Lab Blank	UF3 (1/1)	07/12/96	< 0.0017 ± 0.0001	< 0.0004 ± 0.0003	5.2 ± na	28 ± na
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.0009 ± 0.0006	< 0.0001 ± 0.0001	1.9 ± na	31 ± na
Field Blank	8LCh (1/1)	07/17/96	< 0.0017 ± 0.0011	0.0005 ± 0.0005	10.3 ± na	37 ± na
Field Blank	MemF (1/1)	07/17/96	< 0.0017 ± 0.0008	< 0.0004 ± 0.0002	4.9 ± na	24 ± na
Field Blank	CapF (1/1)	07/17/96	< 0.0009 ± 0.0002	< 0.0001 ± 0.0000	17.3 ± na	26 ± 0
Field Blank	UF2 (1/1)	07/17/96	< 0.0009 ± 0.0003	< 0.0001 ± 0.0000	1.2 ± na	21 ± na
Field Blank	UF3 (1/1)	07/17/96	< 0.0009 ± 0.0003	< 0.0001 ± 0.0001	1.7 ± na	— ± —
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0008 ± 0.0006	1.4 ± 0.4	13.4 ± na
Lab Blank	20LCh (1/1)	09/18/96	< 0.003 ± 0.001	< 0.0003 ± 0.0000	2.5 ± 1.0	9.7 ± na
Lab Blank	MemF (1/1)	09/18/96	< 0.002 ± 0.000	< 0.0004 ± 0.0001	6.0 ± 2.9	21.2 ± na
Lab Blank	CapF (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0004 ± 0.0002	3.9 ± 2.1	10.5 ± na
Lab Blank	UF2 (1/1)	09/18/96	< 0.003 ± 0.001	< 0.0003 ± 0.0001	1.4 ± na	15.0 ± na
Lab Blank	UF3 (1/1)	09/18/96	< 0.002 ± 0.002	< 0.0008 ± 0.0001	2.1 ± 0.9	8.6 ± na
Lab Blank	THB (1/1)	09/18/96	< 0.002 ± 0.000	< 0.0004 ± 0.0002	4.9 ± 0.9	— ± —
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.002 ± 0.002	< 0.0008 ± 0.0003	0.6 ± na	10.1 ± 3.3
Field Blank	20LCh (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0004 ± 0.0003	2.8 ± na	18.1 ± na
Field Blank	MemF (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0008 ± 0.0004	2.6 ± 1.0	11.7 ± 4.3
Field Blank	CapF (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0004 ± 0.0001	2.7 ± 2.1	9.9 ± na
Field Blank	UF2 (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0008 ± 0.0003	3.7 ± 3.3	8.0 ± 1.5
Field Blank	UF3 (1/1)	09/18/96	< 0.002 ± 0.000	< 0.0004 ± 0.0001	5.1 ± 0.0	11.3 ± na
Field Blank	THB (1/1)	09/18/96	< 0.002 ± 0.001	< 0.0004 ± 0.0001	< 0.4 ± na	10.6 ± na
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.003 ± 0.002	< 0.0005 ± 0.0001	11.5 ± na	< 3 ± na
Lab Blank	8LCh (1/1)	11/13/96	< 0.003 ± 0.001	< 0.0005 ± 0.0004	3.2 ± na	< 3 ± na
Lab Blank	MemF (1/1)	11/13/96	< 0.003 ± 0.002	< 0.0005 ± 0.0001	5.1 ± 0.0	2.1 ± na

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Gadolinium (µg/L)	Holmium (µg/L)	Iron (ICP-AES) (µg/L)	Iron (UV-vis) (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.003 ± 0.001	< 0.0005 ± 0.0001	2.8 ± na	4.6 ± na
Lab Blank	UF2 (1/1)	11/13/96	< 0.003 ± 0.001	< 0.0005 ± 0.0005	1.8 ± 0.2	< 3 ± na
Lab Blank	UF3 (1/1)	11/13/96	< 0.003 ± 0.001	< 0.0005 ± 0.0004	2.9 ± 0.8	< 3 ± na
Lab Blank	THB (1/1)	11/13/96	< 0.003 ± 0.000	< 0.0005 ± 0.0003	1.5 ± 0.1	— ± —
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0003	1.5 ± 1.4	7.4 ± na
Field Blank	8LCh (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0003	1.9 ± 2.2	< 3 ± 2.6
Field Blank	MemF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0002	4.7 ± na	< 3 ± 0.6
Field Blank	CapF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0005	6.4 ± 0.9	7.2 ± na
Field Blank	UF1 (1/1)	11/20/96	< 0.003 ± 0.002	< 0.0005 ± 0.0002	2.7 ± na	< 3 ± 0.8
Field Blank	UF3 (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0001	2.6 ± 2.1	< 3 ± na
Field Blank	THB (1/1)	11/20/96	< 0.003 ± 0.002	< 0.0005 ± 0.0001	3.0 ± 0.9	— ± —
Field Blank	CapF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.0005 ± 0.0003	2.7 ± 2.8	— ± —
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.0013 ± 0.0003	< 0.0004 ± 0.0002	1.1 ± 0.4	< 3 ± na
Lab Blank	MemF (1/1)	12/16/96	< 0.0013 ± 0.0002	< 0.0004 ± 0.0000	1.3 ± 0.8	4.4 ± na
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	4.2 ± na
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.0013 ± 0.0005	< 0.0004 ± 0.0000	5.2 ± 2.9	< 3 ± na
Lab Blank	UF3 (1/1)	12/16/96	< 0.0013 ± 0.0004	< 0.0004 ± 0.0000	4.0 ± 2.2	8.7 ± na
Lab Blank	THB (1/1)	12/16/96	< 0.0013 ± 0.0006	< 0.0004 ± 0.0001	1.1 ± na	4.8 ± na
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.0013 ± 0.0015	< 0.0004 ± 0.0001	2.2 ± 0.3	4.0 ± na
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.0013 ± 0.0007	< 0.0004 ± 0.0001	1.2 ± 0.7	< 3 ± na
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.0013 ± 0.0003	< 0.0004 ± 0.0001	2.3 ± 0.9	4.1 ± na
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.0013 ± 0.0011	< 0.0004 ± 0.0001	1.4 ± 1.0	3.0 ± na
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.0013 ± 0.0003	< 0.0004 ± 0.0001	4.3 ± na	3.9 ± na
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.0013 ± 0.0011	< 0.0004 ± 0.0001	4.7 ± 1.2	< 3 ± na
Lab Blank	UF1 (1/1)	12/16/96	< 0.0013 ± 0.0006	< 0.0004 ± 0.0001	4.5 ± 2.9	3.1 ± na
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.0013 ± 0.0003	< 0.0004 ± 0.0001	1.6 ± na	6.4 ± na
Field Blank	8LCh (1/1)	12/17/96	< 0.0013 ± 0.0006	< 0.0004 ± 0.0001	3.5 ± 1.3	— ± —
Field Blank	MemF (1/1)	12/17/96	< 0.0013 ± 0.0008	< 0.0004 ± 0.0000	2.0 ± 1.8	3.1 ± na
Field Blank	CapF (1/1)	12/17/96	< 0.0013 ± 0.0008	< 0.0004 ± 0.0002	2.6 ± 2.6	— ± —
Field Blank	UF2 (1/1)	12/17/96	< 0.0013 ± 0.0009	< 0.0004 ± 0.0000	3.4 ± 3.9	< 3 ± na
Field Blank	THB (1/1)	12/17/96	< 0.0013 ± 0.0003	< 0.0004 ± 0.0001	3.1 ± na	— ± —
Lab Blank	DIW (1/1)	01/06/97	< 0.002 ± 0.001	< 0.0003 ± 0.0001	< 0.8 ± 0.2	< 3 ± na

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Gadolinium (µg/L)	Holmium (µg/L)	Iron (ICP-AES) (µg/L)	Iron (UV-vis) (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.002 ± 0.001	< 0.0003 ± 0.0002	2.8 ± na	— ± —
Lab Blank	MemF (1/1)	01/06/97	< 0.002 ± 0.001	< 0.0003 ± 0.0001	5.8 ± 2.6	< 3 ± na
Lab Blank	CapF (1/1)	01/06/97	< 0.001 ± 0.001	< 0.0004 ± 0.0003	— ± —	— ± —
Lab Blank	UF2 (1/2)	01/06/97	< 0.002 ± 0.002	< 0.0003 ± 0.0002	5.4 ± 1.6	< 3 ± na
Lab Blank	UF2 (2/2)	01/06/97	< 0.002 ± 0.002	< 0.0003 ± 0.0001	5 ± 1	< 3 ± na
Lab Blank	UF3 (1/1)	01/06/97	0.011 ± 0.002	0.0010 ± 0.0002	115 ± 1	15 ± na
Lab Blank	THB (1/1)	01/06/97	< 0.002 ± 0.000	< 0.0003 ± 0.0001	4.1 ± 1.9	< 3 ± na
Lab Blank	25LCb (1/1)	01/06/97	< 0.002 ± 0.000	< 0.0003 ± 0.0002	3.9 ± na	< 3 ± na
Lab Blank	DIW (1/1)	01/06/97	< 0.002 ± 0.001	< 0.0003 ± 0.0002	4.7 ± 0.4	— ± —
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.002 ± 0.001	< 0.0003 ± 0.0001	2.6 ± na	< 3 ± na
Lab Blank	UF2 (1/1)	05/28/97	< 0.001 ± 0.001	< 0.0004 ± 0.0002	3.9 ± 0.5	— ± —
Lab Blank	UF3 (1/1)	05/28/97	0.001 ± 0.001	< 0.0004 ± 0.0001	10.2 ± na	— ± —
Lab Blank	THB (1/1)	05/28/97	< 0.001 ± 0.001	< 0.0004 ± 0.0000	1.6 ± 0.2	— ± —
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.001 ± 0.000	< 0.0004 ± 0.0001	2.2 ± na	— ± —
Field Blank	DIW (2/2)	06/05/97	< 0.001 ± 0.001	< 0.0004 ± 0.0001	2.2 ± 0.3	— ± —
Field Blank	CapF (1/3)	06/05/97	< 0.001 ± 0.001	< 0.0004 ± 0.0001	< 0.9 ± 0.2	5.6 ± 2.1
Field Blank	UFVP (1/1)	06/05/97	< 0.001 ± 0.001	< 0.0004 ± 0.0001	1.1 ± 0.6	6.9 ± 0.5
Field Blank	JyCn (1/1)	06/05/97	< 0.001 ± 0.000	< 0.0004 ± 0.0001	2.9 ± na	< 3 ± 2.2
Field Blank	CapF (2/3)	06/05/97	< 0.002 ± 0.001	< 0.0005 ± 0.0002	4.1 ± 2.2	— ± —
Field Blank	CapF (3/3)	06/05/97	< 0.002 ± 0.003	< 0.0005 ± 0.0003	2.8 ± 0.9	— ± —
Field Blank	SCDI (1/1)	06/05/97	< 0.002 ± 0.003	< 0.0005 ± 0.0000	3.5 ± 3.9	— ± —
Field Blank	SCADI (1/1)	06/05/97	< 0.002 ± 0.002	< 0.0005 ± 0.0000	< 0.9 ± 0.2	— ± —
Field Blank	TfTb (1/1)	06/05/97	< 0.002 ± 0.001	< 0.0005 ± 0.0002	< 0.9 ± na	< 3 ± 1.0
Lab Blank	DIW (1/1)	05/28/97	< 0.001 ± 0.000	< 0.0004 ± 0.0001	< 0.9 ± 0.2	— ± —
Lab Blank	MemF (1/1)	05/28/97	< 0.001 ± 0.001	< 0.0004 ± 0.0002	2.7 ± na	— ± —
Lab Blank	CapF (1/1)	05/28/97	< 0.001 ± 0.001	< 0.0004 ± 0.0001	< 0.7 ± 0.0	155.3 ± 6.3

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Iron (II) (UV-vis) (µg/L)	Lanthanum (µg/L)	Lead (comp.) (µg/L)	Lithium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 3 ± na	0.0002 ± 0.0002	< 0.005 ± 0.000	< 0.02 ± 0.01
Lab Blank	8LCh (1/1)	07/10/96	< 3 ± na	0.0011 ± 0.0002	0.014 ± 0.001	< 0.02 ± 0.02
Lab Blank	MemF (1/1)	07/10/96	< 3 ± na	0.0004 ± 0.0003	0.008 ± 0.001	< 0.02 ± 0.01
Lab Blank	CapF (1/1)	07/10/96	< 3 ± na	< 0.0002 ± 0.0002	< 0.005 ± 0.001	< 0.02 ± 0.02
Lab Blank	UF1 (1/1)	07/10/96	< 3 ± na	< 0.0005 ± 0.0004	< 0.004 ± 0.001	< 0.08 ± 0.08
Lab Blank	UF2 (1/1)	07/10/96	< 3 ± na	< 0.0002 ± 0.0001	< 0.005 ± 0.002	< 0.02 ± 0.01
Lab Blank	UF3 (1/1)	07/12/96	< 3 ± na	0.0005 ± 0.0002	0.016 ± 0.003	< 0.08 ± 0.04
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 3 ± na	< 0.0002 ± 0.0001	< 0.005 ± 0.001	< 0.02 ± 0.02
Field Blank	8LCh (1/1)	07/17/96	< 3 ± na	0.0023 ± 0.0002	0.022 ± 0.001	< 0.08 ± 0.05
Field Blank	MemF (1/1)	07/17/96	< 3 ± na	< 0.0005 ± 0.0007	< 0.004 ± 0.001	< 0.08 ± 0.01
Field Blank	CapF (1/1)	07/17/96	< 3 ± 2	0.0003 ± 0.0002	0.028 ± 0.001	< 0.02 ± 0.01
Field Blank	UF2 (1/1)	07/17/96	< 3 ± na	< 0.0002 ± 0.0001	< 0.005 ± 0.001	< 0.02 ± 0.01
Field Blank	UF3 (1/1)	07/17/96	— ± —	< 0.0002 ± 0.0002	< 0.005 ± 0.002	< 0.02 ± 0.01
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 3 ± na	< 0.0008 ± 0.0005	< 0.004 ± 0.003	< 0.04 ± 0.01
Lab Blank	20LCh (1/1)	09/18/96	< 3 ± na	< 0.0005 ± 0.0006	0.007 ± 0.001	< 0.04 ± 0.01
Lab Blank	MemF (1/1)	09/18/96	4.5 ± na	< 0.0004 ± 0.0000	< 0.008 ± 0.000	< 0.04 ± 0.04
Lab Blank	CapF (1/1)	09/18/96	< 3 ± na	< 0.0004 ± 0.0003	0.029 ± 0.005	< 0.04 ± 0.01
Lab Blank	UF2 (1/1)	09/18/96	< 3 ± na	< 0.0005 ± 0.0006	0.009 ± 0.004	< 0.04 ± 0.02
Lab Blank	UF3 (1/1)	09/18/96	< 3 ± na	< 0.0008 ± 0.0004	0.007 ± 0.005	< 0.04 ± 0.02
Lab Blank	THB (1/1)	09/18/96	— ± —	< 0.0004 ± 0.0004	0.009 ± 0.003	< 0.04 ± 0.01
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 3 ± 2.4	< 0.0008 ± 0.0003	0.009 ± 0.008	< 0.04 ± 0.01
Field Blank	20LCh (1/1)	09/18/96	3.7 ± na	< 0.0004 ± 0.0006	< 0.004 ± 0.002	< 0.04 ± 0.02
Field Blank	MemF (1/1)	09/18/96	< 3 ± 0.6	< 0.0008 ± 0.0003	0.005 ± 0.002	< 0.04 ± 0.02
Field Blank	CapF (1/1)	09/18/96	< 3 ± na	< 0.0004 ± 0.0000	0.007 ± 0.002	< 0.04 ± 0.02
Field Blank	UF2 (1/1)	09/18/96	< 3 ± 1.8	< 0.0008 ± 0.0001	< 0.004 ± 0.004	< 0.04 ± 0.05
Field Blank	UF3 (1/1)	09/18/96	< 3 ± na	0.0004 ± 0.0002	< 0.004 ± 0.001	< 0.04 ± 0.01
Field Blank	THB (1/1)	09/18/96	< 3 ± na	< 0.0004 ± 0.0004	< 0.004 ± 0.004	< 0.04 ± 0.03
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 3 ± na	< 0.0007 ± 0.0005	< 0.007 ± 0.011	< 0.02 ± 0.00
Lab Blank	8LCh (1/1)	11/13/96	< 3 ± na	< 0.0007 ± 0.0005	< 0.005 ± 0.001	< 0.02 ± 0.01
Lab Blank	MemF (1/1)	11/13/96	< 3 ± na	0.0013 ± 0.0010	0.008 ± 0.000	< 0.02 ± 0.01

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Iron (II) (UV-vis) (µg/L)	Lanthanum (µg/L)	Lead (comp.) (µg/L)	Lithium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 3 ± na	< 0.0007 ± 0.0002	< 0.005 ± 0.013	< 0.02 ± 0.02
Lab Blank	UF2 (1/1)	11/13/96	< 3 ± na	< 0.0007 ± 0.0004	< 0.005 ± 0.001	< 0.02 ± 0.00
Lab Blank	UF3 (1/1)	11/13/96	< 3 ± na	0.0010 ± 0.0006	< 0.005 ± 0.010	< 0.02 ± 0.00
Lab Blank	THB (1/1)	11/13/96	— ± —	< 0.0007 ± 0.0001	0.006 ± 0.007	< 0.02 ± 0.02
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 3 ± na	< 0.0007 ± 0.0001	< 0.005 ± 0.005	< 0.02 ± 0.01
Field Blank	8LCh (1/1)	11/20/96	< 3 ± 0.0	0.0008 ± 0.0004	< 0.005 ± 0.013	< 0.02 ± 0.02
Field Blank	MemF (1/1)	11/20/96	< 3 ± 0.4	< 0.0007 ± 0.0005	< 0.005 ± 0.001	< 0.02 ± 0.01
Field Blank	CapF (1/1)	11/20/96	< 3 ± na	< 0.0007 ± 0.0000	< 0.005 ± 0.002	< 0.02 ± 0.01
Field Blank	UF1 (1/1)	11/20/96	< 3 ± 0.0	< 0.0007 ± 0.0002	< 0.005 ± 0.006	< 0.02 ± 0.01
Field Blank	UF3 (1/1)	11/20/96	< 3 ± na	< 0.0007 ± 0.0004	< 0.005 ± 0.001	< 0.02 ± 0.00
Field Blank	THB (1/1)	11/20/96	— ± —	0.0023 ± 0.0000	< 0.005 ± 0.001	< 0.02 ± 0.01
Field Blank	CapF (1/1)	11/20/96	— ± —	< 0.0007 ± 0.0001	< 0.005 ± 0.003	< 0.02 ± 0.00
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0003	< 0.003 ± 0.000	< 0.03 ± 0.01
Lab Blank	MemF (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0002	0.006 ± 0.003	< 0.03 ± 0.01
Lab Blank	CapF (1/1)	12/16/96	< 3 ± na	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0004	0.004 ± 0.002	< 0.03 ± 0.01
Lab Blank	UF3 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0002	0.004 ± 0.005	< 0.03 ± 0.01
Lab Blank	THB (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0003	0.006 ± 0.005	< 0.03 ± 0.02
Lab Blank	20LCh-1 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0005	< 0.003 ± 0.004	< 0.03 ± 0.00
Lab Blank	20LCh-2 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0002	< 0.003 ± 0.001	< 0.03 ± 0.01
Lab Blank	20LCh-3 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0002	0.005 ± 0.002	< 0.03 ± 0.01
Lab Blank	20LCh-4 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0004	< 0.003 ± 0.004	< 0.03 ± 0.01
Lab Blank	20LCh-5 (1/1)	12/16/96	< 3 ± na	0.0014 ± 0.0003	< 0.012 ± 0.010	< 0.03 ± 0.02
Lab Blank	20LCh-6 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0003	0.010 ± 0.008	< 0.03 ± 0.01
Lab Blank	UF1 (1/1)	12/16/96	< 3 ± na	< 0.0004 ± 0.0002	< 0.003 ± 0.002	< 0.03 ± 0.01
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 3 ± na	0.0005 ± 0.0001	0.012 ± 0.002	< 0.03 ± 0.03
Field Blank	8LCh (1/1)	12/17/96	— ± —	0.0006 ± 0.0003	0.007 ± 0.004	< 0.03 ± 0.00
Field Blank	MemF (1/1)	12/17/96	< 3 ± na	< 0.0004 ± 0.0001	0.020 ± 0.001	< 0.03 ± 0.01
Field Blank	CapF (1/1)	12/17/96	— ± —	< 0.0004 ± 0.0002	0.010 ± 0.008	< 0.03 ± 0.01
Field Blank	UF2 (1/1)	12/17/96	< 3 ± na	< 0.0004 ± 0.0000	0.004 ± 0.003	< 0.03 ± 0.00
Field Blank	THB (1/1)	12/17/96	— ± —	0.0012 ± 0.0009	0.007 ± 0.004	< 0.03 ± 0.01
Lab Blank	DIW (1/1)	01/06/97	< 3 ± na	< 0.0006 ± 0.0002	< 0.004 ± 0.002	< 0.07 ± 0.00

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Iron (II) (UV-vis) (µg/L)	Lanthanum (µg/L)	Lead (comp.) (µg/L)	Lithium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	— ± —	< 0.0006 ± 0.0000	< 0.004 ± 0.001	< 0.07 ± 0.00
Lab Blank	MemF (1/1)	01/06/97	< 3 ± na	< 0.0006 ± 0.0002	< 0.004 ± 0.003	< 0.07 ± 0.00
Lab Blank	CapF (1/1)	01/06/97	— ± —	< 0.0004 ± 0.0003	0.03 ± 0.00	< 0.5 ± 0.5
Lab Blank	UF2 (1/2)	01/06/97	< 3 ± na	< 0.0006 ± 0.0003	< 0.004 ± 0.003	< 0.07 ± 0.02
Lab Blank	UF2 (2/2)	01/06/97	< 3 ± na	< 0.0006 ± 0.0001	0.004 ± 0.003	< 0.06 ± 0.01
Lab Blank	UF3 (1/1)	01/06/97	< 3 ± na	0.0190 ± 0.0008	0.027 ± 0.002	< 0.07 ± 0.01
Lab Blank	THB (1/1)	01/06/97	< 3 ± na	< 0.0006 ± 0.0002	< 0.004 ± 0.002	< 0.07 ± 0.03
Lab Blank	25LCb (1/1)	01/06/97	< 3 ± na	< 0.0006 ± 0.0003	0.007 ± 0.001	< 0.07 ± 0.00
Lab Blank	DIW (1/1)	01/06/97	— ± —	< 0.0006 ± 0.0001	0.083 ± 0.006	< 0.07 ± 0.03
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 3 ± na	< 0.0006 ± 0.0001	< 0.004 ± 0.001	< 0.07 ± 0.01
Lab Blank	UF2 (1/1)	05/28/97	— ± —	< 0.0004 ± 0.0001	< 0.01 ± 0.01	< 0.5 ± 0.2
Lab Blank	UF3 (1/1)	05/28/97	— ± —	0.0020 ± 0.0006	0.01 ± 0.01	< 0.5 ± 0.2
Lab Blank	THB (1/1)	05/28/97	— ± —	< 0.0004 ± 0.0001	< 0.01 ± 0.00	< 0.5 ± 0.2
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	— ± —	0.0004 ± 0.0001	< 0.01 ± 0.00	< 0.5 ± 0.2
Field Blank	DIW (2/2)	06/05/97	— ± —	< 0.0004 ± 0.0003	< 0.008 ± 0.000	< 0.5 ± 0.1
Field Blank	CapF (1/3)	06/05/97	< 3 ± 1.1	< 0.0004 ± 0.0002	< 0.01 ± 0.00	< 0.5 ± 0.1
Field Blank	UFVP (1/1)	06/05/97	< 3 ± 2.2	< 0.0004 ± 0.0001	< 0.01 ± 0.00	< 0.5 ± 0.1
Field Blank	JyCn (1/1)	06/05/97	< 3 ± 0.2	0.0006 ± 0.0003	< 0.01 ± 0.00	< 0.5 ± 0.2
Field Blank	CapF (2/3)	06/05/97	— ± —	< 0.0006 ± 0.0002	< 0.008 ± 0.001	< 0.2 ± 0.1
Field Blank	CapF (3/3)	06/05/97	— ± —	< 0.0006 ± 0.0004	< 0.008 ± 0.000	< 0.2 ± 0.3
Field Blank	SCDI (1/1)	06/05/97	— ± —	< 0.0006 ± 0.0007	< 0.01 ± 0.01	< 0.2 ± 0.1
Field Blank	SCADI (1/1)	06/05/97	— ± —	< 0.0006 ± 0.0004	< 0.01 ± 0.00	0.2 ± 0.8
Field Blank	TfTb (1/1)	06/05/97	< 3 ± 0.6	< 0.0006 ± 0.0005	< 0.01 ± 0.00	< 0.2 ± 0.0
Lab Blank	DIW (1/1)	05/28/97	— ± —	< 0.0004 ± 0.0004	< 0.01 ± 0.00	< 0.5 ± 0.2
Lab Blank	MemF (1/1)	05/28/97	— ± —	< 0.0004 ± 0.0002	< 0.008 ± 0.003	< 0.5 ± 0.2
Lab Blank	CapF (1/1)	05/28/97	< 3 ± 2.3	< 0.0004 ± 0.0002	< 0.008 ± 0.001	< 0.5 ± 0.1

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Lutetium (µg/L)	Magnesium (mg/L)	Manganese (µg/L)	Mercury (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.0003 ± 0.0001	< 0.001 ± 0.000	< 0.005 ± 0.002	0.0005 ± 0.0002
Lab Blank	8LCh (1/1)	07/10/96	< 0.0003 ± 0.0001	0.003 ± 0.000	0.14 ± 0.00	< 0.0004 ± 0.0001
Lab Blank	MemF (1/1)	07/10/96	< 0.0003 ± 0.0001	< 0.001 ± 0.000	0.006 ± 0.002	0.0005 ± 0.0002
Lab Blank	CapF (1/1)	07/10/96	< 0.0003 ± 0.0000	< 0.001 ± 0.000	0.007 ± 0.004	0.0007 ± 0.0001
Lab Blank	UF1 (1/1)	07/10/96	< 0.0006 ± 0.0001	< 0.001 ± 0.000	< 0.02 ± 0.00	< 0.0004 ± 0.0001
Lab Blank	UF2 (1/1)	07/10/96	< 0.0003 ± 0.0000	< 0.001 ± 0.000	< 0.005 ± 0.001	< 0.0004 ± 0.0001
Lab Blank	UF3 (1/1)	07/12/96	< 0.0006 ± 0.0002	< 0.001 ± 0.000	0.03 ± 0.01	— ± —
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	0.0007 ± 0.0001
Field Blank	DIW (1/1)	07/17/96	< 0.0003 ± 0.0001	< 0.003 ± 0.000	0.009 ± 0.003	< 0.0004 ± 0.0001
Field Blank	8LCh (1/1)	07/17/96	< 0.0006 ± 0.0002	0.004 ± 0.001	0.31 ± 0.03	0.0022 ± 0.0003
Field Blank	MemF (1/1)	07/17/96	< 0.0006 ± 0.0002	0.016 ± 0.026	< 0.02 ± 0.03	0.0006 ± 0.0001
Field Blank	CapF (1/1)	07/17/96	< 0.0003 ± 0.0001	< 0.003 ± 0.000	0.14 ± 0.00	0.0059 ± 0.0013
Field Blank	UF2 (1/1)	07/17/96	< 0.0003 ± 0.0001	< 0.003 ± 0.002	0.017 ± 0.006	< 0.0004 ± 0.0000
Field Blank	UF3 (1/1)	07/17/96	< 0.0003 ± 0.0001	< 0.003 ± 0.002	0.005 ± 0.001	0.0008 ± 0.0002
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	< 0.0004 ± 0.0003
Lab Blank	DIW (1/1)	09/18/96	< 0.0008 ± 0.0001	< 0.009 ± 0.005	< 0.02 ± 0.01	< 0.0004 ± 0.0002
Lab Blank	20LCh (1/1)	09/18/96	< 0.0004 ± 0.0001	< 0.006 ± 0.003	< 0.03 ± 0.01	< 0.0004 ± 0.0001
Lab Blank	MemF (1/1)	09/18/96	< 0.0003 ± 0.0001	< 0.004 ± 0.002	0.031 ± 0.007	< 0.0004 ± 0.0002
Lab Blank	CapF (1/1)	09/18/96	< 0.0003 ± 0.0002	< 0.006 ± 0.000	0.015 ± 0.026	0.0004 ± 0.0001
Lab Blank	UF2 (1/1)	09/18/96	< 0.0004 ± 0.0002	< 0.006 ± 0.000	< 0.03 ± 0.01	< 0.0004 ± 0.0002
Lab Blank	UF3 (1/1)	09/18/96	< 0.0008 ± 0.0001	< 0.009 ± 0.001	0.02 ± 0.00	— ± —
Lab Blank	THB (1/1)	09/18/96	< 0.0003 ± 0.0004	< 0.006 ± 0.001	0.33 ± 0.03	— ± —
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	0.0004 ± 0.0001
Field Blank	DIW (1/1)	09/18/96	< 0.0008 ± 0.0004	< 0.008 ± 0.008	< 0.02 ± 0.00	< 0.0004 ± 0.0001
Field Blank	20LCh (1/1)	09/18/96	< 0.0003 ± 0.0003	< 0.004 ± 0.001	< 0.014 ± 0.010	0.0007 ± 0.0001
Field Blank	MemF (1/1)	09/18/96	< 0.0008 ± 0.0002	< 0.008 ± 0.001	0.03 ± 0.01	< 0.0004 ± 0.0003
Field Blank	CapF (1/1)	09/18/96	< 0.0003 ± 0.0003	< 0.004 ± 0.001	< 0.014 ± 0.002	< 0.0004 ± 0.0002
Field Blank	UF2 (1/1)	09/18/96	< 0.0008 ± 0.0000	< 0.008 ± 0.001	< 0.02 ± 0.00	0.0005 ± 0.0001
Field Blank	UF3 (1/1)	09/18/96	< 0.0003 ± 0.0002	< 0.004 ± 0.001	0.040 ± 0.007	< 0.0004 ± 0.0002
Field Blank	THB (1/1)	09/18/96	< 0.0003 ± 0.0001	< 0.004 ± 0.002	< 0.014 ± 0.002	< 0.0004 ± 0.0003
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	< 0.0004 ± 0.0002
Lab Blank	DIW (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.003 ± 0.000	< 0.04 ± 0.03	< 0.0004 ± 0.0002
Lab Blank	8LCh (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.003 ± 0.000	0.06 ± 0.02	< 0.0004 ± 0.0002
Lab Blank	MemF (1/1)	11/13/96	< 0.0007 ± 0.0002	< 0.003 ± 0.000	< 0.04 ± 0.01	< 0.0004 ± 0.0001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Lutetium (µg/L)	Magnesium (mg/L)	Manganese (µg/L)	Mercury (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.0007 ± 0.0003	< 0.003 ± 0.001	< 0.04 ± 0.00	0.0025 ± 0.0001
Lab Blank	UF2 (1/1)	11/13/96	< 0.0007 ± 0.0001	< 0.003 ± 0.000	< 0.04 ± 0.02	0.0008 ± 0.0001
Lab Blank	UF3 (1/1)	11/13/96	< 0.0007 ± 0.0005	< 0.003 ± 0.000	< 0.04 ± 0.01	— ± —
Lab Blank	THB (1/1)	11/13/96	< 0.0007 ± 0.0001	< 0.003 ± 0.001	< 0.04 ± 0.02	— ± —
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	0.0007 ± 0.0001
Field Blank	DIW (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.003 ± 0.000	< 0.04 ± 0.01	0.0012 ± 0.0001
Field Blank	8LCh (1/1)	11/20/96	< 0.0007 ± 0.0002	< 0.003 ± 0.000	0.10 ± 0.01	0.0011 ± 0.0000
Field Blank	MemF (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.003 ± 0.000	0.09 ± 0.02	0.0012 ± 0.0002
Field Blank	CapF (1/1)	11/20/96	< 0.0007 ± 0.0002	< 0.003 ± 0.000	< 0.04 ± 0.01	0.0010 ± 0.0002
Field Blank	UF1 (1/1)	11/20/96	< 0.0007 ± 0.0005	< 0.0008 ± 0.0003	< 0.04 ± 0.02	0.0011 ± 0.0001
Field Blank	UF3 (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.0008 ± 0.0004	< 0.04 ± 0.01	0.0009 ± 0.0004
Field Blank	THB (1/1)	11/20/96	< 0.0007 ± 0.0003	0.0047 ± 0.0075	0.15 ± 0.04	0.0012 ± 0.0001
Field Blank	CapF (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.0011 ± 0.0003	< 0.04 ± 0.02	0.0012 ± 0.0001
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	0.0004 ± 0.0003
Lab Blank	DIW (1/1)	12/16/96	< 0.0002 ± 0.0002	< 0.009 ± 0.000	< 0.012 ± 0.001	0.0007 ± 0.0002
Lab Blank	MemF (1/1)	12/16/96	< 0.0002 ± 0.0000	< 0.018 ± 0.002	< 0.012 ± 0.019	< 0.0004 ± 0.0003
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	< 0.0004 ± 0.0001
Lab Blank	UF1 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.009 ± 0.001	< 0.012 ± 0.002	0.0014 ± 0.0001
Lab Blank	UF3 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.009 ± 0.001	< 0.012 ± 0.003	0.0010 ± 0.0002
Lab Blank	THB (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.018 ± 0.001	< 0.012 ± 0.003	— ± —
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.018 ± 0.004	0.022 ± 0.005	< 0.0004 ± 0.0002
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.0002 ± 0.0000	< 0.018 ± 0.008	< 0.012 ± 0.002	0.0005 ± 0.0003
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.009 ± 0.001	0.073 ± 0.009	0.0007 ± 0.0002
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.018 ± 0.001	< 0.012 ± 0.002	0.0010 ± 0.0000
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.018 ± 0.003	< 0.03 ± 0.03	0.0004 ± 0.0001
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.009 ± 0.000	< 0.012 ± 0.004	0.0008 ± 0.0004
Lab Blank	UF1 (1/1)	12/16/96	0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.012 ± 0.004	0.0006 ± 0.0002
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	0.0005 ± 0.0001
Field Blank	DIW (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.007 ± 0.001	< 0.012 ± 0.013	< 0.0004 ± 0.0003
Field Blank	8LCh (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.007 ± 0.000	0.036 ± 0.003	0.0012 ± 0.0002
Field Blank	MemF (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.009 ± 0.002	0.097 ± 0.006	0.0009 ± 0.0001
Field Blank	CapF (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.007 ± 0.000	0.024 ± 0.014	0.0005 ± 0.0001
Field Blank	UF2 (1/1)	12/17/96	< 0.0002 ± 0.0002	< 0.009 ± 0.000	< 0.012 ± 0.003	0.0007 ± 0.0001
Field Blank	THB (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.009 ± 0.000	0.178 ± 0.003	0.0015 ± 0.0001
Lab Blank	DIW (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.000	< 0.014 ± 0.003	< 0.0004 ± 0.0003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Lutetium (µg/L)	Magnesium (mg/L)	Manganese (µg/L)	Mercury (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.0005 ± 0.0002	< 0.007 ± 0.000	< 0.014 ± 0.002	< 0.0004 ± 0.0002
Lab Blank	MemF (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.000	< 0.014 ± 0.007	0.0005 ± 0.0002
Lab Blank	CapF (1/1)	01/06/97	< 0.0003 ± 0.0002	na ± na	0.02 ± 0.00	< 0.0004 ± 0.0001
Lab Blank	UF2 (1/2)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.000	< 0.014 ± 0.002	< 0.0004 ± 0.0002
Lab Blank	UF2 (2/2)	01/06/97	< 0.0005 ± 0.0003	< 0.004 ± 0.000	< 0.05 ± 0.01	— ± —
Lab Blank	UF3 (1/1)	01/06/97	< 0.0005 ± 0.0001	0.033 ± 0.000	1.49 ± 0.03	0.0007 ± 0.0003
Lab Blank	THB (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.002	< 0.014 ± 0.003	— ± —
Lab Blank	25LCb (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.000	< 0.014 ± 0.003	0.0006 ± 0.0002
Lab Blank	DIW (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.007 ± 0.001	0.016 ± 0.009	< 0.0004 ± 0.0004
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	0.0010 ± 0.0003
Field Blank	THB (1/1)	01/06/97	< 0.0005 ± 0.0000	< 0.007 ± 0.003	< 0.014 ± 0.008	0.0017 ± 0.0003
Lab Blank	UF2 (1/1)	05/28/97	< 0.0003 ± 0.0001	< 0.001 ± 0.000	< 0.01 ± 0.01	0.0007 ± 0.0004
Lab Blank	UF3 (1/1)	05/28/97	< 0.0003 ± 0.0002	0.002 ± 0.001	0.23 ± 0.02	— ± —
Lab Blank	THB (1/1)	05/28/97	< 0.0003 ± 0.0001	< 0.001 ± 0.000	0.06 ± 0.01	0.0017 ± 0.0003
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	0.0006 ± 0.0003
Field Blank	DIW (1/2)	06/05/97	< 0.0003 ± 0.0002	< 0.001 ± 0.000	0.04 ± 0.01	0.0018 ± 0.0001
Field Blank	DIW (2/2)	06/05/97	< 0.0003 ± 0.0001	< 0.001 ± 0.000	0.036 ± 0.002	0.0021 ± 0.0003
Field Blank	CapF (1/3)	06/05/97	< 0.0003 ± 0.0002	< 0.001 ± 0.001	0.07 ± 0.01	0.0021 ± 0.0002
Field Blank	UFVP (1/1)	06/05/97	< 0.0003 ± 0.0001	< 0.001 ± 0.000	< 0.006 ± 0.005	0.0005 ± 0.0002
Field Blank	JyCn (1/1)	06/05/97	< 0.0003 ± 0.0002	< 0.001 ± 0.000	0.55 ± 0.01	< 0.0004 ± 0.0003
Field Blank	CapF (2/3)	06/05/97	< 0.0002 ± 0.0002	< 0.001 ± 0.000	0.06 ± 0.00	0.0006 ± 0.0002
Field Blank	CapF (3/3)	06/05/97	0.0004 ± 0.0001	< 0.001 ± 0.000	0.08 ± 0.01	0.0012 ± 0.0005
Field Blank	SCDI (1/1)	06/05/97	< 0.0002 ± 0.0002	< 0.003 ± 0.002	0.018 ± 0.011	0.0034 ± 0.0005
Field Blank	SCADI (1/1)	06/05/97	< 0.0002 ± 0.0004	< 0.003 ± 0.002	0.13 ± 0.02	0.0025 ± 0.0003
Field Blank	TfTb (1/1)	06/05/97	0.0004 ± 0.0002	< 0.003 ± 0.001	< 0.008 ± 0.012	0.0039 ± 0.0001
Lab Blank	DIW (1/1)	05/28/97	< 0.0003 ± 0.0002	< 0.001 ± 0.000	< 0.01 ± 0.00	0.0005 ± 0.0001
Lab Blank	MemF (1/1)	05/28/97	< 0.0003 ± 0.0001	< 0.001 ± 0.000	0.071 ± 0.002	0.0011 ± 0.0002
Lab Blank	CapF (1/1)	05/28/97	< 0.0003 ± 0.0000	< 0.001 ± 0.000	< 0.006 ± 0.005	0.0012 ± 0.0000

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Molybdenum (µg/L)	Neodymium (µg/L)	Nickel (µg/L)	Potassium (mg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.02 ± 0.01	< 0.0014 ± 0.0002	< 0.11 ± 0.04	< 0.01 ± 0.00
Lab Blank	8LCh (1/1)	07/10/96	< 0.02 ± 0.01	< 0.0014 ± 0.0006	0.12 ± 0.00	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	07/10/96	< 0.02 ± 0.01	< 0.0014 ± 0.0008	< 0.11 ± 0.05	< 0.01 ± 0.00
Lab Blank	CapF (1/1)	07/10/96	< 0.02 ± 0.01	< 0.0014 ± 0.0006	< 0.11 ± 0.05	< 0.01 ± 0.00
Lab Blank	UF1 (1/1)	07/10/96	< 0.017 ± 0.009	< 0.003 ± 0.002	< 0.02 ± 0.03	< 0.01 ± 0.00
Lab Blank	UF2 (1/1)	07/10/96	< 0.02 ± 0.01	< 0.0014 ± 0.0008	< 0.11 ± 0.04	< 0.01 ± 0.00
Lab Blank	UF3 (1/1)	07/12/96	< 0.017 ± 0.001	< 0.003 ± 0.002	0.14 ± 0.00	< 0.01 ± 0.00
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.02 ± 0.01	< 0.0014 ± 0.0008	< 0.11 ± 0.05	< 0.01 ± 0.00
Field Blank	8LCh (1/1)	07/17/96	< 0.017 ± 0.021	< 0.003 ± 0.002	0.25 ± 0.01	< 0.01 ± 0.00
Field Blank	MemF (1/1)	07/17/96	< 0.017 ± 0.013	< 0.003 ± 0.002	< 0.02 ± 0.05	< 0.01 ± 0.00
Field Blank	CapF (1/1)	07/17/96	< 0.02 ± 0.01	< 0.0014 ± 0.0004	< 0.11 ± 0.05	< 0.01 ± 0.00
Field Blank	UF2 (1/1)	07/17/96	< 0.02 ± 0.01	< 0.0014 ± 0.0002	< 0.11 ± 0.05	< 0.01 ± 0.00
Field Blank	UF3 (1/1)	07/17/96	< 0.02 ± 0.03	< 0.0014 ± 0.0005	< 0.11 ± 0.04	< 0.01 ± 0.00
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.04 ± 0.00	< 0.003 ± 0.003	< 0.02 ± 0.00	< 0.01 ± 0.00
Lab Blank	20LCh (1/1)	09/18/96	< 0.04 ± 0.02	< 0.003 ± 0.002	< 0.11 ± 0.00	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	09/18/96	< 0.05 ± 0.00	< 0.002 ± 0.001	0.019 ± 0.004	< 0.01 ± 0.01
Lab Blank	CapF (1/1)	09/18/96	< 0.05 ± 0.02	< 0.002 ± 0.000	0.027 ± 0.002	< 0.01 ± 0.00
Lab Blank	UF2 (1/1)	09/18/96	0.09 ± 0.00	< 0.003 ± 0.001	< 0.11 ± 0.01	0.01 ± 0.01
Lab Blank	UF3 (1/1)	09/18/96	< 0.04 ± 0.00	< 0.003 ± 0.001	0.03 ± 0.01	< 0.01 ± 0.00
Lab Blank	THB (1/1)	09/18/96	< 0.05 ± 0.01	< 0.002 ± 0.001	0.88 ± 0.01	< 0.01 ± 0.00
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	0.13 ± 0.00	< 0.003 ± 0.002	< 0.02 ± 0.01	< 0.01 ± 0.00
Field Blank	20LCh (1/1)	09/18/96	< 0.05 ± 0.00	< 0.002 ± 0.002	0.020 ± 0.020	< 0.01 ± 0.00
Field Blank	MemF (1/1)	09/18/96	< 0.04 ± 0.03	< 0.003 ± 0.003	< 0.02 ± 0.01	< 0.01 ± 0.00
Field Blank	CapF (1/1)	09/18/96	< 0.05 ± 0.01	< 0.002 ± 0.002	0.063 ± 0.021	< 0.01 ± 0.00
Field Blank	UF2 (1/1)	09/18/96	< 0.04 ± 0.02	< 0.003 ± 0.002	< 0.02 ± 0.01	< 0.01 ± 0.00
Field Blank	UF3 (1/1)	09/18/96	< 0.05 ± 0.02	< 0.002 ± 0.001	< 0.016 ± 0.010	< 0.01 ± 0.00
Field Blank	THB (1/1)	09/18/96	< 0.05 ± 0.04	< 0.002 ± 0.001	< 0.016 ± 0.012	< 0.01 ± 0.00
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.07 ± 0.04	< 0.003 ± 0.001	< 0.02 ± 0.01	< 0.01 ± 0.00
Lab Blank	8LCh (1/1)	11/13/96	< 0.07 ± 0.03	< 0.003 ± 0.001	< 0.02 ± 0.01	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	11/13/96	< 0.07 ± 0.02	< 0.003 ± 0.001	0.02 ± 0.01	< 0.01 ± 0.00

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Molybdenum (µg/L)	Neodymium (µg/L)	Nickel (µg/L)	Potassium (mg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.07 ± 0.00	< 0.003 ± 0.001	0.03 ± 0.00	0.02 ± NA
Lab Blank	UF2 (1/1)	11/13/96	< 0.07 ± 0.02	< 0.003 ± 0.001	< 0.02 ± 0.01	< 0.01 ± 0.00
Lab Blank	UF3 (1/1)	11/13/96	< 0.07 ± 0.09	< 0.003 ± 0.001	0.04 ± 0.03	< 0.01 ± 0.00
Lab Blank	THB (1/1)	11/13/96	< 0.07 ± 0.05	< 0.003 ± 0.002	< 0.02 ± 0.00	< 0.01 ± 0.00
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.07 ± 0.04	< 0.003 ± 0.002	0.03 ± 0.01	< 0.01 ± 0.00
Field Blank	8LCh (1/1)	11/20/96	< 0.07 ± 0.03	< 0.003 ± 0.001	0.14 ± 0.01	< 0.01 ± 0.00
Field Blank	MemF (1/1)	11/20/96	< 0.07 ± 0.04	< 0.003 ± 0.001	0.11 ± 0.01	< 0.01 ± 0.00
Field Blank	CapF (1/1)	11/20/96	< 0.07 ± 0.02	< 0.003 ± 0.000	0.08 ± 0.01	< 0.01 ± 0.00
Field Blank	UF1 (1/1)	11/20/96	< 0.07 ± 0.02	< 0.003 ± 0.001	< 0.02 ± 0.00	< 0.01 ± 0.00
Field Blank	UF3 (1/1)	11/20/96	< 0.07 ± 0.02	< 0.003 ± 0.001	< 0.02 ± 0.00	< 0.01 ± 0.00
Field Blank	THB (1/1)	11/20/96	< 0.07 ± 0.04	< 0.003 ± 0.000	0.11 ± 0.00	< 0.01 ± 0.00
Field Blank	CapF (1/1)	11/20/96	< 0.07 ± 0.05	< 0.003 ± 0.000	< 0.02 ± 0.02	< 0.01 ± 0.00
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.03 ± 0.03	< 0.0019 ± 0.0003	< 0.012 ± 0.017	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	12/16/96	< 0.03 ± 0.02	< 0.0019 ± 0.0004	< 0.012 ± 0.001	< 0.01 ± 0.00
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	0.03 ± 0.02	< 0.0019 ± 0.0012	< 0.012 ± 0.008	0.02 ± 0.02
Lab Blank	UF3 (1/1)	12/16/96	< 0.03 ± 0.02	< 0.0019 ± 0.0009	< 0.012 ± 0.003	< 0.01 ± 0.00
Lab Blank	THB (1/1)	12/16/96	< 0.03 ± 0.01	< 0.0019 ± 0.0003	< 0.012 ± 0.019	< 0.01 ± 0.00
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.03 ± 0.01	< 0.0019 ± 0.0003	0.054 ± 0.011	< 0.01 ± 0.00
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.03 ± 0.00	< 0.0019 ± 0.0016	< 0.012 ± 0.014	< 0.01 ± 0.00
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.03 ± 0.01	< 0.0019 ± 0.0005	0.41 ± 0.03	< 0.01 ± 0.00
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.03 ± 0.00	< 0.0019 ± 0.0006	< 0.012 ± 0.006	< 0.01 ± 0.00
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.03 ± 0.02	< 0.0019 ± 0.0014	< 0.012 ± 0.006	< 0.01 ± 0.00
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.03 ± 0.00	< 0.0019 ± 0.0008	< 0.012 ± 0.017	< 0.01 ± 0.00
Lab Blank	UF1 (1/1)	12/16/96	< 0.03 ± 0.00	< 0.0019 ± 0.0003	< 0.012 ± 0.005	< 0.01 ± 0.00
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.03 ± 0.00	< 0.0019 ± 0.0007	0.019 ± 0.038	< 0.01 ± 0.00
Field Blank	8LCh (1/1)	12/17/96	< 0.03 ± 0.01	0.0021 ± 0.0011	0.025 ± 0.005	< 0.01 ± 0.00
Field Blank	MemF (1/1)	12/17/96	< 0.03 ± 0.00	< 0.0019 ± 0.0005	0.060 ± 0.007	< 0.01 ± 0.00
Field Blank	CapF (1/1)	12/17/96	0.03 ± 0.02	< 0.0019 ± 0.0006	0.04 ± 0.01	< 0.01 ± 0.00
Field Blank	UF2 (1/1)	12/17/96	< 0.03 ± 0.02	< 0.0019 ± 0.0010	< 0.012 ± 0.007	< 0.01 ± 0.00
Field Blank	THB (1/1)	12/17/96	< 0.03 ± 0.00	< 0.0019 ± 0.0002	0.069 ± 0.014	< 0.01 ± 0.00
Lab Blank	DIW (1/1)	01/06/97	< 0.04 ± 0.00	< 0.0013 ± 0.0002	< 0.04 ± 0.00	0.01 ± 0.02

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Molybdenum (µg/L)	Neodymium (µg/L)	Nickel (µg/L)	Potassium (mg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.04 ± 0.00	< 0.0013 ± 0.0007	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0005	< 0.04 ± 0.01	< 0.01 ± 0.00
Lab Blank	CapF (1/1)	01/06/97	< 0.05 ± 0.01	< 0.002 ± 0.002	0.06 ± 0.01	±
Lab Blank	UF2 (1/2)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0003	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	UF2 (2/2)	01/06/97	< 0.04 ± 0.01	< 0.003 ± 0.001	< 0.09 ± 0.00	< 0.01 ± 0.00
Lab Blank	UF3 (1/1)	01/06/97	< 0.04 ± 0.01	0.0273 ± 0.0013	0.19 ± 0.01	0.01 ± 0.00
Lab Blank	THB (1/1)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0004	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	25LCb (1/1)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0007	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	DIW (1/1)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0004	< 0.04 ± 0.01	< 0.01 ± 0.00
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.04 ± 0.01	< 0.0013 ± 0.0008	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	UF2 (1/1)	05/28/97	< 0.05 ± 0.02	< 0.002 ± 0.001	< 0.007 ± 0.006	< 0.01 ± 0.00
Lab Blank	UF3 (1/1)	05/28/97	< 0.05 ± 0.02	0.002 ± 0.001	0.08 ± 0.03	0.05 ± 0.06
Lab Blank	THB (1/1)	05/28/97	< 0.05 ± 0.01	< 0.002 ± 0.001	0.06 ± 0.00	< 0.01 ± 0.00
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.05 ± 0.02	< 0.002 ± 0.001	0.04 ± 0.00	0.01 ± 0.01
Field Blank	DIW (2/2)	06/05/97	< 0.05 ± 0.03	< 0.002 ± 0.001	0.03 ± 0.00	< 0.01 ± 0.00
Field Blank	CapF (1/3)	06/05/97	< 0.05 ± 0.03	< 0.002 ± 0.000	0.45 ± 0.01	< 0.01 ± 0.00
Field Blank	UFVP (1/1)	06/05/97	< 0.05 ± 0.00	< 0.002 ± 0.000	< 0.007 ± 0.008	< 0.01 ± 0.00
Field Blank	JyCn (1/1)	06/05/97	< 0.05 ± 0.00	< 0.002 ± 0.001	0.007 ± 0.005	0.01 ± 0.03
Field Blank	CapF (2/3)	06/05/97	< 0.05 ± 0.00	< 0.002 ± 0.001	0.28 ± 0.01	< 0.01 ± 0.00
Field Blank	CapF (3/3)	06/05/97	< 0.05 ± 0.00	< 0.002 ± 0.001	0.47 ± 0.00	< 0.01 ± 0.00
Field Blank	SCDI (1/1)	06/05/97	< 0.05 ± 0.03	0.002 ± 0.004	< 0.01 ± 0.01	0.01 ± 0.00
Field Blank	SCADI (1/1)	06/05/97	< 0.05 ± 0.02	< 0.002 ± 0.002	1.1 ± 0.1	0.01 ± 0.01
Field Blank	TfTb (1/1)	06/05/97	< 0.05 ± 0.02	< 0.002 ± 0.001	0.02 ± 0.02	< 0.01 ± 0.00
Lab Blank	DIW (1/1)	05/28/97	< 0.05 ± 0.01	< 0.002 ± 0.000	< 0.007 ± 0.012	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	05/28/97	< 0.05 ± 0.01	< 0.002 ± 0.001	0.06 ± 0.00	< 0.01 ± 0.00
Lab Blank	CapF (1/1)	05/28/97	< 0.05 ± 0.01	< 0.002 ± 0.000	< 0.007 ± 0.007	< 0.01 ± 0.00

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Praseodymium (µg/L)	Rhenium (µg/L)	Rubidium (µg/L)	Samarium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.0002 ± 0.0002	< 0.0003 ± 0.0000	< 0.002 ± 0.000	< 0.0017 ± 0.0006
Lab Blank	8LCh (1/1)	07/10/96	< 0.0002 ± 0.0002	< 0.0003 ± 0.0001	< 0.002 ± 0.002	< 0.0017 ± 0.0003
Lab Blank	MemF (1/1)	07/10/96	< 0.0002 ± 0.0001	< 0.0003 ± 0.0002	< 0.002 ± 0.002	< 0.0017 ± 0.0003
Lab Blank	CapF (1/1)	07/10/96	< 0.0002 ± 0.0000	< 0.0003 ± 0.0000	< 0.002 ± 0.001	< 0.0017 ± 0.0003
Lab Blank	UF1 (1/1)	07/10/96	< 0.0004 ± 0.0005	< 0.0013 ± 0.0004	0.0033 ± 0.0014	< 0.003 ± 0.002
Lab Blank	UF2 (1/1)	07/10/96	< 0.0002 ± 0.0000	< 0.0003 ± 0.0000	< 0.002 ± 0.000	< 0.0017 ± 0.0003
Lab Blank	UF3 (1/1)	07/12/96	< 0.0004 ± 0.0001	< 0.0013 ± 0.0006	0.0029 ± 0.0003	< 0.003 ± 0.002
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.0002 ± 0.0000	< 0.0003 ± 0.0001	< 0.002 ± 0.000	< 0.0017 ± 0.0007
Field Blank	8LCh (1/1)	07/17/96	0.0005 ± 0.0002	< 0.0013 ± 0.0003	0.0028 ± 0.0608	< 0.003 ± 0.001
Field Blank	MemF (1/1)	07/17/96	< 0.0004 ± 0.0004	< 0.0013 ± 0.0007	< 0.0015 ± 0.0051	< 0.003 ± 0.001
Field Blank	CapF (1/1)	07/17/96	< 0.0002 ± 0.0001	< 0.0003 ± 0.0001	< 0.002 ± 0.000	< 0.0017 ± 0.0008
Field Blank	UF2 (1/1)	07/17/96	< 0.0002 ± 0.0002	< 0.0003 ± 0.0001	< 0.002 ± 0.001	< 0.0017 ± 0.0005
Field Blank	UF3 (1/1)	07/17/96	< 0.0002 ± 0.0001	< 0.0003 ± 0.0001	< 0.002 ± 0.001	< 0.0017 ± 0.0009
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	0.0004 ± 0.0004	< 0.0010 ± 0.0002	0.0020 ± 0.0016	< 0.006 ± 0.002
Lab Blank	20LCh (1/1)	09/18/96	< 0.0004 ± 0.0001	< 0.0008 ± 0.0004	< 0.004 ± 0.002	< 0.003 ± 0.000
Lab Blank	MemF (1/1)	09/18/96	< 0.0005 ± 0.0001	< 0.0006 ± 0.0003	< 0.003 ± 0.001	< 0.003 ± 0.002
Lab Blank	CapF (1/1)	09/18/96	< 0.0005 ± 0.0001	< 0.0006 ± 0.0008	< 0.003 ± 0.002	< 0.003 ± 0.001
Lab Blank	UF2 (1/1)	09/18/96	< 0.0004 ± 0.0003	< 0.0008 ± 0.0002	< 0.004 ± 0.001	< 0.003 ± 0.002
Lab Blank	UF3 (1/1)	09/18/96	0.0003 ± 0.0004	< 0.0010 ± 0.0000	< 0.0013 ± 0.0012	< 0.006 ± 0.003
Lab Blank	THB (1/1)	09/18/96	< 0.0005 ± 0.0002	< 0.0006 ± 0.0002	< 0.003 ± 0.002	< 0.003 ± 0.002
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.0003 ± 0.0002	< 0.0010 ± 0.0004	0.0018 ± 0.0023	< 0.006 ± 0.001
Field Blank	20LCh (1/1)	09/18/96	< 0.0005 ± 0.0001	< 0.0006 ± 0.0004	< 0.003 ± 0.003	< 0.003 ± 0.001
Field Blank	MemF (1/1)	09/18/96	< 0.0003 ± 0.0005	< 0.0010 ± 0.0011	< 0.0013 ± 0.0001	< 0.006 ± 0.002
Field Blank	CapF (1/1)	09/18/96	< 0.0005 ± 0.0001	< 0.0006 ± 0.0003	< 0.003 ± 0.002	< 0.003 ± 0.002
Field Blank	UF2 (1/1)	09/18/96	< 0.0003 ± 0.0002	< 0.0010 ± 0.0005	< 0.0013 ± 0.0012	< 0.006 ± 0.002
Field Blank	UF3 (1/1)	09/18/96	< 0.0005 ± 0.0001	< 0.0006 ± 0.0000	< 0.003 ± 0.002	< 0.003 ± 0.002
Field Blank	THB (1/1)	09/18/96	< 0.0005 ± 0.0003	< 0.0006 ± 0.0007	< 0.003 ± 0.000	0.003 ± 0.001
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0005	< 0.02 ± 0.00	< 0.004 ± 0.002
Lab Blank	8LCh (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0001	< 0.02 ± 0.00	< 0.004 ± 0.001
Lab Blank	MemF (1/1)	11/13/96	< 0.0007 ± 0.0004	< 0.0013 ± 0.0004	< 0.02 ± 0.00	< 0.004 ± 0.000

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Praseodymium (µg/L)	Rhenium (µg/L)	Rubidium (µg/L)	Samarium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.0007 ± 0.0002	< 0.0013 ± 0.0001	< 0.02 ± 0.00	< 0.004 ± 0.000
Lab Blank	UF2 (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0005	< 0.02 ± 0.00	< 0.004 ± 0.002
Lab Blank	UF3 (1/1)	11/13/96	< 0.0007 ± 0.0002	< 0.0013 ± 0.0006	< 0.02 ± 0.00	< 0.004 ± 0.002
Lab Blank	THB (1/1)	11/13/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0008	< 0.02 ± 0.00	< 0.004 ± 0.001
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.0007 ± 0.0002	< 0.0013 ± 0.0005	< 0.02 ± 0.00	< 0.004 ± 0.001
Field Blank	8LCh (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0004	< 0.02 ± 0.00	< 0.004 ± 0.002
Field Blank	MemF (1/1)	11/20/96	< 0.0007 ± 0.0002	< 0.0013 ± 0.0008	< 0.02 ± 0.00	< 0.004 ± 0.003
Field Blank	CapF (1/1)	11/20/96	< 0.0007 ± 0.0001	< 0.0013 ± 0.0004	< 0.02 ± 0.00	< 0.004 ± 0.000
Field Blank	UF1 (1/1)	11/20/96	< 0.0007 ± 0.0004	< 0.0013 ± 0.0005	< 0.02 ± 0.00	< 0.004 ± 0.003
Field Blank	UF3 (1/1)	11/20/96	< 0.0007 ± 0.0002	< 0.0013 ± 0.0006	< 0.02 ± 0.00	< 0.004 ± 0.002
Field Blank	THB (1/1)	11/20/96	< 0.0007 ± 0.0003	< 0.0013 ± 0.0005	< 0.02 ± 0.00	< 0.004 ± 0.001
Field Blank	CapF (1/1)	11/20/96	< 0.0007 ± 0.0000	< 0.0013 ± 0.0004	< 0.02 ± 0.00	< 0.004 ± 0.002
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.0002 ± 0.0000	< 0.0006 ± 0.0003	< 0.0015 ± 0.0003	< 0.0016 ± 0.0009
Lab Blank	MemF (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0001	0.0018 ± 0.0019	< 0.0016 ± 0.0010
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.0002 ± 0.0002	< 0.0006 ± 0.0002	< 0.0015 ± 0.0005	< 0.0016 ± 0.0017
Lab Blank	UF3 (1/1)	12/16/96	< 0.0002 ± 0.0003	< 0.0006 ± 0.0002	0.0023 ± 0.0021	< 0.0016 ± 0.0002
Lab Blank	THB (1/1)	12/16/96	0.0002 ± 0.0002	< 0.0006 ± 0.0002	0.0018 ± 0.0031	< 0.0016 ± 0.0009
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0002	< 0.0015 ± 0.0006	< 0.0016 ± 0.0003
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0001	< 0.0015 ± 0.0015	< 0.0016 ± 0.0006
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0000	0.0038 ± 0.0018	0.0017 ± 0.0018
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.0002 ± 0.0003	< 0.0006 ± 0.0001	< 0.0015 ± 0.0005	< 0.0016 ± 0.0016
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0003	0.0022 ± 0.0005	< 0.0016 ± 0.0012
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0002	0.0017 ± 0.0002	< 0.0016 ± 0.0004
Lab Blank	UF1 (1/1)	12/16/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0003	< 0.0015 ± 0.0005	< 0.0016 ± 0.0006
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.0002 ± 0.0002	< 0.0006 ± 0.0001	0.0024 ± 0.0024	0.0016 ± 0.0007
Field Blank	8LCh (1/1)	12/17/96	< 0.0002 ± 0.0000	< 0.0006 ± 0.0001	0.0020 ± 0.0009	< 0.0016 ± 0.0010
Field Blank	MemF (1/1)	12/17/96	< 0.0002 ± 0.0000	< 0.0006 ± 0.0002	0.0047 ± 0.0005	< 0.0016 ± 0.0011
Field Blank	CapF (1/1)	12/17/96	< 0.0002 ± 0.0002	< 0.0006 ± 0.0001	0.0043 ± 0.0029	< 0.0016 ± 0.0009
Field Blank	UF2 (1/1)	12/17/96	< 0.0002 ± 0.0001	< 0.0006 ± 0.0001	0.0055 ± 0.0006	< 0.0016 ± 0.0013
Field Blank	THB (1/1)	12/17/96	0.0003 ± 0.0000	< 0.0006 ± 0.0003	0.0054 ± 0.0012	< 0.0016 ± 0.0003
Lab Blank	DIW (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0003	< 0.003 ± 0.001	< 0.003 ± 0.001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Praseodymium (µg/L)	Rhenium (µg/L)	Rubidium (µg/L)	Samarium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0002	< 0.003 ± 0.002	< 0.003 ± 0.001
Lab Blank	MemF (1/1)	01/06/97	< 0.0005 ± 0.0002	< 0.0006 ± 0.0002	< 0.003 ± 0.001	< 0.003 ± 0.001
Lab Blank	CapF (1/1)	01/06/97	< 0.0003 ± 0.0005	< 0.0007 ± 0.0003	< 0.002 ± 0.001	< 0.003 ± 0.002
Lab Blank	UF2 (1/2)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0001	< 0.003 ± 0.001	< 0.003 ± 0.002
Lab Blank	UF2 (2/2)	01/06/97	< 0.0006 ± 0.0003	< 0.0005 ± 0.0005	< 0.0018 ± 0.0019	< 0.003 ± 0.002
Lab Blank	UF3 (1/1)	01/06/97	0.0058 ± 0.0003	< 0.0006 ± 0.0001	0.093 ± 0.002	0.007 ± 0.004
Lab Blank	THB (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0002	< 0.003 ± 0.000	< 0.003 ± 0.002
Lab Blank	25LCb (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0001	< 0.003 ± 0.001	< 0.003 ± 0.001
Lab Blank	DIW (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0003	0.032 ± 0.002	< 0.003 ± 0.001
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.0005 ± 0.0001	< 0.0006 ± 0.0002	< 0.003 ± 0.001	< 0.003 ± 0.001
Lab Blank	UF2 (1/1)	05/28/97	< 0.0003 ± 0.0003	< 0.0007 ± 0.0002	0.003 ± 0.001	< 0.003 ± 0.001
Lab Blank	UF3 (1/1)	05/28/97	< 0.0003 ± 0.0002	< 0.0007 ± 0.0005	0.017 ± 0.005	< 0.003 ± 0.002
Lab Blank	THB (1/1)	05/28/97	< 0.0003 ± 0.0001	< 0.0007 ± 0.0003	0.003 ± 0.001	< 0.003 ± 0.001
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.0003 ± 0.0001	< 0.0007 ± 0.0002	0.002 ± 0.001	< 0.003 ± 0.001
Field Blank	DIW (2/2)	06/05/97	< 0.0003 ± 0.0001	< 0.0007 ± 0.0001	0.003 ± 0.001	< 0.003 ± 0.001
Field Blank	CapF (1/3)	06/05/97	< 0.0003 ± 0.0000	< 0.0007 ± 0.0003	0.053 ± 0.002	< 0.003 ± 0.000
Field Blank	UFVP (1/1)	06/05/97	< 0.0003 ± 0.0001	< 0.0007 ± 0.0001	< 0.002 ± 0.001	< 0.003 ± 0.001
Field Blank	JyCn (1/1)	06/05/97	< 0.0003 ± 0.0001	< 0.0007 ± 0.0001	0.14 ± 0.00	< 0.003 ± 0.001
Field Blank	CapF (2/3)	06/05/97	< 0.0003 ± 0.0003	< 0.0008 ± 0.0003	0.002 ± 0.001	< 0.003 ± 0.001
Field Blank	CapF (3/3)	06/05/97	< 0.0003 ± 0.0002	< 0.0008 ± 0.0003	0.003 ± 0.000	< 0.003 ± 0.000
Field Blank	SCDI (1/1)	06/05/97	< 0.0003 ± 0.0001	< 0.0008 ± 0.0005	0.048 ± 0.007	< 0.003 ± 0.001
Field Blank	SCADI (1/1)	06/05/97	< 0.0003 ± 0.0000	< 0.0008 ± 0.0002	0.053 ± 0.005	< 0.003 ± 0.004
Field Blank	TfTb (1/1)	06/05/97	< 0.0003 ± 0.0002	< 0.0008 ± 0.0007	< 0.001 ± 0.001	< 0.003 ± 0.001
Lab Blank	DIW (1/1)	05/28/97	< 0.0003 ± 0.0002	< 0.0007 ± 0.0001	< 0.002 ± 0.001	< 0.003 ± 0.000
Lab Blank	MemF (1/1)	05/28/97	< 0.0003 ± 0.0002	< 0.0007 ± 0.0003	< 0.002 ± 0.001	< 0.003 ± 0.001
Lab Blank	CapF (1/1)	05/28/97	< 0.0003 ± 0.0002	< 0.0007 ± 0.0002	< 0.002 ± 0.000	< 0.003 ± 0.001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)	Sodium (mg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.06 ± 0.04	0.04 ± 0.01	< 0.04 ± 0.01	< 0.01 ± 0.01
Lab Blank	8LCh (1/1)	07/10/96	< 0.06 ± 0.05	0.04 ± 0.01	< 0.04 ± 0.01	< 0.01 ± 0.00
Lab Blank	MemF (1/1)	07/10/96	< 0.06 ± 0.03	0.04 ± 0.01	< 0.04 ± 0.00	< 0.01 ± 0.00
Lab Blank	CapF (1/1)	07/10/96	< 0.06 ± 0.05	0.05 ± 0.01	< 0.04 ± 0.01	< 0.01 ± 0.00
Lab Blank	UF1 (1/1)	07/10/96	< 0.07 ± 0.00	0.08 ± 0.02	< 0.02 ± 0.01	< 0.01 ± 0.00
Lab Blank	UF2 (1/1)	07/10/96	< 0.06 ± 0.03	0.07 ± 0.01	< 0.04 ± 0.02	< 0.01 ± 0.01
Lab Blank	UF3 (1/1)	07/12/96	< 0.07 ± 0.02	0.04 ± 0.02	< 0.02 ± 0.01	< 0.01 ± 0.01
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	0.06 ± 0.03	< 0.18 ± 0.15	< 0.04 ± 0.02	< 0.01 ± 0.00
Field Blank	8LCh (1/1)	07/17/96	< 0.07 ± 0.07	< 0.18 ± 0.03	< 0.02 ± 0.01	0.01 ± 0.01
Field Blank	MemF (1/1)	07/17/96	< 0.07 ± 0.04	< 0.08 ± 0.09	< 0.02 ± 0.01	< 0.03 ± 0.03
Field Blank	CapF (1/1)	07/17/96	< 0.06 ± 0.02	< 0.18 ± 0.02	< 0.04 ± 0.01	< 0.01 ± 0.00
Field Blank	UF2 (1/1)	07/17/96	< 0.06 ± 0.05	< 0.08 ± 0.03	< 0.04 ± 0.00	< 0.03 ± 0.00
Field Blank	UF3 (1/1)	07/17/96	< 0.06 ± 0.03	< 0.18 ± 0.20	< 0.04 ± 0.01	< 0.01 ± 0.00
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.13 ± 0.04	0.04 ± 0.02	< 0.03 ± 0.03	< 0.05 ± 0.01
Lab Blank	20LCh (1/1)	09/18/96	< 0.3 ± 0.1	0.05 ± 0.03	< 0.02 ± 0.03	< 0.04 ± 0.02
Lab Blank	MemF (1/1)	09/18/96	< 0.2 ± 0.3	0.067 ± 0.011	< 0.02 ± 0.00	< 0.04 ± 0.02
Lab Blank	CapF (1/1)	09/18/96	< 0.2 ± 0.1	0.05 ± 0.01	< 0.02 ± 0.00	< 0.04 ± 0.01
Lab Blank	UF2 (1/1)	09/18/96	< 0.3 ± 0.0	0.10 ± 0.02	< 0.02 ± 0.01	< 0.05 ± 0.01
Lab Blank	UF3 (1/1)	09/18/96	< 0.13 ± 0.02	0.08 ± 0.01	< 0.03 ± 0.01	< 0.05 ± 0.01
Lab Blank	THB (1/1)	09/18/96	< 0.2 ± 0.2	0.17 ± 0.02	< 0.02 ± 0.01	< 0.04 ± 0.02
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.13 ± 0.04	0.052 ± 0.016	< 0.03 ± 0.03	< 0.04 ± 0.03
Field Blank	20LCh (1/1)	09/18/96	< 0.2 ± 0.1	0.063 ± 0.013	< 0.02 ± 0.00	< 0.04 ± 0.00
Field Blank	MemF (1/1)	09/18/96	< 0.13 ± 0.14	0.077 ± 0.014	< 0.03 ± 0.02	< 0.04 ± 0.02
Field Blank	CapF (1/1)	09/18/96	< 0.2 ± 0.1	0.081 ± 0.008	< 0.02 ± 0.01	< 0.04 ± 0.01
Field Blank	UF2 (1/1)	09/18/96	< 0.13 ± 0.05	0.080 ± 0.006	0.07 ± 0.01	< 0.04 ± 0.01
Field Blank	UF3 (1/1)	09/18/96	< 0.2 ± 0.1	0.086 ± 0.009	< 0.02 ± 0.00	< 0.04 ± 0.02
Field Blank	THB (1/1)	09/18/96	< 0.2 ± 0.1	0.063 ± 0.002	< 0.02 ± 0.01	< 0.04 ± 0.02
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.12 ± 0.07	0.06 ± 0.01	< 0.1 ± 0.04	< 0.03 ± 0.01
Lab Blank	8LCh (1/1)	11/13/96	0.16 ± 0.30	0.06 ± 0.01	< 0.1 ± 0.02	< 0.03 ± 0.02
Lab Blank	MemF (1/1)	11/13/96	0.13 ± 0.17	0.06 ± 0.02	< 0.1 ± 0.01	< 0.03 ± 0.01

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)	Sodium (mg/L)
Lab Blank	CapF (1/1)	11/14/96	0.14 ± 0.20	< 0.06 ± 0.00	< 0.1 ± 0.03	< 0.03 ± 0.01
Lab Blank	UF2 (1/1)	11/13/96	< 0.12 ± 0.06	0.11 ± 0.01	< 0.15 ± 0.02	< 0.03 ± 0.01
Lab Blank	UF3 (1/1)	11/13/96	< 0.12 ± 0.08	0.07 ± 0.00	< 0.1 ± 0.05	< 0.03 ± 0.01
Lab Blank	THB (1/1)	11/13/96	< 0.12 ± 0.15	0.08 ± 0.00	< 0.1 ± 0.03	< 0.03 ± 0.01
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.12 ± 0.13	< 0.06 ± 0.01	< 0.1 ± 0.07	< 0.03 ± 0.01
Field Blank	8LCh (1/1)	11/20/96	< 0.12 ± 0.02	< 0.06 ± 0.01	< 0.1 ± 0.04	< 0.03 ± 0.01
Field Blank	MemF (1/1)	11/20/96	0.20 ± 0.03	< 0.06 ± 0.01	< 0.1 ± 0.03	< 0.03 ± 0.01
Field Blank	CapF (1/1)	11/20/96	0.17 ± 0.16	< 0.06 ± 0.01	< 0.1 ± 0.02	< 0.03 ± 0.01
Field Blank	UF1 (1/1)	11/20/96	< 0.12 ± 0.06	0.10 ± 0.06	< 0.1 ± 0.02	< 0.005 ± 0.003
Field Blank	UF3 (1/1)	11/20/96	< 0.12 ± 0.21	< 0.09 ± 0.05	< 0.1 ± 0.01	< 0.005 ± 0.010
Field Blank	THB (1/1)	11/20/96	< 0.12 ± 0.16	< 0.09 ± 0.04	< 0.1 ± 0.03	< 0.004 ± 0.014
Field Blank	CapF (1/1)	11/20/96	< 0.12 ± 0.10	< 0.09 ± 0.04	< 0.1 ± 0.03	< 0.004 ± 0.006
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.11 ± 0.08	0.12 ± 0.01	< 0.03 ± 0.02	< 0.06 ± 0.02
Lab Blank	MemF (1/1)	12/16/96	< 0.11 ± 0.04	0.08 ± 0.03	< 0.03 ± 0.00	< 0.08 ± 0.09
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.11 ± 0.08	0.10 ± 0.01	0.05 ± 0.01	< 0.06 ± 0.03
Lab Blank	UF3 (1/1)	12/16/96	< 0.11 ± 0.03	0.09 ± 0.04	0.03 ± 0.03	< 0.06 ± 0.03
Lab Blank	THB (1/1)	12/16/96	< 0.11 ± 0.04	0.08 ± 0.07	< 0.03 ± 0.01	< 0.08 ± 0.16
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.11 ± 0.03	0.06 ± 0.02	< 0.03 ± 0.00	< 0.08 ± 0.08
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.11 ± 0.07	0.03 ± 0.02	0.08 ± 0.04	< 0.08 ± 0.03
Lab Blank	20LCh-3 (1/1)	12/16/96	< 0.11 ± 0.06	0.09 ± 0.02	< 0.03 ± 0.01	< 0.06 ± 0.04
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.11 ± 0.02	0.07 ± 0.01	0.05 ± 0.04	< 0.08 ± 0.04
Lab Blank	20LCh-5 (1/1)	12/16/96	< 0.11 ± 0.06	0.06 ± 0.02	0.04 ± 0.04	< 0.08 ± 0.02
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.11 ± 0.06	0.06 ± 0.00	< 0.03 ± 0.00	< 0.06 ± 0.04
Lab Blank	UF1 (1/1)	12/16/96	< 0.11 ± 0.07	0.07 ± 0.00	< 0.03 ± 0.01	< 0.018 ± 0.016
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.11 ± 0.04	0.06 ± 0.01	< 0.03 ± 0.02	< 0.018 ± 0.004
Field Blank	8LCh (1/1)	12/17/96	< 0.11 ± 0.00	0.08 ± 0.01	< 0.03 ± 0.01	< 0.018 ± 0.016
Field Blank	MemF (1/1)	12/17/96	< 0.11 ± 0.05	0.06 ± 0.01	< 0.03 ± 0.00	< 0.06 ± 0.03
Field Blank	CapF (1/1)	12/17/96	< 0.11 ± 0.02	0.07 ± 0.01	0.07 ± 0.02	< 0.018 ± 0.009
Field Blank	UF2 (1/1)	12/17/96	< 0.11 ± 0.03	0.08 ± 0.01	< 0.03 ± 0.02	< 0.06 ± 0.04
Field Blank	THB (1/1)	12/17/96	< 0.11 ± 0.03	0.07 ± 0.02	< 0.03 ± 0.00	< 0.06 ± 0.03
Lab Blank	DIW (1/1)	01/06/97	< 0.2 ± 0.1	< 0.04 ± 0.00	0.07 ± 0.02	< 0.018 ± 0.005

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)	Sodium (mg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.2 ± 0.0	< 0.04 ± 0.01	< 0.02 ± 0.01	< 0.018 ± 0.014
Lab Blank	MemF (1/1)	01/06/97	< 0.2 ± 0.0	< 0.04 ± 0.01	< 0.02 ± 0.02	< 0.018 ± 0.004
Lab Blank	CapF (1/1)	01/06/97	< 0.3 ± 0.3	< 0.05 ± 0.01	< 0.2 ± 0.1	na ± na
Lab Blank	UF2 (1/2)	01/06/97	< 0.2 ± 0.1	0.05 ± 0.01	< 0.02 ± 0.02	< 0.018 ± 0.000
Lab Blank	UF2 (2/2)	01/06/97	< 0.09 ± 0.04	0.06 ± 0.02	< 0.04 ± 0.01	< 0.03 ± 0.01
Lab Blank	UF3 (1/1)	01/06/97	< 0.2 ± 0.1	0.31 ± 0.00	< 0.02 ± 0.00	< 0.018 ± 0.005
Lab Blank	THB (1/1)	01/06/97	< 0.2 ± 0.1	< 0.04 ± 0.01	< 0.02 ± 0.00	< 0.018 ± 0.003
Lab Blank	25LCb (1/1)	01/06/97	< 0.2 ± 0.0	< 0.04 ± 0.01	< 0.02 ± 0.00	< 0.018 ± 0.004
Lab Blank	DIW (1/1)	01/06/97	< 0.2 ± 0.1	< 0.04 ± 0.02	< 0.02 ± 0.00	< 0.018 ± 0.004
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.2 ± 0.1	< 0.04 ± 0.01	< 0.02 ± 0.00	< 0.018 ± 0.002
Lab Blank	UF2 (1/1)	05/28/97	< 0.3 ± 0.1	0.16 ± 0.03	< 0.2 ± 0.1	< 0.06 ± 0.02
Lab Blank	UF3 (1/1)	05/28/97	< 0.3 ± 0.1	< 0.05 ± 0.03	< 0.2 ± 0.1	< 0.06 ± 0.02
Lab Blank	THB (1/1)	05/28/97	< 0.3 ± 0.1	< 0.05 ± 0.02	< 0.2 ± 0.0	< 0.06 ± 0.00
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.3 ± 0.1	< 0.05 ± 0.02	< 0.2 ± 0.1	< 0.06 ± 0.01
Field Blank	DIW (2/2)	06/05/97	< 0.1 ± 0.1	< 0.05 ± 0.02	< 0.2 ± 0.2	< 0.06 ± 0.01
Field Blank	CapF (1/3)	06/05/97	< 0.3 ± 0.1	< 0.05 ± 0.03	< 0.2 ± 0.1	< 0.06 ± 0.03
Field Blank	UFVP (1/1)	06/05/97	< 0.1 ± 0.1	< 0.05 ± 0.02	< 0.2 ± 0.1	< 0.06 ± 0.01
Field Blank	JyCn (1/1)	06/05/97	< 0.3 ± 0.1	< 0.05 ± 0.03	< 0.2 ± 0.0	< 0.06 ± 0.01
Field Blank	CapF (2/3)	06/05/97	< 0.1 ± 0.0	< 0.07 ± 0.03	< 0.2 ± 0.1	< 0.05 ± 0.03
Field Blank	CapF (3/3)	06/05/97	< 0.1 ± 0.0	< 0.07 ± 0.04	< 0.2 ± 0.0	< 0.1 ± 0.1
Field Blank	SCDI (1/1)	06/05/97	< 0.2 ± 0.0	< 0.07 ± 0.03	< 0.2 ± 0.1	< 0.1 ± 0.1
Field Blank	SCADI (1/1)	06/05/97	< 0.2 ± 0.5	< 0.07 ± 0.02	< 0.2 ± 0.1	< 0.1 ± 0.1
Field Blank	TfTb (1/1)	06/05/97	< 0.2 ± 0.2	< 0.07 ± 0.04	< 0.2 ± 0.1	< 0.07 ± 0.01
Lab Blank	DIW (1/1)	05/28/97	< 0.3 ± 0.1	< 0.05 ± 0.03	< 0.2 ± 0.1	< 0.06 ± 0.02
Lab Blank	MemF (1/1)	05/28/97	< 0.1 ± 0.0	< 0.05 ± 0.03	< 0.2 ± 0.1	< 0.06 ± 0.02
Lab Blank	CapF (1/1)	05/28/97	< 0.1 ± 0.1	< 0.05 ± 0.01	< 0.2 ± 0.1	< 0.06 ± 0.02

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Strontium (µg/L)	Terbium (µg/L)	Thallium (µg/L)	Thulium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.04 ± 0.01	< 0.0002 ± 0.0000	< 0.0009 ± 0.0004	< 0.0003 ± 0.0000
Lab Blank	8LCh (1/1)	07/10/96	0.07 ± 0.06	< 0.0002 ± 0.0001	< 0.0009 ± 0.0003	< 0.0003 ± 0.0000
Lab Blank	MemF (1/1)	07/10/96	< 0.04 ± 0.01	< 0.0002 ± 0.0000	< 0.0009 ± 0.0001	< 0.0003 ± 0.0000
Lab Blank	CapF (1/1)	07/10/96	< 0.04 ± 0.00	< 0.0002 ± 0.0001	< 0.0009 ± 0.0004	< 0.0003 ± 0.0001
Lab Blank	UF1 (1/1)	07/10/96	< 0.08 ± 0.03	< 0.0003 ± 0.0001	< 0.0014 ± 0.0011	0.0005 ± 0.0001
Lab Blank	UF2 (1/1)	07/10/96	< 0.04 ± 0.01	< 0.0002 ± 0.0001	< 0.0009 ± 0.0002	< 0.0003 ± 0.0001
Lab Blank	UF3 (1/1)	07/12/96	< 0.08 ± 0.00	0.0006 ± 0.0001	< 0.0014 ± 0.0004	< 0.0003 ± 0.0002
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.04 ± 0.01	< 0.0002 ± 0.0001	< 0.0009 ± 0.0005	< 0.0003 ± 0.0000
Field Blank	8LCh (1/1)	07/17/96	< 0.08 ± 0.47	< 0.0003 ± 0.0005	< 0.0014 ± 0.0007	< 0.0003 ± 0.0002
Field Blank	MemF (1/1)	07/17/96	< 0.08 ± 0.25	< 0.0003 ± 0.0003	< 0.0014 ± 0.0018	< 0.0003 ± 0.0002
Field Blank	CapF (1/1)	07/17/96	< 0.04 ± 0.02	< 0.0002 ± 0.0001	< 0.0009 ± 0.0004	< 0.0003 ± 0.0000
Field Blank	UF2 (1/1)	07/17/96	< 0.04 ± 0.01	< 0.0002 ± 0.0000	< 0.0009 ± 0.0004	< 0.0003 ± 0.0001
Field Blank	UF3 (1/1)	07/17/96	< 0.04 ± 0.01	< 0.0002 ± 0.0000	< 0.0009 ± 0.0005	< 0.0003 ± 0.0001
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.007 ± 0.001	< 0.0005 ± 0.0003	< 0.002 ± 0.000	< 0.0005 ± 0.0001
Lab Blank	20LCh (1/1)	09/18/96	< 0.007 ± 0.003	< 0.0008 ± 0.0002	< 0.005 ± 0.001	< 0.0005 ± 0.0002
Lab Blank	MemF (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0004 ± 0.0003	< 0.0013 ± 0.0005	< 0.0006 ± 0.0000
Lab Blank	CapF (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0004 ± 0.0004	< 0.0013 ± 0.0004	< 0.0006 ± 0.0003
Lab Blank	UF2 (1/1)	09/18/96	< 0.007 ± 0.003	< 0.0008 ± 0.0002	< 0.005 ± 0.002	< 0.0005 ± 0.0001
Lab Blank	UF3 (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0005 ± 0.0001	< 0.002 ± 0.001	< 0.0005 ± 0.0002
Lab Blank	THB (1/1)	09/18/96	< 0.007 ± 0.001	< 0.0004 ± 0.0004	< 0.0013 ± 0.0011	< 0.0006 ± 0.0003
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0005 ± 0.0006	< 0.002 ± 0.000	< 0.0005 ± 0.0001
Field Blank	20LCh (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0004 ± 0.0002	< 0.0013 ± 0.0009	< 0.0006 ± 0.0001
Field Blank	MemF (1/1)	09/18/96	< 0.007 ± 0.003	< 0.0005 ± 0.0004	< 0.002 ± 0.001	< 0.0005 ± 0.0007
Field Blank	CapF (1/1)	09/18/96	< 0.007 ± 0.001	< 0.0004 ± 0.0001	< 0.0013 ± 0.0003	< 0.0006 ± 0.0003
Field Blank	UF2 (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0005 ± 0.0004	< 0.002 ± 0.001	< 0.0005 ± 0.0003
Field Blank	UF3 (1/1)	09/18/96	< 0.007 ± 0.001	< 0.0004 ± 0.0000	< 0.0013 ± 0.0010	< 0.0006 ± 0.0003
Field Blank	THB (1/1)	09/18/96	< 0.007 ± 0.002	< 0.0004 ± 0.0004	< 0.0013 ± 0.0017	< 0.0006 ± 0.0002
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.4 ± 0.1	< 0.0008 ± 0.0003	< 0.007 ± 0.002	< 0.0006 ± 0.0001
Lab Blank	8LCh (1/1)	11/13/96	< 0.4 ± 0.0	< 0.0008 ± 0.0002	< 0.007 ± 0.002	< 0.0006 ± 0.0001
Lab Blank	MemF (1/1)	11/13/96	< 0.4 ± 0.0	< 0.0008 ± 0.0002	< 0.007 ± 0.001	< 0.0006 ± 0.0001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Strontium (µg/L)	Terbium (µg/L)	Thallium (µg/L)	Thulium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.4 ± 0.1	< 0.0008 ± 0.0004	< 0.007 ± 0.001	< 0.0006 ± 0.0001
Lab Blank	UF2 (1/1)	11/13/96	< 0.4 ± 0.1	< 0.0008 ± 0.0002	< 0.007 ± 0.001	< 0.0006 ± 0.0002
Lab Blank	UF3 (1/1)	11/13/96	< 0.4 ± 0.0	< 0.0008 ± 0.0002	< 0.007 ± 0.001	< 0.0006 ± 0.0003
Lab Blank	THB (1/1)	11/13/96	< 0.4 ± 0.0	< 0.0008 ± 0.0000	< 0.007 ± 0.002	< 0.0006 ± 0.0005
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	< 0.4 ± 0.0	< 0.0008 ± 0.0004	< 0.007 ± 0.001	< 0.0006 ± 0.0000
Field Blank	8LCh (1/1)	11/20/96	< 0.4 ± 0.0	< 0.0008 ± 0.0005	< 0.007 ± 0.000	< 0.0006 ± 0.0002
Field Blank	MemF (1/1)	11/20/96	< 0.4 ± 0.0	< 0.0008 ± 0.0002	< 0.007 ± 0.001	< 0.0006 ± 0.0002
Field Blank	CapF (1/1)	11/20/96	< 0.4 ± 0.0	< 0.0008 ± 0.0000	< 0.007 ± 0.001	< 0.0006 ± 0.0002
Field Blank	UF1 (1/1)	11/20/96	< 0.4 ± 0.1	< 0.0008 ± 0.0002	< 0.007 ± 0.001	< 0.0006 ± 0.0002
Field Blank	UF3 (1/1)	11/20/96	< 0.4 ± 0.1	< 0.0008 ± 0.0001	< 0.007 ± 0.000	< 0.0006 ± 0.0003
Field Blank	THB (1/1)	11/20/96	< 0.4 ± 0.1	< 0.0008 ± 0.0001	< 0.007 ± 0.000	< 0.0006 ± 0.0002
Field Blank	CapF (1/1)	11/20/96	< 0.4 ± 0.0	< 0.0008 ± 0.0001	< 0.007 ± 0.001	< 0.0006 ± 0.0003
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	< 0.02 ± 0.034	< 0.0003 ± 0.0002	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	MemF (1/1)	12/16/96	0.037 ± 0.035	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.02 ± 0.011	< 0.0003 ± 0.0001	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	UF3 (1/1)	12/16/96	< 0.02 ± 0.010	< 0.0003 ± 0.0002	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	THB (1/1)	12/16/96	0.023 ± 0.021	< 0.0003 ± 0.0000	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.02 ± 0.005	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.02 ± 0.027	< 0.0003 ± 0.0001	< 0.004 ± 0.002	< 0.0002 ± 0.0001
Lab Blank	20LCh-3 (1/1)	12/16/96	0.042 ± 0.028	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0002
Lab Blank	20LCh-4 (1/1)	12/16/96	0.020 ± 0.014	< 0.0003 ± 0.0002	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	20LCh-5 (1/1)	12/16/96	0.034 ± 0.010	< 0.0003 ± 0.0002	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	20LCh-6 (1/1)	12/16/96	< 0.02 ± 0.012	< 0.0003 ± 0.0000	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	UF1 (1/1)	12/16/96	< 0.02 ± 0.005	< 0.0003 ± 0.0003	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	0.028 ± 0.038	< 0.0003 ± 0.0000	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Field Blank	8LCh (1/1)	12/17/96	< 0.02 ± 0.019	< 0.0003 ± 0.0002	< 0.004 ± 0.001	< 0.0002 ± 0.0002
Field Blank	MemF (1/1)	12/17/96	0.039 ± 0.015	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Field Blank	CapF (1/1)	12/17/96	0.050 ± 0.026	< 0.0003 ± 0.0000	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Field Blank	UF2 (1/1)	12/17/96	0.024 ± 0.014	< 0.0003 ± 0.0001	< 0.004 ± 0.002	< 0.0002 ± 0.0002
Field Blank	THB (1/1)	12/17/96	0.071 ± 0.024	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	DIW (1/1)	01/06/97	< 0.02 ± 0.028	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Strontium (µg/L)	Terbium (µg/L)	Thallium (µg/L)	Thulium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.02 ± 0.026	< 0.0003 ± 0.0001	< 0.004 ± 0.001	< 0.0002 ± 0.0001
Lab Blank	MemF (1/1)	01/06/97	< 0.02 ± 0.031	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0000
Lab Blank	CapF (1/1)	01/06/97	< 0.06 ± 0.06	< 0.0004 ± 0.0002	< 0.007 ± 0.001	< 0.0004 ± 0.0001
Lab Blank	UF2 (1/2)	01/06/97	< 0.02 ± 0.026	< 0.0003 ± 0.0001	< 0.004 ± 0.001	< 0.0002 ± 0.0000
Lab Blank	UF2 (2/2)	01/06/97	< 0.05 ± 0.01	< 0.0004 ± 0.0002	< 0.007 ± 0.000	< 0.0005 ± 0.0001
Lab Blank	UF3 (1/1)	01/06/97	0.063 ± 0.005	0.0008 ± 0.0001	< 0.004 ± 0.000	0.0002 ± 0.0001
Lab Blank	THB (1/1)	01/06/97	< 0.02 ± 0.015	< 0.0003 ± 0.0000	< 0.004 ± 0.000	< 0.0002 ± 0.0000
Lab Blank	25LCb (1/1)	01/06/97	< 0.02 ± 0.018	< 0.0003 ± 0.0001	< 0.004 ± 0.001	< 0.0002 ± 0.0000
Lab Blank	DIW (1/1)	01/06/97	0.031 ± 0.032	< 0.0003 ± 0.0001	< 0.004 ± 0.000	< 0.0002 ± 0.0002
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.02 ± 0.018	< 0.0003 ± 0.0002	< 0.004 ± 0.000	< 0.0002 ± 0.0001
Lab Blank	UF2 (1/1)	05/28/97	< 0.06 ± 0.00	< 0.0004 ± 0.0002	< 0.007 ± 0.001	< 0.0004 ± 0.0001
Lab Blank	UF3 (1/1)	05/28/97	< 0.06 ± 0.02	< 0.0004 ± 0.0003	< 0.007 ± 0.001	< 0.0004 ± 0.0001
Lab Blank	THB (1/1)	05/28/97	< 0.06 ± 0.02	< 0.0004 ± 0.0002	< 0.007 ± 0.000	< 0.0004 ± 0.0001
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.06 ± 0.02	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0002
Field Blank	DIW (2/2)	06/05/97	< 0.06 ± 0.01	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0000
Field Blank	CapF (1/3)	06/05/97	< 0.06 ± 0.01	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0000
Field Blank	UFVP (1/1)	06/05/97	< 0.06 ± 0.02	< 0.0004 ± 0.0001	< 0.007 ± 0.000	< 0.0004 ± 0.0000
Field Blank	JyCn (1/1)	06/05/97	< 0.06 ± 0.01	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0001
Field Blank	CapF (2/3)	06/05/97	< 0.07 ± 0.03	< 0.0007 ± 0.0002	< 0.008 ± 0.001	< 0.0004 ± 0.0002
Field Blank	CapF (3/3)	06/05/97	0.09 ± 0.05	< 0.0007 ± 0.0001	< 0.008 ± 0.001	< 0.0004 ± 0.0003
Field Blank	SCDI (1/1)	06/05/97	< 0.07 ± 0.09	< 0.0007 ± 0.0002	< 0.008 ± 0.001	< 0.0004 ± 0.0004
Field Blank	SCADI (1/1)	06/05/97	0.07 ± 0.14	< 0.0007 ± 0.0004	< 0.008 ± 0.002	< 0.0004 ± 0.0004
Field Blank	TfTb (1/1)	06/05/97	< 0.07 ± 0.09	< 0.0007 ± 0.0003	< 0.008 ± 0.001	< 0.0004 ± 0.0002
Lab Blank	DIW (1/1)	05/28/97	< 0.06 ± 0.00	< 0.0004 ± 0.0002	< 0.007 ± 0.001	< 0.0004 ± 0.0002
Lab Blank	MemF (1/1)	05/28/97	< 0.06 ± 0.02	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0001
Lab Blank	CapF (1/1)	05/28/97	< 0.06 ± 0.01	< 0.0004 ± 0.0001	< 0.007 ± 0.001	< 0.0004 ± 0.0000

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Uranium (µg/L)	Vanadium (µg/L)	Ytterbium (µg/L)	Yttrium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	< 0.0014 ± 0.0011	< 0.02 ± 0.01	< 0.0007 ± 0.0003	< 0.0004 ± 0.0002
Lab Blank	8LCh (1/1)	07/10/96	< 0.0014 ± 0.0002	< 0.02 ± 0.00	< 0.0007 ± 0.0002	< 0.0004 ± 0.0005
Lab Blank	MemF (1/1)	07/10/96	< 0.0014 ± 0.0006	< 0.02 ± 0.01	< 0.0007 ± 0.0003	< 0.0004 ± 0.0001
Lab Blank	CapF (1/1)	07/10/96	< 0.0014 ± 0.0004	< 0.02 ± 0.02	< 0.0007 ± 0.0002	< 0.0004 ± 0.0003
Lab Blank	UF1 (1/1)	07/10/96	< 0.0011 ± 0.0004	< 0.03 ± 0.03	0.0014 ± 0.0001	0.0002 ± 0.0006
Lab Blank	UF2 (1/1)	07/10/96	0.0030 ± 0.0044	< 0.02 ± 0.01	< 0.0007 ± 0.0003	< 0.0004 ± 0.0001
Lab Blank	UF3 (1/1)	07/12/96	< 0.0011 ± 0.0009	0.05 ± 0.03	< 0.001 ± 0.0004	0.0007 ± 0.0001
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	< 0.0014 ± 0.0014	< 0.02 ± 0.01	< 0.0007 ± 0.0003	< 0.0004 ± 0.0000
Field Blank	8LCh (1/1)	07/17/96	< 0.0011 ± 0.0061	< 0.03 ± 0.13	< 0.001 ± 0.0011	0.0017 ± 0.0014
Field Blank	MemF (1/1)	07/17/96	< 0.0011 ± 0.0015	< 0.03 ± 0.05	< 0.001 ± 0.0008	0.0003 ± 0.0001
Field Blank	CapF (1/1)	07/17/96	< 0.0014 ± 0.0002	< 0.02 ± 0.00	< 0.0007 ± 0.0001	< 0.0004 ± 0.0002
Field Blank	UF2 (1/1)	07/17/96	< 0.0014 ± 0.0021	< 0.02 ± 0.02	< 0.0007 ± 0.0001	< 0.0004 ± 0.0002
Field Blank	UF3 (1/1)	07/17/96	< 0.0014 ± 0.0002	< 0.02 ± 0.01	< 0.0007 ± 0.0006	< 0.0004 ± 0.0003
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	< 0.006 ± 0.001	0.09 ± 0.10	< 0.002 ± 0.0014	< 0.0004 ± 0.0004
Lab Blank	20LCh (1/1)	09/18/96	< 0.013 ± 0.000	< 0.04 ± 0.04	< 0.0008 ± 0.0000	< 0.0009 ± 0.0005
Lab Blank	MemF (1/1)	09/18/96	< 0.004 ± 0.000	< 0.03 ± 0.07	0.0009 ± 0.0006	< 0.0005 ± 0.0002
Lab Blank	CapF (1/1)	09/18/96	< 0.004 ± 0.001	< 0.03 ± 0.01	< 0.0006 ± 0.0002	< 0.0005 ± 0.0003
Lab Blank	UF2 (1/1)	09/18/96	< 0.013 ± 0.002	< 0.04 ± 0.03	0.0012 ± 0.0003	< 0.0009 ± 0.0006
Lab Blank	UF3 (1/1)	09/18/96	< 0.006 ± 0.003	0.10 ± 0.12	< 0.002 ± 0.0002	< 0.0004 ± 0.0005
Lab Blank	THB (1/1)	09/18/96	< 0.004 ± 0.001	< 0.03 ± 0.04	< 0.0006 ± 0.0007	< 0.0005 ± 0.0002
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	< 0.006 ± 0.002	< 0.09 ± 0.04	< 0.002 ± 0.0002	< 0.0004 ± 0.0003
Field Blank	20LCh (1/1)	09/18/96	< 0.004 ± 0.001	< 0.03 ± 0.02	0.0009 ± 0.0003	< 0.0005 ± 0.0002
Field Blank	MemF (1/1)	09/18/96	< 0.006 ± 0.001	< 0.09 ± 0.08	< 0.002 ± 0.0007	< 0.0004 ± 0.0004
Field Blank	CapF (1/1)	09/18/96	< 0.004 ± 0.001	< 0.03 ± 0.01	< 0.0006 ± 0.0011	< 0.0005 ± 0.0006
Field Blank	UF2 (1/1)	09/18/96	0.048 ± 0.011	< 0.09 ± 0.01	< 0.002 ± 0.0000	< 0.0004 ± 0.0003
Field Blank	UF3 (1/1)	09/18/96	< 0.004 ± 0.002	0.04 ± 0.02	< 0.0006 ± 0.0001	< 0.0005 ± 0.0002
Field Blank	THB (1/1)	09/18/96	< 0.004 ± 0.001	0.04 ± 0.01	< 0.0006 ± 0.0005	< 0.0005 ± 0.0001
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	< 0.003 ± 0.003	< 0.04 ± 0.02	< 0.0013 ± 0.0007	< 0.0006 ± 0.0002
Lab Blank	8LCh (1/1)	11/13/96	< 0.003 ± 0.001	< 0.04 ± 0.01	< 0.0013 ± 0.0005	0.0007 ± 0.0005
Lab Blank	MemF (1/1)	11/13/96	< 0.003 ± 0.005	< 0.04 ± 0.02	< 0.0013 ± 0.0010	< 0.0006 ± 0.0001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Uranium (µg/L)	Vanadium (µg/L)	Ytterbium (µg/L)	Yttrium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	< 0.003 ± 0.001	< 0.04 ± 0.01	< 0.0013 ± 0.0010	< 0.0006 ± 0.0003
Lab Blank	UF2 (1/1)	11/13/96	< 0.003 ± 0.003	< 0.04 ± 0.01	< 0.0013 ± 0.0009	< 0.0006 ± 0.0005
Lab Blank	UF3 (1/1)	11/13/96	0.003 ± 0.003	< 0.04 ± 0.01	< 0.0013 ± 0.0007	0.0013 ± 0.0002
Lab Blank	THB (1/1)	11/13/96	< 0.003 ± 0.002	< 0.04 ± 0.01	< 0.0013 ± 0.0005	< 0.0006 ± 0.0006
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	0.004 ± 0.006	< 0.04 ± 0.01	< 0.0013 ± 0.0006	< 0.0006 ± 0.0003
Field Blank	8LCh (1/1)	11/20/96	< 0.003 ± 0.003	< 0.04 ± 0.01	< 0.0013 ± 0.0005	< 0.0006 ± 0.0002
Field Blank	MemF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.04 ± 0.01	< 0.0013 ± 0.0008	< 0.0006 ± 0.0002
Field Blank	CapF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.04 ± 0.01	< 0.0013 ± 0.0015	< 0.0006 ± 0.0002
Field Blank	UF1 (1/1)	11/20/96	< 0.003 ± 0.002	< 0.04 ± 0.01	< 0.0013 ± 0.0003	< 0.0006 ± 0.0003
Field Blank	UF3 (1/1)	11/20/96	< 0.003 ± 0.001	< 0.04 ± 0.01	< 0.0013 ± 0.0006	< 0.0006 ± 0.0005
Field Blank	THB (1/1)	11/20/96	< 0.003 ± 0.002	< 0.04 ± 0.00	< 0.0013 ± 0.0002	0.0009 ± 0.0008
Field Blank	CapF (1/1)	11/20/96	< 0.003 ± 0.001	< 0.04 ± 0.00	< 0.0013 ± 0.0001	< 0.0006 ± 0.0001
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	0.0008 ± 0.0010	< 0.011 ± 0.008	< 0.0008 ± 0.0003	< 0.0001 ± 0.0003
Lab Blank	MemF (1/1)	12/16/96	< 0.0005 ± 0.0004	< 0.011 ± 0.007	< 0.0008 ± 0.0001	< 0.0001 ± 0.0002
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	< 0.0005 ± 0.0003	< 0.011 ± 0.006	< 0.0008 ± 0.0002	< 0.0001 ± 0.0001
Lab Blank	UF3 (1/1)	12/16/96	0.0005 ± 0.0002	< 0.011 ± 0.006	< 0.0008 ± 0.0003	< 0.0001 ± 0.0003
Lab Blank	THB (1/1)	12/16/96	< 0.0005 ± 0.0001	< 0.011 ± 0.004	< 0.0008 ± 0.0002	0.0003 ± 0.0003
Lab Blank	20LCh-1 (1/1)	12/16/96	< 0.0005 ± 0.0004	< 0.011 ± 0.006	< 0.0008 ± 0.0001	0.0002 ± 0.0005
Lab Blank	20LCh-2 (1/1)	12/16/96	< 0.0005 ± 0.0001	< 0.011 ± 0.004	< 0.0008 ± 0.0002	< 0.0001 ± 0.0005
Lab Blank	20LCh-3 (1/1)	12/16/96	0.0006 ± 0.0007	< 0.011 ± 0.007	< 0.0008 ± 0.0004	0.0004 ± 0.0006
Lab Blank	20LCh-4 (1/1)	12/16/96	< 0.0005 ± 0.0004	< 0.011 ± 0.004	< 0.0008 ± 0.0003	0.0002 ± 0.0001
Lab Blank	20LCh-5 (1/1)	12/16/96	0.0007 ± 0.0009	< 0.012 ± 0.006	< 0.0008 ± 0.0002	0.0004 ± 0.0005
Lab Blank	20LCh-6 (1/1)	12/16/96	0.0005 ± 0.0002	< 0.011 ± 0.004	< 0.0008 ± 0.0002	< 0.0001 ± 0.0001
Lab Blank	UF1 (1/1)	12/16/96	< 0.0005 ± 0.0007	< 0.011 ± 0.010	< 0.0008 ± 0.0002	< 0.0001 ± 0.0002
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	< 0.0005 ± 0.0003	< 0.011 ± 0.001	< 0.0008 ± 0.0003	< 0.0001 ± 0.0000
Field Blank	8LCh (1/1)	12/17/96	< 0.0005 ± 0.0003	< 0.011 ± 0.003	< 0.0008 ± 0.0004	< 0.0001 ± 0.0004
Field Blank	MemF (1/1)	12/17/96	0.0006 ± 0.0013	< 0.011 ± 0.015	< 0.0008 ± 0.0007	0.0004 ± 0.0003
Field Blank	CapF (1/1)	12/17/96	< 0.0005 ± 0.0003	< 0.011 ± 0.014	< 0.0008 ± 0.0001	0.0007 ± 0.0001
Field Blank	UF2 (1/1)	12/17/96	< 0.0005 ± 0.0004	< 0.011 ± 0.006	< 0.0008 ± 0.0001	< 0.0001 ± 0.0002
Field Blank	THB (1/1)	12/17/96	< 0.0005 ± 0.0006	< 0.011 ± 0.002	< 0.0008 ± 0.0007	0.0006 ± 0.0003
Lab Blank	DIW (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.004	< 0.0007 ± 0.0007	< 0.0004 ± 0.0003

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Uranium (µg/L)	Vanadium (µg/L)	Ytterbium (µg/L)	Yttrium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.001 ± 0.000	< 0.008 ± 0.003	< 0.0007 ± 0.0000	< 0.0004 ± 0.0000
Lab Blank	MemF (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.008	< 0.0007 ± 0.0007	< 0.0004 ± 0.0002
Lab Blank	CapF (1/1)	01/06/97	< 0.002 ± 0.001	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0006
Lab Blank	UF2 (1/2)	01/06/97	< 0.001 ± 0.001	< 0.008 ± 0.000	< 0.0007 ± 0.0003	< 0.0004 ± 0.0002
Lab Blank	UF2 (2/2)	01/06/97	0.146 ± 0.036	< 0.011 ± 0.008	< 0.0016 ± 0.0005	< 0.0007 ± 0.0002
Lab Blank	UF3 (1/1)	01/06/97	< 0.001 ± 0.000	0.21 ± 0.00	0.0016 ± 0.0004	0.023 ± 0.001
Lab Blank	THB (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.002	< 0.0007 ± 0.0003	< 0.0004 ± 0.0001
Lab Blank	25LCb (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.003	< 0.0007 ± 0.0004	< 0.0004 ± 0.0002
Lab Blank	DIW (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.003	< 0.0007 ± 0.0001	< 0.0004 ± 0.0004
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.001 ± 0.000	< 0.008 ± 0.005	< 0.0007 ± 0.0003	< 0.0004 ± 0.0002
Lab Blank	UF2 (1/1)	05/28/97	< 0.002 ± 0.002	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0002
Lab Blank	UF3 (1/1)	05/28/97	< 0.002 ± 0.001	0.03 ± 0.01	< 0.001 ± 0.000	0.0024 ± 0.0010
Lab Blank	THB (1/1)	05/28/97	< 0.002 ± 0.000	< 0.02 ± 0.01	< 0.001 ± 0.001	< 0.0005 ± 0.0002
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	< 0.002 ± 0.001	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0003
Field Blank	DIW (2/2)	06/05/97	< 0.002 ± 0.001	< 0.02 ± 0.02	< 0.001 ± 0.000	< 0.0005 ± 0.0004
Field Blank	CapF (1/3)	06/05/97	< 0.002 ± 0.002	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0003
Field Blank	UFVP (1/1)	06/05/97	< 0.002 ± 0.001	< 0.02 ± 0.02	< 0.001 ± 0.000	< 0.0005 ± 0.0000
Field Blank	JyCn (1/1)	06/05/97	< 0.002 ± 0.001	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0002
Field Blank	CapF (2/3)	06/05/97	< 0.004 ± 0.008	< 0.03 ± 0.03	< 0.0008 ± 0.0008	< 0.0005 ± 0.0006
Field Blank	CapF (3/3)	06/05/97	< 0.004 ± 0.004	< 0.03 ± 0.01	< 0.0008 ± 0.0006	< 0.0005 ± 0.0001
Field Blank	SCDI (1/1)	06/05/97	< 0.004 ± 0.001	< 0.03 ± 0.02	0.0008 ± 0.0011	0.0007 ± 0.0010
Field Blank	SCADI (1/1)	06/05/97	< 0.004 ± 0.002	< 0.03 ± 0.03	< 0.0008 ± 0.0013	0.0006 ± 0.0008
Field Blank	TfTb (1/1)	06/05/97	< 0.004 ± 0.000	< 0.03 ± 0.05	< 0.0008 ± 0.0006	< 0.0005 ± 0.0004
Lab Blank	DIW (1/1)	05/28/97	< 0.002 ± 0.001	< 0.02 ± 0.01	< 0.001 ± 0.001	< 0.0005 ± 0.0004
Lab Blank	MemF (1/1)	05/28/97	< 0.002 ± 0.003	< 0.02 ± 0.01	< 0.001 ± 0.000	< 0.0005 ± 0.0000
Lab Blank	CapF (1/1)	05/28/97	< 0.002 ± 0.001	< 0.02 ± 0.01	< 0.001 ± 0.001	< 0.0005 ± 0.0001

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Zinc (µg/L)	Zirconium (µg/L)
Lab Blank	DIW (1/1)	07/10/96	0.20 ± 0.07	< 0.017 ± 0.001
Lab Blank	8LCh (1/1)	07/10/96	0.73 ± 0.02	< 0.017 ± 0.001
Lab Blank	MemF (1/1)	07/10/96	0.45 ± 0.04	< 0.017 ± 0.002
Lab Blank	CapF (1/1)	07/10/96	0.21 ± 0.07	< 0.017 ± 0.002
Lab Blank	UF1 (1/1)	07/10/96	0.57 ± 0.21	0.008 ± 0.005
Lab Blank	UF2 (1/1)	07/10/96	0.32 ± 0.06	< 0.017 ± 0.003
Lab Blank	UF3 (1/1)	07/12/96	0.86 ± 0.11	< 0.007 ± 0.001
Lab Blank	HgP (1/1)	07/12/96	— ± —	— ± —
Field Blank	DIW (1/1)	07/17/96	0.22 ± 0.09	< 0.017 ± 0.002
Field Blank	8LCh (1/1)	07/17/96	0.62 ± 0.13	< 0.007 ± 0.004
Field Blank	MemF (1/1)	07/17/96	0.98 ± 0.07	< 0.007 ± 0.011
Field Blank	CapF (1/1)	07/17/96	0.81 ± 0.13	< 0.017 ± 0.004
Field Blank	UF2 (1/1)	07/17/96	0.38 ± 0.05	< 0.017 ± 0.002
Field Blank	UF3 (1/1)	07/17/96	0.36 ± 0.06	< 0.017 ± 0.001
Field Blank	HgP (1/1)	07/17/96	— ± —	— ± —
Lab Blank	DIW (1/1)	09/18/96	0.16 ± 0.05	< 0.003 ± 0.002
Lab Blank	20LCh (1/1)	09/18/96	0.17 ± 0.12	< 0.008 ± 0.001
Lab Blank	MemF (1/1)	09/18/96	0.23 ± 0.08	< 0.009 ± 0.004
Lab Blank	CapF (1/1)	09/18/96	0.61 ± 0.03	< 0.009 ± 0.002
Lab Blank	UF2 (1/1)	09/18/96	0.31 ± 0.10	< 0.008 ± 0.002
Lab Blank	UF3 (1/1)	09/18/96	0.24 ± 0.03	< 0.003 ± 0.002
Lab Blank	THB (1/1)	09/18/96	0.31 ± 0.14	< 0.009 ± 0.005
Lab Blank	HgP (1/1)	09/18/96	— ± —	— ± —
Field Blank	DIW (1/1)	09/18/96	0.14 ± 0.02	< 0.003 ± 0.001
Field Blank	20LCh (1/1)	09/18/96	0.14 ± 0.04	< 0.009 ± 0.003
Field Blank	MemF (1/1)	09/18/96	2.3 ± 0.2	< 0.003 ± 0.003
Field Blank	CapF (1/1)	09/18/96	0.29 ± 0.07	< 0.009 ± 0.003
Field Blank	UF2 (1/1)	09/18/96	0.05 ± 0.01	< 0.003 ± 0.000
Field Blank	UF3 (1/1)	09/18/96	0.80 ± 0.03	< 0.009 ± 0.001
Field Blank	THB (1/1)	09/18/96	0.32 ± 0.05	< 0.009 ± 0.003
Field Blank	HgP (1/1)	09/18/96	— ± —	— ± —
Lab Blank	DIW (1/1)	11/13/96	0.20 ± 0.01	< 0.02 ± 0.01
Lab Blank	8LCh (1/1)	11/13/96	0.16 ± 0.00	< 0.02 ± 0.00
Lab Blank	MemF (1/1)	11/13/96	0.15 ± 0.12	< 0.02 ± 0.00

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Zinc (µg/L)	Zirconium (µg/L)
Lab Blank	CapF (1/1)	11/14/96	0.32 ± 0.01	< 0.02 ± 0.00
Lab Blank	UF2 (1/1)	11/13/96	0.36 ± 0.13	< 0.02 ± 0.00
Lab Blank	UF3 (1/1)	11/13/96	0.49 ± 0.02	< 0.02 ± 0.00
Lab Blank	THB (1/1)	11/13/96	1.15 ± 0.06	< 0.02 ± 0.01
Lab Blank	HgP (1/1)	11/13/96	— ± —	— ± —
Field Blank	DIW (1/1)	11/20/96	0.60 ± 0.04	< 0.02 ± 0.00
Field Blank	8LCh (1/1)	11/20/96	0.47 ± 0.05	< 0.02 ± 0.00
Field Blank	MemF (1/1)	11/20/96	0.41 ± 0.00	< 0.02 ± 0.00
Field Blank	CapF (1/1)	11/20/96	0.50 ± 0.01	< 0.02 ± 0.00
Field Blank	UF1 (1/1)	11/20/96	< 0.03 ± 0.05	< 0.02 ± 0.00
Field Blank	UF3 (1/1)	11/20/96	0.44 ± 0.05	< 0.02 ± 0.00
Field Blank	THB (1/1)	11/20/96	0.46 ± 0.08	< 0.02 ± 0.00
Field Blank	CapF (1/1)	11/20/96	< 0.03 ± 0.03	< 0.02 ± 0.00
Field Blank	HgP (1/1)	11/20/96	— ± —	— ± —
Lab Blank	DIW (1/1)	12/16/96	0.13 ± 0.18	< 0.003 ± 0.003
Lab Blank	MemF (1/1)	12/16/96	0.18 ± 0.02	0.012 ± 0.006
Lab Blank	CapF (1/1)	12/16/96	— ± —	— ± —
Lab Blank	HgP (1/2)	12/16/96	— ± —	— ± —
Lab Blank	UF1 (1/1)	12/16/96	0.18 ± 0.16	0.007 ± 0.006
Lab Blank	UF3 (1/1)	12/16/96	0.32 ± 0.09	0.006 ± 0.006
Lab Blank	THB (1/1)	12/16/96	0.17 ± 0.05	0.006 ± 0.003
Lab Blank	20LCh-1 (1/1)	12/16/96	0.15 ± 0.10	0.016 ± 0.003
Lab Blank	20LCh-2 (1/1)	12/16/96	0.05 ± 0.04	< 0.003 ± 0.002
Lab Blank	20LCh-3 (1/1)	12/16/96	0.43 ± 0.09	0.014 ± 0.011
Lab Blank	20LCh-4 (1/1)	12/16/96	0.12 ± 0.03	< 0.003 ± 0.003
Lab Blank	20LCh-5 (1/1)	12/16/96	0.29 ± 0.19	< 0.003 ± 0.003
Lab Blank	20LCh-6 (1/1)	12/16/96	0.54 ± 0.02	< 0.003 ± 0.003
Lab Blank	UF1 (1/1)	12/16/96	< 0.03 ± 0.05	< 0.003 ± 0.003
Lab Blank	HgP (2/2)	12/16/96	— ± —	— ± —
Field Blank	DIW (1/1)	12/17/96	0.28 ± 0.11	0.004 ± 0.003
Field Blank	8LCh (1/1)	12/17/96	1.08 ± 0.08	0.005 ± 0.005
Field Blank	MemF (1/1)	12/17/96	0.55 ± 0.00	0.012 ± 0.002
Field Blank	CapF (1/1)	12/17/96	0.57 ± 0.23	0.008 ± 0.002
Field Blank	UF2 (1/1)	12/17/96	0.17 ± 0.07	0.004 ± 0.000
Field Blank	THB (1/1)	12/17/96	0.70 ± 0.03	0.015 ± 0.009
Lab Blank	DIW (1/1)	01/06/97	< 0.08 ± 0.03	< 0.009 ± 0.002

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Zinc (µg/L)	Zirconium (µg/L)
Lab Blank	UF1 (1/1)	01/05/97	< 0.08 ± 0.04	< 0.009 ± 0.001
Lab Blank	MemF (1/1)	01/06/97	< 0.08 ± 0.07	< 0.009 ± 0.001
Lab Blank	CapF (1/1)	01/06/97	0.50 ± 0.01	< 0.008 ± 0.004
Lab Blank	UF2 (1/2)	01/06/97	< 0.08 ± 0.05	< 0.009 ± 0.003
Lab Blank	UF2 (2/2)	01/06/97	0.15 ± 0.09	< 0.007 ± 0.002
Lab Blank	UF3 (1/1)	01/06/97	0.44 ± 0.15	< 0.009 ± 0.001
Lab Blank	THB (1/1)	01/06/97	0.24 ± 0.05	< 0.009 ± 0.002
Lab Blank	25LCb (1/1)	01/06/97	0.09 ± 0.10	< 0.009 ± 0.002
Lab Blank	DIW (1/1)	01/06/97	1.2 ± 0.0	< 0.009 ± 0.001
Lab Blank	HgP (1/1)	01/06/97	— ± —	— ± —
Field Blank	THB (1/1)	01/06/97	< 0.08 ± 0.03	< 0.009 ± 0.001
Lab Blank	UF2 (1/1)	05/28/97	0.07 ± 0.03	< 0.008 ± 0.004
Lab Blank	UF3 (1/1)	05/28/97	3.6 ± 1.1	< 0.008 ± 0.001
Lab Blank	THB (1/1)	05/28/97	1.1 ± 0.2	< 0.008 ± 0.003
Lab Blank	HgP (1/1)	05/28/97	— ± —	— ± —
Field Blank	DIW (1/2)	06/05/97	1.1 ± 0.0	< 0.008 ± 0.004
Field Blank	DIW (2/2)	06/05/97	1.1 ± 0.0	< 0.008 ± 0.003
Field Blank	CapF (1/3)	06/05/97	< 0.07 ± 0.02	< 0.008 ± 0.001
Field Blank	UFVP (1/1)	06/05/97	< 0.07 ± 0.06	< 0.008 ± 0.003
Field Blank	JyCn (1/1)	06/05/97	< 0.07 ± 0.02	< 0.008 ± 0.005
Field Blank	CapF (2/3)	06/05/97	0.68 ± 0.17	< 0.005 ± 0.002
Field Blank	CapF (3/3)	06/05/97	0.56 ± 0.01	< 0.005 ± 0.001
Field Blank	SCDI (1/1)	06/05/97	< 0.03 ± 0.07	< 0.005 ± 0.003
Field Blank	SCADI (1/1)	06/05/97	0.06 ± 0.04	< 0.005 ± 0.005
Field Blank	TfTb (1/1)	06/05/97	0.31 ± 0.07	< 0.005 ± 0.005
Lab Blank	DIW (1/1)	05/28/97	< 0.07 ± 0.02	< 0.008 ± 0.004
Lab Blank	MemF (1/1)	05/28/97	0.93 ± 0.03	< 0.008 ± 0.005
Lab Blank	CapF (1/1)	05/28/97	0.44 ± 0.07	< 0.008 ± 0.004

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Table A2-2. Results of laboratory and field blanks for water sample processing—*Continued*

Blank Type	Process Type	Date (mm/dd/yy)	Lead (µg/L) ICP-MS
	Blanks for lead grab samples		
Lab blank	Grab (1/1)	09/18/96	0.005 ± 0.002
Field Blank	DWI (1/1)	09/27/96	< 0.004 ± 0.003
Field Blank	UF1 (1/1)	09/27/96	< 0.004 ± 0.002
Field Blank	Grab (1/1)	09/27/96	< 0.004 ± 0.003
Lab blank	DWI (1/1)	11/13/96	< 0.005 ± 0.007
Lab blank	Grab (1/1)	11/13/96	< 0.005 ± 0.002
Lab blank	Mem F (1/1)	11/13/96	0.018 ± 0.013
Lab blank	UF1 (1/1)	11/13/96	< 0.005 ± 0.008
Lab blank	Grab (1/1)	11/13/96	< 0.005 ± 0.008
Field Blank	DWI (1/1)	11/18/96	< 0.005 ± 0.009
Field Blank	Cap F (1/1)	11/18/96	0.012 ± 0.018
Field Blank	UF1 (1/1)	11/18/96	0.008 ± 0.024
Field Blank	Grab (1/1)	11/18/96	0.016 ± 0.031
Lab blank	DWI (1/1)	07/10/96	< 0.004 ± 0.006
Lab blank	Cap F (1/1)	07/10/96	< 0.004 ± 0.005
Lab blank	UF1 (1/1)	07/10/96	< 0.004 ± 0.003
Lab blank	UF2 (1/1)	07/10/96	< 0.004 ± 0.003
Lab blank	Grab (1/1)	07/10/96	< 0.004 ± 0.004
Field Blank	Grab (1/1)	07/17/96	< 0.005 ± 0.003
Field Blank	DWI (1/1)	07/17/96	< 0.005 ± 0.001
Field Blank	Cap F (1/1)	07/17/96	0.017 ± 0.003
Field Blank	UF2 (1/1)	07/17/96	0.025 ± 0.002
Field Blank	UF3 (1/1)	07/17/96	< 0.005 ± 0.001
Field Blank	Mem F (1/1)	07/17/96	0.03 ± 0.003
Field Blank	DWI (1/1)	12/17/96	0.005 ± 0.007
Field Blank	Grab (1/1)	12/17/96	0.007 ± 0.005
Lab blank	DWI (1/1)	01/06/97	< 0.004 ± 0.003
Lab blank	UF2 (1/1)	01/06/97	< 0.004 ± 0.001
Lab blank	DWI (1/1)	05/28/97	< 0.01 ± 0
Lab blank	Mem F (1/1)	05/28/97	< 0.008 ± 0.003
Lab blank	UF2 (1/1)	05/28/97	< 0.01 ± 0
Lab blank	Cap F (1/1)	05/28/97	< 0.01 ± 0
Field Blank	DWI (1/1)	06/05/97	< 0.01 ± 0
Field Blank	Cap F (1/2)	06/05/97	< 0.008 ± 0.001
Field Blank	UF3 (Verona) (1/1)	06/05/97	< 0.01 ± 0
Field Blank	Grab (1/1)	06/05/97	< 0.01 ± 0
Field Blank	JyCn (1/1)	06/05/97	< 0.01 ± 0
Field Blank	Cap F (2/2)	06/05/97	< 0.008 ± 0.001
Field Blank	SCDI (1/1)	06/05/97	<0.01 ± 0
Field Blank	TfTb	06/05/97	0.01 ± 0.01

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Table A2-3. Observed metal concentrations and percentage recovery in biological reference materials processed using the same methods as caddisfly samples

[NIST, National Institute of Standards and Technology; SRM, Standard Reference Material. Dividing micrograms per sample by dry weight gives concentrations in micrograms per gram dry weight. Certified concentration values reported by the NIST for SRM 1566a–Oyster tissue and SRM 50–Albacore tuna are presented in Table 22. Percentage recovery is the measured value divided by the NIST certified value and multiplied by 100. g, gram; µg/sample, microgram per sample. —, no certified value]

Reference material	Tissue	Dry weight (in g)	Aluminum	Cadmium	Copper	Iron	Lead	Zinc
				Observed Concentration (in µg/sample)				
NIST SRM1566	Oyster	0.3941	134.5	4.31	63.4	520	0.457	850
NIST SRM1566	Oyster	0.401	124.7	4.24	59.9	511	0.324	800
NIST SRM1566	Oyster	0.4133	142.8	4.36	65.3	549	0.339	811
NIST SRM1566	Oyster	0.4342	140.5	4.38	57.6	509	0.368	841
NIST SRM1566	Oyster	0.4125	138.2	4.61	63.0	499	0.339	819
NIST SRM50	Tuna	0.354	7.6	0.07	3.1	53.7	0.593	13.8
NIST SRM50	Tuna	0.4242	7.1	0.04	3.1	51.9	0.684	14.4
NIST SRM50	Tuna	0.3798	7.1	0.04	3.2	52.7	0.553	14.5
NIST SRM50	Tuna	0.434	5.1	0.05	2.8	50.7	0.392	13.1
NIST SRM50	Tuna	0.443	4.5	0.10	3.2	54.2	0.384	13.1
				Percentage Recovery				
NIST SRM1566	Oyster	0.3941	67	104	96	97	123	102
NIST SRM1566	Oyster	0.401	62	102	90	95	87	96
NIST SRM1566	Oyster	0.4133	71	105	99	102	91	98
NIST SRM1566	Oyster	0.4342	70	105	87	94	99	101
NIST SRM1566	Oyster	0.4125	68	111	95	93	91	99
NIST SRM50	Tuna	0.354	—	—	—	—	129	102
NIST SRM50	Tuna	0.4242	—	—	—	—	149	106
NIST SRM50	Tuna	0.3798	—	—	—	—	120	106
NIST SRM50	Tuna	0.434	—	—	—	—	85	97
NIST SRM50	Tuna	0.443	—	—	—	—	83	96

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Table A2-4. Procedural blanks for caddisfly samples collected from the Sacramento River and Cottonwood Creek, October 21–23, 1996

[Blanks were processed with samples using identical methods; Br., Bridge; Cr., Creek; R., River; Sac., Sacramento; <, less than; µg/sample, microgram per sample]

Station	Sample ID	Sample Fraction	Aluminum (µg/sample)	Cadmium (µg/sample)	Copper (µg/sample)	Iron (µg/sample)	Lead (µg/sample)	Zinc (µg/sample)
Sac. R.–Rodeo	SRRBLK1wb	Whole body	0.71	< 0.002	0.016	3	0.019	0.33
	SRRBLK1c	Cytosol	0.33	< 0.003	< 0.006	< 0.3	0.006	0.21
Sac. R.–Churn Cr.	SRABLK1wb	Whole body	0.41	< 0.003	0.013	2	0.008	0.26
	SRABLK1c	Cytosol	0.35	< 0.003	< 0.006	< 1	0.005	< 0.18
Sac. R.–Balls Ferry	SRBFBLK1wb	Whole body	0.8	0.041	< 0.006	1	0.005	< 0.18
	SRBFBLK1c	Cytosol	0.81	0.016	< 0.006	< 0.5	< 0.003	< 0.18
Sac. R.–Bend Br.	SRBBLK1wb	Whole body	0.35	< 0.003	0.013	3	0.011	0.31
	SRBBLK1c	Cytosol	0.6	0.003	< 0.006	< 0.7	0.009	< 0.18
Sac. R.–Tehama	SRTBLK1wb	Whole body	0.68	< 0.003	< 0.006	< 0.6	0.006	< 0.18
	SRTBLK1c	Cytosol	0.17	< 0.003	< 0.006	< 1	0.006	< 0.18
Cottonwood Cr.	SRCCBLK1wb	Whole body	0.35	< 0.003	0.073	2	0.007	< 0.18
	SRCCBLK1c	Cytosol	0.26	< 0.003	< 0.006	< 0.6	0.19	0.52

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Table A2-5. Concentration data for standard reference materials

[n, number of times standards were analyzed. Median, median value of all analyses; MAD, median absolute deviation of all observations (cf., Rousseeuw, 1990); NIST, National Institute of Standards and Technology; seq., sequential; SRM, Standard Reference Material; PUB, published concentration value for standard reference material. (All values for NIST standards are certified values unless indicated by "(i)" for "informational purposes;" all values for USGS standards are most probable values); PUB–SD, standard deviation of the published concentration vaue; USGS, U.S. Geological Survey; wt %, weight percent; *, standard diluted 1/10 for analysis; **, standard diluted 1/100 for analysis. —, not analyzed; nr, not reported. µg/g, microgram per gram, µg/L, microgram per liter; mg/L, milligram per liter;]

	Aluminum						Antimony					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643d*	µg/L	618	129	5	127.6	3.5	µg/L	260	54.7	1.8	54.1	1.1
SRM 2704–total digestion	wt %	19	5.7	0.44	6.11	0.16	µg/g	19	3.9	0.15	3.79	0.15
SRM 2704–sum of seq. digestion	wt %	5	3.2	0.33	6.11	0.16	µg/g	5	3.9	0.30	3.79	0.15
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	28	2.2	51	nr
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	µg/L	50	132	6	127	38	µg/L	50	9.4	0.5	9.4	0.5
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	µg/L	42	85	2	83	30	—	—	—	—	—	—
T113	µg/L	201	317	8	317	31	µg/L	149	17.1	0.8	18.9	4.8
T117	µg/L	246	76	3	79	19.4	µg/L	153	5.7	0.3	5.5	0.96
T119	µg/L	75	167	5	171	30	µg/L	33	8.7	0.2	8.6	1.41
T125	µg/L	205	22	1	24	8.56	µg/L	114	6.2	0.2	6.24	1.305
T129	µg/L	94	47	1	50	11.9	µg/L	94	0.2	0.0	0.55	0.87
T131	µg/L	100	129	4	132	20	µg/L	17	56.3	0.7	56.2	6.7
T133	µg/L	60	52	1	52.1	8.1	µg/L	21	14.6	0.6	14.4	2.4
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	µg/L	42	31	1	30.5	6.9	—	—	—	—	—	—
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	µg/L	411	68	2	67.6	11	µg/L	89	8.8	0.2	8.8	0.96
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Arsenic						Barium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	57	76.2	3.8	76	7	µg/L	42	48	3	46	2
SRM 1643b*	µg/L	159	53.0	2.9	49	nr	µg/L	159	44	3	44	2
SRM 1643d*	µg/L	289	53.3	2.4	56.02	0.73	µg/L	306	502	18	506.5	8.9
SRM 2704–total digestion	—	—	—	—	—	—	µg/g	19	400	30	414	12
SRM 2704–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	230	22	414	12
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	µg/L	50	57	4	59.7	16
T103	µg/L	50	3.2	0.1	3.2	0.9	µg/L	50	42	1	40.5	3.2
T105	—	—	—	—	—	—	µg/L	155	7.5	0.9	7.6	7
T107	—	—	—	—	—	—	µg/L	202	186	9	192	11
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	µg/L	162	23.9	0.6	23.8	3	µg/L	149	70	3	70	7
T117	µg/L	167	7.4	0.3	6.9	1.4	µg/L	153	98	4	98.5	6.3
T119	µg/L	33	4.0	0.1	4.2	0.57	µg/L	33	44	2	44	3
T125	µg/L	126	10.3	0.4	10.2	1.54	µg/L	114	17	1	16.9	1.67
T129	µg/L	94	0.2	0.1	0.55	1.14	µg/L	94	34	2	34	1.9
T131	µg/L	22	54.8	2.2	56.6	5.4	µg/L	17	445	17	507	22
T133	µg/L	21	27.1	0.5	27.1	3.3	µg/L	21	148	4	148	9
T135	—	—	—	—	—	—	µg/L	110	66	5	67.8	4.3
T137	—	—	—	—	—	—	µg/L	111	63	7	65	4.8
T143	—	—	—	—	—	—	µg/L	40	82	10	81.9	4.5
T145	µg/L	101	9.7	0.3	9.88	1.04	µg/L	89	37	1	37.1	1.9
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Beryllium						Boron					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	42	19.4	1.1	19	2	—	—	—	—	—	—
SRM 1643b*	µg/L	159	18.8	0.8	19	2	µg/L	159	100	12	94	nr
SRM 1643d*	µg/L	260	11.9	0.6	12.53	0.28	µg/L	351	150	22	144.8	5.2
SRM 2704–total digestion	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	µg/L	33	491	22	495	9
T101	—	—	—	—	—	—	µg/L	50	332	18	370	21
T103	µg/L	50	5.0	0.1	4.8	1	µg/L	50	111	5	120	39
T105	—	—	—	—	—	—	µg/L	155	144	7	142	300
T107	—	—	—	—	—	—	µg/L	202	136	9	130	7
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	µg/L	149	10.5	0.5	10	0.9	µg/L	175	199	12	188	19
T117	µg/L	153	4.7	0.2	4.8	0.4	µg/L	218	147	8	151	20.8
T119	µg/L	33	13.2	0.3	13.6	1.7	µg/L	33	27	1	28	8.9
T125	µg/L	114	15.0	0.5	15	1.19	µg/L	182	18	3	19.4	8.02
T129	—	—	—	—	—	—	µg/L	94	10	4	11.6	2.8
T131	µg/L	17	12.2	0.3	12.2	0.8	µg/L	46	151	12	141	12
T133	µg/L	21	35.2	1.9	35	2.2	µg/L	21	299	15	297	16
T135	—	—	—	—	—	—	µg/L	110	10	3	13	11
T137	—	—	—	—	—	—	µg/L	111	14	4	16	4
T143	—	—	—	—	—	—	µg/L	40	33	6	35	5
T145	µg/L	89	9.0	0.2	9.04	0.7	µg/L	244	46	2	45.6	5.8
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Cadmium						Calcium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	159	11.5	0.4	10	1	—	—	—	—	—	—
SRM 1643b*	µg/L	159	20.2	0.8	20	1	mg/L	18	34.7	0.5	35	nr
SRM 1643d*	µg/L	622	6.50	0.62	6.47	0.37	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	3.70	0.15	3.45	0.22	wt %	19	2.70	0.15	2.60	0.03
SRM 2704–sum of seq. digestion	µg/g	5	3.5	0.23	3.45	0.22	wt %	5	2.8	0.17	2.6	0.03
SRM 1645–sum of seq. digestion	µg/g	5	7.7	0.44	10.2	1.5	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	mg/L	33	184	8	202	15
T101	—	—	—	—	—	—	mg/L	50	71.4	2.5	72.5	0.7
T103	µg/L	50	1.78	0.06	1.7	0.4	mg/L	80	55.2	2.2	54.7	2
T105	—	—	—	—	—	—	mg/L	155	72.5	3.1	73	4.2
T107	—	—	—	—	—	—	mg/L	202	12.3	0.9	11.7	0.2
T111	µg/L	46	24.5	0.3	23	1.9	—	—	—	—	—	—
T113	µg/L	201	4.12	0.14	4.23	0.8	—	—	—	—	—	—
T117	µg/L	246	2.25	0.08	2.2	0.4	mg/L	55	20.9	0.4	20.9	1.2
T119	µg/L	79	2.94	0.08	2.8	0.44	—	—	—	—	—	—
T125	µg/L	205	7.43	0.16	7.2	0.75	mg/L	99	9.7	0.4	9.34	0.53
T129	µg/L	94	0.28	0.07	0.34	0.15	—	—	—	—	—	—
T131	µg/L	104	6.13	0.18	6.1	0.47	mg/L	41	31.4	1.2	30.6	1.2
T133	µg/L	63	22.8	0.4	23	2.1	mg/L	38	7.5	1.0	7.04	0.33
T135	—	—	—	—	—	—	mg/L	110	11.0	0.7	10.4	0.6
T137	µg/L	46	6.96	0.09	6.8	0.52	mg/L	111	38.7	2.8	38.1	1.5
T143	—	—	—	—	—	—	mg/L	40	53.1	3.6	53.7	2.2
T145	µg/L	435	9.29	0.17	9.33	0.82	mg/L	46	31.2	3.9	30.7	1.3
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Cerium						Chromium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	µg/L	87	19.0	1.6	17	2
SRM 1643b*	—	—	—	—	—	—	µg/L	159	19.6	1.7	18.6	0.4
SRM 1643d*	—	—	—	—	—	—	µg/L	323	19.0	1.3	18.53	0.2
SRM 2704–total digestion	µg/g	19	55	10	72(i)	nr	µg/g	19	130	15	135	5
SRM 2704–sum of seq. digestion	µg/g	5	24	11	72(i)	nr	µg/g	5	140	10	135	5
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	wt %	5	2.6 0	0.31	2.96	0.28
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	—	—	—	—	—	—	µg/L	50	5.6	1.5	5.5	1.3
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	µg/L	8	26.0	1.0	25.8	3.7
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	µg/L	193	10.3	0.4	10.3	1.59
T119	—	—	—	—	—	—	µg/L	41	18.5	0.7	18.6	2.2
T125	—	—	—	—	—	—	µg/L	150	4.2	0.3	3.99	0.71
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	µg/L	39	19.3	0.8	18.6	2.1
T133	—	—	—	—	—	—	µg/L	28	38.1	1.5	38	3.2
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	µg/L	8	19.3	0.1	19.4	2
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	—	—	—	—	—	—	µg/L	181	15.1	0.6	15.3	1.4
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Cobalt						Copper					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	86	21.9	1.0	19	2	µg/L	159	20.7	1.5	18	2
SRM 1643b*	µg/L	159	26.1	0.9	26	1	µg/L	159	23.9	1.9	21.9	0.4
SRM 1643d*	µg/L	366	24.8	0.7	25	0.59	µg/L	622	21.3	1.5	20.5	3.8
SRM 2704–total digestion	µg/g	19	14.0	1.5	14.0	0.6	µg/g	19	96.0	5.9	98.6	5.0
SRM 2704–sum of seq. digestion	µg/g	5	12.5	1.2	14	0.6	µg/g	5	98	10	98.6	5
SRM 1645–sum of seq. digestion	µg/g	5	6.9	0.6	8	nr	µg/g	5	92	6	109	19
USGS Standards												
T99	—	—	—	—	—	—	µg/L	33	26	2	28	5
T101	—	—	—	—	—	—	µg/L	50	47	4	50	7
T103	µg/L	50	3.1	0.1	5.2	3.1	µg/L	50	82.6	2.0	83.3	5.7
T105	—	—	—	—	—	—	µg/L	155	19.2	1.7	20	4
T107	—	—	—	—	—	—	µg/L	202	30	2	30	2
T111	µg/L	46	9.0	0.2	9	1.7	µg/L	46	10.7	0.3	10.9	2.1
T113	µg/L	175	10.4	0.4	10.2	1.3	µg/L	201	46.1	1.3	47	5
T117	µg/L	180	4.1	0.2	4.3	0.74	µg/L	246	6.0	0.2	6	1.76
T119	µg/L	79	5.2	0.1	5.1	0.96	µg/L	79	2.1	0.1	2	1
T125	µg/L	148	9.7	0.3	9.45	0.78	µg/L	205	18.1	0.5	17.4	2.1
T129	—	—	—	—	—	—	µg/L	94	2.3	0.1	2.7	1.4
T131	µg/L	80	24.7	0.6	24.6	1.9	µg/L	104	20.5	0.6	20.2	2
T133	µg/L	63	20.0	0.4	20	1.5	µg/L	63	85.3	2.2	85.3	4.5
T135	—	—	—	—	—	—	µg/L	110	62	5	62.0	4.2
T137	—	—	—	—	—	—	µg/L	46	1.7	0.1	1.9	1.2
T143	—	—	—	—	—	—	µg/L	40	21.7	4.4	22.3	1.9
T145	µg/L	325	10.0	0.2	10	0.9	µg/L	435	11.0	0.2	11	1.4
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Dysprosium						Europium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	4.6	0.3	6(i)	nr	µg/g	19	1.1	0.1	1.3(i)	nr
SRM 2704–sum of seq. digestion	µg/g	5	2.9	0.3	6(i)	nr	µg/g	5	0.65	0.05	1.3(i)	nr
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	—	—	—	—	—	—	—	—	—	—	—	—
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	—	—	—	—	—	—
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	—	—	—	—	—	—	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	—	—	—	—	—	—
T133	—	—	—	—	—	—	—	—	—	—	—	—
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	—	—	—	—	—	—
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	—	—	—	—	—	—	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Iron						Lanthanum					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	mg/L	18	0.106	0.004	0.099	0.008	—	—	—	—	—	—
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	wt %	19	4.20	0.15	4.11	0.10	µg/g	19	24	4	29(i)	nr
SRM 2704–sum of seq. digestion	wt %	5	4.34	0.21	4.11	0.1	µg/g	5	8.9	3.9	29(i)	nr
SRM 1645–sum of seq. digestion	wt %	5	9.8	0.04	11.3	1.2	µg/g	5	6.7	0	9	nr
USGS Standards												
T99	mg/L	33	0.138	0.006	0.137	0.007	—	—	—	—	—	—
T101	mg/L	50	0.189	0.014	0.191	0.005	—	—	—	—	—	—
T103	mg/L	80	0.042	0.005	0.041	0.0076	—	—	—	—	—	—
T105	mg/L	155	0.019	0.006	0.024	0.012	—	—	—	—	—	—
T107	mg/L	202	0.055	0.007	0.052	0.002	—	—	—	—	—	—
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	mg/L	55	0.475	0.008	0.474	0.0182	—	—	—	—	—	—
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	mg/L	99	0.099	0.006	0.0979	0.0073	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	mg/L	41	0.085	0.008	0.0907	0.0089	—	—	—	—	—	—
T133	mg/L	38	0.035	0.009	0.0314	0.0067	—	—	—	—	—	—
T135	mg/L	110	0.228	0.015	0.228	0.011	—	—	—	—	—	—
T137	mg/L	111	0.066	0.013	0.071	0.009	—	—	—	—	—	—
T143	mg/L	40	0.220	0.026	0.222	0.014	—	—	—	—	—	—
T145	mg/L	46	0.104	0.018	0.101	0.008	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Lead						Lithium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	159	28.0	1.2	27	1	—	—	—	—	—	—
SRM 1643b*	µg/L	159	23.6	0.9	23.7	0.7	—	—	—	—	—	—
SRM 1643d*	µg/L	622	18.2	0.7	18.15	0.64	µg/L	364	16.8	1.0	16.5	0.55
SRM 2704–total digestion	µg/g	19	150	10	161	17	µg/g	19	45.0	1.5	47.5	4.1
SRM 2704–sum of seq. digestion	µg/g	5	160	7	161	17	µg/g	5	44.1	1.9	47.5	4.1
SRM 1645–sum of seq. digestion	µg/g	5	610	15	714	28	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	µg/L	50	8.4	0.4	7.7	2.1	µg/L	50	29.8	1.1	32.5	3.1
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	µg/L	46	19.9	0.6	18.8	5.8	µg/L	8	12.0	0.4	11.4	3.9
T113	—	—	—	—	—	—	µg/L	149	45.5	1.7	45	7
T117	µg/L	246	4.8	0.2	5	1.33	µg/L	204	20.4	0.7	20	2.48
T119	µg/L	79	7.0	0.3	6.7	1.12	µg/L	41	60.3	2.0	60.5	4.2
T125	µg/L	205	8.2	0.3	8.11	1.21	µg/L	160	15.9	0.7	16.2	1.58
T129	—	—	—	—	—	—	µg/L	94	18.0	0.6	18	2.6
T131	µg/L	104	16.5	0.9	18.1	2.7	µg/L	43	17.4	0.6	17	1.5
T133	µg/L	63	27.5	0.8	27.8	2.7	µg/L	28	51.2	2.0	51	3.5
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	µg/L	46	6.3	0.2	6.3	1	µg/L	8	9.0	0.2	8.7	1.5
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	µg/L	435	12.7	0.3	12.7	1.2	µg/L	225	27.2	0.7	27.3	2.5
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Lutetium						Magnesium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	mg/L	18	8.4	0.1	8.5	nr
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	0.4	0.0	0.6(i)	nr	wt %	19	1.10	0.15	1.20	0.02
SRM 2704–sum of seq. digestion	µg/g	5	0.19	0.03	0.6(i)	nr	wt %	5	0.75	0.11	1.2	0.02
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	mg/L	33	113	5	113	2
T101	—	—	—	—	—	—	mg/L	50	52.6	1.4	52.6	0.6
T103	—	—	—	—	—	—	mg/L	80	30.5	1.0	30.5	1.2
T105	—	—	—	—	—	—	mg/L	155	65.5	2.8	66.8	2.7
T107	—	—	—	—	—	—	mg/L	202	2.2	0.1	2.1	0.03
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	mg/L	55	10.1	0.1	10.05	0.44
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	—	—	—	—	—	—	mg/L	99	2.0	0.1	2	0.11
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	mg/L	41	7.9	0.2	8	0.28
T133	—	—	—	—	—	—	mg/L	38	6.0	0.4	5.82	0.21
T135	—	—	—	—	—	—	mg/L	110	2.0	0.1	2	0.09
T137	—	—	—	—	—	—	mg/L	111	10.2	0.8	10.1	0.5
T143	—	—	—	—	—	—	mg/L	40	10.2	0.9	10.4	0.5
T145	—	—	—	—	—	—	mg/L	46	8.7	0.8	8.68	0.45
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Manganese						Mercury					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	70	34.6	2.5	31	2	—	—	—	—	—	—
SRM 1643b*	µg/L	159	32.6	2.0	28	2	—	—	—	—	—	—
SRM 1643d*	µg/L	334	39.2	1.8	37.66	0.83	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	570	15	555	19	µg/g	18	1.55	0.10	1.47	0.07
SRM 2704–sum of seq. digestion	µg/g	5	560	13	555	19	µg/g	5	1.42	0.06	1.47	0.07
SRM 1645–sum of seq. digestion	µg/g	5	690	44	785	97	—	—	—	—	—	—
USGS Standards												
T99	µg/L	33	82	4	82	14	—	—	—	—	—	—
T101	µg/L	50	48	2	50	4	—	—	—	—	—	—
T103	µg/L	50	1.5	0.5	9	2.1	—	—	—	—	—	—
T105	µg/L	155	73	3	73	7	—	—	—	—	—	—
T107	µg/L	202	47	2	45	6	—	—	—	—	—	—
T111	µg/L	46	556	25	619	54	—	—	—	—	—	—
T113	µg/L	149	65	2	65	5	—	—	—	—	—	—
T117	µg/L	178	214	8	220	14.9	—	—	—	—	—	—
T119	µg/L	79	35.2	0.8	35	2.9	—	—	—	—	—	—
T125	µg/L	137	18.4	0.7	18	1.22	—	—	—	—	—	—
T129	µg/L	94	25.6	1.0	25.2	2.2	—	—	—	—	—	—
T131	µg/L	74	38.6	1.2	37.8	3	—	—	—	—	—	—
T133	µg/L	63	119	3	121	7	—	—	—	—	—	—
T135	µg/L	110	423	22	423	20	—	—	—	—	—	—
T137	µg/L	46	95	2	98	5	—	—	—	—	—	—
T143	µg/L	40	17.9	2.2	18.2	1.9	—	—	—	—	—	—
T145	µg/L	311	21.0	0.5	20.9	1.5	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	µg/L	302	0.024	0.004	0.022	0.008
Hg10**	—	—	—	—	—	—	µg/L	70	1.42	0.12	1.40	0.30
Hg12**	—	—	—	—	—	—	µg/L	220	1.39	0.08	1.44	0.25
Hg15**	—	—	—	—	—	—	µg/L	3	0.44	0.06	0.41	0.20
Hg24**	—	—	—	—	—	—	µg/L	10	0.42	0.03	0.42	0.05

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Molybdenum						Nickel					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	57	108	6	95	6	µg/L	99	55.7	1.7	55	3
SRM 1643b*	µg/L	159	97	3	85	3	µg/L	159	50.1	2.9	49	3
SRM 1643d*	µg/L	273	115	4	112.9	1.7	µg/L	377	58.3	1.7	58.1	2.7
SRM 2704–total digestion	—	—	—	—	—	—	µg/g	19	45.0	4.4	44.1	3.0
SRM 2704–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	40.6	7.0	44.1	3
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	39	3	45.8	2.9
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	µg/L	50	38.0	0.9	36.5	4.6	µg/L	50	6.8	0.3	6.7	2.5
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	µg/L	46	15.4	0.4	15.5	4.1
T113	µg/L	149	33.5	1.1	34	5	µg/L	175	2.3	0.2	2.1	1.2
T117	µg/L	166	11.1	0.5	11.8	2	µg/L	192	9.1	0.5	10	2.45
T119	µg/L	33	10.8	0.3	11.9	2.4	µg/L	79	22.5	0.5	21.8	2.2
T125	µg/L	126	19.1	0.7	20.1	1.78	µg/L	160	11.5	0.4	11.2	1.04
T129	µg/L	94	19.9	0.8	20.3	2.1	µg/L	94	1.7	0.2	1.7	1.7
T131	µg/L	21	120	3	112	10	µg/L	83	56.8	1.5	56.3	4.7
T133	µg/L	21	47.9	0.6	46	4.2	µg/L	63	27.0	0.7	27.2	3.1
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	µg/L	46	14.7	0.3	15	2.5
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	µg/L	118	8.8	0.3	9.23	1.29	µg/L	352	10.8	0.4	11	1.3
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Rubidium						Samarium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643d*	µg/L	260	12.9	0.4	13	nr	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	64	24	100(i)	nr	µg/g	19	5.7	0.7	6.7(i)	nr
SRM 2704–sum of seq. digestion	µg/g	5	34	10	100(i)	nr	µg/g	5	3.8	0.7	6.7(i)	nr
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	—	—	—	—	—	—	—	—	—	—	—	—
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	—	—	—	—	—	—
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	—	—	—	—	—	—	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	—	—	—	—	—	—
T133	—	—	—	—	—	—	—	—	—	—	—	—
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	—	—	—	—	—	—
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	—	—	—	—	—	—	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Selenium						Silica					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	114	9.0	2.3	11	1	—	—	—	—	—	—
SRM 1643b*	µg/L	159	7.9	1.4	9.7	0.5	—	—	—	—	—	—
SRM 1643d*	µg/L	389	9.7	1.4	11.43	0.17	—	—	—	—	—	—
SRM 2704–total digestion	wt %	—	—	—	—	—	wt %	19	29.9	2.1	29.08	0.13
SRM 2704–sum of seq. digestion	wt %	—	—	—	—	—	wt %	5	31.1	1.5	29.08	0.13
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	mg/L	33	11.1	0.5	10.9	0.3
T101	—	—	—	—	—	—	mg/L	50	6.86	0.24	6.97	0.177
T103	µg/L	50	3.2	0.3	2.9	1	mg/L	80	7.46	0.34	7.5	0.2
T105	—	—	—	—	—	—	mg/L	155	25.4	1.0	25.4	1.5
T107	—	—	—	—	—	—	mg/L	202	7.92	0.39	7.7	0.2
T111	µg/L	46	3.7	0.2	3.3	1	—	—	—	—	—	—
T113	µg/L	175	19.2	0.6	19	3.7	—	—	—	—	—	—
T117	µg/L	205	6.0	0.5	6	1.46	mg/L	55	11.8	0.2	11.85	0.64
T119	µg/L	79	9.9	0.4	9.8	1.33	—	—	—	—	—	—
T125	µg/L	172	9.7	0.4	9.78	1.85	mg/L	99	5.19	0.17	5.18	0.32
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	µg/L	88	9.9	0.5	11.2	2	mg/L	41	5.83	0.26	5.8	0.9
T133	µg/L	63	20.2	0.9	21.4	3.7	mg/L	38	10.2	0.9	10.1	0.7
T135	—	—	—	—	—	—	mg/L	110	4.39	0.42	4.28	0.31
T137	—	—	—	—	—	—	mg/L	111	6.89	0.57	6.96	0.56
T143	—	—	—	—	—	—	mg/L	40	23.2	1.6	23.4	1.7
T145	µg/L	381	10.0	0.4	10.1	1.3	mg/L	46	11.5	1.3	11.3	0.7
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Silver						Sodium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	µg/L	159	10.1	1.0	9.8	0.8	mg/L	18	8.4	0.1	8	nr
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	—	—	—	—	—	—	wt %	19	0.620	0.089	0.547	0.014
SRM 2704–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	mg/L	33	328	22	323	5
T101	—	—	—	—	—	—	mg/L	50	100	6	96.8	1.2
T103	µg/L	50	3.2	0.5	3.3	0.9	mg/L	80	108	6	107	5
T105	—	—	—	—	—	—	mg/L	155	295	22	298	17
T107	—	—	—	—	—	—	mg/L	202	21.7	2.4	20.7	0.3
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	µg/L	188	4.1	1.5	5	1	—	—	—	—	—	—
T117	µg/L	232	1.5	0.4	1.4	0.64	mg/L	55	19.9	0.6	20	1.26
T119	µg/L	33	2.4	0.6	4	1.31	—	—	—	—	—	—
T125	µg/L	194	3.1	1.2	3.83	0.604	mg/L	99	22.6	1.1	22.3	1.2
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	µg/L	51	0.9	0.5	1.26	0.24	mg/L	41	22.7	2.6	21.4	0.8
T133	µg/L	21	8.3	1.7	7.44	0.89	mg/L	38	31.9	4.9	29.4	1.2
T135	—	—	—	—	—	—	mg/L	110	31.5	3.2	30.8	1.2
T137	—	—	—	—	—	—	mg/L	111	22.8	3.4	22	1.1
T143	—	—	—	—	—	—	mg/L	40	33.9	4.8	34	1.6
T145	µg/L	256	7.6	0.3	7.55	0.92	mg/L	46	41.8	7.3	41.2	1.9
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Strontium						Thallium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	42	234	23	239	5	—	—	—	—	—	—
SRM 1643b*	µg/L	159	233	7	227	6	µg/L	159	7.9	0.4	8.0	0.2
SRM 1643d*	µg/L	306	296	10	294.8	3.4	µg/L	260	7.3	0.3	7.28	0.25
SRM 2704–total digestion	µg/g	19	120	15	130(i)	nr	µg/g	19	1.00	0.03	1.06	0.07
SRM 2704–sum of seq. digestion	µg/g	5	84	9	130(i)	nr	µg/g	5	1.05	0.04	1.06	0.07
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	1.1	0.1	1.44	0.07
USGS Standards												
T99	µg/L	33	3,900	200	3,900	100	—	—	—	—	—	—
T101	µg/L	50	1,200	0	1,200	36	—	—	—	—	—	—
T103	µg/L	50	753	13	743	34	µg/L	50	2.4	0.1	2	nr
T105	µg/L	155	1,600	0	1,560	80	—	—	—	—	—	—
T107	µg/L	202	63	4	61	4	—	—	—	—	—	—
T111	µg/L	—	—	—	—	—	—	—	—	—	—	—
T113	µg/L	149	33	1	31.9	3.7	—	—	—	—	—	—
T117	µg/L	153	266	4	265	11.1	—	—	—	—	—	—
T119	µg/L	33	74	3	73	5.4	—	—	—	—	—	—
T125	µg/L	114	46	2	46	2.3	—	—	—	—	—	—
T129	µg/L	94	182	3	181	11	—	—	—	—	—	—
T131	µg/L	17	301	6	295	14	—	—	—	—	—	—
T133	µg/L	21	127	3	123	6	—	—	—	—	—	—
T135	µg/L	110	47	3	46	2	—	—	—	—	—	—
T137	µg/L	111	231	17	230	14	—	—	—	—	—	—
T143	µg/L	40	301	21	306	15	—	—	—	—	—	—
T145	µg/L	89	203	5	203	9	µg/L	89	15.3	0.4	15.3	2.7
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Thorium						Tin					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	8.1	0.9	9.2	nr	µg/g	18	14.5	8.7	9.5	nr
SRM 2704–sum of seq. digestion	µg/g	5	3.6	0.6	9.2	nr	µg/g	5	20.1	0.4	9.5	nr
SRM 1645–sum of seq. digestion	µg/g	5	1.6	0.1	1.62	0.22	—	—	—	—	—	—
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	—	—	—	—	—	—	—	—	—	—	—	—
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	—	—	—	—	—	—
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	—	—	—	—	—	—	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	—	—	—	—	—	—
T133	—	—	—	—	—	—	—	—	—	—	—	—
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	—	—	—	—	—	—
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	—	—	—	—	—	—	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Titanium						Uranium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643b*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 1643d*	—	—	—	—	—	—	—	—	—	—	—	—
SRM 2704–total digestion	wt %	19	0.460	0.015	0.457	0.018	µg/g	19	3.10	0.15	3.13	0.13
SRM 2704–sum of seq. digestion	wt %	5	0.463	0.015	0.457	0.018	µg/g	5	3.0	0.1	3.13	0.13
SRM 1645–sum of seq. digestion	—	—	—	—	—	—	µg/g	5	1.1	0.1	1.11	0.05
USGS Standards												
T99	—	—	—	—	—	—	—	—	—	—	—	—
T101	—	—	—	—	—	—	—	—	—	—	—	—
T103	—	—	—	—	—	—	—	—	—	—	—	—
T105	—	—	—	—	—	—	—	—	—	—	—	—
T107	—	—	—	—	—	—	—	—	—	—	—	—
T111	—	—	—	—	—	—	—	—	—	—	—	—
T113	—	—	—	—	—	—	—	—	—	—	—	—
T117	—	—	—	—	—	—	—	—	—	—	—	—
T119	—	—	—	—	—	—	—	—	—	—	—	—
T125	—	—	—	—	—	—	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	—	—	—	—	—	—	—	—	—	—	—	—
T133	—	—	—	—	—	—	—	—	—	—	—	—
T135	—	—	—	—	—	—	—	—	—	—	—	—
T137	—	—	—	—	—	—	—	—	—	—	—	—
T143	—	—	—	—	—	—	—	—	—	—	—	—
T145	—	—	—	—	—	—	µg/L	101	1.11	0.04	1.1	0.1
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Vanadium						Ytterbium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	57	57.1	2.7	53	3	—	—	—	—	—	—
SRM 1643b*	µg/L	159	45.8	2.3	45.2	0.4	—	—	—	—	—	—
SRM 1643d*	µg/L	282	35.3	1.3	35.1	1.4	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	89	3	95	4	µg/g	19	2.6	0.1	2.8(i)	nr
SRM 2704–sum of seq. digestion	µg/g	5	94	1	95	4	µg/g	5	1.26	0.39	2.8(i)	nr
SRM 1645–sum of seq. digestion	µg/g	5	8.5	1.8	23.5	6.9	µg/g	—	—	—	—	—
USGS Standards												
T99	µg/L	33	9	2	12	6	—	—	—	—	—	—
T101	µg/L	50	16	2	17	5	—	—	—	—	—	—
T103	µg/L	50	40.2	1.0	40.4	4.1	—	—	—	—	—	—
T105	µg/L	155	6	2	5	7	—	—	—	—	—	—
T107	µg/L	202	15	3	14	3	—	—	—	—	—	—
T111	µg/L	9	27.8	0.4	27	3.3	—	—	—	—	—	—
T113	µg/L	149	9.4	0.4	9.4	1.5	—	—	—	—	—	—
T117	µg/L	166	4.6	0.2	4.7	1.8	—	—	—	—	—	—
T119	µg/L	42	3.9	0.1	3.8	0.9	—	—	—	—	—	—
T125	µg/L	126	6.8	0.3	6.56	0.89	—	—	—	—	—	—
T129	—	—	—	—	—	—	—	—	—	—	—	—
T131	µg/L	31	35.7	2.0	34.2	3.2	—	—	—	—	—	—
T133	µg/L	29	13.0	0.5	13	1.7	—	—	—	—	—	—
T135	µg/L	110	53	4	53	4	—	—	—	—	—	—
T137	µg/L	9	13.3	0.1	14	1.6	—	—	—	—	—	—
T143	µg/L	40	29	4	30	3	—	—	—	—	—	—
T145	µg/L	144	11.3	0.5	11.7	1.7	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Table A2-5. Concentration data for standard reference materials—*Continued*

	Zinc						Zirconium					
	Units	n	Median	MAD	PUB	PUB–SD	Units	n	Median	MAD	PUB	PUB–SD
NIST Standards												
SRM 1643a*	µg/L	159	66	4	72	4	—	—	—	—	—	—
SRM 1643b*	µg/L	159	65	5	66	2	—	—	—	—	—	—
SRM 1643d*	µg/L	622	72	3	72.48	0.65	—	—	—	—	—	—
SRM 2704–total digestion	µg/g	19	440	15	438	12	µg/g	19	350	44	300(i)	nr
SRM 2704–sum of seq. digestion	µg/g	5	414	25	438	12	µg/g	5	303	14	300(i)	nr
SRM 1645–sum of seq. digestion	µg/g	5	1,560	100	1,720	169	—	—	—	—	—	—
USGS Standards												
T99	µg/L	33	32	5	36	7	—	—	—	—	—	—
T101	µg/L	50	64	8	66	8	—	—	—	—	—	—
T103	µg/L	50	19	1	26.5	4.1	—	—	—	—	—	—
T105	µg/L	155	89	7	90	12	—	—	—	—	—	—
T107	µg/L	202	82	9	76	10	—	—	—	—	—	—
T111	µg/L	46	295	6	320	23	—	—	—	—	—	—
T113	µg/L	201	57	2	55.5	6.1	—	—	—	—	—	—
T117	µg/L	246	176	5	176	9.3	—	—	—	—	—	—
T119	µg/L	79	25	1	24.8	4.7	—	—	—	—	—	—
T125	µg/L	205	4.5	0.5	5.95	4.01	—	—	—	—	—	—
T129	µg/L	94	71	3	72	4.8	—	—	—	—	—	—
T131	µg/L	104	68	5	72	4.4	—	—	—	—	—	—
T133	µg/L	63	51	1	53	4.4	—	—	—	—	—	—
T135	µg/L	110	48	8	48.2	4.7	—	—	—	—	—	—
T137	µg/L	46	48	1	49.5	4.2	—	—	—	—	—	—
T143	µg/L	40	22	4	20.0	2.2	—	—	—	—	—	—
T145	µg/L	435	10	0	10	2.4	—	—	—	—	—	—
Hg7*	—	—	—	—	—	—	—	—	—	—	—	—
Hg10**	—	—	—	—	—	—	—	—	—	—	—	—
Hg12**	—	—	—	—	—	—	—	—	—	—	—	—
Hg15**	—	—	—	—	—	—	—	—	—	—	—	—
Hg24**	—	—	—	—	—	—	—	—	—	—	—	—

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Appendix 3. Data for Field Parameters, Anions, Nutrients, Organic Carbon, and Sampling Sites

Table A3-1. Field measurements and concentrations of anions, nutrients, and organic carbon.

Table A3-2. Sampling site numbers, names, and locations.

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Table A3-1. Field measurements and concentrations of anions, nutrients, and organic carbon

[Br., bridge; C, carbon; °C, degrees Celsius; $CaCO_3$, calcium carbonate; Cr., creek; N, nitrogen; P, phosphorus; R., River; Sac., Sacramento; SO_4, sulfate; est, estimated value. mm/dd/yy, month/day/year; ft^3/sec, cubic foot per second; mg/L, milligram per liter; µS/cm, microsiemen per centimeter at 25 degrees Celsius; <, less than; —, no data available]

Site	Date (mm/dd/yy)	Time	Stream discharge, daily mean (ft^3/s)	Water temperature, (°C)	Specific conductance, unfiltered (µS/cm)	Dissolved oxygen (mg/L)	pH, standard units	Alkalinity, filtered (mg/L as $CaCO_3$)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Fluoride, filtered (mg/L)	Nitrogen, ammonia, filtered, (mg/L as N)
Sac. R.–Shasta	07/12/96	1130	12,085	11	110	12.1	7.8	52	1.7	3.2	<0.10	<0.015
Sac. R.–Shasta	09/19/96	1100	6,946	12	112	12.5	7.7	49	1.5	3.4	<0.10	<0.015
Sac. R.–Shasta	11/19/96	1030	4,297	13	120	7.6	7.4	55	1.8	3.1	<0.10	<0.015
Sac. R.–Shasta	12/12/96	1030	31,632	12.5	124	11.8	7.3	56	—	—	—	—
Sac. R.–Shasta	05/29/97	1030	6,513	8.5	107	12.4	7.7	—	1.6	3.4	<0.10	<0.015
Sac. R.–Keswick	07/11/96	900	14,815	11	100	10.8	7.7	46	1.4	2.6	<0.10	0.04
Sac. R.–Keswick	09/19/96	1800	9,503	12.5	98	11.9	7.6	43	1.2	2.8	<0.10	0.02
Sac. R.–Keswick	11/21/96	1200	5,294	13	108	8.7	7.4	49	1.6	3.9	<0.10	0.11
Sac. R.–Keswick	12/11/96	1730	35,269	—	111	—	7.8	—	—	—	—	—
Sac. R.–Keswick	01/02/97	1900	42,161	10	111	13.2	7.6	19	—	—	—	<0.015
Sac. R.–Keswick	05/28/97	1730	9,938	9.5	99	10.6	7.7	—	—	—	—	<0.015
Sac. R.–Bend Br.	07/11/96	1430	15,100	13.5	106	11.5	7.9	47	1.8	2.8	<0.10	0.02
Sac. R.–Bend Br.	09/20/96	1300	9,500	13	106	10.7	7.8	46	1.7	3.3	<0.10	<0.015
Sac. R.–Bend Br.	11/22/96	1330	7,660	13	129	9.7	7.8	52	4.4	5.4	<0.10	0.09
Sac. R.–Bend Br.	12/12/96	1700	43,900	12	111	11	7.8	50	2.2	4.6	<0.10	0.02
Sac. R.–Bend Br.	01/03/97	1230	91,000	10.5	104	11.4	7.9	43	1.7	4	<0.10	<0.015
Sac. R.–Bend Br.	05/30/97	1200	10,200	12.5	111	10.4	7.7	46	1.9	3.2	<0.10	<0.015
Sac. R.–Colusa	07/16/96	1300	11,300	19	117	9.3	8.1	52	2.2	3.3	<0.10	0.03
Sac. R.–Colusa	09/25/96	1300	9,240	17.5	123	9.4	7.8	54	2.5	4	<0.10	<0.015
Sac. R.–Colusa	11/14/96	1120	5,810	13.5	144	10.3	7.8	58	4.2	5.3	<0.10	<0.015
Sac. R.–Colusa	12/16/96	1330	33,400	11	130	10.6	7.9	55	3.4	4.8	<0.10	0.03
Sac. R.–Colusa	01/04/97	1300	50,200	11	100	9.5	7.7	42	1.9	4.2	<0.10	<0.015
Sac. R.–Colusa	06/03/97	1250	8,180	18	121	9.4	7.9	48	2.8	4.6	<0.10	<0.015
Sac. R.–Verona	07/18/96	1240	16,400	20.5	112	9.3	8	47	2.2	3.2	<0.10	0.03
Sac. R.–Verona	09/26/96	1200	12,300	19	147	9	7.8	63	4.1	5.9	<0.10	<0.015
Sac. R.–Verona	11/13/96	1030	9,990	13.5	146	10.8	7.8	57	5.8	5.3	<0.10	0.05
Sac. R.–Verona	12/18/96	1100	58,900	10.5	117	10.4	7.9	50	3	4.2	<0.10	<0.015
Sac. R.–Verona	01/28/97	1230	71,200	10	62	11	7.5	24	1.4	2.6	<0.10	0.03
Sac. R.–Verona	06/04/97	1130	10,800	20	138	8.2	7.9	54	4.4	5.9	<0.10	<0.015
Sac. R.–Freeport	07/17/96	1100	20,200	20	101	9.2	7.8	—	2.3	3	<0.10	0.03
Sac. R.–Freeport	09/24/96	1130	14,900	19.5	149	8.8	7.8	62	5.9	6	<0.10	<0.015
Sac. R.–Freeport	11/15/96	1030	12,800	13	128	10.4	7.9	49	4.2	4.8	<0.10	<0.015
Sac. R.–Freeport	12/17/96	1130	75,400	11	98	10.5	7.6	42	2.4	3.4	<0.10	0.03
Sac. R.–Freeport	01/06/97	1100	93,700	9.5	51	7.7	7	21	1.1	1.7	<0.10	0.02
Sac. R.–Freeport	06/05/97	1030	13,200	20	115	8.6	8	46	3.9	4.3	<0.10	<0.015
Flat Cr.	12/11/96	1530	11	—	40	—	—	69	0.49	9.2	<0.10	<0.015

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Table A3-1. Field measurements and concentrations of anions, nutrients, and organic carbon—*Continued*

Site	Date (mm/dd/yy)	Time	Stream discharge, daily mean (ft^3/s)	Water temperature, (°C)	Specific conductance, unfiltered (µS/cm)	Dissolved oxygen (mg/L)	pH, standard units	Alkalinity, filtered (mg/L as $CaCO_3$)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Fluoride, filtered (mg/L)	Nitrogen, ammonia, filtered, (mg/L as N)
Flat Cr.	05/29/97	1600	1	25.5	175	6.4	6.7	—	1.5	55	0.11	<0.015
Spring Cr.–Weir	12/11/96	1400	200	11.5	129	10	4.4	—	0.5	57	<0.10	0.032
Spring Cr.–Weir	05/28/97	1100	10	20.5	495	8.7	4	—	0.57	230	<0.10	0.069
Spring Cr.–Road	01/02/97	1730	850	13	237	—	3.7	—	0.14	15	<0.10	0.048
Whiskeytown	12/11/96	1330	3,900	—	—	—	—	—	—	—	—	—
Whiskeytown	05/29/97	1410	2,720	—	—	—	—	—	—	—	—	—
Spring Cr. arm	07/12/96	1730	2,690	12	74	—	7.5	38	1	1.4	<0.10	<0.015
Spring Cr. arm	09/18/96	1500	2,460	11.5	75	10.2	7.6	35	1	1.6	<0.10	<0.015
Spring Cr. arm	11/20/96	1200	1,450	11.5	92	9.7	7.3	36	1.2	4.7	<0.10	0.02
Spring Cr. arm	12/11/96	1635	4,100	10.5	22	10.2	7.4	30	—	—	—	—
Spring Cr. arm	05/28/97	1400	2,725	11	81	9.6	7.5	—	1.1	2.8	<0.10	<0.015
Colusa Basin Drain	06/06/97	1110	500 (est)	23	712	6	8.1	200	37	92	0.4	—
Yolo Bypass	01/07/97	1400	160,000	9.5	93	—	7.2	41	2.2	3.5	<0.10	<0.015

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Table A3-1. Field measurements and concentrations of anions, nutrients, and organic carbon—*Continued*

Site	Date (mm/dd/yy)	Time	Stream discharge, daily mean (ft^3/s)	Nitrogen, ammonia plus organic, unfiltered (mg/L as N)	Nitrogen, ammonia plus organic, filtered (mg/L as N)	Nitrogen, nitrite, filtered (mg/L as N)	Nitrogen, nitrate plus nitrite, filtered (mg/L as N)	Phosphorus, unfiltered (mg/L as P)	Phosphorus, filtered (mg/L as P)	Phosphorus, ortho, filtered (mg/L as P)	Carbon, organic, filtered (mg/L as C)	Carbon, organic, suspended (mg/L as C)
Sac. R.–Shasta	07/12/96	1130	12,085	<0.20	<0.20	<0.01	0.13	0.03	0.02	0.03	1.2	0.4
Sac. R.–Shasta	09/19/96	1100	6,946	<0.20	<0.20	<0.01	0.13	0.02	0.02	0.03	1.1	0.2
Sac. R.–Shasta	11/19/96	1030	4,297	<0.20	<0.20	<0.01	0.1	0.03	0.01	0.02	0.9	0.2
Sac. R.–Shasta	12/12/96	1030	31,632	—	—	—	—	—	—	—	—	—
Sac. R.–Shasta	05/29/97	1030	6,513	<0.20	<0.20	<0.01	0.094	<0.010	<0.01	0.025	—	—
Sac. R.–Keswick	07/11/96	900	14,815	<0.20	<0.20	<0.01	0.12	<0.010	0.02	0.02	1.3	0.2
Sac. R.–Keswick	09/19/96	1800	9,503	<0.20	<0.20	<0.01	0.1	0.010	<0.01	0.02	1.1	<0.10
Sac. R.–Keswick	11/21/96	1200	5,294	<0.20	<0.20	0.01	0.1	0.020	<0.01	0.02	1.2	0.1
Sac. R.–Keswick	12/11/96	1730	35,269	—	—	—	—	—	—	—	—	—
Sac. R.–Keswick	01/02/97	1900	42,161	<0.20	<0.20	<0.01	0.09	<0.010	<0.01	<0.010	2.4	2.4
Sac. R.–Keswick	05/28/97	1730	9,938	<0.20	0.21	<0.01	0.079	<0.010	<0.01	0.016	—	—
Sac. R.–Bend Br.	07/11/96	1430	15,100	<0.20	<0.20	<0.01	0.12	0.130	<0.01	0.02	1.4	0.8
Sac. R.–Bend Br.	09/20/96	1300	9,500	<0.20	<0.20	<0.01	0.1	0.04	0.01	0.02	1.2	0.3
Sac. R.–Bend Br.	11/22/96	1330	7,660	<0.20	<0.20	0.02	0.25	0.03	0.03	0.03	1.6	0.3
Sac. R.–Bend Br.	12/12/96	1700	43,900	<0.20	<0.20	0.02	0.14	0.050	<0.01	0.02	1.5	0.4
Sac. R.–Bend Br.	01/03/97	1230	91,000	0.3	<0.20	<0.01	0.1	0.230	<0.01	<0.010	1.5	1.0
Sac. R.–Bend Br.	05/30/97	1200	10,200	<0.20	<0.20	<0.01	0.098	0.062	0.018	0.02	—	—
Sac. R.–Colusa	07/16/96	1300	11,300	<0.20	<0.20	<0.01	0.13	0.02	0.02	0.03	1.3	—
Sac. R.–Colusa	09/25/96	1300	9,240	<0.20	<0.20	0.02	0.13	0.040	<0.01	0.02	1.2	0.4
Sac. R.–Colusa	11/14/96	1120	5,810	<0.20	<0.20	<0.01	0.16	0.03	0.02	0.02	1.3	0.2
Sac. R.–Colusa	12/16/96	1330	33,400	<0.20	<0.20	<0.01	0.15	0.070	<0.01	0.02	1.4	—
Sac. R.–Colusa	01/04/97	1300	50,200	0.5	<0.20	<0.01	0.13	0.25	0.02	0.02	1.2	0.3
Sac. R.–Colusa	06/03/97	1250	8,180	<0.20	<0.20	<0.01	0.094	0.045	0.01	0.019	—	—
Sac. R.–Verona	07/18/96	1240	16,400	<0.20	<0.20	<0.01	0.11	0.020	<0.01	0.02	1.4	0.2
Sac. R.–Verona	09/26/96	1200	12,300	<0.20	<0.20	<0.01	0.1	0.04	0.02	0.02	1.4	0.4
Sac. R.–Verona	11/13/96	1030	9,990	<0.20	<0.20	0.03	0.17	0.04	0.04	0.03	1.9	0.4
Sac. R.–Verona	12/18/96	1100	58,900	<0.20	<0.20	0.01	0.13	0.050	<0.01	0.02	2	0.4
Sac. R.–Verona	01/28/97	1230	71,200	0.4	<0.20	<0.01	0.14	0.17	0.11	0.02	2.6	—
Sac. R.–Verona	06/04/97	1130	10,800	<0.20	<0.20	<0.01	0.12	0.040	<0.01	0.029	—	—
Sac. R.–Freeport	07/17/96	1100	20,200	<0.20	<0.20	<0.01	0.11	0.02	0.01	0.02	1.3	0.3
Sac. R.–Freeport	09/24/96	1130	14,900	<0.20	<0.20	0.02	0.14	0.040	<0.01	0.03	1.5	0.6
Sac. R.–Freeport	11/15/96	1030	12,800	<0.20	<0.20	<0.01	0.1	0.03	0.04	0.02	1.7	0.2
Sac. R.–Freeport	12/17/96	1130	75,400	<0.20	<0.20	<0.01	0.14	0.030	<0.01	0.01	2.2	0.6
Sac. R.–Freeport	01/06/97	1100	93,700	0.2	<0.20	<0.01	0.12	0.21	0.01	<0.010	2.1	1.4
Sac. R.–Freeport	06/05/97	1030	13,200	<0.20	<0.20	<0.01	0.123	0.033	<0.01	0.028	1.4	0.2
Flat Cr.	12/11/96	1530	11	<0.20	<0.20	0.014	0.063	<0.010	<0.01	<0.010	1.2	—

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Table A3-1. Field measurements and concentrations of anions, nutrients, and organic carbon—*Continued*

Site	Date (mm/dd/yy)	Time	Stream discharge, daily mean (ft^3/s)	Nitrogen, ammonia plus organic, unfiltered (mg/L as N)	Nitrogen, ammonia plus organic, filtered (mg/L as N)	Nitrogen, nitrite, filtered (mg/L as N)	Nitrogen, nitrate plus nitrite, filtered (mg/L as N)	Phosphorus, unfiltered (mg/L as P)	Phosphorus, filtered (mg/L as P)	Phosphorus, ortho, filtered (mg/L as P)	Carbon, organic, filtered (mg/L as C)	Carbon, organic, suspended (mg/L as C)
Flat Cr.	05/29/97	1600	1	<0.20	<0.20	<0.01	<0.05	<0.010	<0.01	<0.010	1.0	<0.10
Spring Cr.–Weir	12/11/96	1400	200	<0.20	<0.20	0.011	0.06	<0.010	<0.01	<0.010	1.2	—
Spring Cr.–Weir	05/28/97	1100	10	<0.20	<0.20	<0.01	<0.05	<0.010	<0.01	<0.010	0.4	—
Spring Cr.–Road	01/02/97	1730	850	<0.20	<0.20	<0.01	0.087	<0.010	<0.01	<0.010	0.9	0.2
Whiskeytown	12/11/96	1330	3,900	—	—	—	—	—	—	—	—	—
Whiskeytown	05/29/97	1410	2,720	—	—	—	—	—	—	—	—	—
Spring Cr. arm	07/12/96	1730	2,690	<0.20	<0.20	<0.01	<0.05	<0.010	<0.01	<0.010	1.4	0.2
Spring Cr. arm	09/18/96	1500	2,460	<0.20	<0.20	<0.01	0.07	<0.010	<0.01	0.01	1.2	0.2
Spring Cr. arm	11/20/96	1200	1,450	<0.20	<0.20	<0.01	<0.05	<0.010	<0.01	<0.010	1.1	0.3
Spring Cr. arm	12/11/96	1635	4,100	—	—	—	—	—	—	—	—	—
Spring Cr. arm	05/28/97	1400	2,725	<0.20	<0.20	<0.01	<0.05	<0.010	<0.01	<0.010	—	—
Colusa Basin Drain	06/06/97	1110	500 (est)	—	—	—	—	—	—	—	4.8	1.2
Yolo Bypass	01/07/97	1400	160,000	0.3	<0.20	<0.01	0.13	0.070	<0.01	0.02	2.0	1.3

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Table A3-2. Sampling site numbers, names, and locations

[Report site numbers refer to figure 8 and table 1; deg, degrees; min, minutes; sec, seconds; latitude and longitude referenced to NAD27; NAD27, North American Datum 1927; USGS, U.S. Geological Survey. All latitude values are N of the equator and all longitude values W of the central meridian]

Report site number	Site name	USGS site identification number	Site latitude (deg min sec)	Site longitude (deg min sec)
1	Sacramento River below Shasta Dam, California	404259122252501	40° 42′ 59″	122° 25′ 25″
2	Sacramento River below Keswick Dam, California	403633122264301	40° 36′ 33″	122° 26′ 43″
3	Sacramento River at Rodeo Park near Redding, California	403528122224301	40° 35′ 28″	122° 22′ 43″
4	Sacramento River above Churn Creek near Anderson, California	402827122185801	40° 28′ 27″	122° 18′ 58″
5	Sacramento River at Balls Ferry	402507122113201	40° 25′ 07″	122° 11′ 32″
6	Sacramento River above Bend Bridge near Red Bluff, California	11377100	40° 17′ 19″	122° 11′ 08″
7	Sacramento River at Tehama, California	400139122070301	40° 01′ 39″	122° 07′ 03″
8	Sacramento River at Colusa, California	11389500	39° 12′ 51″	121° 59′ 57″
9	Sacramento River at Verona, California	11425500	38° 46′ 28″	121° 35′ 50″
10	Sacramento River at Tower Bridge at Sacramento, California	383430121302001	38° 34′ 30″	121° 30′ 20″
11	Sacramento River at Freeport, California	11447650	38° 27′ 20″	121° 30′ 07″
12	Flat Creek near Keswick, California	403824122264601	40° 38′ 24″	122° 26′ 46″
13	Spring Creek below Spring Creek Debris Dam near Keswick, California	403746122281201	40° 37′ 46″	122° 28′ 12″
14	Spring Creek below Iron Mountain Road near Keswick, California	403746122280301	40° 37′ 46″	122° 28′ 03″
15	Whiskeytown Lake at Spring Creek Power Plant near Keswick, California	403741122275901	40° 37′ 41″	122° 27′ 59″
16	Keswick Reservoir, Spring Creek arm, near Keswick, California	403750122272301	40° 37′ 50″	122° 27′ 23″
17	Cottonwood Creek near Cottonwood, California	11376000	40° 23′ 14″	122° 14′ 15″
18	Colusa Basin Drain at Road 99E near Knights Landing, California	11390890	38° 48′ 45″	121° 46′ 23″
19	Yolo Bypass at Interstate 80 near West Sacramento, California	11453120	38° 34′ 01″	121° 36′ 51″

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Appendix 4. Metal Concentrations in Water Samples

Table A4-1. Concentrations of major cations and trace elements in filtered water samples.

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples

Table A4-3. Lead concentrations in filtered water samples collected at a single point in the stream cross section.

Table A4-4. Lead concentrations in unfiltered (whole) water samples collected at a single point in the stream cross section.

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples

[Ax, axial; Br., bridge; Cap, capsule filter (Gelman); Cr., creek; CV–AFS, cold–vapor/atomic fluorescence spectrometry; comp., composite sample; dup, duplicate; ICP–AES, inductively coupled plasma–atomic emission spectrometry; ICP–MS, inductively coupled plasma–mass spectrometry; Mem, membrane filter (Nuclepore); R., river; Sac., Sacramento; Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples; Tan, tangential-flow ultrafilter (Millipore Minitan); UV–VIS, ultraviolet–visible spectroscopy. kd, kilodalton; mm/dd/yy, month-day-year; mg/L, microgram per liter; mm, micrometer; mg/L, milligram per liter; —, no data available; <, less than indicated detection limit]

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP–MS	Antimony (µg/L) ICP–MS	Arsenic (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	0.40 mm Mem	1/2	9.2 ± 0.2	0.040 ± 0.003	1.1 ± 0.0	15 ± 0	< 0.018 ± 0.007
Sac. R.–Shasta	07/12/96	0.40 mm Mem	2/2	5.8 ± 0.1	0.037 ± 0.005	1.1 ± 0.0	15 ± 1	0.0040 ± 0.0023
Sac. R.–Shasta	07/12/96	0.45 mm Cap	1/2	2.4 ± 0.0	0.033 ± 0.002	1.1 ± 0.0	14 ± 0	< 0.01 ± 0.00
Sac. R.–Shasta	07/12/96	0.45 mm Cap	2/2	2.2 ± 0.1	0.033 ± 0.003	1.0 ± 0.0	15 ± 0	< 0.004 ± 0.003
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	1.7 ± 0.1	0.033 ± 0.002	1.1 ± 0.0	14 ± 0	< 0.01 ± 0.00
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	1.6 ± 0.1	0.030 ± 0.003	0.99 ± 0.02	14 ± 0	< 0.018 ± 0.008
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 mm Mem	1/2	14 ± 1	0.051 ± 0.007	1.1 ± 0.0	14 ± 0	0.015 ± 0.017
Sac. R.–Shasta	09/19/96	0.40 mm Mem	2/2	15 ± 0	0.056 ± 0.002	1.1 ± 0.1	14 ± 0	0.014 ± 0.009
Sac. R.–Shasta	09/19/96	0.45 mm Cap	1/2	2.8 ± 0.1	0.051 ± 0.005	1.1 ± 0.0	14 ± 0	< 0.013 ± 0.008
Sac. R.–Shasta	09/19/96	0.45 mm Cap	2/2	2.6 ± 0.1	0.034 ± 0.008	1.0 ± 0.0	14 ± 0	< 0.03 ± 0.02
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	2.1 ± 0.2	0.028 ± 0.004	0.86 ± 0.02	13 ± 0	< 0.03 ± 0.03
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	1.8 ± 0.0	0.050 ± 0.012	0.81 ± 0.03	12 ± 0	< 0.013 ± 0.004
Sac. R.–Shasta	11/19/96	0.40 mm Mem	1/2	3.0 ± 0.1	0.037 ± 0.004	1.5 ± 0.0	13 ± 0	< 0.02 ± 0.01
Sac. R.–Shasta	11/19/96	0.40 mm Mem	2/2	3.0 ± 0.1	0.042 ± 0.003	1.5 ± 0.0	13 ± 0	< 0.02 ± 0.00
Sac. R.–Shasta	11/19/96	0.45 mm Cap	1/2	2.0 ± 0.1	0.029 ± 0.003	1.5 ± 0.0	13 ± 0	< 0.02 ± 0.00
Sac. R.–Shasta	11/19/96	0.45 mm Cap	2/2	1.4 ± 0.0	0.030 ± 0.005	1.5 ± 0.1	13 ± 0	< 0.02 ± 0.02
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	0.94 ± 0.06	0.032 ± 0.006	1.1 ± 0.0	12 ± 0	< 0.02 ± 0.00
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	0.94 ± 0.02	0.032 ± 0.012	1.1 ± 0.0	11 ± 1	< 0.02 ± 0.01
Sac. R.–Shasta	12/12/96	0.40 mm Mem	1/2	11 ± 0	0.040 ± 0.006	1.6 ± 0.0	14 ± 0	< 0.02 ± 0.01
Sac. R.–Shasta	12/12/96	0.40 mm Mem	2/2	10 ± 0	0.050 ± 0.011	1.8 ± 0.0	13 ± 0	< 0.02 ± 0.01
Sac. R.–Shasta	12/12/96	0.45 mm Cap	1/2	6.8 ± 0.2	0.051 ± 0.008	1.7 ± 0.0	13 ± 0	< 0.014 ± 0.003
Sac. R.–Shasta	12/12/96	0.45 mm Cap	2/2	6.6 ± 0.1	0.053 ± 0.006	1.7 ± 0.0	14 ± 0	< 0.014 ± 0.006
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	5.3 ± 0.1	0.048 ± 0.005	1.2 ± 0.0	12 ± 1	< 0.014 ± 0.006
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	4.9 ± 0.1	0.032 ± 0.001	1.2 ± 0.0	11 ± 1	< 0.02 ± 0.02
Sac. R.–Shasta	05/29/97	0.40 mm Mem	1/2	43 ± 1	0.034 ± 0.012	1.1 ± 0.0	14 ± 0	< 0.04 ± 0.01
Sac. R.–Shasta	05/29/97	0.40 mm Mem	2/2	14 ± 1	0.036 ± 0.010	1.1 ± 0.0	14 ± 0	< 0.04 ± 0.00
Sac. R.–Shasta	05/29/97	0.45 mm Cap	1/2	2.8 ± 0.2	0.029 ± 0.016	1.1 ± 0.0	13 ± 0	< 0.04 ± 0.02
Sac. R.–Shasta	05/29/97	0.45 mm Cap	2/2	2.8 ± 0.1	0.030 ± 0.010	1.0 ± 0.0	14 ± 0	< 0.04 ± 0.02
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	1.7 ± 0.1	0.026 ± 0.010	0.66 ± 0.03	11 ± 0	< 0.04 ± 0.02
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	1.7 ± 0.1	0.024 ± 0.017	0.63 ± 0.02	11 ± 0	< 0.04 ± 0.01
Sac. R.–Keswick	07/11/96	0.40 mm Mem	1/2	3.5 ± 0.0	0.032 ± 0.002	0.84 ± 0.02	12 ± 0	< 0.004 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP-MS	Antimony (µg/L) ICP-MS	Arsenic (µg/L) ICP-MS	Barium (µg/L) ICP-MS	Beryllium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	3.3 ± 0.1	0.030 ± 0.000	0.82 ± 0.02	12 ± 0	< 0.004 ± 0.002
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	2.8 ± 0.0	0.033 ± 0.001	0.84 ± 0.01	13 ± 0	< 0.004 ± 0.003
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	3.0 ± 0.0	0.035 ± 0.003	0.85 ± 0.01	13 ± 0	0.0054 ± 0.0020
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	2.0 ± 0.1	0.032 ± 0.002	0.78 ± 0.02	12 ± 0	< 0.004 ± 0.002
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	2.2 ± 0.1	0.031 ± 0.003	0.82 ± 0.02	13 ± 0	0.0043 ± 0.0004
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	2.1 ± 0.2	0.030 ± 0.005	0.76 ± 0.02	12 ± 0	< 0.004 ± 0.001
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	8.7 ± 0.0	0.041 ± 0.005	0.69 ± 0.06	11 ± 0	< 0.013 ± 0.007
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	8.4 ± 0.1	0.021 ± 0.006	0.77 ± 0.03	11 ± 0	< 0.03 ± 0.01
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	6.8 ± 0.2	0.031 ± 0.009	0.74 ± 0.01	11 ± 0	< 0.03 ± 0.02
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	6.6 ± 0.1	0.028 ± 0.007	0.72 ± 0.02	11 ± 0	< 0.03 ± 0.01
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	5.1 ± 0.1	0.048 ± 0.010	0.47 ± 0.02	8.9 ± 0.1	< 0.013 ± 0.001
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	4.8 ± 0.0	0.048 ± 0.007	0.50 ± 0.04	9.1 ± 0.1	< 0.013 ± 0.017
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	5.0 ± 0.0	0.038 ± 0.006	0.51 ± 0.04	9.2 ± 0.1	0.016 ± 0.004
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	19 ± 0	0.056 ± 0.006	1.7 ± 0.0	11 ± 0	< 0.02 ± 0.01
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	18 ± 0	0.057 ± 0.006	1.5 ± 0.1	11 ± 0	< 0.02 ± 0.01
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	12 ± 0	0.054 ± 0.002	1.5 ± 0.1	11 ± 0	< 0.02 ± 0.01
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	13 ± 0	0.056 ± 0.007	1.4 ± 0.0	11 ± 0	< 0.02 ± 0.00
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	11 ± 0	0.044 ± 0.007	0.98 ± 0.05	9.3 ± 0.5	< 0.02 ± 0.01
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	11 ± 0	0.056 ± 0.018	0.97 ± 0.03	8.9 ± 0.0	< 0.02 ± 0.01
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	38 ± 1	0.041 ± 0.003	1.6 ± 0.0	13 ± 0	< 0.02 ± 0.00
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	31 ± 0	0.045 ± 0.005	1.6 ± 0.1	13 ± 1	< 0.02 ± 0.01
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	23 ± 0	0.059 ± 0.021	1.6 ± 0.0	13 ± 0	< 0.014 ± 0.002
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	23 ± 1	0.041 ± 0.006	1.5 ± 0.0	13 ± 0	< 0.02 ± 0.00
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	20 ± 0	0.032 ± 0.002	0.92 ± 0.01	11 ± 0	< 0.02 ± 0.01
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	20 ± 0	0.036 ± 0.005	0.87 ± 0.05	10 ± 0	< 0.02 ± 0.01
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	17 ± 1	0.040 ± 0.006	1.1 ± 0.0	13 ± 0	< 0.014 ± 0.001
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	16 ± 0	0.047 ± 0.006	1.1 ± 0.0	12 ± 1	< 0.014 ± 0.003
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	15 ± 0	0.047 ± 0.007	1.1 ± 0.0	14 ± 0	< 0.014 ± 0.005
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	15 ± 0	0.043 ± 0.004	1.1 ± 0.1	13 ± 0	< 0.014 ± 0.006
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	12 ± 0	0.044 ± 0.005	0.87 ± 0.03	12 ± 1	< 0.014 ± 0.008
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	12 ± 0	0.044 ± 0.020	0.91 ± 0.02	12 ± 0	< 0.014 ± 0.006
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	13 ± 0	0.047 ± 0.002	0.93 ± 0.03	13 ± 0	< 0.015 ± 0.019
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	6.9 ± 0.4	0.038 ± 0.008	0.88 ± 0.06	12 ± 0	< 0.04 ± 0.01
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	35 ± 2	0.035 ± 0.012	0.87 ± 0.04	12 ± 0	< 0.04 ± 0.01

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP-MS	Antimony (µg/L) ICP-MS	Arsenic (µg/L) ICP-MS	Barium (µg/L) ICP-MS	Beryllium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	5.4 ± 0.3	0.034 ± 0.008	0.86 ± 0.03	12 ± 0	< 0.04 ± 0.02
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	5.3 ± 0.1	0.032 ± 0.013	0.88 ± 0.06	12 ± 0	< 0.04 ± 0.03
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	4.1 ± 0.1	0.028 ± 0.014	0.60 ± 0.03	10 ± 0	< 0.04 ± 0.01
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	4.2 ± 0.1	0.045 ± 0.015	0.65 ± 0.01	10 ± 0	< 0.04 ± 0.01
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	5.9 ± 0.0	0.039 ± 0.005	0.90 ± 0.01	15 ± 0	< 0.018 ± 0.001
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	6.3 ± 0.3	0.030 ± 0.006	0.93 ± 0.01	14 ± 1	< 0.01 ± 0.00
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	3.9 ± 0.1	0.039 ± 0.005	0.86 ± 0.02	14 ± 0	< 0.004 ± 0.001
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	3.7 ± 0.0	0.033 ± 0.003	0.94 ± 0.02	14 ± 0	< 0.01 ± 0.00
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	2.2 ± 0.0	0.040 ± 0.002	0.98 ± 0.02	15 ± 0	< 0.01 ± 0.00
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	2.0 ± 0.0	0.033 ± 0.000	0.78 ± 0.01	13 ± 1	< 0.004 ± 0.002
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	4.7 ± 0.1	0.035 ± 0.010	0.77 ± 0.01	13 ± 0	< 0.03 ± 0.02
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	5.7 ± 0.5	0.051 ± 0.002	0.80 ± 0.01	14 ± 1	< 0.017 ± 0.014
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	4.4 ± 0.1	0.047 ± 0.009	0.75 ± 0.06	13 ± 0	< 0.013 ± 0.011
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	4.6 ± 0.1	0.059 ± 0.001	0.80 ± 0.02	13 ± 1	< 0.017 ± 0.013
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	2.7 ± 0.0	0.043 ± 0.003	0.48 ± 0.04	11 ± 0	< 0.013 ± 0.015
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	2.5 ± 0.1	0.038 ± 0.003	0.50 ± 0.06	11 ± 0	< 0.013 ± 0.005
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	12 ± 0	0.056 ± 0.001	1.3 ± 0.1	17 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	12 ± 0	0.059 ± 0.008	1.3 ± 0.1	16 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	9.7 ± 0.2	0.058 ± 0.008	1.3 ± 0.1	16 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	9.6 ± 0.3	0.057 ± 0.007	1.3 ± 0.0	16 ± 0	< 0.02 ± 0.00
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	6.9 ± 0.2	0.042 ± 0.004	0.72 ± 0.02	13 ± 0	< 0.02 ± 0.00
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	6.8 ± 0.4	0.048 ± 0.012	0.76 ± 0.03	13 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	14 ± 1	0.047 ± 0.005	1.3 ± 0.0	17 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	19 ± 0	0.059 ± 0.009	1.3 ± 0.0	17 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	12 ± 0	0.059 ± 0.002	1.3 ± 0.0	16 ± 0	< 0.02 ± 0.02
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	12 ± 0	0.053 ± 0.005	1.2 ± 0.1	16 ± 0	< 0.02 ± 0.00
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	9.4 ± 0.1	0.046 ± 0.011	0.79 ± 0.03	13 ± 0	< 0.02 ± 0.01
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	9.8 ± 0.2	0.043 ± 0.010	0.78 ± 0.01	14 ± 1	< 0.02 ± 0.01
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	80 ± 1	0.050 ± 0.004	0.89 ± 0.04	16 ± 1	< 0.014 ± 0.004
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	7.1 ± 0.0	0.077 ± 0.034	0.89 ± 0.03	16 ± 0	< 0.014 ± 0.005
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	10 ± 0	0.060 ± 0.007	0.91 ± 0.04	16 ± 0	< 0.014 ± 0.003
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	9.8 ± 0.2	0.061 ± 0.009	0.90 ± 0.03	16 ± 0	< 0.014 ± 0.007

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP-MS	Antimony (µg/L) ICP-MS	Arsenic (µg/L) ICP-MS	Barium (µg/L) ICP-MS	Beryllium (µg/L) ICP-MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	4.0 ± 0.1	0.049 ± 0.002	0.70 ± 0.04	14 ± 1	< 0.014 ± 0.002
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	3.9 ± 0.1	0.043 ± 0.001	0.68 ± 0.03	13 ± 0	< 0.014 ± 0.005
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	17 ± 1	0.038 ± 0.005	0.85 ± 0.03	14 ± 0	< 0.04 ± 0.01
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	6.1 ± 0.3	0.033 ± 0.011	0.83 ± 0.01	14 ± 0	< 0.04 ± 0.02
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	5.1 ± 0.7	0.040 ± 0.008	0.83 ± 0.03	14 ± 0	< 0.04 ± 0.01
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	5.0 ± 0.3	0.040 ± 0.006	0.79 ± 0.00	14 ± 0	< 0.04 ± 0.00
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	3.6 ± 0.3	0.045 ± 0.000	0.62 ± 0.04	12 ± 0	< 0.04 ± 0.02
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	3.6 ± 0.1	0.029 ± 0.017	0.62 ± 0.04	12 ± 0	< 0.04 ± 0.01
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	14 ± 0	0.057 ± 0.002	1.3 ± 0.0	18 ± 0	< 0.01 ± 0.00
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	23 ± 0	0.049 ± 0.003	1.3 ± 0.0	17 ± 0	< 0.01 ± 0.00
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	5.4 ± 0.1	0.058 ± 0.004	1.1 ± 0.0	16 ± 1	< 0.018 ± 0.005
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	3.9 ± 0.1	0.065 ± 0.006	1.2 ± 0.1	17 ± 0	< 0.013 ± 0.011
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	3.1 ± 0.0	0.058 ± 0.007	1.2 ± 0.0	17 ± 0	< 0.013 ± 0.012
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	2.9 ± 0.1	0.065 ± 0.005	1.2 ± 0.1	17 ± 0	< 0.013 ± 0.005
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	2.9 ± 0.1	0.054 ± 0.001	1.2 ± 0.1	19 ± 0	0.018 ± 0.003
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	1.5 ± 0.0	0.069 ± 0.003	0.94 ± 0.07	15 ± 0	< 0.013 ± 0.006
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	1.5 ± 0.1	0.054 ± 0.007	0.96 ± 0.05	15 ± 0	< 0.013 ± 0.009
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	3.7 ± 0.1	0.058 ± 0.001	1.8 ± 0.1	18 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	3.5 ± 0.1	0.066 ± 0.009	1.8 ± 0.1	18 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	2.5 ± 0.1	0.054 ± 0.016	1.8 ± 0.1	19 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	2.2 ± 0.1	0.063 ± 0.019	1.7 ± 0.1	19 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	1.4 ± 0.1	0.049 ± 0.005	1.3 ± 0.1	17 ± 0	< 0.02 ± 0.00
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	2.0 ± 0.1	0.051 ± 0.002	1.4 ± 0.0	17 ± 0	< 0.02 ± 0.00
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	8.9 ± 0.3	0.069 ± 0.015	1.6 ± 0.0	22 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	7.4 ± 0.1	0.065 ± 0.009	1.5 ± 0.0	21 ± 0	< 0.02 ± 0.00
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	6.8 ± 0.1	0.074 ± 0.003	1.5 ± 0.1	21 ± 1	< 0.014 ± 0.002
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	6.2 ± 0.1	0.072 ± 0.008	1.5 ± 0.1	20 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	3.7 ± 0.2	0.063 ± 0.005	1.0 ± 0.0	18 ± 0	< 0.014 ± 0.000
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	3.9 ± 0.1	0.053 ± 0.005	1.1 ± 0.0	18 ± 0	< 0.02 ± 0.01
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	5.8 ± 0.1	0.13 ± 0.03	1.0 ± 0.0	16 ± 0	< 0.014 ± 0.008
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	5.8 ± 0.3	0.12 ± 0.01	0.99 ± 0.02	16 ± 1	< 0.014 ± 0.008

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP–MS	Antimony (µg/L) ICP–MS	Arsenic (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	17 ± 0	0.13 ± 0.00	1.0 ± 0.0	17 ± 1	< 0.014 ± 0.008
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	14 ± 1	0.12 ± 0.01	1.0 ± 0.0	17 ± 0	< 0.014 ± 0.005
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	4.4 ± 0.2	0.13 ± 0.01	0.98 ± 0.01	15 ± 0	< 0.014 ± 0.006
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	4.4 ± 0.1	0.13 ± 0.01	0.96 ± 0.03	15 ± 0	< 0.014 ± 0.006
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	19 ± 0	0.073 ± 0.007	1.3 ± 0.0	17 ± 0	< 0.04 ± 0.02
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	44 ± 2	0.070 ± 0.006	1.3 ± 0.0	17 ± 0	< 0.04 ± 0.01
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	3.8 ± 0.2	0.067 ± 0.008	1.4 ± 0.0	17 ± 0	< 0.04 ± 0.01
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	3.8 ± 0.1	0.066 ± 0.011	1.3 ± 0.0	17 ± 0	< 0.04 ± 0.01
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	2.5 ± 0.0	0.060 ± 0.011	1.1 ± 0.0	15 ± 0	< 0.04 ± 0.02
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	2.6 ± 0.2	0.066 ± 0.001	1.2 ± 0.0	15 ± 0	< 0.04 ± 0.02
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	8.9 ± 0.2	0.052 ± 0.003	1.1 ± 0.0	17 ± 0	< 0.018 ± 0.001
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	24 ± 0	0.050 ± 0.003	1.0 ± 0.0	17 ± 0	< 0.004 ± 0.001
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	4.8 ± 0.1	0.049 ± 0.001	1.1 ± 0.0	17 ± 0	< 0.004 ± 0.001
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	4.4 ± 0.0	0.049 ± 0.004	1.0 ± 0.0	16 ± 0	< 0.004 ± 0.005
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	3.1 ± 0.0	0.047 ± 0.005	1.0 ± 0.0	14 ± 0	< 0.01 ± 0.00
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	2.7 ± 0.1	0.048 ± 0.006	0.97 ± 0.02	16 ± 0	< 0.004 ± 0.002
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	33 ± 0	0.068 ± 0.000	1.4 ± 0.0	22 ± 1	< 0.017 ± 0.005
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	6.5 ± 0.2	0.077 ± 0.010	1.4 ± 0.0	21 ± 0	< 0.017 ± 0.004
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	2.0 ± 0.2	0.063 ± 0.002	1.4 ± 0.0	23 ± 0	< 0.017 ± 0.002
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	2.1 ± 0.1	0.075 ± 0.001	1.4 ± 0.0	22 ± 3	< 0.017 ± 0.006
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	1.1 ± 0.0	0.066 ± 0.003	1.1 ± 0.0	19 ± 0	< 0.013 ± 0.020
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	1.1 ± 0.0	0.090 ± 0.005	1.2 ± 0.1	19 ± 0	< 0.013 ± 0.007
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	14 ± 1	0.059 ± 0.008	1.7 ± 0.1	21 ± 0	< 0.02 ± 0.01
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	16 ± 0	0.054 ± 0.003	1.8 ± 0.0	22 ± 0	< 0.02 ± 0.01
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	11 ± 1	0.075 ± 0.006	1.2 ± 0.0	19 ± 0	< 0.014 ± 0.007
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	5.0 ± 0.2	0.057 ± 0.009	1.1 ± 0.0	19 ± 0	< 0.02 ± 0.01
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	4.4 ± 0.1	0.065 ± 0.010	1.1 ± 0.0	19 ± 0	< 0.02 ± 0.00
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	4.4 ± 0.3	0.062 ± 0.000	1.2 ± 0.0	19 ± 0	< 0.02 ± 0.01
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	2.0 ± 0.1	0.046 ± 0.007	1.1 ± 0.0	17 ± 1	< 0.02 ± 0.00
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	2.1 ± 0.1	0.059 ± 0.005	1.0 ± 0.1	18 ± 1	< 0.02 ± 0.02

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP-MS	Antimony (µg/L) ICP-MS	Arsenic (µg/L) ICP-MS	Barium (µg/L) ICP-MS	Beryllium (µg/L) ICP-MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	8.9 ± 0.3	0.078 ± 0.012	1.6 ± 0.0	20 ± 0	< 0.04 ± 0.03
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	3.7 ± 0.2	0.076 ± 0.009	1.6 ± 0.1	21 ± 0	< 0.04 ± 0.01
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	3.2 ± 0.2	0.074 ± 0.009	1.6 ± 0.0	21 ± 1	< 0.04 ± 0.01
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	3.1 ± 0.1	0.071 ± 0.009	1.6 ± 0.0	21 ± 0	< 0.04 ± 0.01
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	1.6 ± 0.1	0.060 ± 0.011	1.0 ± 0.0	18 ± 1	< 0.04 ± 0.05
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	1.7 ± 0.1	0.066 ± 0.010	1.0 ± 0.0	18 ± 0	< 0.04 ± 0.04
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	7.4 ± 0.1	0.041 ± 0.003	1.0 ± 0.0	16 ± 0	< 0.01 ± 0.00
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	6.9 ± 0.1	0.044 ± 0.002	1.0 ± 0.0	15 ± 0	< 0.01 ± 0.01
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	9.4 ± 0.1	0.054 ± 0.011	1.0 ± 0.0	16 ± 0	< 0.018 ± 0.021
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	9.3 ± 0.3	0.045 ± 0.005	1.1 ± 0.0	16 ± 0	< 0.01 ± 0.00
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	2.1 ± 0.1	0.043 ± 0.005	0.68 ± 0.02	13 ± 0	< 0.004 ± 0.001
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	2.5 ± 0.0	0.048 ± 0.004	1.1 ± 0.0	16 ± 0	< 0.004 ± 0.001
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	2.6 ± 0.1	0.083 ± 0.003	1.3 ± 0.0	21 ± 0	< 0.013 ± 0.007
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	1.9 ± 0.1	0.090 ± 0.002	1.4 ± 0.0	21 ± 0	< 0.013 ± 0.011
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	2.0 ± 0.1	0.058 ± 0.010	1.4 ± 0.0	22 ± 0	< 0.03 ± 0.01
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	2.0 ± 0.0	0.072 ± 0.018	1.4 ± 0.0	21 ± 0	< 0.013 ± 0.001
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	1.3 ± 0.1	0.051 ± 0.000	0.87 ± 0.01	18 ± 1	< 0.017 ± 0.008
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	1.2 ± 0.0	0.049 ± 0.007	0.90 ± 0.04	19 ± 0	< 0.03 ± 0.03
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	2.9 ± 0.1	0.048 ± 0.005	1.3 ± 0.0	19 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	2.2 ± 0.2	0.040 ± 0.005	1.2 ± 0.0	19 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	1.7 ± 0.2	0.038 ± 0.004	1.2 ± 0.0	19 ± 1	< 0.02 ± 0.01
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	1.9 ± 0.1	0.039 ± 0.004	1.2 ± 0.0	19 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	0.78 ± 0.09	0.032 ± 0.007	0.74 ± 0.05	16 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	0.80 ± 0.05	0.034 ± 0.008	0.74 ± 0.03	15 ± 0	< 0.02 ± 0.00
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	6.9 ± 0.1	0.051 ± 0.008	0.90 ± 0.00	17 ± 0	< 0.02 ± 0.00
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	10 ± 0	0.054 ± 0.005	0.90 ± 0.01	17 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	6.9 ± 0.1	0.060 ± 0.015	0.91 ± 0.02	17 ± 0	< 0.02 ± 0.00
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	6.8 ± 0.3	0.064 ± 0.023	0.89 ± 0.02	17 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	3.3 ± 0.2	0.052 ± 0.010	0.84 ± 0.01	16 ± 1	< 0.02 ± 0.01
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	3.4 ± 0.2	0.057 ± 0.015	0.79 ± 0.03	15 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	13 ± 0	0.036 ± 0.003	0.48 ± 0.04	9.3 ± 0.0	< 0.014 ± 0.003
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	11 ± 0	0.034 ± 0.002	0.46 ± 0.03	9.2 ± 0.3	< 0.014 ± 0.004

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP–MS	Antimony (µg/L) ICP–MS	Arsenic (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	30 ± 1	0.034 ± 0.006	0.48 ± 0.06	10 ± 0	< 0.014 ± 0.005
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	30 ± 1	0.030 ± 0.000	0.49 ± 0.03	11 ± 0	< 0.014 ± 0.005
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	6.6 ± 0.0	0.035 ± 0.006	0.38 ± 0.06	7.4 ± 0.2	< 0.014 ± 0.005
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	6.8 ± 0.2	0.035 ± 0.006	0.36 ± 0.02	8.0 ± 0.3	< 0.014 ± 0.014
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	4.2 ± 0.2	0.073 ± 0.008	1.3 ± 0.0	19 ± 0	< 0.04 ± 0.02
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	5.1 ± 0.1	0.076 ± 0.012	1.2 ± 0.1	19 ± 0	< 0.04 ± 0.03
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	3.1 ± 0.1	0.068 ± 0.011	1.2 ± 0.0	18 ± 1	< 0.04 ± 0.02
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	3.1 ± 0.0	0.073 ± 0.011	1.2 ± 0.0	18 ± 1	< 0.04 ± 0.01
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	2.0 ± 0.0	0.059 ± 0.013	0.76 ± 0.05	15 ± 1	< 0.04 ± 0.05
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	1.9 ± 0.0	0.061 ± 0.021	0.79 ± 0.03	15 ± 0	< 0.04 ± 0.02
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	15 ± 1	0.067 ± 0.005	1.4 ± 0.1	19 ± 1	< 0.02 ± 0.01
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	29 ± 0	0.073 ± 0.010	1.4 ± 0.1	19 ± 0	0.016 ± 0.016
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	3.4 ± 0.4	0.072 ± 0.002	1.3 ± 0.1	19 ± 0	0.019 ± 0.016
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	3.1 ± 0.1	0.079 ± 0.004	1.3 ± 0.0	18 ± 1	0.017 ± 0.014
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	1.4 ± 0.2	0.054 ± 0.008	0.81 ± 0.04	15 ± 0	< 0.02 ± 0.01
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	1.5 ± 0.2	0.069 ± 0.032	0.81 ± 0.06	15 ± 0	< 0.02 ± 0.01
Flat Cr.	12/11/96	0.40 µm Mem	1/2	64 ± 2	0.041 ± 0.007	0.10 ± 0.02	5.0 ± 0.1	< 0.014 ± 0.006
Flat Cr.	12/11/96	0.40 µm Mem	2/2	63 ± 3	0.041 ± 0.005	0.10 ± 0.01	4.9 ± 0.1	< 0.014 ± 0.006
Flat Cr.	12/11/96	0.45 µm Cap	1/2	43 ± 1	0.034 ± 0.002	0.094 ± 0.011	4.9 ± 0.2	< 0.02 ± 0.01
Flat Cr.	12/11/96	0.45 µm Cap	2/2	43 ± 1	0.038 ± 0.004	0.090 ± 0.001	5.0 ± 0.0	< 0.014 ± 0.001
Flat Cr.	12/11/96	10 kd Tan	1/2	30 ± 0	0.030 ± 0.002	0.14 ± 0.02	3.9 ± 0.2	< 0.02 ± 0.00
Flat Cr.	12/11/96	10 kd Tan	2/2	31 ± 1	0.038 ± 0.001	0.18 ± 0.04	3.8 ± 0.0	< 0.014 ± 0.005
Flat Cr.	05/29/97	0.40 µm Mem	1/2	2.1 ± 0.0	0.052 ± 0.008	0.49 ± 0.03	7.9 ± 0.2	< 0.02 ± 0.01
Flat Cr.	05/29/97	0.40 µm Mem	2/2	2.2 ± 0.3	0.057 ± 0.006	0.48 ± 0.04	8.1 ± 0.2	< 0.02 ± 0.01
Flat Cr.	05/29/97	0.45 mm Cap	1/2	1.7 ± 0.2	0.059 ± 0.004	0.43 ± 0.01	8.0 ± 0.2	< 0.02 ± 0.03
Flat Cr.	05/29/97	0.45 µm Cap	2/2	1.8 ± 0.1	0.061 ± 0.004	0.43 ± 0.03	7.8 ± 0.1	< 0.02 ± 0.02
Flat Cr.	05/29/97	10 kd Tan	1/2	1.1 ± 0.1	0.056 ± 0.010	0.38 ± 0.03	6.7 ± 0.4	< 0.02 ± 0.01
Flat Cr.	05/29/97	10 kd Tan	2/2	1.1 ± 0.1	0.054 ± 0.010	0.39 ± 0.02	6.8 ± 0.1	< 0.02 ± 0.02
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	2,370 ± 180	0.019 ± 0.003	0.17 ± 0.03	8.5 ± 0.1	0.053 ± 0.010
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	2,540 ± 530	< 0.017 ± 0.006	0.21 ± 0.01	9.1 ± 0.4	0.059 ± 0.013
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	3,190 ± 90	< 0.017 ± 0.006	0.20 ± 0.00	8.9 ± 0.3	0.066 ± 0.003
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	2,590 ± 510	0.018 ± 0.002	0.16 ± 0.01	8.5 ± 0.1	0.044 ± 0.009
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	2,520 ± 40	0.024 ± 0.001	0.24 ± 0.03	8.4 ± 0.0	0.058 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP-MS	Antimony (µg/L) ICP-MS	Arsenic (µg/L) ICP-MS	Barium (µg/L) ICP-MS	Beryllium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	2,530 ± 130	< 0.017 ± 0.006	0.21 ± 0.01	8.8 ± 0.3	0.044 ± 0.005
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	4,480 ± 260	< 0.02 ± 0.01	0.12 ± 0.01	24 ± 1	0.12 ± 0.01
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	4,520 ± 80	< 0.02 ± 0.00	0.12 ± 0.02	24 ± 0	0.11 ± 0.01
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	4,080 ± 130	< 0.02 ± 0.00	0.14 ± 0.01	24 ± 0	0.12 ± 0.01
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	4,240 ± 40	< 0.02 ± 0.00	0.14 ± 0.02	24 ± 0	0.12 ± 0.01
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	3,980 ± 180	< 0.02 ± 0.01	0.10 ± 0.02	23 ± 0	0.14 ± 0.00
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	3,930 ± 50	< 0.02 ± 0.01	0.12 ± 0.02	23 ± 0	0.11 ± 0.01
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	2,140 ± 80	0.13 ± 0.01	3.8 ± 0.0	20 ± 0	0.051 ± 0.012
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	2,040 ± 0	0.14 ± 0.01	4.0 ± 0.0	20 ± 0	0.058 ± 0.003
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	2,050 ± 30	0.14 ± 0.01	4.0 ± 0.0	21 ± 0	0.045 ± 0.008
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	2,040 ± 30	0.15 ± 0.01	4.2 ± 0.0	20 ± 0	0.055 ± 0.007
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	2,070 ± 10	0.13 ± 0.00	4.1 ± 0.0	19 ± 1	0.048 ± 0.000
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	1,930 ± 100	0.14 ± 0.01	3.7 ± 0.0	19 ± 0	0.056 ± 0.002
Whiskeytown	12/11/96	0.40 µm Mem	1/2	6.5 ± 0.1	0.028 ± 0.004	0.36 ± 0.01	7.1 ± 0.3	< 0.02 ± 0.01
Whiskeytown	12/11/96	0.40 µm Mem	2/2	6.9 ± 0.2	0.037 ± 0.010	0.39 ± 0.04	7.1 ± 0.0	< 0.014 ± 0.003
Whiskeytown	12/11/96	0.45 µm Cap	1/2	3.0 ± 0.2	0.043 ± 0.005	0.38 ± 0.03	6.6 ± 0.3	< 0.014 ± 0.005
Whiskeytown	12/11/96	0.45 µm Cap	2/2	2.9 ± 0.1	0.037 ± 0.005	0.38 ± 0.03	7.0 ± 0.3	< 0.02 ± 0.01
Whiskeytown	12/11/96	10 kd Tan	1/2	2.2 ± 0.4	0.035 ± 0.006	0.42 ± 0.04	6.5 ± 0.0	< 0.014 ± 0.003
Whiskeytown	12/11/96	10 kd Tan	2/2	2.2 ± 0.2	0.032 ± 0.005	0.42 ± 0.02	6.3 ± 0.2	< 0.02 ± 0.01
Whiskeytown	05/29/97	0.40 µm Mem	1/2	5.0 ± 0.4	0.032 ± 0.002	0.38 ± 0.05	6.2 ± 0.3	< 0.02 ± 0.03
Whiskeytown	05/29/97	0.40 µm Mem	2/2	29 ± 0	0.029 ± 0.003	0.38 ± 0.04	6.0 ± 0.2	< 0.02 ± 0.03
Whiskeytown	05/29/97	0.45 µm Cap	1/2	2.9 ± 0.1	0.031 ± 0.003	0.35 ± 0.01	6.2 ± 0.2	< 0.02 ± 0.02
Whiskeytown	05/29/97	0.45 µm Cap	2/2	3.5 ± 0.3	0.033 ± 0.005	0.37 ± 0.03	6.2 ± 0.1	< 0.02 ± 0.01
Whiskeytown	05/29/97	10 kd Tan	1/2	2.5 ± 0.2	0.025 ± 0.004	0.28 ± 0.02	5.2 ± 0.1	< 0.02 ± 0.01
Whiskeytown	05/29/97	10 kd Tan	2/2	2.4 ± 0.1	0.023 ± 0.005	0.28 ± 0.01	5.1 ± 0.1	< 0.02 ± 0.01
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	4.5 ± 0.3	0.020 ± 0.001	0.27 ± 0.01	7.0 ± 0.1	< 0.01 ± 0.00
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	4.3 ± 0.1	0.023 ± 0.004	0.23 ± 0.01	6.6 ± 0.3	< 0.004 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	3.7 ± 0.2	0.029 ± 0.003	0.27 ± 0.02	6.7 ± 0.2	< 0.018 ± 0.004
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	4.9 ± 0.4	0.025 ± 0.002	0.28 ± 0.02	7.2 ± 0.4	< 0.018 ± 0.005
Spring Cr. arm	07/12/96	10 kd Tan	1/3	4.1 ± 0.4	0.022 ± 0.006	0.25 ± 0.03	6.6 ± 0.2	< 0.018 ± 0.004
Spring Cr. arm	07/12/96	10 kd Tan	2/3	3.5 ± 0.1	0.018 ± 0.002	0.26 ± 0.02	6.4 ± 0.4	< 0.01 ± 0.00
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	9.3 ± 0.1	0.037 ± 0.006	0.23 ± 0.04	6.4 ± 0.1	< 0.013 ± 0.017
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	9.1 ± 0.2	0.040 ± 0.005	0.22 ± 0.03	6.4 ± 0.0	< 0.013 ± 0.010

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Aluminum (µg/L) ICP–MS	Antimony (µg/L) ICP–MS	Arsenic (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	8.3 ± 0.2	0.040 ± 0.006	0.18 ± 0.00	6.3 ± 0.2	< 0.013 ± 0.010
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	8.1 ± 0.1	0.038 ± 0.005	0.21 ± 0.02	6.3 ± 0.1	< 0.013 ± 0.012
Spring Cr. arm	09/18/96	10 kd Tan	1/2	7.6 ± 0.1	0.035 ± 0.007	0.16 ± 0.01	5.5 ± 0.1	< 0.013 ± 0.001
Spring Cr. arm	09/18/96	10 kd Tan	2/2	7.6 ± 0.2	0.038 ± 0.003	0.18 ± 0.03	5.5 ± 0.1	< 0.013 ± 0.005
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	61 ± 2	0.020 ± 0.003	0.29 ± 0.01	6.8 ± 0.2	< 0.02 ± 0.00
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	48 ± 1	0.024 ± 0.004	0.28 ± 0.01	6.7 ± 0.3	< 0.02 ± 0.00
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	33 ± 2	0.020 ± 0.008	0.23 ± 0.03	6.5 ± 0.2	< 0.02 ± 0.01
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	32 ± 1	0.029 ± 0.012	0.26 ± 0.03	6.8 ± 0.1	< 0.02 ± 0.00
Spring Cr. arm	11/20/96	10 kd Tan	1/2	36 ± 2	< 0.018 ± 0.009	0.22 ± 0.02	5.6 ± 0.4	< 0.02 ± 0.01
Spring Cr. arm	11/20/96	10 kd Tan	2/2	35 ± 1	< 0.018 ± 0.004	0.21 ± 0.02	5.5 ± 0.2	< 0.02 ± 0.00
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	67 ± 2	0.033 ± 0.001	0.19 ± 0.01	7.0 ± 0.2	< 0.014 ± 0.003
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	56 ± 1	0.028 ± 0.003	0.18 ± 0.01	7.3 ± 0.0	< 0.014 ± 0.006
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	53 ± 0	0.022 ± 0.007	0.17 ± 0.01	7.2 ± 0.3	< 0.02 ± 0.02
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	52 ± 1	0.028 ± 0.006	0.18 ± 0.02	7.3 ± 0.3	< 0.02 ± 0.01
Spring Cr. arm	12/11/96	10 kd Tan	1/2	57 ± 2	< 0.017 ± 0.003	0.13 ± 0.02	5.5 ± 0.3	< 0.02 ± 0.01
Spring Cr. arm	12/11/96	10 kd Tan	2/2	58 ± 1	0.025 ± 0.007	0.15 ± 0.02	5.8 ± 0.0	< 0.014 ± 0.003
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	28 ± 1	0.033 ± 0.004	0.40 ± 0.02	6.5 ± 0.5	< 0.02 ± 0.01
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	21 ± 0	0.028 ± 0.004	0.37 ± 0.04	6.2 ± 0.5	< 0.02 ± 0.01
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	12 ± 0	0.030 ± 0.004	0.35 ± 0.00	6.1 ± 0.2	< 0.02 ± 0.01
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	12 ± 0	0.031 ± 0.003	0.37 ± 0.01	6.2 ± 0.4	< 0.02 ± 0.01
Spring Cr. arm	05/28/97	10 kd Tan	1/2	12 ± 0	0.020 ± 0.005	0.23 ± 0.01	5.0 ± 0.2	< 0.02 ± 0.00
Spring Cr. arm	05/28/97	10 kd Tan	2/2	13 ± 1	0.020 ± 0.005	0.21 ± 0.01	5.0 ± 0.2	< 0.02 ± 0.01
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	9.8 ± 0.3	0.29 ± 0.02	3.6 ± 0.0	97 ± 3	< 0.02 ± 0.01
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	2.2 ± 0.3	0.30 ± 0.00	3.8 ± 0.3	100 ± 3	< 0.02 ± 0.00
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	1.2 ± 0.1	0.29 ± 0.00	3.4 ± 0.1	106 ± 4	< 0.02 ± 0.01
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	1.1 ± 0.2	0.27 ± 0.00	3.6 ± 0.0	105 ± 5	< 0.02 ± 0.01
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	0.90 ± 0.18	0.26 ± 0.01	2.8 ± 0.0	89 ± 1	< 0.02 ± 0.01
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	0.88 ± 0.26	0.26 ± 0.01	2.7 ± 0.0	94 ± 0	< 0.02 ± 0.01
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	45 ± 1	0.095 ± 0.005	1.1 ± 0.0	16 ± 0	< 0.014 ± 0.004
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	5.4 ± 0.5	0.091 ± 0.001	1.0 ± 0.0	16 ± 1	< 0.014 ± 0.005
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	19 ± 1	0.11 ± 0.00	0.99 ± 0.03	17 ± 0	< 0.014 ± 0.004
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	18 ± 0	0.12 ± 0.00	1.0 ± 0.0	17 ± 0	< 0.014 ± 0.006
Yolo Bypass	01/07/97	10 kd Tan	1/2	2.6 ± 0.1	0.075 ± 0.005	0.76 ± 0.03	13 ± 1	< 0.014 ± 0.002
Yolo Bypass	01/07/97	10 kd Tan	2/2	2.8 ± 0.2	0.075 ± 0.010	0.79 ± 0.01	13 ± 1	< 0.014 ± 0.004

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	< 0.005 ± 0.001	33 ± 1	0.025 ± 0.006	10 ± 0	0.019 ± 0.000
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	< 0.004 ± 0.001	31 ± 0	0.031 ± 0.001	10 ± 0	0.016 ± 0.000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	< 0.005 ± 0.000	31 ± 1	0.016 ± 0.004	10 ± 0	0.014 ± 0.000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	< 0.004 ± 0.000	30 ± 0	0.018 ± 0.000	10 ± 0	0.017 ± 0.000
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	< 0.005 ± 0.000	32 ± 1	0.017 ± 0.003	10 ± 0	0.0068 ± 0.0006
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	< 0.005 ± 0.002	31 ± 0	0.021 ± 0.008	9.7 ± 0.0	0.0060 ± 0.0011
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	34 ± 1	0.032 ± 0.001	12 ± 0	0.024 ± 0.003
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	34 ± 3	0.034 ± 0.007	12 ± 1	0.030 ± 0.001
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	36 ± 1	0.030 ± 0.004	12 ± 1	0.012 ± 0.001
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	< 0.006 ± 0.000	31 ± 1	0.024 ± 0.003	11 ± 0	0.011 ± 0.000
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	< 0.006 ± 0.003	33 ± 1	0.023 ± 0.006	11 ± 0	0.0033 ± 0.0008
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	< 0.01 ± 0.00	32 ± 1	0.021 ± 0.003	11 ± 1	0.0045 ± 0.0004
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	< 0.007 ± 0.001	41 ± 1	< 0.009 ± 0.001	12 ± 0	0.0046 ± 0.0006
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	< 0.007 ± 0.003	41 ± 2	< 0.007 ± 0.001	12 ± 0	0.0051 ± 0.0004
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	< 0.007 ± 0.000	39 ± 1	< 0.007 ± 0.003	12 ± 0	0.0056 ± 0.0009
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	41 ± 1	< 0.007 ± 0.006	12 ± 0	0.0036 ± 0.0005
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	< 0.007 ± 0.001	40 ± 1	0.0087 ± 0.0033	11 ± 0	0.0011 ± 0.0004
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	< 0.007 ± 0.000	41 ± 2	< 0.007 ± 0.006	11 ± 0	0.00094 ± 0.00079
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	50 ± 6	0.036 ± 0.004	11 ± 1	0.011 ± 0.001
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	53 ± 9	0.040 ± 0.009	11 ± 0	0.0090 ± 0.0015
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	< 0.011 ± 0.001	45 ± 3	0.041 ± 0.006	11 ± 1	0.013 ± 0.001
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	< 0.011 ± 0.002	47 ± 4	0.034 ± 0.011	11 ± 1	0.0090 ± 0.0004
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	< 0.011 ± 0.001	46 ± 3	0.039 ± 0.008	9.6 ± 0.6	0.0027 ± 0.0004
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	< 0.01 ± 0.00	56 ± 2	0.028 ± 0.004	9.4 ± 0.7	0.0018 ± 0.0004
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	< 0.001 ± 0.001	32 ± 1	0.027 ± 0.010	10 ± 0	0.034 ± 0.001
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	32 ± 1	0.021 ± 0.006	10 ± 0	0.017 ± 0.001
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	< 0.001 ± 0.000	31 ± 1	0.012 ± 0.002	9.8 ± 0.6	0.015 ± 0.000
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	31 ± 1	0.0062 ± 0.0047	9.9 ± 0.5	0.015 ± 0.000
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	< 0.001 ± 0.000	32 ± 3	< 0.006 ± 0.002	8.3 ± 0.4	0.0019 ± 0.0005
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	< 0.001 ± 0.001	31 ± 1	< 0.006 ± 0.003	8.1 ± 0.3	0.0020 ± 0.0005
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	< 0.004 ± 0.000	25 ± 0	0.017 ± 0.002	8.7 ± 0.1	0.012 ± 0.000

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	< 0.004 ± 0.001	26 ± 1	0.017 ± 0.001	8.7 ± 0.0	0.013 ± 0.000
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	< 0.004 ± 0.001	25 ± 0	0.017 ± 0.001	8.5 ± 0.1	0.019 ± 0.000
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	< 0.004 ± 0.001	25 ± 0	0.019 ± 0.003	8.7 ± 0.1	0.019 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	< 0.004 ± 0.000	25 ± 1	0.018 ± 0.001	8.4 ± 0.1	0.0076 ± 0.0015
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	< 0.004 ± 0.001	25 ± 0	0.016 ± 0.001	8.4 ± 0.1	0.0091 ± 0.0002
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	< 0.004 ± 0.000	24 ± 1	0.014 ± 0.003	8.4 ± 0.1	0.0075 ± 0.0010
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	24 ± 2	0.031 ± 0.007	8.2 ± 0.1	0.019 ± 0.003
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	< 0.006 ± 0.001	24 ± 0	0.026 ± 0.004	8.6 ± 0.4	0.014 ± 0.000
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	< 0.006 ± 0.002	25 ± 0	0.025 ± 0.002	9.0 ± 0.1	0.013 ± 0.000
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	< 0.006 ± 0.001	24 ± 1	0.018 ± 0.002	8.2 ± 0.2	0.016 ± 0.001
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	< 0.01 ± 0.00	24 ± 2	0.018 ± 0.007	8.0 ± 0.0	0.0045 ± 0.0006
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	< 0.01 ± 0.00	24 ± 1	0.015 ± 0.002	7.3 ± 0.1	0.0024 ± 0.0002
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	< 0.01 ± 0.00	24 ± 2	0.021 ± 0.007	7.4 ± 0.3	0.0032 ± 0.0002
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	< 0.007 ± 0.001	33 ± 1	0.048 ± 0.010	10 ± 0	0.023 ± 0.000
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	< 0.007 ± 0.001	32 ± 1	0.049 ± 0.012	10 ± 0	0.022 ± 0.001
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	< 0.007 ± 0.000	31 ± 1	0.040 ± 0.004	9.9 ± 0.4	0.018 ± 0.003
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	33 ± 1	0.049 ± 0.005	9.8 ± 0.3	0.017 ± 0.001
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	< 0.007 ± 0.001	32 ± 1	0.039 ± 0.003	8.2 ± 0.2	0.0021 ± 0.0008
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	< 0.007 ± 0.001	31 ± 2	0.039 ± 0.005	8.3 ± 0.2	0.0024 ± 0.0003
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	52 ± 11	0.070 ± 0.006	10 ± 0	0.031 ± 0.004
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	43 ± 7	0.064 ± 0.005	10 ± 0	0.023 ± 0.004
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	< 0.011 ± 0.005	39 ± 0	0.076 ± 0.006	10 ± 0	0.028 ± 0.002
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	47 ± 5	0.071 ± 0.005	10 ± 0	0.028 ± 0.001
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	< 0.01 ± 0.00	54 ± 8	0.050 ± 0.004	8.2 ± 0.5	0.0034 ± 0.0008
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	< 0.01 ± 0.00	47 ± 11	0.052 ± 0.003	8.1 ± 0.3	0.0042 ± 0.0008
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	34 ± 1	0.11 ± 0.00	9.5 ± 0.5	0.020 ± 0.003
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	< 0.008 ± 0.000	37 ± 1	0.10 ± 0.01	9.9 ± 0.5	0.019 ± 0.002
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	< 0.008 ± 0.000	38 ± 1	0.16 ± 0.02	9.5 ± 0.4	0.039 ± 0.002
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	< 0.008 ± 0.001	35 ± 0	0.14 ± 0.02	9.8 ± 0.4	0.040 ± 0.001
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	< 0.008 ± 0.001	34 ± 1	0.084 ± 0.024	9.1 ± 0.6	0.0072 ± 0.0011
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	< 0.008 ± 0.000	34 ± 1	0.085 ± 0.002	8.9 ± 0.3	0.0064 ± 0.0005
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	< 0.014 ± 0.002	35 ± 1	0.085 ± 0.012	9.1 ± 0.1	0.0056 ± 0.0003
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	26 ± 1	0.016 ± 0.007	8.7 ± 0.4	0.011 ± 0.001
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	26 ± 1	0.036 ± 0.004	8.7 ± 0.4	0.026 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	25 ± 0	0.015 ± 0.003	8.5 ± 0.5	0.016 ± 0.000
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	26 ± 1	0.018 ± 0.004	8.3 ± 0.2	0.015 ± 0.001
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	< 0.001 ± 0.000	27 ± 2	0.011 ± 0.005	7.5 ± 0.6	0.0040 ± 0.0001
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	< 0.001 ± 0.001	27 ± 2	0.012 ± 0.006	7.6 ± 0.4	0.0031 ± 0.0007
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	< 0.005 ± 0.000	28 ± 0	0.042 ± 0.003	9.1 ± 0.1	0.012 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	< 0.005 ± 0.000	27 ± 0	0.026 ± 0.001	9.2 ± 0.0	0.012 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	< 0.004 ± 0.001	27 ± 0	0.023 ± 0.001	9.0 ± 0.1	0.015 ± 0.001
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	< 0.005 ± 0.000	28 ± 1	0.016 ± 0.003	8.9 ± 0.0	0.015 ± 0.000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	< 0.005 ± 0.000	29 ± 1	0.023 ± 0.001	9.2 ± 0.1	0.0022 ± 0.0000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	< 0.004 ± 0.001	26 ± 0	0.020 ± 0.001	8.8 ± 0.1	0.0038 ± 0.0002
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	< 0.006 ± 0.001	28 ± 1	0.026 ± 0.008	8.7 ± 0.1	0.0076 ± 0.0007
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	< 0.006 ± 0.001	29 ± 1	0.022 ± 0.010	9.3 ± 0.3	0.0081 ± 0.0011
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	28 ± 2	0.019 ± 0.001	8.5 ± 0.3	0.015 ± 0.001
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	< 0.006 ± 0.002	28 ± 1	0.017 ± 0.006	9.2 ± 0.6	0.011 ± 0.003
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	< 0.01 ± 0.00	27 ± 1	0.014 ± 0.004	8.0 ± 0.3	< 0.0011 ± 0.0004
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	< 0.01 ± 0.00	26 ± 1	0.015 ± 0.005	8.0 ± 0.6	< 0.0011 ± 0.0006
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	< 0.007 ± 0.001	39 ± 2	0.022 ± 0.012	11 ± 1	0.020 ± 0.002
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	< 0.007 ± 0.000	39 ± 2	0.029 ± 0.006	11 ± 0	0.019 ± 0.001
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	< 0.007 ± 0.001	38 ± 1	0.020 ± 0.005	11 ± 0	0.015 ± 0.000
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	38 ± 1	0.021 ± 0.008	11 ± 0	0.017 ± 0.002
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	< 0.007 ± 0.001	40 ± 2	0.021 ± 0.008	9.1 ± 0.4	0.0011 ± 0.0001
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	< 0.007 ± 0.002	38 ± 1	0.020 ± 0.003	9.1 ± 0.4	0.0023 ± 0.0007
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	44 ± 5	0.018 ± 0.007	11 ± 0	0.020 ± 0.002
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	45 ± 11	0.022 ± 0.004	11 ± 0	0.023 ± 0.002
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	40 ± 10	0.023 ± 0.002	10 ± 0	0.021 ± 0.002
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	39 ± 11	0.030 ± 0.004	10 ± 0	0.020 ± 0.002
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	< 0.01 ± 0.00	41 ± 10	0.021 ± 0.005	8.8 ± 0.4	0.0027 ± 0.0008
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	< 0.01 ± 0.00	39 ± 11	0.019 ± 0.004	8.7 ± 0.5	0.0021 ± 0.0003
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	28 ± 1	0.0093 ± 0.0014	9.4 ± 0.2	0.088 ± 0.003
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	< 0.008 ± 0.000	29 ± 2	< 0.005 ± 0.002	9.1 ± 0.0	0.027 ± 0.001
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	< 0.008 ± 0.001	30 ± 3	0.014 ± 0.006	8.8 ± 0.4	0.038 ± 0.002
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	< 0.008 ± 0.000	28 ± 1	0.016 ± 0.006	9.3 ± 0.4	0.040 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	< 0.008 ± 0.001	28 ± 2	< 0.005 ± 0.002	7.9 ± 0.1	0.010 ± 0.001
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	< 0.008 ± 0.001	30 ± 4	0.0078 ± 0.0035	8.5 ± 0.3	0.0087 ± 0.0014
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	28 ± 0	0.013 ± 0.010	9.2 ± 0.2	0.017 ± 0.001
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	< 0.001 ± 0.000	28 ± 1	0.015 ± 0.012	9.2 ± 0.2	0.0086 ± 0.0008
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	< 0.001 ± 0.000	29 ± 1	0.013 ± 0.004	9.2 ± 0.5	0.012 ± 0.000
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	< 0.001 ± 0.000	27 ± 1	0.013 ± 0.004	8.9 ± 0.5	0.014 ± 0.001
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	< 0.001 ± 0.000	27 ± 1	< 0.006 ± 0.003	7.9 ± 0.4	0.0029 ± 0.0008
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	< 0.001 ± 0.001	28 ± 1	0.0072 ± 0.0024	7.9 ± 0.4	0.0030 ± 0.0008
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	< 0.005 ± 0.000	34 ± 1	0.0095 ± 0.0017	10 ± 0	0.016 ± 0.000
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	< 0.005 ± 0.000	34 ± 0	0.011 ± 0.004	10 ± 0	0.026 ± 0.000
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	< 0.005 ± 0.002	34 ± 0	0.016 ± 0.001	9.9 ± 0.1	0.018 ± 0.000
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	41 ± 2	0.014 ± 0.003	11 ± 1	0.011 ± 0.001
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	40 ± 2	0.010 ± 0.003	12 ± 0	0.0076 ± 0.0018
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	40 ± 1	0.011 ± 0.004	11 ± 0	0.017 ± 0.000
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	< 0.006 ± 0.001	41 ± 5	0.0072 ± 0.0055	12 ± 0	0.014 ± 0.000
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	< 0.01 ± 0.00	41 ± 2	< 0.006 ± 0.003	11 ± 0	0.0019 ± 0.0005
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	< 0.01 ± 0.00	40 ± 1	0.010 ± 0.005	10 ± 1	0.0018 ± 0.0006
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	< 0.007 ± 0.002	57 ± 2	0.0060 ± 0.0023	13 ± 0	0.013 ± 0.001
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	< 0.007 ± 0.000	57 ± 2	0.0095 ± 0.0043	13 ± 0	0.014 ± 0.001
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	< 0.007 ± 0.001	57 ± 2	0.0063 ± 0.0038	13 ± 0	0.011 ± 0.001
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	58 ± 1	< 0.005 ± 0.004	13 ± 0	0.013 ± 0.001
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	< 0.007 ± 0.001	55 ± 2	0.0062 ± 0.0013	11 ± 0	0.0014 ± 0.0010
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	< 0.007 ± 0.001	55 ± 1	0.0060 ± 0.0014	12 ± 0	0.0019 ± 0.0002
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	50 ± 2	0.0056 ± 0.0025	11 ± 2	0.015 ± 0.000
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	50 ± 1	0.012 ± 0.005	13 ± 0	0.015 ± 0.000
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	< 0.011 ± 0.001	49 ± 3	0.024 ± 0.006	13 ± 2	0.019 ± 0.001
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	50 ± 2	< 0.013 ± 0.003	9.5 ± 0.8	0.016 ± 0.002
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	< 0.011 ± 0.001	49 ± 1	< 0.005 ± 0.002	10 ± 2	0.0030 ± 0.0007
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	< 0.01 ± 0.00	48 ± 4	0.0079 ± 0.0035	9.7 ± 2.0	0.0034 ± 0.0022
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	30 ± 0	< 0.005 ± 0.004	9.6 ± 0.3	0.026 ± 0.001
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	< 0.008 ± 0.001	27 ± 1	< 0.005 ± 0.001	9.6 ± 0.4	0.024 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	< 0.008 ± 0.000	29 ± 2	0.013 ± 0.003	9.7 ± 0.5	0.051 ± 0.001
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	< 0.008 ± 0.001	29 ± 2	< 0.005 ± 0.003	9.8 ± 0.4	0.053 ± 0.004
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	< 0.008 ± 0.001	31 ± 2	0.0061 ± 0.0019	9.1 ± 0.3	0.014 ± 0.002
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	< 0.008 ± 0.001	28 ± 2	< 0.005 ± 0.003	8.9 ± 0.5	0.014 ± 0.003
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	< 0.001 ± 0.001	39 ± 0	< 0.008 ± 0.002	11 ± 0	0.016 ± 0.001
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	< 0.001 ± 0.000	38 ± 0	< 0.008 ± 0.002	10 ± 0	0.034 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	38 ± 1	< 0.008 ± 0.003	10 ± 0	0.015 ± 0.000
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	38 ± 0	< 0.008 ± 0.003	10 ± 0	0.013 ± 0.001
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	< 0.001 ± 0.001	37 ± 0	< 0.008 ± 0.002	9.5 ± 0.1	0.0028 ± 0.0004
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	< 0.001 ± 0.001	38 ± 0	< 0.008 ± 0.002	9.4 ± 0.4	0.0024 ± 0.0005
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	< 0.005 ± 0.002	29 ± 1	0.0070 ± 0.0023	9.0 ± 0.1	0.015 ± 0.001
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	< 0.004 ± 0.001	27 ± 1	0.024 ± 0.001	9.3 ± 0.4	0.034 ± 0.001
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	< 0.004 ± 0.001	27 ± 0	0.013 ± 0.002	9.1 ± 0.3	0.022 ± 0.000
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	< 0.004 ± 0.001	27 ± 1	< 0.006 ± 0.000	9.2 ± 0.4	0.019 ± 0.000
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	< 0.005 ± 0.000	28 ± 0	< 0.004 ± 0.006	9.7 ± 0.1	0.0092 ± 0.0002
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	< 0.004 ± 0.000	26 ± 0	< 0.006 ± 0.000	9.6 ± 0.2	0.0078 ± 0.0000
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	< 0.006 ± 0.000	47 ± 0	0.015 ± 0.002	12 ± 1	0.039 ± 0.001
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	< 0.006 ± 0.001	45 ± 1	0.0089 ± 0.0044	13 ± 0	0.011 ± 0.000
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	< 0.006 ± 0.002	47 ± 2	0.018 ± 0.003	12 ± 0	0.014 ± 0.001
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	< 0.006 ± 0.002	45 ± 1	0.014 ± 0.003	12 ± 0	0.015 ± 0.004
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	< 0.01 ± 0.00	46 ± 2	0.0069 ± 0.0026	11 ± 0	0.0014 ± 0.0004
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	< 0.01 ± 0.00	44 ± 0	0.0066 ± 0.0043	11 ± 0	0.0035 ± 0.0001
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	< 0.007 ± 0.000	46 ± 1	0.0057 ± 0.0037	14 ± 0	0.037 ± 0.001
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	48 ± 1	0.011 ± 0.002	14 ± 0	0.035 ± 0.001
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	< 0.011 ± 0.003	35 ± 2	0.011 ± 0.006	9.4 ± 1.2	0.031 ± 0.001
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	35 ± 0	< 0.004 ± 0.005	9.8 ± 0.3	0.021 ± 0.002
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	34 ± 0	0.0085 ± 0.0052	9.8 ± 0.0	0.030 ± 0.002
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	34 ± 2	< 0.004 ± 0.003	9.2 ± 1.2	0.028 ± 0.005
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	< 0.01 ± 0.00	33 ± 2	0.0070 ± 0.0059	9.0 ± 0.3	0.0081 ± 0.0011
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	< 0.01 ± 0.00	32 ± 2	< 0.004 ± 0.000	9.2 ± 0.2	0.0086 ± 0.0014

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP–MS	Boron (µg/L) ICP–MS	Cadmium (µg/L) ICP–MS	Calcium (mg/L) ICP–AES	Cerium (µg/L) ICP–MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	< 0.001 ± 0.001	41 ± 1	0.0089 ± 0.0038	12 ± 0	0.011 ± 0.000
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	42 ± 0	< 0.008 ± 0.001	12 ± 1	0.0063 ± 0.0007
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	41 ± 2	0.011 ± 0.004	11 ± 1	0.013 ± 0.000
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	< 0.001 ± 0.000	41 ± 1	0.011 ± 0.007	12 ± 0	0.014 ± 0.000
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	< 0.001 ± 0.001	42 ± 3	< 0.008 ± 0.004	10 ± 0	0.0018 ± 0.0005
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	< 0.001 ± 0.001	41 ± 1	< 0.008 ± 0.011	9.8 ± 0.5	0.0011 ± 0.0001
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	< 0.005 ± 0.001	24 ± 1	0.042 ± 0.002	8.5 ± 0.1	0.015 ± 0.000
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	< 0.005 ± 0.001	24 ± 1	0.013 ± 0.003	8.7 ± 0.1	0.014 ± 0.001
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	< 0.005 ± 0.001	26 ± 1	< 0.006 ± 0.002	9.0 ± 0.1	0.024 ± 0.000
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	< 0.005 ± 0.000	24 ± 0	< 0.004 ± 0.003	8.8 ± 0.4	0.023 ± 0.000
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	< 0.004 ± 0.000	24 ± 0	0.0067 ± 0.0002	7.7 ± 0.4	0.0025 ± 0.0008
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	< 0.004 ± 0.000	24 ± 1	0.010 ± 0.010	9.1 ± 0.3	0.0031 ± 0.0003
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	43 ± 2	0.011 ± 0.005	11 ± 0	0.011 ± 0.001
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	43 ± 5	0.0071 ± 0.0034	12 ± 1	0.0055 ± 0.0008
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	< 0.006 ± 0.004	41 ± 0	0.014 ± 0.006	12 ± 0	0.016 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	43 ± 2	0.027 ± 0.003	11 ± 0	0.017 ± 0.000
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	< 0.006 ± 0.003	40 ± 1	0.0086 ± 0.0029	9.8 ± 0.5	0.0014 ± 0.0005
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	< 0.006 ± 0.001	42 ± 1	< 0.006 ± 0.003	11 ± 0	0.0018 ± 0.0003
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	< 0.007 ± 0.000	35 ± 3	0.0062 ± 0.0032	11 ± 0	0.013 ± 0.001
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	< 0.007 ± 0.003	35 ± 1	0.0059 ± 0.0020	11 ± 0	0.0081 ± 0.0011
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	< 0.007 ± 0.002	35 ± 1	0.0061 ± 0.0022	11 ± 0	0.012 ± 0.000
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	< 0.007 ± 0.000	35 ± 1	< 0.005 ± 0.004	11 ± 0	0.011 ± 0.000
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	< 0.007 ± 0.000	35 ± 1	< 0.005 ± 0.007	9.4 ± 0.1	0.00068 ± 0.00049
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	< 0.007 ± 0.000	35 ± 1	< 0.005 ± 0.002	9.0 ± 0.4	0.00073 ± 0.00010
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	25 ± 3	0.0042 ± 0.0046	8.5 ± 0.1	0.029 ± 0.003
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	28 ± 5	< 0.004 ± 0.003	8.7 ± 2.2	0.028 ± 0.002
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	24 ± 3	< 0.013 ± 0.003	8.8 ± 2.3	0.040 ± 0.001
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	25 ± 2	< 0.013 ± 0.012	8.5 ± 1.9	0.044 ± 0.000
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	< 0.01 ± 0.00	24 ± 2	< 0.004 ± 0.001	7.9 ± 1.5	0.012 ± 0.002
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	< 0.01 ± 0.00	23 ± 1	0.0058 ± 0.0046	7.5 ± 1.6	0.012 ± 0.002
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	5.0 ± 1.1	< 0.005 ± 0.006	4.5 ± 0.1	0.11 ± 0.00
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	< 0.008 ± 0.001	5.6 ± 1.0	< 0.005 ± 0.002	4.7 ± 0.0	0.098 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP-MS	Boron (µg/L) ICP-MS	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	< 0.008 ± 0.000	5.6 ± 0.5	< 0.005 ± 0.004	4.5 ± 0.2	0.14 ± 0.00
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	< 0.008 ± 0.001	7.1 ± 0.5	< 0.005 ± 0.001	4.7 ± 0.3	0.16 ± 0.00
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	< 0.008 ± 0.001	5.6 ± 1.8	< 0.005 ± 0.004	3.8 ± 0.2	0.020 ± 0.002
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	< 0.008 ± 0.001	5.3 ± 2.4	< 0.005 ± 0.007	3.7 ± 0.1	0.022 ± 0.001
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	< 0.001 ± 0.001	32 ± 2	0.0090 ± 0.0021	9.9 ± 0.5	0.0088 ± 0.0001
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	< 0.001 ± 0.000	34 ± 0	< 0.008 ± 0.007	10 ± 0	0.0091 ± 0.0011
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	< 0.001 ± 0.000	31 ± 1	< 0.008 ± 0.003	9.9 ± 0.6	0.014 ± 0.002
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	31 ± 1	< 0.008 ± 0.003	10 ± 1	0.014 ± 0.000
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	< 0.001 ± 0.001	32 ± 2	< 0.008 ± 0.005	8.1 ± 0.3	0.0022 ± 0.0005
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	< 0.001 ± 0.000	32 ± 1	< 0.008 ± 0.002	8.2 ± 0.5	0.0021 ± 0.0001
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	< 0.002 ± 0.000	31 ± 1	0.012 ± 0.001	10 ± 0	0.018 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	< 0.002 ± 0.001	32 ± 1	< 0.005 ± 0.003	10 ± 0	0.029 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	< 0.002 ± 0.000	31 ± 1	0.0074 ± 0.0030	10 ± 0	0.013 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	< 0.002 ± 0.000	34 ± 0	0.0055 ± 0.0035	10 ± 1	0.015 ± 0.001
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	< 0.002 ± 0.000	31 ± 1	< 0.005 ± 0.002	8.5 ± 0.3	0.0015 ± 0.0004
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	< 0.002 ± 0.000	32 ± 2	0.0048 ± 0.0034	8.3 ± 0.3	0.0011 ± 0.0002
Flat Cr.	12/11/96	0.40 µm Mem	1/2	< 0.011 ± 0.001	2.2 ± 0.3	0.17 ± 0.02	2.5 ± 0.2	0.072 ± 0.001
Flat Cr.	12/11/96	0.40 µm Mem	2/2	< 0.011 ± 0.002	3.1 ± 1.0	0.17 ± 0.01	2.6 ± 0.2	0.070 ± 0.003
Flat Cr.	12/11/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	2.2 ± 0.8	0.16 ± 0.01	2.8 ± 0.4	0.055 ± 0.001
Flat Cr.	12/11/96	0.45 µm Cap	2/2	< 0.011 ± 0.001	2.0 ± 0.1	0.16 ± 0.02	2.8 ± 0.2	0.049 ± 0.000
Flat Cr.	12/11/96	10 kd Tan	1/2	< 0.01 ± 0.00	2.3 ± 0.8	0.15 ± 0.01	2.3 ± 0.2	0.024 ± 0.001
Flat Cr.	12/11/96	10 kd Tan	2/2	< 0.011 ± 0.001	2.1 ± 0.8	0.13 ± 0.00	2.4 ± 0.1	0.025 ± 0.001
Flat Cr.	05/29/97	0.40 µm Mem	1/2	< 0.002 ± 0.000	5.6 ± 1.1	0.071 ± 0.003	13 ± 1	0.028 ± 0.002
Flat Cr.	05/29/97	0.40 µm Mem	2/2	< 0.002 ± 0.001	8.6 ± 3.5	0.074 ± 0.003	13 ± 1	0.028 ± 0.002
Flat Cr.	05/29/97	0.45 mm Cap	1/2	< 0.002 ± 0.001	8.8 ± 4.0	0.062 ± 0.004	13 ± 0	0.018 ± 0.001
Flat Cr.	05/29/97	0.45 µm Cap	2/2	< 0.002 ± 0.001	8.3 ± 4.0	0.073 ± 0.006	13 ± 1	0.016 ± 0.001
Flat Cr.	05/29/97	10 kd Tan	1/2	< 0.002 ± 0.000	8.4 ± 4.3	0.053 ± 0.002	11 ± 1	0.0059 ± 0.0010
Flat Cr.	05/29/97	10 kd Tan	2/2	< 0.002 ± 0.000	5.9 ± 1.1	0.054 ± 0.007	11 ± 1	0.0061 ± 0.0010
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	< 4 ± 2.00	3.5 ± 0.0	8.3 ± 0.5	4.6 ± 0.0
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	< 4 ± 1.00	3.5 ± 0.1	8.0 ± 1.4	4.9 ± 0.2
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	3.2 ± 0.5	3.5 ± 0.1	9.5 ± 0.5	4.7 ± 0.1
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	< 4 ± 4.00	3.4 ± 0.0	8.0 ± 1.4	4.7 ± 0.0
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	< 0.011 ± 0.001	< 2 ± 0.69	3.5 ± 0.0	8.3 ± 0.6	4.6 ± 0.1

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP–MS	Boron (µg/L) ICP–MS	Cadmium (µg/L) ICP–MS	Calcium (mg/L) ICP–AES	Cerium (µg/L) ICP–MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	< 0.01 ± 0.00	< 4 ± 2.00	3.5 ± 0.1	8.3 ± 0.6	4.8 ± 0.3
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	< 0.002 ± 0.000	7.5 ± 1.1	6.2 ± 0.2	44 ± 1	9.2 ± 0.1
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	< 0.002 ± 0.000	6.9 ± 0.5	6.2 ± 0.0	46 ± 2	9.4 ± 0.0
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	< 0.002 ± 0.000	6.7 ± 0.2	6.0 ± 0.1	43 ± 0	9.4 ± 0.1
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	< 0.002 ± 0.001	6.5 ± 0.2	6.3 ± 0.1	45 ± 0	9.2 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	< 0.002 ± 0.000	6.9 ± 0.2	5.9 ± 0.1	44 ± 0	9.3 ± 0.1
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	< 0.002 ± 0.000	6.7 ± 0.7	5.8 ± 0.0	43 ± 2	9.1 ± 0.1
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	< 5 ± 1.75	9.1 ± 0.0	6.7 ± 0.1	3.2 ± 0.0
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	< 0.008 ± 0.001	< 5 ± 1.75	8.9 ± 0.0	6.5 ± 0.1	3.3 ± 0.0
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	< 0.008 ± 0.000	< 5 ± 0.50	8.7 ± 0.0	6.4 ± 0.0	3.2 ± 0.1
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	< 0.008 ± 0.001	< 5 ± 1.06	9.2 ± 0.2	6.6 ± 0.2	3.2 ± 0.2
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	< 0.008 ± 0.000	< 3 ± 0.74	8.5 ± 0.2	6.2 ± 0.1	3.1 ± 0.0
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	< 0.008 ± 0.001	< 5 ± 2.74	8.5 ± 0.1	6.2 ± 0.0	3.0 ± 0.0
Whiskeytown	12/11/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	8.2 ± 1.7	0.0044 ± 0.0038	4.2 ± 0.2	0.011 ± 0.001
Whiskeytown	12/11/96	0.40 µm Mem	2/2	< 0.011 ± 0.001	8.6 ± 2.9	0.0062 ± 0.0023	4.2 ± 0.2	0.010 ± 0.001
Whiskeytown	12/11/96	0.45 µm Cap	1/2	< 0.011 ± 0.001	9.0 ± 1.0	0.011 ± 0.003	4.5 ± 0.8	0.0081 ± 0.0003
Whiskeytown	12/11/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	14 ± 1	0.013 ± 0.007	5.1 ± 0.1	0.0076 ± 0.0008
Whiskeytown	12/11/96	10 kd Tan	1/2	< 0.011 ± 0.002	8.7 ± 1.3	0.0063 ± 0.0031	4.0 ± 0.1	0.0045 ± 0.0004
Whiskeytown	12/11/96	10 kd Tan	2/2	< 0.01 ± 0.00	7.4 ± 1.0	0.011 ± 0.007	4.3 ± 0.5	0.0031 ± 0.0012
Whiskeytown	05/29/97	0.40 µm Mem	1/2	< 0.002 ± 0.001	8.9 ± 1.4	< 0.004 ± 0.003	4.5 ± 0.3	0.0070 ± 0.0010
Whiskeytown	05/29/97	0.40 µm Mem	2/2	< 0.002 ± 0.001	9.4 ± 2.1	< 0.004 ± 0.001	4.5 ± 0.3	0.015 ± 0.001
Whiskeytown	05/29/97	0.45 µm Cap	1/2	< 0.002 ± 0.001	9.5 ± 1.7	0.0044 ± 0.0030	4.5 ± 0.3	0.0099 ± 0.0009
Whiskeytown	05/29/97	0.45 µm Cap	2/2	< 0.002 ± 0.001	9.2 ± 1.8	0.011 ± 0.001	4.4 ± 0.3	0.010 ± 0.000
Whiskeytown	05/29/97	10 kd Tan	1/2	< 0.002 ± 0.000	8.1 ± 0.2	< 0.004 ± 0.002	3.9 ± 0.2	0.0019 ± 0.0007
Whiskeytown	05/29/97	10 kd Tan	2/2	< 0.002 ± 0.001	9.0 ± 1.4	< 0.004 ± 0.003	3.9 ± 0.1	0.0020 ± 0.0005
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	< 0.005 ± 0.000	9.2 ± 0.3	0.019 ± 0.003	— ± —	0.0064 ± 0.0002
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	< 0.004 ± 0.000	8.9 ± 0.2	0.0092 ± 0.0023	4.2 ± 0.0	0.0073 ± 0.0013
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	< 0.005 ± 0.001	10 ± 1	0.0074 ± 0.0049	4.3 ± 0.1	0.0073 ± 0.0004
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	< 0.005 ± 0.002	10 ± 1	0.015 ± 0.001	4.3 ± 0.1	0.0088 ± 0.0008
Spring Cr. arm	07/12/96	10 kd Tan	1/3	< 0.005 ± 0.000	11 ± 0	0.017 ± 0.005	4.1 ± 0.1	0.0031 ± 0.0008
Spring Cr. arm	07/12/96	10 kd Tan	2/3	< 0.005 ± 0.000	9.6 ± 0.2	0.0052 ± 0.0044	4.2 ± 0.0	0.0031 ± 0.0003
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	< 0.01 ± 0.00	12 ± 2	0.016 ± 0.001	4.3 ± 0.0	0.023 ± 0.000
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	< 0.01 ± 0.00	12 ± 3	0.015 ± 0.007	4.6 ± 0.1	0.020 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Bismuth (µg/L) ICP–MS	Boron (µg/L) ICP–MS	Cadmium (µg/L) ICP–MS	Calcium (mg/L) ICP–AES	Cerium (µg/L) ICP–MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	11 ± 2	0.015 ± 0.003	4.6 ± 0.3	0.018 ± 0.000
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	11 ± 1	0.016 ± 0.006	4.4 ± 0.4	0.020 ± 0.004
Spring Cr. arm	09/18/96	10 kd Tan	1/2	< 0.01 ± 0.00	9.8 ± 0.0	0.012 ± 0.003	4.0 ± 0.2	0.0054 ± 0.0005
Spring Cr. arm	09/18/96	10 kd Tan	2/2	< 0.01 ± 0.00	11 ± 1	0.010 ± 0.004	3.8 ± 0.3	0.0054 ± 0.0012
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	< 0.007 ± 0.000	8.6 ± 0.3	0.11 ± 0.01	5.4 ± 0.2	0.090 ± 0.001
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	< 0.007 ± 0.000	9.0 ± 0.9	0.10 ± 0.01	5.4 ± 0.2	0.064 ± 0.000
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	< 0.007 ± 0.001	8.6 ± 0.6	0.090 ± 0.003	5.4 ± 0.2	0.079 ± 0.006
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	< 0.007 ± 0.001	8.7 ± 0.9	0.10 ± 0.01	5.6 ± 0.3	0.081 ± 0.003
Spring Cr. arm	11/20/96	10 kd Tan	1/2	< 0.007 ± 0.000	8.3 ± 0.7	0.082 ± 0.008	4.5 ± 0.2	0.0095 ± 0.0027
Spring Cr. arm	11/20/96	10 kd Tan	2/2	< 0.007 ± 0.001	8.5 ± 1.9	0.095 ± 0.011	4.4 ± 0.1	0.011 ± 0.000
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	< 0.011 ± 0.002	7.2 ± 1.4	0.40 ± 0.01	5.6 ± 0.3	0.10 ± 0.01
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	< 0.011 ± 0.001	8.1 ± 3.5	0.39 ± 0.02	5.6 ± 0.3	0.079 ± 0.000
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	< 0.01 ± 0.00	8.4 ± 0.9	0.43 ± 0.03	5.7 ± 0.4	0.17 ± 0.00
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	< 0.01 ± 0.00	9.3 ± 1.2	0.42 ± 0.00	5.5 ± 0.3	0.17 ± 0.01
Spring Cr. arm	12/11/96	10 kd Tan	1/2	< 0.01 ± 0.00	8.8 ± 1.6	0.32 ± 0.01	4.4 ± 0.3	0.023 ± 0.001
Spring Cr. arm	12/11/96	10 kd Tan	2/2	< 0.011 ± 0.000	8.1 ± 2.8	0.32 ± 0.02	4.4 ± 0.2	0.025 ± 0.000
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	< 0.002 ± 0.001	9.4 ± 0.7	0.029 ± 0.005	4.9 ± 0.1	0.020 ± 0.001
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	< 0.002 ± 0.001	9.0 ± 0.8	0.019 ± 0.003	4.9 ± 0.2	0.018 ± 0.001
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	< 0.002 ± 0.001	8.6 ± 0.6	0.023 ± 0.004	4.8 ± 0.2	0.023 ± 0.002
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	< 0.002 ± 0.000	9.2 ± 0.7	0.023 ± 0.007	4.8 ± 0.1	0.024 ± 0.001
Spring Cr. arm	05/28/97	10 kd Tan	1/2	< 0.002 ± 0.001	8.9 ± 0.2	0.017 ± 0.002	3.8 ± 0.1	0.0033 ± 0.0013
Spring Cr. arm	05/28/97	10 kd Tan	2/2	< 0.002 ± 0.001	8.7 ± 0.5	0.016 ± 0.004	3.8 ± 0.1	0.0019 ± 0.0005
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	< 0.002 ± 0.001	334 ± 1	0.0078 ± 0.0050	37 ± 1	0.017 ± 0.001
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	< 0.002 ± 0.002	334 ± 1	0.0093 ± 0.0098	37 ± 1	0.016 ± 0.000
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	< 0.002 ± 0.000	332 ± 5	0.0061 ± 0.0019	36 ± 0	0.023 ± 0.000
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	< 0.002 ± 0.000	341 ± 16	0.0069 ± 0.0025	38 ± 2	0.025 ± 0.001
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	< 0.002 ± 0.000	336 ± 13	< 0.005 ± 0.004	33 ± 1	0.0068 ± 0.0006
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	< 0.002 ± 0.001	340 ± 6	0.0069 ± 0.0045	34 ± 0	0.0070 ± 0.0004
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	< 0.008 ± 0.001	23 ± 0	< 0.005 ± 0.004	8.7 ± 0.2	0.056 ± 0.001
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	< 0.008 ± 0.001	24 ± 1	< 0.005 ± 0.002	8.8 ± 0.0	0.031 ± 0.001
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	< 0.008 ± 0.001	24 ± 2	0.0057 ± 0.0032	8.6 ± 0.3	0.072 ± 0.000
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	< 0.008 ± 0.001	23 ± 0	0.0050 ± 0.0036	8.5 ± 0.2	0.072 ± 0.003
Yolo Bypass	01/07/97	10 kd Tan	1/2	< 0.008 ± 0.001	24 ± 0	0.0054 ± 0.0062	6.9 ± 0.1	0.010 ± 0.002
Yolo Bypass	01/07/97	10 kd Tan	2/2	< 0.008 ± 0.001	24 ± 1	< 0.005 ± 0.002	7.0 ± 0.1	0.012 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP–MS	Cobalt (µg/L) ICP–MS	Copper (µg/L) ICP–MS	Dysprosium (µg/L) ICP–MS	Erbium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	0.44 ± 0.35	< 0.005 ± 0.000	1.5 ± 0.0	0.011 ± 0.000	0.0047 ± 0.0033
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	0.33 ± 0.06	< 0.003 ± 0.002	1.4 ± 0.0	0.011 ± 0.001	0.0043 ± 0.0012
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.28 ± 0.02	< 0.004 ± 0.003	2.2 ± 0.0	0.0071 ± 0.0008	0.0056 ± 0.0000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	0.18 ± 0.03	< 0.003 ± 0.001	1.4 ± 0.1	0.0087 ± 0.0020	0.0053 ± 0.0005
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	0.27 ± 0.03	< 0.004 ± 0.001	1.0 ± 0.0	0.0051 ± 0.0007	0.0032 ± 0.0006
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	< 0.2 ± 0.37	< 0.005 ± 0.003	1.0 ± 0.8	0.0046 ± 0.0012	0.0031 ± 0.0011
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	0.41 ± 0.14	< 0.011 ± 0.004	1.2 ± 0.0	0.010 ± 0.001	0.010 ± 0.001
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	0.53 ± 0.02	0.012 ± 0.010	1.2 ± 0.0	0.011 ± 0.004	0.0065 ± 0.0029
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	0.41 ± 0.15	< 0.011 ± 0.001	1.2 ± 0.0	0.0050 ± 0.0016	0.0070 ± 0.0007
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	0.43 ± 0.10	< 0.008 ± 0.005	1.2 ± 0.1	0.0061 ± 0.0001	0.0037 ± 0.0004
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	0.50 ± 0.09	< 0.008 ± 0.007	0.60 ± 0.04	0.0044 ± 0.0025	< 0.003 ± 0.001
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	0.28 ± 0.05	< 0.011 ± 0.005	0.53 ± 0.02	0.0024 ± 0.0013	0.0037 ± 0.0017
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	0.45 ± 0.07	< 0.009 ± 0.009	0.95 ± 0.06	0.0049 ± 0.0028	< 0.0013 ± 0.0017
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	0.33 ± 0.07	< 0.009 ± 0.002	0.84 ± 0.05	0.0038 ± 0.0006	< 0.0013 ± 0.0002
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.37 ± 0.12	< 0.009 ± 0.007	0.75 ± 0.03	0.0032 ± 0.0012	0.0022 ± 0.0007
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	0.44 ± 0.03	< 0.009 ± 0.001	0.75 ± 0.07	0.0045 ± 0.0000	0.0030 ± 0.0005
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	0.23 ± 0.10	< 0.009 ± 0.002	0.40 ± 0.06	< 0.002 ± 0.000	0.0019 ± 0.0012
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	0.25 ± 0.04	< 0.009 ± 0.003	0.41 ± 0.04	< 0.002 ± 0.001	< 0.0013 ± 0.0020
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	0.46 ± 0.08	< 0.007 ± 0.002	2.7 ± 0.1	0.0054 ± 0.0007	< 0.0019 ± 0.0012
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	0.46 ± 0.02	< 0.007 ± 0.003	2.7 ± 0.1	0.0051 ± 0.0025	0.0039 ± 0.0017
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	0.41 ± 0.00	< 0.009 ± 0.002	3.1 ± 0.1	0.0049 ± 0.0009	0.0037 ± 0.0007
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	0.38 ± 0.03	< 0.009 ± 0.005	2.9 ± 0.0	0.0031 ± 0.0004	0.0052 ± 0.0008
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	0.35 ± 0.09	< 0.009 ± 0.001	1.1 ± 0.1	< 0.0015 ± 0.0010	< 0.002 ± 0.001
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	0.28 ± 0.06	< 0.007 ± 0.004	1.1 ± 0.0	< 0.003 ± 0.001	< 0.0019 ± 0.0011
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	0.44 ± 0.04	0.017 ± 0.004	1.3 ± 0.0	0.0093 ± 0.0016	0.0052 ± 0.0003
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	0.41 ± 0.10	< 0.006 ± 0.002	1.1 ± 0.0	0.0066 ± 0.0010	0.0036 ± 0.0009
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	0.22 ± 0.01	0.0066 ± 0.0027	0.98 ± 0.04	0.0060 ± 0.0014	0.0041 ± 0.0011
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	0.34 ± 0.13	< 0.006 ± 0.003	0.97 ± 0.04	0.0061 ± 0.0013	0.0039 ± 0.0004
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	0.25 ± 0.11	< 0.006 ± 0.002	0.36 ± 0.02	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	0.16 ± 0.08	< 0.006 ± 0.002	0.35 ± 0.02	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	0.26 ± 0.03	0.0042 ± 0.0015	1.1 ± 0.0	0.0081 ± 0.0020	0.0037 ± 0.0005

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	0.24 ± 0.06	< 0.003 ± 0.000	1.1 ± 0.0	0.0083 ± 0.0005	0.0036 ± 0.0001
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	0.35 ± 0.09	0.0042 ± 0.0010	1.2 ± 0.0	0.0093 ± 0.0001	0.0032 ± 0.0006
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	0.35 ± 0.11	0.0042 ± 0.0024	1.1 ± 0.0	0.010 ± 0.001	0.0056 ± 0.0010
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	0.40 ± 0.07	< 0.003 ± 0.002	0.78 ± 0.02	0.0040 ± 0.0002	0.0033 ± 0.0006
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	0.30 ± 0.08	< 0.003 ± 0.001	0.82 ± 0.04	0.0045 ± 0.0010	0.0036 ± 0.0008
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	0.16 ± 0.04	< 0.003 ± 0.002	0.77 ± 0.04	0.0036 ± 0.0002	0.0027 ± 0.0008
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	0.55 ± 0.04	< 0.011 ± 0.005	1.2 ± 0.0	0.010 ± 0.001	0.0086 ± 0.0027
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	0.55 ± 0.11	0.017 ± 0.003	1.2 ± 0.0	0.0099 ± 0.0005	0.0058 ± 0.0033
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	0.80 ± 0.10	0.015 ± 0.008	1.4 ± 0.0	0.0099 ± 0.0017	0.0070 ± 0.0006
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	0.54 ± 0.07	0.014 ± 0.007	1.3 ± 0.0	0.0083 ± 0.0010	0.0039 ± 0.0009
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	0.40 ± 0.09	< 0.011 ± 0.004	0.49 ± 0.05	< 0.0018 ± 0.0006	< 0.0018 ± 0.0014
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	0.39 ± 0.03	< 0.011 ± 0.008	0.52 ± 0.02	0.0019 ± 0.0017	0.0032 ± 0.0013
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	0.39 ± 0.05	< 0.011 ± 0.007	0.51 ± 0.03	< 0.0018 ± 0.0020	< 0.0018 ± 0.0010
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	0.29 ± 0.00	0.029 ± 0.007	2.5 ± 0.0	0.014 ± 0.003	0.011 ± 0.002
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	0.39 ± 0.07	0.026 ± 0.006	2.4 ± 0.0	0.015 ± 0.000	0.0071 ± 0.0003
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	0.37 ± 0.14	0.031 ± 0.006	1.9 ± 0.0	0.013 ± 0.003	0.010 ± 0.003
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	0.43 ± 0.05	0.027 ± 0.004	2.0 ± 0.1	0.017 ± 0.001	0.0096 ± 0.0009
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	0.25 ± 0.05	0.015 ± 0.002	0.72 ± 0.08	< 0.002 ± 0.001	< 0.0013 ± 0.0009
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	0.29 ± 0.12	0.018 ± 0.005	0.70 ± 0.09	0.0025 ± 0.0011	< 0.0013 ± 0.0019
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	0.43 ± 0.06	0.029 ± 0.003	4.7 ± 0.1	0.013 ± 0.001	0.0063 ± 0.0014
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	0.36 ± 0.03	0.026 ± 0.003	4.6 ± 0.0	0.013 ± 0.002	0.0099 ± 0.0023
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	0.38 ± 0.01	0.048 ± 0.004	5.1 ± 0.0	0.011 ± 0.002	0.0076 ± 0.0008
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	0.37 ± 0.03	0.047 ± 0.001	5.1 ± 0.1	0.015 ± 0.001	0.0082 ± 0.0041
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	0.18 ± 0.03	0.010 ± 0.004	1.6 ± 0.1	< 0.003 ± 0.001	0.0030 ± 0.0012
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	0.22 ± 0.04	0.011 ± 0.005	1.5 ± 0.0	< 0.003 ± 0.002	0.0025 ± 0.0011
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	0.35 ± 0.02	0.10 ± 0.01	4.0 ± 0.2	0.0093 ± 0.0020	0.0059 ± 0.0008
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	0.32 ± 0.08	0.097 ± 0.003	3.9 ± 0.1	0.0087 ± 0.0004	0.0068 ± 0.0023
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	0.32 ± 0.02	0.16 ± 0.01	6.7 ± 0.2	0.018 ± 0.002	0.0071 ± 0.0007
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	0.34 ± 0.05	0.17 ± 0.00	9.4 ± 0.1	0.018 ± 0.001	0.0079 ± 0.0014
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	0.28 ± 0.05	0.082 ± 0.004	2.5 ± 0.1	0.0044 ± 0.0009	0.0036 ± 0.0009
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	0.31 ± 0.06	0.088 ± 0.004	2.5 ± 0.0	0.0041 ± 0.0017	0.0032 ± 0.0006
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	0.37 ± 0.15	0.077 ± 0.011	2.5 ± 0.1	0.0071 ± 0.0009	0.0039 ± 0.0028
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	0.36 ± 0.09	0.011 ± 0.004	1.3 ± 0.0	0.0074 ± 0.0021	0.0027 ± 0.0009
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	0.52 ± 0.07	0.026 ± 0.002	1.2 ± 0.0	0.0053 ± 0.0008	0.0036 ± 0.0005

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	0.34 ± 0.05	0.017 ± 0.007	2.1 ± 0.1	0.0067 ± 0.0002	0.0050 ± 0.0012
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	0.31 ± 0.13	0.017 ± 0.001	1.9 ± 0.0	0.0069 ± 0.0011	0.0038 ± 0.0000
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	0.25 ± 0.13	< 0.006 ± 0.003	0.62 ± 0.04	< 0.002 ± 0.000	< 0.002 ± 0.001
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	0.36 ± 0.09	< 0.006 ± 0.002	0.57 ± 0.02	< 0.002 ± 0.000	0.0019 ± 0.0005
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	0.38 ± 0.16	0.042 ± 0.002	1.2 ± 0.0	0.0068 ± 0.0008	0.0028 ± 0.0009
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	0.34 ± 0.01	0.041 ± 0.003	1.3 ± 0.0	0.0049 ± 0.0007	0.0028 ± 0.0003
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	0.42 ± 0.01	0.052 ± 0.002	1.4 ± 0.0	0.0058 ± 0.0000	0.0045 ± 0.0015
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	0.32 ± 0.03	0.040 ± 0.006	1.3 ± 0.0	0.0044 ± 0.0005	0.0049 ± 0.0002
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	0.42 ± 0.03	0.041 ± 0.004	0.94 ± 0.00	0.0023 ± 0.0001	0.0027 ± 0.0017
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	0.31 ± 0.12	0.056 ± 0.002	0.82 ± 0.06	0.0010 ± 0.0003	0.0019 ± 0.0006
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	0.73 ± 0.21	0.016 ± 0.005	1.1 ± 0.0	< 0.003 ± 0.000	< 0.003 ± 0.000
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	0.45 ± 0.06	< 0.006 ± 0.002	1.2 ± 0.1	0.0036 ± 0.0026	0.0027 ± 0.0015
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	0.47 ± 0.10	< 0.011 ± 0.006	1.3 ± 0.0	0.0048 ± 0.0015	0.0047 ± 0.0017
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	0.40 ± 0.04	< 0.006 ± 0.004	1.2 ± 0.1	0.0049 ± 0.0016	0.0045 ± 0.0010
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	0.31 ± 0.12	< 0.011 ± 0.002	0.33 ± 0.04	< 0.0018 ± 0.0011	< 0.0018 ± 0.0007
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	0.35 ± 0.07	< 0.011 ± 0.012	0.33 ± 0.02	< 0.0018 ± 0.0000	< 0.0018 ± 0.0014
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	0.35 ± 0.06	0.012 ± 0.006	2.0 ± 0.0	0.011 ± 0.002	0.0053 ± 0.0013
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	0.30 ± 0.07	0.0098 ± 0.0023	2.0 ± 0.1	0.011 ± 0.005	0.0077 ± 0.0012
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	0.29 ± 0.10	0.018 ± 0.011	1.8 ± 0.1	0.010 ± 0.002	0.0058 ± 0.0000
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	0.27 ± 0.07	0.013 ± 0.004	1.8 ± 0.1	0.0094 ± 0.0008	0.0061 ± 0.0020
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	< 0.12 ± 0.04	< 0.009 ± 0.003	0.57 ± 0.04	< 0.002 ± 0.001	0.0014 ± 0.0004
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	0.20 ± 0.11	< 0.009 ± 0.007	0.63 ± 0.02	< 0.002 ± 0.001	< 0.0013 ± 0.0012
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	0.38 ± 0.02	< 0.007 ± 0.005	3.0 ± 0.1	0.0067 ± 0.0005	0.0071 ± 0.0009
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	0.47 ± 0.05	< 0.007 ± 0.005	3.0 ± 0.1	0.0051 ± 0.0012	0.0056 ± 0.0010
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	0.44 ± 0.06	< 0.007 ± 0.009	3.2 ± 0.1	0.0073 ± 0.0011	0.0024 ± 0.0010
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	0.27 ± 0.03	< 0.007 ± 0.003	4.4 ± 0.0	0.0098 ± 0.0012	0.0072 ± 0.0007
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	0.21 ± 0.04	< 0.007 ± 0.003	0.84 ± 0.04	< 0.003 ± 0.001	< 0.0019 ± 0.0022
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	0.20 ± 0.03	< 0.007 ± 0.006	0.87 ± 0.01	< 0.003 ± 0.003	0.0025 ± 0.0016
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.54 ± 0.08	0.054 ± 0.006	2.0 ± 0.0	0.017 ± 0.001	0.0085 ± 0.0008
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.34 ± 0.03	0.016 ± 0.004	1.8 ± 0.0	0.0077 ± 0.0018	0.0052 ± 0.0019
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	0.37 ± 0.05	0.032 ± 0.002	3.6 ± 0.0	0.013 ± 0.000	0.0083 ± 0.0003
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.33 ± 0.01	0.036 ± 0.001	2.1 ± 0.1	0.011 ± 0.004	0.0063 ± 0.0011

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	0.26 ± 0.04	< 0.006 ± 0.003	1.0 ± 0.0	0.0040 ± 0.0016	0.0044 ± 0.0012
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.24 ± 0.06	0.0083 ± 0.0030	1.0 ± 0.0	0.0037 ± 0.0007	0.0040 ± 0.0008
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	0.45 ± 0.07	0.022 ± 0.001	1.3 ± 0.0	0.0062 ± 0.0007	0.0031 ± 0.0004
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	0.55 ± 0.10	0.016 ± 0.004	1.2 ± 0.0	0.0057 ± 0.0017	0.0031 ± 0.0002
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	0.40 ± 0.04	0.017 ± 0.003	1.5 ± 0.1	0.0053 ± 0.0009	0.0049 ± 0.0009
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	0.36 ± 0.06	0.019 ± 0.002	1.7 ± 0.0	0.0049 ± 0.0006	0.0039 ± 0.0012
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	0.23 ± 0.04	0.0098 ± 0.0027	0.57 ± 0.02	< 0.002 ± 0.001	< 0.002 ± 0.000
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	0.27 ± 0.08	0.010 ± 0.003	0.58 ± 0.07	< 0.002 ± 0.002	< 0.002 ± 0.001
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	0.35 ± 0.03	< 0.004 ± 0.002	1.3 ± 0.0	0.0036 ± 0.0002	0.0025 ± 0.0007
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	0.35 ± 0.01	0.0054 ± 0.0021	1.4 ± 0.0	0.0048 ± 0.0011	0.0030 ± 0.0001
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.59 ± 0.33	< 0.005 ± 0.002	1.8 ± 0.0	0.0051 ± 0.0028	0.0063 ± 0.0003
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	0.52 ± 0.16	0.011 ± 0.005	1.2 ± 0.0	0.0030 ± 0.0006	< 0.0018 ± 0.0005
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	0.33 ± 0.15	0.015 ± 0.003	1.2 ± 0.1	< 0.0018 ± 0.0017	< 0.0018 ± 0.0000
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	0.47 ± 0.14	0.013 ± 0.004	1.5 ± 0.0	0.0022 ± 0.0015	0.0033 ± 0.0021
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	0.39 ± 0.03	0.0084 ± 0.0106	1.3 ± 0.0	0.0042 ± 0.0005	0.0025 ± 0.0005
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	0.41 ± 0.15	< 0.011 ± 0.007	0.54 ± 0.01	< 0.0018 ± 0.0016	< 0.0018 ± 0.0001
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	0.34 ± 0.11	< 0.011 ± 0.006	0.54 ± 0.03	< 0.0018 ± 0.0010	< 0.0018 ± 0.0003
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	0.25 ± 0.04	0.016 ± 0.002	1.4 ± 0.0	0.0023 ± 0.0004	0.0022 ± 0.0001
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	0.29 ± 0.11	0.018 ± 0.002	1.3 ± 0.0	< 0.002 ± 0.001	< 0.0013 ± 0.0004
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	0.30 ± 0.04	0.015 ± 0.001	1.3 ± 0.1	< 0.002 ± 0.001	< 0.0013 ± 0.0003
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	0.31 ± 0.17	0.0096 ± 0.0040	1.3 ± 0.0	0.0040 ± 0.0015	0.0013 ± 0.0019
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	0.20 ± 0.02	< 0.009 ± 0.005	0.57 ± 0.05	< 0.002 ± 0.000	< 0.0013 ± 0.0004
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	0.16 ± 0.04	< 0.009 ± 0.002	0.62 ± 0.03	< 0.002 ± 0.001	0.0014 ± 0.0009
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	0.39 ± 0.05	< 0.007 ± 0.005	1.9 ± 0.0	0.0049 ± 0.0014	0.0051 ± 0.0023
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	0.36 ± 0.08	< 0.007 ± 0.002	2.0 ± 0.1	0.0054 ± 0.0019	0.0063 ± 0.0026
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	0.37 ± 0.05	0.021 ± 0.000	3.9 ± 0.2	0.0070 ± 0.0006	0.0051 ± 0.0005
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	0.53 ± 0.12	0.023 ± 0.000	2.1 ± 0.1	0.0063 ± 0.0023	0.0046 ± 0.0018
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	0.19 ± 0.02	< 0.009 ± 0.003	0.53 ± 0.03	0.0017 ± 0.0013	< 0.002 ± 0.001
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	0.26 ± 0.03	< 0.007 ± 0.007	0.61 ± 0.05	< 0.003 ± 0.002	< 0.0019 ± 0.0012
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	0.27 ± 0.06	0.017 ± 0.004	1.7 ± 0.0	0.0098 ± 0.0011	0.0077 ± 0.0033
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	0.27 ± 0.07	0.023 ± 0.008	1.9 ± 0.1	0.010 ± 0.002	0.0078 ± 0.0019

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP–MS	Cobalt (µg/L) ICP–MS	Copper (µg/L) ICP–MS	Dysprosium (µg/L) ICP–MS	Erbium (µg/L) ICP–MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	0.30 ± 0.03	0.044 ± 0.004	2.5 ± 0.1	0.014 ± 0.002	0.010 ± 0.002
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	0.28 ± 0.01	0.044 ± 0.006	1.8 ± 0.0	0.012 ± 0.001	0.0089 ± 0.0022
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	0.29 ± 0.06	0.024 ± 0.007	1.4 ± 0.0	0.0066 ± 0.0006	0.0059 ± 0.0001
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	0.26 ± 0.08	0.023 ± 0.004	1.4 ± 0.0	0.0081 ± 0.0033	0.0041 ± 0.0010
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	0.42 ± 0.04	0.020 ± 0.004	1.3 ± 0.0	0.0041 ± 0.0012	0.0033 ± 0.0006
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	0.50 ± 0.06	0.032 ± 0.006	1.3 ± 0.0	0.0065 ± 0.0023	0.0048 ± 0.0012
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	0.42 ± 0.03	0.016 ± 0.003	1.6 ± 0.0	0.0034 ± 0.0010	0.0029 ± 0.0002
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	0.33 ± 0.05	0.012 ± 0.003	1.3 ± 0.0	0.0032 ± 0.0020	0.0018 ± 0.0008
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	0.25 ± 0.08	< 0.005 ± 0.001	0.72 ± 0.03	< 0.002 ± 0.001	< 0.002 ± 0.000
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	0.26 ± 0.11	0.0059 ± 0.0019	0.83 ± 0.08	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	0.46 ± 0.30	< 0.005 ± 0.002	1.2 ± 0.1	0.0038 ± 0.0011	< 0.002 ± 0.002
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	0.36 ± 0.09	0.023 ± 0.002	1.2 ± 0.0	0.0044 ± 0.0008	0.0039 ± 0.0002
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.24 ± 0.03	0.0054 ± 0.0014	1.3 ± 0.1	0.0061 ± 0.0001	0.0024 ± 0.0002
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.27 ± 0.01	0.0062 ± 0.0026	1.1 ± 0.0	0.0041 ± 0.0003	0.0026 ± 0.0014
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	< 0.12 ± 0.00	< 0.004 ± 0.003	0.79 ± 0.01	0.0026 ± 0.0002	< 0.0011 ± 0.0003
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	0.20 ± 0.06	0.0055 ± 0.0017	0.75 ± 0.05	0.0021 ± 0.0001	0.0017 ± 0.0005
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	0.40 ± 0.19	0.024 ± 0.008	1.3 ± 0.0	0.0082 ± 0.0017	0.0022 ± 0.0008
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	0.41 ± 0.05	0.0089 ± 0.0005	1.2 ± 0.0	0.0032 ± 0.0010	< 0.0015 ± 0.0005
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	0.35 ± 0.14	0.0069 ± 0.0081	1.4 ± 0.0	0.0039 ± 0.0010	0.0031 ± 0.0027
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	0.24 ± 0.03	< 0.006 ± 0.011	1.3 ± 0.1	0.0030 ± 0.0019	0.0024 ± 0.0008
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	0.25 ± 0.08	< 0.011 ± 0.002	0.61 ± 0.01	0.0019 ± 0.0009	< 0.0018 ± 0.0005
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	0.32 ± 0.09	< 0.011 ± 0.004	0.61 ± 0.03	< 0.0018 ± 0.0021	< 0.0018 ± 0.0009
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	< 0.12 ± 0.05	0.027 ± 0.003	1.3 ± 0.0	0.0071 ± 0.0023	0.0039 ± 0.0011
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	< 0.12 ± 0.01	0.028 ± 0.008	1.4 ± 0.0	0.0063 ± 0.0007	0.0025 ± 0.0014
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.23 ± 0.06	0.026 ± 0.005	1.5 ± 0.0	0.0078 ± 0.0005	0.0050 ± 0.0005
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.28 ± 0.08	0.024 ± 0.010	1.5 ± 0.1	0.0072 ± 0.0018	0.0048 ± 0.0021
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.27 ± 0.06	0.022 ± 0.002	1.3 ± 0.0	0.0051 ± 0.0024	0.0020 ± 0.0011
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.26 ± 0.07	0.027 ± 0.013	1.3 ± 0.1	0.0069 ± 0.0047	0.0062 ± 0.0003
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	0.25 ± 0.08	0.017 ± 0.006	0.83 ± 0.12	0.0035 ± 0.0024	0.0034 ± 0.0012
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	0.24 ± 0.05	0.014 ± 0.005	0.81 ± 0.03	< 0.003 ± 0.002	0.0031 ± 0.0007

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	0.34 ± 0.08	0.011 ± 0.005	1.3 ± 0.0	0.0033 ± 0.0008	0.0027 ± 0.0004
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	0.27 ± 0.07	0.0074 ± 0.0026	1.3 ± 0.0	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	0.26 ± 0.01	0.011 ± 0.004	1.8 ± 0.1	0.0027 ± 0.0018	0.0018 ± 0.0008
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	0.42 ± 0.20	0.012 ± 0.006	1.3 ± 0.0	0.0026 ± 0.0012	0.0021 ± 0.0004
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	0.15 ± 0.18	< 0.005 ± 0.003	0.56 ± 0.03	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	< 0.1 ± 0.11	< 0.005 ± 0.003	0.59 ± 0.03	< 0.002 ± 0.002	< 0.002 ± 0.001
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.15 ± 0.03	0.0059 ± 0.0010	1.1 ± 0.0	0.0035 ± 0.0003	0.0028 ± 0.0009
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	0.13 ± 0.01	< 0.004 ± 0.002	1.0 ± 0.0	0.0034 ± 0.0016	0.0018 ± 0.0007
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	< 0.2 ± 0.38	< 0.005 ± 0.006	1.3 ± 0.0	0.0045 ± 0.0000	0.0049 ± 0.0007
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.13 ± 0.02	< 0.004 ± 0.003	1.1 ± 0.0	0.0052 ± 0.0004	0.0021 ± 0.0000
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	< 0.11 ± 0.05	0.0053 ± 0.0012	0.79 ± 0.02	0.00099 ± 0.00048	0.0011 ± 0.0002
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	0.34 ± 0.06	0.0099 ± 0.0013	0.81 ± 0.02	0.0015 ± 0.0002	< 0.0011 ± 0.0002
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	0.33 ± 0.09	< 0.011 ± 0.008	1.2 ± 0.0	0.0032 ± 0.0011	0.0039 ± 0.0006
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	0.35 ± 0.15	< 0.011 ± 0.005	1.2 ± 0.1	< 0.0018 ± 0.0008	< 0.0018 ± 0.0001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	0.57 ± 0.11	0.011 ± 0.007	1.3 ± 0.0	< 0.003 ± 0.001	< 0.003 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	0.31 ± 0.11	< 0.011 ± 0.006	1.2 ± 0.0	0.0048 ± 0.0024	< 0.0018 ± 0.0007
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	< 0.17 ± 0.06	< 0.006 ± 0.005	0.45 ± 0.04	< 0.0018 ± 0.0013	< 0.0015 ± 0.0004
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	0.46 ± 0.13	0.0092 ± 0.0055	0.45 ± 0.03	< 0.003 ± 0.002	< 0.003 ± 0.001
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	0.12 ± 0.05	0.014 ± 0.004	1.2 ± 0.0	0.0028 ± 0.0007	0.0028 ± 0.0024
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	0.14 ± 0.00	0.012 ± 0.007	1.2 ± 0.1	0.0027 ± 0.0007	0.0025 ± 0.0021
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	0.14 ± 0.04	0.013 ± 0.001	1.2 ± 0.0	< 0.002 ± 0.001	< 0.0013 ± 0.0001
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	0.15 ± 0.08	< 0.009 ± 0.002	1.1 ± 0.1	0.0041 ± 0.0004	< 0.0013 ± 0.0017
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	< 0.12 ± 0.02	< 0.009 ± 0.005	0.38 ± 0.01	< 0.002 ± 0.001	< 0.0013 ± 0.0011
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	0.12 ± 0.10	< 0.009 ± 0.004	0.34 ± 0.01	< 0.002 ± 0.000	< 0.0013 ± 0.0006
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	0.23 ± 0.05	0.019 ± 0.004	1.5 ± 0.0	0.0075 ± 0.0026	0.0065 ± 0.0011
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.21 ± 0.07	0.018 ± 0.006	1.5 ± 0.0	0.0058 ± 0.0022	0.0074 ± 0.0038
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.25 ± 0.07	0.033 ± 0.006	1.3 ± 0.0	0.0077 ± 0.0016	0.0070 ± 0.0015
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.23 ± 0.08	0.029 ± 0.008	1.3 ± 0.0	0.0069 ± 0.0012	0.0062 ± 0.0021
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	0.16 ± 0.05	0.019 ± 0.004	0.76 ± 0.03	0.0037 ± 0.0019	0.0025 ± 0.0005
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.15 ± 0.02	0.019 ± 0.003	0.82 ± 0.08	< 0.003 ± 0.002	0.0041 ± 0.0022
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.19 ± 0.04	0.053 ± 0.002	1.0 ± 0.1	0.013 ± 0.000	0.012 ± 0.001
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.20 ± 0.06	0.046 ± 0.002	1.0 ± 0.0	0.017 ± 0.002	0.011 ± 0.000

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	0.20 ± 0.05	0.059 ± 0.003	1.8 ± 0.1	0.018 ± 0.001	0.013 ± 0.004
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.18 ± 0.04	0.058 ± 0.001	1.1 ± 0.0	0.020 ± 0.002	0.014 ± 0.002
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	0.17 ± 0.15	0.031 ± 0.003	2.0 ± 0.0	0.0041 ± 0.0006	0.0034 ± 0.0013
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.11 ± 0.05	0.029 ± 0.002	0.49 ± 0.04	0.0042 ± 0.0017	0.0029 ± 0.0015
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	0.16 ± 0.08	0.013 ± 0.003	1.2 ± 0.0	< 0.002 ± 0.001	< 0.002 ± 0.001
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	0.14 ± 0.10	0.013 ± 0.003	1.2 ± 0.0	< 0.002 ± 0.002	< 0.002 ± 0.002
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	0.15 ± 0.09	0.015 ± 0.003	1.2 ± 0.0	0.0026 ± 0.0004	0.0026 ± 0.0011
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	0.27 ± 0.13	0.016 ± 0.005	1.2 ± 0.0	0.0037 ± 0.0019	0.0036 ± 0.0025
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	< 0.1 ± 0.13	0.0054 ± 0.0033	0.51 ± 0.02	< 0.002 ± 0.002	< 0.002 ± 0.000
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	< 0.1 ± 0.00	0.0052 ± 0.0018	0.49 ± 0.04	< 0.002 ± 0.002	< 0.002 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	0.27 ± 0.11	0.019 ± 0.004	1.2 ± 0.1	0.0049 ± 0.0006	0.0026 ± 0.0014
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.30 ± 0.09	0.023 ± 0.005	1.2 ± 0.1	0.0048 ± 0.0004	0.0025 ± 0.0020
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	< 0.2 ± 0.14	0.010 ± 0.002	1.1 ± 0.0	0.0059 ± 0.0012	0.0026 ± 0.0024
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	0.33 ± 0.19	0.016 ± 0.002	1.1 ± 0.0	0.0046 ± 0.0018	0.0032 ± 0.0007
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	< 0.2 ± 0.12	< 0.003 ± 0.004	0.39 ± 0.05	0.0019 ± 0.0017	< 0.002 ± 0.002
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	< 0.2 ± 0.26	0.0053 ± 0.0030	0.41 ± 0.03	< 0.002 ± 0.001	< 0.002 ± 0.001
Flat Cr.	12/11/96	0.40 µm Mem	1/2	0.14 ± 0.06	0.26 ± 0.00	5.8 ± 0.2	0.044 ± 0.002	0.033 ± 0.000
Flat Cr.	12/11/96	0.40 µm Mem	2/2	0.13 ± 0.05	0.25 ± 0.00	5.7 ± 0.2	0.040 ± 0.000	0.033 ± 0.007
Flat Cr.	12/11/96	0.45 µm Cap	1/2	0.12 ± 0.04	0.23 ± 0.00	4.7 ± 0.3	0.031 ± 0.002	0.020 ± 0.002
Flat Cr.	12/11/96	0.45 µm Cap	2/2	0.097 ± 0.036	0.22 ± 0.00	4.6 ± 0.2	0.030 ± 0.000	0.025 ± 0.002
Flat Cr.	12/11/96	10 kd Tan	1/2	< 0.05 ± 0.05	0.18 ± 0.02	3.0 ± 0.1	0.020 ± 0.006	0.0098 ± 0.0024
Flat Cr.	12/11/96	10 kd Tan	2/2	0.065 ± 0.021	0.18 ± 0.00	3.0 ± 0.1	0.015 ± 0.002	0.013 ± 0.003
Flat Cr.	05/29/97	0.40 µm Mem	1/2	< 0.05 ± 0.06	0.36 ± 0.01	1.5 ± 0.0	0.028 ± 0.002	0.022 ± 0.002
Flat Cr.	05/29/97	0.40 µm Mem	2/2	< 0.05 ± 0.03	0.37 ± 0.01	1.4 ± 0.0	0.027 ± 0.004	0.024 ± 0.003
Flat Cr.	05/29/97	0.45 mm Cap	1/2	< 0.05 ± 0.05	0.36 ± 0.01	0.79 ± 0.03	0.025 ± 0.003	0.020 ± 0.001
Flat Cr.	05/29/97	0.45 µm Cap	2/2	< 0.05 ± 0.05	0.36 ± 0.01	1.2 ± 0.0	0.023 ± 0.002	0.019 ± 0.002
Flat Cr.	05/29/97	10 kd Tan	1/2	< 0.05 ± 0.04	0.32 ± 0.01	0.44 ± 0.03	0.0075 ± 0.0015	0.0052 ± 0.0016
Flat Cr.	05/29/97	10 kd Tan	2/2	< 0.05 ± 0.03	0.33 ± 0.01	0.47 ± 0.02	0.0079 ± 0.0029	0.0060 ± 0.0019
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	0.19 ± 0.04	4.7 ± 0.1	426 ± 23	2.2 ± 0.0	1.2 ± 0.0
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	0.15 ± 0.07	4.5 ± 0.0	454 ± 24	2.3 ± 0.0	1.2 ± 0.0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	0.24 ± 0.04	4.5 ± 0.0	470 ± 9	2.2 ± 0.1	1.1 ± 0.0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	0.18 ± 0.08	4.6 ± 0.0	452 ± 20	2.1 ± 0.0	1.1 ± 0.0
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	0.25 ± 0.06	4.5 ± 0.1	429 ± 30	2.0 ± 0.0	1.2 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	0.26 ± 0.04	4.5 ± 0.0	429 ± 32	2.2 ± 0.1	1.1 ± 0.0
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	< 0.2 ± 0.07	13 ± 1	476 ± 17	3.3 ± 0.0	1.9 ± 0.0
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	< 0.2 ± 0.06	13 ± 1	496 ± 16	3.4 ± 0.0	1.9 ± 0.0
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	< 0.2 ± 0.04	12 ± 1	464 ± 21	3.3 ± 0.0	1.8 ± 0.1
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	< 0.2 ± 0.06	13 ± 0	471 ± 17	3.3 ± 0.0	1.8 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	0.29 ± 0.14	13 ± 1	456 ± 45	3.3 ± 0.0	1.8 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	0.31 ± 0.12	13 ± 0	451 ± 25	3.3 ± 0.0	1.8 ± 0.0
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	0.49 ± 0.04	6.9 ± 0.0	572 ± 23	1.3 ± 0.0	0.75 ± 0.06
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	0.50 ± 0.04	7.1 ± 0.0	563 ± 23	1.4 ± 0.1	0.77 ± 0.01
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	0.53 ± 0.06	6.9 ± 0.2	549 ± 5	1.5 ± 0.0	0.75 ± 0.00
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	0.58 ± 0.08	7.0 ± 0.0	556 ± 9	1.4 ± 0.1	0.75 ± 0.00
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	0.51 ± 0.06	6.9 ± 0.1	535 ± 6	1.3 ± 0.1	0.65 ± 0.03
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	0.60 ± 0.09	6.5 ± 0.0	522 ± 17	1.3 ± 0.1	0.70 ± 0.02
Whiskeytown	12/11/96	0.40 µm Mem	1/2	0.48 ± 0.07	< 0.007 ± 0.002	0.86 ± 0.02	0.0053 ± 0.0024	0.0057 ± 0.0014
Whiskeytown	12/11/96	0.40 µm Mem	2/2	0.41 ± 0.08	< 0.007 ± 0.007	0.90 ± 0.03	0.0073 ± 0.0015	0.0054 ± 0.0020
Whiskeytown	12/11/96	0.45 µm Cap	1/2	0.46 ± 0.03	< 0.007 ± 0.005	0.94 ± 0.05	0.0053 ± 0.0009	0.0048 ± 0.0009
Whiskeytown	12/11/96	0.45 µm Cap	2/2	0.48 ± 0.02	< 0.007 ± 0.004	1.1 ± 0.0	0.0088 ± 0.0047	0.0024 ± 0.0011
Whiskeytown	12/11/96	10 kd Tan	1/2	0.41 ± 0.01	< 0.009 ± 0.001	0.70 ± 0.02	0.0025 ± 0.0022	0.0024 ± 0.0022
Whiskeytown	12/11/96	10 kd Tan	2/2	0.36 ± 0.03	< 0.007 ± 0.004	0.59 ± 0.05	< 0.003 ± 0.001	< 0.0019 ± 0.0008
Whiskeytown	05/29/97	0.40 µm Mem	1/2	0.58 ± 0.05	0.016 ± 0.005	0.86 ± 0.05	0.0052 ± 0.0030	0.0050 ± 0.0033
Whiskeytown	05/29/97	0.40 µm Mem	2/2	0.88 ± 0.03	0.040 ± 0.003	0.86 ± 0.04	0.0058 ± 0.0012	0.0036 ± 0.0019
Whiskeytown	05/29/97	0.45 µm Cap	1/2	0.57 ± 0.08	0.012 ± 0.002	0.90 ± 0.02	0.0058 ± 0.0008	0.0053 ± 0.0028
Whiskeytown	05/29/97	0.45 µm Cap	2/2	0.51 ± 0.04	0.016 ± 0.004	1.5 ± 0.1	0.0046 ± 0.0009	0.0028 ± 0.0005
Whiskeytown	05/29/97	10 kd Tan	1/2	0.38 ± 0.04	0.0059 ± 0.0006	0.39 ± 0.01	0.0029 ± 0.0020	< 0.002 ± 0.001
Whiskeytown	05/29/97	10 kd Tan	2/2	0.37 ± 0.05	0.0039 ± 0.0014	0.42 ± 0.04	< 0.002 ± 0.001	< 0.002 ± 0.001
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	0.43 ± 0.04	< 0.004 ± 0.002	0.72 ± 0.01	0.0035 ± 0.0006	0.0036 ± 0.0005
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	0.37 ± 0.01	0.0067 ± 0.0016	0.63 ± 0.00	0.0051 ± 0.0002	0.0040 ± 0.0002
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	0.67 ± 0.04	< 0.005 ± 0.001	1.1 ± 0.0	0.0073 ± 0.0012	< 0.002 ± 0.002
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	0.48 ± 0.22	< 0.005 ± 0.002	0.96 ± 0.10	0.0053 ± 0.0011	0.0045 ± 0.0007
Spring Cr. arm	07/12/96	10 kd Tan	1/3	0.60 ± 0.32	< 0.005 ± 0.002	2.5 ± 0.0	0.0038 ± 0.0007	0.0042 ± 0.0005
Spring Cr. arm	07/12/96	10 kd Tan	2/3	0.42 ± 0.02	< 0.004 ± 0.003	0.43 ± 0.01	0.0025 ± 0.0003	0.0014 ± 0.0007
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	0.67 ± 0.09	0.021 ± 0.002	1.1 ± 0.0	0.010 ± 0.001	0.0054 ± 0.0012
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	0.65 ± 0.05	0.017 ± 0.009	1.1 ± 0.0	0.0064 ± 0.0004	0.0078 ± 0.0010

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Chromium (µg/L) ICP-MS	Cobalt (µg/L) ICP-MS	Copper (µg/L) ICP-MS	Dysprosium (µg/L) ICP-MS	Erbium (µg/L) ICP-MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	0.70 ± 0.12	0.013 ± 0.006	1.3 ± 0.0	0.0092 ± 0.0019	0.0029 ± 0.0003
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	0.64 ± 0.01	0.017 ± 0.003	1.1 ± 0.0	0.011 ± 0.004	0.0084 ± 0.0001
Spring Cr. arm	09/18/96	10 kd Tan	1/2	0.51 ± 0.08	0.013 ± 0.007	0.48 ± 0.03	0.0029 ± 0.0003	0.0025 ± 0.0019
Spring Cr. arm	09/18/96	10 kd Tan	2/2	0.53 ± 0.04	0.012 ± 0.009	0.48 ± 0.03	0.0028 ± 0.0009	0.0019 ± 0.0016
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	0.45 ± 0.03	0.29 ± 0.01	5.8 ± 0.1	0.036 ± 0.005	0.014 ± 0.000
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	0.33 ± 0.07	0.27 ± 0.01	4.9 ± 0.1	0.025 ± 0.003	0.013 ± 0.002
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	0.40 ± 0.06	0.26 ± 0.00	3.2 ± 0.1	0.028 ± 0.007	0.014 ± 0.001
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	0.36 ± 0.10	0.27 ± 0.00	3.3 ± 0.1	0.030 ± 0.008	0.014 ± 0.000
Spring Cr. arm	11/20/96	10 kd Tan	1/2	0.38 ± 0.22	0.24 ± 0.00	2.3 ± 0.1	0.0052 ± 0.0008	0.0042 ± 0.0018
Spring Cr. arm	11/20/96	10 kd Tan	2/2	0.26 ± 0.01	0.22 ± 0.01	2.1 ± 0.1	0.0033 ± 0.0022	0.0018 ± 0.0019
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	0.19 ± 0.01	0.55 ± 0.01	16 ± 0	0.034 ± 0.001	0.020 ± 0.001
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	0.17 ± 0.01	0.56 ± 0.03	14 ± 0	0.023 ± 0.003	0.015 ± 0.002
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	0.22 ± 0.06	0.57 ± 0.01	23 ± 0	0.053 ± 0.005	0.028 ± 0.001
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	0.30 ± 0.02	0.57 ± 0.02	23 ± 0	0.057 ± 0.003	0.040 ± 0.001
Spring Cr. arm	12/11/96	10 kd Tan	1/2	0.098 ± 0.076	0.44 ± 0.01	9.1 ± 0.1	0.0075 ± 0.0026	0.0056 ± 0.0036
Spring Cr. arm	12/11/96	10 kd Tan	2/2	0.11 ± 0.01	0.43 ± 0.00	8.9 ± 0.1	0.0069 ± 0.0014	0.0055 ± 0.0015
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	0.74 ± 0.14	0.068 ± 0.002	1.7 ± 0.1	0.0083 ± 0.0023	0.0054 ± 0.0004
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	0.66 ± 0.03	0.058 ± 0.009	1.6 ± 0.0	0.0077 ± 0.0020	0.0069 ± 0.0022
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	0.53 ± 0.06	0.077 ± 0.004	2.1 ± 0.1	0.012 ± 0.003	0.0067 ± 0.0025
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	0.50 ± 0.05	0.070 ± 0.004	1.9 ± 0.0	0.010 ± 0.001	0.0076 ± 0.0013
Spring Cr. arm	05/28/97	10 kd Tan	1/2	0.34 ± 0.08	0.039 ± 0.004	0.54 ± 0.02	0.0021 ± 0.0006	< 0.002 ± 0.001
Spring Cr. arm	05/28/97	10 kd Tan	2/2	0.36 ± 0.08	0.038 ± 0.002	0.53 ± 0.04	< 0.002 ± 0.000	< 0.002 ± 0.000
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	< 0.2 ± 0.02	0.084 ± 0.004	3.0 ± 0.0	0.011 ± 0.002	0.013 ± 0.002
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	< 0.2 ± 0.08	0.081 ± 0.007	3.0 ± 0.1	0.011 ± 0.003	0.014 ± 0.000
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	< 0.2 ± 0.35	0.15 ± 0.01	2.8 ± 0.0	0.0097 ± 0.0006	0.011 ± 0.002
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	< 0.2 ± 0.15	0.15 ± 0.01	2.7 ± 0.1	0.012 ± 0.003	0.012 ± 0.002
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	< 0.2 ± 0.11	0.036 ± 0.002	1.3 ± 0.0	0.0082 ± 0.0018	0.0097 ± 0.0021
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	< 0.2 ± 0.17	0.036 ± 0.003	1.3 ± 0.1	0.0080 ± 0.0025	0.0097 ± 0.0029
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	0.30 ± 0.09	0.055 ± 0.004	1.7 ± 0.0	0.0082 ± 0.0014	0.0089 ± 0.0005
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	0.22 ± 0.01	0.026 ± 0.004	1.6 ± 0.1	0.0074 ± 0.0027	0.0063 ± 0.0012
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	0.27 ± 0.05	0.045 ± 0.005	1.7 ± 0.1	0.015 ± 0.001	0.0082 ± 0.0007
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	0.28 ± 0.06	0.039 ± 0.003	1.7 ± 0.0	0.015 ± 0.002	0.0083 ± 0.0021
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.12 ± 0.01	0.022 ± 0.008	0.92 ± 0.03	0.0042 ± 0.0015	0.0024 ± 0.0004
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.12 ± 0.04	0.021 ± 0.004	0.90 ± 0.06	0.0038 ± 0.0013	0.0026 ± 0.0008

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	0.0029 ± 0.0004	0.012 ± 0.001	0.0017 ± 0.0002	14 ± —	56 ± 1
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	0.0076 ± 0.0001	0.012 ± 0.000	0.0014 ± 0.0000	10 ± —	— ± —
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.0023 ± 0.0003	0.011 ± 0.000	0.0019 ± 0.0001	6.6 ± —	19 ± —
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	0.0081 ± 0.0004	0.012 ± 0.001	0.0022 ± 0.0000	8.2 ± —	— ± —
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	0.0018 ± 0.0009	0.0043 ± 0.0003	0.0010 ± 0.0001	18 ± —	72 ± —
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	0.0032 ± 0.0004	0.0080 ± 0.0002	0.00087 ± 0.00022	< 0.2 ± —	— ± —
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	0.0027 ± 0.0012	0.016 ± 0.003	0.0017 ± 0.0009	21 ± 2	13 ± 0
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	< 0.001 ± 0.000	0.0097 ± 0.0022	0.0026 ± 0.0007	25 ± 1	— ± —
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	0.0035 ± 0.0018	0.016 ± 0.001	0.0013 ± 0.0001	7.5 ± 0.7	15 ± 1
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	0.0027 ± 0.0006	0.0069 ± 0.0009	0.0015 ± 0.0004	6.5 ± 0.3	— ± —
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	0.0030 ± 0.0002	0.0048 ± 0.0018	0.00089 ± 0.00029	6.4 ± —	7.5 ± —
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	0.0015 ± 0.0028	0.0059 ± 0.0009	0.00045 ± 0.00007	4.6 ± —	— ± —
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0041 ± 0.0013	0.00059 ± 0.00019	8.0 ± 4.1	— ± —
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	0.00081 ± 0.00042	0.0053 ± 0.0029	0.00049 ± 0.00025	5.5 ± —	6.5 ± —
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.0013 ± 0.0008	0.0051 ± 0.0007	0.00047 ± 0.00010	5.0 ± 2.5	4.1 ± —
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0042 ± 0.0019	0.00081 ± 0.00045	4.3 ± 2.1	— ± —
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.0016 ± 0.0013	0.00048 ± 0.00037	2.0 ± 1.3	2.9 ± —
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	< 0.001 ± 0.001	0.0029 ± 0.0011	0.00048 ± 0.00017	2.0 ± 0.5	— ± —
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.0076 ± 0.0029	0.0011 ± 0.0002	10 ± —	9.9 ± —
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	0.00099 ± 0.00026	0.0078 ± 0.0050	0.0013 ± 0.0004	14 ± 6	— ± —
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.011 ± 0.001	0.0013 ± 0.0001	4.9 ± —	5.8 ± —
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.0091 ± 0.0011	0.0014 ± 0.0005	7.2 ± 3.1	— ± —
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	< 0.001 ± 0.000	0.0032 ± 0.0012	< 0.0004 ± 0.0002	2.9 ± 2.3	1.3 ± —
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	< 0.001 ± 0.000	< 0.002 ± 0.001	< 0.0007 ± 0.0004	2.7 ± 2.0	— ± —
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	0.0014 ± 0.0009	0.013 ± 0.003	0.0015 ± 0.0001	26 ± —	24 ± 1
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0084 ± 0.0009	0.00080 ± 0.00008	18 ± 8	— ± —
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.010 ± 0.004	0.0014 ± 0.0001	11 ± 3	5.3 ± 1.7
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.010 ± 0.003	0.0013 ± 0.0002	8.6 ± 0.3	— ± —
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.002 ± 0.001	< 0.0005 ± 0.0000	3.6 ± —	3.0 ± 0.4
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.003	< 0.0005 ± 0.0001	1.6 ± 1.2	— ± —
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	0.0061 ± 0.0007	0.0074 ± 0.0004	0.0013 ± 0.0001	6.8 ± —	28 ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP–MS	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	0.0067 ± 0.0001	0.0081 ± 0.0015	0.0016 ± 0.0001	11 ± —	— ± —
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	0.0063 ± 0.0002	0.014 ± 0.001	0.0015 ± 0.0000	6.3 ± —	19 ± —
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	0.0072 ± 0.0013	0.011 ± 0.000	0.0023 ± 0.0001	6.6 ± —	— ± —
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	0.0052 ± 0.0004	0.0052 ± 0.0002	0.00073 ± 0.00008	1.6 ± —	12 ± —
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	0.0048 ± 0.0002	0.0065 ± 0.0001	0.00088 ± 0.00003	2.3 ± —	— ± —
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	0.0054 ± 0.0003	0.0058 ± 0.0007	0.00074 ± 0.00020	2.6 ± —	— ± —
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	0.0028 ± 0.0019	0.012 ± 0.003	0.0022 ± 0.0002	10 ± 0	16 ± —
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	0.0023 ± 0.0012	0.013 ± 0.002	0.0013 ± 0.0008	8.4 ± —	— ± —
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	0.0018 ± 0.0019	0.015 ± 0.001	0.0020 ± 0.0005	9.7 ± 1.6	11 ± 0
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	0.0032 ± 0.0017	0.011 ± 0.005	0.0017 ± 0.0005	11 ± 3	— ± —
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	< 0.001 ± 0.001	< 0.003 ± 0.001	0.00074 ± 0.00053	2.4 ± 0.8	7.7 ± 0.5
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	< 0.001 ± 0.002	0.0035 ± 0.0015	0.0011 ± 0.0008	1.8 ± 0.3	— ± —
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	< 0.001 ± 0.001	0.0026 ± 0.0010	0.00064 ± 0.00025	1.6 ± 0.1	— ± —
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	0.0019 ± 0.0006	0.013 ± 0.002	0.0031 ± 0.0005	21 ± —	18 ± 0
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	0.0014 ± 0.0009	0.018 ± 0.004	0.0037 ± 0.0005	20 ± 1	— ± —
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	0.0019 ± 0.0005	0.016 ± 0.002	0.0028 ± 0.0001	9.8 ± 0.8	12 ± —
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	0.0013 ± 0.0010	0.017 ± 0.002	0.0027 ± 0.0003	9.6 ± 0.8	— ± —
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	0.00077 ± 0.00056	0.0022 ± 0.0027	0.00063 ± 0.00006	1.6 ± 0.0	5.3 ± —
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	< 0.001 ± 0.000	0.0031 ± 0.0011	0.00055 ± 0.00013	2.6 ± —	— ± —
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	0.0014 ± 0.0005	0.016 ± 0.003	0.0028 ± 0.0002	21 ± 1	13 ± —
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	< 0.001 ± 0.000	0.023 ± 0.001	0.0026 ± 0.0002	14 ± —	— ± —
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	0.0012 ± 0.0000	0.019 ± 0.001	0.0026 ± 0.0001	13 ± 3	13 ± —
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	0.0014 ± 0.0014	0.019 ± 0.002	0.0027 ± 0.0007	13 ± 1	— ± —
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	< 0.001 ± 0.000	0.0044 ± 0.0034	< 0.0007 ± 0.0001	3.5 ± —	2.3 ± —
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	< 0.001 ± 0.000	0.0053 ± 0.0025	< 0.0007 ± 0.0002	1.9 ± 1.0	— ± —
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	0.0015 ± 0.0008	0.013 ± 0.003	0.0028 ± 0.0006	26 ± —	31 ± —
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	0.0011 ± 0.0006	0.015 ± 0.003	0.0024 ± 0.0003	31 ± 5	— ± —
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	0.0019 ± 0.0008	0.028 ± 0.003	0.0034 ± 0.0003	86 ± 2	74 ± —
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	0.0022 ± 0.0006	0.030 ± 0.000	0.0036 ± 0.0007	84 ± 4	— ± —
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	< 0.001 ± 0.000	0.0088 ± 0.0037	0.0012 ± 0.0002	6.3 ± 2.5	2.3 ± —
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	0.00052 ± 0.00018	0.0056 ± 0.0009	0.0012 ± 0.0003	4.9 ± —	— ± —
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	< 0.001 ± 0.001	0.0083 ± 0.0013	0.0011 ± 0.0003	4.9 ± 0.7	— ± —
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0083 ± 0.0022	0.00088 ± 0.00024	4.9 ± 0.2	7.3 ± 0.9
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	0.0025 ± 0.0011	0.012 ± 0.001	0.0014 ± 0.0002	22 ± —	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP–MS	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	0.0014 ± 0.0008	0.013 ± 0.002	0.0013 ± 0.0003	8.0 ± 3.5	5.7 ± 3.0
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0094 ± 0.0019	0.0012 ± 0.0001	6.4 ± 0.7	— ± —
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	< 0.001 ± 0.000	0.0023 ± 0.0012	< 0.0005 ± 0.0000	4.0 ± 3.2	5.4 ± 2.8
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	< 0.001 ± 0.000	0.0039 ± 0.0015	< 0.0005 ± 0.0003	1.8 ± —	— ± —
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	0.0023 ± 0.0003	0.0060 ± 0.0012	0.0023 ± 0.0001	11 ± —	94 ± —
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	0.0010 ± 0.0004	0.0096 ± 0.0022	0.0011 ± 0.0001	12 ± —	— ± —
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	0.0061 ± 0.0006	0.0096 ± 0.0005	0.0014 ± 0.0001	11 ± —	19 ± 0
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	0.0023 ± 0.0001	0.0064 ± 0.0002	0.00092 ± 0.00011	11 ± —	— ± —
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	0.00034 ± 0.00013	0.0027 ± 0.0006	0.00045 ± 0.00008	2.4 ± —	15 ± —
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	0.0044 ± 0.0003	0.0023 ± 0.0008	0.00047 ± 0.00006	3.5 ± —	— ± —
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	0.0019 ± 0.0017	0.0048 ± 0.0032	< 0.0008 ± 0.0002	8.1 ± —	11 ± 0
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0090 ± 0.0005	0.00090 ± 0.00009	7.8 ± 0.5	— ± —
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	0.0013 ± 0.0016	0.0044 ± 0.0018	0.00087 ± 0.00060	11 ± 0	19 ± —
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.0075 ± 0.0019	0.0010 ± 0.0003	12 ± 0	— ± —
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.003 ± 0.001	< 0.0003 ± 0.0004	1.7 ± 0.3	12 ± 1
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	0.0023 ± 0.0003	< 0.003 ± 0.002	< 0.0003 ± 0.0000	1.2 ± 0.6	— ± —
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	0.0020 ± 0.0006	0.015 ± 0.002	0.0027 ± 0.0005	21 ± 0	74 ± 3
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.016 ± 0.002	0.0021 ± 0.0002	21 ± 0	— ± —
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.013 ± 0.001	0.0022 ± 0.0004	24 ± 4	16 ± —
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.014 ± 0.001	0.0021 ± 0.0002	18 ± 0	— ± —
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.0016 ± 0.0017	< 0.0004 ± 0.0002	4.2 ± 3.0	5.9 ± —
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	< 0.001 ± 0.000	< 0.0016 ± 0.0005	< 0.0004 ± 0.0000	1.7 ± —	— ± —
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.0098 ± 0.0056	0.0012 ± 0.0006	9.0 ± 0.5	9.7 ± —
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	0.0014 ± 0.0001	0.021 ± 0.000	0.0018 ± 0.0002	17 ± 1	— ± —
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.018 ± 0.002	0.0014 ± 0.0004	10 ± —	11 ± —
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	0.0015 ± 0.0017	0.013 ± 0.003	0.0020 ± 0.0002	12 ± 3	— ± —
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0007 ± 0.0004	2.9 ± 0.1	2.0 ± —
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	< 0.001 ± 0.000	0.0028 ± 0.0022	< 0.0007 ± 0.0002	2.3 ± —	— ± —
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.0024 ± 0.0012	0.026 ± 0.004	0.0030 ± 0.0002	116 ± 1	9.8 ± —
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.0011 ± 0.0008	0.018 ± 0.000	0.0024 ± 0.0001	11 ± —	— ± —
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	0.0020 ± 0.0004	0.019 ± 0.002	0.0022 ± 0.0005	25 ± 2	19 ± —
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.0026 ± 0.0007	0.020 ± 0.001	0.0030 ± 0.0006	24 ± 1	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	< 0.001 ± 0.000	0.0057 ± 0.0019	0.0011 ± 0.0001	6.4 ± 2.8	2.3 ± —
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.00060 ± 0.00039	0.0060 ± 0.0012	0.0013 ± 0.0005	3.6 ± —	— ± —
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	0.0015 ± 0.0007	0.0077 ± 0.0011	0.0012 ± 0.0001	20 ± 3	78 ± 2
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0088 ± 0.0002	0.00094 ± 0.00039	8.7 ± 1.6	— ± —
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.011 ± 0.002	0.00098 ± 0.00009	10 ± —	8.6 ± 2.4
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.0071 ± 0.0003	0.0012 ± 0.0002	8.1 ± 1.0	— ± —
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.002 ± 0.000	< 0.0005 ± 0.0001	< 0.9 ± 0.07	2.6 ± 1.7
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0005 ± 0.0002	1.1 ± 0.0	— ± —
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	0.00096 ± 0.00010	0.0040 ± 0.0005	0.00089 ± 0.00009	26 ± —	43 ± —
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	0.0015 ± 0.0000	0.0051 ± 0.0000	0.0013 ± 0.0001	46 ± —	— ± —
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.0021 ± 0.0010	0.0062 ± 0.0004	0.0011 ± 0.0003	15 ± —	31 ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	< 0.001 ± 0.002	0.0056 ± 0.0009	0.00041 ± 0.00020	12 ± 0	64 ± 2
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	0.0013 ± 0.0013	0.0068 ± 0.0022	0.00054 ± 0.00059	8.1 ± 0.2	— ± —
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	0.0020 ± 0.0003	0.0056 ± 0.0034	0.00064 ± 0.00042	19 ± 1	23 ± —
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0052 ± 0.0009	0.00093 ± 0.00033	18 ± 3	— ± —
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	0.0019 ± 0.0013	< 0.003 ± 0.002	< 0.0003 ± 0.0002	3.7 ± 1.2	8.0 ± —
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.003 ± 0.001	< 0.0003 ± 0.0004	1.7 ± —	— ± —
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	0.0012 ± 0.0009	0.0039 ± 0.0017	0.00068 ± 0.00040	19 ± —	19 ± —
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0056 ± 0.0011	0.00056 ± 0.00023	20 ± 2	— ± —
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.0053 ± 0.0016	0.00054 ± 0.00025	20 ± 4	14 ± 0
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	0.00082 ± 0.00030	0.0065 ± 0.0016	0.00058 ± 0.00037	15 ± 1	— ± —
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.0016 ± 0.0012	< 0.0004 ± 0.0003	2.1 ± 0.0	5.6 ± 1.4
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	< 0.001 ± 0.000	< 0.0016 ± 0.0018	< 0.0004 ± 0.0001	2.9 ± 1.0	— ± —
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.0049 ± 0.0024	0.0015 ± 0.0002	12 ± 0	12 ± —
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.010 ± 0.002	0.0012 ± 0.0006	10 ± 0	— ± —
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.011 ± 0.003	0.0017 ± 0.0006	9.5 ± 0.5	8.6 ± —
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.013 ± 0.001	0.0011 ± 0.0002	12 ± 1	— ± —
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	< 0.001 ± 0.000	0.0020 ± 0.0009	< 0.0004 ± 0.0001	3.8 ± 3.4	1.0 ± —
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.004	< 0.0007 ± 0.0003	0.70 ± —	— ± —
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	0.0018 ± 0.0004	0.016 ± 0.004	0.0026 ± 0.0002	12 ± —	14 ± —
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	0.0013 ± 0.0001	0.015 ± 0.002	0.0018 ± 0.0003	14 ± 3	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	0.0029 ± 0.0010	0.021 ± 0.004	0.0030 ± 0.0004	25 ± 1	17 ± —
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	0.0025 ± 0.0003	0.027 ± 0.004	0.0024 ± 0.0007	25 ± 0	— ± —
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	0.0012 ± 0.0009	0.012 ± 0.002	0.0018 ± 0.0004	7.1 ± 2.8	3.7 ± —
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	0.0010 ± 0.0010	0.0090 ± 0.0018	0.0013 ± 0.0003	4.6 ± —	— ± —
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.0062 ± 0.0008	0.00063 ± 0.00018	26 ± 6	28 ± 3
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	0.0014 ± 0.0006	0.012 ± 0.002	0.0011 ± 0.0001	45 ± 2	— ± —
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.0047 ± 0.0013	0.00059 ± 0.00031	11 ± 0	9.4 ± 2.7
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0054 ± 0.0023	0.00062 ± 0.00028	8.3 ± —	— ± —
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0005 ± 0.0002	1.1 ± 0.2	4.4 ± 3.4
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	< 0.001 ± 0.000	0.0023 ± 0.0011	< 0.0005 ± 0.0003	1.1 ± 0.5	— ± —
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	0.0024 ± 0.0002	0.0027 ± 0.0011	0.0010 ± 0.0004	17 ± —	47 ± 2
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	0.0084 ± 0.0010	0.0073 ± 0.0001	0.00090 ± 0.00011	54 ± —	— ± —
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.0069 ± 0.0002	0.0050 ± 0.0010	0.00073 ± 0.00009	15 ± —	23 ± —
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.0076 ± 0.0007	0.0046 ± 0.0000	0.00064 ± 0.00009	14 ± —	— ± —
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	0.00048 ± 0.00044	0.0019 ± 0.0002	0.00054 ± 0.00006	2.5 ± —	12 ± —
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	0.0064 ± 0.0008	0.0018 ± 0.0002	0.00053 ± 0.00004	3.0 ± —	— ± —
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.0092 ± 0.0003	0.0011 ± 0.0001	83 ± 11	58 ± 5
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0052 ± 0.0016	0.00056 ± 0.00003	19 ± 1	— ± —
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	< 0.001 ± 0.003	0.0033 ± 0.0008	0.00076 ± 0.00024	22 ± 12	18 ± —
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	< 0.001 ± 0.002	0.0037 ± 0.0011	0.00056 ± 0.00031	12 ± 1	— ± —
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.003 ± 0.000	< 0.0003 ± 0.0004	1.7 ± 0.6	9.8 ± —
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	0.0021 ± 0.0011	< 0.003 ± 0.001	< 0.0003 ± 0.0001	1.6 ± 0.3	— ± —
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	25 ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	0.0016 ± 0.0000	0.0089 ± 0.0008	0.0014 ± 0.0005	60 ± 2	55 ± 0
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	0.00087 ± 0.00095	0.0099 ± 0.0003	0.0012 ± 0.0004	61 ± 0	— ± —
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.0014 ± 0.0000	0.016 ± 0.001	0.0015 ± 0.0004	21 ± 1	26 ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.0019 ± 0.0013	0.012 ± 0.004	0.00079 ± 0.00042	13 ± 0	— ± —
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.0018 ± 0.0010	0.013 ± 0.003	0.0017 ± 0.0004	15 ± 0	16 ± —
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.0020 ± 0.0010	0.012 ± 0.006	0.0014 ± 0.0003	15 ± 0	— ± —
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	0.0010 ± 0.0009	0.0050 ± 0.0034	< 0.0007 ± 0.0001	3.1 ± —	3.2 ± —
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	< 0.001 ± 0.001	0.0068 ± 0.0024	< 0.0007 ± 0.0001	5.4 ± 1.2	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP–MS	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES–Axial	Iron (µg/L) UV-Vis
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0054 ± 0.0034	0.00056 ± 0.00028	11 ± —	7.0 ± 1.1
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0023 ± 0.0027	< 0.0005 ± 0.0001	4.2 ± 0.6	— ± —
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.0041 ± 0.0003	< 0.0005 ± 0.0001	8.7 ± 0.0	55 ± 1
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0069 ± 0.0012	< 0.0005 ± 0.0002	7.5 ± 0.1	— ± —
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	< 0.001 ± 0.000	< 0.002 ± 0.002	< 0.0005 ± 0.0003	1.1 ± —	2.7 ± 0.6
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0005 ± 0.0001	4.8 ± 1.9	— ± —
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.0016 ± 0.0002	0.0043 ± 0.0007	0.00045 ± 0.00003	17 ± —	21 ± —
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	0.0010 ± 0.0002	0.0046 ± 0.0006	0.00045 ± 0.00001	16 ± —	— ± —
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	0.0025 ± 0.0000	0.0074 ± 0.0007	0.0015 ± 0.0002	19 ± —	28 ± —
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.0018 ± 0.0001	0.0052 ± 0.0000	0.00090 ± 0.00039	20 ± —	— ± —
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	0.0043 ± 0.0006	0.0019 ± 0.0003	< 0.0002 ± 0.0001	7.3 ± —	11 ± —
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	0.0059 ± 0.0003	0.0015 ± 0.0007	< 0.0002 ± 0.0001	1.5 ± —	— ± —
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	0.0024 ± 0.0010	0.0062 ± 0.0042	0.00039 ± 0.00002	7.9 ± 1.9	15 ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	< 0.003 ± 0.001	< 0.0003 ± 0.0001	3.6 ± 1.0	— ± —
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	0.0026 ± 0.0007	0.0063 ± 0.0040	< 0.0008 ± 0.0003	15 ± 0	18 ± —
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	0.0012 ± 0.0030	0.0051 ± 0.0014	0.00058 ± 0.00029	15 ± 1	— ± —
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	< 0.001 ± 0.001	< 0.002 ± 0.001	< 0.0004 ± 0.0001	2.6 ± 1.5	14 ± —
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0008 ± 0.0005	6.6 ± 1.5	— ± —
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0062 ± 0.0006	0.00074 ± 0.00044	25 ± 1	24 ± —
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	< 0.001 ± 0.001	0.0034 ± 0.0012	0.00049 ± 0.00017	15 ± —	— ± —
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.0041 ± 0.0024	0.00059 ± 0.00047	16 ± 1	13 ± —
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.0039 ± 0.0007	0.00051 ± 0.00022	15 ± 0	— ± —
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	< 0.001 ± 0.000	< 0.0016 ± 0.0012	< 0.0004 ± 0.0003	0.93 ± 0.13	3.3 ± —
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	< 0.001 ± 0.000	< 0.0016 ± 0.0004	< 0.0004 ± 0.0003	1.1 ± 0.8	— ± —
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	< 0.001 ± 0.001	0.011 ± 0.002	0.0015 ± 0.0005	14 ± 1	18 ± —
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.0028 ± 0.0007	0.0088 ± 0.0044	0.0019 ± 0.0003	21 ± 4	— ± —
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.0036 ± 0.0000	0.018 ± 0.005	0.0021 ± 0.0003	22 ± 0	20 ± —
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.0013 ± 0.0009	0.013 ± 0.003	0.0031 ± 0.0002	22 ± 2	— ± —
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	< 0.001 ± 0.001	0.0058 ± 0.0020	< 0.0007 ± 0.0005	4.1 ± —	3.2 ± —
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.0013 ± 0.0010	0.0067 ± 0.0028	< 0.0007 ± 0.0000	3.4 ± 0.5	— ± —
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.0032 ± 0.0007	0.030 ± 0.007	0.0038 ± 0.0002	21 ± 1	18 ± —
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.0027 ± 0.0001	0.026 ± 0.006	0.0039 ± 0.0003	19 ± 4	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	0.0033 ± 0.0007	0.032 ± 0.001	0.0039 ± 0.0005	29 ± —	27 ± —
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.0038 ± 0.0006	0.038 ± 0.003	0.0037 ± 0.0006	31 ± 1	— ± —
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	0.00079 ± 0.00021	0.0057 ± 0.0010	0.00097 ± 0.00008	4.9 ± 1.1	2.6 ± —
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.00065 ± 0.00048	0.0075 ± 0.0015	0.00081 ± 0.00020	8.6 ± —	— ± —
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0029 ± 0.0010	< 0.0005 ± 0.0002	9.5 ± 0.1	7.7 ± 5.2
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	< 0.001 ± 0.000	< 0.002 ± 0.003	< 0.0005 ± 0.0004	6.5 ± —	— ± —
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.0035 ± 0.0013	0.00066 ± 0.00015	10 ± 3	11 ± 4
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0048 ± 0.0032	< 0.0005 ± 0.0004	10 ± 0	— ± —
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	< 0.001 ± 0.000	< 0.002 ± 0.003	< 0.0005 ± 0.0003	3.7 ± 2.9	5.5 ± 0.4
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.002	< 0.0005 ± 0.0002	0.90 ± —	— ± —
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0061 ± 0.0028	0.00062 ± 0.00017	18 ± 0	7.2 ± 2.0
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.0015 ± 0.0005	0.0076 ± 0.0015	0.0012 ± 0.0006	32 ± 2	— ± —
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	< 0.001 ± 0.001	0.0040 ± 0.0010	0.0010 ± 0.0003	8.8 ± —	10 ± 2
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	< 0.001 ± 0.001	0.0053 ± 0.0020	0.00061 ± 0.00041	7.5 ± 0.4	— ± —
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	< 0.001 ± 0.000	< 0.002 ± 0.001	< 0.0003 ± 0.0002	< 0.7 ± 0.00	4.0 ± 2.2
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.001	< 0.0003 ± 0.0001	< 0.9 ± 0.29	— ± —
Flat Cr.	12/11/96	0.40 µm Mem	1/2	0.0045 ± 0.0003	0.061 ± 0.002	0.0091 ± 0.0014	41 ± 1	20 ± —
Flat Cr.	12/11/96	0.40 µm Mem	2/2	0.0044 ± 0.0002	0.053 ± 0.001	0.0088 ± 0.0001	52 ± 17	— ± —
Flat Cr.	12/11/96	0.45 µm Cap	1/2	0.0042 ± 0.0006	0.042 ± 0.001	0.0060 ± 0.0001	13 ± 2	6.5 ± —
Flat Cr.	12/11/96	0.45 µm Cap	2/2	0.0027 ± 0.0001	0.045 ± 0.005	0.0066 ± 0.0000	10 ± 0	— ± —
Flat Cr.	12/11/96	10 kd Tan	1/2	0.0024 ± 0.0007	0.022 ± 0.001	0.0040 ± 0.0001	3.4 ± —	7.7 ± —
Flat Cr.	12/11/96	10 kd Tan	2/2	0.0016 ± 0.0005	0.029 ± 0.001	0.0038 ± 0.0002	3.6 ± 0.3	— ± —
Flat Cr.	05/29/97	0.40 µm Mem	1/2	0.0040 ± 0.0010	0.030 ± 0.001	0.0061 ± 0.0005	190 ± 5	273 ± 2
Flat Cr.	05/29/97	0.40 µm Mem	2/2	0.0030 ± 0.0012	0.031 ± 0.001	0.0057 ± 0.0002	166 ± 3	— ± —
Flat Cr.	05/29/97	0.45 mm Cap	1/2	0.0034 ± 0.0010	0.028 ± 0.001	0.0049 ± 0.0003	167 ± 5	178 ± 3
Flat Cr.	05/29/97	0.45 µm Cap	2/2	0.0029 ± 0.0007	0.024 ± 0.001	0.0050 ± 0.0005	159 ± 8	— ± —
Flat Cr.	05/29/97	10 kd Tan	1/2	< 0.001 ± 0.000	0.0072 ± 0.0013	0.0016 ± 0.0002	97 ± 19	75 ± 5
Flat Cr.	05/29/97	10 kd Tan	2/2	< 0.001 ± 0.001	0.0082 ± 0.0011	0.0018 ± 0.0003	75 ± 2	— ± —
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	0.26 ± 0.00	2.9 ± 0.1	0.39 ± 0.01	878 ± 1	930 ± 6
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	0.22 ± 0.01	2.9 ± 0.0	0.41 ± 0.01	978 ± 44	— ± —
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	0.25 ± 0.04	3.0 ± 0.1	0.39 ± 0.02	1,080 ± 50	970 ± 4
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	0.24 ± 0.05	2.8 ± 0.1	0.38 ± 0.02	1,010 ± 30	— ± —
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	0.18 ± 0.00	2.8 ± 0.2	0.40 ± 0.02	978 ± 26	930 ± 4

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	0.23 ± 0.01	2.9 ± 0.1	0.39 ± 0.02	973 ± 78	— ± —
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	0.56 ± 0.06	4.6 ± 0.2	0.60 ± 0.00	1,030 ± 150	1,070 ± 10
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	0.52 ± 0.01	4.7 ± 0.0	0.59 ± 0.00	1,120 ± 50	— ± —
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	0.50 ± 0.02	4.5 ± 0.1	0.57 ± 0.01	1,420 ± 10	1,430 ± 50
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	0.51 ± 0.01	4.6 ± 0.0	0.58 ± 0.01	1,500 ± 0	— ± —
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	0.51 ± 0.00	4.6 ± 0.0	0.57 ± 0.02	595 ± 20	657 ± 36
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	0.50 ± 0.00	4.5 ± 0.1	0.58 ± 0.00	586 ± 4	— ± —
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	0.14 ± 0.01	1.9 ± 0.0	0.25 ± 0.00	12,000 ± 400	12,700 ± 64
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	0.14 ± 0.01	1.9 ± 0.0	0.24 ± 0.02	12,100 ± 100	— ± —
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	0.15 ± 0.00	2.0 ± 0.0	0.25 ± 0.00	12,000 ± 100	— ± —
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	0.14 ± 0.01	2.0 ± 0.0	0.27 ± 0.00	11,900 ± 300	13,100 ± 100
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	0.13 ± 0.00	1.9 ± 0.1	0.24 ± 0.02	11,600 ± 0	12,300 ± 100
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	0.14 ± 0.00	1.8 ± 0.0	0.23 ± 0.01	11,000 ± 600	— ± —
Whiskeytown	12/11/96	0.40 µm Mem	1/2	0.0013 ± 0.0002	0.0096 ± 0.0049	0.0012 ± 0.0001	20 ± 7	13 ± —
Whiskeytown	12/11/96	0.40 µm Mem	2/2	< 0.001 ± 0.000	0.0080 ± 0.0018	0.0014 ± 0.0002	17 ± 1	13 ± —
Whiskeytown	12/11/96	0.45 µm Cap	1/2	< 0.001 ± 0.000	0.0064 ± 0.0002	0.0019 ± 0.0005	14 ± 2	281 ±
Whiskeytown	12/11/96	0.45 µm Cap	2/2	< 0.001 ± 0.000	0.0089 ± 0.0007	0.0023 ± 0.0006	11 ± —	281 ±
Whiskeytown	12/11/96	10 kd Tan	1/2	< 0.001 ± 0.000	0.0051 ± 0.0014	< 0.0004 ± 0.0001	2.1 ± 0.0	3.3 ± —
Whiskeytown	12/11/96	10 kd Tan	2/2	< 0.001 ± 0.001	0.0033 ± 0.0018	< 0.0007 ± 0.0005	2.4 ± 0.5	3.3 ± —
Whiskeytown	05/29/97	0.40 µm Mem	1/2	< 0.001 ± 0.000	0.0066 ± 0.0018	0.00070 ± 0.00022	9.1 ± —	13 ± 2
Whiskeytown	05/29/97	0.40 µm Mem	2/2	0.0015 ± 0.0008	0.0053 ± 0.0007	0.00089 ± 0.00010	34 ± 2	— ± —
Whiskeytown	05/29/97	0.45 µm Cap	1/2	0.0015 ± 0.0002	0.0091 ± 0.0020	0.0010 ± 0.0002	12 ± 1	5.8 ± 1.4
Whiskeytown	05/29/97	0.45 µm Cap	2/2	0.0014 ± 0.0004	0.0065 ± 0.0032	0.0011 ± 0.0003	9.4 ± —	— ± —
Whiskeytown	05/29/97	10 kd Tan	1/2	< 0.001 ± 0.001	0.0030 ± 0.0024	0.00045 ± 0.00026	1.8 ± 0.3	2.2 ± 0.3
Whiskeytown	05/29/97	10 kd Tan	2/2	< 0.001 ± 0.000	0.0024 ± 0.0023	0.00036 ± 0.00013	3.8 ± 3.9	— ± —
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	0.00081 ± 0.00011	0.0060 ± 0.0007	0.00095 ± 0.00009	9.6 ± —	22 ± —
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	0.0036 ± 0.0002	0.0071 ± 0.0004	0.0011 ± 0.0002	11 ± —	22 ± —
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	0.0022 ± 0.0010	0.0069 ± 0.0012	0.0014 ± 0.0003	25 ± —	30 ± —
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	0.0024 ± 0.0001	0.0065 ± 0.0001	0.0013 ± 0.0000	7.2 ± —	30 ± —
Spring Cr. arm	07/12/96	10 kd Tan	1/3	0.0020 ± 0.0006	0.0038 ± 0.0012	0.00050 ± 0.00036	1.6 ± —	19 ± —
Spring Cr. arm	07/12/96	10 kd Tan	2/3	0.00050 ± 0.00026	0.0029 ± 0.0003	0.00055 ± 0.00013	1.5 ± —	19 ± —
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	0.0026 ± 0.0009	0.023 ± 0.003	0.0016 ± 0.0009	8.7 ± 0.5	15 ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	0.0022 ± 0.0016	0.014 ± 0.004	0.0024 ± 0.0006	7.8 ± 0.7	15 ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Europium (µg/L) ICP-MS	Gadolinium (µg/L) ICP-MS	Holmium (µg/L) ICP-MS	Iron (µg/L) ICP-AES-Axial	Iron (µg/L) UV-Vis
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	0.0016 ± 0.0004	0.016 ± 0.003	0.0021 ± 0.0005	8.3 ± —	12 ± —
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	0.0022 ± 0.0010	0.014 ± 0.001	0.0014 ± 0.0007	11 ± 2	— ± —
Spring Cr. arm	09/18/96	10 kd Tan	1/2	< 0.001 ± 0.001	0.0066 ± 0.0026	0.00040 ± 0.00043	3.8 ± —	9.9 ± —
Spring Cr. arm	09/18/96	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.003 ± 0.001	0.00090 ± 0.00057	2.7 ± 0.4	— ± —
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	0.0040 ± 0.0003	0.049 ± 0.008	0.0060 ± 0.0013	61 ± 0	45 ± —
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	0.0021 ± 0.0001	0.035 ± 0.000	0.0038 ± 0.0002	40 ± 0	— ± —
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	0.0039 ± 0.0002	0.041 ± 0.001	0.0062 ± 0.0006	43 ± 1	42 ± 0
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	0.0020 ± 0.0001	0.050 ± 0.003	0.0054 ± 0.0012	48 ± 3	— ± —
Spring Cr. arm	11/20/96	10 kd Tan	1/2	< 0.001 ± 0.000	0.0071 ± 0.0022	0.0010 ± 0.0003	5.2 ± 1.3	3.4 ± 0.2
Spring Cr. arm	11/20/96	10 kd Tan	2/2	< 0.001 ± 0.001	0.0079 ± 0.0013	0.0014 ± 0.0001	1.9 ± —	— ± —
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	0.0032 ± 0.0004	0.050 ± 0.001	0.0064 ± 0.0005	20 ± 0	11 ± —
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	0.0025 ± 0.0000	0.038 ± 0.003	0.0050 ± 0.0003	7.9 ± —	— ± —
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	0.0078 ± 0.0006	0.084 ± 0.004	0.011 ± 0.001	22 ± 0	21 ± —
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	0.0080 ± 0.0031	0.093 ± 0.003	0.010 ± 0.000	22 ± 0	— ± —
Spring Cr. arm	12/11/96	10 kd Tan	1/2	0.00099 ± 0.00121	0.011 ± 0.006	0.0019 ± 0.0005	3.5 ± 2.3	3.3 ± —
Spring Cr. arm	12/11/96	10 kd Tan	2/2	0.0011 ± 0.0002	0.010 ± 0.003	0.0013 ± 0.0005	11 ± 14	— ± —
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	0.0021 ± 0.0006	0.015 ± 0.001	0.0015 ± 0.0002	19 ± 1	37 ± 0
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	0.0016 ± 0.0003	0.012 ± 0.003	0.0020 ± 0.0005	11 ± 1	— ± —
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	0.0020 ± 0.0006	0.0099 ± 0.0017	0.0016 ± 0.0001	7.3 ± —	32 ± 29
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	0.0028 ± 0.0007	0.015 ± 0.002	0.0021 ± 0.0004	7.9 ± 1.2	— ± —
Spring Cr. arm	05/28/97	10 kd Tan	1/2	< 0.001 ± 0.001	0.0042 ± 0.0022	< 0.0003 ± 0.0003	2.8 ± 2.9	3.8 ± 2.2
Spring Cr. arm	05/28/97	10 kd Tan	2/2	< 0.001 ± 0.001	< 0.002 ± 0.001	< 0.0003 ± 0.0003	6.4 ± —	— ± —
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	0.0026 ± 0.0042	0.010 ± 0.002	0.0027 ± 0.0002	14 ± 4	17 ± 1
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	< 0.001 ± 0.000	0.010 ± 0.002	0.0029 ± 0.0002	< 10 ± 9.60	— ± —
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	0.0071 ± 0.0001	0.012 ± 0.003	0.0028 ± 0.0001	5.2 ± —	7.4 ± 1.6
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	0.0037 ± 0.0005	0.010 ± 0.001	0.0025 ± 0.0000	7.3 ± 2.1	— ± —
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	< 0.001 ± 0.001	0.0066 ± 0.0038	0.0020 ± 0.0002	4.5 ± 2.2	5.7 ± 2.6
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	0.0035 ± 0.0014	0.0067 ± 0.0015	0.0023 ± 0.0007	1.9 ± —	— ± —
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	0.0016 ± 0.0002	0.018 ± 0.000	0.0027 ± 0.0004	90 ± —	11 ± —
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	0.0010 ± 0.0004	0.014 ± 0.002	0.0021 ± 0.0007	13 ± —	— ± —
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	0.0024 ± 0.0003	0.019 ± 0.005	0.0029 ± 0.0004	46 ± 14	22 ± —
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	0.0016 ± 0.0001	0.020 ± 0.001	0.0029 ± 0.0003	33 ± —	— ± —
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.00085 ± 0.00103	0.0056 ± 0.0019	0.0011 ± 0.0001	5.2 ± —	3.4 ± —
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.00073 ± 0.00003	0.0054 ± 0.0020	0.00082 ± 0.00026	6.8 ± 1.0	— ± —

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP-MS	Lead (comp.) (µg/L) ICP-MS	Lithium (µg/L) ICP-MS	Lutetium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	33 ± 0	0.016 ± 0.000	0.023 ± 0.003	1.7 ± 0.0	0.00084 ± 0.00026
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	— ± —	0.015 ± 0.000	0.012 ± 0.002	1.7 ± 0.0	0.00076 ± 0.00009
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	13 ± —	0.017 ± 0.001	0.060 ± 0.002	1.7 ± 0.0	0.00043 ± 0.00009
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	— ± —	0.018 ± 0.001	0.0083 ± 0.0018	1.6 ± 0.0	0.00080 ± 0.00005
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	41 ± —	0.0086 ± 0.0003	< 0.005 ± 0.001	1.7 ± 0.0	0.00050 ± 0.00007
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	— ± —	0.011 ± 0.000	<0.005 ± 0.005	1.6 ± 0.1	0.0011 ± 0.0001
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	13 ± 2	0.021 ± 0.001	0.031 ± 0.005	1.7 ± 0.1	0.00064 ± 0.00019
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	— ± —	0.022 ± 0.000	0.010 ± 0.002	1.7 ± 0.0	0.00097 ± 0.00058
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	12 ± 1	0.017 ± 0.000	0.027 ± 0.005	1.7 ± 0.1	0.00083 ± 0.00066
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	— ± —	0.015 ± 0.000	0.0085 ± 0.0008	1.4 ± 0.3	0.00083 ± 0.00042
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	6.3 ± —	0.0052 ± 0.0002	0.0046 ± 0.0027	1.6 ± 0.5	< 0.0008 ± 0.0005
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	— ± —	0.0054 ± 0.0022	0.0067 ± 0.0035	1.6 ± 0.0	< 0.0004 ± 0.0001
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	5.9 ± —	0.0061 ± 0.0011	0.0089 ± 0.0024	2.3 ± 0.1	< 0.0005 ± 0.0002
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	— ± —	0.0065 ± 0.0011	< 0.005 ± 0.003	2.4 ± 0.0	0.00071 ± 0.00008
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	2.6 ± —	0.0074 ± 0.0010	< 0.005 ± 0.003	2.3 ± 0.1	0.00053 ± 0.00057
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	— ± —	0.0059 ± 0.0005	< 0.005 ± 0.003	2.3 ± 0.1	< 0.0005 ± 0.0000
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	1.5 ± —	0.0030 ± 0.0008	< 0.013 ± 0.012	2.2 ± 0.0	0.00057 ± 0.00017
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	— ± —	0.0022 ± 0.0011	< 0.005 ± 0.002	2.2 ± 0.1	< 0.0005 ± 0.0003
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	9.7 ± —	0.0079 ± 0.0011	0.017 ± 0.003	2.7 ± 0.1	0.00050 ± 0.00042
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	— ± —	0.0074 ± 0.0010	0.014 ± 0.002	2.8 ± 0.2	< 0.0004 ± 0.0001
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	5.5 ± —	0.011 ± 0.000	0.014 ± 0.003	2.7 ± 0.0	0.00055 ± 0.00030
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	— ± —	0.0090 ± 0.0005	0.012 ± 0.003	2.7 ± 0.0	0.00022 ± 0.00015
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	0.90 ± —	0.0028 ± 0.0010	0.0064 ± 0.0049	2.5 ± 0.0	0.00024 ± 0.00011
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	— ± —	0.0022 ± 0.0007	0.0045 ± 0.0020	2.6 ± 0.1	0.00051 ± 0.00065
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	21 ± 1	0.021 ± 0.001	0.011 ± 0.004	1.7 ± 0.0	0.00095 ± 0.00040
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	— ± —	0.013 ± 0.001	< 0.006 ± 0.002	1.6 ± 0.1	0.0012 ± 0.0001
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	5.4 ± 3.4	0.013 ± 0.000	< 0.006 ± 0.003	1.5 ± 0.2	0.00088 ± 0.00050
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	— ± —	0.014 ± 0.001	< 0.006 ± 0.001	1.5 ± 0.2	0.00075 ± 0.00023
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	2.4 ± 0.2	0.0019 ± 0.0007	< 0.006 ± 0.006	1.4 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	— ± —	0.0024 ± 0.0001	< 0.006 ± 0.003	1.4 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	21 ± —	0.013 ± 0.000	0.0085 ± 0.0041	1.4 ± 0.0	0.00058 ± 0.00009

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP-MS	Lead (comp.) (µg/L) ICP-MS	Lithium (µg/L) ICP-MS	Lutetium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	— ± —	0.012 ± 0.000	0.0051 ± 0.0001	1.4 ± 0.0	0.00096 ± 0.00006
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	14 ± —	0.017 ± 0.000	0.0042 ± 0.0040	1.4 ± 0.0	0.00079 ± 0.00029
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	— ± —	0.017 ± 0.000	0.0097 ± 0.0006	1.4 ± 0.0	0.00058 ± 0.00003
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	7.0 ± —	0.0076 ± 0.0007	0.0048 ± 0.0043	1.4 ± 0.0	< 0.0003 ± 0.0002
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	— ± —	0.0078 ± 0.0004	0.012 ± 0.003	1.4 ± 0.0	0.00056 ± 0.00000
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	— ± —	0.0079 ± 0.0004	0.0067 ± 0.0017	1.3 ± 0.0	0.00039 ± 0.00008
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	14 ± —	0.015 ± 0.003	0.0079 ± 0.0026	1.3 ± 0.1	0.00068 ± 0.00044
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	— ± —	0.012 ± 0.001	0.0095 ± 0.0016	< 1.2 ± 0.01	< 0.0008 ± 0.0000
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	11 ± 1	0.014 ± 0.002	0.022 ± 0.003	< 1.2 ± 0.25	0.0011 ± 0.0001
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	— ± —	0.013 ± 0.001	0.011 ± 0.005	< 1.2 ± 0.28	0.0011 ± 0.0003
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	4.6 ± 1.7	0.0032 ± 0.0001	0.015 ± 0.004	1.2 ± 0.0	< 0.0004 ± 0.0000
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	— ± —	0.0028 ± 0.0013	< 0.005 ± 0.002	1.2 ± 0.0	< 0.0004 ± 0.0001
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	— ± —	0.0032 ± 0.0004	0.0097 ± 0.0070	1.2 ± 0.0	< 0.0004 ± 0.0003
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	18 ± 4	0.015 ± 0.001	0.024 ± 0.008	1.9 ± 0.0	0.0015 ± 0.0001
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	— ± —	0.013 ± 0.001	0.028 ± 0.006	1.9 ± 0.0	0.00091 ± 0.00055
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	11 ± —	0.013 ± 0.001	0.011 ± 0.000	1.8 ± 0.1	0.00053 ± 0.00004
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	— ± —	0.012 ± 0.001	0.0084 ± 0.0012	1.9 ± 0.0	0.0010 ± 0.0003
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	2.6 ± —	0.0021 ± 0.0004	< 0.005 ± 0.005	1.7 ± 0.0	< 0.0005 ± 0.0003
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	— ± —	0.0023 ± 0.0003	0.012 ± 0.003	1.7 ± 0.1	0.00054 ± 0.00031
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	9.2 ± —	0.017 ± 0.001	0.025 ± 0.008	2.5 ± 0.1	0.0012 ± 0.0006
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	— ± —	0.015 ± 0.002	0.023 ± 0.009	2.4 ± 0.1	0.00097 ± 0.00024
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	9.0 ± —	0.017 ± 0.001	0.010 ± 0.002	2.4 ± 0.0	0.00073 ± 0.00051
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	— ± —	0.015 ± 0.001	0.038 ± 0.003	2.5 ± 0.1	0.00073 ± 0.00035
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	0.50 ± —	0.0027 ± 0.0010	0.0078 ± 0.0055	2.3 ± 0.0	0.00078 ± 0.00026
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	— ± —	0.0023 ± 0.0009	0.062 ± 0.010	2.2 ± 0.0	< 0.0004 ± 0.0004
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	14 ± —	0.013 ± 0.000	0.015 ± 0.004	1.9 ± 0.0	0.0011 ± 0.0004
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	— ± —	0.015 ± 0.002	0.012 ± 0.002	1.9 ± 0.0	0.00072 ± 0.00021
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	21 ± —	0.032 ± 0.002	0.041 ± 0.002	1.9 ± 0.0	0.0011 ± 0.0004
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	— ± —	0.028 ± 0.002	0.027 ± 0.003	2.0 ± 0.0	0.00093 ± 0.00019
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	1.2 ± —	0.0057 ± 0.0011	< 0.005 ± 0.003	1.9 ± 0.0	0.00059 ± 0.00017
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	— ± —	0.0052 ± 0.0011	0.0052 ± 0.0022	1.9 ± 0.1	0.00067 ± 0.00045
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	— ± —	0.0061 ± 0.0007	0.0079 ± 0.0089	2.0 ± 0.0	0.0012 ± 0.0003
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	4.7 ± 2.7	0.0095 ± 0.0009	< 0.006 ± 0.010	1.4 ± 0.1	0.00071 ± 0.00019
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	— ± —	0.015 ± 0.001	0.0070 ± 0.0028	1.4 ± 0.2	0.0010 ± 0.0004

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP–MS	Lead (comp.) (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	4.2 ± 0.9	0.014 ± 0.000	0.012 ± 0.006	1.3 ± 0.1	0.0010 ± 0.0002
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	— ± —	0.012 ± 0.000	0.026 ± 0.008	1.4 ± 0.1	0.00048 ± 0.00024
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	3.8 ± 2.0	0.0031 ± 0.0005	< 0.006 ± 0.004	1.2 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	— ± —	0.0033 ± 0.0005	< 0.006 ± 0.009	1.3 ± 0.2	0.00052 ± 0.00031
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	53 ± —	0.0094 ± 0.0004	0.015 ± 0.004	1.4 ± 0.0	< 0.0006 ± 0.0002
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	— ± —	0.011 ± 0.000	0.046 ± 0.001	1.5 ± 0.0	0.00045 ± 0.00008
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	16 ± 2	0.011 ± 0.000	0.022 ± 0.004	1.4 ± 0.0	0.00051 ± 0.00020
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	— ± —	0.011 ± 0.001	0.011 ± 0.002	1.5 ± 0.0	0.00080 ± 0.00014
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	13 ± —	0.0034 ± 0.0006	0.0053 ± 0.0010	1.5 ± 0.1	< 0.0003 ± 0.0000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	— ± —	0.0034 ± 0.0004	0.0067 ± 0.0007	1.4 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	10 ± 0	0.0085 ± 0.0003	0.011 ± 0.002	< 1.2 ± 0.11	< 0.0008 ± 0.0005
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	— ± —	0.0081 ± 0.0012	< 0.008 ± 0.002	1.4 ± 0.1	0.0010 ± 0.0001
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	17 ± —	0.010 ± 0.001	0.022 ± 0.005	1.3 ± 0.0	0.0013 ± 0.0001
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	— ± —	0.0092 ± 0.0013	0.0059 ± 0.0023	1.3 ± 0.0	0.00036 ± 0.00005
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	5.8 ± 1.9	0.0012 ± 0.0006	0.0051 ± 0.0022	1.3 ± 0.0	< 0.0004 ± 0.0000
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	— ± —	0.0019 ± 0.0004	< 0.005 ± 0.006	1.3 ± 0.0	< 0.0004 ± 0.0002
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	70 ± 0	0.014 ± 0.000	0.021 ± 0.004	1.9 ± 0.0	0.00087 ± 0.00015
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	— ± —	0.012 ± 0.001	0.027 ± 0.007	1.9 ± 0.0	0.0011 ± 0.0007
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	15 ± —	0.011 ± 0.000	0.017 ± 0.009	1.9 ± 0.0	0.00097 ± 0.00003
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	— ± —	0.012 ± 0.001	0.014 ± 0.006	1.9 ± 0.1	0.00093 ± 0.00019
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	3.3 ± —	0.0015 ± 0.0005	0.017 ± 0.011	1.8 ± 0.0	< 0.0005 ± 0.0000
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	— ± —	0.0019 ± 0.0007	< 0.013 ± 0.005	1.7 ± 0.0	< 0.0005 ± 0.0002
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	10 ± —	0.013 ± 0.001	0.0052 ± 0.0021	2.1 ± 0.1	0.0015 ± 0.0003
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	— ± —	0.014 ± 0.001	0.014 ± 0.003	2.1 ± 0.1	0.0011 ± 0.0007
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	9.8 ± —	0.015 ± 0.001	0.013 ± 0.005	2.0 ± 0.1	0.00078 ± 0.00039
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	— ± —	0.013 ± 0.002	0.025 ± 0.004	1.9 ± 0.1	0.00072 ± 0.00029
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	3.3 ± —	0.0022 ± 0.0009	0.0038 ± 0.0017	1.9 ± 0.1	< 0.0004 ± 0.0003
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	— ± —	0.0020 ± 0.0010	0.0079 ± 0.0080	1.9 ± 0.1	< 0.0004 ± 0.0003
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	13 ± —	0.041 ± 0.002	0.042 ± 0.012	1.5 ± 0.0	0.00096 ± 0.00005
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	— ± —	0.018 ± 0.001	0.0059 ± 0.0008	1.4 ± 0.1	0.0012 ± 0.0004
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	18 ± —	0.027 ± 0.001	0.045 ± 0.005	1.4 ± 0.0	0.0012 ± 0.0002
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	— ± —	0.026 ± 0.001	0.015 ± 0.006	1.5 ± 0.0	0.00093 ± 0.00038

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP-MS	Lead (comp.) (µg/L) ICP-MS	Lithium (µg/L) ICP-MS	Lutetium (µg/L) ICP-MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	3.0 ± —	0.0074 ± 0.0018	0.0052 ± 0.0017	1.4 ± 0.0	< 0.0004 ± 0.0001
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	— ± —	0.0090 ± 0.0008	< 0.005 ± 0.002	1.4 ± 0.1	0.00045 ± 0.00029
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	37 ± 5	0.0090 ± 0.0007	0.0090 ± 0.0029	1.4 ± 0.1	0.00063 ± 0.00017
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	— ± —	0.0075 ± 0.0005	< 0.006 ± 0.006	1.5 ± 0.2	0.00038 ± 0.00024
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	6.8 ± 1.5	0.011 ± 0.000	0.020 ± 0.010	1.4 ± 0.2	0.00079 ± 0.00023
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	— ± —	0.011 ± 0.000	0.015 ± 0.008	1.3 ± 0.1	0.00060 ± 0.00023
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	1.1 ± 0.4	0.0027 ± 0.0005	< 0.006 ± 0.011	1.2 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	— ± —	0.0025 ± 0.0008	< 0.006 ± 0.006	1.2 ± 0.1	0.00029 ± 0.00038
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	34 ± —	0.0088 ± 0.0001	0.019 ± 0.003	1.7 ± 0.0	< 0.0003 ± 0.0000
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	— ± —	0.013 ± 0.002	0.020 ± 0.001	1.7 ± 0.0	0.00047 ± 0.00003
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	24 ± —	0.011 ± 0.000	0.055 ± 0.007	1.6 ± 0.1	< 0.0006 ± 0.0001
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	49 ± 0	0.0066 ± 0.0002	0.012 ± 0.005	1.8 ± 0.0	< 0.0004 ± 0.0002
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	— ± —	0.0034 ± 0.0006	0.0087 ± 0.0040	1.7 ± 0.0	< 0.0004 ± 0.0007
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	22 ± —	0.0090 ± 0.0017	0.032 ± 0.005	1.7 ± 0.0	0.00067 ± 0.00025
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	— ± —	0.0097 ± 0.0007	0.020 ± 0.006	1.6 ± 0.1	< 0.0003 ± 0.0002
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	8.7 ± —	0.0013 ± 0.0003	0.0085 ± 0.0037	1.7 ± 0.0	< 0.0004 ± 0.0003
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	— ± —	0.0017 ± 0.0002	0.0048 ± 0.0053	1.7 ± 0.0	< 0.0004 ± 0.0003
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	19 ± —	0.0080 ± 0.0006	0.016 ± 0.002	2.6 ± 0.0	0.00054 ± 0.00021
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	— ± —	0.0072 ± 0.0009	0.014 ± 0.001	2.6 ± 0.1	< 0.0005 ± 0.0002
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	14 ± 1	0.0076 ± 0.0010	0.0090 ± 0.0002	2.6 ± 0.1	< 0.0005 ± 0.0000
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	— ± —	0.0086 ± 0.0008	0.011 ± 0.001	2.7 ± 0.0	< 0.0005 ± 0.0003
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	4.2 ± 0.9	0.0013 ± 0.0004	< 0.005 ± 0.002	2.5 ± 0.1	< 0.0005 ± 0.0003
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	— ± —	0.0018 ± 0.0002	0.022 ± 0.003	2.5 ± 0.0	< 0.0005 ± 0.0002
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	14 ± —	0.011 ± 0.002	< 0.006 ± 0.009	2.5 ± 0.0	0.00065 ± 0.00053
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	— ± —	0.0081 ± 0.0022	< 0.006 ± 0.008	2.5 ± 0.0	< 0.0004 ± 0.0005
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	8.2 ± —	0.012 ± 0.001	0.17 ± 0.01	2.3 ± 0.0	0.00067 ± 0.00039
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	— ± —	0.0099 ± 0.0006	0.013 ± 0.006	2.5 ± 0.1	< 0.0004 ± 0.0004
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	2.4 ± —	0.0022 ± 0.0008	0.0069 ± 0.0070	2.3 ± 0.1	0.00029 ± 0.00002
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	— ± —	0.0025 ± 0.0002	0.0060 ± 0.0109	2.4 ± 0.0	< 0.0004 ± 0.0004
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	20 ± —	0.019 ± 0.001	0.019 ± 0.003	1.2 ± 0.1	0.00094 ± 0.00028
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	— ± —	0.019 ± 0.001	0.0087 ± 0.0035	1.2 ± 0.1	0.0011 ± 0.0006

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP–MS	Lead (comp.) (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	17 ± —	0.034 ± 0.002	0.055 ± 0.016	1.1 ± 0.0	0.0012 ± 0.0001
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	— ± —	0.032 ± 0.003	0.037 ± 0.013	1.2 ± 0.0	0.0011 ± 0.0002
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	4.9 ± —	0.013 ± 0.002	0.0064 ± 0.0022	1.2 ± 0.0	0.00092 ± 0.00027
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	— ± —	0.011 ± 0.001	0.0053 ± 0.0036	1.2 ± 0.0	0.00050 ± 0.00008
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	20 ± 8	0.0081 ± 0.0007	0.015 ± 0.003	1.8 ± 0.1	0.00045 ± 0.00036
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	— ± —	0.014 ± 0.001	0.024 ± 0.004	1.9 ± 0.1	0.00081 ± 0.00024
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	8.8 ± 6.3	0.0079 ± 0.0007	0.013 ± 0.007	1.9 ± 0.0	0.00046 ± 0.00024
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	— ± —	0.0081 ± 0.0002	0.010 ± 0.003	1.8 ± 0.0	0.00058 ± 0.00011
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	4.7 ± 6.2	0.0019 ± 0.0004	< 0.005 ± 0.002	1.7 ± 0.2	0.00026 ± 0.00023
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	— ± —	0.0021 ± 0.0000	0.0095 ± 0.0105	1.8 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	39 ± 2	0.0076 ± 0.0002	0.013 ± 0.002	1.2 ± 0.0	< 0.0006 ± 0.0003
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	— ± —	0.014 ± 0.000	0.038 ± 0.002	1.2 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	20 ± —	0.011 ± 0.000	0.028 ± 0.004	1.1 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	— ± —	0.010 ± 0.000	0.024 ± 0.002	1.1 ± 0.0	0.00037 ± 0.00027
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	11 ± —	0.0060 ± 0.0009	0.017 ± 0.001	1.1 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	— ± —	0.0053 ± 0.0004	0.0081 ± 0.0013	1.1 ± 0.0	< 0.0003 ± 0.0000
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	47 ± 1	0.019 ± 0.001	0.027 ± 0.003	1.6 ± 0.0	0.00099 ± 0.00011
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	— ± —	0.0064 ± 0.0006	0.012 ± 0.004	1.7 ± 0.0	0.00063 ± 0.00029
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	19 ± —	0.0089 ± 0.0022	0.014 ± 0.004	1.7 ± 0.1	0.00079 ± 0.00006
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	— ± —	0.0070 ± 0.0007	0.017 ± 0.005	1.6 ± 0.1	0.00037 ± 0.00023
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	9.9 ± —	0.0015 ± 0.0012	< 0.005 ± 0.002	1.7 ± 0.0	< 0.0004 ± 0.0002
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	— ± —	0.0019 ± 0.0004	< 0.005 ± 0.004	1.6 ± 0.0	< 0.0004 ± 0.0004
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	23 ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	50 ± 1	0.020 ± 0.001	0.028 ± 0.015	1.8 ± 0.0	0.00084 ± 0.00023
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	— ± —	0.019 ± 0.002	0.031 ± 0.012	1.8 ± 0.0	< 0.0005 ± 0.0004
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	16 ± —	0.015 ± 0.001	0.018 ± 0.006	1.5 ± 0.0	0.0014 ± 0.0001
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	— ± —	0.012 ± 0.002	0.025 ± 0.009	1.5 ± 0.1	0.00074 ± 0.00083
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	19 ± —	0.015 ± 0.001	0.0061 ± 0.0085	1.5 ± 0.1	0.00061 ± 0.00055
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	— ± —	0.017 ± 0.001	0.0086 ± 0.0059	1.5 ± 0.1	0.00066 ± 0.00016
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	4.1 ± —	0.0055 ± 0.0004	0.013 ± 0.008	1.5 ± 0.1	0.00047 ± 0.00008
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	— ± —	0.0043 ± 0.0007	< 0.006 ± 0.007	1.4 ± 0.1	< 0.0004 ± 0.0002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP–MS	Lead (comp.) (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	7.5 ± 6.5	0.0053 ± 0.0004	0.013 ± 0.010	1.7 ± 0.0	0.00045 ± 0.00019
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	— ± —	0.0037 ± 0.0007	0.0051 ± 0.0010	1.6 ± 0.1	0.00049 ± 0.00028
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	53 ± 3	0.0077 ± 0.0003	0.020 ± 0.003	1.6 ± 0.2	0.00051 ± 0.00028
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	— ± —	0.0072 ± 0.0005	0.018 ± 0.013	1.7 ± 0.2	0.00055 ± 0.00008
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	1.6 ± 0.7	0.0012 ± 0.0004	< 0.005 ± 0.005	1.3 ± 0.4	0.00045 ± 0.00001
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	— ± —	0.0019 ± 0.0007	0.0097 ± 0.0047	1.5 ± 0.3	0.00030 ± 0.00032
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	19 ± —	0.0083 ± 0.0006	0.037 ± 0.003	1.1 ± 0.0	0.00036 ± 0.00014
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	— ± —	0.0088 ± 0.0005	0.027 ± 0.001	1.1 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	23 ± —	0.014 ± 0.000	0.031 ± 0.007	1.1 ± 0.1	< 0.0006 ± 0.0001
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	— ± —	0.014 ± 0.000	0.026 ± 0.001	1.1 ± 0.0	0.00073 ± 0.00008
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	9.0 ± —	0.0018 ± 0.0002	0.029 ± 0.001	1.0 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	— ± —	0.0021 ± 0.0006	0.015 ± 0.001	1.1 ± 0.0	< 0.0003 ± 0.0001
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	17 ± —	0.0066 ± 0.0009	0.0093 ± 0.0046	1.5 ± 0.0	< 0.0004 ± 0.0002
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	— ± —	0.0036 ± 0.0012	0.0042 ± 0.0020	1.5 ± 0.1	0.00057 ± 0.00032
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	18 ± —	0.0089 ± 0.0006	0.017 ± 0.001	< 1.2 ± 0.23	< 0.0008 ± 0.0001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	— ± —	0.0087 ± 0.0016	0.019 ± 0.004	1.5 ± 0.0	0.00048 ± 0.00001
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	13 ± —	0.00053 ± 0.00055	0.011 ± 0.001	1.3 ± 0.1	< 0.0003 ± 0.0002
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	— ± —	0.0020 ± 0.0007	0.0069 ± 0.0009	< 1.2 ± 0.20	0.00085 ± 0.00022
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	24 ± —	0.0067 ± 0.0004	0.014 ± 0.010	1.5 ± 0.0	< 0.0005 ± 0.0003
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	— ± —	0.0054 ± 0.0021	0.0086 ± 0.0006	1.5 ± 0.0	< 0.0005 ± 0.0000
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	12 ± —	0.0070 ± 0.0007	0.010 ± 0.001	1.5 ± 0.1	< 0.0005 ± 0.0001
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	— ± —	0.0076 ± 0.0006	0.017 ± 0.003	1.5 ± 0.1	< 0.0005 ± 0.0002
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	3.3 ± —	0.0012 ± 0.0004	< 0.005 ± 0.003	1.4 ± 0.0	< 0.0005 ± 0.0002
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	— ± —	0.0011 ± 0.0005	0.013 ± 0.007	1.4 ± 0.0	< 0.0005 ± 0.0003
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	19 ± —	0.013 ± 0.002	0.0077 ± 0.0046	1.1 ± 0.1	0.00074 ± 0.00058
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	— ± —	0.015 ± 0.002	0.020 ± 0.010	1.1 ± 0.1	< 0.0004 ± 0.0005
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	16 ± —	0.024 ± 0.001	0.012 ± 0.014	1.1 ± 0.0	0.0013 ± 0.0000
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	— ± —	0.023 ± 0.002	0.010 ± 0.012	1.1 ± 0.1	0.0016 ± 0.0006
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	3.0 ± —	0.0061 ± 0.0012	< 0.006 ± 0.007	1.0 ± 0.1	< 0.0004 ± 0.0006
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	— ± —	0.0067 ± 0.0006	< 0.006 ± 0.008	1.1 ± 0.0	0.00072 ± 0.00012
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	18 ± —	0.081 ± 0.004	0.0098 ± 0.0046	0.31 ± 0.01	0.00094 ± 0.00014
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	— ± —	0.075 ± 0.002	0.013 ± 0.002	0.33 ± 0.04	0.0015 ± 0.0003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP-MS	Lead (comp.) (µg/L) ICP-MS	Lithium (µg/L) ICP-MS	Lutetium (µg/L) ICP-MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	20 ± —	0.099 ± 0.006	0.057 ± 0.011	0.31 ± 0.02	0.0018 ± 0.0002
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	— ± —	0.11 ± 0.00	0.026 ± 0.005	0.33 ± 0.03	0.0028 ± 0.0002
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	3.5 ± —	0.018 ± 0.002	0.0071 ± 0.0020	0.29 ± 0.03	0.00063 ± 0.00008
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	— ± —	0.017 ± 0.002	0.0062 ± 0.0044	0.27 ± 0.01	0.00054 ± 0.00030
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	5.7 ± 1.7	0.0039 ± 0.0007	0.0070 ± 0.0035	1.3 ± 0.1	< 0.0002 ± 0.0002
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	— ± —	0.0052 ± 0.0007	0.0071 ± 0.0029	1.2 ± 0.2	0.00036 ± 0.00011
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	12 ± 8	0.0074 ± 0.0006	0.012 ± 0.002	1.2 ± 0.1	0.00034 ± 0.00022
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	— ± —	0.0074 ± 0.0003	0.0085 ± 0.0035	1.3 ± 0.0	0.00066 ± 0.00038
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	4.0 ± 0.6	0.0017 ± 0.0002	0.0063 ± 0.0030	1.2 ± 0.4	< 0.0002 ± 0.0003
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	— ± —	0.0012 ± 0.0003	0.0066 ± 0.0040	1.3 ± 0.3	< 0.0002 ± 0.0001
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	7.6 ± 3.2	0.0083 ± 0.0013	0.015 ± 0.004	1.4 ± 0.2	< 0.0005 ± 0.0003
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	— ± —	0.013 ± 0.001	0.018 ± 0.003	1.4 ± 0.0	< 0.0005 ± 0.0001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	7.8 ± 0.8	0.0077 ± 0.0011	0.013 ± 0.006	1.3 ± 0.1	< 0.0005 ± 0.0005
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	— ± —	0.0087 ± 0.0016	0.0078 ± 0.0024	1.4 ± 0.2	< 0.0005 ± 0.0001
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	3.0 ± 1.2	0.0014 ± 0.0005	< 0.005 ± 0.002	1.2 ± 0.1	< 0.0005 ± 0.0003
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	— ± —	0.0014 ± 0.0003	< 0.005 ± 0.005	1.2 ± 0.1	< 0.0005 ± 0.0000
Flat Cr.	12/11/96	0.40 µm Mem	1/2	14 ± —	0.028 ± 0.001	0.022 ± 0.011	0.27 ± 0.03	0.0039 ± 0.0000
Flat Cr.	12/11/96	0.40 µm Mem	2/2	— ± —	0.025 ± 0.000	0.013 ± 0.002	0.30 ± 0.01	0.0040 ± 0.0005
Flat Cr.	12/11/96	0.45 µm Cap	1/2	6.3 ± —	0.022 ± 0.000	< 0.012 ± 0.005	0.26 ± 0.01	0.0029 ± 0.0012
Flat Cr.	12/11/96	0.45 µm Cap	2/2	— ± —	0.020 ± 0.001	< 0.012 ± 0.004	0.27 ± 0.02	0.0030 ± 0.0001
Flat Cr.	12/11/96	10 kd Tan	1/2	6.8 ± —	0.010 ± 0.002	< 0.012 ± 0.005	0.24 ± 0.04	0.0017 ± 0.0003
Flat Cr.	12/11/96	10 kd Tan	2/2	— ± —	0.011 ± 0.001	< 0.012 ± 0.020	0.22 ± 0.04	0.0021 ± 0.0004
Flat Cr.	05/29/97	0.40 µm Mem	1/2	75 ± 22	0.013 ± 0.002	0.0088 ± 0.0037	< 0.06 ± 0.02	0.0037 ± 0.0002
Flat Cr.	05/29/97	0.40 µm Mem	2/2	— ± —	0.013 ± 0.001	0.0099 ± 0.0018	< 0.06 ± 0.01	0.0039 ± 0.0006
Flat Cr.	05/29/97	0.45 mm Cap	1/2	122 ± 13	0.0093 ± 0.0004	< 0.003 ± 0.002	< 0.06 ± 0.01	0.0031 ± 0.0005
Flat Cr.	05/29/97	0.45 µm Cap	2/2	— ± —	0.0088 ± 0.0003	0.0084 ± 0.0017	< 0.06 ± 0.01	0.0033 ± 0.0014
Flat Cr.	05/29/97	10 kd Tan	1/2	75 ± 2	0.0030 ± 0.0008	< 0.005 ± 0.002	< 0.06 ± 0.03	0.0015 ± 0.0003
Flat Cr.	05/29/97	10 kd Tan	2/2	— ± —	0.0033 ± 0.0006	< 0.005 ± 0.004	< 0.06 ± 0.03	0.0012 ± 0.0004
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	730 ± 16	2.1 ± 0.0	1.1 ± 0.0	3.2 ± 0.1	0.11 ± 0.00
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	— ± —	2.2 ± 0.0	1.1 ± 0.0	3.2 ± 0.0	0.11 ± 0.00
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	850 ± 6	2.1 ± 0.0	1.2 ± 0.0	3.2 ± 0.2	0.11 ± 0.00
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	— ± —	2.1 ± 0.0	1.1 ± 0.1	3.3 ± 0.0	0.11 ± 0.01
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	790 ± 18	2.1 ± 0.1	1.1 ± 0.1	3.1 ± 0.0	0.11 ± 0.00

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP-MS	Lead (comp.) (µg/L) ICP-MS	Lithium (µg/L) ICP-MS	Lutetium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	— ± —	2.1 ± 0.1	1.1 ± 0.0	3.1 ± 0.1	0.11 ± 0.00
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	711 ± 17	3.7 ± 0.2	3.4 ± 0.1	8.9 ± 0.1	0.18 ± 0.00
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	— ± —	3.7 ± 0.1	3.3 ± 0.1	9.2 ± 0.1	0.18 ± 0.00
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	994 ± 81	3.5 ± 0.0	3.5 ± 0.1	9.2 ± 0.1	0.18 ± 0.00
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	— ± —	3.7 ± 0.0	3.6 ± 0.1	9.1 ± 0.1	0.18 ± 0.00
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	196 ± 2	3.6 ± 0.2	3.0 ± 0.0	9.1 ± 0.3	0.18 ± 0.01
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	— ± —	3.7 ± 0.1	3.0 ± 0.1	9.1 ± 0.4	0.18 ± 0.00
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	11,500 ± 200	1.6 ± 0.0	3.5 ± 0.2	1.6 ± 0.1	0.065 ± 0.002
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	— ± —	1.6 ± 0.0	3.6 ± 0.2	1.7 ± 0.0	0.070 ± 0.006
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	11,600 ± 100	1.6 ± 0.0	3.7 ± 0.0	1.6 ± 0.0	0.070 ± 0.007
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	— ± —	1.6 ± 0.1	3.6 ± 0.0	1.6 ± 0.1	0.066 ± 0.002
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	11,100 ± 200	1.5 ± 0.0	3.3 ± 0.1	1.6 ± 0.1	0.066 ± 0.007
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	— ± —	1.5 ± 0.0	3.3 ± 0.1	1.5 ± 0.0	0.068 ± 0.000
Whiskeytown	12/11/96	0.40 µm Mem	1/2	10 ± —	0.0057 ± 0.0009	0.017 ± 0.004	0.65 ± 0.01	0.00061 ± 0.00075
Whiskeytown	12/11/96	0.40 µm Mem	2/2	— ± —	0.0072 ± 0.0009	0.014 ± 0.005	0.71 ± 0.02	0.00063 ± 0.00022
Whiskeytown	12/11/96	0.45 µm Cap	1/2	267 ± —	0.0077 ± 0.0003	0.053 ± 0.008	0.71 ± 0.02	0.00047 ± 0.00024
Whiskeytown	12/11/96	0.45 µm Cap	2/2	— ± —	0.0068 ± 0.0015	0.036 ± 0.004	0.66 ± 0.04	0.00085 ± 0.00033
Whiskeytown	12/11/96	10 kd Tan	1/2	2.2 ± —	0.0027 ± 0.0002	< 0.012 ± 0.016	0.67 ± 0.06	< 0.0002 ± 0.0001
Whiskeytown	12/11/96	10 kd Tan	2/2	— ± —	0.0025 ± 0.0003	< 0.006 ± 0.014	0.69 ± 0.09	< 0.0004 ± 0.0004
Whiskeytown	05/29/97	0.40 µm Mem	1/2	9.6 ± 2.8	0.0067 ± 0.0012	< 0.005 ± 0.008	0.64 ± 0.02	0.00065 ± 0.00109
Whiskeytown	05/29/97	0.40 µm Mem	2/2	— ± —	0.0084 ± 0.0010	0.0077 ± 0.0032	0.66 ± 0.07	0.00062 ± 0.00039
Whiskeytown	05/29/97	0.45 µm Cap	1/2	3.9 ± 2.9	0.0086 ± 0.0005	0.0034 ± 0.0026	0.60 ± 0.02	< 0.0005 ± 0.0005
Whiskeytown	05/29/97	0.45 µm Cap	2/2	— ± —	0.010 ± 0.000	0.016 ± 0.003	0.61 ± 0.03	< 0.0005 ± 0.0002
Whiskeytown	05/29/97	10 kd Tan	1/2	0.89 ± 0.24	0.0022 ± 0.0006	< 0.005 ± 0.004	0.64 ± 0.03	< 0.0005 ± 0.0003
Whiskeytown	05/29/97	10 kd Tan	2/2	— ± —	0.0021 ± 0.0002	< 0.005 ± 0.005	0.57 ± 0.04	< 0.0005 ± 0.0003
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	15 ± —	0.0065 ± 0.0004	0.014 ± 0.000	0.64 ± 0.00	0.00068 ± 0.00028
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	— ± —	0.0075 ± 0.0002	0.018 ± 0.002	0.59 ± 0.01	0.00047 ± 0.00011
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	15 ± —	0.0066 ± 0.0008	0.0072 ± 0.0014	0.62 ± 0.05	0.00069 ± 0.00015
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	— ± —	0.0087 ± 0.0013	0.015 ± 0.003	0.78 ± 0.05	< 0.0006 ± 0.0002
Spring Cr. arm	07/12/96	10 kd Tan	1/3	10 ± —	0.0032 ± 0.0013	0.011 ± 0.001	0.59 ± 0.04	0.00073 ± 0.00019
Spring Cr. arm	07/12/96	10 kd Tan	2/3	— ± —	0.0031 ± 0.0001	< 0.005 ± 0.000	0.66 ± 0.02	< 0.0003 ± 0.0000
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	13 ± —	0.013 ± 0.001	0.0075 ± 0.0057	0.63 ± 0.02	0.00089 ± 0.00035
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	— ± —	0.0097 ± 0.0003	0.0099 ± 0.0031	0.62 ± 0.04	0.00098 ± 0.00042

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Iron (II) (µg/L) UV-vis	Lanthanum (µg/L) ICP–MS	Lead (comp.) (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	9.6 ± —	0.0091 ± 0.0010	0.048 ± 0.004	0.62 ± 0.02	0.00062 ± 0.00021
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	— ± —	0.012 ± 0.001	0.020 ± 0.002	0.61 ± 0.02	0.00060 ± 0.00005
Spring Cr. arm	09/18/96	10 kd Tan	1/2	6.9 ± —	0.0025 ± 0.0004	< 0.005 ± 0.002	0.58 ± 0.03	< 0.0004 ± 0.0005
Spring Cr. arm	09/18/96	10 kd Tan	2/2	— ± —	0.0031 ± 0.0009	0.025 ± 0.019	0.60 ± 0.03	< 0.0004 ± 0.0000
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	25 ± —	0.036 ± 0.002	0.028 ± 0.013	0.75 ± 0.02	0.0016 ± 0.0003
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	— ± —	0.024 ± 0.001	0.024 ± 0.004	0.72 ± 0.03	0.0016 ± 0.0001
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	22 ± 3	0.031 ± 0.001	0.029 ± 0.005	0.74 ± 0.05	0.0019 ± 0.0001
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	— ± —	0.036 ± 0.002	0.024 ± 0.008	0.74 ± 0.01	0.0020 ± 0.0001
Spring Cr. arm	11/20/96	10 kd Tan	1/2	1.0 ± 0.9	0.0053 ± 0.0005	0.0089 ± 0.0117	0.68 ± 0.04	< 0.0005 ± 0.0000
Spring Cr. arm	11/20/96	10 kd Tan	2/2	— ± —	0.0052 ± 0.0004	< 0.005 ± 0.003	0.70 ± 0.03	< 0.0005 ± 0.0001
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	8.5 ± —	0.050 ± 0.001	0.024 ± 0.005	1.0 ± 0.0	0.0023 ± 0.0002
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	— ± —	0.043 ± 0.003	0.0074 ± 0.0056	1.0 ± 0.0	0.0017 ± 0.0002
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	13 ± —	0.087 ± 0.003	0.037 ± 0.005	1.0 ± 0.0	0.0038 ± 0.0006
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	— ± —	0.089 ± 0.001	0.060 ± 0.003	0.98 ± 0.06	0.0028 ± 0.0001
Spring Cr. arm	12/11/96	10 kd Tan	1/2	2.0 ± —	0.012 ± 0.001	0.011 ± 0.008	0.90 ± 0.06	0.00063 ± 0.00052
Spring Cr. arm	12/11/96	10 kd Tan	2/2	— ± —	0.012 ± 0.000	0.0054 ± 0.0033	0.93 ± 0.06	0.00077 ± 0.00053
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	19 ± 2	0.011 ± 0.000	0.021 ± 0.006	0.66 ± 0.03	0.00079 ± 0.00047
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	— ± —	0.011 ± 0.001	0.0064 ± 0.0070	0.69 ± 0.05	0.00086 ± 0.00050
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	12 ± 2	0.015 ± 0.000	0.0045 ± 0.0028	0.63 ± 0.03	0.00079 ± 0.00008
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	— ± —	0.013 ± 0.000	< 0.005 ± 0.002	0.72 ± 0.05	0.00094 ± 0.00033
Spring Cr. arm	05/28/97	10 kd Tan	1/2	0.59 ± 0.24	0.0024 ± 0.0002	0.0052 ± 0.0016	0.65 ± 0.07	< 0.0005 ± 0.0002
Spring Cr. arm	05/28/97	10 kd Tan	2/2	— ± —	0.0022 ± 0.0008	0.0091 ± 0.0074	0.65 ± 0.00	< 0.0005 ± 0.0003
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	14 ± 1	0.011 ± 0.000	0.017 ± 0.004	9.2 ± 0.4	0.0025 ± 0.0003
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	— ± —	0.013 ± 0.001	0.013 ± 0.012	9.5 ± 0.5	0.0025 ± 0.0005
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	6.4 ± 1.5	0.013 ± 0.001	0.014 ± 0.001	9.3 ± 0.2	0.0023 ± 0.0005
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	— ± —	0.012 ± 0.001	0.017 ± 0.009	9.4 ± 0.1	0.0027 ± 0.0005
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	4.0 ± 0.4	0.0075 ± 0.0011	0.0069 ± 0.0061	8.8 ± 0.1	0.0027 ± 0.0006
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	— ± —	0.0079 ± 0.0004	0.012 ± 0.007	8.7 ± 0.3	0.0022 ± 0.0005
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	12 ± —	0.026 ± 0.002	0.021 ± 0.002	0.91 ± 0.01	0.0014 ± 0.0001
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	— ± —	0.018 ± 0.002	0.010 ± 0.002	0.84 ± 0.03	0.00091 ± 0.00009
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	20 ± —	0.037 ± 0.002	0.042 ± 0.008	0.77 ± 0.01	0.0015 ± 0.0002
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	— ± —	0.038 ± 0.003	0.039 ± 0.007	0.80 ± 0.02	0.0013 ± 0.0003
Yolo Bypass	01/07/97	10 kd Tan	1/2	3.9 ± —	0.0074 ± 0.0008	0.019 ± 0.003	0.82 ± 0.05	< 0.0004 ± 0.0001
Yolo Bypass	01/07/97	10 kd Tan	2/2	— ± —	0.0087 ± 0.0007	0.0060 ± 0.0030	0.74 ± 0.04	0.00061 ± 0.00027

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP-AES	Manganese (µg/L) ICP-MS	Mercury (µg/L) CV-AFS	Molybdenum (µg/L) ICP-MS	Neodymium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	4.3 ± 0.0	0.40 ± 0.03	0.00080 ± 0.00010	0.38 ± 0.02	0.028 ± 0.000
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	4.2 ± 0.0	0.33 ± 0.01	0.00090 ± 0.00020	0.36 ± 0.01	0.024 ± 0.001
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	4.2 ± 0.0	0.22 ± 0.01	0.0014 ± 0.0002	0.35 ± 0.01	0.035 ± 0.000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	4.2 ± 0.0	0.24 ± 0.01	— ± —	0.37 ± 0.02	0.027 ± 0.000
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	4.2 ± 0.0	0.25 ± 0.01	0.0015 ± 0.0001	0.32 ± 0.01	0.013 ± 0.001
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	4.1 ± 0.0	0.30 ± 0.01	0.00070 ± 0.00040	0.31 ± 0.02	0.018 ± 0.003
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	0.00050 ± 0.00030	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	4.3 ± 0.2	1.2 ± 0.0	< 0.0004 ± 0.0001	0.38 ± 0.01	0.028 ± 0.004
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	4.4 ± 0.2	1.8 ± 0.0	0.00054 ± 0.00018	0.37 ± 0.03	0.033 ± 0.002
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	4.4 ± 0.3	0.74 ± 0.04	0.00051 ± 0.00016	0.31 ± 0.04	0.023 ± 0.004
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	4.2 ± 0.1	0.70 ± 0.01	0.00042 ± 0.00017	0.33 ± 0.02	0.025 ± 0.002
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	4.1 ± 0.1	0.70 ± 0.04	0.00074 ± 0.00004	0.27 ± 0.00	0.0087 ± 0.0030
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	4.0 ± 0.1	0.65 ± 0.01	< 0.0004 ± 0.0000	0.30 ± 0.04	0.0061 ± 0.0005
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	4.7 ± 0.1	0.38 ± 0.01	0.00056 ± 0.00025	0.45 ± 0.03	0.013 ± 0.001
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	4.7 ± 0.0	0.36 ± 0.02	< 0.0004 ± 0.0001	0.49 ± 0.00	0.011 ± 0.002
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	4.6 ± 0.0	0.35 ± 0.02	0.00093 ± 0.00023	0.50 ± 0.03	0.0085 ± 0.0022
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	4.6 ± 0.0	0.36 ± 0.02	0.0013 ± 0.0001	0.47 ± 0.03	0.0075 ± 0.0034
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	4.3 ± 0.0	0.28 ± 0.00	0.00058 ± 0.00014	0.32 ± 0.02	< 0.002 ± 0.001
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	4.3 ± 0.1	0.29 ± 0.00	0.00063 ± 0.00013	0.31 ± 0.01	0.0021 ± 0.0020
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	5.0 ± 0.2	1.3 ± 0.0	0.00043 ± 0.00019	0.58 ± 0.00	0.016 ± 0.002
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	5.2 ± 0.1	1.3 ± 0.0	0.00080 ± 0.00001	0.65 ± 0.11	0.014 ± 0.001
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	4.9 ± 0.3	1.4 ± 0.0	0.0011 ± 0.0001	0.53 ± 0.04	0.019 ± 0.002
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	5.0 ± 0.3	1.3 ± 0.0	0.0011 ± 0.0001	0.56 ± 0.02	0.020 ± 0.003
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	4.5 ± 0.2	1.1 ± 0.0	0.0014 ± 0.0003	0.34 ± 0.03	0.0059 ± 0.0003
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	4.4 ± 0.2	1.1 ± 0.0	0.00081 ± 0.00012	0.30 ± 0.01	0.0052 ± 0.0011
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	4.3 ± 0.1	0.67 ± 0.03	0.0018 ± 0.0004	0.37 ± 0.03	0.029 ± 0.002
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	4.2 ± 0.2	0.35 ± 0.01	0.0017 ± 0.0001	0.36 ± 0.04	0.020 ± 0.003
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	4.2 ± 0.2	0.36 ± 0.01	0.0022 ± 0.0006	0.36 ± 0.04	0.021 ± 0.001
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	4.3 ± 0.1	0.21 ± 0.00	0.0020 ± 0.0007	0.35 ± 0.06	0.024 ± 0.002
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	3.6 ± 0.1	0.18 ± 0.00	0.0013 ± 0.0003	0.18 ± 0.05	0.0039 ± 0.0012
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	3.6 ± 0.1	0.18 ± 0.01	0.0011 ± 0.0002	0.17 ± 0.06	0.0046 ± 0.0004
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	4.6 ± 0.0	0.72 ± 0.00	0.0012 ± 0.0001	0.31 ± 0.02	0.017 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP–AES	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	4.6 ± 0.0	0.71 ± 0.01	0.0011 ± 0.0000	0.37 ± 0.00	0.018 ± 0.002
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	4.6 ± 0.0	0.79 ± 0.03	0.0019 ± 0.0002	0.31 ± 0.01	0.027 ± 0.001
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	4.6 ± 0.0	0.80 ± 0.00	0.0010 ± 0.0003	0.33 ± 0.01	0.023 ± 0.001
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	4.5 ± 0.0	0.69 ± 0.02	0.0011 ± 0.0001	0.27 ± 0.00	0.012 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	4.5 ± 0.1	0.73 ± 0.01	0.00090 ± 0.00020	0.29 ± 0.00	0.012 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	4.5 ± 0.1	0.70 ± 0.01	0.00070 ± 0.00030	0.29 ± 0.01	0.012 ± 0.002
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	4.9 ± 0.1	1.7 ± 0.0	0.00047 ± 0.00013	0.25 ± 0.03	0.027 ± 0.003
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	5.2 ± 0.1	1.9 ± 0.1	< 0.0004 ± 0.0001	0.23 ± 0.03	0.021 ± 0.005
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	5.3 ± 0.0	1.7 ± 0.0	0.00046 ± 0.00010	0.24 ± 0.04	0.027 ± 0.006
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	4.9 ± 0.1	1.6 ± 0.0	< 0.0004 ± 0.0003	0.23 ± 0.03	0.027 ± 0.002
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	4.8 ± 0.0	1.5 ± 0.0	0.00064 ± 0.00008	0.18 ± 0.07	0.0050 ± 0.0011
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	4.6 ± 0.2	1.5 ± 0.0	< 0.0004 ± 0.0003	0.19 ± 0.02	0.0048 ± 0.0015
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	4.5 ± 0.1	1.5 ± 0.0	— ± —	0.18 ± 0.02	< 0.003 ± 0.003
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	4.8 ± 0.1	4.2 ± 0.1	0.0015 ± 0.0002	0.38 ± 0.01	0.026 ± 0.001
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	4.7 ± 0.1	4.2 ± 0.0	0.0012 ± 0.0001	0.46 ± 0.01	0.038 ± 0.002
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	4.6 ± 0.1	4.4 ± 0.0	0.0013 ± 0.0001	0.38 ± 0.03	0.031 ± 0.002
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	4.7 ± 0.1	4.4 ± 0.0	0.0014 ± 0.0005	0.41 ± 0.04	0.029 ± 0.005
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	4.0 ± 0.0	2.9 ± 0.1	0.0011 ± 0.0001	0.25 ± 0.03	0.0036 ± 0.0014
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	4.1 ± 0.0	3.0 ± 0.0	0.0010 ± 0.0000	0.20 ± 0.03	0.0029 ± 0.0017
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	5.1 ± 0.1	3.0 ± 0.0	0.00043 ± 0.00015	0.43 ± 0.01	0.036 ± 0.001
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	5.1 ± 0.1	2.8 ± 0.1	0.00063 ± 0.00021	0.47 ± 0.02	0.029 ± 0.003
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	5.1 ± 0.1	3.4 ± 0.0	0.00075 ± 0.00005	0.55 ± 0.05	0.033 ± 0.001
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	5.0 ± 0.1	3.4 ± 0.0	0.00079 ± 0.00009	0.50 ± 0.01	0.035 ± 0.008
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	4.2 ± 0.1	2.2 ± 0.1	0.0010 ± 0.0000	0.26 ± 0.03	0.0072 ± 0.0006
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	4.2 ± 0.1	2.2 ± 0.0	0.00071 ± 0.00011	0.25 ± 0.01	0.0070 ± 0.0031
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	4.4 ± 0.5	7.3 ± 0.2	0.00086 ± 0.00009	0.41 ± 0.03	0.031 ± 0.001
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	4.1 ± 0.8	7.7 ± 0.4	0.00085 ± 0.00035	0.45 ± 0.00	0.025 ± 0.002
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	4.1 ± 0.8	8.9 ± 0.3	0.00085 ± 0.00040	0.39 ± 0.01	0.059 ± 0.002
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	3.9 ± 0.7	9.4 ± 0.2	0.0015 ± 0.0001	0.41 ± 0.01	0.055 ± 0.003
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	4.1 ± 0.8	6.6 ± 0.2	0.00053 ± 0.00032	0.35 ± 0.01	0.013 ± 0.003
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	4.2 ± 0.6	6.6 ± 0.2	< 0.0004 ± 0.0002	0.33 ± 0.01	0.016 ± 0.005
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	4.1 ± 0.1	6.7 ± 0.0	— ± —	0.39 ± 0.00	0.014 ± 0.001
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	4.6 ± 0.2	1.0 ± 0.0	0.0011 ± 0.0002	0.32 ± 0.04	0.017 ± 0.003
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	4.7 ± 0.2	1.4 ± 0.0	0.0037 ± 0.0003	0.30 ± 0.02	0.024 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP-AES	Manganese (µg/L) ICP-MS	Mercury (µg/L) CV-AFS	Molybdenum (µg/L) ICP-MS	Neodymium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	4.6 ± 0.2	1.2 ± 0.0	0.0019 ± 0.0003	0.29 ± 0.03	0.020 ± 0.002
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	4.7 ± 0.1	1.2 ± 0.0	0.0010 ± 0.0002	0.30 ± 0.04	0.022 ± 0.002
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	4.2 ± 0.2	0.91 ± 0.04	0.00066 ± 0.00020	0.18 ± 0.03	0.0023 ± 0.0003
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	4.3 ± 0.1	0.90 ± 0.02	0.00085 ± 0.00024	0.25 ± 0.04	0.0058 ± 0.0020
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	4.8 ± 0.0	2.2 ± 0.0	0.0011 ± 0.0002	0.33 ± 0.02	0.013 ± 0.002
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	4.8 ± 0.0	1.8 ± 0.0	0.0014 ± 0.0002	0.30 ± 0.02	0.015 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	4.7 ± 0.0	1.9 ± 0.0	0.00080 ± 0.00030	0.32 ± 0.01	0.017 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	4.8 ± 0.1	1.7 ± 0.0	— ± —	0.33 ± 0.02	0.016 ± 0.001
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	4.8 ± 0.0	2.2 ± 0.0	0.00040 ± 0.00010	0.44 ± 0.00	0.0059 ± 0.0019
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	4.7 ± 0.0	2.2 ± 0.1	0.0014 ± 0.0000	0.36 ± 0.00	0.0051 ± 0.0009
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	0.0010 ± 0.0002	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	4.9 ± 0.1	2.6 ± 0.0	0.00043 ± 0.00004	0.28 ± 0.01	0.010 ± 0.000
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	5.3 ± 0.1	2.6 ± 0.0	0.00068 ± 0.00009	0.28 ± 0.03	0.0095 ± 0.0006
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	4.8 ± 0.1	2.7 ± 0.0	0.00053 ± 0.00018	0.32 ± 0.05	0.015 ± 0.002
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	5.4 ± 0.1	2.7 ± 0.1	< 0.0004 ± 0.0001	0.32 ± 0.04	0.018 ± 0.001
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	4.6 ± 0.1	2.1 ± 0.0	< 0.0004 ± 0.0001	0.18 ± 0.02	0.0037 ± 0.0013
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	4.6 ± 0.2	2.1 ± 0.0	< 0.0004 ± 0.0001	0.17 ± 0.01	< 0.003 ± 0.000
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	5.3 ± 0.2	2.2 ± 0.0	0.0015 ± 0.0002	0.50 ± 0.15	0.026 ± 0.000
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	5.2 ± 0.1	2.1 ± 0.0	0.00086 ± 0.00034	0.42 ± 0.02	0.025 ± 0.002
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	5.2 ± 0.2	3.0 ± 0.1	0.0015 ± 0.0001	0.40 ± 0.03	0.023 ± 0.004
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	5.2 ± 0.2	3.0 ± 0.0	0.0015 ± 0.0002	0.44 ± 0.02	0.023 ± 0.001
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	4.5 ± 0.2	1.1 ± 0.0	0.00061 ± 0.00018	0.20 ± 0.04	0.0026 ± 0.0010
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	4.5 ± 0.2	1.2 ± 0.1	0.0010 ± 0.0002	0.18 ± 0.02	0.0027 ± 0.0006
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	5.0 ± 0.1	1.4 ± 0.0	0.00099 ± 0.00013	0.46 ± 0.04	0.018 ± 0.003
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	5.0 ± 0.1	1.6 ± 0.0	0.00060 ± 0.00014	0.41 ± 0.01	0.027 ± 0.003
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	4.9 ± 0.1	0.75 ± 0.01	0.0012 ± 0.0001	0.43 ± 0.01	0.019 ± 0.003
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	4.7 ± 0.1	0.73 ± 0.01	0.00090 ± 0.00022	0.42 ± 0.01	0.023 ± 0.005
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	4.2 ± 0.2	0.99 ± 0.02	0.0010 ± 0.0002	0.23 ± 0.01	< 0.003 ± 0.001
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	4.2 ± 0.2	0.94 ± 0.02	0.00080 ± 0.00012	0.23 ± 0.01	< 0.003 ± 0.002
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	4.2 ± 0.7	2.9 ± 0.1	0.0015 ± 0.0004	0.36 ± 0.01	0.065 ± 0.002
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	4.0 ± 0.9	0.92 ± 0.01	0.0014 ± 0.0003	0.40 ± 0.01	0.035 ± 0.001
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	3.8 ± 0.8	4.7 ± 0.2	0.00077 ± 0.00010	0.38 ± 0.03	0.042 ± 0.004
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	4.0 ± 0.3	5.0 ± 0.1	— ± —	0.37 ± 0.02	0.052 ± 0.003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP–AES	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	3.7 ± 0.6	0.74 ± 0.02	< 0.0004 ± 0.0004	0.28 ± 0.01	0.016 ± 0.002
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	3.9 ± 0.5	0.77 ± 0.03	0.00068 ± 0.00025	0.28 ± 0.02	0.013 ± 0.003
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	5.1 ± 0.3	2.0 ± 0.1	0.0017 ± 0.0004	0.32 ± 0.01	0.016 ± 0.003
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	5.0 ± 0.1	1.8 ± 0.0	0.0019 ± 0.0007	0.34 ± 0.04	0.013 ± 0.002
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	5.1 ± 0.2	2.3 ± 0.1	0.0015 ± 0.0000	0.31 ± 0.03	0.013 ± 0.003
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	5.0 ± 0.2	2.3 ± 0.0	0.0013 ± 0.0003	0.30 ± 0.03	0.020 ± 0.001
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	4.7 ± 0.2	1.7 ± 0.1	0.00087 ± 0.00001	0.24 ± 0.04	0.0051 ± 0.0018
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	4.7 ± 0.1	1.7 ± 0.0	0.0012 ± 0.0001	0.17 ± 0.01	0.0041 ± 0.0013
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	5.2 ± 0.1	1.7 ± 0.0	0.0028 ± 0.0004	0.37 ± 0.03	0.010 ± 0.001
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	5.2 ± 0.0	1.8 ± 0.0	— ± —	0.36 ± 0.02	0.018 ± 0.002
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	4.8 ± 0.2	3.4 ± 0.0	0.0024 ± 0.0004	0.36 ± 0.00	0.016 ± 0.001
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	0.0027 ± 0.0003	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	0.0016 ± 0.0002	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	5.4 ± 0.3	3.6 ± 0.0	0.00069 ± 0.00008	0.41 ± 0.02	0.010 ± 0.004
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	5.8 ± 0.1	2.6 ± 0.0	0.00061 ± 0.00037	0.41 ± 0.03	0.0039 ± 0.0016
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	5.4 ± 0.3	4.4 ± 0.1	< 0.0004 ± 0.0001	0.40 ± 0.06	0.010 ± 0.001
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	5.9 ± 0.1	4.3 ± 0.0	0.00061 ± 0.00012	0.39 ± 0.07	0.012 ± 0.001
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	5.5 ± 0.0	2.4 ± 0.0	< 0.0004 ± 0.0001	0.32 ± 0.04	< 0.003 ± 0.000
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	4.7 ± 0.6	2.3 ± 0.0	< 0.0004 ± 0.0000	0.33 ± 0.02	0.0037 ± 0.0029
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	6.2 ± 0.1	6.7 ± 0.1	0.00061 ± 0.00014	0.47 ± 0.01	0.0093 ± 0.0018
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	6.3 ± 0.0	6.1 ± 0.1	0.00063 ± 0.00018	0.42 ± 0.02	0.011 ± 0.003
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	6.3 ± 0.1	7.1 ± 0.2	0.0012 ± 0.0001	0.44 ± 0.03	0.0091 ± 0.0064
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	6.4 ± 0.2	7.2 ± 0.1	0.00077 ± 0.00014	0.46 ± 0.04	0.011 ± 0.001
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	5.8 ± 0.1	5.1 ± 0.1	0.0010 ± 0.0002	0.30 ± 0.01	< 0.002 ± 0.001
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	5.8 ± 0.1	5.1 ± 0.2	0.00060 ± 0.00009	0.32 ± 0.02	< 0.002 ± 0.001
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	5.3 ± 0.9	2.3 ± 0.0	0.00078 ± 0.00033	0.51 ± 0.00	0.017 ± 0.002
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	6.3 ± 0.2	2.1 ± 0.1	0.0013 ± 0.0003	0.48 ± 0.02	0.012 ± 0.001
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	6.0 ± 0.9	2.7 ± 0.0	0.00092 ± 0.00015	0.48 ± 0.00	0.017 ± 0.002
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	4.7 ± 0.3	2.8 ± 0.1	0.0012 ± 0.0001	0.54 ± 0.00	0.018 ± 0.000
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	4.9 ± 0.7	1.8 ± 0.0	0.00073 ± 0.00041	0.30 ± 0.02	0.0038 ± 0.0017
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	4.8 ± 0.9	1.7 ± 0.0	0.00066 ± 0.00031	0.30 ± 0.00	< 0.003 ± 0.001
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	4.0 ± 0.5	0.29 ± 0.03	0.0020 ± 0.0001	0.37 ± 0.01	0.039 ± 0.002
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	3.9 ± 0.8	0.26 ± 0.02	0.0020 ± 0.0002	0.40 ± 0.04	0.039 ± 0.008

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP-AES	Manganese (µg/L) ICP-MS	Mercury (µg/L) CV-AFS	Molybdenum (µg/L) ICP-MS	Neodymium (µg/L) ICP-MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	4.2 ± 0.7	3.2 ± 0.1	0.0017 ± 0.0003	0.39 ± 0.03	0.055 ± 0.000
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	4.2 ± 0.8	3.2 ± 0.1	0.0015 ± 0.0002	0.38 ± 0.00	0.055 ± 0.010
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	3.9 ± 0.8	0.22 ± 0.03	0.0011 ± 0.0002	0.42 ± 0.01	0.029 ± 0.004
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	4.2 ± 0.5	0.21 ± 0.01	0.0011 ± 0.0001	0.37 ± 0.02	0.025 ± 0.005
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	5.5 ± 0.0	1.6 ± 0.0	< 0.0004 ± 0.0001	0.37 ± 0.01	0.012 ± 0.002
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	5.6 ± 0.1	2.3 ± 0.0	0.00045 ± 0.00026	0.36 ± 0.01	0.021 ± 0.002
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	5.4 ± 0.1	2.5 ± 0.1	0.0013 ± 0.0004	0.37 ± 0.03	0.012 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	5.5 ± 0.1	2.3 ± 0.1	0.00085 ± 0.00020	0.34 ± 0.02	0.013 ± 0.001
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	5.3 ± 0.1	0.62 ± 0.01	0.00066 ± 0.00013	0.26 ± 0.03	0.0020 ± 0.0015
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	5.3 ± 0.0	0.59 ± 0.01	0.00040 ± 0.00026	0.29 ± 0.05	0.0028 ± 0.0011
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	4.4 ± 0.0	0.77 ± 0.05	0.0014 ± 0.0002	0.41 ± 0.00	0.0074 ± 0.0019
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	4.6 ± 0.1	2.3 ± 0.1	0.0011 ± 0.0004	0.35 ± 0.00	0.022 ± 0.001
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	4.6 ± 0.1	1.6 ± 0.0	0.0021 ± 0.0003	0.36 ± 0.01	0.014 ± 0.001
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	4.5 ± 0.1	1.5 ± 0.0	— ± —	0.35 ± 0.01	0.016 ± 0.000
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	4.6 ± 0.2	0.43 ± 0.01	0.0011 ± 0.0004	0.32 ± 0.02	0.0079 ± 0.0011
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	4.6 ± 0.2	0.46 ± 0.01	0.00070 ± 0.00020	0.33 ± 0.01	0.0048 ± 0.0006
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	0.0011 ± 0.0001	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	6.5 ± 0.4	6.1 ± 0.1	0.00065 ± 0.00022	0.48 ± 0.05	0.025 ± 0.003
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	7.1 ± 0.1	2.8 ± 0.0	0.00064 ± 0.00033	0.47 ± 0.02	0.0070 ± 0.0011
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	6.8 ± 0.1	5.4 ± 0.0	0.0012 ± 0.0001	0.50 ± 0.01	0.010 ± 0.001
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	6.4 ± 0.0	5.3 ± 0.0	0.00065 ± 0.00011	0.46 ± 0.01	0.0098 ± 0.0022
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	6.0 ± 0.0	2.8 ± 0.0	0.00053 ± 0.00011	0.42 ± 0.07	< 0.003 ± 0.001
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	6.0 ± 0.1	2.9 ± 0.1	0.00051 ± 0.00014	0.39 ± 0.04	0.0087 ± 0.0001
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	0.00071 ± 0.00015	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	6.8 ± 0.1	9.2 ± 0.1	0.0012 ± 0.0005	0.53 ± 0.04	0.024 ± 0.006
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	7.0 ± 0.2	9.0 ± 0.1	0.0014 ± 0.0000	0.52 ± 0.03	0.025 ± 0.002
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	0.0012 ± 0.0001	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	4.6 ± 0.5	3.8 ± 0.1	0.0017 ± 0.0003	0.42 ± 0.01	0.026 ± 0.003
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	4.8 ± 0.1	3.2 ± 0.0	0.0015 ± 0.0005	0.40 ± 0.02	0.017 ± 0.001
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	4.8 ± 0.0	4.3 ± 0.0	0.0012 ± 0.0003	0.43 ± 0.07	0.024 ± 0.002
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	4.5 ± 0.5	4.2 ± 0.0	0.0016 ± 0.0001	0.38 ± 0.03	0.024 ± 0.003
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	4.6 ± 0.2	3.0 ± 0.1	0.00094 ± 0.00025	0.34 ± 0.02	0.0088 ± 0.0009
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	4.6 ± 0.1	3.0 ± 0.0	0.00088 ± 0.00042	0.37 ± 0.04	0.011 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP–AES	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	6.3 ± 0.1	0.68 ± 0.02	0.0013 ± 0.0002	0.50 ± 0.03	0.0077 ± 0.0001
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	6.3 ± 0.0	0.43 ± 0.00	0.00071 ± 0.00012	0.49 ± 0.02	0.0064 ± 0.0008
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	6.2 ± 0.1	1.8 ± 0.0	0.00055 ± 0.00014	0.47 ± 0.02	0.010 ± 0.002
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	6.3 ± 0.1	1.8 ± 0.0	0.00094 ± 0.00005	0.49 ± 0.03	0.011 ± 0.001
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	5.6 ± 0.1	0.28 ± 0.01	0.00095 ± 0.00012	0.28 ± 0.06	0.0035 ± 0.0002
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	5.6 ± 0.1	0.26 ± 0.01	0.00083 ± 0.00017	0.30 ± 0.05	0.0020 ± 0.0017
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	4.1 ± 0.0	0.63 ± 0.01	<0.0004 ± 0.000	0.33 ± 0.00	0.013 ± 0.002
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	4.2 ± 0.0	0.44 ± 0.00	0.00060 ± 0.00000	0.34 ± 0.02	0.011 ± 0.002
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	4.2 ± 0.2	1.2 ± 0.0	0.0016 ± 0.0001	0.36 ± 0.00	0.011 ± 0.002
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	4.3 ± 0.1	0.91 ± 0.01	— ± —	0.33 ± 0.00	0.014 ± 0.001
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	3.9 ± 0.2	0.35 ± 0.01	0.00070 ± 0.00010	0.23 ± 0.01	0.0013 ± 0.0008
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	4.4 ± 0.1	0.35 ± 0.01	0.0010 ± 0.0002	0.38 ± 0.02	0.0038 ± 0.0002
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	0.00080 ± 0.00010	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	6.1 ± 0.2	1.1 ± 0.0	0.00052 ± 0.00007	0.48 ± 0.04	0.0042 ± 0.0008
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	6.4 ± 0.3	0.76 ± 0.04	< 0.0004 ± 0.0002	0.50 ± 0.04	0.0077 ± 0.0017
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	6.6 ± 0.0	1.8 ± 0.0	0.00049 ± 0.00001	0.50 ± 0.02	0.015 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	6.1 ± 0.0	1.8 ± 0.0	0.00063 ± 0.00009	0.52 ± 0.03	0.0086 ± 0.0003
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	5.3 ± 0.2	0.68 ± 0.03	< 0.0004 ± 0.0000	0.26 ± 0.04	< 0.002 ± 0.002
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	5.8 ± 0.0	0.64 ± 0.05	< 0.0004 ± 0.0001	0.30 ± 0.01	< 0.003 ± 0.002
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	5.5 ± 0.2	2.1 ± 0.0	< 0.0004 ± 0.0002	0.45 ± 0.00	0.0073 ± 0.0002
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	5.5 ± 0.1	1.9 ± 0.0	0.00071 ± 0.00021	0.44 ± 0.02	0.0075 ± 0.0011
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	5.5 ± 0.1	2.8 ± 0.0	0.00068 ± 0.00014	0.43 ± 0.00	0.0055 ± 0.0018
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	5.5 ± 0.1	2.8 ± 0.1	0.0015 ± 0.0001	0.42 ± 0.02	0.012 ± 0.002
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	4.7 ± 0.1	1.4 ± 0.0	0.00056 ± 0.00002	0.21 ± 0.02	< 0.002 ± 0.000
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	4.6 ± 0.2	1.3 ± 0.0	0.00083 ± 0.00024	0.25 ± 0.02	< 0.002 ± 0.000
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	3.3 ± 0.3	3.1 ± 0.0	0.0010 ± 0.0002	0.32 ± 0.01	0.025 ± 0.004
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	4.2 ± 0.9	2.7 ± 0.0	0.00084 ± 0.00030	0.37 ± 0.01	0.029 ± 0.004
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	4.2 ± 0.9	6.0 ± 0.1	0.0015 ± 0.0003	0.36 ± 0.02	0.036 ± 0.003
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	4.0 ± 0.7	6.0 ± 0.1	0.0011 ± 0.0002	0.35 ± 0.02	0.038 ± 0.004
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	3.8 ± 0.6	3.8 ± 0.1	0.00059 ± 0.00006	0.23 ± 0.03	0.015 ± 0.002
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	3.7 ± 0.7	3.8 ± 0.1	0.0011 ± 0.0002	0.26 ± 0.01	0.014 ± 0.007
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	1.5 ± 0.1	7.4 ± 0.2	0.0017 ± 0.0001	0.25 ± 0.02	0.10 ± 0.01
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	1.7 ± 0.3	7.5 ± 0.0	0.0020 ± 0.0005	0.24 ± 0.03	0.095 ± 0.011

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP–AES	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	1.7 ± 0.2	8.4 ± 0.2	0.0015 ± 0.0003	0.22 ± 0.02	0.12 ± 0.01
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	1.7 ± 0.1	8.7 ± 0.4	0.0017 ± 0.0001	0.25 ± 0.02	0.11 ± 0.00
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	1.4 ± 0.2	5.5 ± 0.2	0.00051 ± 0.00030	0.11 ± 0.01	0.026 ± 0.006
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	1.5 ± 0.2	5.2 ± 0.1	0.00087 ± 0.00031	0.13 ± 0.02	0.023 ± 0.003
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	5.1 ± 0.1	0.33 ± 0.01	0.00049 ± 0.00005	0.42 ± 0.04	0.0064 ± 0.0008
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	5.2 ± 0.0	0.33 ± 0.01	0.00066 ± 0.00009	0.42 ± 0.04	0.0078 ± 0.0016
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	5.1 ± 0.0	1.5 ± 0.0	0.00085 ± 0.00007	0.42 ± 0.04	0.0089 ± 0.0045
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	5.2 ± 0.1	1.5 ± 0.0	0.00059 ± 0.00017	0.39 ± 0.00	0.0094 ± 0.0015
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	4.4 ± 0.0	0.60 ± 0.01	0.0013 ± 0.0000	0.20 ± 0.04	< 0.002 ± 0.001
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	4.4 ± 0.0	0.59 ± 0.03	0.00069 ± 0.00027	0.20 ± 0.05	< 0.002 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	5.1 ± 0.1	0.74 ± 0.01	0.00068 ± 0.00013	0.46 ± 0.01	0.011 ± 0.003
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	5.1 ± 0.1	1.3 ± 0.1	0.00063 ± 0.00020	0.46 ± 0.01	0.014 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	5.1 ± 0.0	1.5 ± 0.0	0.00098 ± 0.00009	0.45 ± 0.01	0.010 ± 0.002
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	5.2 ± 0.0	1.5 ± 0.0	0.00060 ± 0.00005	0.48 ± 0.01	0.012 ± 0.004
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	4.5 ± 0.1	0.27 ± 0.01	0.00070 ± 0.00008	0.25 ± 0.03	< 0.003 ± 0.001
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	4.5 ± 0.1	0.27 ± 0.02	0.00054 ± 0.00023	0.25 ± 0.01	< 0.003 ± 0.001
Flat Cr.	12/11/96	0.40 µm Mem	1/2	1.5 ± 0.1	15 ± 1	0.0014 ± 0.0003	0.089 ± 0.016	0.089 ± 0.002
Flat Cr.	12/11/96	0.40 µm Mem	2/2	1.5 ± 0.1	15 ± 0	0.0010 ± 0.0003	0.094 ± 0.017	0.092 ± 0.001
Flat Cr.	12/11/96	0.45 µm Cap	1/2	1.6 ± 0.2	15 ± 0	0.0012 ± 0.0003	0.070 ± 0.004	0.066 ± 0.002
Flat Cr.	12/11/96	0.45 µm Cap	2/2	1.7 ± 0.1	15 ± 0	0.0015 ± 0.0003	0.072 ± 0.006	0.070 ± 0.001
Flat Cr.	12/11/96	10 kd Tan	1/2	1.4 ± 0.1	12 ± 0	0.0010 ± 0.0000	0.056 ± 0.015	0.031 ± 0.001
Flat Cr.	12/11/96	10 kd Tan	2/2	1.5 ± 0.1	13 ± 0	0.0011 ± 0.0003	0.070 ± 0.021	0.031 ± 0.001
Flat Cr.	05/29/97	0.40 µm Mem	1/2	6.8 ± 0.2	111 ± 2	0.00075 ± 0.00025	0.23 ± 0.02	0.043 ± 0.004
Flat Cr.	05/29/97	0.40 µm Mem	2/2	6.8 ± 0.0	112 ± 1	0.00089 ± 0.00033	0.24 ± 0.02	0.051 ± 0.003
Flat Cr.	05/29/97	0.45 mm Cap	1/2	6.8 ± 0.2	112 ± 2	0.00056 ± 0.00015	0.25 ± 0.02	0.034 ± 0.001
Flat Cr.	05/29/97	0.45 µm Cap	2/2	6.6 ± 0.2	110 ± 2	0.0010 ± 0.0003	0.24 ± 0.02	0.029 ± 0.003
Flat Cr.	05/29/97	10 kd Tan	1/2	6.0 ± 0.2	97 ± 2	0.0011 ± 0.0003	0.22 ± 0.03	0.0089 ± 0.0027
Flat Cr.	05/29/97	10 kd Tan	2/2	6.1 ± 0.3	101 ± 4	0.0010 ± 0.0003	0.24 ± 0.05	0.011 ± 0.001
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	3.8 ± 0.2	159 ± 2	0.0020 ± 0.0003	< 0.03 ± 0.02	4.7 ± 0.2
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	3.7 ± 0.6	154 ± 1	0.0022 ± 0.0003	< 0.03 ± 0.01	4.9 ± 0.0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	4.2 ± 0.2	158 ± 5	0.0022 ± 0.0003	< 0.03 ± 0.02	4.6 ± 0.0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	3.7 ± 0.6	156 ± 1	0.0016 ± 0.0002	< 0.03 ± 0.01	4.6 ± 0.0
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	3.8 ± 0.2	154 ± 7	0.0015 ± 0.0002	< 0.03 ± 0.01	4.7 ± 0.1

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP-AES	Manganese (µg/L) ICP-MS	Mercury (µg/L) CV-AFS	Molybdenum (µg/L) ICP-MS	Neodymium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	3.8 ± 0.2	153 ± 0	0.0014 ± 0.0004	< 0.03 ± 0.01	4.8 ± 0.3
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	16 ± 1	500 ± 24	0.0040 ± 0.0004	< 0.05 ± 0.03	7.8 ± 0.3
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	16 ± 1	512 ± 18	0.0036 ± 0.0002	< 0.05 ± 0.01	7.5 ± 0.0
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	15 ± 0	483 ± 28	0.0043 ± 0.0003	< 0.05 ± 0.00	7.5 ± 0.6
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	15 ± 0	493 ± 19	0.0048 ± 0.0003	< 0.05 ± 0.00	7.4 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	14 ± 1	492 ± 35	0.0019 ± 0.0001	< 0.05 ± 0.00	7.5 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	14 ± 0	484 ± 20	0.0018 ± 0.0004	< 0.05 ± 0.02	7.5 ± 0.2
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	3.6 ± 0.1	204 ± 0	0.0019 ± 0.0003	< 0.03 ± 0.01	3.6 ± 0.0
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	3.5 ± 0.1	207 ± 6	0.0012 ± 0.0002	< 0.03 ± 0.02	3.5 ± 0.2
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	3.5 ± 0.1	199 ± 0	0.0013 ± 0.0002	< 0.03 ± 0.03	3.7 ± 0.2
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	3.5 ± 0.0	212 ± 0	0.0012 ± 0.0001	< 0.03 ± 0.01	3.7 ± 0.2
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	3.4 ± 0.1	201 ± 1	0.0010 ± 0.0001	< 0.03 ± 0.01	3.4 ± 0.1
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	3.3 ± 0.1	193 ± 0	0.00081 ± 0.00029	< 0.03 ± 0.02	3.5 ± 0.0
Whiskeytown	12/11/96	0.40 µm Mem	1/2	5.3 ± 0.1	1.1 ± 0.0	0.00081 ± 0.00019	0.16 ± 0.03	0.015 ± 0.002
Whiskeytown	12/11/96	0.40 µm Mem	2/2	5.2 ± 0.1	1.2 ± 0.0	0.00044 ± 0.00009	0.17 ± 0.01	0.015 ± 0.002
Whiskeytown	12/11/96	0.45 µm Cap	1/2	5.1 ± 0.2	1.2 ± 0.0	0.00062 ± 0.00024	0.16 ± 0.01	0.011 ± 0.000
Whiskeytown	12/11/96	0.45 µm Cap	2/2	6.1 ± 0.0	1.2 ± 0.0	0.00081 ± 0.00012	0.13 ± 0.01	0.012 ± 0.004
Whiskeytown	12/11/96	10 kd Tan	1/2	5.2 ± 0.0	1.0 ± 0.0	0.00092 ± 0.00028	0.15 ± 0.02	0.0039 ± 0.0002
Whiskeytown	12/11/96	10 kd Tan	2/2	5.5 ± 0.4	1.0 ± 0.0	0.00091 ± 0.00020	0.11 ± 0.00	0.0049 ± 0.0026
Whiskeytown	05/29/97	0.40 µm Mem	1/2	5.8 ± 0.1	0.30 ± 0.01	0.0012 ± 0.0004	0.14 ± 0.02	0.0099 ± 0.0013
Whiskeytown	05/29/97	0.40 µm Mem	2/2	5.8 ± 0.2	0.79 ± 0.01	0.00066 ± 0.00018	0.13 ± 0.02	0.012 ± 0.003
Whiskeytown	05/29/97	0.45 µm Cap	1/2	5.7 ± 0.0	0.54 ± 0.02	0.0016 ± 0.0007	0.14 ± 0.01	0.010 ± 0.005
Whiskeytown	05/29/97	0.45 µm Cap	2/2	5.7 ± 0.0	0.62 ± 0.01	0.0011 ± 0.0003	0.13 ± 0.02	0.016 ± 0.006
Whiskeytown	05/29/97	10 kd Tan	1/2	5.2 ± 0.2	0.24 ± 0.01	0.00069 ± 0.00007	0.096 ± 0.011	0.0037 ± 0.0033
Whiskeytown	05/29/97	10 kd Tan	2/2	5.2 ± 0.1	0.24 ± 0.02	0.00060 ± 0.00018	0.089 ± 0.006	< 0.003 ± 0.003
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	— ± —	0.47 ± 0.00	0.00050 ± 0.00000	0.087 ± 0.006	0.012 ± 0.001
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	5.9 ± 0.1	0.55 ± 0.01	0.00040 ± 0.00000	0.11 ± 0.00	0.012 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	6.0 ± 0.0	0.67 ± 0.04	0.00050 ± 0.00010	0.12 ± 0.01	0.017 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	6.0 ± 0.0	0.75 ± 0.06	— ± —	0.11 ± 0.01	0.012 ± 0.000
Spring Cr. arm	07/12/96	10 kd Tan	1/3	5.8 ± 0.0	0.68 ± 0.07	0.0011 ± 0.0001	0.093 ± 0.012	0.0057 ± 0.0054
Spring Cr. arm	07/12/96	10 kd Tan	2/3	5.9 ± 0.0	0.47 ± 0.02	0.00050 ± 0.00020	0.068 ± 0.014	0.0048 ± 0.0007
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	0.0010 ± 0.0001	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	6.0 ± 0.0	1.5 ± 0.0	< 0.0004 ± 0.0001	0.12 ± 0.03	0.029 ± 0.000
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	6.1 ± 0.0	1.5 ± 0.0	0.00060 ± 0.00003	0.16 ± 0.03	0.024 ± 0.000

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Magnesium (mg/L) ICP-AES	Manganese (µg/L) ICP-MS	Mercury (µg/L) CV-AFS	Molybdenum (µg/L) ICP-MS	Neodymium (µg/L) ICP-MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	6.5 ± 0.1	1.4 ± 0.0	0.0011 ± 0.0000	0.12 ± 0.01	0.017 ± 0.003
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	6.0 ± 0.1	1.4 ± 0.0	< 0.0004 ± 0.0002	0.12 ± 0.02	0.013 ± 0.001
Spring Cr. arm	09/18/96	10 kd Tan	1/2	5.7 ± 0.2	1.3 ± 0.0	0.00063 ± 0.00017	0.093 ± 0.012	0.0055 ± 0.0043
Spring Cr. arm	09/18/96	10 kd Tan	2/2	5.3 ± 0.0	1.3 ± 0.0	< 0.0004 ± 0.0001	0.082 ± 0.020	0.0048 ± 0.0015
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	6.1 ± 0.1	15 ± 0	< 0.0004 ± 0.0002	0.15 ± 0.01	0.083 ± 0.001
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	6.2 ± 0.1	14 ± 0	0.00051 ± 0.00004	0.14 ± 0.02	0.055 ± 0.007
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	6.2 ± 0.0	14 ± 0	0.00063 ± 0.00018	0.14 ± 0.01	0.073 ± 0.005
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	6.3 ± 0.0	14 ± 0	0.00047 ± 0.00007	0.13 ± 0.03	0.072 ± 0.004
Spring Cr. arm	11/20/96	10 kd Tan	1/2	5.2 ± 0.0	12 ± 0	0.0010 ± 0.0001	0.094 ± 0.046	0.0092 ± 0.0039
Spring Cr. arm	11/20/96	10 kd Tan	2/2	5.3 ± 0.1	12 ± 0	0.00056 ± 0.00011	0.090 ± 0.039	0.0076 ± 0.0002
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	5.6 ± 0.1	22 ± 1	0.00045 ± 0.00030	0.11 ± 0.00	0.10 ± 0.01
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	5.7 ± 0.1	21 ± 0	0.00057 ± 0.00004	0.14 ± 0.01	0.090 ± 0.000
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	5.7 ± 0.1	22 ± 0	0.00067 ± 0.00022	0.15 ± 0.01	0.17 ± 0.02
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	5.6 ± 0.1	22 ± 0	0.00087 ± 0.00025	0.16 ± 0.01	0.17 ± 0.00
Spring Cr. arm	12/11/96	10 kd Tan	1/2	4.7 ± 0.2	18 ± 0	0.00051 ± 0.00056	0.10 ± 0.01	0.026 ± 0.004
Spring Cr. arm	12/11/96	10 kd Tan	2/2	4.6 ± 0.1	18 ± 0	< 0.0004 ± 0.0000	0.083 ± 0.023	0.028 ± 0.004
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	5.8 ± 0.2	3.1 ± 0.1	0.0026 ± 0.0003	0.14 ± 0.02	0.023 ± 0.003
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	5.7 ± 0.1	3.0 ± 0.1	0.0023 ± 0.0003	0.14 ± 0.02	0.018 ± 0.000
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	5.6 ± 0.2	3.1 ± 0.1	0.0023 ± 0.0001	0.13 ± 0.02	0.026 ± 0.002
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	5.7 ± 0.2	3.1 ± 0.1	0.0022 ± 0.0002	0.15 ± 0.02	0.027 ± 0.002
Spring Cr. arm	05/28/97	10 kd Tan	1/2	4.9 ± 0.1	2.5 ± 0.1	0.0022 ± 0.0003	0.069 ± 0.006	0.0055 ± 0.0019
Spring Cr. arm	05/28/97	10 kd Tan	2/2	4.9 ± 0.1	2.5 ± 0.1	0.0025 ± 0.0002	0.080 ± 0.013	0.0043 ± 0.0011
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	28 ± 4	0.70 ± 0.02	0.00097 ± 0.00027	3.2 ± 0.0	0.018 ± 0.003
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	29 ± 0	0.60 ± 0.02	0.00066 ± 0.00008	3.3 ± 0.1	0.019 ± 0.002
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	30 ± 2	22 ± 0	0.0021 ± 0.0001	3.3 ± 0.1	0.020 ± 0.002
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	28 ± 3	22 ± 0	0.0022 ± 0.0002	3.4 ± 0.1	0.018 ± 0.003
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	23 ± 1	0.21 ± 0.00	0.00052 ± 0.00014	2.6 ± 0.1	0.012 ± 0.001
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	23 ± 4	0.20 ± 0.01	0.00097 ± 0.00005	2.6 ± 0.1	0.012 ± 0.002
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	4.1 ± 0.0	2.9 ± 0.1	0.0017 ± 0.0004	0.34 ± 0.00	0.041 ± 0.005
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	4.1 ± 0.0	1.8 ± 0.1	0.0014 ± 0.0000	0.35 ± 0.01	0.033 ± 0.001
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	4.1 ± 0.0	3.7 ± 0.1	0.0013 ± 0.0003	0.39 ± 0.03	0.071 ± 0.002
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	3.9 ± 0.1	3.6 ± 0.1	0.0013 ± 0.0002	0.37 ± 0.03	0.068 ± 0.000
Yolo Bypass	01/07/97	10 kd Tan	1/2	3.5 ± 0.0	1.8 ± 0.0	0.0013 ± 0.0003	0.26 ± 0.01	0.014 ± 0.004
Yolo Bypass	01/07/97	10 kd Tan	2/2	3.4 ± 0.1	1.6 ± 0.0	0.00090 ± 0.00018	0.21 ± 0.01	0.014 ± 0.003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	0.67 ± 0.07	1.1 ± 0.0	0.0050 ± 0.0001	< 0.0013 ± 0.0007	2.2 ± 0.0
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	0.74 ± 0.02	1.1 ± 0.0	0.0048 ± 0.0003	0.0013 ± 0.0000	2.1 ± 0.0
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.73 ± 0.05	1.1 ± 0.0	0.0052 ± 0.0000	0.00065 ± 0.00006	2.0 ± 0.0
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	0.77 ± 0.05	1.1 ± 0.0	0.0064 ± 0.0004	0.00057 ± 0.00008	2.0 ± 0.0
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	0.68 ± 0.09	1.0 ± 0.0	0.0022 ± 0.0006	0.00038 ± 0.00037	2.0 ± 0.0
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	0.60 ± 0.04	1.1 ± 0.0	0.0022 ± 0.0002	< 0.0013 ± 0.0003	1.8 ± 0.0
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	0.97 ± 0.06	0.96 ± 0.02	0.0070 ± 0.0002	< 0.0008 ± 0.0004	2.0 ± 0.0
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	1.1 ± 0.0	0.95 ± 0.01	0.0074 ± 0.0018	< 0.0008 ± 0.0005	1.9 ± 0.0
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	0.94 ± 0.07	0.94 ± 0.01	0.0040 ± 0.0003	< 0.0008 ± 0.0008	2.0 ± 0.1
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	1.0 ± 0.1	0.94 ± 0.01	0.0047 ± 0.0001	< 0.0010 ± 0.0002	2.0 ± 0.0
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	0.75 ± 0.08	0.85 ± 0.02	0.0024 ± 0.0000	0.0013 ± 0.0005	1.8 ± 0.0
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	0.81 ± 0.00	0.85 ± 0.01	0.0013 ± 0.0001	< 0.0008 ± 0.0001	1.7 ± 0.0
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	0.50 ± 0.04	1.3 ± 0.0	0.0020 ± 0.0003	< 0.0015 ± 0.0009	2.9 ± 0.0
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	0.49 ± 0.05	1.3 ± 0.0	0.0018 ± 0.0004	< 0.0015 ± 0.0005	3.0 ± 0.0
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.46 ± 0.07	1.3 ± 0.0	0.0013 ± 0.0002	< 0.0015 ± 0.0004	2.9 ± 0.0
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	0.35 ± 0.00	1.3 ± 0.0	0.0021 ± 0.0005	< 0.0015 ± 0.0002	3.0 ± 0.0
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	0.34 ± 0.03	1.2 ± 0.0	< 0.0005 ± 0.0006	< 0.0015 ± 0.0003	2.5 ± 0.0
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	0.31 ± 0.06	1.2 ± 0.0	< 0.0005 ± 0.0003	< 0.0015 ± 0.0007	2.6 ± 0.0
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	0.94 ± 0.06	1.5 ± 0.0	0.0029 ± 0.0005	< 0.0013 ± 0.0010	3.2 ± 0.0
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	0.88 ± 0.12	1.4 ± 0.1	0.0028 ± 0.0004	< 0.0013 ± 0.0001	3.2 ± 0.0
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	0.66 ± 0.04	1.4 ± 0.1	0.0034 ± 0.0002	< 0.0006 ± 0.0000	3.1 ± 0.0
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	0.56 ± 0.03	1.4 ± 0.0	0.0038 ± 0.0002	0.00076 ± 0.00054	3.1 ± 0.1
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	0.72 ± 0.03	1.3 ± 0.0	0.00070 ± 0.00028	0.0011 ± 0.0001	2.7 ± 0.0
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	0.70 ± 0.02	1.3 ± 0.0	0.00060 ± 0.00050	< 0.0013 ± 0.0005	2.9 ± 0.0
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	1.7 ± 0.1	1.2 ± 0.0	0.0059 ± 0.0002	< 0.0008 ± 0.0005	2.0 ± 0.0
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	1.4 ± 0.0	1.2 ± 0.0	0.0037 ± 0.0002	< 0.0008 ± 0.0000	1.9 ± 0.0
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	0.94 ± 0.08	1.1 ± 0.0	0.0044 ± 0.0009	< 0.0008 ± 0.0005	1.8 ± 0.1
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	0.90 ± 0.04	1.1 ± 0.1	0.0044 ± 0.0001	< 0.0008 ± 0.0004	1.9 ± 0.1
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	0.72 ± 0.09	0.99 ± 0.00	0.00059 ± 0.00046	< 0.0008 ± 0.0006	1.6 ± 0.0
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	0.72 ± 0.03	1.0 ± 0.0	0.0010 ± 0.0003	< 0.0008 ± 0.0006	1.6 ± 0.1
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	1.5 ± 0.0	0.91 ± 0.00	0.0041 ± 0.0002	< 0.0005 ± 0.0001	1.6 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	1.5 ± 0.0	0.91 ± 0.02	0.0040 ± 0.0002	< 0.0005 ± 0.0000	1.6 ± 0.0
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	1.6 ± 0.0	0.91 ± 0.00	0.0041 ± 0.0001	0.00067 ± 0.00022	1.6 ± 0.0
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	1.6 ± 0.0	0.90 ± 0.01	0.0051 ± 0.0000	< 0.0005 ± 0.0002	1.6 ± 0.0
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	1.4 ± 0.1	0.85 ± 0.01	0.0022 ± 0.0002	< 0.0005 ± 0.0001	1.5 ± 0.0
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	1.4 ± 0.0	0.88 ± 0.01	0.0022 ± 0.0000	< 0.0005 ± 0.0003	1.5 ± 0.0
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	1.4 ± 0.0	0.86 ± 0.00	0.0020 ± 0.0001	0.00062 ± 0.00021	1.5 ± 0.1
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	2.1 ± 0.1	0.68 ± 0.01	0.0052 ± 0.0005	< 0.0008 ± 0.0002	1.2 ± 0.0
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	2.0 ± 0.1	0.69 ± 0.01	0.0041 ± 0.0014	< 0.0010 ± 0.0003	1.3 ± 0.0
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	2.1 ± 0.0	0.68 ± 0.01	0.0036 ± 0.0010	< 0.0010 ± 0.0011	1.3 ± 0.0
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	2.0 ± 0.1	0.70 ± 0.01	0.0047 ± 0.0003	0.0011 ± 0.0004	1.3 ± 0.0
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	1.5 ± 0.1	0.61 ± 0.01	0.0010 ± 0.0006	< 0.0008 ± 0.0002	1.1 ± 0.0
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	1.5 ± 0.1	0.61 ± 0.01	0.0012 ± 0.0004	< 0.0008 ± 0.0009	1.1 ± 0.0
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	1.5 ± 0.0	0.62 ± 0.00	0.00057 ± 0.00051	< 0.0008 ± 0.0002	1.1 ± 0.0
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	0.71 ± 0.05	1.0 ± 0.0	0.0044 ± 0.0008	< 0.0015 ± 0.0003	2.3 ± 0.1
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	0.74 ± 0.01	1.1 ± 0.0	0.0051 ± 0.0003	< 0.0015 ± 0.0004	2.3 ± 0.1
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	0.90 ± 0.03	1.0 ± 0.0	0.0058 ± 0.0001	< 0.0015 ± 0.0005	2.2 ± 0.1
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	0.69 ± 0.01	1.1 ± 0.0	0.0046 ± 0.0005	< 0.0015 ± 0.0002	2.3 ± 0.1
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	0.51 ± 0.05	0.95 ± 0.02	0.00068 ± 0.00045	< 0.0015 ± 0.0004	2.0 ± 0.0
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	0.51 ± 0.05	0.94 ± 0.03	0.00064 ± 0.00050	< 0.0015 ± 0.0002	2.0 ± 0.0
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	0.63 ± 0.03	1.3 ± 0.0	0.0073 ± 0.0014	0.0014 ± 0.0004	2.7 ± 0.1
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	0.71 ± 0.06	1.3 ± 0.0	0.0053 ± 0.0001	< 0.0013 ± 0.0007	2.8 ± 0.1
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	0.71 ± 0.01	1.3 ± 0.1	0.0060 ± 0.0004	< 0.0006 ± 0.0003	2.6 ± 0.0
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	0.60 ± 0.10	1.3 ± 0.0	0.0061 ± 0.0004	< 0.0013 ± 0.0000	2.7 ± 0.0
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	0.35 ± 0.04	1.1 ± 0.0	0.00099 ± 0.00029	< 0.0013 ± 0.0008	2.4 ± 0.0
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	0.46 ± 0.01	1.1 ± 0.0	0.00064 ± 0.00050	< 0.0013 ± 0.0001	2.4 ± 0.0
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	0.64 ± 0.04	1.1 ± 0.0	0.0047 ± 0.0007	0.00071 ± 0.00059	2.2 ± 0.1
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	0.58 ± 0.03	1.1 ± 0.0	0.0055 ± 0.0011	< 0.0006 ± 0.0006	2.3 ± 0.1
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	0.77 ± 0.03	1.1 ± 0.0	0.0097 ± 0.0008	< 0.0006 ± 0.0004	2.2 ± 0.0
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	0.65 ± 0.06	1.1 ± 0.1	0.0095 ± 0.0005	< 0.0006 ± 0.0005	2.3 ± 0.0
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	0.54 ± 0.06	1.0 ± 0.0	0.0022 ± 0.0006	< 0.0006 ± 0.0002	2.0 ± 0.0
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	0.57 ± 0.09	1.1 ± 0.1	0.0021 ± 0.0001	< 0.0006 ± 0.0004	2.0 ± 0.0
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	0.62 ± 0.06	1.0 ± 0.0	0.0018 ± 0.0003	< 0.0005 ± 0.0003	2.0 ± 0.0
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	1.7 ± 0.1	0.92 ± 0.03	0.0033 ± 0.0003	< 0.0008 ± 0.0005	1.5 ± 0.0
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	2.0 ± 0.1	0.98 ± 0.04	0.0045 ± 0.0002	< 0.0008 ± 0.0002	1.5 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	1.6 ± 0.0	0.90 ± 0.03	0.0037 ± 0.0003	< 0.0008 ± 0.0003	1.5 ± 0.0
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	1.6 ± 0.0	0.92 ± 0.04	0.0049 ± 0.0003	< 0.0008 ± 0.0005	1.5 ± 0.0
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	1.3 ± 0.0	0.83 ± 0.04	0.0011 ± 0.0002	< 0.0008 ± 0.0003	1.3 ± 0.0
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	1.2 ± 0.0	0.87 ± 0.00	0.00093 ± 0.00009	< 0.0008 ± 0.0002	1.3 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	1.2 ± 0.0	0.94 ± 0.01	0.0028 ± 0.0004	< 0.0013 ± 0.0005	1.6 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	1.3 ± 0.0	0.95 ± 0.02	0.0024 ± 0.0004	0.0013 ± 0.0000	1.6 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	1.3 ± 0.0	0.96 ± 0.03	0.0034 ± 0.0001	< 0.0005 ± 0.0002	1.7 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	1.3 ± 0.0	0.95 ± 0.00	0.0031 ± 0.0001	0.00061 ± 0.00016	1.7 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	2.7 ± 0.1	0.96 ± 0.00	0.00091 ± 0.00019	0.00072 ± 0.00012	1.8 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	2.2 ± 0.0	0.92 ± 0.00	0.00074 ± 0.00012	< 0.0005 ± 0.0003	1.6 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	1.6 ± 0.1	0.79 ± 0.02	0.0024 ± 0.0005	< 0.0010 ± 0.0002	1.6 ± 0.0
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	1.6 ± 0.0	0.83 ± 0.00	0.0019 ± 0.0002	< 0.0006 ± 0.0000	1.5 ± 0.0
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	1.8 ± 0.0	0.80 ± 0.01	0.0028 ± 0.0003	< 0.0008 ± 0.0006	1.5 ± 0.0
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	1.7 ± 0.1	0.80 ± 0.00	0.0024 ± 0.0002	< 0.0006 ± 0.0002	1.6 ± 0.0
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	0.97 ± 0.05	0.70 ± 0.01	0.00058 ± 0.00022	< 0.0008 ± 0.0003	1.3 ± 0.0
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	0.93 ± 0.05	0.72 ± 0.00	< 0.0004 ± 0.0001	< 0.0008 ± 0.0005	1.3 ± 0.0
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	1.0 ± 0.1	1.2 ± 0.0	0.0041 ± 0.0016	< 0.0015 ± 0.0003	2.2 ± 0.0
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	0.94 ± 0.11	1.2 ± 0.0	0.0040 ± 0.0005	< 0.0015 ± 0.0002	2.2 ± 0.0
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	1.0 ± 0.1	1.2 ± 0.0	0.0032 ± 0.0003	< 0.0015 ± 0.0000	2.1 ± 0.0
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	0.96 ± 0.09	1.2 ± 0.0	0.0033 ± 0.0004	< 0.0015 ± 0.0001	2.2 ± 0.0
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	0.50 ± 0.05	1.0 ± 0.0	0.00050 ± 0.00046	< 0.0015 ± 0.0001	2.0 ± 0.0
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	0.58 ± 0.12	1.0 ± 0.0	0.00047 ± 0.00048	0.0015 ± 0.0003	1.9 ± 0.0
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	0.86 ± 0.01	1.2 ± 0.1	0.0040 ± 0.0011	< 0.0013 ± 0.0010	2.1 ± 0.1
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	0.87 ± 0.07	1.2 ± 0.0	0.0038 ± 0.0009	0.0018 ± 0.0004	2.0 ± 0.0
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	0.88 ± 0.06	1.2 ± 0.0	0.0039 ± 0.0006	< 0.0013 ± 0.0007	2.0 ± 0.0
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	0.88 ± 0.05	1.1 ± 0.0	0.0038 ± 0.0007	< 0.0013 ± 0.0001	1.9 ± 0.0
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	0.43 ± 0.09	1.1 ± 0.0	0.00072 ± 0.00024	< 0.0013 ± 0.0003	1.9 ± 0.0
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	0.42 ± 0.04	1.1 ± 0.0	0.00085 ± 0.00021	< 0.0013 ± 0.0009	1.9 ± 0.0
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.91 ± 0.03	1.0 ± 0.0	0.012 ± 0.001	0.00067 ± 0.00065	1.1 ± 0.0
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.68 ± 0.03	1.0 ± 0.0	0.0056 ± 0.0013	0.00083 ± 0.00087	1.0 ± 0.0
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	0.65 ± 0.07	1.0 ± 0.0	0.0088 ± 0.0008	< 0.0006 ± 0.0003	1.1 ± 0.0
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.62 ± 0.07	1.0 ± 0.0	0.0082 ± 0.0008	0.00061 ± 0.00023	1.2 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP–MS	Potassium (mg/L) ICP–AES–Ax	Praseodymium (µg/L) ICP–MS	Rhenium (µg/L) ICP–MS	Rubidium (µg/L) ICP–MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	0.53 ± 0.04	0.91 ± 0.03	0.0023 ± 0.0005	0.00073 ± 0.00026	0.88 ± 0.01
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.50 ± 0.01	0.91 ± 0.05	0.0025 ± 0.0001	0.00065 ± 0.00076	0.91 ± 0.02
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	1.7 ± 0.1	0.98 ± 0.05	0.0033 ± 0.0003	< 0.0008 ± 0.0005	1.6 ± 0.0
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	1.6 ± 0.1	0.97 ± 0.02	0.0023 ± 0.0001	< 0.0008 ± 0.0002	1.6 ± 0.0
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	1.6 ± 0.0	0.96 ± 0.02	0.0034 ± 0.0003	< 0.0008 ± 0.0002	1.6 ± 0.0
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	1.5 ± 0.0	0.96 ± 0.02	0.0035 ± 0.0003	0.00092 ± 0.00063	1.5 ± 0.0
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	1.1 ± 0.0	0.87 ± 0.04	0.00071 ± 0.00020	< 0.0008 ± 0.0006	1.4 ± 0.0
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	1.2 ± 0.1	0.88 ± 0.04	0.00071 ± 0.00016	< 0.0008 ± 0.0005	1.4 ± 0.0
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	1.1 ± 0.0	1.0 ± 0.0	0.0025 ± 0.0001	0.00071 ± 0.00022	1.6 ± 0.0
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	1.0 ± 0.1	1.0 ± 0.0	0.0032 ± 0.0001	0.00071 ± 0.00032	1.6 ± 0.0
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.85 ± 0.01	1.0 ± 0.0	0.0027 ± 0.0002	< 0.0013 ± 0.0002	1.6 ± 0.0
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	1.5 ± 0.0	1.0 ± 0.0	0.0028 ± 0.0003	< 0.0008 ± 0.0004	1.6 ± 0.0
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	1.5 ± 0.1	1.0 ± 0.0	0.0013 ± 0.0005	< 0.0008 ± 0.0006	1.6 ± 0.0
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	1.4 ± 0.1	1.0 ± 0.0	0.0015 ± 0.0012	< 0.0008 ± 0.0005	1.6 ± 0.1
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	1.4 ± 0.0	1.0 ± 0.0	0.0020 ± 0.0000	0.00065 ± 0.00028	1.6 ± 0.0
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	1.0 ± 0.1	0.93 ± 0.01	< 0.0004 ± 0.0003	< 0.0008 ± 0.0004	1.4 ± 0.0
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	1.0 ± 0.1	0.92 ± 0.01	0.00053 ± 0.00030	< 0.0008 ± 0.0003	1.4 ± 0.0
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	0.88 ± 0.06	1.2 ± 0.0	0.0027 ± 0.0006	< 0.0015 ± 0.0002	2.0 ± 0.0
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	0.84 ± 0.04	1.3 ± 0.0	0.0022 ± 0.0006	< 0.0015 ± 0.0003	2.1 ± 0.0
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	0.78 ± 0.12	1.3 ± 0.0	0.0016 ± 0.0001	< 0.0015 ± 0.0002	2.1 ± 0.0
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	0.74 ± 0.04	1.3 ± 0.0	0.0021 ± 0.0002	< 0.0015 ± 0.0002	2.1 ± 0.1
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	0.56 ± 0.05	1.2 ± 0.0	< 0.0005 ± 0.0002	< 0.0015 ± 0.0002	1.9 ± 0.0
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	0.58 ± 0.07	1.2 ± 0.0	< 0.0005 ± 0.0002	< 0.0015 ± 0.0005	1.9 ± 0.0
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	1.2 ± 0.1	1.3 ± 0.0	0.0032 ± 0.0002	< 0.0013 ± 0.0007	1.3 ± 0.0
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	1.1 ± 0.0	1.3 ± 0.0	0.0029 ± 0.0004	0.0015 ± 0.0008	1.3 ± 0.0
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	1.4 ± 0.0	1.2 ± 0.0	0.0039 ± 0.0006	< 0.0006 ± 0.0004	1.2 ± 0.0
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	1.2 ± 0.0	1.3 ± 0.0	0.0035 ± 0.0006	< 0.0013 ± 0.0001	1.3 ± 0.0
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	0.81 ± 0.03	1.1 ± 0.0	0.00074 ± 0.00042	< 0.0006 ± 0.0002	1.1 ± 0.0
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	0.86 ± 0.03	1.2 ± 0.0	0.00058 ± 0.00028	< 0.0013 ± 0.0007	1.2 ± 0.0
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	2.1 ± 0.1	1.1 ± 0.1	0.0064 ± 0.0013	< 0.0006 ± 0.0004	0.58 ± 0.00
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	2.0 ± 0.0	1.1 ± 0.0	0.0063 ± 0.0008	0.00075 ± 0.00004	0.57 ± 0.01

C—034957

C-034959

Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	1.6 ± 0.1	1.1 ± 0.0	0.010 ± 0.000	< 0.0006 ± 0.0006	0.59 ± 0.02
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	1.5 ± 0.0	1.1 ± 0.0	0.011 ± 0.001	< 0.0006 ± 0.0006	0.59 ± 0.01
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	1.9 ± 0.1	1.1 ± 0.0	0.0043 ± 0.0003	0.0010 ± 0.0001	0.54 ± 0.02
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	1.9 ± 0.1	1.0 ± 0.0	0.0040 ± 0.0006	0.00090 ± 0.00044	0.53 ± 0.01
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	1.1 ± 0.0	1.1 ± 0.0	0.0022 ± 0.0006	0.0010 ± 0.0002	1.5 ± 0.0
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	1.3 ± 0.1	1.1 ± 0.0	0.0042 ± 0.0002	0.0012 ± 0.0002	1.5 ± 0.0
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	0.88 ± 0.03	1.1 ± 0.0	0.0028 ± 0.0002	< 0.0008 ± 0.0003	1.5 ± 0.0
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	0.84 ± 0.06	1.1 ± 0.1	0.0022 ± 0.0003	< 0.0008 ± 0.0002	1.5 ± 0.0
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	0.73 ± 0.02	1.1 ± 0.0	0.00047 ± 0.00030	< 0.0008 ± 0.0004	1.4 ± 0.0
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	0.80 ± 0.05	1.0 ± 0.0	0.00044 ± 0.00036	< 0.0008 ± 0.0000	1.4 ± 0.0
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	0.47 ± 0.02	0.87 ± 0.01	0.0019 ± 0.0002	0.0019 ± 0.0009	1.1 ± 0.0
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	0.59 ± 0.04	0.90 ± 0.00	0.0042 ± 0.0001	< 0.0005 ± 0.0003	1.1 ± 0.0
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.50 ± 0.02	0.88 ± 0.01	0.0026 ± 0.0002	< 0.0005 ± 0.0002	1.1 ± 0.0
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.50 ± 0.03	0.89 ± 0.01	0.0028 ± 0.0000	< 0.0005 ± 0.0001	1.1 ± 0.0
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	0.63 ± 0.01	0.86 ± 0.00	0.0013 ± 0.0002	0.00066 ± 0.00026	1.1 ± 0.0
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	0.51 ± 0.05	0.87 ± 0.01	0.0012 ± 0.0002	< 0.0005 ± 0.0001	1.1 ± 0.0
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	0.81 ± 0.01	1.0 ± 0.0	0.0046 ± 0.0002	0.00096 ± 0.00015	1.1 ± 0.0
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	0.51 ± 0.00	1.0 ± 0.0	0.0011 ± 0.0002	0.00074 ± 0.00059	1.1 ± 0.0
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	0.62 ± 0.01	1.0 ± 0.0	0.0020 ± 0.0003	< 0.0006 ± 0.0001	1.1 ± 0.0
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	0.57 ± 0.11	1.0 ± 0.0	0.0020 ± 0.0003	0.00079 ± 0.00021	1.1 ± 0.0
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	0.28 ± 0.10	0.94 ± 0.02	0.00040 ± 0.00047	< 0.0008 ± 0.0009	1.0 ± 0.0
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	0.28 ± 0.07	0.95 ± 0.01	0.00054 ± 0.00048	0.00094 ± 0.00098	1.0 ± 0.0
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	0.76 ± 0.03	1.4 ± 0.0	0.0051 ± 0.0005	< 0.0015 ± 0.0003	1.3 ± 0.0
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	0.76 ± 0.05	1.4 ± 0.0	0.0041 ± 0.0006	< 0.0015 ± 0.0004	1.3 ± 0.0
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.86 ± 0.03	1.2 ± 0.1	0.0044 ± 0.0007	0.00080 ± 0.00010	1.0 ± 0.0
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.79 ± 0.06	1.2 ± 0.0	0.0041 ± 0.0014	< 0.0013 ± 0.0010	1.1 ± 0.0
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.79 ± 0.02	1.3 ± 0.0	0.0042 ± 0.0009	< 0.0013 ± 0.0007	1.1 ± 0.0
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.84 ± 0.02	1.2 ± 0.0	0.0047 ± 0.0008	< 0.0013 ± 0.0004	1.0 ± 0.0
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	0.60 ± 0.06	1.1 ± 0.0	0.0015 ± 0.0003	< 0.0013 ± 0.0003	0.95 ± 0.00
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	0.64 ± 0.07	1.1 ± 0.0	0.0013 ± 0.0001	< 0.0013 ± 0.0011	0.94 ± 0.00

C—034958

Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	0.67 ± 0.06	1.1 ± 0.0	0.0017 ± 0.0002	0.0011 ± 0.0010	1.2 ± 0.0
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	0.65 ± 0.02	1.0 ± 0.0	0.0011 ± 0.0001	< 0.0008 ± 0.0003	1.1 ± 0.0
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	0.61 ± 0.05	1.0 ± 0.0	0.0021 ± 0.0002	< 0.0008 ± 0.0001	1.1 ± 0.0
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	0.61 ± 0.02	1.0 ± 0.0	0.0021 ± 0.0003	< 0.0008 ± 0.0003	1.1 ± 0.0
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	0.40 ± 0.03	0.93 ± 0.01	0.00034 ± 0.00029	0.00087 ± 0.00048	0.97 ± 0.08
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	0.42 ± 0.03	0.94 ± 0.00	0.00056 ± 0.00037	< 0.0008 ± 0.0001	0.99 ± 0.04
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.41 ± 0.07	0.81 ± 0.02	0.0026 ± 0.0002	0.00077 ± 0.00016	0.99 ± 0.00
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	0.42 ± 0.07	0.84 ± 0.00	0.0022 ± 0.0002	0.00051 ± 0.00021	1.0 ± 0.0
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	0.43 ± 0.01	0.85 ± 0.01	0.0039 ± 0.0003	< 0.0013 ± 0.0018	1.1 ± 0.0
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.42 ± 0.05	0.86 ± 0.01	0.0032 ± 0.0002	< 0.0003 ± 0.0001	1.0 ± 0.0
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	0.61 ± 0.04	0.75 ± 0.01	0.00043 ± 0.00006	< 0.0005 ± 0.0003	0.91 ± 0.00
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	0.96 ± 0.00	0.91 ± 0.01	0.00082 ± 0.00007	0.00094 ± 0.00022	1.1 ± 0.0
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	0.50 ± 0.07	0.99 ± 0.02	0.0010 ± 0.0004	0.0012 ± 0.0004	1.1 ± 0.0
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	0.54 ± 0.10	0.98 ± 0.01	0.0010 ± 0.0004	< 0.0008 ± 0.0002	1.1 ± 0.0
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	0.62 ± 0.06	0.99 ± 0.00	0.0027 ± 0.0003	0.0015 ± 0.0002	1.1 ± 0.0
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	0.52 ± 0.06	0.98 ± 0.01	0.0021 ± 0.0003	< 0.0008 ± 0.0001	1.1 ± 0.0
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	0.25 ± 0.05	0.89 ± 0.01	< 0.0005 ± 0.0001	< 0.0006 ± 0.0000	0.94 ± 0.01
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	0.32 ± 0.06	0.90 ± 0.01	0.00050 ± 0.00027	0.0021 ± 0.0012	0.97 ± 0.03
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	0.63 ± 0.04	1.2 ± 0.0	0.0024 ± 0.0002	< 0.0015 ± 0.0003	1.2 ± 0.0
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	0.59 ± 0.02	1.2 ± 0.0	0.0015 ± 0.0004	< 0.0015 ± 0.0007	1.2 ± 0.0
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	0.62 ± 0.07	1.2 ± 0.0	0.0019 ± 0.0004	< 0.0015 ± 0.0005	1.2 ± 0.0
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	0.63 ± 0.04	1.2 ± 0.0	0.0013 ± 0.0004	< 0.0015 ± 0.0000	1.2 ± 0.0
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	0.33 ± 0.02	1.1 ± 0.0	< 0.0005 ± 0.0001	< 0.0015 ± 0.0002	1.1 ± 0.0
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	0.33 ± 0.05	1.1 ± 0.0	< 0.0005 ± 0.0001	< 0.0015 ± 0.0003	1.1 ± 0.0
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	0.78 ± 0.04	1.1 ± 0.0	0.0051 ± 0.0003	0.0013 ± 0.0008	0.96 ± 0.02
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.77 ± 0.08	1.2 ± 0.0	0.0056 ± 0.0002	< 0.0013 ± 0.0004	1.0 ± 0.0
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.86 ± 0.09	1.2 ± 0.0	0.0069 ± 0.0007	< 0.0013 ± 0.0001	0.97 ± 0.00
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.94 ± 0.08	1.2 ± 0.0	0.0070 ± 0.0004	< 0.0013 ± 0.0008	0.97 ± 0.05
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	0.69 ± 0.03	1.0 ± 0.0	0.0020 ± 0.0005	< 0.0013 ± 0.0001	0.86 ± 0.03
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.67 ± 0.04	1.1 ± 0.0	0.0026 ± 0.0008	< 0.0013 ± 0.0006	0.93 ± 0.01
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.68 ± 0.04	0.98 ± 0.02	0.022 ± 0.001	< 0.0006 ± 0.0002	1.2 ± 0.0
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.69 ± 0.02	0.98 ± 0.04	0.019 ± 0.002	< 0.0006 ± 0.0005	1.3 ± 0.0

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C-034961

Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP–MS	Potassium (mg/L) ICP–AES–Ax	Praseodymium (µg/L) ICP–MS	Rhenium (µg/L) ICP–MS	Rubidium (µg/L) ICP–MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	0.78 ± 0.07	1.0 ± 0.0	0.024 ± 0.001	< 0.0006 ± 0.0007	1.2 ± 0.0
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.66 ± 0.05	0.98 ± 0.03	0.025 ± 0.001	< 0.0006 ± 0.0004	1.2 ± 0.0
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	0.36 ± 0.02	0.85 ± 0.01	0.0040 ± 0.0008	< 0.0006 ± 0.0004	1.1 ± 0.0
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.36 ± 0.04	0.90 ± 0.03	0.0036 ± 0.0005	< 0.0006 ± 0.0004	1.1 ± 0.0
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	0.68 ± 0.05	0.99 ± 0.00	0.0015 ± 0.0003	0.00091 ± 0.00004	1.0 ± 0.0
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	0.68 ± 0.07	0.97 ± 0.03	0.0016 ± 0.0003	< 0.0008 ± 0.0004	1.1 ± 0.0
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	0.69 ± 0.01	0.97 ± 0.01	0.0021 ± 0.0003	< 0.0008 ± 0.0002	1.1 ± 0.0
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	0.70 ± 0.07	0.97 ± 0.00	0.0019 ± 0.0002	< 0.0008 ± 0.0005	1.0 ± 0.0
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	0.36 ± 0.02	0.83 ± 0.01	< 0.0003 ± 0.0000	< 0.0008 ± 0.0007	0.89 ± 0.05
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	0.37 ± 0.03	0.85 ± 0.02	0.00051 ± 0.00019	< 0.0008 ± 0.0001	0.92 ± 0.03
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	0.67 ± 0.01	0.96 ± 0.01	0.0018 ± 0.0003	0.0013 ± 0.0010	1.1 ± 0.0
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.73 ± 0.02	0.99 ± 0.01	0.0037 ± 0.0001	0.0015 ± 0.0003	1.1 ± 0.1
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	0.54 ± 0.03	0.97 ± 0.02	0.0026 ± 0.0011	0.0015 ± 0.0005	1.1 ± 0.0
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	0.53 ± 0.02	0.97 ± 0.01	0.0021 ± 0.0003	0.0015 ± 0.0009	1.1 ± 0.1
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	0.31 ± 0.04	0.87 ± 0.01	< 0.0003 ± 0.0003	0.0011 ± 0.0006	0.93 ± 0.01
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	0.33 ± 0.03	0.87 ± 0.00	< 0.0003 ± 0.0000	< 0.001 ± 0.001	0.95 ± 0.00
Flat Cr.	12/11/96	0.40 µm Mem	1/2	0.63 ± 0.00	0.19 ± 0.00	0.015 ± 0.002	0.00071 ± 0.00017	0.11 ± 0.00
Flat Cr.	12/11/96	0.40 µm Mem	2/2	0.75 ± 0.00	0.19 ± 0.01	0.014 ± 0.000	0.00078 ± 0.00012	0.10 ± 0.00
Flat Cr.	12/11/96	0.45 µm Cap	1/2	0.67 ± 0.02	0.19 ± 0.01	0.011 ± 0.001	< 0.0013 ± 0.0008	0.10 ± 0.01
Flat Cr.	12/11/96	0.45 µm Cap	2/2	0.78 ± 0.06	0.19 ± 0.00	0.011 ± 0.000	< 0.0006 ± 0.0002	0.096 ± 0.006
Flat Cr.	12/11/96	10 kd Tan	1/2	0.65 ± 0.03	0.25 ± 0.00	0.0054 ± 0.0006	0.0017 ± 0.0011	0.083 ± 0.002
Flat Cr.	12/11/96	10 kd Tan	2/2	0.74 ± 0.01	0.16 ± 0.00	0.0054 ± 0.0015	0.00092 ± 0.00031	0.075 ± 0.000
Flat Cr.	05/29/97	0.40 µm Mem	1/2	< 0.01 ± 0.02	0.33 ± 0.01	0.0071 ± 0.0004	0.0019 ± 0.0007	0.30 ± 0.01
Flat Cr.	05/29/97	0.40 µm Mem	2/2	0.084 ± 0.062	0.35 ± 0.00	0.0078 ± 0.0001	0.0023 ± 0.0005	0.30 ± 0.02
Flat Cr.	05/29/97	0.45 mm Cap	1/2	0.059 ± 0.087	0.34 ± 0.01	0.0047 ± 0.0002	0.0022 ± 0.0005	0.31 ± 0.02
Flat Cr.	05/29/97	0.45 µm Cap	2/2	0.078 ± 0.041	0.34 ± 0.00	0.0039 ± 0.0007	0.0019 ± 0.0010	0.30 ± 0.01
Flat Cr.	05/29/97	10 kd Tan	1/2	0.11 ± 0.02	0.32 ± 0.02	0.0011 ± 0.0002	0.0013 ± 0.0008	0.27 ± 0.01
Flat Cr.	05/29/97	10 kd Tan	2/2	0.13 ± 0.02	0.31 ± 0.00	0.0013 ± 0.0002	0.0014 ± 0.0004	0.28 ± 0.02
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	1.7 ± 0.0	0.39 ± 0.01	0.89 ± 0.01	0.0045 ± 0.0003	0.36 ± 0.00
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	1.9 ± 0.0	0.40 ± 0.01	0.91 ± 0.05	0.0033 ± 0.0006	0.36 ± 0.02
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	1.7 ± 0.0	0.40 ± 0.02	0.86 ± 0.00	< 0.0013 ± 0.0008	0.36 ± 0.01
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	1.7 ± 0.1	0.39 ± 0.01	0.85 ± 0.01	0.0019 ± 0.0002	0.35 ± 0.00
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	1.8 ± 0.0	0.38 ± 0.01	0.84 ± 0.02	0.0033 ± 0.0003	0.33 ± 0.00

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP-MS	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	1.6 ± 0.0	0.37 ± 0.00	0.89 ± 0.04	0.0026 ± 0.0005	0.33 ± 0.01
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	4.3 ± 0.1	2.6 ± 0.0	1.7 ± 0.1	0.016 ± 0.001	4.6 ± 0.0
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	4.7 ± 0.4	2.6 ± 0.0	1.7 ± 0.0	0.019 ± 0.001	4.7 ± 0.1
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	4.2 ± 0.2	2.5 ± 0.0	1.6 ± 0.0	0.0048 ± 0.0004	4.6 ± 0.2
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	4.2 ± 0.3	2.6 ± 0.1	1.6 ± 0.0	0.0074 ± 0.0003	4.7 ± 0.0
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	4.2 ± 0.7	2.5 ± 0.0	1.7 ± 0.0	0.017 ± 0.001	4.4 ± 0.1
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	4.2 ± 0.4	2.4 ± 0.0	1.7 ± 0.0	0.019 ± 0.001	4.4 ± 0.0
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	2.1 ± 0.0	0.52 ± 0.00	0.63 ± 0.00	0.0029 ± 0.0001	0.46 ± 0.00
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	2.0 ± 0.1	0.51 ± 0.01	0.62 ± 0.00	0.0024 ± 0.0007	0.46 ± 0.02
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	2.5 ± 0.1	0.51 ± 0.00	0.66 ± 0.00	< 0.0006 ± 0.0003	0.45 ± 0.00
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	2.0 ± 0.2	0.51 ± 0.02	0.64 ± 0.04	0.00066 ± 0.00048	0.47 ± 0.01
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	2.2 ± 0.1	0.48 ± 0.02	0.61 ± 0.02	0.0021 ± 0.0013	0.44 ± 0.01
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	1.9 ± 0.1	0.48 ± 0.01	0.58 ± 0.02	0.0014 ± 0.0006	0.43 ± 0.02
Whiskeytown	12/11/96	0.40 µm Mem	1/2	2.5 ± 0.1	0.39 ± 0.05	0.0022 ± 0.0002	< 0.0013 ± 0.0007	0.30 ± 0.01
Whiskeytown	12/11/96	0.40 µm Mem	2/2	2.6 ± 0.1	0.36 ± 0.00	0.0021 ± 0.0000	< 0.0006 ± 0.0001	0.28 ± 0.01
Whiskeytown	12/11/96	0.45 µm Cap	1/2	2.5 ± 0.1	0.35 ± 0.00	0.0021 ± 0.0004	0.00060 ± 0.00029	0.28 ± 0.01
Whiskeytown	12/11/96	0.45 µm Cap	2/2	2.4 ± 0.1	0.35 ± 0.00	0.0024 ± 0.0009	< 0.0013 ± 0.0002	0.30 ± 0.01
Whiskeytown	12/11/96	10 kd Tan	1/2	2.4 ± 0.0	0.32 ± 0.01	0.00071 ± 0.00022	< 0.0006 ± 0.0001	0.25 ± 0.00
Whiskeytown	12/11/96	10 kd Tan	2/2	2.3 ± 0.1	0.32 ± 0.00	0.00079 ± 0.00053	< 0.0013 ± 0.0003	0.26 ± 0.00
Whiskeytown	05/29/97	0.40 µm Mem	1/2	3.8 ± 0.0	0.35 ± 0.01	0.0024 ± 0.0006	< 0.001 ± 0.001	0.32 ± 0.02
Whiskeytown	05/29/97	0.40 µm Mem	2/2	4.6 ± 0.1	0.36 ± 0.01	0.0031 ± 0.0003	< 0.001 ± 0.001	0.31 ± 0.02
Whiskeytown	05/29/97	0.45 µm Cap	1/2	4.0 ± 0.1	0.35 ± 0.01	0.0026 ± 0.0005	< 0.001 ± 0.001	0.31 ± 0.02
Whiskeytown	05/29/97	0.45 µm Cap	2/2	4.0 ± 0.0	0.36 ± 0.02	0.0028 ± 0.0002	0.0011 ± 0.0010	0.30 ± 0.01
Whiskeytown	05/29/97	10 kd Tan	1/2	2.8 ± 0.1	0.32 ± 0.01	0.00051 ± 0.00027	< 0.001 ± 0.000	0.28 ± 0.01
Whiskeytown	05/29/97	10 kd Tan	2/2	2.7 ± 0.1	0.31 ± 0.00	0.00053 ± 0.00022	< 0.001 ± 0.001	0.28 ± 0.01
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	3.9 ± 0.0	0.31 ± 0.01	0.0022 ± 0.0003	< 0.0003 ± 0.0001	0.28 ± 0.01
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	3.8 ± 0.0	0.31 ± 0.00	0.0021 ± 0.0005	< 0.0005 ± 0.0005	0.29 ± 0.01
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	3.4 ± 0.1	0.31 ± 0.01	0.0020 ± 0.0002	< 0.0013 ± 0.0006	0.28 ± 0.01
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	4.0 ± 0.0	0.31 ± 0.00	0.0031 ± 0.0002	< 0.0013 ± 0.0004	0.30 ± 0.01
Spring Cr. arm	07/12/96	10 kd Tan	1/3	3.4 ± 0.3	0.29 ± 0.00	0.0010 ± 0.0005	< 0.0013 ± 0.0004	0.30 ± 0.01
Spring Cr. arm	07/12/96	10 kd Tan	2/3	3.4 ± 0.1	0.29 ± 0.00	0.00075 ± 0.00010	0.00043 ± 0.00019	0.27 ± 0.01
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	3.9 ± 0.1	0.31 ± 0.00	0.0036 ± 0.0005	< 0.0008 ± 0.0005	0.30 ± 0.00
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	4.1 ± 0.2	0.31 ± 0.00	0.0038 ± 0.0005	< 0.0008 ± 0.0004	0.30 ± 0.02

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Nickel (µg/L) ICP–MS	Potassium (mg/L) ICP–AES–Ax	Praseodymium (µg/L) ICP–MS	Rhenium (µg/L) ICP–MS	Rubidium (µg/L) ICP–MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	3.9 ± 0.0	0.30 ± 0.00	0.0038 ± 0.0008	< 0.0008 ± 0.0004	0.29 ± 0.01
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	4.0 ± 0.2	0.30 ± 0.01	0.0036 ± 0.0002	< 0.0008 ± 0.0004	0.29 ± 0.01
Spring Cr. arm	09/18/96	10 kd Tan	1/2	3.2 ± 0.1	0.30 ± 0.03	0.0013 ± 0.0004	< 0.0008 ± 0.0007	0.27 ± 0.02
Spring Cr. arm	09/18/96	10 kd Tan	2/2	3.1 ± 0.1	0.27 ± 0.00	0.0014 ± 0.0002	< 0.0008 ± 0.0003	0.27 ± 0.01
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	2.8 ± 0.0	0.37 ± 0.01	0.013 ± 0.003	< 0.0015 ± 0.0002	0.34 ± 0.01
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	2.7 ± 0.0	0.36 ± 0.00	0.0094 ± 0.0002	< 0.0015 ± 0.0005	0.34 ± 0.01
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	3.0 ± 0.1	0.35 ± 0.00	0.013 ± 0.002	< 0.0015 ± 0.0002	0.32 ± 0.01
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	2.8 ± 0.1	0.39 ± 0.03	0.012 ± 0.002	< 0.0015 ± 0.0005	0.33 ± 0.02
Spring Cr. arm	11/20/96	10 kd Tan	1/2	2.2 ± 0.0	0.32 ± 0.00	0.0013 ± 0.0006	< 0.0015 ± 0.0003	0.28 ± 0.02
Spring Cr. arm	11/20/96	10 kd Tan	2/2	2.3 ± 0.1	0.31 ± 0.00	0.0018 ± 0.0005	< 0.0015 ± 0.0000	0.28 ± 0.02
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	3.0 ± 0.1	0.37 ± 0.02	0.018 ± 0.000	0.00091 ± 0.00001	0.29 ± 0.00
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	2.8 ± 0.1	0.35 ± 0.00	0.014 ± 0.000	0.00077 ± 0.00034	0.28 ± 0.01
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	2.3 ± 0.0	0.36 ± 0.01	0.033 ± 0.001	< 0.0013 ± 0.0002	0.30 ± 0.01
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	2.3 ± 0.0	0.36 ± 0.01	0.029 ± 0.001	< 0.0013 ± 0.0001	0.30 ± 0.00
Spring Cr. arm	12/11/96	10 kd Tan	1/2	2.1 ± 0.0	0.31 ± 0.01	0.0030 ± 0.0001	< 0.0013 ± 0.0008	0.26 ± 0.01
Spring Cr. arm	12/11/96	10 kd Tan	2/2	2.4 ± 0.0	0.31 ± 0.00	0.0038 ± 0.0006	0.00086 ± 0.00007	0.25 ± 0.01
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	4.2 ± 0.2	0.38 ± 0.02	0.0040 ± 0.0001	0.0010 ± 0.0006	0.34 ± 0.01
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	3.9 ± 0.1	0.37 ± 0.00	0.0036 ± 0.0003	0.0011 ± 0.0009	0.34 ± 0.01
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	5.1 ± 0.0	0.38 ± 0.01	0.0053 ± 0.0010	< 0.001 ± 0.001	0.33 ± 0.01
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	4.1 ± 0.0	0.37 ± 0.01	0.0054 ± 0.0004	< 0.001 ± 0.001	0.33 ± 0.01
Spring Cr. arm	05/28/97	10 kd Tan	1/2	2.8 ± 0.1	0.31 ± 0.01	0.00072 ± 0.00012	< 0.001 ± 0.001	0.28 ± 0.01
Spring Cr. arm	05/28/97	10 kd Tan	2/2	2.6 ± 0.0	0.32 ± 0.00	0.00056 ± 0.00016	< 0.001 ± 0.001	0.28 ± 0.00
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	2.0 ± 0.1	2.0 ± 0.0	0.0034 ± 0.0003	0.0038 ± 0.0011	0.54 ± 0.00
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	2.0 ± 0.0	nd ± nd	0.0036 ± 0.0002	0.0039 ± 0.0009	0.53 ± 0.01
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	2.0 ± 0.0	2.1 ± 0.1	0.0032 ± 0.0000	0.0039 ± 0.0011	0.51 ± 0.02
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	2.1 ± 0.1	2.2 ± 0.0	0.0032 ± 0.0003	0.0029 ± 0.0000	0.53 ± 0.03
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	1.1 ± 0.1	1.9 ± 0.1	0.0022 ± 0.0001	0.0031 ± 0.0009	0.48 ± 0.01
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	1.1 ± 0.1	2.0 ± 0.0	0.0021 ± 0.0001	0.0052 ± 0.0013	0.48 ± 0.01
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	1.3 ± 0.1	1.2 ± 0.1	0.0086 ± 0.0008	0.00062 ± 0.00031	0.62 ± 0.02
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	1.3 ± 0.1	1.2 ± 0.0	0.0057 ± 0.0007	< 0.0006 ± 0.0002	0.60 ± 0.03
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	1.3 ± 0.1	1.2 ± 0.0	0.011 ± 0.002	0.00060 ± 0.00081	0.56 ± 0.01
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	1.3 ± 0.1	1.1 ± 0.0	0.011 ± 0.002	< 0.0006 ± 0.0004	0.56 ± 0.02
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.86 ± 0.10	0.99 ± 0.03	0.0023 ± 0.0005	< 0.0006 ± 0.0003	0.49 ± 0.03
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.90 ± 0.06	0.99 ± 0.03	0.0024 ± 0.0008	0.00072 ± 0.00079	0.47 ± 0.01

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP-MS	Selenium (µg/L) ICP-MS	Silica (mg/L) ICP-AES	Silver (µg/L) ICP-MS	Sodium (mg/L) ICP-AES
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	0.0086 ± 0.0001	0.083 ± 0.010	22 ± 0	< 0.02 ± 0.01	5.7 ± 0.0
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	0.011 ± 0.001	0.094 ± 0.011	21 ± 0	0.034 ± 0.003	5.6 ± 0.1
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.0053 ± 0.0004	0.16 ± 0.05	21 ± 0	< 0.04 ± 0.00	5.6 ± 0.0
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	0.0085 ± 0.0007	0.085 ± 0.016	21 ± 0	< 0.01 ± 0.00	5.5 ± 0.0
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	0.0031 ± 0.0006	0.11 ± 0.03	21 ± 0	< 0.04 ± 0.01	5.4 ± 0.1
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	0.0040 ± 0.0011	< 0.07 ± 0.04	21 ± 0	< 0.02 ± 0.01	5.4 ± 0.0
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	0.0079 ± 0.0026	< 0.3 ± 0.05	21 ± 1	< 0.02 ± 0.01	5.7 ± 0.1
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	0.0090 ± 0.0034	< 0.3 ± 0.15	21 ± 1	< 0.02 ± 0.01	5.9 ± 0.2
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	0.0039 ± 0.0024	< 0.3 ± 0.05	22 ± 1	< 0.02 ± 0.02	6.0 ± 0.2
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	0.0087 ± 0.0021	< 0.13 ± 0.06	20 ± 1	< 0.03 ± 0.02	5.1 ± 0.3
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	< 0.006 ± 0.005	0.30 ± 0.25	21 ± 0	< 0.03 ± 0.03	5.1 ± 0.2
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.3 ± 0.05	21 ± 1	< 0.02 ± 0.01	5.3 ± 0.3
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.2 ± 0.12	24 ± 0	< 0.05 ± 0.01	7.5 ± 0.1
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	< 0.003 ± 0.000	< 0.2 ± 0.02	23 ± 0	< 0.05 ± 0.02	7.6 ± 0.5
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.0031 ± 0.0009	< 0.2 ± 0.11	23 ± 1	< 0.05 ± 0.01	7.0 ± 0.5
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	0.0047 ± 0.0025	< 0.2 ± 0.03	23 ± 0	< 0.05 ± 0.01	7.0 ± 0.2
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.2 ± 0.09	23 ± 0	< 0.05 ± 0.00	6.9 ± 0.2
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.2 ± 0.08	24 ± 0	< 0.05 ± 0.01	6.9 ± 0.3
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	0.0045 ± 0.0023	< 0.09 ± 0.06	25 ± 1	< 0.07 ± 0.04	8.3 ± 0.7
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	< 0.004 ± 0.004	< 0.09 ± 0.05	25 ± 2	< 0.07 ± 0.01	8.4 ± 1.2
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	0.0056 ± 0.0002	< 0.11 ± 0.08	24 ± 2	< 0.03 ± 0.00	8.5 ± 1.3
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	0.0045 ± 0.0009	< 0.11 ± 0.12	24 ± 0	< 0.03 ± 0.00	7.8 ± 0.0
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	0.0020 ± 0.0027	0.12 ± 0.08	24 ± 1	< 0.03 ± 0.02	7.1 ± 0.3
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	< 0.004 ± 0.002	< 0.09 ± 0.08	23 ± 0	< 0.07 ± 0.00	6.5 ± 0.0
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	0.0086 ± 0.0032	< 0.1 ± 0.02	21 ± 1	< 0.2 ± 0.17	5.7 ± 0.1
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	0.0059 ± 0.0013	< 0.1 ± 0.05	21 ± 1	< 0.2 ± 0.17	5.5 ± 0.2
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	0.0062 ± 0.0007	< 0.1 ± 0.13	20 ± 0	< 0.2 ± 0.17	5.1 ± 0.3
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	0.0067 ± 0.0009	< 0.1 ± 0.13	20 ± 1	< 0.2 ± 0.18	5.4 ± 0.3
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.1 ± 0.02	20 ± 0	< 0.2 ± 0.19	5.1 ± 0.3
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.1 ± 0.07	20 ± 1	< 0.2 ± 0.22	4.9 ± 0.3
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	0.0072 ± 0.0007	0.082 ± 0.014	19 ± 0	< 0.01 ± 0.00	4.6 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP-MS	Selenium (µg/L) ICP-MS	Silica (mg/L) ICP-AES	Silver (µg/L) ICP-MS	Sodium (mg/L) ICP-AES
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	0.0053 ± 0.0002	0.076 ± 0.013	19 ± 0	< 0.01 ± 0.00	4.7 ± 0.1
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	0.0057 ± 0.0008	0.10 ± 0.00	19 ± 0	< 0.01 ± 0.00	4.5 ± 0.1
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	0.010 ± 0.001	0.10 ± 0.00	19 ± 0	< 0.01 ± 0.01	4.6 ± 0.1
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	0.0047 ± 0.0019	0.093 ± 0.012	19 ± 0	< 0.01 ± 0.00	4.4 ± 0.0
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	0.0050 ± 0.0009	0.087 ± 0.020	18 ± 0	< 0.01 ± 0.01	4.4 ± 0.0
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	0.0046 ± 0.0005	0.076 ± 0.018	19 ± 0	< 0.01 ± 0.00	4.5 ± 0.1
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	0.0082 ± 0.0004	< 0.3 ± 0.05	16 ± 0	< 0.02 ± 0.01	3.5 ± 0.1
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	0.0090 ± 0.0030	< 0.13 ± 0.03	17 ± 0	< 0.03 ± 0.00	3.9 ± 0.1
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	0.0064 ± 0.0012	0.16 ± 0.09	17 ± 0	< 0.03 ± 0.00	4.0 ± 0.0
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	0.010 ± 0.002	< 0.13 ± 0.09	16 ± 0	< 0.03 ± 0.01	3.5 ± 0.1
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	< 0.003 ± 0.001	< 0.3 ± 0.05	18 ± 0	< 0.02 ± 0.01	3.9 ± 0.1
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	< 0.003 ± 0.000	< 0.3 ± 0.19	17 ± 0	< 0.02 ± 0.01	3.4 ± 0.0
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	< 0.003 ± 0.001	< 0.3 ± 0.15	17 ± 1	< 0.02 ± 0.01	3.5 ± 0.2
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	0.016 ± 0.004	< 0.2 ± 0.19	20 ± 0	< 0.05 ± 0.01	6.0 ± 0.4
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	0.015 ± 0.002	< 0.2 ± 0.19	20 ± 0	< 0.05 ± 0.03	5.8 ± 0.5
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	0.0099 ± 0.0018	< 0.2 ± 0.00	20 ± 1	< 0.05 ± 0.01	6.1 ± 0.6
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	0.013 ± 0.002	< 0.2 ± 0.15	19 ± 0	< 0.05 ± 0.03	5.8 ± 0.5
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	0.0030 ± 0.0017	< 0.2 ± 0.08	20 ± 0	0.074 ± 0.002	5.1 ± 0.3
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.2 ± 0.21	20 ± 1	< 0.05 ± 0.01	5.4 ± 0.4
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	0.015 ± 0.003	0.15 ± 0.04	23 ± 1	< 0.07 ± 0.01	7.3 ± 0.6
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	0.013 ± 0.004	< 0.09 ± 0.07	23 ± 0	< 0.07 ± 0.03	7.6 ± 0.3
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	0.011 ± 0.005	0.14 ± 0.08	23 ± 0	< 0.03 ± 0.00	7.1 ± 0.1
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	0.0091 ± 0.0016	0.12 ± 0.07	22 ± 1	< 0.07 ± 0.06	7.2 ± 0.7
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	< 0.004 ± 0.001	< 0.09 ± 0.04	22 ± 1	< 0.07 ± 0.02	6.2 ± 0.9
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	< 0.004 ± 0.002	0.10 ± 0.06	22 ± 1	< 0.07 ± 0.02	6.0 ± 0.6
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	0.011 ± 0.002	0.15 ± 0.06	21 ± 1	< 0.04 ± 0.04	6.1 ± 1.1
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	0.012 ± 0.004	0.17 ± 0.02	21 ± 1	< 0.04 ± 0.02	5.8 ± 1.4
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	0.018 ± 0.001	0.088 ± 0.062	22 ± 1	< 0.04 ± 0.01	5.0 ± 0.2
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	0.022 ± 0.001	0.084 ± 0.044	21 ± 0	< 0.04 ± 0.02	4.8 ± 0.0
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	0.0045 ± 0.0010	0.17 ± 0.02	21 ± 1	< 0.04 ± 0.01	5.8 ± 1.2
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	0.0049 ± 0.0015	0.16 ± 0.08	21 ± 1	< 0.04 ± 0.01	6.0 ± 1.0
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	0.0044 ± 0.0029	0.11 ± 0.12	21 ± 0	0.093 ± 0.043	6.2 ± 0.5
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.1 ± 0.20	19 ± 1	< 0.2 ± 0.07	4.4 ± 0.2
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	0.0063 ± 0.0002	< 0.1 ± 0.05	19 ± 1	< 0.2 ± 0.13	4.3 ± 0.1

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP–MS	Selenium (µg/L) ICP–MS	Silica (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	0.0069 ± 0.0017	< 0.1 ± 0.11	18 ± 1	< 0.2 ± 0.16	4.5 ± 0.4
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	0.0061 ± 0.0013	< 0.1 ± 0.07	18 ± 0	< 0.2 ± 0.19	4.6 ± 0.3
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	< 0.003 ± 0.000	< 0.1 ± 0.11	18 ± 0	< 0.2 ± 0.37	4.2 ± 0.5
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.1 ± 0.11	19 ± 1	< 0.2 ± 0.12	4.4 ± 0.2
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	0.0079 ± 0.0014	< 0.07 ± 0.03	19 ± 0	< 0.02 ± 0.03	4.9 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	0.0049 ± 0.0015	0.12 ± 0.04	19 ± 0	< 0.04 ± 0.01	5.0 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	0.0058 ± 0.0012	0.096 ± 0.025	19 ± 0	< 0.01 ± 0.00	4.9 ± 0.0
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	0.0042 ± 0.0022	0.076 ± 0.027	19 ± 0	< 0.04 ± 0.00	4.8 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	< 0.0017 ± 0.0001	0.12 ± 0.06	19 ± 0	< 0.04 ± 0.00	5.0 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	0.0019 ± 0.0006	0.075 ± 0.044	19 ± 0	< 0.01 ± 0.01	5.0 ± 0.0
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	0.011 ± 0.001	0.13 ± 0.10	17 ± 0	< 0.03 ± 0.00	4.1 ± 0.1
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	0.0073 ± 0.0013	< 0.2 ± 0.06	18 ± 0	< 0.02 ± 0.00	4.6 ± 0.1
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	0.0042 ± 0.0013	< 0.3 ± 0.09	17 ± 0	< 0.02 ± 0.01	4.1 ± 0.0
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	0.0035 ± 0.0007	< 0.2 ± 0.11	18 ± 0	< 0.02 ± 0.00	4.8 ± 0.2
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.3 ± 0.08	18 ± 1	< 0.02 ± 0.02	4.3 ± 0.2
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.3 ± 0.12	18 ± 1	< 0.02 ± 0.01	4.5 ± 0.3
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	0.0097 ± 0.0016	< 0.2 ± 0.09	23 ± 1	< 0.05 ± 0.01	6.4 ± 0.4
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	0.0073 ± 0.0005	< 0.2 ± 0.12	22 ± 0	< 0.05 ± 0.01	6.2 ± 0.3
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	0.011 ± 0.002	< 0.2 ± 0.07	22 ± 0	< 0.05 ± 0.01	6.3 ± 0.3
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	0.0074 ± 0.0056	< 0.2 ± 0.17	22 ± 0	< 0.05 ± 0.01	6.4 ± 0.4
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.2 ± 0.15	22 ± 0	< 0.05 ± 0.00	5.8 ± 0.3
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	< 0.003 ± 0.000	< 0.2 ± 0.02	22 ± 0	< 0.05 ± 0.02	5.9 ± 0.3
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	0.010 ± 0.002	0.13 ± 0.11	22 ± 1	< 0.07 ± 0.00	7.3 ± 0.4
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	0.0072 ± 0.0054	0.17 ± 0.18	22 ± 1	< 0.07 ± 0.02	7.5 ± 0.8
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	0.0053 ± 0.0023	< 0.09 ± 0.09	22 ± 1	< 0.07 ± 0.01	7.1 ± 0.6
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	0.0070 ± 0.0028	0.11 ± 0.07	21 ± 1	< 0.07 ± 0.04	6.5 ± 0.1
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	< 0.004 ± 0.003	< 0.09 ± 0.12	22 ± 1	< 0.07 ± 0.03	6.3 ± 0.0
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	< 0.004 ± 0.001	< 0.09 ± 0.09	22 ± 2	< 0.07 ± 0.03	6.5 ± 1.3
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.019 ± 0.003	0.13 ± 0.04	19 ± 1	< 0.04 ± 0.03	5.1 ± 1.2
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.015 ± 0.002	0.097 ± 0.058	18 ± 0	< 0.04 ± 0.01	5.2 ± 1.5
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	0.014 ± 0.001	0.12 ± 0.05	20 ± 1	< 0.04 ± 0.03	4.8 ± 1.2
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.014 ± 0.002	0.11 ± 0.03	18 ± 0	< 0.04 ± 0.01	5.1 ± 0.3

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP–MS	Selenium (µg/L) ICP–MS	Silica (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	0.0058 ± 0.0023	0.10 ± 0.06	18 ± 0	< 0.04 ± 0.01	4.8 ± 1.1
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.0055 ± 0.0021	< 0.07 ± 0.03	19 ± 1	< 0.04 ± 0.01	5.1 ± 0.7
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	0.0062 ± 0.0008	0.17 ± 0.02	19 ± 0	< 0.2 ± 0.13	4.8 ± 0.3
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	0.0039 ± 0.0015	< 0.1 ± 0.12	19 ± 0	< 0.2 ± 0.06	5.2 ± 0.4
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	0.0062 ± 0.0013	< 0.1 ± 0.08	19 ± 1	< 0.2 ± 0.11	5.1 ± 0.4
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	0.0051 ± 0.0019	< 0.1 ± 0.10	18 ± 1	< 0.2 ± 0.14	5.2 ± 0.3
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.1 ± 0.11	18 ± 1	< 0.2 ± 0.18	4.7 ± 0.4
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	< 0.003 ± 0.002	< 0.1 ± 0.17	19 ± 1	< 0.2 ± 0.09	4.8 ± 0.3
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	0.0045 ± 0.0000	0.15 ± 0.04	19 ± 0	< 0.04 ± 0.00	5.5 ± 0.0
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	0.0075 ± 0.0004	0.13 ± 0.02	19 ± 0	< 0.04 ± 0.01	5.6 ± 0.1
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.0044 ± 0.0013	0.13 ± 0.02	19 ± 0	< 0.02 ± 0.01	5.5 ± 0.2
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.3 ± 0.08	19 ± 1	< 0.02 ± 0.04	6.1 ± 0.4
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	0.0038 ± 0.0040	< 0.3 ± 0.03	20 ± 0	0.035 ± 0.003	6.4 ± 0.1
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	< 0.003 ± 0.002	< 0.3 ± 0.05	19 ± 0	< 0.02 ± 0.01	6.3 ± 0.5
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	0.0081 ± 0.0016	< 0.2 ± 0.11	20 ± 0	< 0.02 ± 0.00	6.6 ± 0.1
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.3 ± 0.11	20 ± 0	< 0.02 ± 0.01	6.1 ± 0.4
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.3 ± 0.11	18 ± 2	< 0.02 ± 0.00	5.3 ± 0.9
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.16 ± 0.12	22 ± 1	< 0.05 ± 0.02	7.6 ± 0.2
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	0.0062 ± 0.0029	< 0.16 ± 0.04	22 ± 0	< 0.05 ± 0.02	7.8 ± 0.1
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	0.0039 ± 0.0010	< 0.16 ± 0.10	23 ± 0	< 0.05 ± 0.02	7.7 ± 0.2
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	< 0.003 ± 0.001	< 0.16 ± 0.17	22 ± 1	< 0.05 ± 0.01	7.9 ± 0.4
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.16 ± 0.12	22 ± 0	< 0.05 ± 0.04	7.1 ± 0.3
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	< 0.003 ± 0.002	< 0.16 ± 0.09	22 ± 0	< 0.05 ± 0.01	7.2 ± 0.2
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	0.0050 ± 0.0029	< 0.09 ± 0.03	21 ± 3	< 0.07 ± 0.01	6.9 ± 1.5
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	0.0078 ± 0.0049	0.17 ± 0.09	23 ± 4	< 0.07 ± 0.03	7.5 ± 1.5
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	0.0062 ± 0.0018	< 0.11 ± 0.05	24 ± 3	< 0.03 ± 0.01	8.2 ± 1.4
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	0.0040 ± 0.0027	0.094 ± 0.061	22 ± 0	0.078 ± 0.103	5.7 ± 0.6
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	0.0024 ± 0.0017	< 0.11 ± 0.01	22 ± 3	< 0.03 ± 0.01	6.8 ± 1.3
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	< 0.004 ± 0.002	< 0.09 ± 0.03	21 ± 4	< 0.07 ± 0.01	5.5 ± 0.5
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	0.011 ± 0.003	0.13 ± 0.07	16 ± 1	< 0.03 ± 0.03	4.2 ± 0.7
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	0.017 ± 0.001	0.13 ± 0.05	15 ± 0	< 0.03 ± 0.01	4.1 ± 1.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP-MS	Selenium (µg/L) ICP-MS	Silica (mg/L) ICP-AES	Silver (µg/L) ICP-MS	Sodium (mg/L) ICP-AES
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	0.018 ± 0.004	0.17 ± 0.04	16 ± 1	< 0.03 ± 0.02	4.6 ± 1.0
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	0.017 ± 0.001	0.13 ± 0.08	16 ± 1	< 0.03 ± 0.01	4.5 ± 1.1
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	0.0067 ± 0.0018	< 0.07 ± 0.03	16 ± 1	< 0.04 ± 0.03	4.3 ± 1.2
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	0.0080 ± 0.0031	0.16 ± 0.06	16 ± 1	< 0.03 ± 0.01	4.8 ± 0.9
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.1 ± 0.12	19 ± 0	< 0.2 ± 0.04	6.8 ± 2.9
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	0.0054 ± 0.0026	< 0.1 ± 0.08	19 ± 0	< 0.2 ± 0.09	5.7 ± 0.3
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	0.0057 ± 0.0013	< 0.1 ± 0.12	19 ± 0	< 0.2 ± 0.10	6.5 ± 1.5
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	< 0.003 ± 0.000	< 0.1 ± 0.18	19 ± 0	< 0.2 ± 0.12	6.1 ± 0.7
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.1 ± 0.06	19 ± 0	< 0.2 ± 0.14	5.7 ± 0.7
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	0.0034 ± 0.0021	< 0.1 ± 0.15	19 ± 1	< 0.2 ± 0.05	5.5 ± 0.8
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	< 0.003 ± 0.001	< 0.07 ± 0.04	15 ± 0	< 0.02 ± 0.01	4.8 ± 0.0
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	0.0072 ± 0.0003	0.12 ± 0.01	16 ± 1	< 0.01 ± 0.00	5.0 ± 0.1
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.0045 ± 0.0011	0.12 ± 0.00	16 ± 0	< 0.01 ± 0.00	5.1 ± 0.2
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.0025 ± 0.0002	0.10 ± 0.03	16 ± 0	< 0.01 ± 0.01	5.0 ± 0.3
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	< 0.0017 ± 0.0006	< 0.06 ± 0.04	17 ± 1	< 0.04 ± 0.00	5.2 ± 0.3
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	< 0.0017 ± 0.0008	0.10 ± 0.02	17 ± 1	< 0.01 ± 0.01	5.4 ± 0.1
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	0.011 ± 0.000	< 0.2 ± 0.13	18 ± 1	< 0.02 ± 0.00	8.0 ± 0.6
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	< 0.003 ± 0.001	< 0.2 ± 0.05	19 ± 0	< 0.02 ± 0.00	9.2 ± 0.0
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	0.0052 ± 0.0032	< 0.2 ± 0.11	18 ± 1	< 0.02 ± 0.00	8.7 ± 0.4
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	< 0.003 ± 0.004	< 0.2 ± 0.13	17 ± 0	< 0.02 ± 0.00	7.8 ± 0.1
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	< 0.003 ± 0.003	< 0.3 ± 0.02	18 ± 0	< 0.02 ± 0.02	7.8 ± 0.3
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.3 ± 0.06	18 ± 0	< 0.02 ± 0.03	7.9 ± 0.0
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	0.0082 ± 0.0029	< 0.16 ± 0.07	20 ± 0	< 0.05 ± 0.03	11 ± 0
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	0.0088 ± 0.0002	< 0.16 ± 0.08	20 ± 1	< 0.05 ± 0.03	11 ± 1
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.0088 ± 0.0018	< 0.11 ± 0.04	17 ± 2	< 0.03 ± 0.00	5.5 ± 0.7
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.0069 ± 0.0015	0.15 ± 0.02	18 ± 0	< 0.07 ± 0.05	5.7 ± 0.3
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.0064 ± 0.0015	< 0.09 ± 0.11	18 ± 0	< 0.07 ± 0.01	5.7 ± 0.0
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.010 ± 0.004	< 0.09 ± 0.09	18 ± 0	< 0.07 ± 0.03	5.2 ± 0.8
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	< 0.004 ± 0.001	< 0.09 ± 0.12	18 ± 1	< 0.07 ± 0.04	5.3 ± 0.3
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	< 0.004 ± 0.002	0.093 ± 0.070	18 ± 0	< 0.07 ± 0.04	5.5 ± 0.2

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP–MS	Selenium (µg/L) ICP–MS	Silica (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	< 0.003 ± 0.003	< 0.1 ± 0.13	18 ± 0	< 0.2 ± 0.09	7.8 ± 0.5
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	< 0.003 ± 0.001	< 0.1 ± 0.08	18 ± 1	< 0.2 ± 0.04	7.8 ± 0.4
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	< 0.003 ± 0.000	< 0.1 ± 0.09	18 ± 1	< 0.2 ± 0.08	7.8 ± 0.5
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	0.0039 ± 0.0021	< 0.1 ± 0.08	18 ± 1	< 0.2 ± 0.19	7.3 ± 0.4
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.1 ± 0.16	18 ± 1	< 0.2 ± 0.13	7.3 ± 1.4
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	< 0.003 ± 0.002	< 0.1 ± 0.07	18 ± 1	< 0.2 ± 0.05	7.6 ± 0.3
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.0020 ± 0.0004	< 0.06 ± 0.05	15 ± 0	< 0.04 ± 0.00	4.6 ± 0.1
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	0.0017 ± 0.0017	0.086 ± 0.038	15 ± 0	< 0.04 ± 0.00	4.7 ± 0.1
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	0.0081 ± 0.0001	< 0.07 ± 0.08	16 ± 0	< 0.02 ± 0.01	5.1 ± 0.1
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.0057 ± 0.0009	0.067 ± 0.070	16 ± 1	< 0.04 ± 0.00	4.9 ± 0.3
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	< 0.0017 ± 0.0004	0.090 ± 0.003	16 ± 1	< 0.01 ± 0.00	4.6 ± 0.3
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	< 0.0017 ± 0.0010	0.085 ± 0.014	16 ± 0	< 0.01 ± 0.00	4.9 ± 0.2
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	< 0.003 ± 0.002	< 0.3 ± 0.02	16 ± 0	< 0.02 ± 0.03	7.8 ± 0.2
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	< 0.003 ± 0.001	< 0.3 ± 0.04	17 ± 1	0.057 ± 0.095	8.6 ± 0.5
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	< 0.006 ± 0.002	< 0.13 ± 0.13	17 ± 0	0.029 ± 0.042	9.0 ± 0.4
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	< 0.003 ± 0.002	< 0.3 ± 0.14	17 ± 1	< 0.02 ± 0.00	8.1 ± 0.1
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.2 ± 0.16	15 ± 1	< 0.02 ± 0.01	7.4 ± 0.1
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	< 0.006 ± 0.001	< 0.13 ± 0.12	17 ± 0	< 0.03 ± 0.01	8.2 ± 0.1
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	< 0.003 ± 0.001	< 0.16 ± 0.12	18 ± 0	< 0.05 ± 0.05	7.0 ± 0.4
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	< 0.003 ± 0.003	< 0.16 ± 0.13	18 ± 0	< 0.05 ± 0.02	7.1 ± 0.2
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	0.0036 ± 0.0032	< 0.16 ± 0.07	18 ± 0	< 0.05 ± 0.01	7.0 ± 0.2
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	< 0.003 ± 0.002	< 0.16 ± 0.04	18 ± 0	< 0.05 ± 0.01	7.1 ± 0.2
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.16 ± 0.06	18 ± 0	< 0.05 ± 0.02	6.5 ± 0.2
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.16 ± 0.11	17 ± 1	< 0.05 ± 0.04	6.2 ± 0.4
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	0.0053 ± 0.0023	< 0.09 ± 0.12	15 ± 0	< 0.07 ± 0.02	3.5 ± 0.3
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.0066 ± 0.0007	< 0.09 ± 0.04	15 ± 0	< 0.07 ± 0.05	4.8 ± 1.5
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.0096 ± 0.0057	< 0.09 ± 0.03	15 ± 0	< 0.07 ± 0.05	4.7 ± 1.4
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.011 ± 0.003	< 0.09 ± 0.09	15 ± 0	< 0.07 ± 0.00	4.6 ± 1.5
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	< 0.004 ± 0.003	0.19 ± 0.05	15 ± 0	< 0.07 ± 0.01	4.5 ± 1.1
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.0060 ± 0.0039	< 0.09 ± 0.06	15 ± 0	< 0.07 ± 0.03	4.2 ± 1.1
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.033 ± 0.001	0.076 ± 0.065	8.9 ± 0.5	< 0.04 ± 0.02	1.6 ± 0.1
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.020 ± 0.005	< 0.07 ± 0.01	9.0 ± 0.2	< 0.04 ± 0.00	1.9 ± 0.4

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP-MS	Selenium (µg/L) ICP-MS	Silica (mg/L) ICP-AES	Silver (µg/L) ICP-MS	Sodium (mg/L) ICP-AES
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	0.027 ± 0.005	0.085 ± 0.069	8.9 ± 0.4	< 0.04 ± 0.00	1.9 ± 0.3
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.030 ± 0.006	< 0.07 ± 0.02	9.4 ± 0.4	< 0.04 ± 0.00	1.9 ± 0.2
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	0.0070 ± 0.0038	< 0.07 ± 0.02	9.4 ± 0.4	< 0.04 ± 0.01	1.7 ± 0.3
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.0036 ± 0.0009	< 0.07 ± 0.03	9.3 ± 0.3	< 0.04 ± 0.02	1.8 ± 0.3
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	0.0035 ± 0.0027	< 0.1 ± 0.11	16 ± 1	< 0.2 ± 0.09	6.6 ± 0.4
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	< 0.003 ± 0.001	< 0.1 ± 0.08	16 ± 0	< 0.2 ± 0.15	6.5 ± 0.8
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	0.0034 ± 0.0017	< 0.1 ± 0.08	16 ± 1	< 0.2 ± 0.06	6.4 ± 0.9
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	< 0.003 ± 0.002	< 0.1 ± 0.09	16 ± 0	< 0.2 ± 0.12	6.2 ± 0.3
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	< 0.003 ± 0.003	< 0.1 ± 0.05	16 ± 0	< 0.2 ± 0.17	5.2 ± 0.3
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	< 0.003 ± 0.002	< 0.1 ± 0.12	16 ± 1	< 0.2 ± 0.09	5.3 ± 0.3
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	0.0059 ± 0.0011	< 0.08 ± 0.03	16 ± 1	< 0.2 ± 0.13	6.6 ± 0.4
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.0039 ± 0.0010	< 0.08 ± 0.09	17 ± 1	< 0.2 ± 0.14	6.3 ± 0.1
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	0.0040 ± 0.0010	< 0.08 ± 0.04	17 ± 1	< 0.2 ± 0.15	5.2 ± 1.4
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	0.0036 ± 0.0005	0.096 ± 0.036	17 ± 1	< 0.2 ± 0.17	5.5 ± 0.6
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.08 ± 0.08	16 ± 1	< 0.2 ± 0.18	5.2 ± 1.4
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	< 0.003 ± 0.003	< 0.08 ± 0.08	16 ± 1	< 0.2 ± 0.25	5.4 ± 0.4
Flat Cr.	12/11/96	0.40 µm Mem	1/2	0.041 ± 0.001	0.27 ± 0.07	11 ± 0	< 0.03 ± 0.01	1.7 ± 0.1
Flat Cr.	12/11/96	0.40 µm Mem	2/2	0.037 ± 0.008	< 0.11 ± 0.11	11 ± 0	< 0.03 ± 0.02	1.8 ± 0.1
Flat Cr.	12/11/96	0.45 µm Cap	1/2	0.028 ± 0.000	0.098 ± 0.079	11 ± 0	< 0.07 ± 0.05	1.9 ± 0.3
Flat Cr.	12/11/96	0.45 µm Cap	2/2	0.033 ± 0.002	0.13 ± 0.10	11 ± 0	< 0.03 ± 0.00	2.0 ± 0.3
Flat Cr.	12/11/96	10 kd Tan	1/2	0.018 ± 0.001	< 0.09 ± 0.09	11 ± 0	< 0.07 ± 0.02	1.8 ± 0.2
Flat Cr.	12/11/96	10 kd Tan	2/2	0.016 ± 0.001	< 0.11 ± 0.06	11 ± 0	< 0.03 ± 0.01	1.8 ± 0.1
Flat Cr.	05/29/97	0.40 µm Mem	1/2	0.020 ± 0.001	0.16 ± 0.07	23 ± 1	< 0.2 ± 0.09	5.9 ± 0.2
Flat Cr.	05/29/97	0.40 µm Mem	2/2	0.018 ± 0.000	< 0.1 ± 0.02	23 ± 1	< 0.2 ± 0.05	5.5 ± 0.1
Flat Cr.	05/29/97	0.45 mm Cap	1/2	0.014 ± 0.004	0.17 ± 0.07	23 ± 1	< 0.2 ± 0.07	7.5 ± 1.2
Flat Cr.	05/29/97	0.45 µm Cap	2/2	0.011 ± 0.001	< 0.1 ± 0.09	23 ± 1	< 0.2 ± 0.10	6.9 ± 0.1
Flat Cr.	05/29/97	10 kd Tan	1/2	0.0045 ± 0.0034	< 0.1 ± 0.18	24 ± 1	< 0.2 ± 0.11	6.5 ± 0.7
Flat Cr.	05/29/97	10 kd Tan	2/2	< 0.003 ± 0.002	0.14 ± 0.06	22 ± 2	< 0.2 ± 0.12	8.8 ± 1.0
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	1.8 ± 0.0	0.56 ± 0.02	13 ± 0	< 0.07 ± 0.02	2.7 ± 0.2
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	1.9 ± 0.0	0.61 ± 0.04	13 ± 0	< 0.07 ± 0.02	2.5 ± 0.5
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	1.8 ± 0.0	0.68 ± 0.17	13 ± 0	< 0.07 ± 0.05	3.1 ± 0.1
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	1.8 ± 0.0	0.61 ± 0.17	13 ± 0	< 0.07 ± 0.04	2.5 ± 0.5
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	1.8 ± 0.1	0.88 ± 0.05	13 ± 0	< 0.03 ± 0.02	2.6 ± 0.3

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP–MS	Selenium (µg/L) ICP–MS	Silica (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	1.9 ± 0.0	0.74 ± 0.00	13 ± 0	< 0.07 ± 0.00	2.7 ± 0.3
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	3.0 ± 0.1	1.6 ± 0.2	26 ± 1	< 0.2 ± 0.06	8.2 ± 0.6
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	2.9 ± 0.0	1.7 ± 0.0	26 ± 1	< 0.2 ± 0.07	8.7 ± 0.5
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	2.9 ± 0.2	1.6 ± 0.1	25 ± 0	< 0.2 ± 0.10	7.1 ± 0.4
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	2.8 ± 0.1	1.6 ± 0.1	25 ± 1	< 0.2 ± 0.11	7.7 ± 0.2
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	2.8 ± 0.0	1.6 ± 0.1	26 ± 0	< 0.2 ± 0.14	7.1 ± 0.5
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	2.9 ± 0.1	1.4 ± 0.0	26 ± 0	< 0.2 ± 0.27	6.8 ± 0.1
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	1.2 ± 0.0	0.84 ± 0.03	12 ± 0	0.048 ± 0.029	2.4 ± 0.2
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	1.2 ± 0.0	0.91 ± 0.06	11 ± 0	< 0.04 ± 0.02	2.2 ± 0.2
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	1.3 ± 0.1	0.83 ± 0.02	12 ± 0	< 0.04 ± 0.02	2.4 ± 0.3
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	1.3 ± 0.1	0.94 ± 0.09	11 ± 0	0.052 ± 0.029	2.3 ± 0.2
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	1.2 ± 0.1	0.69 ± 0.06	11 ± 0	< 0.04 ± 0.03	2.4 ± 0.3
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	1.2 ± 0.0	0.67 ± 0.01	11 ± 0	0.058 ± 0.006	2.1 ± 0.1
Whiskeytown	12/11/96	0.40 µm Mem	1/2	0.0043 ± 0.0013	< 0.09 ± 0.00	12 ± 0	< 0.07 ± 0.03	1.8 ± 0.1
Whiskeytown	12/11/96	0.40 µm Mem	2/2	0.0049 ± 0.0027	< 0.11 ± 0.04	12 ± 0	< 0.03 ± 0.04	1.8 ± 0.1
Whiskeytown	12/11/96	0.45 µm Cap	1/2	0.0061 ± 0.0020	< 0.11 ± 0.05	12 ± 0	< 0.03 ± 0.01	1.7 ± 0.1
Whiskeytown	12/11/96	0.45 µm Cap	2/2	0.0055 ± 0.0037	< 0.09 ± 0.01	12 ± 0	< 0.07 ± 0.01	2.2 ± 0.3
Whiskeytown	12/11/96	10 kd Tan	1/2	< 0.0016 ± 0.0016	< 0.11 ± 0.08	12 ± 0	< 0.03 ± 0.02	1.9 ± 0.2
Whiskeytown	12/11/96	10 kd Tan	2/2	< 0.004 ± 0.002	< 0.09 ± 0.05	13 ± 0	< 0.07 ± 0.01	1.9 ± 0.3
Whiskeytown	05/29/97	0.40 µm Mem	1/2	0.0032 ± 0.0032	< 0.1 ± 0.11	13 ± 1	< 0.2 ± 0.09	1.9 ± 0.1
Whiskeytown	05/29/97	0.40 µm Mem	2/2	0.0042 ± 0.0025	< 0.1 ± 0.14	13 ± 1	< 0.2 ± 0.11	1.8 ± 0.5
Whiskeytown	05/29/97	0.45 µm Cap	1/2	0.0046 ± 0.0040	< 0.1 ± 0.22	13 ± 1	< 0.2 ± 0.10	1.8 ± 0.4
Whiskeytown	05/29/97	0.45 µm Cap	2/2	0.0049 ± 0.0026	< 0.1 ± 0.25	12 ± 1	< 0.2 ± 0.12	1.8 ± 0.2
Whiskeytown	05/29/97	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.1 ± 0.17	12 ± 1	< 0.2 ± 0.12	1.8 ± 0.1
Whiskeytown	05/29/97	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.1 ± 0.21	12 ± 0	< 0.2 ± 0.12	1.8 ± 0.2
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	0.0047 ± 0.0005	< 0.06 ± 0.05	— ± —	< 0.04 ± 0.00	— ± —
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	0.0040 ± 0.0007	0.047 ± 0.010	12 ± 0	< 0.01 ± 0.01	1.7 ± 0.0
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	0.010 ± 0.000	< 0.07 ± 0.07	12 ± 0	< 0.02 ± 0.00	1.7 ± 0.0
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	0.0078 ± 0.0018	< 0.07 ± 0.04	12 ± 0	< 0.02 ± 0.01	1.7 ± 0.1
Spring Cr. arm	07/12/96	10 kd Tan	1/3	< 0.003 ± 0.001	< 0.07 ± 0.04	12 ± 0	< 0.02 ± 0.01	1.7 ± 0.0
Spring Cr. arm	07/12/96	10 kd Tan	2/3	< 0.0017 ± 0.0003	0.068 ± 0.050	12 ± 0	< 0.04 ± 0.02	1.7 ± 0.0
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	0.0091 ± 0.0048	< 0.3 ± 0.10	12 ± 0	< 0.02 ± 0.00	1.6 ± 0.0
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	0.010 ± 0.008	< 0.3 ± 0.08	12 ± 1	0.035 ± 0.002	1.8 ± 0.0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Samarium (µg/L) ICP–MS	Selenium (µg/L) ICP–MS	Silica (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	0.011 ± 0.002	< 0.3 ± 0.04	12 ± 1	< 0.02 ± 0.01	1.7 ± 0.1
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	0.0074 ± 0.0008	< 0.3 ± 0.01	12 ± 0	< 0.02 ± 0.00	1.7 ± 0.2
Spring Cr. arm	09/18/96	10 kd Tan	1/2	< 0.003 ± 0.001	< 0.3 ± 0.17	12 ± 1	< 0.02 ± 0.01	1.6 ± 0.1
Spring Cr. arm	09/18/96	10 kd Tan	2/2	< 0.003 ± 0.002	< 0.3 ± 0.04	11 ± 0	< 0.02 ± 0.00	1.5 ± 0.1
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	0.026 ± 0.003	< 0.2 ± 0.00	12 ± 0	< 0.05 ± 0.03	2.2 ± 0.2
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	0.020 ± 0.003	< 0.2 ± 0.06	12 ± 0	< 0.05 ± 0.01	2.2 ± 0.2
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	0.028 ± 0.001	< 0.2 ± 0.12	12 ± 1	< 0.05 ± 0.01	2.2 ± 0.2
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	0.026 ± 0.000	< 0.2 ± 0.03	13 ± 0	< 0.05 ± 0.02	2.4 ± 0.3
Spring Cr. arm	11/20/96	10 kd Tan	1/2	0.0049 ± 0.0014	< 0.2 ± 0.11	12 ± 0	< 0.05 ± 0.00	2.1 ± 0.2
Spring Cr. arm	11/20/96	10 kd Tan	2/2	0.0092 ± 0.0019	< 0.2 ± 0.21	12 ± 0	0.068 ± 0.103	2.0 ± 0.1
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	0.031 ± 0.004	< 0.11 ± 0.07	12 ± 0	< 0.03 ± 0.01	2.7 ± 0.4
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	0.030 ± 0.006	0.22 ± 0.12	12 ± 0	< 0.03 ± 0.01	2.5 ± 0.5
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	0.051 ± 0.006	0.10 ± 0.05	12 ± 0	< 0.07 ± 0.01	2.7 ± 0.6
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	0.054 ± 0.004	0.11 ± 0.05	12 ± 0	< 0.07 ± 0.04	2.5 ± 0.5
Spring Cr. arm	12/11/96	10 kd Tan	1/2	0.011 ± 0.001	< 0.09 ± 0.09	12 ± 0	< 0.07 ± 0.03	2.2 ± 0.4
Spring Cr. arm	12/11/96	10 kd Tan	2/2	0.0093 ± 0.0028	0.12 ± 0.04	12 ± 0	< 0.03 ± 0.01	2.0 ± 0.3
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	0.0066 ± 0.0032	< 0.1 ± 0.02	13 ± 1	< 0.2 ± 0.04	1.8 ± 0.3
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	0.0064 ± 0.0029	< 0.1 ± 0.13	13 ± 1	< 0.2 ± 0.05	2.1 ± 0.5
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	0.0090 ± 0.0009	< 0.1 ± 0.13	13 ± 1	< 0.2 ± 0.22	1.9 ± 0.5
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	0.0082 ± 0.0027	< 0.1 ± 0.07	13 ± 0	< 0.2 ± 0.06	2.2 ± 0.9
Spring Cr. arm	05/28/97	10 kd Tan	1/2	< 0.003 ± 0.002	< 0.1 ± 0.13	13 ± 0	< 0.2 ± 0.05	1.6 ± 0.5
Spring Cr. arm	05/28/97	10 kd Tan	2/2	< 0.003 ± 0.001	< 0.1 ± 0.05	13 ± 0	< 0.2 ± 0.07	1.8 ± 0.5
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	0.0038 ± 0.0030	0.40 ± 0.18	20 ± 1	< 0.2 ± 0.07	93 ± 1
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	0.010 ± 0.004	0.35 ± 0.04	20 ± 1	< 0.2 ± 0.15	86 ± 5
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	0.0074 ± 0.0026	0.40 ± 0.07	20 ± 1	< 0.2 ± 0.04	91 ± 3
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	0.0054 ± 0.0035	0.39 ± 0.03	21 ± 1	< 0.2 ± 0.16	87 ± 3
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	< 0.003 ± 0.001	0.35 ± 0.04	20 ± 1	< 0.2 ± 0.17	68 ± 1
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	0.0036 ± 0.0015	0.30 ± 0.07	20 ± 1	< 0.2 ± 0.07	64 ± 16
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	0.013 ± 0.003	0.11 ± 0.01	15 ± 0	< 0.04 ± 0.01	4.7 ± 0.5
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	0.0084 ± 0.0040	0.17 ± 0.00	15 ± 0	< 0.03 ± 0.01	4.5 ± 0.1
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	0.017 ± 0.001	0.12 ± 0.03	16 ± 0	< 0.03 ± 0.01	4.8 ± 0.7
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	0.015 ± 0.002	< 0.07 ± 0.03	14 ± 0	< 0.03 ± 0.01	4.4 ± 0.2
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.0065 ± 0.0021	0.13 ± 0.04	14 ± 0	< 0.03 ± 0.02	3.8 ± 0.0
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.0040 ± 0.0020	0.13 ± 0.05	14 ± 0	< 0.03 ± 0.01	4.0 ± 0.2

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP-MS	Terbium (µg/L) ICP-MS	Thallium (µg/L) ICP-MS	Thorium (µg/L) ICP-MS	Thulium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	52 ± 0	0.0014 ± 0.0002	0.0021 ± 0.0007	— ± —	0.00076 ± 0.00028
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	53 ± 0	0.00097 ± 0.00010	0.0023 ± 0.0006	— ± —	0.00061 ± 0.00003
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	52 ± 1	0.0011 ± 0.0000	0.0018 ± 0.0003	— ± —	0.00051 ± 0.00007
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	51 ± 0	0.0014 ± 0.0001	0.0024 ± 0.0003	— ± —	0.00091 ± 0.00007
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	51 ± 0	0.00072 ± 0.00001	0.0027 ± 0.0003	— ± —	0.00029 ± 0.00006
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	49 ± 0	0.00052 ± 0.00023	< 0.0014 ± 0.0003	— ± —	0.00089 ± 0.00012
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	52 ± 0	0.0023 ± 0.0004	< 0.005 ± 0.001	< 0.003 ± 0.000	0.00097 ± 0.00031
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	51 ± 1	0.0028 ± 0.0003	< 0.005 ± 0.002	< 0.003 ± 0.001	0.00083 ± 0.00023
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	50 ± 0	0.0014 ± 0.0004	< 0.005 ± 0.000	< 0.003 ± 0.000	0.00081 ± 0.00029
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	51 ± 1	0.00085 ± 0.00007	0.0023 ± 0.0010	< 0.003 ± 0.000	0.00066 ± 0.00084
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	48 ± 1	0.00069 ± 0.00003	< 0.002 ± 0.002	< 0.003 ± 0.001	< 0.0005 ± 0.0008
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	46 ± 0	0.00088 ± 0.00026	< 0.005 ± 0.000	< 0.003 ± 0.001	< 0.0005 ± 0.0002
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	55 ± 0	0.00086 ± 0.00015	< 0.005 ± 0.000	— ± —	0.00053 ± 0.00016
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	55 ± 1	< 0.0005 ± 0.0004	< 0.005 ± 0.003	— ± —	0.00053 ± 0.00026
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	55 ± 0	0.00083 ± 0.00053	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0003
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	56 ± 1	< 0.0005 ± 0.0004	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0000
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	49 ± 2	< 0.0005 ± 0.0003	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0002
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	49 ± 1	< 0.0005 ± 0.0003	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0000
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	55 ± —	0.00072 ± 0.00023	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0001
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	56 ± 0	0.00068 ± 0.00011	< 0.004 ± 0.000	— ± —	< 0.0006 ± 0.0005
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	56 ± 0	0.00059 ± 0.00010	< 0.004 ± 0.000	— ± —	0.00057 ± 0.00010
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	56 ± 1	0.0013 ± 0.0006	< 0.004 ± 0.001	— ± —	0.00046 ± 0.00019
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	49 ± 0	< 0.0003 ± 0.0002	< 0.004 ± 0.001	— ± —	< 0.0002 ± 0.0000
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	49 ± 0	< 0.0005 ± 0.0002	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0002
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	53 ± 0	0.0016 ± 0.0003	< 0.008 ± 0.000	— ± —	0.00097 ± 0.00022
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	52 ± 1	0.0013 ± 0.0001	< 0.008 ± 0.002	— ± —	0.00047 ± 0.00010
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	50 ± 2	0.0013 ± 0.0005	< 0.008 ± 0.001	— ± —	0.00049 ± 0.00018
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	51 ± 2	0.00085 ± 0.00012	< 0.008 ± 0.001	— ± —	0.00087 ± 0.00030
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	43 ± 2	< 0.0007 ± 0.0003	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0002
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	42 ± 1	< 0.0007 ± 0.0002	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0001
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	43 ± 0	0.00084 ± 0.00014	0.0015 ± 0.0004	— ± —	0.00059 ± 0.00021

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP-MS	Terbium (µg/L) ICP-MS	Thallium (µg/L) ICP-MS	Thorium (µg/L) ICP-MS	Thulium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	44 ± 0	0.0012 ± 0.0001	0.0019 ± 0.0003	— ± —	0.00067 ± 0.00007
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	44 ± 1	0.0012 ± 0.0001	0.0018 ± 0.0001	— ± —	0.00033 ± 0.00006
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	44 ± 0	0.0014 ± 0.0001	0.0012 ± 0.0002	— ± —	0.00067 ± 0.00003
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	43 ± 2	0.00060 ± 0.00013	0.0016 ± 0.0005	— ± —	0.00025 ± 0.00010
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	44 ± 1	0.00072 ± 0.00019	0.0018 ± 0.0005	— ± —	0.00040 ± 0.00013
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	42 ± 1	0.00068 ± 0.00017	0.0024 ± 0.0001	— ± —	0.00033 ± 0.00000
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	38 ± 0	0.0020 ± 0.0005	< 0.005 ± 0.001	< 0.003 ± 0.001	0.00056 ± 0.00025
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	39 ± 1	0.00072 ± 0.00026	< 0.002 ± 0.000	< 0.003 ± 0.001	0.00070 ± 0.00017
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	39 ± 1	0.0018 ± 0.0009	< 0.002 ± 0.002	< 0.003 ± 0.000	0.00056 ± 0.00028
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	38 ± 1	0.0015 ± 0.0004	0.0026 ± 0.0026	< 0.003 ± 0.001	< 0.0005 ± 0.0003
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	32 ± 0	< 0.0008 ± 0.0004	< 0.005 ± 0.002	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	33 ± 0	0.00084 ± 0.00032	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	33 ± 0	< 0.0008 ± 0.0004	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	47 ± 1	0.0022 ± 0.0006	< 0.005 ± 0.002	— ± —	0.0013 ± 0.0004
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	47 ± 2	0.0027 ± 0.0000	< 0.005 ± 0.001	— ± —	0.0015 ± 0.0001
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	45 ± 2	0.0025 ± 0.0005	< 0.005 ± 0.002	— ± —	0.00091 ± 0.00007
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	46 ± 2	0.0024 ± 0.0004	< 0.005 ± 0.001	— ± —	0.0014 ± 0.0006
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	39 ± 1	< 0.0005 ± 0.0005	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0001
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	39 ± 1	0.00059 ± 0.00016	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0002
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	52 ± 0	0.0026 ± 0.0006	< 0.004 ± 0.001	— ± —	0.00077 ± 0.00047
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	52 ± 2	0.0021 ± 0.0011	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0002
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	51 ± 0	0.0027 ± 0.0002	< 0.004 ± 0.002	— ± —	0.00049 ± 0.00022
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	51 ± 2	0.0029 ± 0.0010	< 0.004 ± 0.002	— ± —	0.0010 ± 0.0002
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	42 ± 1	< 0.0005 ± 0.0006	< 0.004 ± 0.003	— ± —	< 0.0006 ± 0.0002
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	42 ± 0	< 0.0005 ± 0.0003	< 0.004 ± 0.003	— ± —	< 0.0006 ± 0.0001
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	49 ± 1	0.0018 ± 0.0008	< 0.004 ± 0.002	— ± —	0.00067 ± 0.00033
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	51 ± 3	0.0020 ± 0.0005	< 0.004 ± 0.000	— ± —	0.00063 ± 0.00072
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	48 ± 2	0.0041 ± 0.0010	< 0.004 ± 0.002	— ± —	0.0012 ± 0.0004
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	50 ± 2	0.0033 ± 0.0006	< 0.004 ± 0.002	— ± —	0.00083 ± 0.00051
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	47 ± 2	0.00064 ± 0.00061	< 0.004 ± 0.002	— ± —	0.00042 ± 0.00010
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	46 ± 2	0.0011 ± 0.0002	< 0.004 ± 0.002	— ± —	0.00047 ± 0.00039
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	46 ± 0	0.0010 ± 0.0003	< 0.007 ± 0.001	— ± —	0.00077 ± 0.00006
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	43 ± 1	0.00097 ± 0.00034	< 0.008 ± 0.000	— ± —	0.00044 ± 0.00026
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	43 ± 0	0.0014 ± 0.0002	< 0.008 ± 0.001	— ± —	0.00065 ± 0.00002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP-MS	Terbium (µg/L) ICP-MS	Thallium (µg/L) ICP-MS	Thorium (µg/L) ICP-MS	Thulium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	42 ± 1	0.0011 ± 0.0002	< 0.008 ± 0.001	— ± —	0.00035 ± 0.00016
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	43 ± 1	0.0012 ± 0.0002	< 0.008 ± 0.000	— ± —	0.00067 ± 0.00041
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	37 ± 0	< 0.0007 ± 0.0003	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0000
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	38 ± 1	< 0.0007 ± 0.0002	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0001
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	49 ± 0	0.00068 ± 0.00023	0.0018 ± 0.0007	— ± —	< 0.0003 ± 0.0003
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	48 ± 0	0.0011 ± 0.0001	0.0020 ± 0.0010	— ± —	0.00053 ± 0.00012
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	49 ± 0	0.00060 ± 0.00005	0.0012 ± 0.0000	— ± —	0.00043 ± 0.00010
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	49 ± 0	0.00082 ± 0.00000	0.0026 ± 0.0003	— ± —	0.00038 ± 0.00008
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	51 ± 0	0.00018 ± 0.00010	0.0017 ± 0.0001	— ± —	0.00054 ± 0.00010
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	46 ± 0	0.00039 ± 0.00016	0.0023 ± 0.0003	— ± —	< 0.0002 ± 0.0001
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	45 ± 1	0.0010 ± 0.0008	< 0.002 ± 0.000	< 0.003 ± 0.000	< 0.0005 ± 0.0003
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	44 ± 0	0.00073 ± 0.00019	0.0022 ± 0.0012	< 0.0015 ± 0.0004	< 0.0006 ± 0.0003
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	44 ± 0	0.0012 ± 0.0012	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0004
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	44 ± 0	0.0012 ± 0.0005	< 0.0013 ± 0.0012	< 0.0015 ± 0.0004	< 0.0006 ± 0.0002
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	37 ± 0	< 0.0008 ± 0.0001	< 0.005 ± 0.002	< 0.003 ± 0.001	< 0.0005 ± 0.0000
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	38 ± 0	< 0.0008 ± 0.0003	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	67 ± 2	0.0022 ± 0.0002	< 0.005 ± 0.000	— ± —	0.00047 ± 0.00003
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	64 ± 0	0.0012 ± 0.0000	< 0.005 ± 0.001	— ± —	0.00077 ± 0.00005
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	64 ± 1	0.0026 ± 0.0005	< 0.005 ± 0.001	— ± —	0.00067 ± 0.00024
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	66 ± 1	0.0018 ± 0.0003	< 0.005 ± 0.002	— ± —	0.0011 ± 0.0001
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	53 ± 1	< 0.0005 ± 0.0004	< 0.005 ± 0.002	— ± —	< 0.0003 ± 0.0002
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	54 ± 2	< 0.0005 ± 0.0003	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0001
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	59 ± 1	0.0013 ± 0.0004	< 0.004 ± 0.002	— ± —	0.00075 ± 0.00031
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	61 ± 0	0.0019 ± 0.0004	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0005
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	59 ± 1	0.0020 ± 0.0004	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0001
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	57 ± 1	0.0013 ± 0.0006	< 0.004 ± 0.000	— ± —	0.00061 ± 0.00008
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	50 ± 1	< 0.0005 ± 0.0001	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0003
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	49 ± 0	0.00053 ± 0.00055	< 0.004 ± 0.004	— ± —	< 0.0006 ± 0.0001
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	63 ± 2	0.0031 ± 0.0005	< 0.004 ± 0.002	— ± —	0.0012 ± 0.0001
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	62 ± 3	0.0024 ± 0.0008	< 0.004 ± 0.004	— ± —	0.00068 ± 0.00008
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	60 ± 3	0.0030 ± 0.0000	< 0.004 ± 0.004	— ± —	0.0010 ± 0.0003
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	62 ± 2	0.0021 ± 0.0002	< 0.004 ± 0.002	— ± —	0.00087 ± 0.00044

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	55 ± 2	0.00064 ± 0.00027	< 0.004 ± 0.003	— ± —	0.00026 ± 0.00008
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	55 ± 2	0.00049 ± 0.00018	< 0.004 ± 0.002	— ± —	0.00031 ± 0.00005
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	51 ± 0	0.00083 ± 0.00010	< 0.008 ± 0.001	— ± —	0.00052 ± 0.00020
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	51 ± 1	0.00092 ± 0.00019	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0003
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	50 ± 0	0.0013 ± 0.0005	< 0.008 ± 0.001	— ± —	0.00069 ± 0.00027
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	49 ± 1	0.00095 ± 0.00018	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0001
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	44 ± 1	< 0.0007 ± 0.0002	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0003
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	44 ± 1	< 0.0007 ± 0.0003	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0003
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	59 ± 1	0.00071 ± 0.00007	0.0015 ± 0.0001	— ± —	< 0.0003 ± 0.0000
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	60 ± 0	0.00052 ± 0.00008	0.0024 ± 0.0001	— ± —	0.00033 ± 0.00012
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	55 ± 1	0.00070 ± 0.00023	0.0016 ± 0.0014	— ± —	0.00068 ± 0.00003
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	60 ± 1	< 0.0008 ± 0.0004	< 0.005 ± 0.001	< 0.003 ± 0.000	< 0.0005 ± 0.0003
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	59 ± 1	< 0.0008 ± 0.0006	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0002
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	59 ± 1	< 0.0008 ± 0.0002	< 0.005 ± 0.000	< 0.003 ± 0.001	< 0.0005 ± 0.0002
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	61 ± 0	0.00050 ± 0.00012	0.0025 ± 0.0003	< 0.0015 ± 0.0018	< 0.0006 ± 0.0003
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	55 ± 1	< 0.0008 ± 0.0003	< 0.005 ± 0.001	< 0.003 ± 0.002	< 0.0005 ± 0.0003
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	55 ± 0	< 0.0008 ± 0.0002	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0003
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	76 ± 0	0.00060 ± 0.00050	< 0.005 ± 0.002	— ± —	< 0.0003 ± 0.0001
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	75 ± 0	0.00075 ± 0.00027	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0002
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	75 ± 1	0.00057 ± 0.00035	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0000
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	74 ± 1	< 0.0005 ± 0.0001	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0001
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	68 ± 1	< 0.0005 ± 0.0002	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0002
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	70 ± 1	< 0.0005 ± 0.0001	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0002
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	86 ± 1	0.0013 ± 0.0002	< 0.004 ± 0.006	— ± —	0.00078 ± 0.00023
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	88 ± 0	0.0011 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0003
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	84 ± 1	0.0013 ± 0.0001	< 0.004 ± 0.001	— ± —	0.00047 ± 0.00012
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	87 ± 3	< 0.0005 ± 0.0000	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0002
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	73 ± 0	< 0.0003 ± 0.0002	< 0.004 ± 0.000	— ± —	< 0.0002 ± 0.0000
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	73 ± 0	< 0.0005 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0003
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	83 ± 1	0.0019 ± 0.0008	< 0.004 ± 0.002	— ± —	0.00044 ± 0.00034
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	83 ± 2	0.0020 ± 0.0005	< 0.004 ± 0.003	— ± —	0.00067 ± 0.00010

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	86 ± 4	0.0027 ± 0.0007	< 0.004 ± 0.001	— ± —	0.0012 ± 0.0004
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	88 ± 4	0.0027 ± 0.0002	< 0.004 ± 0.001	— ± —	0.0010 ± 0.0004
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	80 ± 3	0.00058 ± 0.00012	< 0.004 ± 0.002	— ± —	0.00035 ± 0.00015
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	81 ± 0	0.0011 ± 0.0002	< 0.004 ± 0.001	— ± —	0.00053 ± 0.00014
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	64 ± 1	0.00079 ± 0.00020	< 0.008 ± 0.000	— ± —	0.00040 ± 0.00023
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	64 ± 1	0.0010 ± 0.0004	< 0.008 ± 0.000	— ± —	0.00044 ± 0.00003
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	64 ± 1	0.00079 ± 0.00019	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0000
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	64 ± 2	< 0.0007 ± 0.0002	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0002
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	60 ± 0	< 0.0007 ± 0.0001	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0003
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	60 ± 2	< 0.0007 ± 0.0005	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0002
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	61 ± 0	0.00033 ± 0.00008	0.0035 ± 0.0016	— ± —	0.00031 ± 0.00021
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	63 ± 2	0.00097 ± 0.00004	0.0018 ± 0.0004	— ± —	0.00057 ± 0.00007
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	64 ± 0	0.00069 ± 0.00005	0.0012 ± 0.0003	— ± —	< 0.0002 ± 0.0001
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	61 ± 0	0.00073 ± 0.00014	0.0021 ± 0.0006	— ± —	0.00039 ± 0.00011
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	59 ± 0	0.00026 ± 0.00006	0.0014 ± 0.0008	— ± —	< 0.0003 ± 0.0001
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	60 ± 0	< 0.0002 ± 0.0001	0.0014 ± 0.0003	— ± —	< 0.0002 ± 0.0001
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	82 ± 0	0.00039 ± 0.00038	0.0023 ± 0.0014	< 0.0015 ± 0.0006	0.00063 ± 0.00008
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	81 ± 0	0.00059 ± 0.00044	< 0.0013 ± 0.0009	< 0.0015 ± 0.0006	< 0.0006 ± 0.0003
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	82 ± 0	0.00081 ± 0.00039	0.0017 ± 0.0017	0.0016 ± 0.0004	< 0.0006 ± 0.0005
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	82 ± 0	0.00054 ± 0.00036	< 0.0013 ± 0.0012	< 0.0015 ± 0.0011	< 0.0006 ± 0.0002
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	75 ± 1	< 0.0008 ± 0.0004	< 0.005 ± 0.000	< 0.003 ± 0.001	< 0.0005 ± 0.0002
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	75 ± 1	< 0.0008 ± 0.0005	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	86 ± 2	0.0014 ± 0.0003	< 0.005 ± 0.000	— ± —	0.00053 ± 0.00003
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	87 ± 2	0.0015 ± 0.0007	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0001
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	72 ± 0	0.0014 ± 0.0003	< 0.004 ± 0.001	— ± —	0.00036 ± 0.00012
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	73 ± 2	0.00093 ± 0.00040	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0004
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	71 ± 1	0.0018 ± 0.0004	< 0.004 ± 0.004	— ± —	< 0.0006 ± 0.0003
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	71 ± 1	0.0013 ± 0.0001	< 0.004 ± 0.000	— ± —	0.00058 ± 0.00026
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	67 ± 2	< 0.0005 ± 0.0002	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0001
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	68 ± 1	< 0.0005 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP-MS	Terbium (µg/L) ICP-MS	Thallium (µg/L) ICP-MS	Thorium (µg/L) ICP-MS	Thulium (µg/L) ICP-MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	84 ± 1	0.0010 ± 0.0005	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0000
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	83 ± 2	< 0.0007 ± 0.0002	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0001
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	81 ± 2	0.00075 ± 0.00025	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0002
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	83 ± 2	< 0.0007 ± 0.0004	< 0.008 ± 0.000	— ± —	0.00055 ± 0.00019
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	70 ± 5	< 0.0007 ± 0.0003	< 0.008 ± 0.001	— ± —	0.00067 ± 0.00007
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	72 ± 3	< 0.0007 ± 0.0004	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0002
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	57 ± 0	0.00032 ± 0.00002	0.00097 ± 0.00073	— ± —	< 0.0003 ± 0.0000
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	57 ± 0	0.00048 ± 0.00017	< 0.0009 ± 0.0001	— ± —	< 0.0003 ± 0.0001
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	62 ± 0	0.00095 ± 0.00015	0.0028 ± 0.0000	— ± —	0.0011 ± 0.0002
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	59 ± 0	0.00068 ± 0.00003	0.0020 ± 0.0003	— ± —	0.00041 ± 0.00003
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	51 ± 0	0.00025 ± 0.00016	0.0015 ± 0.0001	— ± —	< 0.0002 ± 0.0001
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	63 ± 2	0.00026 ± 0.00004	0.0016 ± 0.0004	— ± —	0.00023 ± 0.00016
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	83 ± 1	< 0.0008 ± 0.0004	< 0.005 ± 0.001	< 0.003 ± 0.000	< 0.0005 ± 0.0001
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	83 ± 3	< 0.0008 ± 0.0003	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	86 ± 2	0.00071 ± 0.00050	< 0.002 ± 0.000	< 0.003 ± 0.002	< 0.0005 ± 0.0003
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	83 ± 0	0.0012 ± 0.0006	< 0.005 ± 0.002	< 0.003 ± 0.000	< 0.0005 ± 0.0001
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	72 ± 0	< 0.0004 ± 0.0001	< 0.0013 ± 0.0010	< 0.0015 ± 0.0006	< 0.0006 ± 0.0001
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	73 ± 4	< 0.0005 ± 0.0001	< 0.002 ± 0.001	< 0.003 ± 0.000	< 0.0005 ± 0.0002
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	73 ± 1	0.00060 ± 0.00059	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0002
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	74 ± 1	0.00062 ± 0.00045	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0003
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	73 ± 2	0.00054 ± 0.00045	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0001
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	73 ± 1	< 0.0005 ± 0.0003	< 0.005 ± 0.001	— ± —	0.00066 ± 0.00014
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	62 ± 1	< 0.0005 ± 0.0002	< 0.005 ± 0.000	— ± —	< 0.0003 ± 0.0002
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	62 ± 1	< 0.0005 ± 0.0001	< 0.005 ± 0.003	— ± —	< 0.0003 ± 0.0001
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	61 ± 1	0.0014 ± 0.0005	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0004
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	63 ± 1	0.0015 ± 0.0009	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0004
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	62 ± 2	0.0021 ± 0.0007	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0006
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	62 ± 1	0.0021 ± 0.0004	< 0.004 ± 0.003	— ± —	0.00090 ± 0.00035
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	57 ± 2	0.00086 ± 0.00042	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0002
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	58 ± 2	< 0.0005 ± 0.0003	< 0.004 ± 0.003	— ± —	< 0.0006 ± 0.0005
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	32 ± 1	0.0031 ± 0.0002	< 0.004 ± 0.002	— ± —	0.0015 ± 0.0001
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	33 ± 0	0.0031 ± 0.0007	< 0.004 ± 0.003	— ± —	0.0014 ± 0.0003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	32 ± 1	0.0036 ± 0.0018	< 0.004 ± 0.002	— ± —	0.0016 ± 0.0001
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	34 ± 2	0.0031 ± 0.0002	< 0.004 ± 0.003	— ± —	0.0018 ± 0.0002
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	27 ± 2	0.00094 ± 0.00017	< 0.004 ± 0.002	— ± —	0.00038 ± 0.00024
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	26 ± 1	0.00073 ± 0.00011	< 0.004 ± 0.003	— ± —	0.00054 ± 0.00027
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	70 ± 2	< 0.0007 ± 0.0003	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0000
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	72 ± 0	< 0.0007 ± 0.0004	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0001
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	72 ± 2	< 0.0007 ± 0.0001	< 0.008 ± 0.001	— ± —	0.00042 ± 0.00018
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	71 ± 0	0.00080 ± 0.00034	< 0.008 ± 0.001	— ± —	< 0.0004 ± 0.0002
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	58 ± 3	< 0.0007 ± 0.0001	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0001
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	59 ± 2	< 0.0007 ± 0.0005	< 0.008 ± 0.000	— ± —	< 0.0004 ± 0.0002
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	78 ± 0	0.00064 ± 0.00034	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0003
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	76 ± 3	0.00085 ± 0.00043	< 0.004 ± 0.001	— ± —	0.00040 ± 0.00030
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	78 ± 1	0.00062 ± 0.00042	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	78 ± 4	< 0.0004 ± 0.0005	< 0.004 ± 0.002	— ± —	0.00049 ± 0.00013
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	63 ± 2	< 0.0004 ± 0.0002	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0004
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	62 ± 2	< 0.0004 ± 0.0004	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0001
Flat Cr.	12/11/96	0.40 µm Mem	1/2	7.9 ± 0.0	0.0076 ± 0.0011	< 0.004 ± 0.001	— ± —	0.0036 ± 0.0004
Flat Cr.	12/11/96	0.40 µm Mem	2/2	8.0 ± 0.0	0.0077 ± 0.0008	< 0.004 ± 0.001	— ± —	0.0031 ± 0.0002
Flat Cr.	12/11/96	0.45 µm Cap	1/2	7.9 ± 0.1	0.0055 ± 0.0003	< 0.004 ± 0.001	— ± —	0.0027 ± 0.0013
Flat Cr.	12/11/96	0.45 µm Cap	2/2	7.8 ± 0.1	0.0052 ± 0.0009	< 0.004 ± 0.001	— ± —	0.0027 ± 0.0001
Flat Cr.	12/11/96	10 kd Tan	1/2	6.4 ± 0.1	0.0033 ± 0.0006	< 0.004 ± 0.002	— ± —	0.0019 ± 0.0004
Flat Cr.	12/11/96	10 kd Tan	2/2	6.7 ± 0.0	0.0031 ± 0.0003	< 0.004 ± 0.001	— ± —	0.0020 ± 0.0001
Flat Cr.	05/29/97	0.40 µm Mem	1/2	31 ± 0	0.0045 ± 0.0003	0.0051 ± 0.0006	— ± —	0.0028 ± 0.0001
Flat Cr.	05/29/97	0.40 µm Mem	2/2	31 ± 1	0.0045 ± 0.0007	0.0052 ± 0.0012	— ± —	0.0031 ± 0.0002
Flat Cr.	05/29/97	0.45 mm Cap	1/2	32 ± 2	0.0039 ± 0.0004	0.0045 ± 0.0016	— ± —	0.0021 ± 0.0001
Flat Cr.	05/29/97	0.45 µm Cap	2/2	30 ± 1	0.0031 ± 0.0001	0.0072 ± 0.0010	— ± —	0.0024 ± 0.0001
Flat Cr.	05/29/97	10 kd Tan	1/2	26 ± 1	0.00083 ± 0.00012	< 0.004 ± 0.000	— ± —	0.00089 ± 0.00018
Flat Cr.	05/29/97	10 kd Tan	2/2	27 ± 1	0.0013 ± 0.0005	0.0045 ± 0.0007	— ± —	0.00070 ± 0.00010
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	13 ± 0	0.36 ± 0.00	0.039 ± 0.000	— ± —	0.12 ± 0.01
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	13 ± 0	0.38 ± 0.00	0.042 ± 0.000	— ± —	0.13 ± 0.01
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	14 ± 0	0.36 ± 0.01	0.040 ± 0.005	— ± —	0.12 ± 0.01
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	13 ± 0	0.37 ± 0.00	0.038 ± 0.001	— ± —	0.11 ± 0.00
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	13 ± 0	0.38 ± 0.00	0.034 ± 0.001	— ± —	0.12 ± 0.01

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	13 ± 0	0.37 ± 0.02	0.033 ± 0.005	— ± —	0.12 ± 0.01
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	53 ± 2	0.63 ± 0.03	0.47 ± 0.00	— ± —	0.20 ± 0.00
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	53 ± 2	0.62 ± 0.00	0.47 ± 0.03	— ± —	0.20 ± 0.00
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	51 ± 3	0.62 ± 0.05	0.46 ± 0.01	— ± —	0.20 ± 0.00
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	53 ± 0	0.60 ± 0.00	0.48 ± 0.01	— ± —	0.20 ± 0.00
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	50 ± 2	0.60 ± 0.00	0.45 ± 0.00	— ± —	0.20 ± 0.00
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	49 ± 3	0.59 ± 0.00	0.45 ± 0.02	— ± —	0.20 ± 0.01
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	15 ± 1	0.27 ± 0.00	0.15 ± 0.00	-- ± --	0.086 ± 0.006
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	15 ± 0	0.25 ± 0.00	0.15 ± 0.00	— ± —	0.087 ± 0.000
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	15 ± 1	0.27 ± 0.00	0.15 ± 0.01	— ± —	0.084 ± 0.008
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	15 ± 1	0.28 ± 0.00	0.14 ± 0.00	— ± —	0.084 ± 0.010
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	15 ± 1	0.24 ± 0.00	0.13 ± 0.01	— ± —	0.079 ± 0.004
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	14 ± 1	0.23 ± 0.00	0.13 ± 0.00	— ± —	0.082 ± 0.004
Whiskeytown	12/11/96	0.40 µm Mem	1/2	23 ± 0	0.00089 ± 0.00012	< 0.004 ± 0.001	— ± —	0.00059 ± 0.00019
Whiskeytown	12/11/96	0.40 µm Mem	2/2	22 ± 0	0.00085 ± 0.00022	< 0.004 ± 0.001	— ± —	0.00050 ± 0.00013
Whiskeytown	12/11/96	0.45 µm Cap	1/2	23 ± 0	0.00085 ± 0.00031	< 0.004 ± 0.001	— ± —	0.00057 ± 0.00017
Whiskeytown	12/11/96	0.45 µm Cap	2/2	23 ± 0	0.0016 ± 0.0006	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0001
Whiskeytown	12/11/96	10 kd Tan	1/2	21 ± 0	0.00067 ± 0.00025	< 0.004 ± 0.001	— ± —	< 0.0002 ± 0.0001
Whiskeytown	12/11/96	10 kd Tan	2/2	21 ± 1	< 0.0005 ± 0.0006	< 0.004 ± 0.002	— ± —	< 0.0006 ± 0.0001
Whiskeytown	05/29/97	0.40 µm Mem	1/2	22 ± 1	0.00074 ± 0.00034	< 0.004 ± 0.001	— ± —	0.00054 ± 0 00027
Whiskeytown	05/29/97	0.40 µm Mem	2/2	22 ± 2	0.0011 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0002
Whiskeytown	05/29/97	0.45 µm Cap	1/2	22 ± 1	0.00093 ± 0.00049	< 0.004 ± 0.002	— ± —	0.00071 ± 0.00044
Whiskeytown	05/29/97	0.45 µm Cap	2/2	22 ± 1	0.0012 ± 0.0002	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0001
Whiskeytown	05/29/97	10 kd Tan	1/2	19 ± 1	< 0.0004 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0003
Whiskeytown	05/29/97	10 kd Tan	2/2	19 ± 0	< 0.0004 ± 0.0004	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0002
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	20 ± 0	0.00084 ± 0.00005	< 0.0009 ± 0.0003	— ± —	0.00040 ± 0.00008
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	20 ± 0	0.00075 ± 0.00012	< 0.0009 ± 0.0000	— ± —	0.00054 ± 0.00010
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	20 ± 0	0.00065 ± 0.00018	< 0.0014 ± 0.0024	— ± —	< 0.0003 ± 0.0002
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	21 ± 1	0.0012 ± 0.0001	< 0.0014 ± 0.0000	— ± —	0.00072 ± 0.00023
Spring Cr. arm	07/12/96	10 kd Tan	1/3	19 ± 0	0.00072 ± 0.00014	< 0.0014 ± 0.0007	— ± —	< 0.0003 ± 0.0001
Spring Cr. arm	07/12/96	10 kd Tan	2/3	20 ± 0	0.00042 ± 0.00006	< 0.0009 ± 0.0004	— ± —	< 0.0003 ± 0.0000
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	19 ± 0	0.0016 ± 0.0001	< 0.005 ± 0.001	< 0.003 ± 0.002	< 0.0005 ± 0.0000
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	19 ± 0	0.0017 ± 0.0005	< 0.005 ± 0.001	< 0.003 ± 0.001	0.0011 ± 0.0002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	19 ± 0	0.0014 ± 0.0002	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0001
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	19 ± 0	0.0021 ± 0.0003	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0003
Spring Cr. arm	09/18/96	10 kd Tan	1/2	17 ± 0	< 0.0008 ± 0.0002	< 0.005 ± 0.000	< 0.003 ± 0.001	< 0.0005 ± 0.0002
Spring Cr. arm	09/18/96	10 kd Tan	2/2	17 ± 0	< 0.0008 ± 0.0003	< 0.005 ± 0.001	< 0.003 ± 0.001	< 0.0005 ± 0.0003
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	22 ± 1	0.0059 ± 0.0002	< 0.005 ± 0.002	— ± —	0.0018 ± 0.0001
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	22 ± 0	0.0044 ± 0.0005	< 0.005 ± 0.001	— ± —	0.0015 ± 0.0000
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	21 ± 1	0.0054 ± 0.0006	< 0.005 ± 0.000	— ± —	0.0019 ± 0.0000
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	21 ± 1	0.0054 ± 0.0002	< 0.005 ± 0.000	— ± —	0.0016 ± 0.0006
Spring Cr. arm	11/20/96	10 kd Tan	1/2	18 ± 1	0.0011 ± 0.0005	< 0.005 ± 0.002	— ± —	< 0.0003 ± 0.0002
Spring Cr. arm	11/20/96	10 kd Tan	2/2	18 ± 1	< 0.0005 ± 0.0005	< 0.005 ± 0.001	— ± —	< 0.0003 ± 0.0000
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	22 ± 0	0.0054 ± 0.0004	0.0051 ± 0.0002	— ± —	0.0025 ± 0.0000
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	22 ± 0	0.0037 ± 0.0000	< 0.004 ± 0.001	— ± —	0.0015 ± 0.0002
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	22 ± 0	0.0094 ± 0.0009	< 0.004 ± 0.001	— ± —	0.0027 ± 0.0006
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	22 ± 1	0.0089 ± 0.0006	0.0053 ± 0.0017	— ± —	0.0035 ± 0.0002
Spring Cr. arm	12/11/96	10 kd Tan	1/2	17 ± 0	0.00085 ± 0.00071	< 0.004 ± 0.001	— ± —	< 0.0006 ± 0.0003
Spring Cr. arm	12/11/96	10 kd Tan	2/2	18 ± 0	0.0011 ± 0.0001	< 0.004 ± 0.001	— ± —	0.00036 ± 0.00010
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	23 ± 1	0.0023 ± 0.0001	< 0.004 ± 0.001	— ± —	0.00085 ± 0.00017
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	23 ± 1	0.0016 ± 0.0007	< 0.004 ± 0.001	— ± —	0.00073 ± 0.00024
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	22 ± 1	0.0020 ± 0.0003	< 0.004 ± 0.000	— ± —	0.00061 ± 0.00008
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	23 ± 1	0.0016 ± 0.0003	< 0.004 ± 0.002	— ± —	0.00077 ± 0.00019
Spring Cr. arm	05/28/97	10 kd Tan	1/2	18 ± 1	0.00046 ± 0.00007	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0001
Spring Cr. arm	05/28/97	10 kd Tan	2/2	18 ± 0	< 0.0004 ± 0.0003	< 0.004 ± 0.001	— ± —	< 0.0004 ± 0.0001
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	486 ± 10	0.0012 ± 0.0001	< 0.004 ± 0.001	— ± —	0.0017 ± 0.0004
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	479 ± 4	0.0019 ± 0.0004	< 0.004 ± 0.000	— ± —	0.0016 ± 0.0003
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	474 ± 4	0.0015 ± 0.0004	< 0.004 ± 0.001	— ± —	0.0019 ± 0.0003
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	485 ± 2	0.0016 ± 0.0001	< 0.004 ± 0.001	— ± —	0.0019 ± 0.0003
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	437 ± 16	0.0011 ± 0.0000	< 0.004 ± 0.000	— ± —	0.0015 ± 0.0002
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	445 ± 0	0.0013 ± 0.0003	< 0.004 ± 0.001	— ± —	0.0017 ± 0.0003
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	64 ± 3	0.0031 ± 0.0002	< 0.004 ± 0.000	— ± —	0.0012 ± 0.0002
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	65 ± 3	0.0015 ± 0.0004	< 0.004 ± 0.002	— ± —	0.0010 ± 0.0002
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	67 ± 2	0.0028 ± 0.0007	< 0.004 ± 0.003	— ± —	0.0012 ± 0.0003
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	65 ± 3	0.0024 ± 0.0005	< 0.004 ± 0.002	— ± —	0.0013 ± 0.0003
Yolo Bypass	01/07/97	10 kd Tan	1/2	55 ± 3	0.00077 ± 0.00070	< 0.004 ± 0.003	— ± —	0.00057 ± 0.00022
Yolo Bypass	01/07/97	10 kd Tan	2/2	52 ± 2	0.0010 ± 0.0004	< 0.004 ± 0.001	— ± —	0.00030 ± 0.00029

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	0.12 ± 0.00	3.6 ± 0.0	0.0052 ± 0.0017	0.052 ± 0.000
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	0.11 ± 0.00	3.7 ± 0.1	0.0036 ± 0.0002	0.047 ± 0.001
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.10 ± 0.00	3.5 ± 0.0	0.0055 ± 0.0006	0.055 ± 0.003
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	0.11 ± 0.00	3.5 ± 0.0	0.0032 ± 0.0004	0.054 ± 0.000
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	0.11 ± 0.00	3.4 ± 0.0	0.0011 ± 0.0001	0.031 ± 0.002
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	0.11 ± 0.00	3.2 ± 0.1	0.0048 ± 0.0006	0.030 ± 0.001
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	0.092 ± 0.015	3.2 ± 0.1	0.0041 ± 0.0001	0.060 ± 0.002
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	0.088 ± 0.017	3.2 ± 0.1	0.0031 ± 0.0005	0.061 ± 0.008
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	0.10 ± 0.01	3.2 ± 0.1	0.0047 ± 0.0005	0.051 ± 0.001
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	0.099 ± 0.015	3.0 ± 0.0	< 0.002 ± 0.000	0.050 ± 0.001
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	0.097 ± 0.021	2.9 ± 0.1	0.0029 ± 0.0024	0.024 ± 0.002
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	0.072 ± 0.013	2.7 ± 0.0	0.0022 ± 0.0009	0.022 ± 0.002
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	0.12 ± 0.00	4.1 ± 0.1	0.0030 ± 0.0022	0.025 ± 0.002
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	0.13 ± 0.00	4.1 ± 0.1	0.0030 ± 0.0013	0.027 ± 0.003
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.11 ± 0.00	4.1 ± 0.1	0.0034 ± 0.0028	0.027 ± 0.002
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	0.12 ± 0.00	4.1 ± 0.0	0.0021 ± 0.0007	0.027 ± 0.003
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	0.090 ± 0.002	3.6 ± 0.0	< 0.0014 ± 0.0002	0.011 ± 0.001
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	0.10 ± 0.01	3.6 ± 0.1	< 0.0014 ± 0.0011	0.012 ± 0.001
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	0.14 ± 0.00	4.5 ± 0.0	0.0024 ± 0.0019	0.033 ± 0.003
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	0.14 ± 0.00	4.6 ± 0.1	0.0027 ± 0.0016	0.035 ± 0.003
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	0.13 ± 0.00	4.6 ± 0.0	0.0030 ± 0.0011	0.041 ± 0.003
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	0.13 ± 0.00	4.7 ± 0.4	0.0047 ± 0.0003	0.041 ± 0.001
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	0.099 ± 0.000	3.8 ± 0.1	0.0018 ± 0.0002	0.014 ± 0.001
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	0.10 ± 0.01	3.8 ± 0.0	< 0.002 ± 0.001	0.012 ± 0.001
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	0.091 ± 0.001	3.6 ± 0.1	0.0045 ± 0.0010	0.051 ± 0.003
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	0.098 ± 0.005	3.5 ± 0.1	0.0038 ± 0.0007	0.039 ± 0.000
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	0.089 ± 0.001	3.2 ± 0.0	0.0036 ± 0.0007	0.041 ± 0.001
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	0.091 ± 0.006	3.3 ± 0.0	0.0041 ± 0.0006	0.042 ± 0.000
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	0.064 ± 0.003	2.6 ± 0.0	< 0.0008 ± 0.0011	0.010 ± 0.001
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	0.062 ± 0.002	2.6 ± 0.1	0.00086 ± 0.00086	0.0091 ± 0.0003
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	0.088 ± 0.002	2.7 ± 0.0	0.0035 ± 0.0001	0.038 ± 0.000

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	0.081 ± 0.003	2.7 ± 0.0	0.0043 ± 0.0002	0.041 ± 0.000
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	0.088 ± 0.002	2.7 ± 0.0	0.0064 ± 0.0006	0.047 ± 0.000
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	0.092 ± 0.004	2.8 ± 0.0	0.0047 ± 0.0006	0.048 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	0.081 ± 0.005	2.7 ± 0.1	0.0021 ± 0.0004	0.028 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	0.087 ± 0.010	2.7 ± 0.0	0.0029 ± 0.0002	0.028 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	0.084 ± 0.000	2.6 ± 0.0	0.0023 ± 0.0002	0.027 ± 0.001
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	0.078 ± 0.024	2.0 ± 0.0	0.0063 ± 0.0028	0.059 ± 0.000
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	0.066 ± 0.007	2.1 ± 0.1	0.0061 ± 0.0013	0.049 ± 0.001
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	0.059 ± 0.002	2.1 ± 0.0	0.0056 ± 0.0019	0.057 ± 0.000
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	0.062 ± 0.004	2.0 ± 0.0	0.0034 ± 0.0003	0.053 ± 0.001
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	0.051 ± 0.013	1.7 ± 0.0	< 0.0008 ± 0.0003	0.015 ± 0.003
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	0.049 ± 0.010	1.7 ± 0.0	0.0016 ± 0.0020	0.016 ± 0.001
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	0.044 ± 0.007	1.8 ± 0.0	0.0015 ± 0.0012	0.015 ± 0.001
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	0.091 ± 0.003	3.2 ± 0.1	0.013 ± 0.001	0.091 ± 0.008
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	0.089 ± 0.001	3.1 ± 0.1	0.0097 ± 0.0009	0.089 ± 0.000
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	0.087 ± 0.001	3.1 ± 0.1	0.0071 ± 0.0020	0.086 ± 0.002
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	0.090 ± 0.000	3.0 ± 0.1	0.0087 ± 0.0032	0.076 ± 0.000
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	0.057 ± 0.001	2.5 ± 0.0	< 0.0014 ± 0.0004	0.018 ± 0.002
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	0.059 ± 0.000	2.5 ± 0.1	0.0015 ± 0.0019	0.015 ± 0.001
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	0.12 ± 0.02	4.0 ± 0.0	0.0065 ± 0.0013	0.080 ± 0.001
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	0.12 ± 0.01	4.1 ± 0.1	0.0067 ± 0.0014	0.075 ± 0.002
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	0.11 ± 0.00	4.0 ± 0.1	0.0049 ± 0.0009	0.075 ± 0.002
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	0.12 ± 0.01	3.9 ± 0.1	0.0052 ± 0.0026	0.079 ± 0.002
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	0.085 ± 0.004	3.1 ± 0.0	< 0.002 ± 0.002	0.017 ± 0.001
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	0.075 ± 0.002	3.1 ± 0.0	< 0.002 ± 0.001	0.018 ± 0.002
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	0.094 ± 0.005	2.5 ± 0.0	0.0044 ± 0.0004	0.065 ± 0.002
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	0.094 ± 0.005	2.5 ± 0.0	0.0045 ± 0.0021	0.068 ± 0.004
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	0.088 ± 0.006	2.7 ± 0.1	0.011 ± 0.000	0.10 ± 0.00
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	0.093 ± 0.002	2.8 ± 0.0	0.0075 ± 0.0013	0.10 ± 0.00
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	0.081 ± 0.001	2.3 ± 0.1	0.0021 ± 0.0008	0.036 ± 0.003
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	0.087 ± 0.009	2.2 ± 0.0	0.0016 ± 0.0005	0.037 ± 0.001
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	0.088 ± 0.003	2.3 ± 0.0	0.0032 ± 0.0009	0.035 ± 0.002
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	0.071 ± 0.003	2.6 ± 0.2	0.0028 ± 0.0012	0.034 ± 0.000
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	0.076 ± 0.005	2.7 ± 0.1	0.0031 ± 0.0011	0.041 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	0.073 ± 0.004	2.6 ± 0.1	0.0045 ± 0.0010	0.040 ± 0.003
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	0.075 ± 0.003	2.5 ± 0.0	0.0031 ± 0.0007	0.042 ± 0.001
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	0.053 ± 0.007	2.2 ± 0.1	< 0.0008 ± 0.0002	0.015 ± 0.000
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	0.056 ± 0.001	2.2 ± 0.1	0.0010 ± 0.0003	0.014 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	0.087 ± 0.002	2.9 ± 0.0	0.0037 ± 0.0001	0.028 ± 0.001
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	0.074 ± 0.005	2.8 ± 0.0	0.0035 ± 0.0003	0.031 ± 0.003
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	0.083 ± 0.001	2.9 ± 0.0	0.0033 ± 0.0001	0.033 ± 0.002
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	0.091 ± 0.009	2.9 ± 0.0	0.0031 ± 0.0002	0.035 ± 0.000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	0.086 ± 0.001	2.9 ± 0.0	0.00080 ± 0.00011	0.020 ± 0.001
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	0.077 ± 0.002	2.7 ± 0.0	0.0016 ± 0.0003	0.014 ± 0.000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	0.058 ± 0.005	2.3 ± 0.1	< 0.002 ± 0.001	0.029 ± 0.003
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	0.065 ± 0.001	2.4 ± 0.0	0.0035 ± 0.0007	0.028 ± 0.001
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	0.063 ± 0.009	2.2 ± 0.1	0.0036 ± 0.0018	0.037 ± 0.004
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	0.057 ± 0.006	2.5 ± 0.0	0.0017 ± 0.0006	0.037 ± 0.001
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	0.040 ± 0.012	1.8 ± 0.0	0.0013 ± 0.0011	0.0084 ± 0.0009
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	0.047 ± 0.012	1.8 ± 0.0	< 0.0008 ± 0.0003	0.0063 ± 0.0008
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	0.085 ± 0.003	3.1 ± 0.1	0.0070 ± 0.0006	0.071 ± 0.001
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	0.083 ± 0.006	3.0 ± 0.1	0.0060 ± 0.0021	0.068 ± 0.003
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	0.082 ± 0.004	3.0 ± 0.0	0.0054 ± 0.0011	0.068 ± 0.005
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	0.080 ± 0.002	3.0 ± 0.1	0.0066 ± 0.0021	0.068 ± 0.002
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	0.049 ± 0.002	2.4 ± 0.1	< 0.0014 ± 0.0003	0.0080 ± 0.0005
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	0.054 ± 0.003	2.4 ± 0.1	< 0.0014 ± 0.0008	0.010 ± 0.000
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	0.10 ± 0.00	3.5 ± 0.0	0.0046 ± 0.0019	0.047 ± 0.002
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	0.11 ± 0.00	3.4 ± 0.0	0.0042 ± 0.0009	0.055 ± 0.004
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	0.099 ± 0.011	3.4 ± 0.1	0.0034 ± 0.0015	0.052 ± 0.003
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	0.093 ± 0.004	3.2 ± 0.1	0.0061 ± 0.0017	0.054 ± 0.001
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	0.066 ± 0.002	2.8 ± 0.0	< 0.002 ± 0.000	0.010 ± 0.000
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	0.065 ± 0.007	2.8 ± 0.1	< 0.002 ± 0.001	0.0089 ± 0.0005
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.087 ± 0.009	2.3 ± 0.0	0.0098 ± 0.0001	0.084 ± 0.005
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.080 ± 0.003	2.2 ± 0.0	0.0067 ± 0.0007	0.056 ± 0.002
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	0.080 ± 0.002	2.1 ± 0.1	0.0076 ± 0.0011	0.065 ± 0.002
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.077 ± 0.001	2.2 ± 0.0	0.0071 ± 0.0013	0.070 ± 0.005

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP–MS	Vanadium (µg/L) ICP–MS	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	0.072 ± 0.006	1.8 ± 0.0	0.0035 ± 0.0008	0.027 ± 0.003
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.071 ± 0.008	1.8 ± 0.0	0.0031 ± 0.0016	0.030 ± 0.001
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	0.063 ± 0.002	2.6 ± 0.1	0.0031 ± 0.0003	0.035 ± 0.000
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	0.059 ± 0.004	2.6 ± 0.1	0.0025 ± 0.0011	0.031 ± 0.000
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	0.066 ± 0.006	2.6 ± 0.1	0.0027 ± 0.0009	0.036 ± 0.000
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	0.066 ± 0.002	2.5 ± 0.1	0.0032 ± 0.0005	0.036 ± 0.000
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	0.053 ± 0.004	2.2 ± 0.1	< 0.0008 ± 0.0006	0.013 ± 0.000
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	0.053 ± 0.007	2.2 ± 0.1	0.0015 ± 0.0003	0.012 ± 0.000
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	0.096 ± 0.001	3.2 ± 0.0	0.0021 ± 0.0009	0.022 ± 0.000
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	0.091 ± 0.010	3.2 ± 0.0	0.0023 ± 0.0004	0.030 ± 0.001
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.087 ± 0.006	3.0 ± 0.3	0.0038 ± 0.0006	0.025 ± 0.001
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	0.10 ± 0.01	3.0 ± 0.0	0.0011 ± 0.0013	0.019 ± 0.002
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	0.17 ± 0.01	3.1 ± 0.0	0.0016 ± 0.0006	0.017 ± 0.002
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	0.13 ± 0.04	3.2 ± 0.0	0.0018 ± 0.0000	0.021 ± 0.001
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	0.11 ± 0.00	3.2 ± 0.0	0.0026 ± 0.0008	0.023 ± 0.000
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	0.098 ± 0.007	2.7 ± 0.0	0.0014 ± 0.0013	0.0079 ± 0.0012
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	0.093 ± 0.003	2.8 ± 0.0	0.0020 ± 0.0003	0.0055 ± 0.0002
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	0.13 ± 0.00	3.6 ± 0.0	0.0020 ± 0.0012	0.024 ± 0.001
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	0.13 ± 0.00	3.6 ± 0.1	< 0.0014 ± 0.0013	0.023 ± 0.003
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	0.12 ± 0.00	3.6 ± 0.0	0.0018 ± 0.0015	0.023 ± 0.001
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	0.13 ± 0.01	3.7 ± 0.1	0.0022 ± 0.0013	0.022 ± 0.001
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	0.11 ± 0.00	3.2 ± 0.0	< 0.0014 ± 0.0006	0.0063 ± 0.0008
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	0.11 ± 0.00	3.3 ± 0.1	< 0.0014 ± 0.0005	0.0066 ± 0.0000
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	0.11 ± 0.00	3.5 ± 0.0	0.0035 ± 0.0021	0.039 ± 0.002
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	0.11 ± 0.00	3.5 ± 0.0	0.0029 ± 0.0018	0.039 ± 0.001
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	0.11 ± 0.00	3.4 ± 0.1	0.0042 ± 0.0009	0.039 ± 0.002
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	0.11 ± 0.01	3.6 ± 0.0	0.0040 ± 0.0009	0.042 ± 0.002
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	0.081 ± 0.006	2.9 ± 0.0	0.0012 ± 0.0011	0.010 ± 0.001
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	0.085 ± 0.002	3.0 ± 0.0	0.0021 ± 0.0016	0.012 ± 0.002
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	0.057 ± 0.002	1.7 ± 0.0	0.0071 ± 0.0017	0.063 ± 0.004
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	0.061 ± 0.003	1.7 ± 0.0	0.0076 ± 0.0007	0.065 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	0.052 ± 0.004	1.7 ± 0.0	0.0091 ± 0.0014	0.075 ± 0.005
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	0.054 ± 0.002	1.8 ± 0.0	0.0067 ± 0.0012	0.079 ± 0.003
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	0.062 ± 0.006	1.6 ± 0.0	0.0050 ± 0.0007	0.052 ± 0.000
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	0.060 ± 0.001	1.6 ± 0.1	0.0039 ± 0.0013	0.046 ± 0.003
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	0.094 ± 0.008	2.9 ± 0.0	0.0020 ± 0.0004	0.022 ± 0.002
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	0.094 ± 0.002	3.0 ± 0.0	0.0040 ± 0.0000	0.031 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	0.089 ± 0.001	2.9 ± 0.0	0.0015 ± 0.0003	0.021 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	0.091 ± 0.005	2.9 ± 0.0	0.0020 ± 0.0011	0.021 ± 0.001
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	0.083 ± 0.004	2.7 ± 0.0	0.00097 ± 0.00078	0.0093 ± 0.0009
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	0.084 ± 0.006	2.7 ± 0.0	< 0.0008 ± 0.0008	0.0094 ± 0.0007
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	0.13 ± 0.00	2.8 ± 0.0	0.0032 ± 0.0003	0.018 ± 0.001
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	0.12 ± 0.00	2.8 ± 0.1	0.0035 ± 0.0003	0.026 ± 0.002
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.12 ± 0.00	2.8 ± 0.0	0.0016 ± 0.0006	0.022 ± 0.000
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.13 ± 0.00	2.6 ± 0.0	0.0028 ± 0.0001	0.022 ± 0.001
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	0.11 ± 0.01	2.5 ± 0.0	0.00077 ± 0.00042	0.014 ± 0.000
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	0.13 ± 0.00	2.6 ± 0.0	0.00097 ± 0.00041	0.012 ± 0.001
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	0.19 ± 0.00	3.6 ± 0.0	0.0033 ± 0.0009	0.033 ± 0.001
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	0.19 ± 0.00	3.5 ± 0.0	0.0018 ± 0.0006	0.016 ± 0.001
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	0.19 ± 0.00	3.5 ± 0.1	< 0.0006 ± 0.0013	0.017 ± 0.004
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	0.18 ± 0.02	3.5 ± 0.1	0.0023 ± 0.0010	0.021 ± 0.003
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	0.16 ± 0.02	3.0 ± 0.1	0.00084 ± 0.00055	0.0091 ± 0.0043
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	0.17 ± 0.01	3.1 ± 0.0	< 0.0008 ± 0.0002	0.010 ± 0.001
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	0.22 ± 0.00	3.2 ± 0.1	0.0025 ± 0.0004	0.035 ± 0.002
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	0.21 ± 0.00	3.3 ± 0.0	0.0027 ± 0.0010	0.036 ± 0.001
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.11 ± 0.00	2.5 ± 0.0	0.0045 ± 0.0008	0.045 ± 0.000
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.11 ± 0.00	2.5 ± 0.0	0.0036 ± 0.0008	0.039 ± 0.003
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.099 ± 0.001	2.4 ± 0.0	0.0053 ± 0.0020	0.044 ± 0.002
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.11 ± 0.01	2.4 ± 0.0	0.0043 ± 0.0025	0.043 ± 0.001
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	0.093 ± 0.004	2.3 ± 0.1	0.0031 ± 0.0017	0.018 ± 0.001
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	0.088 ± 0.004	2.3 ± 0.0	0.0025 ± 0.0011	0.023 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP–MS	Vanadium (µg/L) ICP–MS	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	0.16 ± 0.00	3.5 ± 0.1	0.0020 ± 0.0013	0.018 ± 0.002
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	0.17 ± 0.01	3.5 ± 0.1	0.0014 ± 0.0006	0.014 ± 0.001
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	0.16 ± 0.01	3.4 ± 0.0	0.0022 ± 0.0008	0.020 ± 0.000
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	0.16 ± 0.01	3.5 ± 0.0	0.0024 ± 0.0009	0.018 ± 0.001
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	0.14 ± 0.00	2.9 ± 0.1	< 0.0008 ± 0.0002	0.0067 ± 0.0005
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	0.13 ± 0.00	3.0 ± 0.0	0.00077 ± 0.00049	0.0071 ± 0.0008
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.12 ± 0.01	2.5 ± 0.0	0.0014 ± 0.0003	0.017 ± 0.000
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	0.11 ± 0.00	2.5 ± 0.0	0.0021 ± 0.0002	0.020 ± 0.000
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	0.13 ± 0.00	2.6 ± 0.0	0.0037 ± 0.0000	0.025 ± 0.000
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.11 ± 0.00	2.5 ± 0.0	0.0012 ± 0.0004	0.024 ± 0.001
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	0.087 ± 0.001	2.2 ± 0.0	0.00094 ± 0.00063	0.0052 ± 0.0004
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	0.14 ± 0.00	2.7 ± 0.0	0.0011 ± 0.0005	0.0090 ± 0.0004
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	0.21 ± 0.00	3.2 ± 0.0	0.0026 ± 0.0027	0.016 ± 0.001
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	0.26 ± 0.03	3.1 ± 0.0	0.0016 ± 0.0008	0.014 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	0.20 ± 0.00	3.2 ± 0.1	< 0.002 ± 0.001	0.021 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	0.20 ± 0.02	3.2 ± 0.0	< 0.0008 ± 0.0004	0.023 ± 0.002
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	0.14 ± 0.00	2.6 ± 0.0	< 0.0006 ± 0.0002	0.0054 ± 0.0005
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	0.15 ± 0.00	2.7 ± 0.0	0.0022 ± 0.0003	0.0065 ± 0.0017
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	0.16 ± 0.00	2.4 ± 0.0	0.0019 ± 0.0014	0.015 ± 0.000
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	0.16 ± 0.01	2.4 ± 0.1	0.0026 ± 0.0021	0.017 ± 0.001
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	0.15 ± 0.01	2.4 ± 0.0	0.0016 ± 0.0008	0.021 ± 0.002
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	0.14 ± 0.00	2.4 ± 0.0	0.0017 ± 0.0004	0.017 ± 0.000
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	0.095 ± 0.005	1.9 ± 0.1	< 0.0014 ± 0.0006	0.0041 ± 0.0012
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	0.093 ± 0.002	1.9 ± 0.0	< 0.0014 ± 0.0002	0.0033 ± 0.0006
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	0.089 ± 0.006	2.1 ± 0.0	0.0045 ± 0.0011	0.044 ± 0.004
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.091 ± 0.008	2.1 ± 0.0	0.0032 ± 0.0000	0.043 ± 0.003
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.082 ± 0.004	2.1 ± 0.1	0.0054 ± 0.0017	0.057 ± 0.003
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.084 ± 0.006	2.0 ± 0.0	0.0074 ± 0.0012	0.052 ± 0.002
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	0.082 ± 0.006	1.8 ± 0.0	0.0021 ± 0.0015	0.022 ± 0.002
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.077 ± 0.009	1.9 ± 0.0	0.0037 ± 0.0006	0.025 ± 0.001
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.052 ± 0.004	0.95 ± 0.02	0.011 ± 0.002	0.095 ± 0.002
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.051 ± 0.003	0.99 ± 0.02	0.0087 ± 0.0002	0.090 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	0.047 ± 0.002	0.96 ± 0.01	0.011 ± 0.001	0.10 ± 0.01
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.053 ± 0.006	1.0 ± 0.0	0.011 ± 0.001	0.11 ± 0.00
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	0.024 ± 0.002	0.80 ± 0.04	0.0022 ± 0.0001	0.026 ± 0.003
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.026 ± 0.001	0.82 ± 0.04	0.0027 ± 0.0008	0.025 ± 0.001
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	0.14 ± 0.01	2.9 ± 0.0	0.0013 ± 0.0008	0.014 ± 0.001
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	0.15 ± 0.00	2.9 ± 0.1	0.00080 ± 0.00085	0.014 ± 0.001
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	0.13 ± 0.00	2.9 ± 0.0	0.0019 ± 0.0010	0.017 ± 0.001
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	0.13 ± 0.01	2.9 ± 0.0	0.0019 ± 0.0005	0.019 ± 0.001
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	0.095 ± 0.001	2.2 ± 0.0	< 0.0008 ± 0.0009	0.0050 ± 0.0013
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	0.092 ± 0.005	2.2 ± 0.0	< 0.0008 ± 0.0008	0.0053 ± 0.0003
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	0.15 ± 0.01	3.3 ± 0.0	0.0021 ± 0.0008	0.018 ± 0.002
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.15 ± 0.00	3.2 ± 0.0	0.0042 ± 0.0012	0.025 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	0.15 ± 0.01	3.3 ± 0.0	0.0035 ± 0.0016	0.018 ± 0.001
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	0.14 ± 0.01	3.5 ± 0.1	0.0019 ± 0.0005	0.019 ± 0.002
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	0.11 ± 0.00	2.5 ± 0.1	0.0011 ± 0.0005	0.0062 ± 0.0009
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	0.10 ± 0.01	2.6 ± 0.0	< 0.001 ± 0.001	0.0057 ± 0.0004
Flat Cr.	12/11/96	0.40 µm Mem	1/2	0.0040 ± 0.0016	0.27 ± 0.02	0.026 ± 0.000	0.24 ± 0.01
Flat Cr.	12/11/96	0.40 µm Mem	2/2	0.0043 ± 0.0010	0.27 ± 0.02	0.026 ± 0.001	0.23 ± 0.00
Flat Cr.	12/11/96	0.45 µm Cap	1/2	0.0035 ± 0.0012	0.24 ± 0.02	0.021 ± 0.008	0.17 ± 0.00
Flat Cr.	12/11/96	0.45 µm Cap	2/2	0.0030 ± 0.0005	0.24 ± 0.02	0.019 ± 0.003	0.18 ± 0.00
Flat Cr.	12/11/96	10 kd Tan	1/2	< 0.0019 ± 0.0004	0.21 ± 0.01	0.013 ± 0.001	0.10 ± 0.00
Flat Cr.	12/11/96	10 kd Tan	2/2	0.0029 ± 0.0004	0.21 ± 0.02	0.013 ± 0.000	0.10 ± 0.00
Flat Cr.	05/29/97	0.40 µm Mem	1/2	< 0.002 ± 0.000	0.35 ± 0.00	0.021 ± 0.003	0.19 ± 0.00
Flat Cr.	05/29/97	0.40 µm Mem	2/2	0.0026 ± 0.0015	0.38 ± 0.03	0.020 ± 0.003	0.18 ± 0.00
Flat Cr.	05/29/97	0.45 mm Cap	1/2	< 0.002 ± 0.001	0.37 ± 0.04	0.018 ± 0.001	0.17 ± 0.00
Flat Cr.	05/29/97	0.45 µm Cap	2/2	< 0.002 ± 0.002	0.37 ± 0.07	0.022 ± 0.001	0.17 ± 0.00
Flat Cr.	05/29/97	10 kd Tan	1/2	< 0.002 ± 0.001	0.22 ± 0.06	0.0071 ± 0.0017	0.061 ± 0.001
Flat Cr.	05/29/97	10 kd Tan	2/2	< 0.002 ± 0.001	0.22 ± 0.03	0.0067 ± 0.0008	0.066 ± 0.001
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	0.092 ± 0.003	0.027 ± 0.015	0.78 ± 0.05	10 ± 0
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	0.083 ± 0.001	< 0.02 ± 0.01	0.76 ± 0.00	10 ± 0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	0.097 ± 0.013	< 0.02 ± 0.00	0.79 ± 0.07	10 ± 0
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	0.093 ± 0.004	< 0.02 ± 0.00	0.79 ± 0.10	9.8 ± 0.0
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	0.098 ± 0.002	0.012 ± 0.005	0.78 ± 0.02	10 ± 0

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP–MS	Vanadium (µg/L) ICP–MS	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	0.094 ± 0.007	< 0.02 ± 0.01	0.78 ± 0.06	9.8 ± 0.1
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	0.13 ± 0.01	< 0.05 ± 0.02	1.3 ± 0.0	16 ± 0
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	0.13 ± 0.01	< 0.05 ± 0.03	1.3 ± 0.0	17 ± 0
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	0.12 ± 0.01	< 0.05 ± 0.03	1.2 ± 0.0	16 ± 0
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	0.13 ± 0.01	< 0.05 ± 0.03	1.3 ± 0.1	17 ± 0
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	0.13 ± 0.01	< 0.05 ± 0.03	1.2 ± 0.0	16 ± 0
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	0.13 ± 0.01	< 0.05 ± 0.03	1.2 ± 0.0	16 ± 1
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	0.21 ± 0.00	0.027 ± 0.004	0.57 ± 0.03	6.9 ± 0.2
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	0.22 ± 0.02	0.028 ± 0.005	0.60 ± 0.01	6.7 ± 0.0
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	0.21 ± 0.00	0.11 ± 0.01	0.56 ± 0.04	6.6 ± 0.2
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	0.23 ± 0.00	0.12 ± 0.00	0.59 ± 0.05	7.1 ± 0.1
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	0.22 ± 0.00	0.037 ± 0.002	0.54 ± 0.00	6.8 ± 0.0
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	0.21 ± 0.00	0.038 ± 0.002	0.55 ± 0.02	6.5 ± 0.2
Whiskeytown	12/11/96	0.40 µm Mem	1/2	0.038 ± 0.003	0.46 ± 0.02	0.0041 ± 0.0005	0.042 ± 0.001
Whiskeytown	12/11/96	0.40 µm Mem	2/2	0.040 ± 0.002	0.50 ± 0.01	0.0041 ± 0.0004	0.045 ± 0.000
Whiskeytown	12/11/96	0.45 µm Cap	1/2	0.035 ± 0.001	0.46 ± 0.00	0.0033 ± 0.0007	0.042 ± 0.001
Whiskeytown	12/11/96	0.45 µm Cap	2/2	0.037 ± 0.005	0.47 ± 0.01	0.0038 ± 0.0007	0.040 ± 0.002
Whiskeytown	12/11/96	10 kd Tan	1/2	0.032 ± 0.001	0.43 ± 0.02	0.0024 ± 0.0006	0.023 ± 0.002
Whiskeytown	12/11/96	10 kd Tan	2/2	0.033 ± 0.003	0.42 ± 0.04	0.0022 ± 0.0003	0.019 ± 0.003
Whiskeytown	05/29/97	0.40 µm Mem	1/2	0.032 ± 0.002	0.48 ± 0.06	0.0032 ± 0.0009	0.027 ± 0.003
Whiskeytown	05/29/97	0.40 µm Mem	2/2	0.032 ± 0.005	0.52 ± 0.05	0.0033 ± 0.0011	0.032 ± 0.003
Whiskeytown	05/29/97	0.45 µm Cap	1/2	0.029 ± 0.004	0.47 ± 0.04	0.0031 ± 0.0004	0.033 ± 0.001
Whiskeytown	05/29/97	0.45 µm Cap	2/2	0.028 ± 0.001	0.48 ± 0.08	0.0042 ± 0.0013	0.033 ± 0.002
Whiskeytown	05/29/97	10 kd Tan	1/2	0.018 ± 0.001	0.43 ± 0.07	< 0.001 ± 0.001	0.011 ± 0.001
Whiskeytown	05/29/97	10 kd Tan	2/2	0.019 ± 0.001	0.41 ± 0.04	< 0.001 ± 0.000	0.011 ± 0.001
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	0.028 ± 0.004	0.45 ± 0.01	0.0026 ± 0.0002	0.036 ± 0.000
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	0.029 ± 0.003	0.45 ± 0.00	0.0026 ± 0.0005	0.036 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	0.026 ± 0.005	0.49 ± 0.06	0.0028 ± 0.0008	0.037 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	0.029 ± 0.005	0.54 ± 0.24	0.0029 ± 0.0005	0.038 ± 0.001
Spring Cr. arm	07/12/96	10 kd Tan	1/3	0.027 ± 0.005	0.47 ± 0.06	0.0046 ± 0.0005	0.019 ± 0.001
Spring Cr. arm	07/12/96	10 kd Tan	2/3	0.023 ± 0.003	0.43 ± 0.00	0.0013 ± 0.0003	0.021 ± 0.000
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	0.032 ± 0.009	0.45 ± 0.02	0.0060 ± 0.0012	0.058 ± 0.002
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	0.11 ± 0.01	0.44 ± 0.02	0.0039 ± 0.0019	0.055 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Uranium (µg/L) ICP-MS	Vanadium (µg/L) ICP-MS	Ytterbium (µg/L) ICP-MS	Yttrium (µg/L) ICP-MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	0.017 ± 0.005	0.41 ± 0.03	0.0041 ± 0.0009	0.058 ± 0.001
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	0.019 ± 0.006	0.42 ± 0.01	0.0072 ± 0.0002	0.053 ± 0.004
Spring Cr. arm	09/18/96	10 kd Tan	1/2	0.017 ± 0.006	0.38 ± 0.01	< 0.0008 ± 0.0004	0.019 ± 0.001
Spring Cr. arm	09/18/96	10 kd Tan	2/2	< 0.013 ± 0.000	0.37 ± 0.01	0.0016 ± 0.0003	0.017 ± 0.001
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	0.030 ± 0.002	0.44 ± 0.03	0.014 ± 0.001	0.18 ± 0.00
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	0.029 ± 0.001	0.38 ± 0.01	0.012 ± 0.000	0.13 ± 0.00
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	0.025 ± 0.002	0.38 ± 0.03	0.012 ± 0.002	0.17 ± 0.00
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	0.022 ± 0.005	0.38 ± 0.04	0.015 ± 0.001	0.17 ± 0.00
Spring Cr. arm	11/20/96	10 kd Tan	1/2	0.018 ± 0.001	0.33 ± 0.07	0.0033 ± 0.0026	0.033 ± 0.003
Spring Cr. arm	11/20/96	10 kd Tan	2/2	0.022 ± 0.003	0.30 ± 0.00	0.0033 ± 0.0008	0.033 ± 0.003
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	0.032 ± 0.002	0.31 ± 0.01	0.011 ± 0.002	0.21 ± 0.00
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	0.032 ± 0.001	0.30 ± 0.01	0.0091 ± 0.0001	0.16 ± 0.00
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	0.027 ± 0.004	0.31 ± 0.01	0.025 ± 0.003	0.35 ± 0.00
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	0.024 ± 0.001	0.32 ± 0.02	0.026 ± 0.001	0.34 ± 0.02
Spring Cr. arm	12/11/96	10 kd Tan	1/2	0.022 ± 0.003	0.26 ± 0.01	0.0022 ± 0.0008	0.053 ± 0.002
Spring Cr. arm	12/11/96	10 kd Tan	2/2	0.024 ± 0.001	0.26 ± 0.01	0.0030 ± 0.0010	0.051 ± 0.003
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	0.034 ± 0.005	0.52 ± 0.02	0.0056 ± 0.0016	0.051 ± 0.002
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	0.030 ± 0.002	0.49 ± 0.02	0.0049 ± 0.0017	0.050 ± 0.003
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	0.029 ± 0.006	0.49 ± 0.04	0.0050 ± 0.0005	0.059 ± 0.001
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	0.027 ± 0.005	0.51 ± 0.04	0.0050 ± 0.0015	0.059 ± 0.001
Spring Cr. arm	05/28/97	10 kd Tan	1/2	0.017 ± 0.001	0.38 ± 0.01	< 0.001 ± 0.001	0.011 ± 0.001
Spring Cr. arm	05/28/97	10 kd Tan	2/2	0.017 ± 0.001	0.38 ± 0.03	0.0011 ± 0.0011	0.010 ± 0.002
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	1.5 ± 0.1	10 ± 0	0.012 ± 0.001	0.082 ± 0.001
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	1.6 ± 0.0	10 ± 0	0.015 ± 0.001	0.087 ± 0.003
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	1.6 ± 0.0	9.8 ± 0.2	0.013 ± 0.000	0.079 ± 0.000
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	1.6 ± 0.0	10 ± 1	0.017 ± 0.000	0.077 ± 0.003
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	1.3 ± 0.1	9.0 ± 0.4	0.0099 ± 0.0013	0.066 ± 0.004
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	1.3 ± 0.1	9.3 ± 0.0	0.010 ± 0.001	0.066 ± 0.000
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	0.081 ± 0.006	2.1 ± 0.0	0.0065 ± 0.0013	0.068 ± 0.003
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	0.082 ± 0.001	2.1 ± 0.0	0.0048 ± 0.0015	0.053 ± 0.002
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	0.075 ± 0.002	2.1 ± 0.1	0.0078 ± 0.0030	0.079 ± 0.001
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	0.081 ± 0.000	2.1 ± 0.0	0.0065 ± 0.0024	0.075 ± 0.001
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.061 ± 0.003	1.7 ± 0.1	0.0031 ± 0.0018	0.029 ± 0.005
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.059 ± 0.001	1.6 ± 0.0	0.0038 ± 0.0004	0.024 ± 0.001

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP–MS	Zirconium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	0.40 µm Mem	1/1	2.3 ± 0.1	0.054 ± 0.003
Sac. R.–Shasta	07/12/96	0.40 µm Mem	2/2	2.2 ± 0.1	0.045 ± 0.000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	1/1	3.1 ± 0.0	< 0.017 ± 0.000
Sac. R.–Shasta	07/12/96	0.45 µm Cap	2/2	2.3 ± 0.1	0.023 ± 0.007
Sac. R.–Shasta	07/12/96	10 kd Tan	1/3	2.2 ± 0.0	< 0.017 ± 0.003
Sac. R.–Shasta	07/12/96	10 kd Tan	2/3	2.4 ± 0.1	0.019 ± 0.007
Sac. R.–Shasta	07/12/96	10 kd Tan	3/3	— ± —	— ± —
Sac. R.–Shasta	09/19/96	0.40 µm Mem	1/2	4.5 ± 0.2	0.043 ± 0.000
Sac. R.–Shasta	09/19/96	0.40 µm Mem	2/2	4.3 ± 0.1	0.029 ± 0.010
Sac. R.–Shasta	09/19/96	0.45 µm Cap	1/2	4.9 ± 0.4	0.015 ± 0.010
Sac. R.–Shasta	09/19/96	0.45 µm Cap	2/2	4.3 ± 0.1	0.0094 ± 0.0000
Sac. R.–Shasta	09/19/96	10 kd Tan	1/2	3.6 ± 0.1	< 0.003 ± 0.001
Sac. R.–Shasta	09/19/96	10 kd Tan	2/2	3.5 ± 0.1	< 0.008 ± 0.005
Sac. R.–Shasta	11/19/96	0.40 µm Mem	1/2	1.0 ± 0.2	0.016 ± 0.003
Sac. R.–Shasta	11/19/96	0.40 µm Mem	2/2	0.86 ± 0.06	0.015 ± 0.007
Sac. R.–Shasta	11/19/96	0.45 µm Cap	1/2	0.77 ± 0.09	0.011 ± 0.004
Sac. R.–Shasta	11/19/96	0.45 µm Cap	2/2	0.94 ± 0.09	0.0078 ± 0.0046
Sac. R.–Shasta	11/19/96	10 kd Tan	1/2	1.3 ± 0.2	< 0.005 ± 0.000
Sac. R.–Shasta	11/19/96	10 kd Tan	2/2	1.1 ± 0.0	0.0070 ± 0.0011
Sac. R.–Shasta	12/12/96	0.40 µm Mem	1/2	3.7 ± 0.1	0.014 ± 0.005
Sac. R.–Shasta	12/12/96	0.40 µm Mem	2/2	4.0 ± 0.1	0.022 ± 0.007
Sac. R.–Shasta	12/12/96	0.45 µm Cap	1/2	4.9 ± 0.2	0.028 ± 0.003
Sac. R.–Shasta	12/12/96	0.45 µm Cap	2/2	5.0 ± 0.2	0.015 ± 0.005
Sac. R.–Shasta	12/12/96	10 kd Tan	1/2	3.3 ± 0.0	0.013 ± 0.007
Sac. R.–Shasta	12/12/96	10 kd Tan	2/2	3.5 ± 0.1	< 0.006 ± 0.001
Sac. R.–Shasta	05/29/97	0.40 µm Mem	1/2	1.1 ± 0.0	0.069 ± 0.009
Sac. R.–Shasta	05/29/97	0.40 µm Mem	2/2	0.99 ± 0.12	0.038 ± 0.005
Sac. R.–Shasta	05/29/97	0.45 µm Cap	1/2	1.1 ± 0.1	0.027 ± 0.000
Sac. R.–Shasta	05/29/97	0.45 µm Cap	2/2	1.0 ± 0.1	0.017 ± 0.002
Sac. R.–Shasta	05/29/97	10 kd Tan	1/2	0.79 ± 0.07	< 0.005 ± 0.005
Sac. R.–Shasta	05/29/97	10 kd Tan	2/2	0.63 ± 0.07	< 0.005 ± 0.005
Sac. R.–Keswick	07/11/96	0.40 µm Mem	1/2	3.1 ± 0.4	0.028 ± 0.005

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Sac. R.–Keswick	07/11/96	0.40 µm Mem	2/2	1.7 ± 0.1	0.030 ± 0.005
Sac. R.–Keswick	07/11/96	0.45 µm Cap	1/2	1.8 ± 0.1	0.031 ± 0.007
Sac. R.–Keswick	07/11/96	0.45 µm Cap	2/2	1.8 ± 0.1	0.029 ± 0.003
Sac. R.–Keswick	07/11/96	10 kd Tan	1/3	1.8 ± 0.0	0.019 ± 0.004
Sac. R.–Keswick	07/11/96	10 kd Tan	2/3	2.2 ± 0.5	0.016 ± 0.004
Sac. R.–Keswick	07/11/96	10 kd Tan	3/3	2.1 ± 0.6	0.012 ± 0.006
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/2	2.9 ± 0.0	0.016 ± 0.005
Sac. R.–Keswick	09/19/96	0.40 µm Mem	2/2	3.4 ± 0.0	0.013 ± 0.004
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/2	3.5 ± 0.1	0.0092 ± 0.0030
Sac. R.–Keswick	09/19/96	0.45 µm Cap	2/2	3.0 ± 0.1	0.0077 ± 0.0019
Sac. R.–Keswick	09/19/96	10 kd Tan	1/3	2.6 ± 0.1	< 0.008 ± 0.001
Sac. R.–Keswick	09/19/96	10 kd Tan	2/3	2.3 ± 0.1	< 0.008 ± 0.005
Sac. R.–Keswick	09/19/96	10 kd Tan	3/3	2.4 ± 0.1	< 0.008 ± 0.003
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/2	3.9 ± 0.1	0.0084 ± 0.0026
Sac. R.–Keswick	11/21/96	0.40 µm Mem	2/2	4.0 ± 0.2	0.014 ± 0.008
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/2	4.5 ± 0.3	0.0096 ± 0.0056
Sac. R.–Keswick	11/21/96	0.45 µm Cap	2/2	4.5 ± 0.1	0.0086 ± 0.0042
Sac. R.–Keswick	11/21/96	10 kd Tan	1/2	2.9 ± 0.1	0.0055 ± 0.0004
Sac. R.–Keswick	11/21/96	10 kd Tan	2/2	2.9 ± 0.1	< 0.005 ± 0.005
Sac. R.–Keswick	12/11/96	0.40 µm Mem	1/2	7.0 ± 0.1	0.015 ± 0.008
Sac. R.–Keswick	12/11/96	0.40 µm Mem	2/2	6.5 ± 0.2	0.012 ± 0.001
Sac. R.–Keswick	12/11/96	0.45 µm Cap	1/2	8.4 ± 0.2	0.014 ± 0.005
Sac. R.–Keswick	12/11/96	0.45 µm Cap	2/2	8.8 ± 0.4	0.026 ± 0.006
Sac. R.–Keswick	12/11/96	10 kd Tan	1/2	4.9 ± 0.2	< 0.006 ± 0.003
Sac. R.–Keswick	12/11/96	10 kd Tan	2/2	4.9 ± 0.1	0.0081 ± 0.0031
Sac. R.–Keswick	01/02/97	0.40 µm Mem	1/2	8.9 ± 0.2	0.011 ± 0.005
Sac. R.–Keswick	01/02/97	0.40 µm Mem	2/2	9.2 ± 0.2	0.014 ± 0.004
Sac. R.–Keswick	01/02/97	0.45 µm Cap	1/2	16 ± 1	0.010 ± 0.004
Sac. R.–Keswick	01/02/97	0.45 µm Cap	2/2	16 ± 0	0.017 ± 0.006
Sac. R.–Keswick	01/02/97	10 kd Tan	1/3	8.1 ± 0.2	< 0.006 ± 0.000
Sac. R.–Keswick	01/02/97	10 kd Tan	2/3	8.1 ± 0.2	0.0084 ± 0.0039
Sac. R.–Keswick	01/02/97	10 kd Tan	3/3	7.9 ± 0.3	< 0.007 ± 0.001
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/2	1.5 ± 0.1	0.019 ± 0.004
Sac. R.–Keswick	05/28/97	0.40 µm Mem	2/2	1.5 ± 0.0	0.038 ± 0.003

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/2	2.6 ± 0.1	0.017 ± 0.002
Sac. R.–Keswick	05/28/97	0.45 µm Cap	2/2	2.2 ± 0.2	0.013 ± 0.003
Sac. R.–Keswick	05/28/97	10 kd Tan	1/2	1.6 ± 0.1	< 0.005 ± 0.002
Sac. R.–Keswick	05/28/97	10 kd Tan	2/2	1.7 ± 0.1	0.0063 ± 0.0046
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/2	1.7 ± 0.0	0.051 ± 0.003
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	2/2	1.5 ± 0.0	0.029 ± 0.000
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/2	1.6 ± 0.0	0.031 ± 0.003
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	2/2	1.3 ± 0.1	0.022 ± 0.000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/3	1.3 ± 0.1	< 0.017 ± 0.002
Sac. R.–Bend Br.	07/11/96	10 kd Tan	2/3	1.2 ± 0.1	0.020 ± 0.007
Sac. R.–Bend Br.	07/11/96	10 kd Tan	3/3	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/2	2.8 ± 0.7	0.016 ± 0.002
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	2/2	2.6 ± 0.6	0.022 ± 0.005
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/2	2.9 ± 0.1	0.023 ± 0.004
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	2/2	2.7 ± 0.1	0.017 ± 0.003
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/2	1.9 ± 0.1	< 0.008 ± 0.003
Sac. R.–Bend Br.	09/20/96	10 kd Tan	2/2	2.3 ± 0.2	< 0.008 ± 0.005
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	1/2	2.0 ± 0.1	0.058 ± 0.011
Sac. R.–Bend Br.	11/22/96	0.40 µm Mem	2/2	2.0 ± 0.1	0.054 ± 0.005
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	1/2	2.7 ± 0.1	0.044 ± 0.007
Sac. R.–Bend Br.	11/22/96	0.45 µm Cap	2/2	2.7 ± 0.0	0.041 ± 0.005
Sac. R.–Bend Br.	11/22/96	10 kd Tan	1/2	1.9 ± 0.3	< 0.005 ± 0.001
Sac. R.–Bend Br.	11/22/96	10 kd Tan	2/2	1.9 ± 0.4	< 0.005 ± 0.007
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	1/2	1.1 ± 0.1	0.031 ± 0.005
Sac. R.–Bend Br.	12/12/96	0.40 µm Mem	2/2	1.2 ± 0.0	0.032 ± 0.006
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	1/2	1.4 ± 0.0	0.026 ± 0.004
Sac. R.–Bend Br.	12/12/96	0.45 µm Cap	2/2	1.9 ± 0.1	0.020 ± 0.008
Sac. R.–Bend Br.	12/12/96	10 kd Tan	1/2	0.80 ± 0.06	< 0.006 ± 0.002
Sac. R.–Bend Br.	12/12/96	10 kd Tan	2/2	0.76 ± 0.02	0.0075 ± 0.0046
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	1/2	0.79 ± 0.05	0.078 ± 0.015
Sac. R.–Bend Br.	01/03/97	0.40 µm Mem	2/2	0.32 ± 0.04	0.037 ± 0.009
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	1/2	2.0 ± 0.0	0.033 ± 0.005
Sac. R.–Bend Br.	01/03/97	0.45 µm Cap	2/2	0.84 ± 0.02	0.028 ± 0.002

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Sac. R.–Bend Br.	01/03/97	10 kd Tan	1/2	0.43 ± 0.07	0.0093 ± 0.0028
Sac. R.–Bend Br.	01/03/97	10 kd Tan	2/2	0.36 ± 0.03	0.017 ± 0.004
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	1/2	1.1 ± 0.2	0.046 ± 0.004
Sac. R.–Bend Br.	05/30/97	0.40 µm Mem	2/2	0.94 ± 0.07	0.038 ± 0.000
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	1/2	2.3 ± 0.3	0.028 ± 0.004
Sac. R.–Bend Br.	05/30/97	0.45 µm Cap	2/2	3.2 ± 0.1	0.027 ± 0.003
Sac. R.–Bend Br.	05/30/97	10 kd Tan	1/2	1.1 ± 0.1	0.0067 ± 0.0023
Sac. R.–Bend Br.	05/30/97	10 kd Tan	2/2	1.0 ± 0.1	< 0.005 ± 0.003
Sac. R.–Colusa	07/16/96	0.40 µm Mem	1/2	0.62 ± 0.21	0.035 ± 0.006
Sac. R.–Colusa	07/16/96	0.40 µm Mem	2/2	0.67 ± 0.07	0.035 ± 0.001
Sac. R.–Colusa	07/16/96	0.45 µm Cap	1/1	1.4 ± 0.0	0.034 ± 0.004
Sac. R.–Colusa	07/16/96	10 kd Tan	1/2	— ± —	— ± —
Sac. R.–Colusa	07/16/96	10 kd Tan	2/2	— ± —	— ± —
Sac. R.–Colusa	09/25/96	0.40 µm Mem	1/2	0.49 ± 0.03	0.021 ± 0.006
Sac. R.–Colusa	09/25/96	0.40 µm Mem	2/2	1.3 ± 0.1	0.034 ± 0.008
Sac. R.–Colusa	09/25/96	0.45 µm Cap	1/2	0.94 ± 0.10	0.018 ± 0.000
Sac. R.–Colusa	09/25/96	0.45 µm Cap	2/2	1.2 ± 0.4	0.019 ± 0.001
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	0.33 ± 0.04	0.013 ± 0.004
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	0.39 ± 0.04	0.014 ± 0.003
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/2	0.55 ± 0.03	0.035 ± 0.008
Sac. R.–Colusa	11/13/96	0.40 µm Mem	2/2	0.50 ± 0.02	0.039 ± 0.000
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/2	0.51 ± 0.03	0.022 ± 0.003
Sac. R.–Colusa	11/13/96	0.45 µm Cap	2/2	0.48 ± 0.04	0.023 ± 0.009
Sac. R.–Colusa	11/13/96	10 kd Tan	1/2	0.34 ± 0.01	0.0070 ± 0.0051
Sac. R.–Colusa	11/13/96	10 kd Tan	2/2	0.50 ± 0.12	0.010 ± 0.009
Sac. R.–Colusa	12/16/96	0.40 µm Mem	1/2	0.61 ± 0.05	0.039 ± 0.009
Sac. R.–Colusa	12/16/96	0.40 µm Mem	2/2	0.71 ± 0.21	0.023 ± 0.006
Sac. R.–Colusa	12/16/96	0.45 µm Cap	1/2	1.8 ± 0.2	0.032 ± 0.008
Sac. R.–Colusa	12/16/96	0.45 µm Cap	2/2	0.87 ± 0.01	0.020 ± 0.003
Sac. R.–Colusa	12/16/96	10 kd Tan	1/2	0.55 ± 0.07	0.015 ± 0.001
Sac. R.–Colusa	12/16/96	10 kd Tan	2/2	0.61 ± 0.06	0.0074 ± 0.0022
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/2	0.16 ± 0.02	0.074 ± 0.012
Sac. R.–Colusa	01/04/97	0.40 µm Mem	2/2	0.21 ± 0.08	0.049 ± 0.015

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP–MS	Zirconium (µg/L) ICP–MS
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/2	1.1 ± 0.0	0.067 ± 0.012
Sac. R.–Colusa	01/04/97	0.45 µm Cap	2/2	0.40 ± 0.06	0.081 ± 0.006
Sac. R.–Colusa	01/04/97	10 kd Tan	1/2	0.17 ± 0.03	0.043 ± 0.008
Sac. R.–Colusa	01/04/97	10 kd Tan	2/2	0.20 ± 0.04	0.041 ± 0.019
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/2	1.0 ± 0.3	0.029 ± 0.000
Sac. R.–Colusa	06/03/97	0.40 µm Mem	2/2	0.46 ± 0.06	0.067 ± 0.005
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/2	1.2 ± 0.0	0.017 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	2/2	0.99 ± 0.13	0.016 ± 0.002
Sac. R.–Colusa	06/03/97	10 kd Tan	1/2	0.60 ± 0.28	< 0.005 ± 0.002
Sac. R.–Colusa	06/03/97	10 kd Tan	2/2	0.88 ± 0.33	0.0055 ± 0.0042
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/2	1.3 ± 0.1	0.039 ± 0.005
Sac. R.–Verona	07/18/96	0.40 µm Mem	2/2	1.9 ± 0.7	0.032 ± 0.006
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/2	0.37 ± 0.04	0.033 ± 0.009
Sac. R.–Verona	07/18/96	0.45 µm Cap	2/2	0.62 ± 0.17	0.027 ± 0.008
Sac. R.–Verona	07/18/96	10 kd Tan	1/3	0.24 ± 0.03	< 0.017 ± 0.000
Sac. R.–Verona	07/18/96	10 kd Tan	2/3	0.17 ± 0.08	0.017 ± 0.004
Sac. R.–Verona	07/18/96	10 kd Tan	3/3	— ± —	— ± —
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/2	0.63 ± 0.06	0.025 ± 0.000
Sac. R.–Verona	09/26/96	0.40 µm Mem	2/2	0.71 ± 0.19	0.013 ± 0.003
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/2	0.58 ± 0.07	0.019 ± 0.004
Sac. R.–Verona	09/26/96	0.45 µm Cap	2/2	0.64 ± 0.09	0.017 ± 0.002
Sac. R.–Verona	09/26/96	10 kd Tan	1/2	0.33 ± 0.13	< 0.008 ± 0.003
Sac. R.–Verona	09/26/96	10 kd Tan	2/2	0.35 ± 0.07	< 0.008 ± 0.003
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	— ± —	— ± —
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/2	0.63 ± 0.07	0.047 ± 0.015
Sac. R.–Verona	11/14/96	0.45 µm Cap	2/2	0.55 ± 0.06	0.073 ± 0.036
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	— ± —	— ± —
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/2	0.62 ± 0.10	0.035 ± 0.005
Sac. R.–Verona	12/18/96	0.40 µm Mem	2/2	0.58 ± 0.03	0.038 ± 0.013
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/2	0.59 ± 0.03	0.033 ± 0.003
Sac. R.–Verona	12/18/96	0.45 µm Cap	2/2	0.70 ± 0.06	0.032 ± 0.005
Sac. R.–Verona	12/18/96	10 kd Tan	1/2	0.62 ± 0.07	0.016 ± 0.006
Sac. R.–Verona	12/18/96	10 kd Tan	2/2	0.30 ± 0.08	0.013 ± 0.005

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/2	0.49 ± 0.08	0.025 ± 0.012
Sac. R.–Verona	06/04/97	0.40 µm Mem	2/2	0.32 ± 0.21	0.024 ± 0.009
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/2	1.2 ± 0.0	0.013 ± 0.003
Sac. R.–Verona	06/04/97	0.45 µm Cap	2/2	1.1 ± 0.5	0.013 ± 0.004
Sac. R.–Verona	06/04/97	10 kd Tan	1/2	0.27 ± 0.08	0.0057 ± 0.0074
Sac. R.–Verona	06/04/97	10 kd Tan	2/2	0.57 ± 0.17	< 0.005 ± 0.003
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/2	0.59 ± 0.05	< 0.017 ± 0.001
Sac. R.–Freeport	07/17/96	0.40 µm Mem	2/2	1.1 ± 0.1	0.019 ± 0.008
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/2	0.81 ± 0.04	0.067 ± 0.000
Sac. R.–Freeport	07/17/96	0.45 µm Cap	2/2	0.55 ± 0.04	0.036 ± 0.002
Sac. R.–Freeport	07/17/96	10 kd Tan	1/3	0.34 ± 0.08	0.014 ± 0.006
Sac. R.–Freeport	07/17/96	10 kd Tan	2/3	0.37 ± 0.12	0.018 ± 0.004
Sac. R.–Freeport	07/17/96	10 kd Tan	3/3	— ± —	— ± —
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/2	0.96 ± 0.06	0.015 ± 0.004
Sac. R.–Freeport	09/24/96	0.40 µm Mem	2/2	0.64 ± 0.08	0.013 ± 0.003
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/2	0.67 ± 0.04	0.012 ± 0.001
Sac. R.–Freeport	09/24/96	0.45 µm Cap	2/2	0.69 ± 0.03	0.025 ± 0.014
Sac. R.–Freeport	09/24/96	10 kd Tan	1/2	2.2 ± 0.1	< 0.009 ± 0.003
Sac. R.–Freeport	09/24/96	10 kd Tan	2/2	0.58 ± 0.01	< 0.003 ± 0.001
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/2	0.75 ± 0.07	0.027 ± 0.003
Sac. R.–Freeport	11/12/96	0.40 µm Mem	2/2	0.61 ± 0.05	0.017 ± 0.006
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/2	1.0 ± 0.0	0.014 ± 0.004
Sac. R.–Freeport	11/12/96	0.45 µm Cap	2/2	1.0 ± 0.1	0.015 ± 0.000
Sac. R.–Freeport	11/12/96	10 kd Tan	1/2	0.54 ± 0.03	< 0.005 ± 0.005
Sac. R.–Freeport	11/12/96	10 kd Tan	2/2	0.70 ± 0.06	< 0.005 ± 0.001
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/2	0.63 ± 0.13	0.047 ± 0.006
Sac. R.–Freeport	12/17/96	0.40 µm Mem	2/2	0.47 ± 0.28	0.10 ± 0.01
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/2	0.51 ± 0.06	0.062 ± 0.019
Sac. R.–Freeport	12/17/96	0.45 µm Cap	2/2	0.65 ± 0.09	0.053 ± 0.014
Sac. R.–Freeport	12/17/96	10 kd Tan	1/2	0.42 ± 0.06	0.023 ± 0.003
Sac. R.–Freeport	12/17/96	10 kd Tan	2/2	0.34 ± 0.11	0.019 ± 0.003
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/2	0.11 ± 0.02	0.10 ± 0.00
Sac. R.–Freeport	01/06/97	0.40 µm Mem	2/2	0.31 ± 0.07	0.10 ± 0.01

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/2	1.1 ± 0.2	0.091 ± 0.018
Sac. R.–Freeport	01/06/97	0.45 µm Cap	2/2	0.20 ± 0.02	0.090 ± 0.014
Sac. R.–Freeport	01/06/97	10 kd Tan	1/2	1.2 ± 0.1	0.017 ± 0.003
Sac. R.–Freeport	01/06/97	10 kd Tan	2/2	0.085 ± 0.014	0.022 ± 0.002
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/2	1.1 ± 0.1	0.015 ± 0.003
Sac. R.–Freeport	06/05/97	0.40 µm Mem	2/2	0.23 ± 0.04	0.013 ± 0.005
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/2	0.22 ± 0.02	0.013 ± 0.002
Sac. R.–Freeport	06/05/97	0.45 µm Cap	2/2	0.28 ± 0.04	0.016 ± 0.002
Sac. R.–Freeport	06/05/97	10 kd Tan	1/2	0.35 ± 0.05	< 0.005 ± 0.002
Sac. R.–Freeport	06/05/97	10 kd Tan	2/2	0.32 ± 0.03	< 0.005 ± 0.003
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	1/2	0.39 ± 0.10	0.024 ± 0.004
Sac. R.–Freeport, dup	06/05/97	0.40 µm Mem	2/2	0.35 ± 0.15	0.027 ± 0.003
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	1/2	0.25 ± 0.14	0.018 ± 0.003
Sac. R.–Freeport, dup	06/05/97	0.45 µm Cap	2/2	0.25 ± 0.09	0.021 ± 0.001
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	1/2	0.093 ± 0.056	< 0.004 ± 0.002
Sac. R.–Freeport, dup	06/05/97	10 kd Tan	2/2	0.13 ± 0.08	< 0.004 ± 0.000
Flat Cr.	12/11/96	0.40 µm Mem	1/2	23 ± 1	0.026 ± 0.004
Flat Cr.	12/11/96	0.40 µm Mem	2/2	23 ± 1	0.020 ± 0.004
Flat Cr.	12/11/96	0.45 µm Cap	1/2	18 ± 0	0.020 ± 0.001
Flat Cr.	12/11/96	0.45 µm Cap	2/2	18 ± 1	0.023 ± 0.006
Flat Cr.	12/11/96	10 kd Tan	1/2	13 ± 0	0.0084 ± 0.0021
Flat Cr.	12/11/96	10 kd Tan	2/2	12 ± 0	0.011 ± 0.004
Flat Cr.	05/29/97	0.40 µm Mem	1/2	5.5 ± 0.1	0.0066 ± 0.0060
Flat Cr.	05/29/97	0.40 µm Mem	2/2	5.9 ± 0.2	0.0068 ± 0.0009
Flat Cr.	05/29/97	0.45 mm Cap	1/2	6.8 ± 0.3	0.0070 ± 0.0015
Flat Cr.	05/29/97	0.45 µm Cap	2/2	7.8 ± 0.1	0.0053 ± 0.0028
Flat Cr.	05/29/97	10 kd Tan	1/2	5.3 ± 0.3	< 0.004 ± 0.002
Flat Cr.	05/29/97	10 kd Tan	2/2	5.0 ± 0.1	< 0.004 ± 0.000
Spring Cr.–Weir	12/11/96	0.40 µm Mem	1/2	529 ± 9	0.039 ± 0.006
Spring Cr.–Weir	12/11/96	0.40 µm Mem	2/2	565 ± 27	0.040 ± 0.005
Spring Cr.–Weir	12/11/96	0.45 µm Cap	1/2	568 ± 7	0.044 ± 0.002
Spring Cr.–Weir	12/11/96	0.45 µm Cap	2/2	567 ± 18	0.036 ± 0.009
Spring Cr.–Weir	12/11/96	10 kd Tan	1/2	560 ± 4	0.041 ± 0.000

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Spring Cr.–Weir	12/11/96	10 kd Tan	2/2	544 ± 7	0.043 ± 0.006
Spring Cr.–Weir	05/28/97	0.40 µm Mem	1/2	992 ± 40	0.010 ± 0.001
Spring Cr.–Weir	05/28/97	0.40 µm Mem	2/2	1,020 ± 50	0.0088 ± 0.0022
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/2	916 ± 15	0.011 ± 0.001
Spring Cr.–Weir	05/28/97	0.45 µm Cap	2/2	968 ± 4	0.0079 ± 0.0013
Spring Cr.–Weir	05/28/97	10 kd Tan	1/2	853 ± 2	0.0076 ± 0.0037
Spring Cr.–Weir	05/28/97	10 kd Tan	2/2	884 ± 4	0.0076 ± 0.0020
Spring Cr.–Road	01/02/97	0.40 µm Mem	1/2	1,360 ± 30	0.051 ± 0.004
Spring Cr.–Road	01/02/97	0.40 µm Mem	2/2	1,350 ± 40	0.066 ± 0.020
Spring Cr.–Road	01/02/97	0.45 µm Cap	1/2	1,320 ± 30	0.063 ± 0.007
Spring Cr.–Road	01/02/97	0.45 µm Cap	2/2	1,340 ± 20	0.064 ± 0.002
Spring Cr.–Road	01/02/97	10 kd Tan	1/2	1,280 ± 20	0.057 ± 0.007
Spring Cr.–Road	01/02/97	10 kd Tan	2/2	1,250 ± 30	0.053 ± 0.004
Whiskeytown	12/11/96	0.40 µm Mem	1/2	0.55 ± 0.04	0.036 ± 0.024
Whiskeytown	12/11/96	0.40 µm Mem	2/2	0.66 ± 0.04	0.020 ± 0.005
Whiskeytown	12/11/96	0.45 µm Cap	1/2	1.1 ± 0.0	0.011 ± 0.003
Whiskeytown	12/11/96	0.45 µm Cap	2/2	1.3 ± 0.1	0.012 ± 0.003
Whiskeytown	12/11/96	10 kd Tan	1/2	0.92 ± 0.11	0.016 ± 0.009
Whiskeytown	12/11/96	10 kd Tan	2/2	0.94 ± 0.08	< 0.006 ± 0.002
Whiskeytown	05/29/97	0.40 µm Mem	1/2	0.18 ± 0.05	0.011 ± 0.003
Whiskeytown	05/29/97	0.40 µm Mem	2/2	0.18 ± 0.06	0.014 ± 0.002
Whiskeytown	05/29/97	0.45 µm Cap	1/2	0.67 ± 0.04	0.010 ± 0.003
Whiskeytown	05/29/97	0.45 µm Cap	2/2	3.8 ± 0.4	0.0091 ± 0.0023
Whiskeytown	05/29/97	10 kd Tan	1/2	0.17 ± 0.03	< 0.004 ± 0.001
Whiskeytown	05/29/97	10 kd Tan	2/2	0.34 ± 0.15	< 0.004 ± 0.002
Spring Cr. arm	07/12/96	0.40 µm Mem	1/2	1.6 ± 0.1	< 0.017 ± 0.005
Spring Cr. arm	07/12/96	0.40 µm Mem	2/2	1.6 ± 0.2	0.016 ± 0.001
Spring Cr. arm	07/12/96	0.45 µm Cap	1/2	1.3 ± 0.0	0.024 ± 0.008
Spring Cr. arm	07/12/96	0.45 µm Cap	2/2	1.2 ± 0.2	0.029 ± 0.012
Spring Cr. arm	07/12/96	10 kd Tan	1/3	0.84 ± 0.05	0.019 ± 0.005
Spring Cr. arm	07/12/96	10 kd Tan	2/3	0.68 ± 0.05	< 0.017 ± 0.001
Spring Cr. arm	07/12/96	10 kd Tan	3/3	— ± —	— ± —
Spring Cr. arm	09/18/96	0.40 µm Mem	1/2	2.5 ± 0.0	0.0092 ± 0.0074
Spring Cr. arm	09/18/96	0.40 µm Mem	2/2	2.5 ± 0.0	< 0.008 ± 0.004

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Table A4-1. Concentrations of major cations and trace elements in filtered water samples—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Zinc (µg/L) ICP-MS	Zirconium (µg/L) ICP-MS
Spring Cr. arm	09/18/96	0.45 µm Cap	1/2	2.8 ± 0.0	< 0.008 ± 0.004
Spring Cr. arm	09/18/96	0.45 µm Cap	2/2	2.9 ± 0.2	< 0.008 ± 0.001
Spring Cr. arm	09/18/96	10 kd Tan	1/2	2.2 ± 0.0	< 0.008 ± 0.001
Spring Cr. arm	09/18/96	10 kd Tan	2/2	2.5 ± 0.5	< 0.008 ± 0.004
Spring Cr. arm	11/20/96	0.40 µm Mem	1/2	14 ± 0	0.014 ± 0.008
Spring Cr. arm	11/20/96	0.40 µm Mem	2/2	12 ± 0	0.0088 ± 0.0087
Spring Cr. arm	11/20/96	0.45 µm Cap	1/2	15 ± 1	0.0054 ± 0.0037
Spring Cr. arm	11/20/96	0.45 µm Cap	2/2	16 ± 0	0.0078 ± 0.0062
Spring Cr. arm	11/20/96	10 kd Tan	1/2	11 ± 0	< 0.005 ± 0.005
Spring Cr. arm	11/20/96	10 kd Tan	2/2	11 ± 0	< 0.005 ± 0.002
Spring Cr. arm	12/11/96	0.40 µm Mem	1/2	47 ± 1	0.0053 ± 0.0042
Spring Cr. arm	12/11/96	0.40 µm Mem	2/2	47 ± 1	0.0050 ± 0.0017
Spring Cr. arm	12/11/96	0.45 µm Cap	1/2	56 ± 1	0.0059 ± 0.0022
Spring Cr. arm	12/11/96	0.45 µm Cap	2/2	55 ± 1	< 0.006 ± 0.002
Spring Cr. arm	12/11/96	10 kd Tan	1/2	36 ± 0	< 0.006 ± 0.002
Spring Cr. arm	12/11/96	10 kd Tan	2/2	35 ± 0	0.0037 ± 0.0026
Spring Cr. arm	05/28/97	0.40 µm Mem	1/2	2.3 ± 0.3	0.0091 ± 0.0011
Spring Cr. arm	05/28/97	0.40 µm Mem	2/2	2.0 ± 0.1	0.0097 ± 0.0027
Spring Cr. arm	05/28/97	0.45 µm Cap	1/2	3.1 ± 0.2	< 0.004 ± 0.000
Spring Cr. arm	05/28/97	0.45 µm Cap	2/2	2.8 ± 0.1	0.0074 ± 0.0015
Spring Cr. arm	05/28/97	10 kd Tan	1/2	2.3 ± 0.2	< 0.004 ± 0.000
Spring Cr. arm	05/28/97	10 kd Tan	2/2	1.8 ± 0.2	< 0.004 ± 0.001
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/2	0.43 ± 0.07	0.040 ± 0.010
Colusa Basin Drain	06/06/97	0.40 µm Mem	2/2	0.53 ± 0.26	0.041 ± 0.003
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/2	0.40 ± 0.09	0.033 ± 0.008
Colusa Basin Drain	06/06/97	0.45 µm Cap	2/2	0.50 ± 0.10	0.036 ± 0.004
Colusa Basin Drain	06/06/97	10 kd Tan	1/2	0.26 ± 0.09	0.0094 ± 0.0034
Colusa Basin Drain	06/06/97	10 kd Tan	2/2	0.35 ± 0.08	0.016 ± 0.007
Yolo Bypass	01/07/97	0.40 µm Mem	1/2	0.56 ± 0.14	0.080 ± 0.004
Yolo Bypass	01/07/97	0.40 µm Mem	2/2	0.35 ± 0.01	0.052 ± 0.009
Yolo Bypass	01/07/97	0.45 µm Cap	1/2	0.88 ± 0.10	0.088 ± 0.006
Yolo Bypass	01/07/97	0.45 µm Cap	2/2	0.49 ± 0.01	0.095 ± 0.004
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.18 ± 0.04	0.019 ± 0.004
Yolo Bypass	01/07/97	10 kd Tan	2/2	0.23 ± 0.08	0.015 ± 0.005

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples

[Ax, axial; Br., bridge; Cr., creek; CV–AFS, cold vapor atomic fluorescence spectrometry; dup, duplicate; ICP–AES, inductively coupled plasma–atomic emission spectrometry; ICP–MS, inductively coupled plasma–mass spectrometry; R., river; Sac., Sacramento; Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples. UV–vis, ultraviolet–visible spectroscopy; mm/dd/yy, month/day/year; µg/L, microgram per liter; mg/L, milligram per liter. <, less than the indicated detection limit; —, no data available]

Site	Date (mm/dd/yy)	Split Replicate	Aluminum (µg/L) ICP–MS/ICP–AES	Antimony (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS	Bismuth (µg/L) ICP–AES
Sac. R.- Shasta	07/12/96	1/2	209 ± 1	0.041 ± 0.004	15 ± 1	<0.03 ± 0.04	<0.003 ± 0.004
Sac. R.–Shasta	07/12/96	2/2	187 ± 5	0.033 ± 0.005	15 ± 0	<0.03 ± 0.00	<0.003 ± 0.003
Sac. R.–Shasta	09/19/96	1/2	73 ± 3	0.044 ± 0.015	15 ± 0	<0.03 ± 0.02	<0.003 ± 0.001
Sac. R.–Shasta	09/19/96	2/2	98 ± 14	0.046 ± 0.006	15 ± 1	<0.1 ± 0.1	<0.004 ± 0.000
Sac. R.–Shasta	11/19/96	1/2	53 ± 4	0.043 ± 0.013	14 ± 0	<0.1 ± 0.1	<0.004 ± 0.001
Sac. R.–Shasta	11/19/96	2/2	52 ± 4	0.051 ± 0.007	14 ± 1	<0.1 ± 0.0	<0.004 ± 0.001
Sac. R.–Shasta	12/12/96	1/2	97 ± 3	0.047 ± 0.010	14 ± 0	<0.03 ± 0.00	<0.004 ± 0.001
Sac. R.–Shasta	12/12/96	2/2	95 ± 4	0.053 ± 0.008	14 ± 0	<0.03 ± 0.01	0.0065 ± 0.0007
Sac. R.–Shasta	05/29/97	1/2	397 ± 23	0.040 ± 0.005	16 ± 0	<0.03 ± 0.04	<0.004 ± 0.001
Sac. R.–Shasta	05/29/97	2/2	414 ± 7	0.052 ± 0.015	15 ± 1	<0.03 ± 0.02	<0.004 ± 0.001
Sac. R.–Keswick	07/11/96	1/2	175 ± 14	0.038 ± 0.005	13 ± 0	<0.03 ± 0.02	<0.003 ± 0.002
Sac. R.–Keswick	07/11/96	2/2	169 ± 2	0.040 ± 0.006	13 ± 0	<0.03 ± 0.02	<0.003 ± 0.001
Sac. R.–Keswick	09/19/96	1/2	85 ± 15	0.041 ± 0.000	11 ± 1	0.12 ± 0.10	0.0052 ± 0.0028
Sac. R.–Keswick	09/19/96	2/2	57 ± 3	0.035 ± 0.010	11 ± 0	<0.03 ± 0.01	<0.003 ± 0.001
Sac. R.–Keswick	11/21/96	1/2	243 ± 31	0.078 ± 0.008	12 ± 1	0.12 ± 0.09	0.012 ± 0.001
Sac. R.–Keswick	11/21/96	2/2	222 ± 5	0.087 ± 0.009	12 ± 0	<0.1 ± 0.1	0.015 ± 0.001
Sac. R.–Keswick	12/11/96	1/2	157 ± 2	0.060 ± 0.007	13 ± 0	<0.03 ± 0.00	0.0087 ± 0.0032
Sac. R.–Keswick	12/11/96	2/2	165 ± 3	0.053 ± 0.003	13 ± 0	<0.03 ± 0.02	0.0066 ± 0.0024
Sac. R.–Keswick	01/02/97	1/2	609 ± 5	0.072 ± 0.004	18 ± 1	<0.03 ± 0.02	0.013 ± 0.005
Sac. R.–Keswick	01/02/97	2/2	594 ± 13	0.062 ± 0.009	17 ± 0	<0.03 ± 0.02	0.0090 ± 0.0001
Sac. R.–Keswick	05/28/97	1/2	390 ± 17	0.040 ± 0.005	14 ± 1	<0.03 ± 0.02	<0.004 ± 0.001
Sac. R.–Keswick	05/28/97	2/2	386 ± 21	0.041 ± 0.005	14 ± 1	<0.03 ± 0.04	<0.004 ± 0.001
Sac. R.–Bend Br.	07/11/96	1/2	223 ± 5	0.042 ± 0.006	15 ± 1	<0.03 ± 0.02	<0.003 ± 0.001
Sac. R.–Bend Br.	07/11/96	2/2	230 ± 5	0.053 ± 0.016	16 ± 0	<0.03 ± 0.02	<0.003 ± 0.000
Sac. R.–Bend Br.	09/20/96	1/2	131 ± 5	0.042 ± 0.004	14 ± 0	<0.03 ± 0.02	<0.003 ± 0.001
Sac. R.–Bend Br.	09/20/96	2/2	154 ± 20	0.047 ± 0.010	14 ± 1	0.12 ± 0.08	<0.004 ± 0.001
Sac. R.–Bend Br.	11/22/96	1/2	558 ± 55	0.094 ± 0.004	20 ± 0	<0.1 ± 0.1	0.012 ± 0.000
Sac. R.–Bend Br.	11/22/96	2/2	520 ± 11	0.086 ± 0.002	20 ± 0	<0.1 ± 0.0	0.013 ± 0.001
Sac. R.–Bend Br.	12/12/96	1/2	1,730 ± 36	0.093 ± 0.007	28 ± 2	0.035 ± 0.011	0.011 ± 0.000
Sac. R.–Bend Br.	12/12/96	2/2	1,730 ± 120	0.10 ± 0.01	25 ± 0	0.032 ± 0.018	0.017 ± 0.001
Sac. R.–Bend Br.	01/03/97	1/2	6,030 ± 1,000	0.14 ± 0.01	58 ± 5	0.12 ± 0.03	0.031 ± 0.001
Sac. R.–Bend Br.	01/03/97	2/2	6,010 ± 780	0.13 ± 0.01	58 ± 0	0.11 ± 0.01	0.031 ± 0.003

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Table A4-2. *Concentrations of major cations and trace elements in unfiltered (whole) water samples—Continued*

Site	Date	Split Replicate	Aluminum (µg/L) ICP–MS/ICP–AES	Antimony (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS	Bismuth (µg/L) ICP–AES
Sac. R.–Bend Br.	05/30/97	1/2	396 ± 16	0.047 ± 0.006	15 ± 0	<0.03 ± 0.02	<0.004 ± 0.001
Sac. R.–Bend Br.	05/30/97	2/2	405 ± 24	0.050 ± 0.007	16 ± 0	<0.03 ± 0.05	<0.004 ± 0.001
Sac. R.–Colusa	07/16/96	1/1	2,790 ± 280	0.066 ± 0.004	35 ± 2	0.028 ± 0.013	0.0066 ± 0.0007
Sac. R.–Colusa	09/25/96	1/2	559 ± 25	0.074 ± 0.013	21 ± 1	<0.1 ± 0.1	0.0073 ± 0.0012
Sac. R.–Colusa	09/25/96	2/2	608 ± 66	0.071 ± 0.020	21 ± 0	0.12 ± 0.04	<0.004 ± 0.001
Sac. R.–Colusa	11/13/96	1/2	1,060 ± 53	0.077 ± 0.012	25 ± 1	<0.03 ± 0.01	<0.005 ± 0.000
Sac. R.–Colusa	11/13/96	2/2	1,110 ± 67	0.067 ± 0.005	25 ± 1	<0.03 ± 0.01	<0.005 ± 0.003
Sac. R.–Colusa	12/16/96	1/2	3,380 ± 140	0.12 ± 0.00	48 ± 1	0.057 ± 0.006	0.016 ± 0.001
Sac. R.–Colusa	12/16/96	2/2	3,450 ± 50	0.13 ± 0.00	47 ± 1	0.059 ± 0.002	0.028 ± 0.003
Sac. R.–Colusa	01/04/97	1/2	21,600 ± 280	0.33 ± 0.01	133 ± 8	0.34 ± 0.03	0.091 ± 0.002
Sac. R.–Colusa	01/04/97	2/2	21,300 ± 310	0.33 ± 0.01	143 ± 0	0.30 ± 0.02	0.087 ± 0.001
Sac. R.–Colusa	06/03/97	1/2	1,010 ± 23	0.081 ± 0.003	21 ± 3	<0.03 ± 0.01	0.0075 ± 0.0022
Sac. R.–Colusa	06/03/97	2/2	1,080 ± 74	0.088 ± 0.002	19 ± 4	<0.03 ± 0.01	<0.005 ± 0.001
Sac. R.–Verona	07/18/96	1/2	1,200 ± 130	0.056 ± 0.006	24 ± 1	<0.03 ± 0.01	<0.005 ± 0.001
Sac. R.–Verona	07/18/96	2/2	1,180 ± 51	0.058 ± 0.015	20 ± 5	<0.03 ± 0.01	<0.005 ± 0.002
Sac. R.–Verona	09/26/96	1/2	1,600 ± 37	0.074 ± 0.002	31 ± 1	0.026 ± 0.009	0.0060 ± 0.0019
Sac. R.–Verona	09/26/96	2/2	1,600 ± 64	0.077 ± 0.005	30 ± 1	0.029 ± 0.004	0.0070 ± 0.0018
Sac. R.–Verona	11/14/96	1/2	1,130 ± 58	0.084 ± 0.011	30 ± 2	<0.03 ± 0.02	<0.005 ± 0.000
Sac. R.–Verona	11/14/96	2/2	1,160 ± 85	0.073 ± 0.002	30 ± 1	0.027 ± 0.018	<0.005 ± 0.001
Sac. R.–Verona	12/18/96	1/2	1,770 ± 31	0.088 ± 0.008	30 ± 2	0.034 ± 0.010	0.018 ± 0.001
Sac. R.–Verona	12/18/96	2/2	1,770 ± 35	0.076 ± 0.002	29 ± 2	0.029 ± 0.001	0.0078 ± 0.0004
Sac. R.–Verona	06/04/97	1/2	1,180 ± 140	0.089 ± 0.006	29 ± 2	<0.03 ± 0.01	0.0060 ± 0.0009
Sac. R.–Verona	06/04/97	2/2	1,200 ± 120	0.091 ± 0.009	21 ± 1	<0.03 ± 0.01	<0.005 ± 0.001
Sac. R.–Freeport	07/17/96	1/2	965 ± 12	0.060 ± 0.005	22 ± 1	<0.03 ± 0.00	0.0068 ± 0.0021
Sac. R.–Freeport	07/17/96	2/2	902 ± 13	0.062 ± 0.017	22 ± 0	<0.03 ± 0.04	0.0063 ± 0.0014
Sac. R.–Freeport	09/24/96	1/2	737 ± 70	0.074 ± 0.001	27 ± 1	<0.1 ± 0.1	0.0078 ± 0.0001
Sac. R.–Freeport	09/24/96	2/2	765 ± 13	0.070 ± 0.000	27 ± 0	<0.03 ± 0.02	<0.003 ± 0.001
Sac. R.–Freeport	11/12/96	1/2	323 ± 29	0.061 ± 0.008	23 ± 1	<0.1 ± 0.1	0.0038 ± 0.0019
Sac. R.–Freeport	11/12/96	2/2	317 ± 22	0.062 ± 0.012	22 ± 0	<0.1 ± 0.0	0.0047 ± 0.0025
Sac. R.–Freeport	12/17/96	1/2	2,020 ± 110	0.075 ± 0.006	30 ± 0	0.026 ± 0.008	0.013 ± 0.001
Sac. R.–Freeport	12/17/96	2/2	1,950 ± 190	0.076 ± 0.001	32 ± 1	0.033 ± 0.010	0.0084 ± 0.0004
Sac. R.–Freeport	01/06/97	1/2	9,790 ± 1,600	0.10 ± 0.00	86 ± 3	0.19 ± 0.00	0.050 ± 0.000
Sac. R.–Freeport	01/06/97	1/2	9,890 ± 1,200	0.092 ± 0.008	87 ± 4	0.19 ± 0.00	0.051 ± 0.003
Sac. R.–Freeport	06/05/97	1/2	802 ± 36	0.089 ± 0.006	23 ± 0	<0.03 ± 0.01	<0.004 ± 0.001
Sac. R.–Freeport	06/05/97	2/2	809 ± 39	0.10 ± 0.00	23 ± 1	<0.03 ± 0.02	0.0048 ± 0.0002
Sac. R.–Freeport, dup	06/05/97	1/2	456 ± 26	0.089 ± 0.006	21 ± 1	<0.03 ± 0.03	<0.004 ± 0.002

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Aluminum (µg/L) ICP–MS/ICP–AES	Antimony (µg/L) ICP–MS	Barium (µg/L) ICP–MS	Beryllium (µg/L) ICP–MS	Bismuth (µg/L) ICP–AES
Sac. R.–Freeport, dup	06/05/97	2/2	456 ± 25	0.089 ± 0.006	21 ± 1	<0.03 ± 0.04	<0.004 ± 0.001
Flat Cr.	12/11/96	1/2	321 ± 7	0.044 ± 0.006	5.4 ± 0.3	<0.03 ± 0.03	<0.004 ± 0.001
Flat Cr.	12/11/96	2/2	323 ± 13	0.038 ± 0.002	5.3 ± 0.2	<0.03 ± 0.04	<0.004 ± 0.002
Flat Cr.	05/29/97	1/2	5 ± 0	0.071 ± 0.005	7.6 ± 0.5	<0.03 ± 0.03	0.0039 ± 0.0037
Flat Cr.	05/29/97	2/2	5 ± 0	0.061 ± 0.005	7.5 ± 0.4	<0.03 ± 0.02	<0.004 ± 0.001
Spring Cr.–Weir	12/11/96	1/2	2,900 ± 130	0.032 ± 0.006	8.6 ± 0.2	0.061 ± 0.008	0.0079 ± 0.0015
Spring Cr.–Weir	12/11/96	2/2	2,960 ± 31	0.034 ± 0.007	8.7 ± 0.2	0.054 ± 0.003	0.0084 ± 0.0005
Spring Cr.–Weir	05/28/97	1/2	5,450 ± 330	<0.02 ± 0.00	25 ± 4	0.12 ± 0.02	<0.005 ± 0.000
Spring Cr.–Weir	05/28/97	2/2	5,390 ± 120	<0.02 ± 0.00	22 ± 2	0.14 ± 0.02	<0.005 ± 0.000
Spring Cr.–Road	01/02/97	1/2	2,590 ± 170	0.16 ± 0.01	19 ± 1	0.039 ± 0.009	0.015 ± 0.001
Spring Cr.–Road	01/02/97	2/2	2,650 ± 190	0.17 ± 0.01	18 ± 0	0.049 ± 0.015	0.018 ± 0.001
Whiskeytown	12/11/96	1/2	33 ± 1	0.030 ± 0.005	6.9 ± 0.2	<0.03 ± 0.01	<0.004 ± 0.001
Whiskeytown	12/11/96	2/2	32 ± 1	0.029 ± 0.005	7.4 ± 0.2	<0.03 ± 0.00	<0.003 ± 0.001
Whiskeytown	05/29/97	1/2	419 ± 18	0.052 ± 0.004	8.4 ± 0.1	<0.03 ± 0.02	<0.004 ± 0.000
Whiskeytown	05/29/97	2/2	411 ± 14	0.062 ± 0.007	8.0 ± 0.3	<0.03 ± 0.02	<0.004 ± 0.001
Spring Cr. arm	07/12/96	1/2	20 ± 3	0.025 ± 0.003	7.2 ± 0.4	<0.03 ± 0.04	<0.003 ± 0.001
Spring Cr. arm	07/12/96	2/2	20 ± 3	0.024 ± 0.004	7.1 ± 0.5	<0.03 ± 0.01	<0.003 ± 0.001
Spring Cr. arm	09/18/96	1/2	26 ± 1	0.026 ± 0.008	6.6 ± 0.3	<0.03 ± 0.01	<0.003 ± 0.001
Spring Cr. arm	09/18/96	2/2	36 ± 3	0.054 ± 0.033	6.6 ± 0.6	0.14 ± 0.10	<0.004 ± 0.001
Spring Cr. arm	11/20/96	1/2	205 ± 23	0.029 ± 0.004	7.2 ± 0.3	<0.1 ± 0.1	<0.004 ± 0.002
Spring Cr. arm	11/20/96	2/2	203 ± 18	0.037 ± 0.013	7.1 ± 0.3	<0.1 ± 0.1	<0.004 ± 0.001
Spring Cr. arm	12/11/96	1/2	359 ± 17	0.035 ± 0.010	7.2 ± 0.2	<0.03 ± 0.03	<0.004 ± 0.000
Spring Cr. arm	12/11/96	2/2	364 ± 24	0.035 ± 0.005	7.5 ± 0.1	<0.03 ± 0.01	<0.004 ± 0.002
Spring Cr. arm	05/28/97	1/2	436 ± 29	0.070 ± 0.006	8.1 ± 0.5	<0.03 ± 0.02	0.0050 ± 0.0003
Spring Cr. arm	05/28/97	2/2	427 ± 25	0.044 ± 0.008	8.5 ± 0.3	<0.03 ± 0.03	<0.004 ± 0.002
Colusa Basin Drain	06/06/97	1/2	5,220 ± 170	0.30 ± 0.03	139 ± 22	0.11 ± 0.01	0.030 ± 0.002
Colusa Basin Drain	06/06/97	2/2	5,420 ± 230	0.29 ± 0.01	153 ± 3	0.14 ± 0.01	0.025 ± 0.002
Yolo Bypass	01/07/97	1/2	8,890 ± 560	0.20 ± 0.01	76 ± 1	0.15 ± 0.01	0.048 ± 0.000
Yolo Bypass	01/07/97	2/2	9,510 ± 150	0.20 ± 0.01	75 ± 2	0.16 ± 0.01	0.040 ± 0.002

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Boron (mg/L) ICP–AES	Cadmium (µg/L) ICP–MS	Calcium (mg/L) ICP–AES	Cerium (µg/L) ICP–MS	Chromium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	0.032 ± 0.004	0.033 ± 0.007	11 ± 1	0.11 ± 0.00	19 ± 1
Sac. R.–Shasta	07/12/96	2/2	0.029 ± 0.002	0.032 ± 0.005	10 ± 0	0.11 ± 0.00	20 ± 2
Sac. R.–Shasta	09/19/96	1/2	0.030 ± 0.002	0.033 ± 0.002	11 ± 0	0.060 ± 0.001	21 ± 2
Sac. R.–Shasta	09/19/96	2/2	0.030 ± 0.002	0.043 ± 0.001	11 ± 0	0.066 ± 0.005	16 ± 3
Sac. R.–Shasta	11/19/96	1/2	0.040 ± 0.001	0.012 ± 0.006	12 ± 1	0.037 ± 0.003	17 ± 1
Sac. R.–Shasta	11/19/96	2/2	0.039 ± 0.001	0.018 ± 0.003	12 ± 0	0.036 ± 0.005	16 ± 1
Sac. R.–Shasta	12/12/96	1/2	0.047 ± 0.002	0.050 ± 0.004	11 ± 0	0.083 ± 0.002	13 ± 0
Sac. R.–Shasta	12/12/96	2/2	0.049 ± 0.001	0.088 ± 0.003	10 ± 0	0.098 ± 0.006	14 ± 1
Sac. R.–Shasta	05/29/97	1/2	0.032 ± 0.002	0.023 ± 0.002	11 ± 0	0.27 ± 0.01	13 ± 1
Sac. R.–Shasta	05/29/97	2/2	0.032 ± 0.001	0.026 ± 0.004	11 ± 0	0.26 ± 0.00	13 ± 1
Sac. R.–Keswick	07/11/96	1/2	0.025 ± 0.001	0.032 ± 0.008	8.6 ± 0.3	0.096 ± 0.004	20 ± 2
Sac. R.–Keswick	07/11/96	2/2	0.030 ± 0.005	0.024 ± 0.004	9.1 ± 0.2	0.099 ± 0.003	20 ± 3
Sac. R.–Keswick	09/19/96	1/2	0.020 ± 0.002	0.040 ± 0.012	8.5 ± 0.5	0.059 ± 0.007	17 ± 2
Sac. R.–Keswick	09/19/96	2/2	0.024 ± 0.002	0.022 ± 0.002	8.7 ± 0.1	0.053 ± 0.002	22 ± 2
Sac. R.–Keswick	11/21/96	1/2	0.033 ± 0.001	0.093 ± 0.003	9.8 ± 0.8	0.11 ± 0.00	18 ± 3
Sac. R.–Keswick	11/21/96	2/2	0.032 ± 0.001	0.086 ± 0.006	10 ± 0	0.11 ± 0.00	16 ± 3
Sac. R.–Keswick	12/11/96	1/2	0.044 ± 0.000	0.094 ± 0.003	10 ± 1	0.16 ± 0.01	15 ± 1
Sac. R.–Keswick	12/11/96	2/2	0.044 ± 0.002	0.099 ± 0.004	9.8 ± 0.2	0.15 ± 0.01	13 ± 1
Sac. R.–Keswick	01/02/97	1/2	0.038 ± 0.004	0.21 ± 0.00	10 ± 1	0.53 ± 0.03	21 ± 1
Sac. R.–Keswick	01/02/97	2/2	0.036 ± 0.004	0.20 ± 0.01	10 ± 0	0.52 ± 0.01	20 ± 1
Sac. R.–Keswick	05/28/97	1/2	0.026 ± 0.003	0.020 ± 0.006	9.0 ± 0.4	0.23 ± 0.01	14 ± 1
Sac. R.–Keswick	05/28/97	2/2	0.028 ± 0.003	0.024 ± 0.006	9.3 ± 0.3	0.23 ± 0.01	13 ± 1
Sac. R.–Bend Br.	07/11/96	1/2	0.028 ± 0.004	0.030 ± 0.005	9.4 ± 0.9	0.12 ± 0.00	19 ± 3
Sac. R.–Bend Br.	07/11/96	2/2	0.027 ± 0.001	0.033 ± 0.001	9.1 ± 0.3	0.14 ± 0.00	20 ± 4
Sac. R.–Bend Br.	09/20/96	1/2	0.027 ± 0.001	0.026 ± 0.004	9.4 ± 0.1	0.10 ± 0.00	21 ± 2
Sac. R.–Bend Br.	09/20/96	2/2	0.025 ± 0.001	0.033 ± 0.013	8.8 ± 0.4	0.099 ± 0.006	16 ± 3
Sac. R.–Bend Br.	11/22/96	1/2	0.039 ± 0.000	0.064 ± 0.005	12 ± 0	0.28 ± 0.00	19 ± 2
Sac. R.–Bend Br.	11/22/96	2/2	0.037 ± 0.003	0.062 ± 0.004	11 ± 1	0.28 ± 0.00	19 ± 3
Sac. R.–Bend Br.	12/12/96	1/2	0.044 ± 0.006	0.082 ± 0.006	10 ± 0	1.1 ± 0.1	24 ± 0
Sac. R.–Bend Br.	12/12/96	2/2	0.040 ± 0.002	0.089 ± 0.003	10 ± 1	1.1 ± 0.1	16 ± 0
Sac. R.–Bend Br.	01/03/97	1/2	0.038 ± 0.009	0.11 ± 0.00	11 ± 0	4.2 ± 0.4	26 ± 0
Sac. R.–Bend Br.	01/03/97	2/2	0.036 ± 0.006	0.11 ± 0.00	9.9 ± 1.0	4.2 ± 0.0	23 ± 0

C-035003
C—035002

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Boron (mg/L) ICP-AES	Cadmium (µg/L) ICP-MS	Calcium (mg/L) ICP-AES	Cerium (µg/L) ICP-MS	Chromium (µg/L) ICP-MS
Sac. R.–Bend Br.	05/30/97	1/2	0.027 ± 0.001	0.034 ± 0.006	9.5 ± 0.2	0.24 ± 0.00	14 ± 2
Sac. R.–Bend Br.	05/30/97	2/2	0.028 ± 0.002	0.035 ± 0.003	9.5 ± 0.2	0.25 ± 0.02	13 ± 2
Sac. R.–Colusa	07/16/96	1/1	0.036 ± 0.001	0.074 ± 0.008	11 ± 1	1.1 ± 0.3	14 ± 0
Sac. R.–Colusa	09/25/96	1/2	0.035 ± 0.001	0.028 ± 0.001	12 ± 0	0.27 ± 0.02	18 ± 4
Sac. R.–Colusa	09/25/96	2/2	0.040 ± 0.000	0.040 ± 0.009	11 ± 1	0.30 ± 0.02	18 ± 2
Sac. R.–Colusa	11/13/96	1/2	0.054 ± 0.002	0.033 ± 0.004	13 ± 0	0.42 ± 0.03	11 ± 1
Sac. R.–Colusa	11/13/96	2/2	0.052 ± 0.000	0.030 ± 0.001	13 ± 1	0.41 ± 0.03	11 ± 0
Sac. R.–Colusa	12/16/96	1/2	0.056 ± 0.003	0.086 ± 0.001	13 ± 0	1.8 ± 0.0	18 ± 1
Sac. R.–Colusa	12/16/96	2/2	0.054 ± 0.001	0.10 ± 0.00	13 ± 0	2.1 ± 0.0	18 ± 2
Sac. R.–Colusa	01/04/97	1/2	0.073 ± 0.005	0.20 ± 0.00	14 ± 1	11 ± 1	52 ± 1
Sac. R.–Colusa	01/04/97	2/2	0.074 ± 0.005	0.22 ± 0.01	14 ± 1	12 ± 0	53 ± 2
Sac. R.–Colusa	06/03/97	1/2	0.037 ± 0.001	0.042 ± 0.001	11 ± 0	0.58 ± 0.10	12 ± 0
Sac. R.–Colusa	06/03/97	2/2	0.037 ± 0.001	0.029 ± 0.003	11 ± 0	0.57 ± 0.15	12 ± 0
Sac. R.–Verona	07/18/96	1/2	0.030 ± 0.005	0.038 ± 0.003	9.7 ± 1.1	0.67 ± 0.05	12 ± 0
Sac. R.–Verona	07/18/96	2/2	0.032 ± 0.001	0.071 ± 0.000	9.7 ± 0.3	0.58 ± 0.15	12 ± 0
Sac. R.–Verona	09/26/96	1/2	0.047 ± 0.002	0.042 ± 0.000	13 ± 0	0.76 ± 0.03	16 ± 1
Sac. R.–Verona	09/26/96	2/2	0.042 ± 0.002	0.038 ± 0.001	13 ± 0	0.76 ± 0.01	15 ± 2
Sac. R.–Verona	11/14/96	1/2	0.046 ± 0.001	0.037 ± 0.004	14 ± 0	0.63 ± 0.07	13 ± 1
Sac. R.–Verona	11/14/96	2/2	0.044 ± 0.006	0.034 ± 0.003	14 ± 1	0.60 ± 0.13	11 ± 0
Sac. R.–Verona	12/18/96	1/2	0.038 ± 0.001	0.049 ± 0.002	11 ± 0	1.1 ± 0.1	15 ± 2
Sac. R.–Verona	12/18/96	2/2	0.037 ± 0.003	0.036 ± 0.004	11 ± 0	0.98 ± 0.06	15 ± 2
Sac. R.–Verona	06/04/97	1/2	0.040 ± 0.004	0.040 ± 0.003	12 ± 1	0.86 ± 0.08	12 ± 0
Sac. R.–Verona	06/04/97	2/2	0.043 ± 0.003	0.038 ± 0.004	12 ± 1	0.63 ± 0.01	12 ± 0
Sac. R.–Freeport	07/17/96	1/2	0.025 ± 0.005	0.037 ± 0.002	9.3 ± 0.3	0.63 ± 0.01	22 ± 4
Sac. R.–Freeport	07/17/96	2/2	0.025 ± 0.002	0.045 ± 0.005	8.8 ± 0.1	0.57 ± 0.03	23 ± 4
Sac. R.–Freeport	09/24/96	1/2	0.036 ± 0.003	0.041 ± 0.007	12 ± 1	0.47 ± 0.01	18 ± 3
Sac. R.–Freeport	09/24/96	2/2	0.040 ± 0.002	0.021 ± 0.004	12 ± 0	0.50 ± 0.00	21 ± 3
Sac. R.–Freeport	11/12/96	1/2	0.032 ± 0.003	0.017 ± 0.008	11 ± 0	0.21 ± 0.00	16 ± 2
Sac. R.–Freeport	11/12/96	2/2	0.032 ± 0.001	0.020 ± 0.010	11 ± 0	0.21 ± 0.01	16 ± 2
Sac. R.–Freeport	12/17/96	1/2	0.028 ± 0.001	0.060 ± 0.003	9.3 ± 0.5	1.3 ± 0.0	16 ± 0
Sac. R.–Freeport	12/17/96	2/2	0.028 ± 0.003	0.049 ± 0.007	9.0 ± 0.9	1.4 ± 0.1	15 ± 0
Sac. R.–Freeport	01/06/97	1/2	0.018 ± 0.006	0.079 ± 0.000	6.2 ± 1.0	12 ± 1	21 ± 2
Sac. R.–Freeport	01/06/97	2/2	0.020 ± 0.004	0.071 ± 0.005	6.2 ± 0.7	13 ± 0	21 ± 1
Sac. R.–Freeport	06/05/97	1/2	0.033 ± 0.002	0.026 ± 0.002	11 ± 0	0.58 ± 0.00	14 ± 1
Sac. R.–Freeport	06/05/97	2/2	0.033 ± 0.004	0.026 ± 0.004	11 ± 0	0.58 ± 0.04	14 ± 1
Sac. R.–Freeport, dup	06/05/97	1/2	0.027 ± 0.002	0.020 ± 0.007	10 ± 0	0.39 ± 0.001	14 ± 1

C-035004
C—035003

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Boron (mg/L) ICP–AES	Cadmium (µg/L) ICP–MS	Calcium (mg/L) ICP–AES	Cerium (µg/L) ICP–MS	Chromium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.031 ± 0.001	0.022 ± 0.001	10 ± 0	0.41 ± 0.01	13 ± 1
Flat Cr.	12/11/96	1/2	<0.005 ± 0.002	0.17 ± 0.01	2.9 ± 0.1	0.23 ± 0.00	13 ± 1
Flat Cr.	12/11/96	2/2	<0.005 ± 0.003	0.19 ± 0.01	2.9 ± 0.2	0.21 ± 0.01	12 ± 1
Flat Cr.	05/29/97	1/2	0.0076 ± 0.0014	0.092 ± 0.005	13 ± 1	0.040 ± 0.001	11 ± 1
Flat Cr.	05/29/97	2/2	0.0068 ± 0.0018	0.086 ± 0.005	14 ± 0	0.039 ± 0.004	12 ± 1
Spring Cr.–Weir	12/11/96	1/2	0.0066 ± 0.0017	3.7 ± 0.0	8.1 ± 0.4	4.6 ± 0.0	11 ± 1
Spring Cr.–Weir	12/11/96	2/2	0.0083 ± 0.0011	3.7 ± 0.0	8.3 ± 0.3	4.8 ± 0.1	13 ± 1
Spring Cr.–Weir	05/28/97	1/2	0.0092 ± 0.0014	6.6 ± 0.0	45 ± 3	9.8 ± 0.0	7.7 ± 1.3
Spring Cr.–Weir	05/28/97	2/2	0.0089 ± 0.0015	6.5 ± 0.0	45 ± 1	9.9 ± 0.4	7.3 ± 0.9
Spring Cr.–Road	01/02/97	1/2	0.024 ± 0.001	8.2 ± 0.0	5.7 ± 0.4	3.0 ± 0.1	7.3 ± 1.9
Spring Cr.–Road	01/02/97	2/2	0.025 ± 0.003	8.2 ± 0.2	5.8 ± 0.6	3.0 ± 0.0	7.2 ± 2.9
Whiskeytown	12/11/96	1/2	0.011 ± 0.001	0.014 ± 0.002	4.8 ± 0.4	0.033 ± 0.001	13 ± 1
Whiskeytown	12/11/96	2/2	0.012 ± 0.001	<0.006 ± 0.000	4.7 ± 0.1	0.034 ± 0.003	20 ± 3
Whiskeytown	05/29/97	1/2	0.0076 ± 0.0008	0.010 ± 0.001	4.8 ± 0.1	0.18 ± 0.01	14 ± 1
Whiskeytown	05/29/97	2/2	0.012 ± 0.001	0.016 ± 0.004	4.8 ± 0.1	0.17 ± 0.01	17 ± 1
Spring Cr. arm	07/12/96	1/2	0.011 ± 0.004	<0.006 ± 0.001	4.5 ± 0.1	0.019 ± 0.001	19 ± 3
Spring Cr. arm	07/12/96	2/2	0.0091 ± 0.0009	0.012 ± 0.004	4.4 ± 0.2	0.021 ± 0.001	20 ± 3
Spring Cr. arm	09/18/96	1/2	0.0081 ± 0.0004	0.015 ± 0.002	4.5 ± 0.2	0.038 ± 0.003	21 ± 1
Spring Cr. arm	09/18/96	2/2	0.0072 ± 0.0016	0.028 ± 0.008	4.4 ± 0.1	0.043 ± 0.001	17 ± 2
Spring Cr. arm	11/20/96	1/2	0.0050 ± 0.0020	0.13 ± 0.01	5.3 ± 0.3	0.23 ± 0.01	16 ± 2
Spring Cr. arm	11/20/96	2/2	0.011 ± 0.002	0.16 ± 0.00	5.3 ± 0.3	0.24 ± 0.02	15 ± 2
Spring Cr. arm	12/11/96	1/2	0.0089 ± 0.0010	0.49 ± 0.00	5.4 ± 0.2	0.60 ± 0.01	13 ± 1
Spring Cr. arm	12/11/96	2/2	0.0083 ± 0.0012	0.47 ± 0.02	5.3 ± 0.2	0.64 ± 0.01	13 ± 1
Spring Cr. arm	05/28/97	1/2	0.011 ± 0.003	0.042 ± 0.011	5.0 ± 0.1	0.20 ± 0.01	18 ± 2
Spring Cr. arm	05/28/97	2/2	0.0097 ± 0.0026	0.040 ± 0.004	5.0 ± 0.2	0.21 ± 0.00	17 ± 2
Colusa Basin Drain	06/06/97	1/2	0.33 ± 0.00	0.044 ± 0.003	38 ± 1	3.9 ± 0.6	24 ± 1
Colusa Basin Drain	06/06/97	2/2	0.34 ± 0.01	0.046 ± 0.001	39 ± 2	4.2 ± 0.2	24 ± 1
Yolo Bypass	01/07/97	1/2	0.039 ± 0.004	0.099 ± 0.006	9.0 ± 0.8	5.7 ± 0.1	28 ± 1
Yolo Bypass	01/07/97	2/2	0.040 ± 0.003	0.10 ± 0.00	9.9 ± 0.5	5.6 ± 0.1	27 ± 0

C-035005
C—035004

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Cobalt (µg/L) ICP–MS	Copper (µg/L) ICP–MS	Dysprosium (µg/L) ICP–MS	Erbium (µg/L) ICP–MS	Europium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	0.042 ± 0.010	1.8 ± 0.1	0.016 ± 0.001	0.013 ± 0.000	0.0057 ± 0.0016
Sac. R.–Shasta	07/12/96	2/2	0.036 ± 0.009	1.9 ± 0.2	0.020 ± 0.005	0.013 ± 0.006	0.0048 ± 0.0009
Sac. R.–Shasta	09/19/96	1/2	0.014 ± 0.007	1.4 ± 0.1	0.013 ± 0.001	0.012 ± 0.003	0.0033 ± 0.0006
Sac. R.–Shasta	09/19/96	2/2	0.015 ± 0.012	1.7 ± 0.1	0.015 ± 0.004	0.0087 ± 0.0056	0.0062 ± 0.0009
Sac. R.–Shasta	11/19/96	1/2	0.025 ± 0.007	1.4 ± 0.1	0.013 ± 0.005	0.0097 ± 0.0041	0.0056 ± 0.0012
Sac. R.–Shasta	11/19/96	2/2	0.022 ± 0.004	1.3 ± 0.1	0.014 ± 0.004	0.0086 ± 0.0021	0.0047 ± 0.0016
Sac. R.–Shasta	12/12/96	1/2	0.060 ± 0.008	4.1 ± 0.2	0.023 ± 0.002	0.0087 ± 0.0011	0.0048 ± 0.0010
Sac. R.–Shasta	12/12/96	2/2	0.061 ± 0.005	4.3 ± 0.2	0.021 ± 0.000	0.011 ± 0.000	0.0069 ± 0.0015
Sac. R.–Shasta	05/29/97	1/2	0.13 ± 0.00	1.7 ± 0.1	0.041 ± 0.006	0.020 ± 0.002	0.014 ± 0.002
Sac. R.–Shasta	05/29/97	2/2	0.13 ± 0.01	1.7 ± 0.0	0.034 ± 0.004	0.022 ± 0.002	0.011 ± 0.002
Sac. R.–Keswick	07/11/96	1/2	0.038 ± 0.003	1.6 ± 0.2	0.019 ± 0.003	0.010 ± 0.002	0.0048 ± 0.0010
Sac. R.–Keswick	07/11/96	2/2	0.040 ± 0.002	1.5 ± 0.1	0.012 ± 0.000	0.011 ± 0.001	0.0062 ± 0.0002
Sac. R.–Keswick	09/19/96	1/2	0.041 ± 0.006	1.9 ± 0.1	0.023 ± 0.002	0.012 ± 0.005	0.0060 ± 0.0016
Sac. R.–Keswick	09/19/96	2/2	0.027 ± 0.005	1.6 ± 0.1	0.015 ± 0.002	0.0093 ± 0.0009	0.0036 ± 0.0012
Sac. R.–Keswick	11/21/96	1/2	0.17 ± 0.02	4.4 ± 0.4	0.044 ± 0.003	0.024 ± 0.005	0.0070 ± 0.0012
Sac. R.–Keswick	11/21/96	2/2	0.17 ± 0.02	4.3 ± 0.4	0.044 ± 0.003	0.027 ± 0.004	0.0084 ± 0.0027
Sac. R.–Keswick	12/11/96	1/2	0.12 ± 0.01	7.7 ± 0.2	0.059 ± 0.002	0.030 ± 0.003	0.011 ± 0.002
Sac. R.–Keswick	12/11/96	2/2	0.13 ± 0.01	7.8 ± 0.1	0.048 ± 0.006	0.025 ± 0.002	0.013 ± 0.003
Sac. R.–Keswick	01/02/97	1/2	0.48 ± 0.01	14 ± 0	0.10 ± 0.01	0.067 ± 0.002	0.019 ± 0.000
Sac. R.–Keswick	01/02/97	2/2	0.46 ± 0.01	14 ± 2	0.11 ± 0.00	0.069 ± 0.008	0.023 ± 0.003
Sac. R.–Keswick	05/28/97	1/2	0.24 ± 0.02	2.0 ± 0.2	0.038 ± 0.001	0.020 ± 0.002	0.011 ± 0.002
Sac. R.–Keswick	05/28/97	2/2	0.24 ± 0.02	1.9 ± 0.1	0.034 ± 0.001	0.019 ± 0.001	0.0089 ± 0.0004
Sac. R.–Bend Br.	07/11/96	1/2	0.13 ± 0.00	1.7 ± 0.1	0.022 ± 0.001	0.015 ± 0.001	0.0056 ± 0.0002
Sac. R.–Bend Br.	07/11/96	2/2	0.12 ± 0.01	1.7 ± 0.0	0.019 ± 0.005	0.013 ± 0.002	0.0049 ± 0.0013
Sac. R.–Bend Br.	09/20/96	1/2	0.074 ± 0.010	1.6 ± 0.0	0.021 ± 0.001	0.010 ± 0.002	0.0039 ± 0.0011
Sac. R.–Bend Br.	09/20/96	2/2	0.082 ± 0.013	2.0 ± 0.1	0.021 ± 0.005	0.015 ± 0.005	0.0056 ± 0.0007
Sac. R.–Bend Br.	11/22/96	1/2	0.39 ± 0.04	4.3 ± 0.3	0.056 ± 0.006	0.039 ± 0.001	0.013 ± 0.001
Sac. R.–Bend Br.	11/22/96	2/2	0.38 ± 0.04	4.3 ± 0.0	0.061 ± 0.008	0.033 ± 0.007	0.014 ± 0.002
Sac. R.–Bend Br.	12/12/96	1/2	1.1 ± 0.0	7.9 ± 0.0	0.15 ± 0.00	0.078 ± 0.007	0.038 ± 0.001
Sac. R.–Bend Br.	12/12/96	2/2	1.1 ± 0.0	8.3 ± 0.1	0.16 ± 0.01	0.079 ± 0.004	0.034 ± 0.001
Sac. R.–Bend Br.	01/03/97	1/2	3.3 ± 0.1	14 ± 0	0.52 ± 0.01	0.25 ± 0.01	0.12 ± 0.00
Sac. R.–Bend Br.	01/03/97	2/2	3.3 ± 0.0	14 ± 0	0.49 ± 0.02	0.24 ± 0.00	0.13 ± 0.00

C-035006
C—035005

C-035007

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Cobalt (µg/L) ICP–MS	Copper (µg/L) ICP–MS	Dysprosium (µg/L) ICP–MS	Erbium (µg/L) ICP–MS	Europium (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	0.26 ± 0.03	2.2 ± 0.1	0.038 ± 0.004	0.018 ± 0.001	0.011 ± 0.002
Sac. R.–Bend Br.	05/30/97	2/2	0.27 ± 0.02	2.2 ± 0.2	0.035 ± 0.002	0.020 ± 0.004	0.012 ± 0.001
Sac. R.–Colusa	07/16/96	1/1	1.2 ± 0.1	5.4 ± 0.4	0.16 ± 0.02	0.082 ± 0.002	0.042 ± 0.002
Sac. R.–Colusa	09/25/96	1/2	0.30 ± 0.04	2.7 ± 0.2	0.039 ± 0.002	0.020 ± 0.004	0.011 ± 0.002
Sac. R.–Colusa	09/25/96	2/2	0.30 ± 0.04	3.0 ± 0.2	0.038 ± 0.006	0.023 ± 0.002	0.015 ± 0.001
Sac. R.–Colusa	11/13/96	1/2	0.45 ± 0.02	2.7 ± 0.2	0.064 ± 0.005	0.036 ± 0.004	0.017 ± 0.001
Sac. R.–Colusa	11/13/96	2/2	0.43 ± 0.02	2.7 ± 0.1	0.057 ± 0.001	0.027 ± 0.002	0.015 ± 0.001
Sac. R.–Colusa	12/16/96	1/2	1.8 ± 0.0	8.5 ± 0.1	0.26 ± 0.01	0.13 ± 0.01	0.066 ± 0.005
Sac. R.–Colusa	12/16/96	2/2	1.9 ± 0.1	12 ± 0	0.29 ± 0.01	0.14 ± 0.00	0.075 ± 0.003
Sac. R.–Colusa	01/04/97	1/2	12 ± 0	35 ± 0	1.6 ± 0.1	0.84 ± 0.02	0.40 ± 0.00
Sac. R.–Colusa	01/04/97	2/2	11 ± 0	35 ± 0	1.6 ± 0.0	0.83 ± 0.01	0.41 ± 0.00
Sac. R.–Colusa	06/03/97	1/2	0.64 ± 0.03	3.6 ± 0.2	0.087 ± 0.004	0.045 ± 0.003	0.019 ± 0.002
Sac. R.–Colusa	06/03/97	2/2	0.70 ± 0.08	3.9 ± 0.5	0.093 ± 0.005	0.048 ± 0.002	0.020 ± 0.000
Sac. R.–Verona	07/18/96	1/2	0.56 ± 0.02	3.1 ± 0.1	0.081 ± 0.006	0.040 ± 0.006	0.019 ± 0.000
Sac. R.–Verona	07/18/96	2/2	0.61 ± 0.03	3.2 ± 0.3	0.078 ± 0.010	0.039 ± 0.006	0.019 ± 0.005
Sac. R.–Verona	09/26/96	1/2	0.70 ± 0.01	3.8 ± 0.1	0.10 ± 0.00	0.056 ± 0.001	0.027 ± 0.002
Sac. R.–Verona	09/26/96	2/2	0.70 ± 0.01	3.7 ± 0.1	0.10 ± 0.00	0.058 ± 0.001	0.028 ± 0.001
Sac. R.–Verona	11/14/96	1/2	0.55 ± 0.02	3.4 ± 0.3	0.079 ± 0.004	0.043 ± 0.002	0.019 ± 0.003
Sac. R.–Verona	11/14/96	2/2	0.53 ± 0.02	3.7 ± 0.5	0.083 ± 0.006	0.044 ± 0.005	0.020 ± 0.001
Sac. R.–Verona	12/18/96	1/2	0.98 ± 0.05	5.6 ± 0.2	0.15 ± 0.01	0.075 ± 0.006	0.037 ± 0.001
Sac. R.–Verona	12/18/96	2/2	0.89 ± 0.02	4.4 ± 0.1	0.13 ± 0.00	0.067 ± 0.002	0.034 ± 0.003
Sac. R.–Verona	06/04/97	1/2	0.72 ± 0.02	4.0 ± 0.1	0.11 ± 0.00	0.057 ± 0.003	0.025 ± 0.002
Sac. R.–Verona	06/04/97	2/2	0.77 ± 0.05	4.3 ± 0.4	0.11 ± 0.01	0.052 ± 0.004	0.023 ± 0.001
Sac. R.–Freeport	07/17/96	1/2	0.38 ± 0.01	2.5 ± 0.0	0.069 ± 0.005	0.036 ± 0.002	0.020 ± 0.001
Sac. R.–Freeport	07/17/96	2/2	0.43 ± 0.06	2.6 ± 0.1	0.065 ± 0.013	0.037 ± 0.003	0.017 ± 0.002
Sac. R.–Freeport	09/24/96	1/2	0.42 ± 0.04	3.1 ± 0.3	0.055 ± 0.005	0.027 ± 0.004	0.019 ± 0.003
Sac. R.–Freeport	09/24/96	2/2	0.31 ± 0.00	2.4 ± 0.1	0.052 ± 0.007	0.028 ± 0.003	0.015 ± 0.001
Sac. R.–Freeport	11/12/96	1/2	0.20 ± 0.02	2.1 ± 0.1	0.029 ± 0.001	0.014 ± 0.006	0.0098 ± 0.0016
Sac. R.–Freeport	11/12/96	2/2	0.19 ± 0.03	2.2 ± 0.1	0.026 ± 0.002	0.016 ± 0.004	0.0077 ± 0.0008
Sac. R.–Freeport	12/17/96	1/2	1.1 ± 0.0	5.2 ± 0.1	0.16 ± 0.01	0.082 ± 0.007	0.039 ± 0.002
Sac. R.–Freeport	12/17/96	2/2	1.1 ± 0.0	4.8 ± 0.1	0.17 ± 0.01	0.084 ± 0.006	0.041 ± 0.001
Sac. R.–Freeport	01/06/97	1/2	4.6 ± 0.1	14 ± 0	0.69 ± 0.01	0.35 ± 0.00	0.19 ± 0.01
Sac. R.–Freeport	01/06/97	2/2	4.4 ± 0.1	14 ± 0	0.68 ± 0.01	0.35 ± 0.00	0.20 ± 0.00
Sac. R.–Freeport	06/05/97	1/2	0.43 ± 0.03	2.8 ± 0.1	0.068 ± 0.001	0.032 ± 0.007	0.021 ± 0.000
Sac. R.–Freeport	06/05/97	2/2	0.45 ± 0.02	2.9 ± 0.1	0.066 ± 0.001	0.031 ± 0.000	0.022 ± 0.003
Sac. R.–Freeport, dup	06/05/97	1/2	0.28 ± 0.002	2.3 ± 0.1	0.043 ± 0.002	0.17 ± 0.002	0.017 ± 0.001

C—035006

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Cobalt (µg/L) ICP–MS	Copper (µg/L) ICP–MS	Dysprosium (µg/L) ICP–MS	Erbium (µg/L) ICP–MS	Europium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.29 ± 0.03	2.3 ± 0.1	0.049 ± 0.002	0.025 ± 0.004	0.014 ± 0.000
Flat Cr.	12/11/96	1/2	0.30 ± 0.01	11 ± 0	0.11 ± 0.00	0.064 ± 0.005	0.023 ± 0.000
Flat Cr.	12/11/96	2/2	0.30 ± 0.02	11 ± 0	0.11 ± 0.01	0.066 ± 0.004	0.023 ± 0.004
Flat Cr.	05/29/97	1/2	0.35 ± 0.02	1.8 ± 0.1	0.041 ± 0.002	0.031 ± 0.004	0.0061 ± 0.0020
Flat Cr.	05/29/97	2/2	0.35 ± 0.02	1.8 ± 0.1	0.040 ± 0.007	0.032 ± 0.006	0.0056 ± 0.0017
Spring Cr.–Weir	12/11/96	1/2	4.4 ± 0.0	402 ± 17	2.2 ± 0.0	1.1 ± 0.0	0.33 ± 0.01
Spring Cr.–Weir	12/11/96	2/2	4.4 ± 0.1	410 ± 15	2.2 ± 0.0	1.1 ± 0.0	0.33 ± 0.01
Spring Cr.–Weir	05/28/97	1/2	12 ± 0	500 ± 31	3.8 ± 0.2	1.9 ± 0.1	0.51 ± 0.00
Spring Cr.–Weir	05/28/97	2/2	12 ± 0	496 ± 13	3.7 ± 0.0	1.8 ± 0.1	0.52 ± 0.01
Spring Cr.–Road	01/02/97	1/2	6.3 ± 0.1	547 ± 2	1.4 ± 0.0	0.73 ± 0.01	0.22 ± 0.00
Spring Cr.–Road	01/02/97	2/2	6.3 ± 0.3	539 ± 43	1.4 ± 0.0	0.69 ± 0.01	0.22 ± 0.00
Whiskeytown	12/11/96	1/2	0.025 ± 0.003	1.2 ± 0.0	0.012 ± 0.001	0.0061 ± 0.0032	<0.001 ± 0.002
Whiskeytown	12/11/96	2/2	0.018 ± 0.007	1.1 ± 0.1	0.010 ± 0.002	0.0075 ± 0.0012	0.0016 ± 0.0009
Whiskeytown	05/29/97	1/2	0.61 ± 0.04	1.7 ± 0.1	0.029 ± 0.004	0.016 ± 0.002	0.0083 ± 0.0006
Whiskeytown	05/29/97	2/2	0.58 ± 0.01	1.7 ± 0.1	0.026 ± 0.002	0.013 ± 0.004	0.0090 ± 0.0005
Spring Cr. arm	07/12/96	1/2	0.029 ± 0.014	0.80 ± 0.07	0.0086 ± 0.0021	0.0034 ± 0.0009	0.0018 ± 0.0012
Spring Cr. arm	07/12/96	2/2	0.027 ± 0.011	0.89 ± 0.03	0.0088 ± 0.0027	0.0079 ± 0.0016	0.0023 ± 0.0012
Spring Cr. arm	09/18/96	1/2	0.047 ± 0.006	1.2 ± 0.0	0.016 ± 0.002	0.0087 ± 0.0033	0.0021 ± 0.0003
Spring Cr. arm	09/18/96	2/2	0.053 ± 0.013	1.7 ± 0.0	0.019 ± 0.004	0.011 ± 0.002	0.0035 ± 0.0013
Spring Cr. arm	11/20/96	1/2	0.35 ± 0.03	11 ± 0	0.10 ± 0.01	0.066 ± 0.004	0.018 ± 0.003
Spring Cr. arm	11/20/96	2/2	0.36 ± 0.03	12 ± 0	0.089 ± 0.003	0.052 ± 0.003	0.016 ± 0.002
Spring Cr. arm	12/11/96	1/2	0.60 ± 0.02	46 ± 2	0.27 ± 0.00	0.14 ± 0.00	0.052 ± 0.001
Spring Cr. arm	12/11/96	2/2	0.59 ± 0.04	49 ± 1	0.30 ± 0.00	0.14 ± 0.00	0.060 ± 0.002
Spring Cr. arm	05/28/97	1/2	0.67 ± 0.02	3.4 ± 0.3	0.034 ± 0.001	0.022 ± 0.002	0.0087 ± 0.0004
Spring Cr. arm	05/28/97	2/2	0.63 ± 0.04	3.1 ± 0.0	0.034 ± 0.003	0.022 ± 0.006	0.011 ± 0.002
Colusa Basin Drain	06/06/97	1/2	3.7 ± 0.1	13 ± 0	0.47 ± 0.03	0.21 ± 0.01	0.11 ± 0.00
Colusa Basin Drain	06/06/97	2/2	3.5 ± 0.1	12 ± 0	0.49 ± 0.01	0.22 ± 0.00	0.11 ± 0.00
Yolo Bypass	01/07/97	1/2	4.9 ± 0.0	17 ± 0	0.72 ± 0.01	0.36 ± 0.00	0.18 ± 0.00
Yolo Bypass	01/07/97	2/2	4.9 ± 0.0	17 ± 0	0.70 ± 0.01	0.36 ± 0.01	0.17 ± 0.00

C-035008
C—035007

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES	Iron (µg/L) UV–vis	Iron (II) (µg/L) UV–vis
Sac. R.–Shasta	07/12/96	1/2	0.023 ± 0.000	0.0040 ± 0.0005	147 ± 15	105 ± 2	54 ± 13
Sac. R.–Shasta	07/12/96	2/2	0.031 ± 0.000	0.0036 ± 0.0007	130 ± 28	— ± —	— ± —
Sac. R.–Shasta	09/19/96	1/2	0.021 ± 0.002	0.0032 ± 0.0002	39 ± 6	41 ± —	29 ± —
Sac. R.–Shasta	09/19/96	2/2	0.023 ± 0.005	0.0028 ± 0.0001	71 ± 21	— ± —	— ± —
Sac. R.–Shasta	11/19/96	1/2	0.016 ± 0.004	0.0019 ± 0.0003	49 ± 12	30 ± 0	22 ± 0
Sac. R.–Shasta	11/19/96	2/2	0.017 ± 0.002	0.0017 ± 0.0006	45 ± 13	— ± —	— ± —
Sac. R.–Shasta	12/12/96	1/2	0.027 ± 0.002	0.0037 ± 0.0004	83 ± 9	51 ± —	27 ± —
Sac. R.–Shasta	12/12/96	2/2	0.029 ± 0.004	0.0043 ± 0.0009	83 ± 10	— ± —	— ± —
Sac. R.–Shasta	05/29/97	1/2	0.056 ± 0.007	0.0067 ± 0.0005	338 ± 34	152 ± 3	46 ± 1
Sac. R.–Shasta	05/29/97	2/2	0.057 ± 0.006	0.0069 ± 0.0003	349 ± 18	— ± —	— ± —
Sac. R.–Keswick	07/11/96	1/2	0.028 ± 0.003	0.0041 ± 0.0002	114 ± 15	40 ± 0	16 ± 9
Sac. R.–Keswick	07/11/96	2/2	0.024 ± 0.001	0.0031 ± 0.0009	118 ± 6	— ± —	— ± —
Sac. R.–Keswick	09/19/96	1/2	0.028 ± 0.005	0.0044 ± 0.0002	70 ± 13	40 ± 4	31 ± 2
Sac. R.–Keswick	09/19/96	2/2	0.024 ± 0.004	0.0025 ± 0.0008	33 ± 12	— ± —	— ± —
Sac. R.–Keswick	11/21/96	1/2	0.060 ± 0.006	0.0088 ± 0.0012	248 ± 32	132 ± —	73 ± —
Sac. R.–Keswick	11/21/96	2/2	0.056 ± 0.008	0.0086 ± 0.0004	250 ± 41	— ± —	— ± —
Sac. R.–Keswick	12/11/96	1/2	0.072 ± 0.004	0.0095 ± 0.0007	153 ± 6	101 ± —	37 ± —
Sac. R.–Keswick	12/11/96	2/2	0.074 ± 0.010	0.0097 ± 0.0012	163 ± 11	— ± —	— ± —
Sac. R.–Keswick	01/02/97	1/2	0.16 ± 0.03	0.020 ± 0.001	812 ± 15	436 ± —	145 ± —
Sac. R.–Keswick	01/02/97	2/2	0.16 ± 0.00	0.016 ± 0.000	809 ± 119	— ± —	— ± —
Sac. R.–Keswick	05/28/97	1/2	0.051 ± 0.005	0.0068 ± 0.0010	392 ± 37	167 ± 6	49 ± 2
Sac. R.–Keswick	05/28/97	2/2	0.052 ± 0.006	0.0071 ± 0.0010	380 ± 39	— ± —	— ± —
Sac. R.–Bend Br.	07/11/96	1/2	0.023 ± 0.003	0.0034 ± 0.0009	175 ± 9	181 ± 4	70 ± 0
Sac. R.–Bend Br.	07/11/96	2/2	0.032 ± 0.004	0.0039 ± 0.0004	182 ± 12	— ± —	— ± —
Sac. R.–Bend Br.	09/20/96	1/2	0.028 ± 0.003	0.0035 ± 0.0005	113 ± 7	122 ± —	67 ± —
Sac. R.–Bend Br.	09/20/96	2/2	0.032 ± 0.003	0.0030 ± 0.0000	150 ± 30	— ± —	— ± —
Sac. R.–Bend Br.	11/22/96	1/2	0.077 ± 0.009	0.011 ± 0.000	645 ± 53	385 ± —	248 ± —
Sac. R.–Bend Br.	11/22/96	2/2	0.079 ± 0.003	0.012 ± 0.001	602 ± 20	— ± —	— ± —
Sac. R.–Bend Br.	12/12/96	1/2	0.21 ± 0.01	0.024 ± 0.001	2,080 ± 48	1,060 ± —	397 ± —
Sac. R.–Bend Br.	12/12/96	2/2	0.21 ± 0.01	0.027 ± 0.001	2,070 ± 110	— ± —	— ± —
Sac. R.–Bend Br.	01/03/97	1/2	0.70 ± 0.04	0.086 ± 0.001	7,210 ± 590	2,320 ± —	657 ± —
Sac. R.–Bend Br.	01/03/97	2/2	0.66 ± 0.01	0.083 ± 0.004	7,150 ± 450	— ± —	— ± —

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C-035009

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES	Iron (µg/L) UV–vis	Iron (II) (µg/L) UV–vis
Sac. R.–Bend Br.	05/30/97	1/2	0.052 ± 0.007	0.0066 ± 0.0007	408 ± 34	214 ± 5	79 ± 3
Sac. R.–Bend Br.	05/30/97	2/2	0.054 ± 0.012	0.0071 ± 0.0006	386 ± 3	— ± —	— ± —
Sac. R.–Colusa	07/16/96	1/1	0.23 ± 0.02	0.028 ± 0.000	2,330 ± 120	1,610 ± 11	647 ± 14
Sac. R.–Colusa	09/25/96	1/2	0.057 ± 0.008	0.0084 ± 0.0011	593 ± 72	406 ± —	201 ± —
Sac. R.–Colusa	09/25/96	2/2	0.060 ± 0.004	0.0068 ± 0.0011	596 ± 49	— ± —	— ± —
Sac. R.–Colusa	11/13/96	1/2	0.099 ± 0.006	0.010 ± 0.001	847 ± 11	771 ± —	334 ± —
Sac. R.–Colusa	11/13/96	2/2	0.087 ± 0.004	0.0098 ± 0.0011	826 ± 8	— ± —	— ± —
Sac. R.–Colusa	12/16/96	1/2	0.37 ± 0.00	0.044 ± 0.001	3,830 ± 66	1,860 ± —	478 ± —
Sac. R.–Colusa	12/16/96	2/2	0.41 ± 0.02	0.049 ± 0.001	4,050 ± 130	— ± —	— ± —
Sac. R.–Colusa	01/04/97	1/2	2.1 ± 0.0	0.27 ± 0.00	23,700 ± 5	6,670 ± —	1,640 ± —
Sac. R.–Colusa	01/04/97	2/2	2.1 ± 0.0	0.27 ± 0.00	23,200 ± 21	— ± —	— ± —
Sac. R.–Colusa	06/03/97	1/2	0.13 ± 0.02	0.015 ± 0.001	1,120 ± 61	471 ± 17	148 ± 46
Sac. R.–Colusa	06/03/97	2/2	0.14 ± 0.02	0.015 ± 0.001	1,250 ± 120	— ± —	— ± —
Sac. R.–Vero—	07/18/96	1/2	0.12 ± 0.01	0.012 ± 0.000	1,010 ± 29	1,060 ± —	384 ± —
Sac. R.–Vero—	07/18/96	2/2	0.12 ± 0.01	0.012 ± 0.001	1,090 ± 64	— ± —	— ± —
Sac. R.–Vero—	09/26/96	1/2	0.15 ± 0.02	0.017 ± 0.000	1,590 ± 36	1,370 ± —	544 ± —
Sac. R.–Vero—	09/26/96	2/2	0.16 ± 0.01	0.018 ± 0.001	1,590 ± 36	— ± —	— ± —
Sac. R.–Vero—	11/14/96	1/2	0.13 ± 0.01	0.013 ± 0.001	1,090 ± 41	850 ± —	331 ± —
Sac. R.–Vero—	11/14/96	2/2	0.12 ± 0.01	0.014 ± 0.001	1,090 ± 30	— ± —	— ± —
Sac. R.–Vero—	12/18/96	1/2	0.20 ± 0.02	0.025 ± 0.001	1,980 ± 75	986 ± —	294 ± —
Sac. R.–Vero—	12/18/96	2/2	0.19 ± 0.01	0.021 ± 0.000	1,870 ± 49	— ± —	— ± —
Sac. R.–Vero—	06/04/97	1/2	0.16 ± 0.01	0.019 ± 0.001	1,330 ± 68	532 ± 15	146 ± 33
Sac. R.–Vero—	06/04/97	2/2	0.15 ± 0.01	0.018 ± 0.002	1,490 ± 79	— ± —	— ± —
Sac. R.–Freeport	07/17/96	1/2	0.10 ± 0.02	0.011 ± 0.001	861 ± 69	745 ± —	271 ± —
Sac. R.–Freeport	07/17/96	2/2	0.098 ± 0.002	0.0097 ± 0.0014	845 ± 17	— ± —	— ± —
Sac. R.–Freeport	09/24/96	1/2	0.092 ± 0.008	0.0092 ± 0.0005	691 ± 31	540 ± —	237 ± —
Sac. R.–Freeport	09/24/96	2/2	0.079 ± 0.001	0.0087 ± 0.0001	700 ± 19	— ± —	— ± —
Sac. R.–Freeport	11/12/96	1/2	0.044 ± 0.006	0.0066 ± 0.0010	413 ± 41	261 ± 7	127 ± 1
Sac. R.–Freeport	11/12/96	2/2	0.046 ± 0.000	0.0049 ± 0.0005	414 ± 26	— ± —	— ± —
Sac. R.–Freeport	12/17/96	1/2	0.21 ± 0.01	0.026 ± 0.001	2,220 ± 73	983 ± —	305 ± —
Sac. R.–Freeport	12/17/96	2/2	0.22 ± 0.02	0.027 ± 0.002	2,240 ± 84	— ± —	— ± —
Sac. R.–Freeport	01/06/97	1/2	0.98 ± 0.03	0.11 ± 0.00	8,470 ± 94	3,400 ± —	841 ± —
Sac. R.–Freeport	01/06/97	1/2	0.97 ± 0.03	0.11 ± 0.00	8,300 ± 38	— ± —	— ± —
Sac. R.–Freeport	06/05/97	1/2	0.097 ± 0.002	0.012 ± 0.001	852 ± 11	303 ± 26	76 ± 14
Sac. R.–Freeport	06/05/97	2/2	0.11 ± 0.01	0.013 ± 0.001	870 ± 0	— ± —	— ± —
Sac. R.–Freeport, dup	06/05/97	1/2	0.068 ± 0.009	0.0086 ± 0.0011	583 ± 54	204 ± 7	54 ± 0

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C-035011

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Gadolinium (µg/L) ICP–MS	Holmium (µg/L) ICP–MS	Iron (µg/L) ICP–AES	Iron (µg/L) UV–vis	Iron (II) (µg/L) UV–vis
Sac. R.–Freeport, dup	06/05/97	2/2	0.065 ± 0.002	0.0083 ± 0.0009	580 ± 48	— ± —	— ± —
Flat Cr.	12/11/96	1/2	0.16 ± 0.00	0.023 ± 0.001	227 ± 15	100 ± —	49 ± —
Flat Cr.	12/11/96	2/2	0.15 ± 0.01	0.021 ± 0.001	225 ± 18	— ± —	— ± —
Flat Cr.	05/29/97	1/2	0.057 ± 0.008	0.0083 ± 0.0001	354 ± 34	351 ± 6	153 ± 17
Flat Cr.	05/29/97	2/2	0.055 ± 0.003	0.0087 ± 0.0002	355 ± 39	— ± —	— ± —
Spring Cr.–Weir	12/11/96	1/2	2.8 ± 0.1	0.37 ± 0.00	1,420 ± 50	1,180 ± 4	880 ± 9
Spring Cr.–Weir	12/11/96	2/2	2.8 ± 0.0	0.37 ± 0.00	1,400 ± 33	— ± —	— ± —
Spring Cr.–Weir	05/28/97	1/2	5.0 ± 0.1	0.64 ± 0.00	1,860 ± 92	1,930 ± 150	848 ± 110
Spring Cr.–Weir	05/28/97	2/2	5.1 ± 0.1	0.61 ± 0.00	1,800 ± 12	— ± —	— ± —
Spring Cr.–Road	01/02/97	1/2	1.8 ± 0.0	0.24 ± 0.00	12,800 ± 640	13,300 ± 800	11,800 ± 710
Spring Cr.–Road	01/02/97	2/2	1.8 ± 0.0	0.24 ± 0.00	13,000 ± 920	— ± —	— ± —
Whiskeytown	12/11/96	1/2	0.016 ± 0.002	0.0020 ± 0.0002	45 ± 5	30 ± —	22 ± —
Whiskeytown	12/11/96	2/2	0.014 ± 0.001	0.0024 ± 0.0005	35 ± 9	— ± —	— ± —
Whiskeytown	05/29/97	1/2	0.037 ± 0.003	0.0047 ± 0.0010	563 ± 34	245 ± 1	55 ± 4
Whiskeytown	05/29/97	2/2	0.037 ± 0.005	0.0042 ± 0.0004	560 ± 28	— ± —	— ± —
Spring Cr. arm	07/12/96	1/2	0.014 ± 0.002	0.0020 ± 0.0007	<30 ± 30	40 ± —	27 ± —
Spring Cr. arm	07/12/96	2/2	0.012 ± 0.004	0.0022 ± 0.0013	<30 ± 28	— ± —	— ± —
Spring Cr. arm	09/18/96	1/2	0.024 ± 0.002	0.0024 ± 0.0005	<30 ± 4	35 ± 2	25 ± 1
Spring Cr. arm	09/18/96	2/2	0.028 ± 0.004	0.0031 ± 0.0003	63 ± 20	— ± —	— ± —
Spring Cr. arm	11/20/96	1/2	0.13 ± 0.02	0.018 ± 0.001	213 ± 33	165 ± 5	44 ± 1
Spring Cr. arm	11/20/96	2/2	0.14 ± 0.00	0.018 ± 0.001	218 ± 24	— ± —	— ± —
Spring Cr. arm	12/11/96	1/2	0.38 ± 0.00	0.046 ± 0.000	198 ± 13	162 ± —	42 ± —
Spring Cr. arm	12/11/96	2/2	0.40 ± 0.00	0.048 ± 0.001	201 ± 29	— ± —	— ± —
Spring Cr. arm	05/28/97	1/2	0.054 ± 0.003	0.0085 ± 0.0001	577 ± 62	264 ± 3	64 ± 1
Spring Cr. arm	05/28/97	2/2	0.054 ± 0.005	0.0068 ± 0.0003	529 ± 18	— ± —	— ± —
Colusa Basin Drain	06/06/97	1/2	0.73 ± 0.05	0.073 ± 0.001	6,840 ± 95	1,980 ± 210	202 ± 60
Colusa Basin Drain	06/06/97	2/2	0.72 ± 0.02	0.075 ± 0.001	6,660 ± 32	— ± —	— ± —
Yolo Bypass	01/07/97	1/2	0.93 ± 0.01	0.12 ± 0.00	10,800 ± 510	3,870 ± —	700 ± —
Yolo Bypass	01/07/97	2/2	0.93 ± 0.02	0.12 ± 0.00	10,700 ± 320	— ± —	— ± —

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Lanthanum (µg/L) ICP–MS	Lead (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS	Magnesium (mg/L) ICP–AES
Sac. R.–Shasta	07/12/96	1/2	0.061 ± 0.001	0.056 ± 0.004	1.9 ± 0.5	0.0023 ± 0.0005	4.4 ± 0.3
Sac. R.–Shasta	07/12/96	2/2	0.062 ± 0.005	0.060 ± 0.014	1.4 ± 0.2	0.0022 ± 0.0002	4.1 ± 0.1
Sac. R.–Shasta	09/19/96	1/2	0.043 ± 0.002	0.023 ± 0.005	1.7 ± 0.2	0.0011 ± 0.0007	4.3 ± 0.0
Sac. R.–Shasta	09/19/96	2/2	0.042 ± 0.005	0.043 ± 0.007	2.0 ± 0.0	0.0021 ± 0.0006	4.2 ± 0.1
Sac. R.–Shasta	11/19/96	1/2	0.025 ± 0.000	0.029 ± 0.006	3.2 ± 0.4	0.0014 ± 0.0005	4.7 ± 0.2
Sac. R.–Shasta	11/19/96	2/2	0.023 ± 0.003	0.022 ± 0.001	3.1 ± 0.4	0.0017 ± 0.0008	4.8 ± 0.1
Sac. R.–Shasta	12/12/96	1/2	0.038 ± 0.001	0.076 ± 0.005	2.9 ± 0.1	0.0013 ± 0.0004	5.0 ± 0.1
Sac. R.–Shasta	12/12/96	2/2	0.041 ± 0.000	0.16 ± 0.01	2.8 ± 0.1	0.0020 ± 0.0002	4.8 ± 0.1
Sac. R.–Shasta	05/29/97	1/2	0.12 ± 0.00	0.12 ± 0.00	1.7 ± 0.1	0.0029 ± 0.0005	4.3 ± 0.1
Sac. R.–Shasta	05/29/97	2/2	0.11 ± 0.00	0.11 ± 0.00	1.8 ± 0.2	0.0028 ± 0.0001	4.2 ± 0.1
Sac. R.–Keswick	07/11/96	1/2	0.056 ± 0.003	0.078 ± 0.010	1.4 ± 0.3	0.0018 ± 0.0004	4.5 ± 0.1
Sac. R.–Keswick	07/11/96	2/2	0.052 ± 0.000	0.076 ± 0.003	1.4 ± 0.2	0.0016 ± 0.0005	4.8 ± 0.1
Sac. R.–Keswick	09/19/96	1/2	0.038 ± 0.003	0.051 ± 0.007	1.8 ± 0.3	0.0022 ± 0.0005	5.0 ± 0.2
Sac. R.–Keswick	09/19/96	2/2	0.035 ± 0.002	0.038 ± 0.003	1.3 ± 0.2	0.0009 ± 0.0003	5.2 ± 0.1
Sac. R.–Keswick	11/21/96	1/2	0.046 ± 0.002	0.29 ± 0.00	2.7 ± 0.6	0.0034 ± 0.0015	4.8 ± 0.3
Sac. R.–Keswick	11/21/96	2/2	0.051 ± 0.001	0.30 ± 0.00	2.2 ± 0.1	0.0033 ± 0.0006	4.9 ± 0.2
Sac. R.–Keswick	12/11/96	1/2	0.068 ± 0.003	0.36 ± 0.01	2.5 ± 0.1	0.0034 ± 0.0003	5.3 ± 0.1
Sac. R.–Keswick	12/11/96	2/2	0.065 ± 0.002	0.21 ± 0.00	2.6 ± 0.2	0.0030 ± 0.0004	5.0 ± 0.1
Sac. R.–Keswick	01/02/97	1/2	0.20 ± 0.00	0.55 ± 0.02	2.2 ± 0.2	0.0078 ± 0.0001	4.5 ± 0.2
Sac. R.–Keswick	01/02/97	2/2	0.19 ± 0.00	0.52 ± 0.04	2.0 ± 0.4	0.0068 ± 0.0006	4.4 ± 0.1
Sac. R.–Keswick	05/28/97	1/2	0.097 ± 0.001	0.11 ± 0.00	1.5 ± 0.1	0.0026 ± 0.0005	4.7 ± 0.1
Sac. R.–Keswick	05/28/97	2/2	0.10 ± 0.00	0.097 ± 0.003	1.5 ± 0.2	0.0024 ± 0.0001	4.9 ± 0.0
Sac. R.–Bend Br.	07/11/96	1/2	0.062 ± 0.001	0.091 ± 0.024	1.5 ± 0.3	0.0014 ± 0.0004	4.9 ± 0.4
Sac. R.–Bend Br.	07/11/96	2/2	0.072 ± 0.001	0.10 ± 0.01	1.6 ± 0.5	0.0025 ± 0.0002	4.8 ± 0.1
Sac. R.–Bend Br.	09/20/96	1/2	0.049 ± 0.001	0.065 ± 0.001	1.3 ± 0.2	0.0017 ± 0.0006	5.3 ± 0.1
Sac. R.–Bend Br.	09/20/96	2/2	0.050 ± 0.005	0.078 ± 0.002	2.0 ± 0.5	0.0024 ± 0.0011	5.1 ± 0.2
Sac. R.–Bend Br.	11/22/96	1/2	0.12 ± 0.01	0.41 ± 0.00	3.0 ± 0.5	0.0048 ± 0.0012	5.7 ± 0.1
Sac. R.–Bend Br.	11/22/96	2/2	0.12 ± 0.00	0.43 ± 0.02	3.0 ± 0.7	0.0051 ± 0.0007	5.5 ± 0.3
Sac. R.–Bend Br.	12/12/96	1/2	0.45 ± 0.03	0.69 ± 0.02	3.6 ± 0.0	0.0081 ± 0.0008	6.0 ± 0.1
Sac. R.–Bend Br.	12/12/96	2/2	0.47 ± 0.04	1.1 ± 0.0	3.7 ± 0.1	0.0096 ± 0.0005	5.9 ± 0.3
Sac. R.–Bend Br.	01/03/97	1/2	1.7 ± 0.1	2.3 ± 0.1	6.0 ± 0.1	0.030 ± 0.002	6.6 ± 0.0
Sac. R.–Bend Br.	01/03/97	2/2	1.7 ± 0.0	2.2 ± 0.0	6.6 ± 0.3	0.030 ± 0.001	6.1 ± 0.5

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Lanthanum (µg/L) ICP–MS	Lead (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS	Magnesium (mg/L) ICP–AES
Sac. R.–Bend Br.	05/30/97	1/2	0.097 ± 0.002	0.16 ± 0.00	1.6 ± 0.1	0.0033 ± 0.0003	5.2 ± 0.2
Sac. R.–Bend Br.	05/30/97	2/2	0.10 ± 0.00	0.16 ± 0.01	1.6 ± 0.2	0.0027 ± 0.0003	5.1 ± 0.1
Sac. R.–Colusa	07/16/96	1/1	0.44 ± 0.11	0.73 ± 0.02	3.5 ± 0.0	0.0083 ± 0.0004	6.1 ± 0.5
Sac. R.–Colusa	09/25/96	1/2	0.12 ± 0.00	0.16 ± 0.00	2.6 ± 0.3	0.0040 ± 0.0006	5.7 ± 0.3
Sac. R.–Colusa	09/25/96	2/2	0.14 ± 0.00	0.19 ± 0.02	3.0 ± 0.5	0.0025 ± 0.0011	5.7 ± 0.2
Sac. R.–Colusa	11/13/96	1/2	0.18 ± 0.01	0.25 ± 0.01	3.3 ± 0.1	0.0036 ± 0.0004	6.6 ± 0.2
Sac. R.–Colusa	11/13/96	2/2	0.18 ± 0.01	0.24 ± 0.00	3.4 ± 0.0	0.0035 ± 0.0006	6.6 ± 0.4
Sac. R.–Colusa	12/16/96	1/2	0.75 ± 0.02	1.1 ± 0.0	5.3 ± 0.1	0.016 ± 0.000	6.9 ± 0.2
Sac. R.–Colusa	12/16/96	2/2	0.87 ± 0.03	5.2 ± 0.0	5.6 ± 0.0	0.016 ± 0.001	6.9 ± 0.0
Sac. R.–Colusa	01/04/97	1/2	4.2 ± 0.3	7.8 ± 0.0	24 ± 0	0.098 ± 0.000	12 ± 1
Sac. R.–Colusa	01/04/97	2/2	4.4 ± 0.1	7.6 ± 0.0	23 ± 1	0.098 ± 0.001	13 ± 0
Sac. R.–Colusa	06/03/97	1/2	0.23 ± 0.04	0.37 ± 0.02	2.6 ± 0.1	0.0054 ± 0.0011	5.9 ± 0.1
Sac. R.–Colusa	06/03/97	2/2	0.22 ± 0.06	0.40 ± 0.04	2.6 ± 0.1	0.0059 ± 0.0003	6.2 ± 0.7
Sac. R.–Verona	07/18/96	1/2	0.28 ± 0.02	0.41 ± 0.01	1.9 ± 0.0	0.0043 ± 0.0006	4.9 ± 0.5
Sac. R.–Verona	07/18/96	2/2	0.24 ± 0.06	0.41 ± 0.03	1.9 ± 0.0	0.0049 ± 0.0005	4.9 ± 0.2
Sac. R.–Verona	09/26/96	1/2	0.32 ± 0.02	0.42 ± 0.02	2.9 ± 0.1	0.0060 ± 0.0008	7.3 ± 0.0
Sac. R.–Verona	09/26/96	2/2	0.32 ± 0.01	0.43 ± 0.02	2.9 ± 0.1	0.0063 ± 0.0005	7.4 ± 0.1
Sac. R.–Verona	11/14/96	1/2	0.26 ± 0.03	0.37 ± 0.02	2.6 ± 0.1	0.0045 ± 0.0005	7.7 ± 0.2
Sac. R.–Verona	11/14/96	2/2	0.24 ± 0.06	0.39 ± 0.02	2.7 ± 0.1	0.0051 ± 0.0009	7.7 ± 0.3
Sac. R.–Verona	12/18/96	1/2	0.47 ± 0.03	2.2 ± 0.0	2.8 ± 0.0	0.0092 ± 0.0010	5.6 ± 0.1
Sac. R.–Verona	12/18/96	2/2	0.41 ± 0.03	0.60 ± 0.01	2.8 ± 0.1	0.0086 ± 0.0004	5.6 ± 0.1
Sac. R.–Verona	06/04/97	1/2	0.33 ± 0.03	0.50 ± 0.01	2.4 ± 0.2	0.0063 ± 0.0003	6.5 ± 0.6
Sac. R.–Verona	06/04/97	2/2	0.28 ± 0.07	0.52 ± 0.02	2.5 ± 0.0	0.0066 ± 0.0005	6.6 ± 0.5
Sac. R.–Freeport	07/17/96	1/2	0.29 ± 0.02	0.36 ± 0.00	1.3 ± 0.1	0.0057 ± 0.0002	4.6 ± 0.1
Sac. R.–Freeport	07/17/96	2/2	0.24 ± 0.00	0.38 ± 0.01	1.4 ± 0.0	0.0039 ± 0.0002	4.4 ± 0.0
Sac. R.–Freeport	09/24/96	1/2	0.20 ± 0.00	0.29 ± 0.00	2.4 ± 0.0	0.0045 ± 0.0008	6.4 ± 0.1
Sac. R.–Freeport	09/24/96	2/2	0.20 ± 0.00	0.27 ± 0.01	1.8 ± 0.2	0.0039 ± 0.0006	6.7 ± 0.0
Sac. R.–Freeport	11/12/96	1/2	0.092 ± 0.003	0.14 ± 0.01	2.2 ± 0.3	0.0022 ± 0.0014	5.7 ± 0.1
Sac. R.–Freeport	11/12/96	2/2	0.094 ± 0.003	0.14 ± 0.01	2.2 ± 0.5	0.0023 ± 0.0011	5.6 ± 0.1
Sac. R.–Freeport	12/17/96	1/2	0.55 ± 0.01	1.4 ± 0.0	2.5 ± 0.1	0.010 ± 0.000	4.9 ± 0.2
Sac. R.–Freeport	12/17/96	2/2	0.58 ± 0.02	0.81 ± 0.02	2.5 ± 0.0	0.011 ± 0.001	4.7 ± 0.4
Sac. R.–Freeport	01/06/97	1/2	4.6 ± 0.2	4.4 ± 0.1	4.9 ± 0.1	0.046 ± 0.002	3.9 ± 0.5
Sac. R.–Freeport	01/06/97	1/2	4.7 ± 0.2	4.5 ± 0.0	4.8 ± 0.0	0.046 ± 0.000	3.9 ± 0.4
Sac. R.–Freeport	06/05/97	1/2	0.23 ± 0.00	0.39 ± 0.01	1.8 ± 0.1	0.0043 ± 0.0005	5.4 ± 0.1
Sac. R.–Freeport	06/05/97	2/2	0.23 ± 0.01	0.38 ± 0.01	1.8 ± 0.2	0.0046 ± 0.0003	5.4 ± 0.2
Sac. R.–Freeport, dup	06/05/97	1/2	0.16 ± 0.01	0.26 ± 0.01	1.6 ± 0.2	0.0032 ± 0.0001	5.3 ± 0.1

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Lanthanum (µg/L) ICP–MS	Lead (µg/L) ICP–MS	Lithium (µg/L) ICP–MS	Lutetium (µg/L) ICP–MS	Magnesium (mg/L) ICP–AES
Sac. R.–Freeport, dup	06/05/97	2/2	0.16 ± 0.00	0.29 ± 0.01	1.7 ± 0.3	0.0039 ± 0.0002	5.3 ± 0.1
Flat Cr.	12/11/96	1/2	0.073 ± 0.000	0.15 ± 0.00	0.43 ± 0.06	0.0099 ± 0.0008	1.7 ± 0.0
Flat Cr.	12/11/96	2/2	0.065 ± 0.002	0.23 ± 0.01	0.44 ± 0.13	0.0094 ± 0.0004	1.7 ± 0.1
Flat Cr.	05/29/97	1/2	0.019 ± 0.002	0.034 ± 0.008	0.17 ± 0.06	0.0048 ± 0.0002	6.8 ± 0.5
Flat Cr.	05/29/97	2/2	0.020 ± 0.003	0.020 ± 0.004	<0.1 ± 0.1	0.0043 ± 0.0002	7.1 ± 0.2
Spring Cr.–Weir	12/11/96	1/2	2.0 ± 0.0	1.4 ± 0.1	3.2 ± 0.0	0.12 ± 0.00	3.7 ± 0.2
Spring Cr.–Weir	12/11/96	2/2	2.1 ± 0.0	1.4 ± 0.0	3.3 ± 0.1	0.11 ± 0.00	3.7 ± 0.1
Spring Cr.–Weir	05/28/97	1/2	3.8 ± 0.0	3.8 ± 0.0	8.9 ± 0.4	0.17 ± 0.01	15 ± 1
Spring Cr.–Weir	05/28/97	2/2	3.9 ± 0.2	3.7 ± 0.1	9.1 ± 0.1	0.16 ± 0.00	15 ± 0
Spring Cr.–Road	01/02/97	1/2	1.5 ± 0.0	4.0 ± 0.0	1.7 ± 0.0	0.076 ± 0.001	3.2 ± 0.2
Spring Cr.–Road	01/02/97	2/2	1.4 ± 0.0	4.0 ± 0.1	1.8 ± 0.1	0.072 ± 0.000	3.3 ± 0.3
Whiskeytown	12/11/96	1/2	0.015 ± 0.001	0.069 ± 0.002	0.87 ± 0.09	<0.0008 ± 0.0001	5.7 ± 0.4
Whiskeytown	12/11/96	2/2	0.018 ± 0.001	0.052 ± 0.009	0.68 ± 0.19	0.0013 ± 0.0003	5.5 ± 0.2
Whiskeytown	05/29/97	1/2	0.067 ± 0.001	0.12 ± 0.01	0.90 ± 0.16	0.0020 ± 0.0004	6.5 ± 0.2
Whiskeytown	05/29/97	2/2	0.065 ± 0.003	0.12 ± 0.00	0.89 ± 0.15	0.0017 ± 0.0003	6.4 ± 0.2
Spring Cr. arm	07/12/96	1/2	0.013 ± 0.001	0.030 ± 0.008	0.40 ± 0.08	0.0010 ± 0.00092	6.1 ± 0.1
Spring Cr. arm	07/12/96	2/2	0.015 ± 0.001	0.031 ± 0.004	0.45 ± 0.03	0.0011 ± 0.0005	6.1 ± 0.0
Spring Cr. arm	09/18/96	1/2	0.019 ± 0.001	0.026 ± 0.016	0.72 ± 0.12	0.0015 ± 0.0004	6.3 ± 0.2
Spring Cr. arm	09/18/96	2/2	0.023 ± 0.001	0.047 ± 0.007	1.1 ± 0.1	0.0016 ± 0.0006	6.2 ± 0.1
Spring Cr. arm	11/20/96	1/2	0.085 ± 0.002	0.11 ± 0.01	1.1 ± 0.3	0.0079 ± 0.0010	6.2 ± 0.3
Spring Cr. arm	11/20/96	2/2	0.085 ± 0.001	0.10 ± 0.01	1.1 ± 0.3	0.0059 ± 0.0009	6.1 ± 0.4
Spring Cr. arm	12/11/96	1/2	0.25 ± 0.00	0.26 ± 0.00	1.2 ± 0.2	0.015 ± 0.000	5.5 ± 0.2
Spring Cr. arm	12/11/96	2/2	0.28 ± 0.00	0.26 ± 0.01	1.2 ± 0.2	0.014 ± 0.001	5.5 ± 0.1
Spring Cr. arm	05/28/97	1/2	0.078 ± 0.005	0.080 ± 0.001	1.1 ± 0.1	0.0028 ± 0.0009	6.4 ± 0.0
Spring Cr. arm	05/28/97	2/2	0.079 ± 0.001	0.086 ± 0.005	0.96 ± 0.13	0.0029 ± 0.0008	6.4 ± 0.1
Colusa Basin Drain	06/06/97	1/2	1.4 ± 0.2	2.2 ± 0.0	15 ± 1	0.024 ± 0.000	29 ± 1
Colusa Basin Drain	06/06/97	2/2	1.5 ± 0.1	2.1 ± 0.0	15 ± 0	0.024 ± 0.001	30 ± 1
Yolo Bypass	01/07/97	1/2	2.2 ± 0.0	3.5 ± 0.0	8.5 ± 0.3	0.046 ± 0.001	6.8 ± 0.5
Yolo Bypass	01/07/97	2/2	2.1 ± 0.0	3.5 ± 0.1	8.4 ± 0.1	0.043 ± 0.000	7.4 ± 0.3

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS	Nickel (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	3.8 ± 0.2	0.0007 ± 0.0003	0.38 ± 0.02	0.091 ± 0.003	1.0 ± 0.1
Sac. R.–Shasta	07/12/96	2/2	3.3 ± 0.3	0.0009 ± 0.0002	0.34 ± 0.01	0.087 ± 0.007	0.87 ± 0.05
Sac. R.–Shasta	09/19/96	1/2	4.5 ± 0.1	<0.0004 ± 0.0002	0.32 ± 0.02	0.060 ± 0.006	1.0 ± 0.0
Sac. R.–Shasta	09/19/96	2/2	5.3 ± 0.4	<0.0004 ± 0.0002	0.40 ± 0.02	0.060 ± 0.007	1.4 ± 0.1
Sac. R.–Shasta	11/19/96	1/2	21 ± 1	0.0010 ± 0.0001	0.56 ± 0.03	0.030 ± 0.005	0.70 ± 0.07
Sac. R.–Shasta	11/19/96	2/2	21 ± 1	0.0008 ± 0.0001	0.56 ± 0.01	0.033 ± 0.007	0.89 ± 0.27
Sac. R.–Shasta	12/12/96	1/2	7.9 ± 0.4	0.0007 ± 0.0001	0.49 ± 0.01	0.064 ± 0.011	0.85 ± 0.03
Sac. R.–Shasta	12/12/96	2/2	7.8 ± 0.4	0.0011 ± 0.0002	0.52 ± 0.01	0.076 ± 0.005	0.87 ± 0.03
Sac. R.–Shasta	05/29/97	1/2	5.1 ± 0.4	0.0024 ± 0.0002	0.32 ± 0.01	0.17 ± 0.01	2.4 ± 0.2
Sac. R.–Shasta	05/29/97	2/2	5.0 ± 0.2	0.0024 ± 0.0004	0.33 ± 0.04	0.16 ± 0.00	2.5 ± 0.0
Sac. R.–Keswick	07/11/96	1/2	4.2 ± 0.3	0.0010 ± 0.0002	0.29 ± 0.03	0.078 ± 0.003	1.6 ± 0.1
Sac. R.–Keswick	07/11/96	2/2	4.2 ± 0.2	0.0012 ± 0.0000	0.27 ± 0.03	0.077 ± 0.006	1.5 ± 0.0
Sac. R.–Keswick	09/19/96	1/2	6.3 ± 0.3	0.0006 ± 0.0002	0.29 ± 0.03	0.052 ± 0.005	2.7 ± 0.2
Sac. R.–Keswick	09/19/96	2/2	5.3 ± 0.3	0.0010 ± 0.0002	0.24 ± 0.02	0.055 ± 0.006	2.0 ± 0.1
Sac. R.–Keswick	11/21/96	1/2	22 ± 2	0.0026 ± 0.0003	0.44 ± 0.04	0.099 ± 0.010	1.2 ± 0.1
Sac. R.–Keswick	11/21/96	2/2	21 ± 1	0.0021 ± 0.0001	0.40 ± 0.01	0.10 ± 0.00	1.3 ± 0.2
Sac. R.–Keswick	12/11/96	1/2	12 ± 0	0.0017 ± 0.0003	0.43 ± 0.00	0.14 ± 0.01	1.1 ± 0.0
Sac. R.–Keswick	12/11/96	2/2	12 ± 0	0.0016 ± 0.0001	0.43 ± 0.02	0.14 ± 0.01	1.0 ± 0.1
Sac. R.–Keswick	01/02/97	1/2	25 ± 0	0.0075 ± 0.0003	0.35 ± 0.03	0.37 ± 0.03	1.6 ± 0.0
Sac. R.–Keswick	01/02/97	2/2	25 ± 3	0.0082 ± 0.0004	0.33 ± 0.04	0.39 ± 0.01	1.6 ± 0.0
Sac. R.–Keswick	05/28/97	1/2	7.2 ± 0.5	0.0023 ± 0.0004	0.24 ± 0.01	0.15 ± 0.01	6.8 ± 0.2
Sac. R.–Keswick	05/28/97	2/2	7.1 ± 0.6	0.0050 ± 0.0002	0.23 ± 0.02	0.15 ± 0.01	7.0 ± 0.4
Sac. R.–Bend Br.	07/11/96	1/2	6.5 ± 0.2	0.0015 ± 0.0002	0.30 ± 0.01	0.090 ± 0.009	1.7 ± 0.0
Sac. R.–Bend Br.	07/11/96	2/2	7.1 ± 0.4	0.0017 ± 0.0002	0.39 ± 0.01	0.091 ± 0.011	1.7 ± 0.1
Sac. R.–Bend Br.	09/20/96	1/2	7.4 ± 0.3	0.0019 ± 0.0001	0.25 ± 0.00	0.071 ± 0.007	1.9 ± 0.0
Sac. R.–Bend Br.	09/20/96	2/2	8.5 ± 0.7	0.0006 ± 0.0001	0.31 ± 0.01	0.064 ± 0.004	2.6 ± 0.1
Sac. R.–Bend Br.	11/22/96	1/2	28 ± 2	0.0033 ± 0.0004	0.46 ± 0.03	0.18 ± 0.00	3.5 ± 0.3
Sac. R.–Bend Br.	11/22/96	2/2	29 ± 1	0.0034 ± 0.0001	0.44 ± 0.03	0.18 ± 0.01	3.3 ± 0.1
Sac. R.–Bend Br.	12/12/96	1/2	51 ± 1	0.0072 ± 0.0001	0.31 ± 0.02	0.62 ± 0.04	9.1 ± 0.2
Sac. R.–Bend Br.	12/12/96	2/2	52 ± 1	0.0064 ± 0.0006	0.31 ± 0.03	0.65 ± 0.05	10 ± 0
Sac. R.–Bend Br.	01/03/97	1/2	148 ± 2	0.019 ± 0.000	0.21 ± 0.01	2.3 ± 0.2	16 ± 1
Sac. R.–Bend Br.	01/03/97	2/2	149 ± 0	— ± —	0.22 ± 0.01	2.2 ± 0.0	16 ± 0

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS	Nickel (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	9.6 ± 0.6	0.0032 ± 0.0004	0.30 ± 0.01	0.15 ± 0.00	6.5 ± 0.1
Sac. R.–Bend Br.	05/30/97	2/2	9.8 ± 0.7	0.0025 ± 0.0004	0.27 ± 0.03	0.15 ± 0.00	6.7 ± 0.3
Sac. R.–Colusa	07/16/96	1/1	50 ± 3	0.0065 ± 0.0001	0.22 ± 0.01	0.59 ± 0.10	7.9 ± 0.5
Sac. R.–Colusa	09/25/96	1/2	20 ± 2	0.0017 ± 0.0003	0.53 ± 0.18	0.14 ± 0.00	3.3 ± 0.3
Sac. R.–Colusa	09/25/96	2/2	20 ± 1	0.0017 ± 0.0003	0.43 ± 0.02	0.16 ± 0.01	3.3 ± 0.3
Sac. R.–Colusa	11/13/96	1/2	25 ± 0	0.0022 ± 0.0001	0.34 ± 0.00	0.25 ± 0.01	3.1 ± 0.2
Sac. R.–Colusa	11/13/96	2/2	25 ± 0	0.0025 ± 0.0001	0.37 ± 0.02	0.24 ± 0.00	3.1 ± 0.1
Sac. R.–Colusa	12/16/96	1/2	82 ± 1	0.010 ± 0.000	0.27 ± 0.03	1.1 ± 0.0	11 ± 0
Sac. R.–Colusa	12/16/96	2/2	94 ± 1	0.010 ± 0.001	0.32 ± 0.02	1.2 ± 0.0	11 ± 0
Sac. R.–Colusa	01/04/97	1/2	467 ± 2	0.081 ± 0.000	0.23 ± 0.01	6.3 ± 0.1	52 ± 1
Sac. R.–Colusa	01/04/97	2/2	458 ± 1	0.081 ± 0.000	0.28 ± 0.09	6.2 ± 0.0	51 ± 0
Sac. R.–Colusa	06/03/97	1/2	30 ± 2	0.0047 ± 0.0001	0.28 ± 0.02	0.33 ± 0.06	7.1 ± 0.4
Sac. R.–Colusa	06/03/97	2/2	34 ± 3	0.0044 ± 0.0001	0.29 ± 0.05	0.32 ± 0.06	7.5 ± 0.9
Sac. R.–Verona	07/18/96	1/2	33 ± 1	0.0043 ± 0.0001	0.29 ± 0.03	0.34 ± 0.02	3.8 ± 0.1
Sac. R.–Verona	07/18/96	2/2	36 ± 2	0.0048 ± 0.0001	0.30 ± 0.04	0.30 ± 0.06	4.2 ± 0.4
Sac. R.–Verona	09/26/96	1/2	44 ± 0	0.0047 ± 0.0000	0.39 ± 0.03	0.44 ± 0.01	4.2 ± 0.1
Sac. R.–Verona	09/26/96	2/2	44 ± 0	0.0052 ± 0.0001	0.37 ± 0.00	0.44 ± 0.02	4.1 ± 0.1
Sac. R.–Verona	11/14/96	1/2	55 ± 2	0.0036 ± 0.0004	0.48 ± 0.00	0.33 ± 0.03	3.4 ± 0.4
Sac. R.–Verona	11/14/96	2/2	55 ± 1	— ± —	0.44 ± 0.01	0.32 ± 0.05	3.4 ± 0.1
Sac. R.–Verona	12/18/96	1/2	49 ± 1	0.0072 ± 0.0005	0.26 ± 0.02	0.64 ± 0.04	5.9 ± 0.1
Sac. R.–Verona	12/18/96	2/2	46 ± 0	0.0073 ± 0.0001	0.25 ± 0.00	0.56 ± 0.03	5.4 ± 0.2
Sac. R.–Verona	06/04/97	1/2	48 ± 2	0.0055 ± 0.0003	0.35 ± 0.03	0.45 ± 0.02	5.5 ± 0.1
Sac. R.–Verona	06/04/97	2/2	54 ± 4	0.0047 ± 0.0000	0.35 ± 0.01	0.40 ± 0.09	6.3 ± 0.5
Sac. R.–Freeport	07/17/96	1/2	30 ± 1	0.0042 ± 0.0004	0.31 ± 0.05	0.33 ± 0.00	2.4 ± 0.0
Sac. R.–Freeport	07/17/96	2/2	29 ± 1	0.0041 ± 0.0003	0.28 ± 0.03	0.32 ± 0.00	2.5 ± 0.0
Sac. R.–Freeport	09/24/96	1/2	34 ± 3	0.0025 ± 0.0003	0.52 ± 0.02	0.24 ± 0.00	3.0 ± 0.3
Sac. R.–Freeport	09/24/96	2/2	27 ± 1	0.0022 ± 0.0004	0.41 ± 0.04	0.27 ± 0.01	2.1 ± 0.1
Sac. R.–Freeport	11/12/96	1/2	21 ± 1	0.0013 ± 0.0003	0.49 ± 0.02	0.13 ± 0.01	1.7 ± 0.2
Sac. R.–Freeport	11/12/96	2/2	21 ± 1	0.0018 ± 0.0006	0.48 ± 0.03	0.11 ± 0.00	1.6 ± 0.1
Sac. R.–Freeport	12/17/96	1/2	55 ± 0	0.0097 ± 0.0001	0.18 ± 0.01	0.71 ± 0.01	6.6 ± 0.1
Sac. R.–Freeport	12/17/96	2/2	57 ± 1	0.0094 ± 0.0001	0.19 ± 0.01	0.74 ± 0.03	6.5 ± 0.1
Sac. R.–Freeport	01/06/97	1/2	201 ± 1	0.028 ± 0.000	0.14 ± 0.01	4.8 ± 0.0	17 ± 0
Sac. R.–Freeport	01/06/97	1/2	194 ± 6	0.030 ± 0.000	0.15 ± 0.01	4.7 ± 0.2	16 ± 0
Sac. R.–Freeport	06/05/97	1/2	31 ± 1	0.0051 ± 0.0003	0.35 ± 0.01	0.30 ± 0.00	3.7 ± 0.2
Sac. R.–Freeport	06/05/97	2/2	32 ± 0	0.0046 ± 0.0002	0.35 ± 0.01	0.29 ± 0.01	3.8 ± 0.3
Sac. R.–Freeport, dup	06/05/97	1/2	23 ± 2	0.0031 ± 0.0001	0.37 ± 0.01	0.21 ± 0.01	2.7 ± 0.2

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Manganese (µg/L) ICP–MS	Mercury (µg/L) CV–AFS	Molybdenum (µg/L) ICP–MS	Neodymium (µg/L) ICP–MS	Nickel (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	23 ± 1	0.0033 ± 0.0003	0.37 ± 0.04	0.22 ± 0.01	2.7 ± 0.2
Flat Cr.	12/11/96	1/2	19 ± 1	0.0031 ± 0.0004	<0.08 ± 0.01	0.23 ± 0.01	0.94 ± 0.00
Flat Cr.	12/11/96	2/2	19 ± 1	0.0035 ± 0.0000	<0.08 ± 0.01	0.21 ± 0.01	1.3 ± 0.2
Flat Cr.	05/29/97	1/2	119 ± 7	0.0019 ± 0.0000	0.24 ± 0.02	0.069 ± 0.007	0.13 ± 0.02
Flat Cr.	05/29/97	2/2	114 ± 3	0.0021 ± 0.0002	0.22 ± 0.03	0.073 ± 0.002	0.12 ± 0.03
Spring Cr.–Weir	12/11/96	1/2	160 ± 1	0.012 ± 0.000	<0.1 ± 0.0	4.8 ± 0.0	1.6 ± 0.0
Spring Cr.–Weir	12/11/96	2/2	161 ± 2	0.014 ± 0.000	<0.1 ± 0.0	5.0 ± 0.1	1.6 ± 0.1
Spring Cr.–Weir	05/28/97	1/2	536 ± 4	0.0092 ± 0.0004	<0.09 ± 0.00	8.7 ± 0.1	4.4 ± 0.1
Spring Cr.–Weir	05/28/97	2/2	531 ± 8	0.0088 ± 0.0002	<0.09 ± 0.03	8.8 ± 0.3	4.2 ± 0.2
Spring Cr.–Road	01/02/97	1/2	197 ± 3	0.038 ± 0.000	<0.1 ± 0.0	3.3 ± 0.0	1.8 ± 0.0
Spring Cr.–Road	01/02/97	2/2	200 ± 7	0.042 ± 0.000	<0.1 ± 0.0	3.3 ± 0.0	1.8 ± 0.1
Whiskeytown	12/11/96	1/2	5.8 ± 0.1	0.0009 ± 0.00035	0.15 ± 0.01	0.022 ± 0.001	2.6 ± 0.1
Whiskeytown	12/11/96	2/2	5.8 ± 0.2	0.0010 ± 0.0003	0.15 ± 0.04	0.026 ± 0.002	2.3 ± 0.1
Whiskeytown	05/29/97	1/2	12 ± 1	0.0028 ± 0.0002	<0.08 ± 0.02	0.095 ± 0.007	21 ± 1
Whiskeytown	05/29/97	2/2	12 ± 1	0.0028 ± 0.0003	0.11 ± 0.04	0.088 ± 0.007	20 ± 0
Spring Cr. arm	07/12/96	1/2	4.4 ± 0.5	0.0012 ± 0.0001	0.086 ± 0.009	0.026 ± 0.006	3.5 ± 0.4
Spring Cr. arm	07/12/96	2/2	4.6 ± 0.4	0.0011 ± 0.0002	0.090 ± 0.020	0.024 ± 0.006	3.4 ± 0.0
Spring Cr. arm	09/18/96	1/2	6.1 ± 0.1	0.0010 ± 0.00018	0.090 ± 0.017	0.037 ± 0.003	3.6 ± 0.1
Spring Cr. arm	09/18/96	2/2	7.3 ± 0.4	0.0009 ± 0.00025	0.11 ± 0.00	0.044 ± 0.007	4.9 ± 0.3
Spring Cr. arm	11/20/96	1/2	24 ± 2	0.0010 ± 0.0002	0.13 ± 0.00	0.21 ± 0.01	3.6 ± 0.3
Spring Cr. arm	11/20/96	2/2	24 ± 2	0.0013 ± 0.0002	0.15 ± 0.01	0.20 ± 0.02	3.7 ± 0.2
Spring Cr. arm	12/11/96	1/2	26 ± 1	0.0035 ± 0.0003	0.098 ± 0.008	0.60 ± 0.02	2.5 ± 0.1
Spring Cr. arm	12/11/96	2/2	26 ± 2	0.0031 ± 0.0002	0.11 ± 0.02	0.65 ± 0.01	2.5 ± 0.2
Spring Cr. arm	05/28/97	1/2	14 ± 1	0.0040 ± 0.0002	0.086 ± 0.009	0.11 ± 0.00	20 ± 1
Spring Cr. arm	05/28/97	2/2	14 ± 1	0.0040 ± 0.0000	<0.08 ± 0.01	0.12 ± 0.01	20 ± 1
Colusa Basin Drain	06/06/97	1/2	284 ± 3	0.0083 ± 0.0001	2.1 ± 0.1	2.0 ± 0.3	24 ± 1
Colusa Basin Drain	06/06/97	2/2	278 ± 2	0.0098 ± 0.0002	2.0 ± 0.0	2.1 ± 0.1	23 ± 1
Yolo Bypass	01/07/97	1/2	206 ± 3	0.046 ± 0.000	0.20 ± 0.01	3.0 ± 0.0	25 ± 0
Yolo Bypass	01/07/97	2/2	204 ± 1	0.046 ± 0.001	0.20 ± 0.01	3.0 ± 0.0	25 ± 0

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Potassium (mg/L) ICP–AES-Ax	Praseodymium (µg/L) ICP–MS	Rhenium (µg/L) ICP–MS	Rubidum (µg/L) ICP–MS	Samarium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	1.1 ± 0.0	0.018 ± 0.002	<0.001 ± 0.001	2.1 ± 0.0	0.022 ± 0.002
Sac. R.–Shasta	07/12/96	2/2	1.1 ± 0.0	0.019 ± 0.000	<0.001 ± 0.000	2.1 ± 0.2	0.023 ± 0.002
Sac. R.–Shasta	09/19/96	1/2	0.97 ± 0.00	0.011 ± 0.001	<0.001 ± 0.001	2.0 ± 0.1	0.017 ± 0.004
Sac. R.–Shasta	09/19/96	2/2	0.96 ± 0.01	0.011 ± 0.000	0.0017 ± 0.0007	2.2 ± 0.0	0.025 ± 0.012
Sac. R.–Shasta	11/19/96	1/2	1.2 ± 0.0	0.0067 ± 0.0009	0.0025 ± 0.0017	3.2 ± 0.1	0.015 ± 0.006
Sac. R.–Shasta	11/19/96	2/2	1.2 ± 0.0	0.0067 ± 0.0006	0.0032 ± 0.0009	3.2 ± 0.1	0.0099 ± 0.0135
Sac. R.–Shasta	12/12/96	1/2	1.4 ± 0.0	0.012 ± 0.000	<0.002 ± 0.001	3.2 ± 0.0	0.020 ± 0.001
Sac. R.–Shasta	12/12/96	2/2	1.3 ± 0.0	0.013 ± 0.001	<0.002 ± 0.001	3.1 ± 0.1	0.024 ± 0.004
Sac. R.–Shasta	05/29/97	1/2	1.1 ± 0.0	0.035 ± 0.002	<0.002 ± 0.001	2.1 ± 0.1	0.047 ± 0.000
Sac. R.–Shasta	05/29/97	2/2	1.1 ± 0.0	0.033 ± 0.001	<0.002 ± 0.000	2.0 ± 0.0	0.044 ± 0.004
Sac. R.–Keswick	07/11/96	1/2	0.90 ± 0.02	0.016 ± 0.001	<0.001 ± 0.000	1.7 ± 0.1	0.015 ± 0.004
Sac. R.–Keswick	07/11/96	2/2	0.91 ± 0.02	0.015 ± 0.001	<0.001 ± 0.001	1.7 ± 0.1	0.022 ± 0.006
Sac. R.–Keswick	09/19/96	1/2	0.69 ± 0.00	0.010 ± 0.002	<0.001 ± 0.001	1.4 ± 0.1	0.019 ± 0.003
Sac. R.–Keswick	09/19/96	2/2	0.69 ± 0.00	0.011 ± 0.001	<0.001 ± 0.001	1.3 ± 0.0	0.014 ± 0.002
Sac. R.–Keswick	11/21/96	1/2	1.0 ± 0.0	0.018 ± 0.000	0.0035 ± 0.0007	2.5 ± 0.0	0.036 ± 0.008
Sac. R.–Keswick	11/21/96	2/2	1.0 ± 0.0	0.020 ± 0.000	0.0021 ± 0.0009	2.4 ± 0.0	0.047 ± 0.006
Sac. R.–Keswick	12/11/96	1/2	1.2 ± 0.0	0.025 ± 0.002	<0.002 ± 0.001	2.7 ± 0.0	0.043 ± 0.004
Sac. R.–Keswick	12/11/96	2/2	1.2 ± 0.0	0.022 ± 0.001	<0.002 ± 0.000	2.7 ± 0.0	0.046 ± 0.002
Sac. R.–Keswick	01/02/97	1/2	1.1 ± 0.0	0.071 ± 0.004	<0.001 ± 0.000	2.5 ± 0.1	0.095 ± 0.002
Sac. R.–Keswick	01/02/97	2/2	1.1 ± 0.0	0.065 ± 0.001	<0.001 ± 0.001	2.5 ± 0.0	0.12 ± 0.01
Sac. R.–Keswick	05/28/97	1/2	0.90 ± 0.01	0.030 ± 0.003	<0.002 ± 0.001	1.6 ± 0.1	0.037 ± 0.003
Sac. R.–Keswick	05/28/97	2/2	0.89 ± 0.01	0.028 ± 0.002	<0.002 ± 0.000	1.6 ± 0.1	0.042 ± 0.002
Sac. R.–Bend Br.	07/11/96	1/2	0.94 ± 0.00	0.018 ± 0.001	0.0012 ± 0.0013	1.7 ± 0.1	0.023 ± 0.004
Sac. R.–Bend Br.	07/11/96	2/2	0.94 ± 0.02	0.019 ± 0.001	<0.001 ± 0.000	1.7 ± 0.0	0.026 ± 0.007
Sac. R.–Bend Br.	09/20/96	1/2	0.83 ± 0.01	0.015 ± 0.001	<0.001 ± 0.001	1.6 ± 0.0	0.022 ± 0.006
Sac. R.–Bend Br.	09/20/96	2/2	0.82 ± 0.00	0.012 ± 0.000	0.0017 ± 0.0010	1.8 ± 0.1	0.024 ± 0.007
Sac. R.–Bend Br.	11/22/96	1/2	1.1 ± 0.0	0.036 ± 0.001	0.0019 ± 0.0015	2.6 ± 0.0	0.054 ± 0.011
Sac. R.–Bend Br.	11/22/96	2/2	1.1 ± 0.0	0.036 ± 0.001	0.0026 ± 0.0012	2.5 ± 0.0	0.056 ± 0.013
Sac. R.–Bend Br.	12/12/96	1/2	1.3 ± 0.0	0.13 ± 0.01	0.0012 ± 0.0003	2.9 ± 0.0	0.16 ± 0.01
Sac. R.–Bend Br.	12/12/96	2/2	1.3 ± 0.0	0.13 ± 0.01	0.0012 ± 0.0003	2.9 ± 0.1	0.17 ± 0.01
Sac. R.–Bend Br.	01/03/97	1/2	1.6 ± 0.1	0.47 ± 0.04	0.0008 ± 0.0003	4.1 ± 0.1	0.63 ± 0.01
Sac. R.–Bend Br.	01/03/97	2/2	1.5 ± 0.0	0.47 ± 0.01	<0.0006 ± 0.0005	4.1 ± 0.0	0.56 ± 0.01

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Potassium (mg/L) ICP-AES-Ax	Praseodymium (µg/L) ICP-MS	Rhenium (µg/L) ICP-MS	Rubidum (µg/L) ICP-MS	Samarium (µg/L) ICP-MS
Sac. R.–Bend Br.	05/30/97	1/2	0.96 ± 0.02	0.027 ± 0.000	<0.002 ± 0.000	1.7 ± 0.0	0.037 ± 0.006
Sac. R.–Bend Br.	05/30/97	2/2	0.95 ± 0.01	0.032 ± 0.000	<0.002 ± 0.000	1.7 ± 0.0	0.043 ± 0.006
Sac. R.–Colusa	07/16/96	1/1	1.2 ± 0.0	0.12 ± 0.03	<0.0008 ± 0.0003	2.8 ± 0.1	0.18 ± 0.03
Sac. R.–Colusa	09/25/96	1/2	1.1 ± 0.0	0.031 ± 0.001	0.0022 ± 0.0010	2.1 ± 0.1	0.052 ± 0.014
Sac. R.–Colusa	09/25/96	2/2	1.1 ± 0.0	0.035 ± 0.000	0.0031 ± 0.0007	2.1 ± 0.1	0.060 ± 0.005
Sac. R.–Colusa	11/13/96	1/2	1.3 ± 0.0	0.049 ± 0.004	0.0010 ± 0.0004	2.5 ± 0.0	0.073 ± 0.009
Sac. R.–Colusa	11/13/96	2/2	1.3 ± 0.0	0.047 ± 0.004	<0.0008 ± 0.0005	2.4 ± 0.0	0.068 ± 0.008
Sac. R.–Colusa	12/16/96	1/2	1.5 ± 0.0	0.22 ± 0.01	0.0007 ± 0.0001	2.9 ± 0.0	0.30 ± 0.00
Sac. R.–Colusa	12/16/96	2/2	1.5 ± 0.0	0.26 ± 0.01	0.0011 ± 0.0005	3.0 ± 0.0	0.34 ± 0.01
Sac. R.–Colusa	01/04/97	1/2	2.3 ± 0.0	1.3 ± 0.0	0.0011 ± 0.0003	7.4 ± 0.0	1.7 ± 0.1
Sac. R.–Colusa	01/04/97	2/2	2.3 ± 0.0	1.3 ± 0.0	0.0011 ± 0.0005	7.5 ± 0.0	1.7 ± 0.0
Sac. R.–Colusa	06/03/97	1/2	1.1 ± 0.0	0.064 ± 0.010	<0.0008 ± 0.0001	2.0 ± 0.1	0.096 ± 0.012
Sac. R.–Colusa	06/03/97	2/2	1.1 ± 0.0	0.067 ± 0.016	<0.0008 ± 0.0004	2.0 ± 0.1	0.095 ± 0.018
Sac. R.–Verona	07/18/96	1/2	0.97 ± 0.00	0.074 ± 0.006	<0.0008 ± 0.0001	1.7 ± 0.0	0.097 ± 0.014
Sac. R.–Verona	07/18/96	2/2	0.98 ± 0.02	0.063 ± 0.016	<0.0008 ± 0.0002	1.7 ± 0.0	0.088 ± 0.019
Sac. R.–Verona	09/26/96	1/2	1.2 ± 0.0	0.090 ± 0.005	<0.0006 ± 0.0004	2.0 ± 0.0	0.12 ± 0.00
Sac. R.–Verona	09/26/96	2/2	1.2 ± 0.0	0.092 ± 0.005	0.0007 ± 0.00034	2.0 ± 0.0	0.12 ± 0.01
Sac. R.–Verona	11/14/96	1/2	1.4 ± 0.0	0.071 ± 0.007	<0.0008 ± 0.0004	1.9 ± 0.0	0.10 ± 0.01
Sac. R.–Verona	11/14/96	2/2	1.4 ± 0.0	0.068 ± 0.016	<0.0008 ± 0.0003	1.9 ± 0.0	0.093 ± 0.022
Sac. R.–Verona	12/18/96	1/2	1.3 ± 0.0	0.13 ± 0.01	<0.0006 ± 0.0002	2.0 ± 0.1	0.16 ± 0.01
Sac. R.–Verona	12/18/96	2/2	1.3 ± 0.0	0.12 ± 0.01	<0.0006 ± 0.0001	1.8 ± 0.0	0.15 ± 0.01
Sac. R.–Verona	06/04/97	1/2	1.1 ± 0.0	0.093 ± 0.008	<0.0008 ± 0.0002	1.8 ± 0.1	0.12 ± 0.01
Sac. R.–Verona	06/04/97	2/2	1.1 ± 0.0	0.069 ± 0.000	<0.0008 ± 0.0004	1.8 ± 0.0	0.12 ± 0.03
Sac. R.–Freeport	07/17/96	1/2	0.90 ± 0.01	0.071 ± 0.001	<0.001 ± 0.000	1.5 ± 0.0	0.091 ± 0.007
Sac. R.–Freeport	07/17/96	2/2	0.92 ± 0.01	0.068 ± 0.001	<0.001 ± 0.001	1.5 ± 0.0	0.084 ± 0.006
Sac. R.–Freeport	09/24/96	1/2	1.1 ± 0.0	0.054 ± 0.001	0.0035 ± 0.0006	1.7 ± 0.1	0.066 ± 0.011
Sac. R.–Freeport	09/24/96	2/2	1.1 ± 0.0	0.056 ± 0.001	<0.001 ± 0.001	1.5 ± 0.0	0.069 ± 0.010
Sac. R.–Freeport	11/12/96	1/2	1.2 ± 0.0	0.025 ± 0.001	0.0027 ± 0.0013	1.5 ± 0.1	0.035 ± 0.005
Sac. R.–Freeport	11/12/96	2/2	1.2 ± 0.0	0.024 ± 0.000	0.0017 ± 0.0014	1.6 ± 0.0	0.031 ± 0.007
Sac. R.–Freeport	12/17/96	1/2	1.2 ± 0.0	0.15 ± 0.00	0.0008 ± 0.00014	2.0 ± 0.0	0.17 ± 0.01
Sac. R.–Freeport	12/17/96	2/2	1.3 ± 0.0	0.16 ± 0.00	0.0008 ± 0.00054	2.1 ± 0.0	0.18 ± 0.00
Sac. R.–Freeport	01/06/97	1/2	1.8 ± 0.0	1.1 ± 0.0	<0.0006 ± 0.0004	7.9 ± 0.1	1.0 ± 0.0
Sac. R.–Freeport	01/06/97	1/2	1.9 ± 0.0	1.1 ± 0.0	<0.0006 ± 0.0003	7.9 ± 0.2	1.0 ± 0.0
Sac. R.–Freeport	06/05/97	1/2	1.0 ± 0.0	0.064 ± 0.001	<0.002 ± 0.001	1.6 ± 0.0	0.076 ± 0.000
Sac. R.–Freeport	06/05/97	2/2	1.0 ± 0.0	0.065 ± 0.003	<0.002 ± 0.000	1.6 ± 0.1	0.087 ± 0.005
Sac. R.–Freeport, dup	06/05/97	1/2	1.0 ± 0.0	0.046 ± 0.003	<0.002 ± 0.000	1.4 ± 0.0	0.058 ± 0.001

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Potassium (mg/L) ICP–AES-Ax	Praseodymium (µg/L) ICP–MS	Rhenium (µg/L) ICP–MS	Rubidum (µg/L) ICP–MS	Samarium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.99 ± 0.00	0.044 ± 0.000	<0.002 ± 0.000	1.4 ± 0.1	0.055 ± 0.010
Flat Cr.	12/11/96	1/2	0.19 ± 0.01	0.038 ± 0.000	<0.002 ± 0.000	0.14 ± 0.01	0.10 ± 0.00
Flat Cr.	12/11/96	2/2	0.18 ± 0.00	0.036 ± 0.001	<0.002 ± 0.000	0.15 ± 0.01	0.092 ± 0.005
Flat Cr.	05/29/97	1/2	0.33 ± 0.01	0.010 ± 0.001	<0.002 ± 0.000	0.29 ± 0.01	0.028 ± 0.004
Flat Cr.	05/29/97	2/2	0.33 ± 0.00	0.0095 ± 0.0005	<0.002 ± 0.001	0.29 ± 0.02	0.030 ± 0.004
Spring Cr.–Weir	12/11/96	1/2	0.37 ± 0.00	0.84 ± 0.00	0.0031 ± 0.0001	0.36 ± 0.01	1.7 ± 0.0
Spring Cr.–Weir	12/11/96	2/2	0.38 ± 0.00	0.90 ± 0.01	0.0029 ± 0.0003	0.37 ± 0.02	1.8 ± 0.1
Spring Cr.–Weir	05/28/97	1/2	2.5 ± 0.0	1.5 ± 0.0	0.020 ± 0.000	4.5 ± 0.0	3.2 ± 0.1
Spring Cr.–Weir	05/28/97	2/2	2.5 ± 0.0	1.5 ± 0.0	0.019 ± 0.000	4.5 ± 0.0	3.2 ± 0.1
Spring Cr.–Road	01/02/97	1/2	0.50 ± 0.01	0.59 ± 0.01	0.0022 ± 0.0004	0.46 ± 0.00	1.2 ± 0.0
Spring Cr.–Road	01/02/97	2/2	0.50 ± 0.01	0.58 ± 0.01	0.0020 ± 0.0001	0.45 ± 0.00	1.1 ± 0.0
Whiskeytown	12/11/96	1/2	0.34 ± 0.01	0.0045 ± 0.0005	<0.002 ± 0.000	0.31 ± 0.01	0.0076 ± 0.0032
Whiskeytown	12/11/96	2/2	0.35 ± 0.01	0.0044 ± 0.0002	<0.001 ± 0.000	0.30 ± 0.02	0.0084 ± 0.0046
Whiskeytown	05/29/97	1/2	0.36 ± 0.01	0.019 ± 0.000	<0.002 ± 0.001	0.40 ± 0.01	0.028 ± 0.004
Whiskeytown	05/29/97	2/2	0.36 ± 0.01	0.018 ± 0.001	<0.002 ± 0.000	0.39 ± 0.03	0.024 ± 0.005
Spring Cr. arm	07/12/96	1/2	0.31 ± 0.00	0.0044 ± 0.0009	<0.001 ± 0.000	0.30 ± 0.03	0.0062 ± 0.0051
Spring Cr. arm	07/12/96	2/2	0.31 ± 0.01	0.0047 ± 0.0006	0.0020 ± 0.0025	0.29 ± 0.01	0.013 ± 0.004
Spring Cr. arm	09/18/96	1/2	0.31 ± 0.00	0.0066 ± 0.0004	<0.001 ± 0.001	0.31 ± 0.01	0.014 ± 0.004
Spring Cr. arm	09/18/96	2/2	0.31 ± 0.01	0.0076 ± 0.0002	<0.001 ± 0.000	0.36 ± 0.01	0.014 ± 0.012
Spring Cr. arm	11/20/96	1/2	0.34 ± 0.01	0.035 ± 0.001	0.0017 ± 0.0012	0.37 ± 0.02	0.079 ± 0.014
Spring Cr. arm	11/20/96	2/2	0.35 ± 0.00	0.037 ± 0.000	0.0022 ± 0.0019	0.38 ± 0.00	0.064 ± 0.001
Spring Cr. arm	12/11/96	1/2	0.35 ± 0.01	0.10 ± 0.00	<0.002 ± 0.000	0.31 ± 0.02	0.21 ± 0.02
Spring Cr. arm	12/11/96	2/2	0.35 ± 0.01	0.11 ± 0.00	0.0016 ± 0.0004	0.32 ± 0.02	0.22 ± 0.01
Spring Cr. arm	05/28/97	1/2	0.37 ± 0.01	0.023 ± 0.002	<0.002 ± 0.000	0.40 ± 0.03	0.032 ± 0.001
Spring Cr. arm	05/28/97	2/2	0.36 ± 0.00	0.024 ± 0.001	<0.002 ± 0.000	0.42 ± 0.02	0.036 ± 0.004
Colusa Basin Drain	06/06/97	1/2	2.5 ± 0.0	0.41 ± 0.06	0.0043 ± 0.0001	4.3 ± 0.1	0.55 ± 0.06
Colusa Basin Drain	06/06/97	2/2	2.5 ± 0.1	0.43 ± 0.01	0.0036 ± 0.0004	4.2 ± 0.1	0.59 ± 0.03
Yolo Bypass	01/07/97	1/2	1.7 ± 0.0	0.62 ± 0.01	<0.0006 ± 0.0003	4.5 ± 0.0	0.79 ± 0.02
Yolo Bypass	01/07/97	2/2	1.8 ± 0.1	0.61 ± 0.00	<0.0006 ± 0.0003	4.4 ± 0.0	0.78 ± 0.01

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Silica (as SiO_2) (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	24 ± 2	<0.2 ± 0.0	6.7 ± 0.2	52 ± 0	0.0036 ± 0.0002
Sac. R.–Shasta	07/12/96	2/2	21 ± 0	<0.2 ± 0.0	5.6 ± 0.2	51 ± 1	0.0038 ± 0.0008
Sac. R.–Shasta	09/19/96	1/2	21 ± 0	<0.2 ± 0.0	5.5 ± 0.0	52 ± 2	0.0031 ± 0.0006
Sac. R.–Shasta	09/19/96	2/2	21 ± 1	<0.09 ± 0.04	5.1 ± 0.3	76 ± 0	0.0030 ± 0.0011
Sac. R.–Shasta	11/19/96	1/2	24 ± 1	<0.09 ± 0.00	6.5 ± 0.3	64 ± 2	0.0027 ± 0.0009
Sac. R.–Shasta	11/19/96	2/2	25 ± 0	<0.09 ± 0.01	6.7 ± 0.3	64 ± 1	0.0020 ± 0.0011
Sac. R.–Shasta	12/12/96	1/2	25 ± 0	<0.2 ± 0.3	7.3 ± 0.1	56 ± 2	0.0039 ± 0.0009
Sac. R.–Shasta	12/12/96	2/2	24 ± 0	<0.2 ± 0.0	6.9 ± 0.0	55 ± 3	0.0038 ± 0.0011
Sac. R.–Shasta	05/29/97	1/2	24 ± 1	<0.2 ± 0.0	6.0 ± 0.2	52 ± 3	0.0078 ± 0.0006
Sac. R.–Shasta	05/29/97	2/2	23 ± 1	<0.2 ± 0.1	5.7 ± 0.3	50 ± 1	0.0069 ± 0.0010
Sac. R.–Keswick	07/11/96	1/2	19 ± 1	<0.2 ± 0.0	4.6 ± 0.2	45 ± 2	0.0039 ± 0.0009
Sac. R.–Keswick	07/11/96	2/2	20 ± 1	<0.2 ± 0.0	4.9 ± 0.1	45 ± 2	0.0033 ± 0.0006
Sac. R.–Keswick	09/19/96	1/2	18 ± 1	<0.09 ± 0.02	3.8 ± 0.3	43 ± 1	0.0030 ± 0.0006
Sac. R.–Keswick	09/19/96	2/2	18 ± 0	<0.2 ± 0.0	3.8 ± 0.0	40 ± 1	0.0028 ± 0.0006
Sac. R.–Keswick	11/21/96	1/2	21 ± 1	<0.09 ± 0.07	5.4 ± 0.5	53 ± 2	0.0080 ± 0.0006
Sac. R.–Keswick	11/21/96	2/2	22 ± 1	<0.09 ± 0.04	5.5 ± 0.2	54 ± 3	0.0087 ± 0.0016
Sac. R.–Keswick	12/11/96	1/2	24 ± 0	<0.2 ± 0.0	6.6 ± 0.4	51 ± 1	0.0091 ± 0.0014
Sac. R.–Keswick	12/11/96	2/2	23 ± 0	<0.2 ± 0.0	6.5 ± 0.0	52 ± 1	0.0096 ± 0.0007
Sac. R.–Keswick	01/02/97	1/2	24 ± 2	<0.2 ± 0.2	5.9 ± 0.5	51 ± 0	0.020 ± 0.001
Sac. R.–Keswick	01/02/97	2/2	24 ± 1	<0.2 ± 0.1	5.8 ± 0.2	52 ± 1	0.021 ± 0.001
Sac. R.–Keswick	05/28/97	1/2	21 ± 1	<0.2 ± 0.0	4.7 ± 0.3	44 ± 2	0.0078 ± 0.0014
Sac. R.–Keswick	05/28/97	2/2	21 ± 0	<0.2 ± 0.0	4.9 ± 0.1	43 ± 1	0.0069 ± 0.0011
Sac. R.–Bend Br.	07/11/96	1/2	21 ± 2	<0.2 ± 0.0	5.3 ± 0.7	49 ± 1	0.0042 ± 0.0007
Sac. R.–Bend Br.	07/11/96	2/2	20 ± 0	<0.2 ± 0.2	5.0 ± 0.2	50 ± 2	0.0040 ± 0.0003
Sac. R.–Bend Br.	09/20/96	1/2	19 ± 0	<0.2 ± 0.0	4.6 ± 0.0	46 ± 1	0.0027 ± 0.0008
Sac. R.–Bend Br.	09/20/96	2/2	18 ± 1	<0.09 ± 0.06	4.3 ± 0.3	50 ± 2	0.0041 ± 0.0009
Sac. R.–Bend Br.	11/22/96	1/2	24 ± 0	<0.09 ± 0.04	7.0 ± 0.0	75 ± 2	0.011 ± 0.001
Sac. R.–Bend Br.	11/22/96	2/2	23 ± 1	<0.09 ± 0.05	6.6 ± 0.3	73 ± 1	0.012 ± 0.002
Sac. R.–Bend Br.	12/12/96	1/2	29 ± 0	<0.2 ± 0.0	6.4 ± 0.2	61 ± 1	0.028 ± 0.002
Sac. R.–Bend Br.	12/12/96	2/2	28 ± 2	<0.2 ± 0.0	6.2 ± 0.5	59 ± 0	0.030 ± 0.001
Sac. R.–Bend Br.	01/03/97	1/2	41 ± 6	<0.2 ± 0.0	5.7 ± 0.2	73 ± 0	0.098 ± 0.005
Sac. R.–Bend Br.	01/03/97	2/2	41 ± 5	<0.2 ± 0.0	5.1 ± 0.7	71 ± 1	0.089 ± 0.000

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Silica (as SiO_2) (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	21 ± 0	<0.2 ± 0.0	5.1 ± 0.2	51 ± 2	0.0069 ± 0.0009
Sac. R.–Bend Br.	05/30/97	2/2	21 ± 0	<0.2 ± 0.0	5.1 ± 0.2	50 ± 0	0.0063 ± 0.0015
Sac. R.–Colusa	07/16/96	1/1	32 ± 3	<0.2 ± 0.0	6.3 ± 0.8	66 ± 2	0.033 ± 0.000
Sac. R.–Colusa	09/25/96	1/2	22 ± 1	0.26 ± 0.03	6.3 ± 0.4	70 ± 3	0.0069 ± 0.0006
Sac. R.–Colusa	09/25/96	2/2	22 ± 1	<0.09 ± 0.00	6.2 ± 0.4	70 ± 2	0.0084 ± 0.0005
Sac. R.–Colusa	11/13/96	1/2	25 ± 1	<0.2 ± 0.0	7.8 ± 0.8	77 ± 1	0.012 ± 0.001
Sac. R.–Colusa	11/13/96	2/2	25 ± 1	<0.2 ± 0.0	7.3 ± 0.7	79 ± 1	0.012 ± 0.001
Sac. R.–Colusa	12/16/96	1/2	36 ± 1	<0.2 ± 0.0	7.9 ± 0.1	93 ± 1	0.050 ± 0.001
Sac. R.–Colusa	12/16/96	2/2	36 ± 0	<0.2 ± 0.0	7.5 ± 0.1	94 ± 0	0.058 ± 0.002
Sac. R.–Colusa	01/04/97	1/2	88 ± 4	<0.2 ± 0.0	5.6 ± 0.3	121 ± 1	0.31 ± 0.00
Sac. R.–Colusa	01/04/97	2/2	90 ± 1	0.21 ± 0.15	5.7 ± 0.1	124 ± 3	0.31 ± 0.01
Sac. R.–Colusa	06/03/97	1/2	23 ± 1	<0.2 ± 0.0	6.0 ± 0.2	64 ± 2	0.017 ± 0.003
Sac. R.–Colusa	06/03/97	2/2	23 ± 0	<0.2 ± 0.0	6.0 ± 0.2	65 ± 2	0.017 ± 0.003
Sac. R.–Verona	07/18/96	1/2	22 ± 1	<0.2 ± 0.0	5.5 ± 0.7	63 ± 1	0.016 ± 0.001
Sac. R.–Verona	07/18/96	2/2	21 ± 1	<0.2 ± 0.0	5.4 ± 0.2	63 ± 2	0.014 ± 0.002
Sac. R.–Verona	09/26/96	1/2	26 ± 1	<0.2 ± 0.0	8.9 ± 0.4	86 ± 1	0.021 ± 0.001
Sac. R.–Verona	09/26/96	2/2	26 ± 0	<0.2 ± 0.0	8.7 ± 0.4	85 ± 2	0.021 ± 0.002
Sac. R.–Verona	11/14/96	1/2	24 ± 1	<0.2 ± 0.1	9.3 ± 1.3	91 ± 3	0.015 ± 0.002
Sac. R.–Verona	11/14/96	2/2	25 ± 2	<0.2 ± 0.0	9.3 ± 1.8	91 ± 2	0.015 ± 0.002
Sac. R.–Verona	12/18/96	1/2	25 ± 0	<0.2 ± 0.0	6.1 ± 0.1	74 ± 0	0.028 ± 0.001
Sac. R.–Verona	12/18/96	2/2	25 ± 0	<0.2 ± 0.0	6.2 ± 0.3	72 ± 0	0.025 ± 0.002
Sac. R.–Verona	06/04/97	1/2	22 ± 2	<0.2 ± 0.0	7.8 ± 0.7	82 ± 3	0.021 ± 0.000
Sac. R.–Verona	06/04/97	2/2	23 ± 1	<0.2 ± 0.0	7.8 ± 0.8	83 ± 3	0.021 ± 0.003
Sac. R.–Freeport	07/17/96	1/2	20 ± 1	<0.2 ± 0.0	5.3 ± 0.2	61 ± 0	0.014 ± 0.000
Sac. R.–Freeport	07/17/96	2/2	19 ± 0	<0.2 ± 0.0	5.0 ± 0.1	61 ± 0	0.012 ± 0.000
Sac. R.–Freeport	09/24/96	1/2	20 ± 1	<0.09 ± 0.09	8.0 ± 0.2	100 ± 3	0.011 ± 0.000
Sac. R.–Freeport	09/24/96	2/2	21 ± 0	<0.2 ± 0.0	8.7 ± 0.1	86 ± 3	0.010 ± 0.001
Sac. R.–Freeport	11/12/96	1/2	18 ± 1	<0.09 ± 0.06	7.4 ± 0.2	85 ± 3	0.0059 ± 0.0004
Sac. R.–Freeport	11/12/96	2/2	18 ± 0	<0.09 ± 0.02	7.1 ± 0.3	85 ± 1	0.0050 ± 0.0016
Sac. R.–Freeport	12/17/96	1/2	24 ± 1	<0.2 ± 0.0	5.0 ± 0.3	65 ± 1	0.031 ± 0.001
Sac. R.–Freeport	12/17/96	2/2	24 ± 2	<0.2 ± 0.0	4.8 ± 0.6	66 ± 0	0.031 ± 0.003
Sac. R.–Freeport	01/06/97	1/2	41 ± 6	<0.2 ± 0.0	2.6 ± 0.5	58 ± 0	0.13 ± 0.00
Sac. R.–Freeport	01/06/97	1/2	42 ± 4	<0.2 ± 0.0	2.6 ± 0.3	59 ± 0	0.14 ± 0.00
Sac. R.–Freeport	06/05/97	1/2	20 ± 0	<0.2 ± 0.0	6.4 ± 0.3	71 ± 0	0.011 ± 0.001
Sac. R.–Freeport	06/05/97	2/2	20 ± 1	<0.2 ± 0.0	6.8 ± 0.1	71 ± 0	0.013 ± 0.001
Sac. R.–Freeport, dup	06/05/97	1/2	19 ± 1	<0.2 ± 0.0	6.5 ± 0.2	72 ± 4	0.0095 ± 0.0007

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Silica (as SiO_2) (mg/L) ICP–AES	Silver (µg/L) ICP–MS	Sodium (mg/L) ICP–AES	Strontium (µg/L) ICP–MS	Terbium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	19 ± 0	<0.2 ± 0.0	6.1 ± 0.8	72 ± 3	0.0074 ± 0.0017
Flat Cr.	12/11/96	1/2	12 ± 0	<0.2 ± 0.0	2.0 ± 0.1	8.0 ± 0.2	0.020 ± 0.001
Flat Cr.	12/11/96	2/2	12 ± 0	<0.2 ± 0.0	2.0 ± 0.1	8.0 ± 0.4	0.020 ± 0.001
Flat Cr.	05/29/97	1/2	23 ± 1	<0.2 ± 0.0	8.2 ± 0.8	30 ± 1	0.0067 ± 0.0011
Flat Cr.	05/29/97	2/2	25 ± 1	<0.2 ± 0.0	8.3 ± 1.1	30 ± 1	0.0064 ± 0.0006
Spring Cr.–Weir	12/11/96	1/2	14 ± 0	<0.2 ± 0.0	2.6 ± 0.2	13 ± 0	0.40 ± 0.00
Spring Cr.–Weir	12/11/96	2/2	14 ± 0	<0.2 ± 0.0	2.6 ± 0.2	13 ± 0	0.42 ± 0.00
Spring Cr.–Weir	05/28/97	1/2	26 ± 1	<0.2 ± 0.0	7.2 ± 0.4	49 ± 0	0.70 ± 0.04
Spring Cr.–Weir	05/28/97	2/2	27 ± 2	<0.2 ± 0.0	7.6 ± 0.7	50 ± 1	0.69 ± 0.02
Spring Cr.–Road	01/02/97	1/2	12 ± 1	<0.2 ± 0.0	1.9 ± 0.1	13 ± 0	0.26 ± 0.00
Spring Cr.–Road	01/02/97	2/2	12 ± 1	<0.2 ± 0.0	2.0 ± 0.2	13 ± 0	0.26 ± 0.01
Whiskeytown	12/11/96	1/2	12 ± 1	<0.2 ± 0.0	2.0 ± 0.2	23 ± 0	0.0015 ± 0.0004
Whiskeytown	12/11/96	2/2	12 ± 0	<0.2 ± 0.0	2.0 ± 0.0	23 ± 1	0.0019 ± 0.0008
Whiskeytown	05/29/97	1/2	15 ± 0	<0.2 ± 0.0	2.0 ± 0.1	22 ± 1	0.0049 ± 0.0004
Whiskeytown	05/29/97	2/2	15 ± 0	<0.2 ± 0.0	1.9 ± 0.1	21 ± 1	0.0042 ± 0.0005
Spring Cr. arm	07/12/96	1/2	13 ± 1	<0.2 ± 0.0	1.8 ± 0.0	23 ± 2	0.0016 ± 0.0007
Spring Cr. arm	07/12/96	2/2	12 ± 0	<0.2 ± 0.0	1.7 ± 0.1	21 ± 1	0.0015 ± 0.0004
Spring Cr. arm	09/18/96	1/2	12 ± 0	<0.2 ± 0.0	1.7 ± 0.1	20 ± 0	0.0026 ± 0.0007
Spring Cr. arm	09/18/96	2/2	12 ± 0	<0.09 ± 0.00	1.6 ± 0.0	22 ± 0	0.0031 ± 0.0006
Spring Cr. arm	11/20/96	1/2	13 ± 1	<0.09 ± 0.03	1.9 ± 0.1	24 ± 1	0.017 ± 0.003
Spring Cr. arm	11/20/96	2/2	12 ± 1	<0.09 ± 0.13	1.9 ± 0.1	24 ± 1	0.017 ± 0.002
Spring Cr. arm	12/11/96	1/2	12 ± 0	<0.2 ± 0.0	2.2 ± 0.1	24 ± 1	0.048 ± 0.001
Spring Cr. arm	12/11/96	2/2	12 ± 0	<0.2 ± 0.0	2.1 ± 0.1	22 ± 1	0.052 ± 0.001
Spring Cr. arm	05/28/97	1/2	15 ± 0	<0.2 ± 0.0	2.0 ± 0.0	22 ± 2	0.0082 ± 0.0006
Spring Cr. arm	05/28/97	2/2	15 ± 0	<0.2 ± 0.0	2.0 ± 0.1	22 ± 1	0.0067 ± 0.0008
Colusa Basin Drain	06/06/97	1/2	42 ± 1	<0.2 ± 0.0	76 ± 1	479 ± 9	0.090 ± 0.006
Colusa Basin Drain	06/06/97	2/2	44 ± 2	<0.2 ± 0.0	82 ± 2	479 ± 1	0.094 ± 0.003
Yolo Bypass	01/07/97	1/2	47 ± 2	<0.2 ± 0.0	4.4 ± 0.4	78 ± 1	0.14 ± 0.00
Yolo Bypass	01/07/97	2/2	50 ± 1	<0.2 ± 0.0	4.8 ± 0.2	78 ± 1	0.14 ± 0.00

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS	Tin (µg/L) ICP–MS	Titanium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	<0.003 ± 0.001	0.0051 ± 0.0013	0.0017 ± 0.0003	0.75 ± 0.03	7.2 ± 0.8
Sac. R.–Shasta	07/12/96	2/2	<0.003 ± 0.000	0.0047 ± 0.0010	0.0007 ± 0.0002	0.17 ± 0.05	5.2 ± 0.6
Sac. R.–Shasta	09/19/96	1/2	<0.003 ± 0.000	<0.003 ± 0.001	0.0011 ± 0.0006	1.1 ± 0.1	1.8 ± 0.3
Sac. R.–Shasta	09/19/96	2/2	0.0047 ± 0.0046	<0.003 ± 0.003	0.0009 ± 0.0004	1.6 ± 0.0	2.3 ± 0.3
Sac. R.–Shasta	11/19/96	1/2	0.0047 ± 0.0008	<0.003 ± 0.001	0.0013 ± 0.0006	0.33 ± 0.12	2.0 ± 0.1
Sac. R.–Shasta	11/19/96	2/2	<0.003 ± 0.001	<0.003 ± 0.002	0.0008 ± 0.0011	0.19 ± 0.07	2.0 ± 0.2
Sac. R.–Shasta	12/12/96	1/2	0.0046 ± 0.0027	<0.003 ± 0.000	0.0013 ± 0.0002	0.81 ± 0.00	1.6 ± 0.2
Sac. R.–Shasta	12/12/96	2/2	<0.002 ± 0.001	0.0027 ± 0.0003	0.0013 ± 0.0001	0.13 ± 0.01	1.8 ± 0.2
Sac. R.–Shasta	05/29/97	1/2	0.0025 ± 0.0018	0.0083 ± 0.0002	0.0023 ± 0.0005	0.12 ± 0.03	11 ± 0
Sac. R.–Shasta	05/29/97	2/2	0.0038 ± 0.0031	0.014 ± 0.000	0.0027 ± 0.0010	0.39 ± 0.20	12 ± 0
Sac. R.–Keswick	07/11/96	1/2	<0.003 ± 0.001	0.0039 ± 0.0013	0.0015 ± 0.0002	<0.1 ± 0.0	4.4 ± 0.5
Sac. R.–Keswick	07/11/96	2/2	<0.003 ± 0.001	0.0044 ± 0.0005	0.0014 ± 0.0001	0.77 ± 0.01	4.4 ± 0.3
Sac. R.–Keswick	09/19/96	1/2	<0.003 ± 0.002	0.0045 ± 0.0018	0.0008 ± 0.0005	1.2 ± 0.0	1.9 ± 0.4
Sac. R.–Keswick	09/19/96	2/2	<0.003 ± 0.002	<0.003 ± 0.003	0.0011 ± 0.0004	1.1 ± 0.1	1.1 ± 0.1
Sac. R.–Keswick	11/21/96	1/2	0.0040 ± 0.0023	0.0032 ± 0.0014	0.0034 ± 0.0002	0.55 ± 0.04	3.8 ± 0.2
Sac. R.–Keswick	11/21/96	2/2	0.0053 ± 0.0030	<0.003 ± 0.000	0.0036 ± 0.0003	0.58 ± 0.06	3.5 ± 0.5
Sac. R.–Keswick	12/11/96	1/2	0.0019 ± 0.0007	0.0042 ± 0.0013	0.0026 ± 0.0006	0.39 ± 0.04	2.1 ± 0.2
Sac. R.–Keswick	12/11/96	2/2	0.0019 ± 0.0023	0.0032 ± 0.0017	0.0028 ± 0.0003	0.20 ± 0.05	2.1 ± 0.1
Sac. R.–Keswick	01/02/97	1/2	0.0095 ± 0.0006	0.013 ± 0.003	0.0054 ± 0.0002	0.18 ± 0.16	11 ± 0
Sac. R.–Keswick	01/02/97	2/2	0.011 ± 0.000	0.012 ± 0.003	0.0068 ± 0.0007	<0.1 ± 0.1	9.9 ± 0.6
Sac. R.–Keswick	05/28/97	1/2	0.0018 ± 0.0024	0.0097 ± 0.0016	0.0026 ± 0.0005	1.0 ± 0.0	10 ± 1
Sac. R.–Keswick	05/28/97	2/2	0.0024 ± 0.0002	0.0086 ± 0.0012	0.0024 ± 0.0005	1.0 ± 0.1	9.8 ± 1.2
Sac. R.–Bend Br.	07/11/96	1/2	<0.003 ± 0.001	0.0057 ± 0.0004	0.0016 ± 0.0004	0.75 ± 0.04	6.1 ± 0.3
Sac. R.–Bend Br.	07/11/96	2/2	<0.003 ± 0.001	0.0064 ± 0.0014	0.0018 ± 0.0011	0.33 ± 0.34	5.9 ± 0.0
Sac. R.–Bend Br.	09/20/96	1/2	<0.003 ± 0.000	0.0032 ± 0.0022	0.0011 ± 0.0001	0.52 ± 0.01	3.3 ± 0.4
Sac. R.–Bend Br.	09/20/96	2/2	<0.003 ± 0.004	0.0059 ± 0.0031	0.0019 ± 0.0001	0.32 ± 0.00	3.3 ± 0.3
Sac. R.–Bend Br.	11/22/96	1/2	0.0042 ± 0.0017	0.011 ± 0.002	0.0038 ± 0.0002	0.24 ± 0.08	11 ± 1
Sac. R.–Bend Br.	11/22/96	2/2	0.0038 ± 0.0008	0.0087 ± 0.0054	0.0038 ± 0.0007	0.19 ± 0.03	10 ± 0
Sac. R.–Bend Br.	12/12/96	1/2	0.0090 ± 0.0010	0.068 ± 0.001	0.0078 ± 0.0005	0.39 ± 0.06	50 ± 0
Sac. R.–Bend Br.	12/12/96	2/2	0.0091 ± 0.0024	0.068 ± 0.006	0.0083 ± 0.0004	0.32 ± 0.16	50 ± 1
Sac. R.–Bend Br.	01/03/97	1/2	0.026 ± 0.000	0.25 ± 0.02	0.025 ± 0.001	0.70 ± 0.16	135 ± 1
Sac. R.–Bend Br.	01/03/97	2/2	0.023 ± 0.001	0.25 ± 0.02	0.025 ± 0.002	0.18 ± 0.05	135 ± 0

C-035024
C—035023

C-035025

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS	Tin (µg/L) ICP–MS	Titanium (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	0.0035 ± 0.0025	0.0070 ± 0.0004	0.0029 ± 0.0006	0.26 ± 0.02	10 ± 1
Sac. R.–Bend Br.	05/30/97	2/2	0.0018 ± 0.0007	0.0078 ± 0.0030	0.0029 ± 0.0005	0.28 ± 0.08	9.6 ± 0.3
Sac. R.–Colusa	07/16/96	1/1	0.010 ± 0.002	0.052 ± 0.001	0.0097 ± 0.0009	<0.2 ± 0.0	59 ± 0
Sac. R.–Colusa	09/25/96	1/2	<0.003 ± 0.001	0.0064 ± 0.0010	0.0032 ± 0.0001	0.37 ± 0.03	11 ± 1
Sac. R.–Colusa	09/25/96	2/2	<0.003 ± 0.000	0.0074 ± 0.0002	0.0026 ± 0.0002	0.47 ± 0.02	11 ± 0
Sac. R.–Colusa	11/13/96	1/2	<0.003 ± 0.000	0.019 ± 0.002	0.0044 ± 0.0002	0.18 ± 0.16	29 ± 1
Sac. R.–Colusa	11/13/96	2/2	0.0047 ± 0.0021	0.018 ± 0.000	0.0039 ± 0.0005	0.21 ± 0.10	18 ± 0
Sac. R.–Colusa	12/16/96	1/2	0.014 ± 0.001	0.087 ± 0.000	0.013 ± 0.001	1.0 ± 0.0	80 ± 0
Sac. R.–Colusa	12/16/96	2/2	0.012 ± 0.002	0.081 ± 0.004	0.015 ± 0.001	1.6 ± 0.0	83 ± 2
Sac. R.–Colusa	01/04/97	1/2	0.069 ± 0.002	0.70 ± 0.00	0.085 ± 0.003	0.27 ± 0.04	329 ± 1
Sac. R.–Colusa	01/04/97	2/2	0.064 ± 0.001	0.70 ± 0.01	0.084 ± 0.003	0.67 ± 0.44	314 ± 6
Sac. R.–Colusa	06/03/97	1/2	0.0051 ± 0.0012	0.018 ± 0.000	0.0066 ± 0.0007	0.35 ± 0.18	22 ± 0
Sac. R.–Colusa	06/03/97	2/2	0.0062 ± 0.0018	0.020 ± 0.002	0.0059 ± 0.0009	0.94 ± 0.15	25 ± 3
Sac. R.–Verona	07/18/96	1/2	<0.003 ± 0.001	0.029 ± 0.002	0.0060 ± 0.0010	0.94 ± 0.05	27 ± 1
Sac. R.–Verona	07/18/96	2/2	0.0039 ± 0.0011	0.033 ± 0.002	0.0043 ± 0.0003	0.51 ± 0.51	31 ± 1
Sac. R.–Verona	09/26/96	1/2	0.0052 ± 0.0006	0.038 ± 0.005	0.0057 ± 0.0003	0.41 ± 0.02	36 ± 1
Sac. R.–Verona	09/26/96	2/2	0.0069 ± 0.0015	0.036 ± 0.003	0.0055 ± 0.0003	<0.1 ± 0.0	34 ± 1
Sac. R.–Verona	11/14/96	1/2	<0.003 ± 0.002	0.027 ± 0.002	0.0057 ± 0.0003	0.68 ± 0.24	23 ± 1
Sac. R.–Verona	11/14/96	2/2	0.0076 ± 0.0049	0.026 ± 0.001	0.0052 ± 0.0006	0.39 ± 0.07	23 ± 0
Sac. R.–Verona	12/18/96	1/2	0.0079 ± 0.0012	0.046 ± 0.003	0.0078 ± 0.0005	0.64 ± 0.03	45 ± 0
Sac. R.–Verona	12/18/96	2/2	0.0062 ± 0.0014	0.043 ± 0.002	0.0071 ± 0.0005	0.91 ± 0.04	41 ± 1
Sac. R.–Verona	06/04/97	1/2	0.0045 ± 0.0006	0.020 ± 0.001	0.0073 ± 0.0004	<0.2 ± 0.0	26 ± 1
Sac. R.–Verona	06/04/97	2/2	0.0061 ± 0.0007	0.022 ± 0.003	0.0068 ± 0.0002	0.29 ± 0.06	28 ± 3
Sac. R.–Freeport	07/17/96	1/2	0.0084 ± 0.0010	0.026 ± 0.001	0.0037 ± 0.0004	0.17 ± 0.14	20 ± 0
Sac. R.–Freeport	07/17/96	2/2	0.0040 ± 0.0001	0.022 ± 0.002	0.0032 ± 0.0002	0.24 ± 0.10	21 ± 1
Sac. R.–Freeport	09/24/96	1/2	<0.003 ± 0.000	0.025 ± 0.002	0.0034 ± 0.0017	0.67 ± 0.14	18 ± 1
Sac. R.–Freeport	09/24/96	2/2	0.0032 ± 0.0006	0.016 ± 0.002	0.0025 ± 0.0006	<0.1 ± 0.1	15 ± 0
Sac. R.–Freeport	11/12/96	1/2	<0.003 ± 0.001	0.0052 ± 0.0013	0.0025 ± 0.0000	0.66 ± 0.04	6.9 ± 0.7
Sac. R.–Freeport	11/12/96	2/2	<0.003 ± 0.002	0.0064 ± 0.0019	0.0017 ± 0.0003	0.51 ± 0.10	6.4 ± 0.3
Sac. R.–Freeport	12/17/96	1/2	0.0084 ± 0.0016	0.059 ± 0.002	0.0082 ± 0.0004	0.46 ± 0.00	51 ± 1
Sac. R.–Freeport	12/17/96	2/2	0.0090 ± 0.0012	0.060 ± 0.001	0.0086 ± 0.0002	0.33 ± 0.02	53 ± 1
Sac. R.–Freeport	01/06/97	1/2	0.054 ± 0.001	1.1 ± 0.0	0.036 ± 0.002	0.26 ± 0.00	329 ± 2
Sac. R.–Freeport	01/06/97	1/2	0.055 ± 0.001	1.1 ± 0.0	0.037 ± 0.000	0.28 ± 0.03	318 ± 11
Sac. R.–Freeport	06/05/97	1/2	0.0036 ± 0.0009	0.018 ± 0.001	0.0043 ± 0.0007	0.10 ± 0.05	17 ± 0
Sac. R.–Freeport	06/05/97	2/2	0.0033 ± 0.0014	0.015 ± 0.000	0.0035 ± 0.0011	0.89 ± 0.07	18 ± 1
Sac. R.–Freeport, dup	06/05/97	1/2	0.0036 ± 0.0017	0.010 ± 0.001	0.0022 ± 0.0003	0.11 ± 0.01	11 ± 1

C—035024

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Thallium (µg/L) ICP–MS	Thorium (µg/L) ICP–MS	Thulium (µg/L) ICP–MS	Tin (µg/L) ICP–MS	Titanium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.0061 ± 0.0001	0.012 ± 0.001	0.0032 ± 0.0007	<0.06 ± 0.01	11 ± 1
Flat Cr.	12/11/96	1/2	0.0039 ± 0.0034	0.0042 ± 0.0008	0.0091 ± 0.0007	0.80 ± 0.02	2.4 ± 0.1
Flat Cr.	12/11/96	2/2	0.0030 ± 0.0015	0.0053 ± 0.0008	0.0081 ± 0.0004	0.84 ± 0.06	2.3 ± 0.3
Flat Cr.	05/29/97	1/2	0.0099 ± 0.0005	0.0030 ± 0.0010	0.0037 ± 0.0009	0.23 ± 0.03	<0.1 ± 0.3
Flat Cr.	05/29/97	2/2	0.0060 ± 0.0022	<0.003 ± 0.001	0.0037 ± 0.0008	<0.06 ± 0.04	<0.1 ± 0.1
Spring Cr.–Weir	12/11/96	1/2	0.038 ± 0.001	0.0085 ± 0.0004	0.11 ± 0.00	0.27 ± 0.01	1.9 ± 0.2
Spring Cr.–Weir	12/11/96	2/2	0.038 ± 0.002	0.0076 ± 0.0009	0.11 ± 0.00	0.33 ± 0.01	2.1 ± 0.2
Spring Cr.–Weir	05/28/97	1/2	0.44 ± 0.03	0.0034 ± 0.0008	0.25 ± 0.02	0.21 ± 0.06	0.55 ± 0.31
Spring Cr.–Weir	05/28/97	2/2	0.44 ± 0.02	0.0041 ± 0.0004	0.23 ± 0.01	0.19 ± 0.12	0.56 ± 0.37
Spring Cr.–Road	01/02/97	1/2	0.15 ± 0.00	0.016 ± 0.004	0.071 ± 0.000	0.37 ± 0.01	5.0 ± 0.2
Spring Cr.–Road	01/02/97	2/2	0.15 ± 0.00	0.014 ± 0.000	0.068 ± 0.000	0.39 ± 0.04	5.3 ± 0.2
Whiskeytown	12/11/96	1/2	<0.002 ± 0.001	<0.003 ± 0.001	0.0010 ± 0.0005	0.83 ± 0.03	0.83 ± 0.18
Whiskeytown	12/11/96	2/2	<0.003 ± 0.001	<0.003 ± 0.001	0.0010 ± 0.00058	0.78 ± 0.05	0.87 ± 0.23
Whiskeytown	05/29/97	1/2	0.0060 ± 0.0011	0.012 ± 0.003	0.0019 ± 0.0004	0.33 ± 0.13	8.2 ± 0.4
Whiskeytown	05/29/97	2/2	<0.002 ± 0.001	0.013 ± 0.001	0.0017 ± 0.0003	0.31 ± 0.12	8.2 ± 0.5
Spring Cr. arm	07/12/96	1/2	<0.003 ± 0.000	<0.003 ± 0.001	<0.0005 ± 0.0001	0.72 ± 0.04	0.54 ± 0.02
Spring Cr. arm	07/12/96	2/2	<0.003 ± 0.001	<0.003 ± 0.001	0.0006 ± 0.00036	<0.1 ± 0.0	0.57 ± 0.28
Spring Cr. arm	09/18/96	1/2	<0.003 ± 0.001	<0.003 ± 0.001	0.0006 ± 0.00027	0.27 ± 0.02	0.63 ± 0.13
Spring Cr. arm	09/18/96	2/2	<0.003 ± 0.003	0.0037 ± 0.0007	0.0011 ± 0.0007	0.75 ± 0.06	0.95 ± 0.20
Spring Cr. arm	11/20/96	1/2	<0.003 ± 0.005	0.0036 ± 0.0013	0.0056 ± 0.0007	0.18 ± 0.10	1.1 ± 0.1
Spring Cr. arm	11/20/96	2/2	0.0055 ± 0.0022	<0.003 ± 0.002	0.0062 ± 0.0014	0.26 ± 0.12	1.0 ± 0.2
Spring Cr. arm	12/11/96	1/2	0.0059 ± 0.0033	0.0046 ± 0.0010	0.016 ± 0.000	0.26 ± 0.04	0.99 ± 0.08
Spring Cr. arm	12/11/96	2/2	0.0048 ± 0.0020	0.0038 ± 0.0023	0.015 ± 0.001	0.48 ± 0.05	0.96 ± 0.20
Spring Cr. arm	05/28/97	1/2	0.0044 ± 0.0025	0.010 ± 0.002	0.0024 ± 0.0002	0.35 ± 0.17	8.1 ± 0.1
Spring Cr. arm	05/28/97	2/2	0.0020 ± 0.0024	0.013 ± 0.001	0.0030 ± 0.0002	0.23 ± 0.05	8.3 ± 0.9
Colusa Basin Drain	06/06/97	1/2	0.021 ± 0.001	0.12 ± 0.00	0.029 ± 0.002	0.50 ± 0.22	79 ± 1
Colusa Basin Drain	06/06/97	2/2	0.023 ± 0.005	0.13 ± 0.00	0.030 ± 0.001	<0.2 ± 0.0	75 ± 1
Yolo Bypass	01/07/97	1/2	0.031 ± 0.001	0.29 ± 0.02	0.039 ± 0.000	0.20 ± 0.04	191 ± 1
Yolo Bypass	01/07/97	2/2	0.032 ± 0.001	0.29 ± 0.01	0.038 ± 0.001	0.17 ± 0.05	190 ± 2

C-035026
C—035025

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Uranium (µg/L) ICP–MS	Vanadium (mg/L) ICP–AES	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS	Zinc (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	0.089 ± 0.002	0.0074 ± 0.0020	0.010 ± 0.003	0.12 ± 0.00	4.0 ± 0.1
Sac. R.–Shasta	07/12/96	2/2	0.092 ± 0.003	<0.004 ± 0.001	0.010 ± 0.002	0.12 ± 0.01	3.8 ± 0.1
Sac. R.–Shasta	09/19/96	1/2	0.080 ± 0.002	<0.003 ± 0.001	0.0064 ± 0.0007	0.088 ± 0.006	4.8 ± 0.1
Sac. R.–Shasta	09/19/96	2/2	0.089 ± 0.006	0.0042 ± 0.0016	0.011 ± 0.003	0.097 ± 0.005	6.2 ± 0.0
Sac. R.–Shasta	11/19/96	1/2	0.13 ± 0.00	<0.003 ± 0.002	0.0072 ± 0.0030	0.063 ± 0.004	3.1 ± 0.8
Sac. R.–Shasta	11/19/96	2/2	0.13 ± 0.01	0.0048 ± 0.0009	0.0077 ± 0.0022	0.064 ± 0.002	2.4 ± 0.0
Sac. R.–Shasta	12/12/96	1/2	0.13 ± 0.01	<0.004 ± 0.001	0.0079 ± 0.0015	0.11 ± 0.00	6.3 ± 0.3
Sac. R.–Shasta	12/12/96	2/2	0.13 ± 0.00	0.0043 ± 0.0018	0.0086 ± 0.0022	0.11 ± 0.00	7.2 ± 0.4
Sac. R.–Shasta	05/29/97	1/2	0.10 ± 0.01	<0.005 ± 0.001	0.016 ± 0.003	0.20 ± 0.02	2.9 ± 0.1
Sac. R.–Shasta	05/29/97	2/2	0.10 ± 0.00	0.0057 ± 0.0003	0.017 ± 0.002	0.19 ± 0.01	3.0 ± 0.5
Sac. R.–Keswick	07/11/96	1/2	0.075 ± 0.004	<0.004 ± 0.000	0.0088 ± 0.0015	0.10 ± 0.01	3.6 ± 0.0
Sac. R.–Keswick	07/11/96	2/2	0.078 ± 0.002	0.0061 ± 0.0006	0.0095 ± 0.0023	0.10 ± 0.00	3.1 ± 0.1
Sac. R.–Keswick	09/19/96	1/2	0.060 ± 0.004	<0.003 ± 0.001	0.011 ± 0.001	0.10 ± 0.00	4.3 ± 0.4
Sac. R.–Keswick	09/19/96	2/2	0.055 ± 0.005	0.0041 ± 0.0013	0.0079 ± 0.0014	0.090 ± 0.004	3.2 ± 0.1
Sac. R.–Keswick	11/21/96	1/2	0.10 ± 0.01	0.0046 ± 0.0008	0.025 ± 0.001	0.25 ± 0.01	8.6 ± 0.6
Sac. R.–Keswick	11/21/96	2/2	0.10 ± 0.01	0.0062 ± 0.0015	0.028 ± 0.003	0.26 ± 0.02	7.8 ± 0.2
Sac. R.–Keswick	12/11/96	1/2	0.11 ± 0.00	0.0045 ± 0.0006	0.018 ± 0.001	0.25 ± 0.01	11 ± 1
Sac. R.–Keswick	12/11/96	2/2	0.12 ± 0.00	0.0041 ± 0.0020	0.019 ± 0.001	0.26 ± 0.01	11 ± 0
Sac. R.–Keswick	01/02/97	1/2	0.11 ± 0.00	0.0048 ± 0.0012	0.041 ± 0.002	0.55 ± 0.01	27 ± 1
Sac. R.–Keswick	01/02/97	2/2	0.11 ± 0.00	0.0051 ± 0.0015	0.042 ± 0.005	0.56 ± 0.02	25 ± 2
Sac. R.–Keswick	05/28/97	1/2	0.086 ± 0.002	<0.005 ± 0.000	0.016 ± 0.002	0.18 ± 0.01	4.0 ± 0.3
Sac. R.–Keswick	05/28/97	2/2	0.087 ± 0.007	0.0049 ± 0.0014	0.015 ± 0.001	0.18 ± 0.01	4.2 ± 0.4
Sac. R.–Bend Br.	07/11/96	1/2	0.071 ± 0.000	<0.005 ± 0.002	0.0090 ± 0.0008	0.11 ± 0.00	3.6 ± 0.1
Sac. R.–Bend Br.	07/11/96	2/2	0.073 ± 0.002	<0.004 ± 0.002	0.012 ± 0.002	0.11 ± 0.01	3.5 ± 0.2
Sac. R.–Bend Br.	09/20/96	1/2	0.055 ± 0.000	<0.003 ± 0.001	0.0073 ± 0.0012	0.10 ± 0.00	4.9 ± 0.2
Sac. R.–Bend Br.	09/20/96	2/2	0.057 ± 0.001	<0.003 ± 0.001	0.012 ± 0.001	0.11 ± 0.01	5.2 ± 0.4
Sac. R.–Bend Br.	11/22/96	1/2	0.095 ± 0.003	0.0041 ± 0.0014	0.031 ± 0.002	0.31 ± 0.00	9.3 ± 0.7
Sac. R.–Bend Br.	11/22/96	2/2	0.10 ± 0.01	0.0045 ± 0.0028	0.030 ± 0.004	0.32 ± 0.00	9.6 ± 0.5
Sac. R.–Bend Br.	12/12/96	1/2	0.12 ± 0.00	0.0059 ± 0.0018	0.055 ± 0.004	0.66 ± 0.01	11 ± 0
Sac. R.–Bend Br.	12/12/96	2/2	0.12 ± 0.00	0.0057 ± 0.0011	0.056 ± 0.006	0.67 ± 0.03	12 ± 0
Sac. R.–Bend Br.	01/03/97	1/2	0.22 ± 0.01	0.015 ± 0.002	0.18 ± 0.01	2.2 ± 0.1	24 ± 0
Sac. R.–Bend Br.	01/03/97	2/2	0.21 ± 0.01	0.015 ± 0.002	0.18 ± 0.00	2.1 ± 0.1	23 ± 0

C-035027

C—035026

Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Uranium (µg/L) ICP–MS	Vanadium (mg/L) ICP–AES	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS	Zinc (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	0.077 ± 0.002	<0.005 ± 0.001	0.016 ± 0.003	0.19 ± 0.01	4.5 ± 0.2
Sac. R.–Bend Br.	05/30/97	2/2	0.074 ± 0.004	<0.005 ± 0.002	0.019 ± 0.002	0.19 ± 0.00	3.9 ± 0.3
Sac. R.–Colusa	07/16/96	1/1	0.12 ± 0.02	0.0092 ± 0.0020	0.056 ± 0.002	0.68 ± 0.03	11 ± 0
Sac. R.–Colusa	09/25/96	1/2	0.11 ± 0.01	0.0041 ± 0.0021	0.022 ± 0.002	0.19 ± 0.00	3.4 ± 0.2
Sac. R.–Colusa	09/25/96	2/2	0.11 ± 0.01	0.0052 ± 0.0007	0.013 ± 0.000	0.19 ± 0.01	3.4 ± 0.3
Sac. R.–Colusa	11/13/96	1/2	0.13 ± 0.01	<0.005 ± 0.008	0.025 ± 0.001	0.27 ± 0.01	4.3 ± 0.1
Sac. R.–Colusa	11/13/96	2/2	0.13 ± 0.00	0.0060 ± 0.0018	0.021 ± 0.004	0.26 ± 0.01	4.6 ± 0.0
Sac. R.–Colusa	12/16/96	1/2	0.15 ± 0.00	0.011 ± 0.002	0.093 ± 0.006	1.1 ± 0.0	15 ± 0
Sac. R.–Colusa	12/16/96	2/2	0.15 ± 0.00	0.010 ± 0.000	0.10 ± 0.00	1.2 ± 0.0	20 ± 0
Sac. R.–Colusa	01/04/97	1/2	0.44 ± 0.01	0.039 ± 0.002	0.60 ± 0.01	6.5 ± 0.0	59 ± 1
Sac. R.–Colusa	01/04/97	2/2	0.42 ± 0.00	0.040 ± 0.001	0.61 ± 0.00	6.7 ± 0.0	60 ± 1
Sac. R.–Colusa	06/03/97	1/2	0.12 ± 0.01	<0.005 ± 0.003	0.036 ± 0.004	0.39 ± 0.01	5.3 ± 0.2
Sac. R.–Colusa	06/03/97	2/2	0.12 ± 0.02	0.0075 ± 0.0014	0.037 ± 0.003	0.42 ± 0.02	5.6 ± 0.5
Sac. R.–Verona	07/18/96	1/2	0.14 ± 0.01	0.0060 ± 0.0010	0.033 ± 0.006	0.36 ± 0.01	4.5 ± 0.3
Sac. R.–Verona	07/18/96	2/2	0.14 ± 0.01	0.0060 ± 0.0013	0.033 ± 0.005	0.35 ± 0.02	4.3 ± 0.3
Sac. R.–Verona	09/26/96	1/2	0.19 ± 0.00	0.0068 ± 0.0013	0.036 ± 0.003	0.44 ± 0.01	5.6 ± 0.2
Sac. R.–Verona	09/26/96	2/2	0.18 ± 0.01	0.0059 ± 0.0009	0.041 ± 0.002	0.45 ± 0.01	5.3 ± 0.1
Sac. R.–Verona	11/14/96	1/2	0.22 ± 0.01	0.0052 ± 0.0027	0.030 ± 0.004	0.35 ± 0.02	4.4 ± 0.1
Sac. R.–Verona	11/14/96	2/2	0.21 ± 0.00	0.0053 ± 0.0045	0.031 ± 0.004	0.38 ± 0.00	4.5 ± 0.4
Sac. R.–Verona	12/18/96	1/2	0.14 ± 0.01	0.0046 ± 0.0010	0.052 ± 0.001	0.61 ± 0.03	8.3 ± 0.2
Sac. R.–Verona	12/18/96	2/2	0.14 ± 0.00	<0.004 ± 0.002	0.050 ± 0.004	0.57 ± 0.03	6.3 ± 0.2
Sac. R.–Verona	06/04/97	1/2	0.21 ± 0.01	0.0056 ± 0.0022	0.045 ± 0.002	0.45 ± 0.00	5.5 ± 0.3
Sac. R.–Verona	06/04/97	2/2	0.23 ± 0.00	0.0069 ± 0.0011	0.045 ± 0.008	0.49 ± 0.02	5.8 ± 0.0
Sac. R.–Freeport	07/17/96	1/2	0.12 ± 0.00	<0.005 ± 0.001	0.028 ± 0.001	0.30 ± 0.00	3.5 ± 0.2
Sac. R.–Freeport	07/17/96	2/2	0.12 ± 0.01	<0.004 ± 0.001	0.026 ± 0.001	0.29 ± 0.02	3.3 ± 0.1
Sac. R.–Freeport	09/24/96	1/2	0.23 ± 0.01	0.0035 ± 0.0015	0.022 ± 0.000	0.28 ± 0.00	3.6 ± 0.3
Sac. R.–Freeport	09/24/96	2/2	0.19 ± 0.00	0.0049 ± 0.0019	0.021 ± 0.002	0.23 ± 0.00	3.1 ± 0.1
Sac. R.–Freeport	11/12/96	1/2	0.17 ± 0.01	0.0035 ± 0.0036	0.012 ± 0.002	0.14 ± 0.01	3.2 ± 0.1
Sac. R.–Freeport	11/12/96	2/2	0.16 ± 0.00	<0.003 ± 0.001	0.013 ± 0.001	0.14 ± 0.00	3.3 ± 0.2
Sac. R.–Freeport	12/17/96	1/2	0.13 ± 0.01	0.0072 ± 0.0034	0.059 ± 0.002	0.67 ± 0.02	8.1 ± 0.1
Sac. R.–Freeport	12/17/96	2/2	0.13 ± 0.00	<0.005 ± 0.001	0.061 ± 0.003	0.69 ± 0.03	7.6 ± 0.3
Sac. R.–Freeport	01/06/97	1/2	0.67 ± 0.00	0.017 ± 0.001	0.27 ± 0.01	2.9 ± 0.0	18 ± 0
Sac. R.–Freeport	01/06/97	1/2	0.67 ± 0.00	0.015 ± 0.001	0.28 ± 0.00	2.8 ± 0.1	17 ± 0
Sac. R.–Freeport	06/05/97	1/2	0.17 ± 0.00	0.0070 ± 0.0012	0.025 ± 0.001	0.31 ± 0.01	3.3 ± 0.1
Sac. R.–Freeport	06/05/97	2/2	0.16 ± 0.00	<0.005 ± 0.002	0.026 ± 0.005	0.32 ± 0.01	3.5 ± 0.3
Sac. R.–Freeport, dup	06/05/97	1/2	0.16 ± 0.00	0.0051 ± 0.0017	0.018 ± 0.002	0.22 ± 0.01	2.7 ± 0.2

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Uranium (µg/L) ICP–MS	Vanadium (mg/L) ICP–AES	Ytterbium (µg/L) ICP–MS	Yttrium (µg/L) ICP–MS	Zinc (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.16 ± 0.00	0.0050 ± 0.0013	0.019 ± 0.002	0.21 ± 0.00	2.8 ± 0.2
Flat Cr.	12/11/96	1/2	0.0081 ± 0.0022	<0.004 ± 0.000	0.055 ± 0.002	0.56 ± 0.00	26 ± 0
Flat Cr.	12/11/96	2/2	0.0072 ± 0.0024	<0.004 ± 0.002	0.054 ± 0.001	0.56 ± 0.01	26 ± 2
Flat Cr.	05/29/97	1/2	0.0023 ± 0.0017	<0.005 ± 0.001	0.028 ± 0.003	0.29 ± 0.01	5.5 ± 0.3
Flat Cr.	05/29/97	2/2	<0.002 ± 0.002	<0.005 ± 0.000	0.026 ± 0.004	0.29 ± 0.00	5.6 ± 0.4
Spring Cr.–Weir	12/11/96	1/2	0.092 ± 0.005	<0.005 ± 0.001	0.75 ± 0.01	9.9 ± 0.0	482 ± 16
Spring Cr.–Weir	12/11/96	2/2	0.094 ± 0.001	<0.004 ± 0.002	0.77 ± 0.01	10 ± 0	471 ± 41
Spring Cr.–Weir	05/28/97	1/2	0.12 ± 0.01	<0.005 ± 0.002	1.3 ± 0.0	18 ± 1	913 ± 43
Spring Cr.–Weir	05/28/97	2/2	0.12 ± 0.01	<0.005 ± 0.003	1.3 ± 0.1	17 ± 0	909 ± 19
Spring Cr.–Road	01/02/97	1/2	0.19 ± 0.01	<0.004 ± 0.004	0.49 ± 0.01	6.2 ± 0.1	1343 ± 97
Spring Cr.–Road	01/02/97	2/2	0.19 ± 0.01	<0.004 ± 0.001	0.47 ± 0.01	6.2 ± 0.1	1396 ± 5
Whiskeytown	12/11/96	1/2	0.040 ± 0.005	<0.004 ± 0.002	0.0052 ± 0.0015	0.067 ± 0.003	1.4 ± 0.1
Whiskeytown	12/11/96	2/2	0.038 ± 0.001	<0.005 ± 0.002	0.0050 ± 0.0013	0.067 ± 0.002	0.81 ± 0.15
Whiskeytown	05/29/97	1/2	0.045 ± 0.003	<0.005 ± 0.002	0.013 ± 0.002	0.14 ± 0.00	1.1 ± 0.1
Whiskeytown	05/29/97	2/2	0.041 ± 0.001	<0.005 ± 0.001	0.014 ± 0.003	0.14 ± 0.00	1.1 ± 0.1
Spring Cr. arm	07/12/96	1/2	0.026 ± 0.001	<0.005 ± 0.001	0.0061 ± 0.0034	0.054 ± 0.009	0.96 ± 0.09
Spring Cr. arm	07/12/96	2/2	0.024 ± 0.003	<0.004 ± 0.001	0.0045 ± 0.0021	0.055 ± 0.004	0.86 ± 0.05
Spring Cr. arm	09/18/96	1/2	0.023 ± 0.001	<0.003 ± 0.002	0.0042 ± 0.0002	0.080 ± 0.006	2.8 ± 0.1
Spring Cr. arm	09/18/96	2/2	0.029 ± 0.002	<0.003 ± 0.002	0.0073 ± 0.0023	0.092 ± 0.003	4.4 ± 0.5
Spring Cr. arm	11/20/96	1/2	0.034 ± 0.004	<0.003 ± 0.001	0.044 ± 0.003	0.54 ± 0.00	20 ± 0
Spring Cr. arm	11/20/96	2/2	0.041 ± 0.004	<0.003 ± 0.002	0.043 ± 0.001	0.54 ± 0.01	21 ± 1
Spring Cr. arm	12/11/96	1/2	0.047 ± 0.003	<0.004 ± 0.000	0.088 ± 0.000	1.4 ± 0.0	60 ± 3
Spring Cr. arm	12/11/96	2/2	0.048 ± 0.005	<0.004 ± 0.001	0.096 ± 0.002	1.4 ± 0.0	60 ± 4
Spring Cr. arm	05/28/97	1/2	0.039 ± 0.001	<0.005 ± 0.000	0.016 ± 0.001	0.21 ± 0.01	4.8 ± 0.5
Spring Cr. arm	05/28/97	2/2	0.046 ± 0.002	<0.005 ± 0.000	0.016 ± 0.002	0.20 ± 0.01	4.8 ± 0.5
Colusa Basin Drain	06/06/97	1/2	1.6 ± 0.1	0.024 ± 0.001	0.16 ± 0.00	1.9 ± 0.0	18 ± 0
Colusa Basin Drain	06/06/97	2/2	1.6 ± 0.0	0.022 ± 0.001	0.16 ± 0.01	1.9 ± 0.0	19 ± 0
Yolo Bypass	01/07/97	1/2	0.28 ± 0.01	0.018 ± 0.001	0.28 ± 0.01	3.0 ± 0.0	25 ± 0
Yolo Bypass	01/07/97	2/2	0.29 ± 0.01	0.020 ± 0.002	0.28 ± 0.00	3.0 ± 0.0	25 ± 0

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Zirconium (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/2	0.27 ± 0.01
Sac. R.–Shasta	07/12/96	2/2	0.26 ± 0.00
Sac. R.–Shasta	09/19/96	1/2	0.089 ± 0.003
Sac. R.–Shasta	09/19/96	2/2	0.12 ± 0.01
Sac. R.–Shasta	11/19/96	1/2	0.033 ± 0.010
Sac. R.–Shasta	11/19/96	2/2	0.026 ± 0.008
Sac. R.–Shasta	12/12/96	1/2	0.062 ± 0.016
Sac. R.–Shasta	12/12/96	2/2	0.086 ± 0.010
Sac. R.–Shasta	05/29/97	1/2	0.31 ± 0.04
Sac. R.–Shasta	05/29/97	2/2	0.36 ± 0.01
Sac. R.–Keswick	07/11/96	1/2	0.23 ± 0.00
Sac. R.–Keswick	07/11/96	2/2	0.21 ± 0.01
Sac. R.–Keswick	09/19/96	1/2	0.14 ± 0.03
Sac. R.–Keswick	09/19/96	2/2	0.049 ± 0.004
Sac. R.–Keswick	11/21/96	1/2	0.066 ± 0.008
Sac. R.–Keswick	11/21/96	2/2	0.039 ± 0.009
Sac. R.–Keswick	12/11/96	1/2	0.054 ± 0.006
Sac. R.–Keswick	12/11/96	2/2	0.043 ± 0.007
Sac. R.–Keswick	01/02/97	1/2	0.22 ± 0.01
Sac. R.–Keswick	01/02/97	2/2	0.21 ± 0.01
Sac. R.–Keswick	05/28/97	1/2	0.27 ± 0.04
Sac. R.–Keswick	05/28/97	2/2	0.31 ± 0.01
Sac. R.–Bend Br.	07/11/96	1/2	0.22 ± 0.01
Sac. R.–Bend Br.	07/11/96	2/2	0.23 ± 0.01
Sac. R.–Bend Br.	09/20/96	1/2	0.067 ± 0.002
Sac. R.–Bend Br.	09/20/96	2/2	0.088 ± 0.003
Sac. R.–Bend Br.	11/22/96	1/2	0.16 ± 0.01
Sac. R.–Bend Br.	11/22/96	2/2	0.16 ± 0.01
Sac. R.–Bend Br.	12/12/96	1/2	0.31 ± 0.00
Sac. R.–Bend Br.	12/12/96	2/2	0.36 ± 0.02
Sac. R.–Bend Br.	01/03/97	1/2	0.36 ± 0.02
Sac. R.–Bend Br.	01/03/97	2/2	0.32 ± 0.01

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Zirconium (µg/L) ICP–MS
Sac. R.–Bend Br.	05/30/97	1/2	0.22 ± 0.02
Sac. R.–Bend Br.	05/30/97	2/2	0.16 ± 0.01
Sac. R.–Colusa	07/16/96	1/1	0.47 ± 0.02
Sac. R.–Colusa	09/25/96	1/2	0.18 ± 0.00
Sac. R.–Colusa	09/25/96	2/2	0.18 ± 0.01
Sac. R.–Colusa	11/13/96	1/2	0.29 ± 0.02
Sac. R.–Colusa	11/13/96	2/2	0.27 ± 0.02
Sac. R.–Colusa	12/16/96	1/2	0.39 ± 0.01
Sac. R.–Colusa	12/16/96	2/2	0.48 ± 0.02
Sac. R.–Colusa	01/04/97	1/2	0.68 ± 0.01
Sac. R.–Colusa	01/04/97	2/2	0.62 ± 0.02
Sac. R.–Colusa	06/03/97	1/2	0.20 ± 0.01
Sac. R.–Colusa	06/03/97	2/2	0.22 ± 0.01
Sac. R.–Verona	07/18/96	1/2	0.28 ± 0.00
Sac. R.–Verona	07/18/96	2/2	0.28 ± 0.01
Sac. R.–Verona	09/26/96	1/2	0.31 ± 0.00
Sac. R.–Verona	09/26/96	2/2	0.31 ± 0.01
Sac. R.–Verona	11/14/96	1/2	0.28 ± 0.01
Sac. R.–Verona	11/14/96	2/2	0.28 ± 0.01
Sac. R.–Verona	12/18/96	1/2	0.46 ± 0.00
Sac. R.–Verona	12/18/96	2/2	0.32 ± 0.00
Sac. R.–Verona	06/04/97	1/2	0.19 ± 0.00
Sac. R.–Verona	06/04/97	2/2	0.20 ± 0.02
Sac. R.–Freeport	07/17/96	1/2	0.22 ± 0.00
Sac. R.–Freeport	07/17/96	2/2	0.22 ± 0.01
Sac. R.–Freeport	09/24/96	1/2	0.25 ± 0.00
Sac. R.–Freeport	09/24/96	2/2	0.19 ± 0.00
Sac. R.–Freeport	11/12/96	1/2	0.12 ± 0.01
Sac. R.–Freeport	11/12/96	2/2	0.14 ± 0.01
Sac. R.–Freeport	12/17/96	1/2	0.42 ± 0.01
Sac. R.–Freeport	12/17/96	2/2	0.39 ± 0.01
Sac. R.–Freeport	01/06/97	1/2	1.1 ± 0.0
Sac. R.–Freeport	01/06/97	1/2	1.1 ± 0.0
Sac. R.–Freeport	06/05/97	1/2	0.18 ± 0.02
Sac. R.–Freeport	06/05/97	2/2	0.16 ± 0.02
Sac. R.–Freeport, dup	06/05/97	1/2	0.15 ± 0.02

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Table A4-2. Concentrations of major cations and trace elements in unfiltered (whole) water samples—*Continued*

Site	Date	Split Replicate	Zirconium (µg/L) ICP–MS
Sac. R.–Freeport, dup	06/05/97	2/2	0.19 ± 0.01
Flat Cr.	12/11/96	1/2	0.040 ± 0.006
Flat Cr.	12/11/96	2/2	0.022 ± 0.003
Flat Cr.	05/29/97	1/2	0.038 ± 0.010
Flat Cr.	05/29/97	2/2	0.012 ± 0.005
Spring Cr.–Weir	12/11/96	1/2	0.048 ± 0.007
Spring Cr.–Weir	12/11/96	2/2	0.051 ± 0.003
Spring Cr.–Weir	05/28/97	1/2	0.044 ± 0.017
Spring Cr.–Weir	05/28/97	2/2	0.046 ± 0.006
Spring Cr.–Road	01/02/97	1/2	0.069 ± 0.004
Spring Cr.–Road	01/02/97	2/2	0.083 ± 0.002
Whiskeytown	12/11/96	1/2	<0.01 ± 0.01
Whiskeytown	12/11/96	2/2	0.033 ± 0.005
Whiskeytown	05/29/97	1/2	0.12 ± 0.01
Whiskeytown	05/29/97	2/2	0.10 ± 0.01
Spring Cr. arm	07/12/96	1/2	0.026 ± 0.009
Spring Cr. arm	07/12/96	2/2	0.017 ± 0.003
Spring Cr. arm	09/18/96	1/2	0.031 ± 0.011
Spring Cr. arm	09/18/96	2/2	0.025 ± 0.011
Spring Cr. arm	11/20/96	1/2	0.017 ± 0.006
Spring Cr. arm	11/20/96	2/2	0.021 ± 0.002
Spring Cr. arm	12/11/96	1/2	0.023 ± 0.008
Spring Cr. arm	12/11/96	2/2	0.036 ± 0.011
Spring Cr. arm	05/28/97	1/2	0.11 ± 0.02
Spring Cr. arm	05/28/97	2/2	0.10 ± 0.02
Colusa Basin Drain	06/06/97	1/2	0.69 ± 0.00
Colusa Basin Drain	06/06/97	2/2	0.86 ± 0.01
Yolo Bypass	01/07/97	1/2	0.54 ± 0.00
Yolo Bypass	01/07/97	2/2	0.63 ± 0.01

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Table A4-3. Lead concentrations in filtered water samples collected at a single point in the stream cross section

[Br., bridge; Cap, capsule filter (Gelman); Cr., creek; dup, duplicate; ICP–MS, inductively coupled plasma/mass spectrometry; Mem, membrane filter (Nuclepore); R., River; Sac., Sacramento; Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples. Tan, tangential-flow ultrafilter (Millipore Minitan); kd, kilodalton; mm/dd/yy, month-day-year. µg/L, microgram per liter; µm, micrometer; <, less than the detection limit]

Site	Date (mm/dd/yy)	Filter	Split replicate	Lead (Pb) (µg/L) ICP–MS
Sac.. R.–Shasta	07/12/96	0.40 µm Mem	1/1	< 0.005 ± 0.001
Sac.. R.–Shasta	07/12/96	0.45 µm Cap	1/1	0.020 ± 0.004
Sac.. R.–Shasta	07/12/96	10 kd Tan	1/1	0.006 ± 0.002
Sac.. R.–Shasta	09/19/96	0.40 µm Mem	1/1	< 0.005 ± 0.001
Sac.. R.–Shasta	09/19/96	0.45 µm Cap	1/1	< 0.008 ± 0.005
Sac.. R.–Shasta	09/19/96	10 kd Tan	1/1	0.022 ± 0.015
Sac.. R.–Shasta	11/19/96	0.40 µm Mem	1/1	< 0.018 ± 0.009
Sac.. R.–Shasta	11/19/96	0.45 µm Cap	1/1	< 0.018 ± 0.001
Sac.. R.–Shasta	11/19/96	10 kd Tan	1/1	< 0.018 ± 0.006
Sac.. R.–Keswick	07/11/96	0.40 µm Mem	1/1	0.005 ± 0.001
Sac.. R.–Keswick	07/11/96	0.45 µm Cap	1/1	0.036 ± 0.000
Sac. R.–Keswick	07/11/96	10 kd Tan	1/2	0.031 ± 0.001
Sac. R.–Keswick	07/11/96	10 kd Tan	2/2	< 0.005 ± 0.004
Sac. R.–Keswick	09/19/96	0.40 µm Mem	1/1	0.007 ± 0.002
Sac. R.–Keswick	09/19/96	0.45 µm Cap	1/1	0.021 ± 0.003
Sac. R.–Keswick	09/19/96	10 kd Tan	1/2	< 0.005 ± 0.002
Sac. R.–Keswick	09/19/96	10 kd Tan	2/2	< 0.008 ± 0.004
Sac. R.–Keswick	11/21/96	0.40 µm Mem	1/1	0.016 ± 0.003
Sac. R.–Keswick	11/21/96	0.45 µm Cap	1/1	< 0.012 ± 0.015
Sac. R.–Keswick	11/21/96	10 kd Tan	1/1	< 0.012 ± 0.013
Sac. R.–Keswick	05/28/97	0.40 µm Mem	1/1	< 0.008 ± 0.008
Sac. R.–Keswick	05/28/97	0.45 µm Cap	1/1	0.066 ± 0.005
Sac. R.–Keswick	05/28/97	10 kd Tan	1/1	< 0.008 ± 0.004
Sac. R.–Bend Br.	07/11/96	0.40 µm Mem	1/1	0.006 ± 0.002
Sac. R.–Bend Br.	07/11/96	0.45 µm Cap	1/1	0.005 ± 0.000
Sac. R.–Bend Br.	07/11/96	10 kd Tan	1/1	0.008 ± 0.006
Sac. R.–Bend Br.	09/20/96	0.40 µm Mem	1/1	< 0.005 ± 0.003
Sac. R.–Bend Br.	09/20/96	0.45 µm Cap	1/1	0.009 ± 0.002
Sac. R.–Bend Br.	09/20/96	10 kd Tan	1/1	< 0.005 ± 0.001
Sac. R.–Verona	11/14/96	10 kd Tan	1/1	0.005 ± 0.004
Sac. R.–Verona	12/18/96	0.40 µm Mem	1/1	< 0.012 ± 0.002
Sac. R.–Verona	12/18/96	0.45 µm Cap	1/1	0.021 ± 0.008
Sac. R.–Verona	12/18/96	10 kd Tan	1/1	< 0.012 ± 0.023
Sac. R.–Verona	06/04/97	0.40 µm Mem	1/1	< 0.008 ± 0.003
Sac. R.–Verona	06/04/97	0.45 µm Cap	1/1	< 0.008 ± 0.002
Sac.. R.–Bend Br.	11/22/96	0.40 µm Mem	1/1	< 0.018 ± 0.004
Sac.. R.–Bend Br.	11/22/96	0.45 µm Cap	1/1	< 0.018 ± 0.006
Sac.. R.–Bend Br.	11/22/96	10 kd Tan	1/1	< 0.018 ± 0.003
Sac.. R.–Bend Br.	01/03/97	0.40 µm Mem	1/1	0.015 ± 0.004
Sac.. R.–Bend Br.	01/03/97	0.45 µm Cap	1/1	0.042 ± 0.007
Sac.. R.–Colusa	07/16/96	0.40 µm Mem	1/1	0.041 ± 0.003
Sac.. R.–Colusa	07/16/96	0.45 µm Cap	1/1	0.039 ± 0.004
Sac.. R.–Colusa	07/16/96	10 kd Tan	1/1	0.033 ± 0.001
Sac.. R.–Colusa	09/25/96	0.40 µm Mem	1/1	0.020 ± 0.002
Sac.. R.–Colusa	09/25/96	0.45 µm Cap	1/1	0.014 ± 0.003
Sac. R.–Colusa	09/25/96	10 kd Tan	1/2	< 0.005 ± 0.001
Sac. R.–Colusa	09/25/96	10 kd Tan	2/2	< 0.009 ± 0.002
Sac. R.–Colusa	11/13/96	0.40 µm Mem	1/1	0.017 ± 0.003
Sac. R.–Colusa	11/13/96	0.45 µm Cap	1/1	0.015 ± 0.007
Sac. R.–Colusa	11/13/96	10 kd Tan	1/1	0.010 ± 0.012
Sac. R.–Colusa	01/04/97	0.40 µm Mem	1/1	0.014 ± 0.004
Sac. R.–Colusa	01/04/97	0.45 µm Cap	1/1	0.048 ± 0.006
Sac. R.–Colusa	01/04/97	10 kd Tan	1/1	0.007 ± 0.001
Sac. R.–Colusa	06/03/97	0.40 µm Mem	1/1	0.012 ± 0.001
Sac. R.–Colusa	06/03/97	0.45 µm Cap	1/1	0.049 ± 0.004
Sac. R.–Colusa	06/03/97	10 kd Tan	1/1	< 0.008 ± 0.003
Sac. R.–Verona	07/18/96	0.40 µm Mem	1/1	0.017 ± 0.002
Sac. R.–Verona	07/18/96	0.45 µm Cap	1/1	0.030 ± 0.004
Sac. R.–Verona	07/18/96	10 kd Tan	1/1	0.007 ± 0.009
Sac. R.–Verona	09/26/96	0.40 µm Mem	1/1	0.043 ± 0.003
Sac. R.–Verona	09/26/96	0.45 µm Cap	1/1	0.012 ± 0.003
Sac. R.–Verona	09/26/96	10 kd Tan	1/1	0.006 ± 0.001
Sac. R.–Verona	11/14/96	0.40 µm Mem	1/1	0.015 ± 0.011
Sac. R.–Verona	11/14/96	0.45 µm Cap	1/1	0.042 ± 0.011
Spring Cr.–Weir	05/28/97	0.45 µm Cap	1/1	3.4 ± 0.2
Spring Cr. arm	07/12/96	0.40 µm Mem	1/1	< 0.005 ± 0.002
Spring Cr. arm	07/12/96	0.45 µm Cap	1/1	0.032 ± 0.009
Spring Cr. arm	07/12/96	10 kd Tan	1/1	0.096 ± 0.001
Spring Cr. arm	09/18/96	0.40 µm Mem	1/1	0.008 ± 0.002
Spring Cr. arm	09/18/96	0.45 µm Cap	1/1	0.011 ± 0.003

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Table A4-3. Lead concentrations in filtered water samples collected at a single point in the stream cross section—*Continued*

Site	Date (mm/dd/yy)	Filter	Split replicate	Lead (Pb) (µg/L) ICP–MS
Sac. R.–Verona	06/04/97	10 kd Tan	1/1	< 0.008 ± 0.002
Sac. R.–Freeport	07/17/96	0.40 µm Mem	1/1	0.013 ± 0.000
Sac. R.–Freeport	07/17/96	0.45 µm Cap	1/1	0.038 ± 0.002
Sac. R.–Freeport	07/17/96	10 kd Tan	1/1	0.97 ± 0.00
Sac. R.–Freeport	09/24/96	0.40 µm Mem	1/1	0.009 ± 0.002
Sac. R.–Freeport	09/24/96	0.45 µm Cap	1/1	0.011 ± 0.003
Sac. R.–Freeport	09/24/96	10 kd Tan	1/1	0.005 ± 0.002
Sac. R.–Freeport	11/12/96	0.40 µm Mem	1/1	0.010 ± 0.004
Sac. R.–Freeport	11/12/96	0.45 µm Cap	1/1	0.011 ± 0.004
Sac. R.–Freeport	11/12/96	10 kd Tan	1/1	0.074 ± 0.004
Sac. R.–Freeport	12/17/96	0.40 µm Mem	1/1	< 0.012 ± 0.005
Sac. R.–Freeport	12/17/96	0.45 µm Cap	1/1	< 0.012 ± 0.003
Sac. R.–Freeport	12/17/96	10 kd Tan	1/1	< 0.012 ± 0.002
Sac. R.–Freeport	01/06/97	0.40 µm Mem	1/1	0.035 ± 0.004
Sac. R.–Freeport	01/06/97	0.45 µm Cap	1/1	0.062 ± 0.005
Sac. R.–Freeport	01/06/97	10 kd Tan	1/1	0.007 ± 0.008
Sac. R.–Freeport	06/05/97	0.40 µm Mem	1/1	0.012 ± 0.003
Sac. R.–Freeport	06/05/97	0.45 µm Cap	1/1	0.009 ± 0.001
Sac. R.–Freeport	06/05/97	10 kd Tan	1/1	< 0.008 ± 0.003
Sac. R.–Freeport, dup.	06/05/97	0.45 µm Cap	1/1	0.008 ± 0.008
Spring Cr. arm	09/18/96	10 kd Tan	1/2	< 0.005 ± 0.002
Spring Cr. arm	09/18/96	10 kd Tan	2/2	< 0.005 ± 0.004
Spring Cr. arm	11/20/96	0.40 µm Mem	1/1	0.012 ± 0.003
Spring Cr. arm	11/20/96	0.45 µm Cap	1/1	0.016 ± 0.006
Spring Cr. arm	11/20/96	10 kd Tan	1/1	< 0.012 ± 0.004
Colusa Basin Drain	06/06/97	0.40 µm Mem	1/1	0.022 ± 0.005
Colusa Basin Drain	06/06/97	0.45 µm Cap	1/1	0.023 ± 0.007
Colusa Basin Drain	06/06/97	10 kd Tan	1/1	< 0.008 ± 0.004
Yolo Bypass	01/07/97	0.40 µm Mem	1/1	0.013 ± 0.001
Yolo Bypass	01/07/97	0.45 µm Cap	1/1	0.028 ± 0.004
Yolo Bypass	01/07/97	10 kd Tan	1/2	0.029 ± 0.004
Yolo Bypass	01/07/97	10 kd Tan	2/2	< 0.005 ± 0.004

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Table A4-4. Lead concentrations in unfiltered (whole) water samples collected from a single point in the stream cross section

[Br., bridge; Cr., creek; dup, duplicate; ICP–MS, inductively coupled plasma/mass spectrometry; R., River; Sac., Sacramento; Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples. mm/dd/yy, month/day/year. µg/L, microgram per liter]

Site	Date (mm/dd/yy)	Split replicate	Lead (µg/L) ICP–MS	Site	Date (mm/dd/yy)	Split replicate	Lead (µg/L) ICP–MS
Sac. R.–Shasta	07/12/96	1/1	0.04 ± 0.01	Sac. R.–Verona	07/18/96	1/1	0.24 ± 0.00
Sac. R.–Shasta	09/19/96	1/1	0.026 ± 0.001	Sac. R.–Verona	09/26/96	1/1	0.26 ± 0.01
Sac. R.–Shasta	11/19/96	1/1	0.041 ± 0.010	Sac. R.–Verona	11/14/96	1/1	0.36 ± 0.02
Sac. R.–Keswick	07/11/96	1/1	0.05 ± 0.00	Sac. R.–Verona	12/18/96	1/1	0.52 ± 0.00
Sac. R.–Keswick	09/19/96	1/1	0.029 ± 0.004	Sac. R.–Verona	06/04/97	1/1	0.49 ± 0.02
Sac. R.–Keswick	11/21/96	1/1	0.31 ± 0.01	Sac. R.–Freeport	07/17/96	1/1	0.33 ± 0.00
Sac. R.–Keswick	05/28/97	1/1	0.16 ± 0.00	Sac. R.–Freeport	09/24/96	1/1	0.30 ± 0.00
Sac. R.–Bend Br.	07/11/96	1/1	0.09 ± 0.00	Sac. R.–Freeport	11/12/96	1/1	0.17 ± 0.00
Sac. R.–Bend Br.	09/20/96	1/1	0.065 ± 0.010	Sac. R.–Freeport	12/17/96	1/1	0.88 ± 0.01
Sac. R.–Bend Br.	11/22/96	1/1	0.32 ± 0.00	Sac. R.–Freeport	01/06/97	1/1	4.5 ± 0.0
Sac. R.–Bend Br.	01/03/97	1/1	4.2 ± 0.2	Sac. R.–Freeport	06/05/97	1/1	0.35 ± 0.01
Sac. R.–Colusa	07/16/96	1/1	0.32 ± 0.02	Freeport, dup.	06/05/97	1/1	0.28 ± 0.01
Sac. R.–Colusa	09/25/96	1/1	0.073 ± 0.000	Spring Cr.	05/28/97	1/1	3.7 ± 0.0
Sac. R.–Colusa	11/13/96	1/1	0.076 ± 0.002	Spring Cr. arm	07/12/96	1/1	0.02 ± 0.01
Sac. R.–Colusa	01/04/97	1/1	8.3 ± 0.1	Spring Cr. arm	09/18/96	1/1	0.044 ± 0.007
Sac. R.–Colusa	06/03/97	1/1	0.39 ± 0.02	Spring Cr. arm	11/20/96	1/1	0.11 ± 0.01
Sac. R.–Verona	07/18/96	1/1	0.24 ± 0.00	Colusa Basin Drain	06/06/97	1/1	2.1 ± 0.1
Sac. R.–Verona	09/26/96	1/1	0.26 ± 0.01	Yolo Bypass	01/07/97	1/2	3.4 ± 0.0
Sac. R.–Verona	11/14/96	1/1	0.36 ± 0.02	Yolo Bypass	01/07/97	2/2	3.5 ± 0.0
Sac. R.–Verona	12/18/96	1/1	0.52 ± 0.00				
Sac. R.–Verona	06/04/97	1/1	0.49 ± 0.02				

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Appendix 5. Metal Concentrations in Sediment and Colloid Samples

Table A5-1. Concentrations of selected elements in streambed sediment samples.

Table A5-2. Concentrations of selected elements in suspended colloid samples.

Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples.

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Table A5-1. Concentrations of selected elements in streambed sediment samples

[Br., Bridge; Cr., Creek; R., River; Sac., Sacramento. mm/yy, month/year; µg/g, microgram per gram; µm, micrometer; <, less than the indicated detection limit]

Site	Size Fraction	Date (mm/yy)	Aluminum (µg/g)	Antimony (µg/g)	Barium (µg/g)	Beryllium (µg/g)	Bismuth (µg/g)	Cadmium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	76,000 ± 0	3.4 ± 0	350 ± 10	< 0.7 ± 0.07	1.6 ± 0.1	2.7 ± 0
Sac. R.–Churn Cr.	< 62 µm	10/96	67,000 ± 1,000	2.7 ± 0	400 ± 0	0.75 ± 0.05	0.92 ± 0.04	3.6 ± 0.2
Sac. R.–Balls Ferry	< 62 µm	10/96	84,000 ± 2,000	1.5 ± 0	510 ± 10	1.2 ± 0.1	0.53 ± 0.03	1.5 ± 0.1
Sac. R.–Bend Br.	< 62 µm	10/96	75,000 ± 2,000	1.1 ± 0	500 ± 0	0.99 ± 0.03	< 0.4 ± 0.02	0.91 ± 0.16
Sac. R.–Tehama	< 62 µm	10/96	58,000 ± 2,000	2.2 ± 0.1	260 ± 0	1.1 ± 0.1	0.53 ± 0.03	1.3 ± 0.1
Sac. R.–Colusa	< 62 µm	11/96	71,000 ± 2,000	0.85 ± 0.02	460 ± 0	0.88 ± 0.06	< 0.4 ± 0.03	0.9 ± 0.09
Sac. R.–Verona	< 62 µm	11/96	76,000 ± 2,000	1.0 ± 0.1	470 ± 0	1.3 ± 0	< 0.5 ± 0.03	0.84 ± 0.02
Sac. R.–Freeport	< 62 µm	11/96	67,000 ± 2,000	0.97 ± 0.02	400 ± 0	1.1 ± 0.1	< 0.4 ± 0.01	0.82 ± 0.04
Cottonwood Cr.	< 62 µm	10/96	70,000 ± 0	1.1 ± 0	480 ± 0	1.2 ± 0.2	< 0.5 ± 0.01	0.39 ± 0.03
Cottonwood Cr.	< 62 µm	6/97	68,000 ± 1,000	1.1 ± 0	440 ± 0	1 ± 0.1	0.73 ± 0.03	0.37 ± 0.06
Cottonwood Cr.	whole sediment	6/97	62,000 ± 1,000	< 0.8 ± 0.05	490 ± 0	1 ± 0	0.66 ± 0.05	0.19 ± 0.04

Site	Size Fraction	Date (mm/yy)	Calcium (µg/g)	Cerium (µg/g)	Chromium (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Dysprosium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	12,000 ± 0	13 ± 1	110 ± 0	18 ± 0	240 ± 10	3.4 ± 0.2
Sac. R.–Churn Cr.	< 62 µm	10/96	13,000 ± 0	15 ± 0	140 ± 10	17 ± 0	250 ± 0	3.4 ± 0
Sac. R.–Balls Ferry	< 62 µm	10/96	15,000 ± 0	20 ± 0	140 ± 0	21 ± 0	100 ± 0	3.1 ± 0.1
Sac. R.–Bend Br.	< 62 µm	10/96	15,000 ± 0	25 ± 0	230 ± 0	22 ± 1	75 ± 2	3.4 ± 0
Sac. R.–Tehama	< 62 µm	10/96	19,000 ± 1,000	14 ± 0	180 ± 10	22 ± 0	78 ± 2	2.7 ± 0
Sac. R.–Colusa	< 62 µm	11/96	16,000 ± 0	21 ± 0	210 ± 0	19 ± 0	70 ± 1	3.3 ± 0.2
Sac. R.–Verona	< 62 µm	11/96	18,000 ± 0	27 ± 0	250 ± 10	24 ± 1	78 ± 1	3.8 ± 0
Sac. R.–Freeport	< 62 µm	11/96	19,000 ± 0	22 ± 0	260 ± 0	22 ± 0	67 ± 2	3.2 ± 0.1
Cottonwood Cr.	< 62 µm	10/96	12,000 ± 0	18 ± 1	230 ± 0	23 ± 0	61 ± 2	2.8 ± 0
Cottonwood Cr.	< 62 µm	6/97	11,000 ± 0	17 ± 0	240 ± 0	21 ± 0	62 ± 3	2.6 ± 0
Cottonwood Cr.	whole sediment	6/97	11,000 ± 0	17 ± 0	240 ± 0	21 ± 0	45 ± 1	2.1 ± 0.1

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Table A5-1. Concentrations of selected elements in streambed sediment samples—*Continued*

Site	Size Fraction	Date (mm/yy)	Erbium (µg/g)	Europium (µg/g)	Gadolinium (µg/g)	Holmium (µg/g)	Iron (µg/g)	Lanthanum (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	2.2 ± 0.2	0.70 ± 0.01	4.5 ± 0.3	0.64 ± 0.04	56,000 ± 1,000	4.7 ± 0.3
Sac. R.–Churn Cr.	< 62 µm	10/96	2.2 ± 0.1	0.62 ± 0.02	4.1 ± 0.1	0.61 ± 0	56,000 ± 2,000	5.4 ± 0.2
Sac. R.–Balls Ferry	< 62 µm	10/96	2.0 ± 0	0.67 ± 0.03	3.8 ± 0.1	0.58 ± 0.03	61,000 ± 2,000	6.9 ± 0
Sac. R.–Bend Br.	< 62 µm	10/96	2.1 ± 0.1	0.79 ± 0.02	4.5 ± 0	0.61 ± 0.01	49,000 ± 2,000	11 ± 0
Sac. R.–Tehama	< 62 µm	10/96	1.7 ± 0.1	0.63 ± 0	3.4 ± 0	0.53 ± 0	48,000 ± 2,000	4.8 ± 0
Sac. R.–Colusa	< 62 µm	11/96	1.9 ± 0	0.76 ± 0.03	4.4 ± 0.2	0.62 ± 0.01	48,000 ± 1,000	8.1 ± 0
Sac. R.–Verona	< 62 µm	11/96	2.3 ± 0	0.87 ± 0.05	5.2 ± 0.1	0.68 ± 0.01	58,000 ± 2,000	11 ± 0
Sac. R.–Freeport	< 62 µm	11/96	2.0 ± 0.1	0.77 ± 0.02	4.4 ± 0.1	0.57 ± 0.02	54,000 ± 2,000	7.9 ± 0.2
Cottonwood Cr.	< 62 µm	10/96	1.8 ± 0.1	0.61 ± 0.01	3.5 ± 0.1	0.5 ± 0.02	50,000 ± 2,000	6.0 ± 0.2
Cottonwood Cr.	< 62 µm	6/97	1.6 ± 0.1	0.64 ± 0.03	3.8 ± 0.2	0.47 ± 0.02	55,000 ± 0	5.5 ± 0.2
Cottonwood Cr.	whole sediment	6/97	1.4 ± 0.1	0.57 ± 0.02	3.1 ± 0.2	0.37 ± 0.01	45,000 ± 0	7.1 ± 0.1

Site	Size Fraction	Date (mm/yy)	Lead (µg/g)	Lithium (µg/g)	Lutetium (µg/g)	Magnesium (µg/g)	Manganese (µg/g)	Mercury (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	36 ± 2	19 ± 2	0.33 ± 0	14,000 ± 0	680 ± 10	0.40 ± 0.01
Sac. R.–Churn Cr.	< 62 µm	10/96	36 ± 1	21 ± 0	0.36 ± 0	13,000 ± 0	640 ± 0	0.39 ± 0
Sac. R.–Balls Ferry	< 62 µm	10/96	24 ± 0	31 ± 0	0.33 ± 0.02	10,000 ± 0	760 ± 30	0.15 ± 0.01
Sac. R.–Bend Br.	< 62 µm	10/96	14 ± 1	29 ± 0	0.34 ± 0.02	19,000 ± 0	810 ± 10	0.08 ± 0
Sac. R.–Tehama	< 62 µm	10/96	14 ± 1	30 ± 1	0.26 ± 0.01	13,000 ± 0	700 ± 30	0.25 ± 0.02
Sac. R.–Colusa	< 62 µm	11/96	12 ± 1	38 ± 1	0.33 ± 0.01	16,000 ± 0	690 ± 10	0.10 ± 0.01
Sac. R.–Verona	< 62 µm	11/96	19 ± 0	36 ± 0	0.35 ± 0.01	17,000 ± 0	980 ± 0	0.07 ± 0.01
Sac. R.–Freeport	< 62 µm	11/96	16 ± 1	33 ± 1	0.32 ± 0	15,000 ± 0	810 ± 10	0.27 ± 0.01
Cottonwood Cr.	< 62 µm	10/96	14 ± 0	46 ± 0	0.30 ± 0.02	17,000 ± 1,000	880 ± 40	0.06 ± 0.01
Cottonwood Cr.	< 62 µm	6/97	12 ± 0	48 ± 3	0.28 ± 0.01	18,000 ± 0	730 ± 10	0.06 ± 0.01
Cottonwood Cr.	whole sediment	6/97	9.7 ± 0.6	39 ± 0	0.23 ± 0	19,000 ± 0	650 ± 0	0.03 ± 0.01

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Table A5-1. Concentrations of selected elements in streambed sediment samples—*Continued*

Site	Size Fraction	Date (mm/yy)	Molybdenum (µg/g)	Neodymium (µg/g)	Nickel (µg/g)	Potassium (µg/g)	Praseodymium (µg/g)	Rhenium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	< 3 ± 0.9	8.3 ± 0.7	49 ± 3	5,100 ± 200	1.6 ± 0.1	< 0.009 ± 0.001
Sac. R.–Churn Cr.	< 62 µm	10/96	< 3 ± 0.6	8.8 ± 0.3	69 ± 1	5,900 ± 100	1.8 ± 0.1	< 0.009 ± 0.003
Sac. R.–Balls Ferry	< 62 µm	10/96	< 3 ± 0.4	10 ± 0	56 ± 0	8,200 ± 500	2.2 ± 0.1	< 0.009 ± 0.002
Sac. R.–Bend Br.	< 62 µm	10/96	< 3 ± 0.2	12 ± 0	150 ± 0	9,400 ± 300	2.8 ± 0	< 0.008 ± 0
Sac. R.–Tehama	< 62 µm	10/96	< 3 ± 0.2	8.1 ± 0.2	110 ± 0	4,600 ± 100	1.7 ± 0	< 0.009 ± 0.001
Sac. R.–Colusa	< 62 µm	11/96	< 3 ± 0.2	11 ± 0	100 ± 0	9,000 ± 100	2.4 ± 0.1	< 0.008 ± 0.002
Sac. R.–Verona	< 62 µm	11/96	< 3 ± 0.2	14 ± 0	130 ± 0	9,300 ± 0	3.1 ± 0	< 0.009 ± 0.002
Sac. R.–Freeport	< 62 µm	11/96	< 3 ± 0	12 ± 0	110 ± 0	6,800 ± 0	2.4 ± 0.1	< 0.008 ± 0.003
Cottonwood Cr.	< 62 µm	10/96	< 3 ± 0.3	9.2 ± 0.2	150 ± 0	9,500 ± 500	2.0 ± 0.1	< 0.009 ± 0.001
Cottonwood Cr.	< 62 µm	6/97	< 3 ± 0.2	9.4 ± 0.5	160 ± 0	7,800 ± 0	1.9 ± 0.1	< 0.008 ± 0.003
Cottonwood Cr.	whole sediment	6/97	< 3 ± 0.4	8.7 ± 0.7	170 ± 0	9,300 ± 200	2.0 ± 0	< 0.009 ± 0.002

Site	Size Fraction	Date (mm/yy)	Rubidium (µg/g)	Samarium (µg/g)	Silica (µg/g)	Silver (µg/g)	Sodium (µg/g)	Strontium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	16 ± 0	2.6 ± 0.2	660,000 ± 10,000	< 1 ± 0.4	19,000 ± 0	100 ± 0
Sac. R.–Churn Cr.	< 62 µm	10/96	10 ± 0	2.7 ± 0.1	600,000 ± 40,000	< 1 ± 0.4	14,000 ± 1,000	110 ± 0
Sac. R.–Balls Ferry	< 62 µm	10/96	13 ± 0	2.9 ± 0.1	600,000 ± 40,000	< 1 ± 0.3	14,000 ± 1,000	170 ± 0
Sac. R.–Bend Br.	< 62 µm	10/96	30 ± 0	3.5 ± 0	630,000 ± 40,000	< 1 ± 0.2	17,000 ± 1,000	150 ± 0
Sac. R.–Tehama	< 62 µm	10/96	4.4 ± 0.4	2.5 ± 0.1	680,000 ± 50,000	< 1 ± 0.2	18,000 ± 2,000	160 ± 0
Sac. R.–Colusa	< 62 µm	11/96	19 ± 0	3.2 ± 0.1	670,000 ± 40,000	< 1 ± 0.1	19,000 ± 1,000	130 ± 0
Sac. R.–Verona	< 62 µm	11/96	21 ± 0	3.9 ± 0	610,000 ± 50,000	< 1 ± 0.3	15,000 ± 1,000	140 ± 0
Sac. R.–Freeport	< 62 µm	11/96	9.3 ± 0.1	3.2 ± 0	640,000 ± 50,000	< 1 ± 0.2	16,000 ± 1,000	140 ± 10
Cottonwood Cr.	< 62 µm	10/96	12 ± 0	2.7 ± 0	650,000 ± 50,000	< 1 ± 0.3	17,000 ± 2,000	120 ± 0
Cottonwood Cr.	< 62 µm	6/97	12 ± 0	2.5 ± 0	630,000 ± 20,000	< 1 ± 0.2	14,000 ± 0	110 ± 0
Cottonwood Cr.	whole sediment	6/97	25 ± 0	2.1 ± 0.1	680,000 ± 20,000	< 1 ± 0.2	16,000 ± 0	130 ± 0

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C-035040

Table A5-1. Concentrations of selected elements in streambed sediment samples—*Continued*

Site	Size Fraction	Date (mm/yy)	Terbium (µg/g)	Thallium (µg/g)	Thorium (µg/g)	Thulium (µg/g)	Tin (µg/g)	Titanium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	0.55 ± 0.01	0.19 ± 0.02	1.5 ± 0.1	0.24 ± 0.01	< 5 ± 0.1	3,800 ± 0
Sac. R.–Churn Cr.	< 62 µm	10/96	0.58 ± 0	0.28 ± 0.04	2.0 ± 0	0.26 ± 0.01	150 ± 20	3,900 ± 0
Sac. R.–Balls Ferry	< 62 µm	10/96	0.52 ± 0.01	0.34 ± 0.02	4.1 ± 0	0.23 ± 0.01	130 ± 20	5,500 ± 0
Sac. R.–Bend Br.	< 62 µm	10/96	0.59 ± 0.02	0.24 ± 0.01	4.3 ± 0.2	0.24 ± 0.01	150 ± 20	4,700 ± 0
Sac. R.–Tehama	< 62 µm	10/96	0.52 ± 0.03	0.24 ± 0.01	3.3 ± 0.1	0.22 ± 0.03	68 ± 3	4,800 ± 200
Sac. R.–Colusa	< 62 µm	11/96	0.59 ± 0	0.27 ± 0.01	3.6 ± 0.3	0.23 ± 0	130 ± 10	5,400 ± 0
Sac. R.–Verona	< 62 µm	11/96	0.63 ± 0.04	0.27 ± 0.01	4.4 ± 0	0.26 ± 0.02	140 ± 20	5,900 ± 0
Sac. R.–Freeport	< 62 µm	11/96	0.55 ± 0.01	0.27 ± 0.02	4.5 ± 0	0.24 ± 0.01	130 ± 10	6,000 ± 100
Cottonwood Cr.	< 62 µm	10/96	0.46 ± 0.01	0.32 ± 0.01	3.7 ± 0	0.21 ± 0.01	160 ± 40	5,100 ± 200
Cottonwood Cr.	< 62 µm	6/97	0.46 ± 0.01	0.30 ± 0	3.8 ± 0.1	0.18 ± 0	< 4 ± 0.3	5,100 ± 0
Cottonwood Cr.	whole sediment	6/97	0.34 ± 0.02	0.24 ± 0.02	3.0 ± 0	0.15 ± 0	< 5 ± 0.4	4,100 ± 0

Site	Size Fraction	Date (mm/yy)	Uranium (µg/g)	Vanadium (µg/g)	Ytterbium (µg/g)	Yttrium (µg/g)	Zinc (µg/g)	Zirconium (µg/g)
Sac. R.–Rodeo	< 62 µm	10/96	1.5 ± 0.1	150 ± 0	2.3 ± 0.1	16 ± 0	410 ± 10	150 ± 0
Sac. R.–Churn Cr.	< 62 µm	10/96	1.7 ± 0	170 ± 10	2.0 ± 0	15 ± 0	550 ± 20	150 ± 0
Sac. R.–Balls Ferry	< 62 µm	10/96	2.2 ± 0	190 ± 10	1.9 ± 0.1	14 ± 0	310 ± 10	240 ± 0
Sac. R.–Bend Br.	< 62 µm	10/96	2.1 ± 0	160 ± 10	1.9 ± 0	16 ± 0	220 ± 10	160 ± 0
Sac. R.–Tehama	< 62 µm	10/96	1.7 ± 0	160 ± 10	1.8 ± 0.1	11 ± 0	230 ± 10	240 ± 0
Sac. R.–Colusa	< 62 µm	11/96	1.7 ± 0	160 ± 0	1.9 ± 0	15 ± 0	170 ± 10	210 ± 0
Sac. R.–Verona	< 62 µm	11/96	2.2 ± 0	190 ± 0	2.0 ± 0.1	17 ± 0	150 ± 0	190 ± 0
Sac. R.–Freeport	< 62 µm	11/96	2.2 ± 0.1	190 ± 10	1.8 ± 0.1	14 ± 0	160 ± 10	200 ± 0
Cottonwood Cr.	< 62 µm	10/96	2.1 ± 0	160 ± 10	1.7 ± 0.1	12 ± 0	110 ± 0	170 ± 0
Cottonwood Cr.	< 62 µm	6/97	2.1 ± 0	160 ± 0	1.7 ± 0	11 ± 0	120 ± 10	240 ± 10
Cottonwood Cr.	whole sediment	6/97	1.7 ± 0.1	130 ± 0	1.4 ± 0.1	9.6 ± 0.3	100 ± 10	200 ± 10

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C-035041

Table A5-2. Concentrations of selected elements in suspended colloid samples

[Values in parenthesis represent minimum values from incomplete dissolution, reported to one significant figure. Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples. Ax, axial; Cap, capsule filter (Gelman); conc., concentration; CV–AFS, cold vapor–atomic fluorescence spectrometry; dup, duplicate; ICP–AES, inductively coupled plasma–atomic emission spectrometry; ICP-MS, inductively coupled plasma–mass spectrometry; na, not analyzed; nd, not determined; R., River; Sac., Sacramento; mm/dd/yy, month/day/year; mg/L, milligram per liter; µg/g, microgram per gram; µm, micrometer]

Site	Date (mm/dd/yy)	Split replicate	Colloid conc. (mg/L)	Sediment conc. (mg/L)	Aluminum (µg/g) ICP–AES	Antimony (µg/g) ICP–MS	Barium (µg/g) ICP–AES	Beryllium (µg/g) ICP–MS	Bismuth (µg/g) ICP–MS
Sac. R.–Shasta	07/12/96	1/1	2.9	3	85,000 ± 1,000	< 1 ± 0	280 ± 0	1.3 ± 0.2	< 0.6 ± 0.01
Sac. R.–Shasta	11/19/96	1/1	0.9	7	86,000 ± 1,000	3.4 ± 0.2	740 ± 10	< 2 ± 0.2	< 2 ± 0.1
Sac. R.–Shasta	12/12/96	1/1	1.4	2	(100,000) ± 0	(10) ± 0	(700) ± 0	(< 1) ± 0.1	(20) ± 1
Sac. R.–Shasta	05/29/97	1/1	9	7	110,000 ± 0	1.0 ± 0.0	470 ± 10	1.4 ± 0.1	< 0.5 ± 0.02
Sac. R.–Keswick	07/11/96	1/1	2.4	5	89,000 ± 1,000	1.9 ± 0.1	340 ± 0	< 1 ± 0	1.6 ± 0.0
Sac. R.–Keswick	11/21/96	1/1	3.3	3	98,000 ± 1,000	7.3 ± 0.1	310 ± 20	0.95 ± 0.16	5.1 ± 0.0
Sac. R.–Keswick	12/11/96	1/1	2.1	3	100,000 ± 3,600	3.9 ± 0.2	790 ± 20	1.3 ± 0.4	2.0 ± 0.1
Sac. R.–Keswick	01/02/97	1/1	13	11	72,000 ± 0	3.5 ± 0.0	780 ± 0	1.4 ± 0.0	0.87 ± 0.04
Sac. R.–Keswick	05/28/97	1/1	9	8	100,000 ± 0	1.4 ± 0.1	430 ± 0	1.3 ± 0.1	< 0.5 ± 0.03
Sac. R.–Bend Br.	07/11/96	1/1	4.3	5	66,000 ± 2,000	1.1 ± 0.1	280 ± 10	< 0.9 ± 0.11	< 0.6 ± 0.03
Sac. R.–Bend Br.	09/20/96	1/1	2.4	4	78,000 ± 3,000	1.4 ± 0.0	570 ± 20	1.5 ± 0.2	< 0.5 ± 0
Sac. R.–Bend Br.	11/22/96	1/1	7.7	15	100,000 ± 1,000	3.8 ± 0.2	600 ± 10	< 3 ± 0.1	4.2 ± 0.2
Sac. R.–Bend Br.	12/12/96	1/1	30	51	87,000 ± 0	1.6 ± 0.1	760 ± 0	1.9 ± 0.1	< 0.5 ± 0.02
Sac. R.–Bend Br.	01/03/97	1/1	113	355	83,000 ± 0	1.8 ± 0.0	720 ± 0	2.0 ± 0.0	< 0.4 ± 0.03
Sac. R.–Bend Br.	05/30/97	1/2	10	14	96,000 ± 1,000	1.5 ± 0.1	430 ± 0	1.3 ± 0.1	< 0.5 ± 0
Sac. R.–Bend Br.	05/30/97	2/2	10	14	96,000 ± 4,000	1.2 ± 0.0	420 ± 0	1.3 ± 0.1	< 0.5 ± 0.03
Sac. R.–Colusa	07/16/96	1/1	51	32	68,000 ± 1,000	1.2 ± 0.0	350 ± 10	0.96 ± 0.18	< 0.5 ± 0
Sac. R.–Colusa	09/25/96	1/1	15	30	51,000 ± 3,000	< 3 ± 0.1	420 ± 10	< 3 ± 0.5	< 2 ± 0
Sac. R.–Colusa	11/13/96	1/1	26	46	59,000 ± 1,000	1.2 ± 0.1	390 ± 0	1.1 ± 0.1	1.6 ± 0.0
Sac. R.–Colusa	12/16/96	1/1	110	51	47,000 ± 600	1.4 ± 0.1	260 ± 0	1.4 ± 0.1	0.31 ± 0.01
Sac. R.–Colusa	01/04/97	1/1	379	579	88,000 ± 1,000	1.9 ± 0.1	750 ± 10	2.0 ± 0.1	< 0.4 ± 0.03
Sac. R.–Colusa	06/03/97	1/1	27	37	93,000 ± 5,000	1.6 ± 0.1	510 ± 30	1.2 ± 0.1	2.6 ± 0.0
Sac. R.–Verona	07/18/96	1/1	21	28	70,000 ± 0	1.4 ± 0.0	440 ± 0	1.2 ± 0.0	< 0.5 ± 0.05
Sac. R.–Verona	09/26/96	1/1	27	32	80,000 ± 3,000	1.2 ± 0.0	590 ± 10	1.2 ± 0.1	< 0.7 ± 0.02
Sac. R.–Verona	11/14/96	1/1	21	24	79,000 ± 0	1.4 ± 0.0	470 ± 0	< 1 ± 0.1	< 0.8 ± 0.12
Sac. R.–Verona	12/18/96	1/1	50	52	54,000 ± 700	1.5 ± 0.1	350 ± 10	1.6 ± 0.0	0.32 ± 0.01
Sac. R.–Verona	06/04/97	1/1	34	38	85,000 ± 1,000	1.2 ± 0.0	550 ± 10	1.7 ± 0.2	< 0.4 ± 0.01
Sac. R.–Freeport	07/17/96	1/1	29	20	(40,000) ± 0	(2) ± 0.2	(300) ± 10	(2) ± 0.2	(0.5) ± 0.02
Sac. R.–Freeport	09/24/96	1/1	34	28	(30,000) ± 0	(2) ± 0.1	(300) ± 0	(2) ± 0.2	(0.6) ± 0.02
Sac. R.–Freeport	11/12/96	1/1	5.8	12	79,000 ± 2,000	1.1 ± 0.1	510 ± 10	1.5 ± 0.2	< 0.6 ± 0.02
Sac. R.–Freeport	12/17/96	1/1	36	64	82,000 ± 0	2.2 ± 0.0	550 ± 0	1.7 ± 0.1	< 0.5 ± 0.02

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Colloid conc. (mg/L)	Sediment conc. (mg/L)	Aluminum (µg/g) ICP–AES	Antimony (µg/g) ICP–MS	Barium (µg/g) ICP–AES	Beryllium (µg/g) ICP–MS	Bismuth (µg/g) ICP–MS
Sac. R.–Freeport	01/06/97	1/2	146	193	110,000 ± 0	1.3 ± 0.1	1,100 ± 0	2.6 ± 0.0	< 0.5 ± 0.02
Sac. R.–Freeport	01/06/97	2/2	146	193	100,000 ± 0	1.2 ± 0.1	940 ± 10	2.4 ± 0.2	< 0.4 ± 0.02
Sac. R.–Freeport	06/05/97	1/1	22	18	90,000 ± 1,000	1.2 ± 0.0	580 ± 20	1.6 ± 0.2	< 0.5 ± 0.05
Sac. R.–Freeport, dup	06/05/97	1/1	13	18	85,000 ± 0	1.2 ± 0.0	500 ± 0	1.5 ± 0.0	< 0.5 ± 0.02
Spring Cr.–Weir	12/11/96	1/1	6.1	na	98,000 ± 2,000	6.6 ± 0.1	290 ± 0	0.73 ± 0.33	3.7 ± 0.0
Spring Cr.–Weir	05/28/97	1/1	86	na	40,000 ± 1,000	6.0 ± 0.1	200 ± 0	2.0 ± 0.5	1.0 ± 0.2
Spring Cr.–Road	01/02/97	1/1	14	na	69,000 ± 6,000	12 ± 0	230 ± 20	< 2 ± 0.3	2.4 ± 0.1
Spring Cr. arm	07/12/96	1/1	0.6	na	33,000 ± 1,000	< 2 ± 0.1	280 ± 0	< 2 ± 0.2	< 1 ± 0.1
Spring Cr. arm	11/20/96	1/1	2.4	na	100,000 ± 0	< 3 ± 0.1	280 ± 10	< 2 ± 0.5	< 1 ± 0
Spring Cr. arm	12/11/96	1/1	4.5	na	100,000 ± 4,000	1.7 ± 0.2	120 ± 10	2.5 ± 0.3	0.80 ± 0.06
Spring Cr. arm	05/28/97	1/1	11	na	88,000 ± 2,000	2.0 ± 0.2	350 ± 10	1.3 ± 0.2	< 0.6 ± 0.03
Colusa Basin Drain	06/06/97	1/1	161	154	81,000 ± 1,000	1.2 ± 0.0	640 ± 10	1.8 ± 0.0	< 0.5 ± 0.01
Yolo Bypass	01/07/97	1/1	144	183	100,000 ± 0	2.0 ± 0.0	840 ± 10	2.2 ± 0.1	< 0.5 ± 0

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C—035041

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Cadmium (µg/g) ICP–MS	Calcium (µg/g) ICP–AES	Cerium (µg/g) ICP–MS	Chromium (µg/g) ICP–AES	Cobalt (µg/g) ICP–MS	Copper (µg/g) ICP–MS/ICP–AES
Sac. R.–Shasta	07/12/96	1/1	2.2 ± 0.2	19,000 ± 0	15 ± 1	98 ± 1	14 ± 0	170 ± 0
Sac. R.–Shasta	11/19/96	1/1	6.5 ± 0.2	8,500 ± 0	35 ± 1	93 ± 17	21 ± 1	300 ± 10
Sac. R.–Shasta	12/12/96	1/1	(3) ± 0.2	(4,000) ± 0	(6) ± 0.6	(200) ± 0	(20) ± 4	(900) ± 0
Sac. R.–Shasta	05/29/97	1/1	1.0 ± 0.1	8,500 ± 700	18 ± 0	140 ± 10	19 ± 0	130 ± 0
Sac. R.–Keswick	07/11/96	1/1	3.9 ± 0.0	22,000 ± 0	23 ± 1	89 ± 3	13 ± 1	170 ± 10
Sac. R.–Keswick	11/21/96	1/1	5.1 ± 0.1	6,200 ± 400	14 ± 0	130 ± 10	35 ± 0	510 ± 10
Sac. R.–Keswick	12/11/96	1/1	5.4 ± 0.1	7,000 ± 100	43 ± 1	100 ± 4	32 ± 0	991 ± 37
Sac. R.–Keswick	01/02/97	1/1	4.8 ± 0.1	5,100 ± 200	15 ± 0	110 ± 0	27 ± 0	760 ± 0
Sac. R.–Keswick	05/28/97	1/1	1.2 ± 0.1	8,100 ± 500	28 ± 1	370 ± 0	35 ± 0	140 ± 0
Sac. R.–Bend Br.	07/11/96	1/1	2.5 ± 0.1	23,000 ± 0	17 ± 1	91 ± 2	15 ± 1	180 ± 0
Sac. R.–Bend Br.	09/20/96	1/1	1.4 ± 0.0	17,000 ± 1,000	36 ± 1	160 ± 10	23 ± 0	140 ± 0
Sac. R.–Bend Br.	11/22/96	1/1	2.6 ± 0.3	6,300 ± 200	25 ± 1	300 ± 0	27 ± 1	710 ± 10
Sac. R.–Bend Br.	12/12/96	1/1	1.4 ± 0.1	9,700 ± 0	43 ± 0	320 ± 0	32 ± 0	200 ± 10
Sac. R.–Bend Br.	01/03/97	1/1	0.92 ± 0.11	9,800 ± 0	37 ± 1	200 ± 0	27 ± 0	140 ± 0
Sac. R.–Bend Br.	05/30/97	1/2	1.1 ± 0.0	8,300 ± 500	30 ± 0	360 ± 0	34 ± 0	140 ± 0
Sac. R.–Bend Br.	05/30/97	2/2	1.2 ± 0.1	8,200 ± 100	17 ± 0	360 ± 0	33 ± 0	150 ± 0
Sac. R.–Colusa	07/16/96	1/1	1.7 ± 0.0	18,000 ± 0	19 ± 0	120 ± 0	18 ± 0	170 ± 0
Sac. R.–Colusa	09/25/96	1/1	2.0 ± 0.2	59,000 ± 3,000	23 ± 1	110 ± 10	19 ± 0	220 ± 10
Sac. R.–Colusa	11/13/96	1/1	2.3 ± 0.1	9,100 ± 400	20 ± 0	130 ± 0	18 ± 0	170 ± 0
Sac. R.–Colusa	12/16/96	1/1	0.87 ± 0.12	9,600 ± 300	18 ± 1	184 ± 10	27 ± 0	130 ± 0
Sac. R.–Colusa	01/04/97	1/1	0.63 ± 0.01	10,000 ± 500	31 ± 0	190 ± 10	27 ± 0	100 ± 0
Sac. R.–Colusa	06/03/97	1/1	1.3 ± 0.1	9,000 ± 500	28 ± 1	250 ± 20	26 ± 0	130 ± 0
Sac. R.–Verona	07/18/96	1/1	2.8 ± 0.1	20,000 ± 0	23 ± 0	180 ± 0	22 ± 0	330 ± 0
Sac. R.–Verona	09/26/96	1/1	1.4 ± 0.1	36,000 ± 0	32 ± 0	170 ± 0	23 ± 0	180 ± 0
Sac. R.–Verona	11/14/96	1/1	1.8 ± 0.1	11,000 ± 0	20 ± 1	190 ± 10	25 ± 0	180 ± 0
Sac. R.–Verona	12/18/96	1/1	0.84 ± 0.05	10,000 ± 200	15 ± 0	190 ± 7	29 ± 0	130 ± 0
Sac. R.–Verona	06/04/97	1/1	0.97 ± 0.05	9,100 ± 500	36 ± 2	190 ± 10	25 ± 0	110 ± 0
Sac. R.–Freeport	07/17/96	1/1	(2) ± 0.1	(10,000) ± 0	(8) ± 0.1	(200) ± 10	(20) ± 1	(200) ± 10
Sac. R.–Freeport	09/24/96	1/1	(4) ± 0	(10,000) ± 0	(10) ± 0	(90) ± 1	(10) ± 2	(200) ± 20
Sac. R.–Freeport	11/12/96	1/1	1.2 ± 0.1	9,300 ± 200	27 ± 1	160 ± 0	23 ± 0	140 ± 0
Sac. R.–Freeport	12/17/96	1/1	0.78 ± 0.11	11,000 ± 0	29 ± 2	230 ± 0	26 ± 0	110 ± 0
Sac. R.–Freeport	01/06/97	1/2	0.57 ± 0.04	15,000 ± 0	95 ± 0	140 ± 0	28 ± 0	120 ± 0
Sac. R.–Freeport	01/06/97	2/2	0.56 ± 0.08	13,000 ± 0	85 ± 0	150 ± 0	29 ± 1	110 ± 0
Sac. R.–Freeport	06/05/97	1/1	1.1 ± 0.1	9,000 ± 300	36 ± 0	180 ± 0	24 ± 0	130 ± 0
Sac. R.–Freeport, dup	06/05/97	1/1	1.1 ± 0.1	8,800 ± 200	29 ± 1	190 ± 0	23 ± 1	140 ± 10
Spring Cr.–Weir	12/11/96	1/1	1.4 ± 0.1	1,000 ± 0	8.4 ± 0.1	60 ± 4	11 ± 0	470 ± 10

C-035042
C-035043

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Cadmium (µg/g) ICP–MS	Calcium (µg/g) ICP–AES	Cerium (µg/g) ICP–MS	Chromium (µg/g) ICP–AES	Cobalt (µg/g) ICP–MS	Copper (µg/g) ICP–MS/ICP–AES
Spring Cr.–Weir	05/28/97	1/1	0.60 ± 0.19	600 ± 10	< 1 ± 0.01	30 ± 4	6.0 ± 0.8	300 ± 110
Spring Cr.–Road	01/02/97	1/1	0.56 ± 0.00	910 ± 160	8.8 ± 0.4	43 ± 5	11 ± 0	230 ± 0
Spring Cr. arm	07/12/96	1/1	2.5 ± 0.1	28,000 ± 0	14 ± 1	130 ± 10	19 ± 1	190 ± 10
Spring Cr. arm	11/20/96	1/1	6.5 ± 0.3	3,900 ± 200	58 ± 0	180 ± 10	18 ± 1	2,400 ± 0
Spring Cr. arm	12/11/96	1/1	12 ± 0	3,800 ± 200	101 ± 1	113 ± 5	14 ± 0	9,400 ± 122
Spring Cr. arm	05/28/97	1/1	1.2 ± 0.0	7,400 ± 200	24 ± 1	870 ± 30	71 ± 3	220 ± 10
Colusa Basin Drain	06/06/97	1/1	0.44 ± 0.07	9,100 ± 600	33 ± 1	180 ± 10	24 ± 0	85 ± 1
Yolo Bypass	01/07/97	1/1	0.80 ± 0.02	9,800 ± 400	39 ± 0	210 ± 10	28 ± 0	130 ± 0

C-035044
C—035043

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Dysprosium (µg/g) ICP–MS	Erbium (µg/g) ICP–MS	Europium (µg/g) ICP–MS	Gadolinium (µg/g) ICP–MS	Holmium (µg/g) ICP–MS	Iron (µg/g) ICP–AES
Sac. R.–Shasta	07/12/96	1/1	3.7 ± 0.1	2.1 ± 0.1	0.76 ± 0.00	4.6 ± 0.1	0.66 ± 0.01	57,000 ± 2,000
Sac. R.–Shasta	11/19/96	1/1	5.8 ± 0.0	3.2 ± 0.2	1.4 ± 0.1	8.6 ± 0.4	0.96 ± 0.03	54,000 ± 0
Sac. R.–Shasta	12/12/96	1/1	(1) ± 0.1	(0.9) ± 0.01	(0.2) ± 0.01	(0.9) ± 0.09	(0.2) ± 0	60,000 ± 1,000
Sac. R.–Shasta	05/29/97	1/1	3.6 ± 0.1	2.4 ± 0.0	0.79 ± 0.02	4.7 ± 0.1	0.70 ± 0.03	66,000 ± 5,000
Sac. R.–Keswick	07/11/96	1/1	3.8 ± 0.0	2.2 ± 0.1	0.94 ± 0.02	5.9 ± 0.2	0.66 ± 0.02	53,000 ± 0
Sac. R.–Keswick	11/21/96	1/1	7.1 ± 0.1	4.4 ± 0.0	1.1 ± 0.0	8.1 ± 0.1	1.4 ± 0.0	84,000 ± 6,000
Sac. R.–Keswick	12/11/96	1/1	12 ± 0	8.5 ± 0.2	2.2 ± 0.0	18 ± 1	2.5 ± 0.2	75,000 ± 2,000
Sac. R.–Keswick	01/02/97	1/1	5.1 ± 0.1	3.4 ± 0.1	0.78 ± 0.01	5.9 ± 0.2	0.99 ± 0.01	81,000 ± 0
Sac. R.–Keswick	05/28/97	1/1	4.0 ± 0.1	2.5 ± 0.0	0.89 ± 0.01	5.5 ± 0.0	0.73 ± 0.01	74,000 ± 5,000
Sac. R.–Bend Br.	07/11/96	1/1	3.2 ± 0.1	2.0 ± 0.1	0.68 ± 0.01	4.3 ± 0.1	0.59 ± 0.00	46,000 ± 2,000
Sac. R.–Bend Br.	09/20/96	1/1	3.9 ± 0.1	2.4 ± 0.1	0.99 ± 0.03	5.4 ± 0.1	0.72 ± 0.01	59,000 ± 2,000
Sac. R.–Bend Br.	11/22/96	1/1	4.5 ± 0.1	2.8 ± 0.3	0.88 ± 0.04	6.0 ± 0.3	0.81 ± 0.05	70,000 ± 0
Sac. R.–Bend Br.	12/12/96	1/1	4.8 ± 0.0	2.9 ± 0.1	1.2 ± 0.0	7.4 ± 0.0	0.82 ± 0.01	63,000 ± 0
Sac. R.–Bend Br.	01/03/97	1/1	4.1 ± 0.1	2.8 ± 0.0	1.0 ± 0.1	6.0 ± 0.0	0.80 ± 0.01	70,000 ± 0
Sac. R.–Bend Br.	05/30/97	1/2	4.1 ± 0.1	2.6 ± 0.0	0.94 ± 0.01	5.5 ± 0.1	0.76 ± 0.01	71,000 ± 4,000
Sac. R.–Bend Br.	05/30/97	2/2	3.3 ± 0.0	2.2 ± 0.0	0.66 ± 0.00	4.3 ± 0.0	0.62 ± 0.01	70,000 ± 1,000
Sac. R.–Colusa	07/16/96	1/1	3.3 ± 0.1	2.0 ± 0.0	0.70 ± 0.03	4.3 ± 0.2	0.60 ± 0.03	56,000 ± 3,000
Sac. R.–Colusa	09/25/96	1/1	3.0 ± 0.2	1.8 ± 0.1	0.71 ± 0.04	4.4 ± 0.4	0.54 ± 0.04	38,000 ± 2,000
Sac. R.–Colusa	11/13/96	1/1	3.6 ± 0.0	2.3 ± 0.1	0.79 ± 0.01	4.9 ± 0.1	0.68 ± 0.01	51,000 ± 2,000
Sac. R.–Colusa	12/16/96	1/1	2.7 ± 0.0	2.1 ± 0.1	0.53 ± 0.00	3.5 ± 0.0	0.59 ± 0.01	65,000 ± 2,000
Sac. R.–Colusa	01/04/97	1/1	3.7 ± 0.1	2.6 ± 0.1	0.85 ± 0.01	4.7 ± 0.0	0.73 ± 0.02	69,000 ± 4,000
Sac. R.–Colusa	06/03/97	1/1	3.9 ± 0.2	2.4 ± 0.2	0.87 ± 0.01	5.3 ± 0.0	0.74 ± 0.01	64,000 ± 4,000
Sac. R.–Verona	07/18/96	1/1	3.2 ± 0.0	2.0 ± 0.1	0.75 ± 0.00	4.4 ± 0.1	0.57 ± 0.02	55,000 ± 3,000
Sac. R.–Verona	09/26/96	1/1	3.6 ± 0.1	2.2 ± 0.1	0.86 ± 0.03	5.1 ± 0.1	0.65 ± 0.01	59,000 ± 2,000
Sac. R.–Verona	11/14/96	1/1	2.2 ± 0.1	1.4 ± 0.1	0.63 ± 0.01	3.5 ± 0.2	0.40 ± 0.02	67,000 ± 1,000
Sac. R.–Verona	12/18/96	1/1	2.3 ± 0.1	1.9 ± 0.1	0.49 ± 0.02	3.0 ± 0.0	0.50 ± 0.00	66,000 ± 1,000
Sac. R.–Verona	06/04/97	1/1	3.8 ± 0.0	2.4 ± 0.0	0.97 ± 0.03	5.4 ± 0.0	0.70 ± 0.01	64,000 ± 4,000
Sac. R.–Freeport	07/17/96	1/1	(1) ± 0.04	(0.5) ± 0.02	(0.2) ± 0.01	(1) ± 0.2	(0.2) ± 0.02	(50,000) ± 1,000
Sac. R.–Freeport	09/24/96	1/1	(1) ± 0	(0.7) ± 0.01	(0.3) ± 0.01	(2) ± 0.2	(0.2) ± 0	(40,000) ± 0
Sac. R.–Freeport	11/12/96	1/1	3.3 ± 0.1	2.1 ± 0.0	0.86 ± 0.00	4.8 ± 0.0	0.62 ± 0.01	65,000 ± 1,000
Sac. R.–Freeport	12/17/96	1/1	3.0 ± 0.2	1.9 ± 0.0	0.82 ± 0.06	4.8 ± 0.0	0.57 ± 0.00	67,000 ± 0
Sac. R.–Freeport	01/06/97	1/2	4.9 ± 0.1	2.8 ± 0.0	1.3 ± 0.0	7.2 ± 0.0	0.88 ± 0.01	69,000 ± 1,000
Sac. R.–Freeport	01/06/97	2/2	4.6 ± 0.0	2.6 ± 0.0	1.3 ± 0.0	7.7 ± 0.2	0.77 ± 0.01	65,000 ± 1,000
Sac. R.–Freeport	06/05/97	1/1	3.7 ± 0.1	2.3 ± 0.0	1.0 ± 0.0	5.9 ± 0.0	0.65 ± 0.02	62,000 ± 1,000
Sac. R.–Freeport, dup	06/05/97	1/1	3.3 ± 0.0	2.0 ± 0.1	0.83 ± 0.02	4.6 ± 0.0	0.55 ± 0.01	61,000 ± 0
Spring Cr.–Weir	12/11/96	1/1	4.3 ± 0.3	3.8 ± 0.1	0.57 ± 0.06	4.9 ± 0.2	0.98 ± 0.06	110,000 ± 2,000

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C—035044

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Dysprosium (µg/g) ICP–MS	Erbium (µg/g) ICP–MS	Europium (µg/g) ICP–MS	Gadolinium (µg/g) ICP–MS	Holmium (µg/g) ICP–MS	Iron (µg/g) ICP–AES
Spring Cr.–Weir	05/28/97	1/1	0.20 ± 0.00	0.20 ± 0.07	< 0.04 ± 0.005	0.30 ± 0.03	0.050 ± 0.005	500,000 ± 0
Spring Cr.–Road	01/02/97	1/1	2.6 ± 0.2	2.0 ± 0.1	0.34 ± 0.02	2.7 ± 0.0	0.55 ± 0.02	180,000 ± 0
Spring Cr. arm	07/12/96	1/1	4.0 ± 0.1	2.5 ± 0.0	0.91 ± 0.03	6.7 ± 0.1	0.72 ± 0.02	34,000 ± 1,000
Spring Cr. arm	11/20/96	1/1	31 ± 1	17 ± 0	4.3 ± 0.2	38 ± 2	5.2 ± 0.3	95,000 ± 1,000
Spring Cr. arm	12/11/96	1/1	50 ± 1	32 ± 0	7.7 ± 0.3	75 ± 3	10 ± 0	72,000 ± 2,000
Spring Cr. arm	05/28/97	1/1	3.4 ± 0.0	2.2 ± 0.2	0.85 ± 0.01	5.2 ± 0.0	0.63 ± 0.02	89,000 ± 2,000
Colusa Basin Drain	06/06/97	1/1	3.4 ± 0.0	2.1 ± 0.1	0.83 ± 0.02	4.5 ± 0.1	0.63 ± 0.00	69,000 ± 5,000
Yolo Bypass	01/07/97	1/1	4.4 ± 0.1	2.9 ± 0.0	0.95 ± 0.01	5.5 ± 0.0	0.82 ± 0.02	72,000 ± 3,000

C-035046
C—035045

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Lanthanum (µg/g) ICP–MS	Lead (µg/g) ICP–MS	Lithium (µg/g) ICP–MS	Lutetium (µg/g) ICP–MS	Magnesium (µg/g) ICP–AES	Manganese (µg/g) ICP–AES
Sac. R.–Shasta	07/12/96	1/1	5.3 ± 0.2	13 ± 0	33 ± 0	0.35 ± 0.02	11,000 ± 0	660 ± 20
Sac. R.–Shasta	11/19/96	1/1	18 ± 1	23 ± 1	33 ± 4	0.47 ± 0.05	9,300 ± 0	18,000 ± 0
Sac. R.–Shasta	12/12/96	1/1	(1.0) ± 0.07	(40) ± 1	(80) ± 5	(0.2) ± 0.01	(300) ± 0	(3,000) ± 0
Sac. R.–Shasta	05/29/97	1/1	7.2 ± 0.0	14 ± 1	37 ± 1	0.35 ± 0.02	16,000 ± 0	500 ± 50
Sac. R.–Keswick	07/11/96	1/1	10 ± 0	16 ± 0	31 ± 1	0.33 ± 0.02	16,000 ± 0	820 ± 0
Sac. R.–Keswick	11/21/96	1/1	4.2 ± 0.1	87 ± 1	25 ± 1	0.60 ± 0.01	19,000 ± 0	3,400 ± 100
Sac. R.–Keswick	12/11/96	1/1	18 ± 0	72 ± 2	26 ± 1	1.0 ± 0.0	14,800 ± 300	2,900 ± 30
Sac. R.–Keswick	01/02/97	1/1	5.0 ± 0.1	39 ± 1	24 ± 0	0.52 ± 0.01	14,000 ± 0	1,100 ± 0
Sac. R.–Keswick	05/28/97	1/1	12 ± 0	13 ± 0	37 ± 0	0.36 ± 0.01	33,000 ± 0	630 ± 50
Sac. R.–Bend Br.	07/11/96	1/1	6.7 ± 0.1	16 ± 0	28 ± 1	0.32 ± 0.00	15,000 ± 0	730 ± 0
Sac. R.–Bend Br.	09/20/96	1/1	16 ± 0	25 ± 1	50 ± 1	0.34 ± 0.02	22,000 ± 0	1,800 ± 0
Sac. R.–Bend Br.	11/22/96	1/1	9.2 ± 0.4	46 ± 1	50 ± 2	0.51 ± 0.03	34,000 ± 0	1,500 ± 0
Sac. R.–Bend Br.	12/12/96	1/1	18 ± 1	21 ± 1	53 ± 1	0.46 ± 0.01	37,000 ± 0	1,300 ± 0
Sac. R.–Bend Br.	01/03/97	1/1	15 ± 0	24 ± 1	51 ± 2	0.41 ± 0.01	24,000 ± 0	1,100 ± 0
Sac. R.–Bend Br.	05/30/97	1/2	13 ± 0	18 ± 0	35 ± 1	0.37 ± 0.02	32,000 ± 0	600 ± 30
Sac. R.–Bend Br.	05/30/97	2/2	6.5 ± 0.0	20 ± 0	36 ± 1	0.36 ± 0.01	32,000 ± 0	610 ± 0
Sac. R.–Colusa	07/16/96	1/1	6.7 ± 0.2	18 ± 0	38 ± 1	0.33 ± 0.02	16,000 ± 0	1,300 ± 0
Sac. R.–Colusa	09/25/96	1/1	10 ± 0	20 ± 1	37 ± 2	0.28 ± 0.04	37,000 ± 0	1,300 ± 100
Sac. R.–Colusa	11/13/96	1/1	7.8 ± 0.1	29 ± 1	38 ± 1	0.32 ± 0.01	13,000 ± 0	1,700 ± 100
Sac. R.–Colusa	12/16/96	1/1	8.0 ± 0.4	19 ± 1	49 ± 1	0.30 ± 0.01	15,000 ± 100	1,380 ± 40
Sac. R.–Colusa	01/04/97	1/1	13 ± 0	20 ± 1	60 ± 0	0.43 ± 0.02	22,000 ± 1,000	1,100 ± 100
Sac. R.–Colusa	06/03/97	1/1	11 ± 0	21 ± 2	47 ± 1	0.36 ± 0.01	25,000 ± 1,000	970 ± 60
Sac. R.–Verona	07/18/96	1/1	9.0 ± 0.1	24 ± 1	40 ± 1	0.32 ± 0.01	19,000 ± 0	1,600 ± 0
Sac. R.–Verona	09/26/96	1/1	14 ± 0	19 ± 0	51 ± 0	0.34 ± 0.02	34,000 ± 0	1,900 ± 0
Sac. R.–Verona	11/14/96	1/1	7.5 ± 0.4	31 ± 0	46 ± 2	0.22 ± 0.01	17,000 ± 0	2,200 ± 0
Sac. R.–Verona	12/18/96	1/1	7.1 ± 0.0	22 ± 1	47 ± 2	0.28 ± 0.02	16,000 ± 0	1,450 ± 0
Sac. R.–Verona	06/04/97	1/1	16 ± 0	20 ± 0	45 ± 1	0.35 ± 0.01	19,000 ± 0	1,100 ± 0
Sac. R.–Freeport	07/17/96	1/1	(3) ± 0	(20) ± 0	(40) ± 0	(0.06) ± 0.005	(10,000) ± 100	(2,000) ± 0
Sac. R.–Freeport	09/24/96	1/1	(4) ± 0	(20) ± 0	(30) ± 1	(0.09) ± 0.005	(10,000) ± 0	(1,000) ± 0
Sac. R.–Freeport	11/12/96	1/1	13 ± 0	26 ± 1	42 ± 2	0.34 ± 0.00	16,000 ± 0	1,900 ± 0
Sac. R.–Freeport	12/17/96	1/1	12 ± 1	24 ± 1	41 ± 0	0.31 ± 0.02	20,000 ± 0	1,300 ± 0
Sac. R.–Freeport	01/06/97	1/2	39 ± 1	32 ± 1	39 ± 1	0.38 ± 0.01	20,000 ± 0	1,200 ± 0
Sac. R.–Freeport	01/06/97	2/2	32 ± 0	34 ± 1	39 ± 1	0.41 ± 0.01	16,000 ± 0	1,100 ± 0
Sac. R.–Freeport	06/05/97	1/1	15 ± 0	22 ± 0	48 ± 0	0.36 ± 0.01	18,000 ± 0	1,300 ± 0
Sac. R.–Freeport, dup	06/05/97	1/1	12 ± 0	22 ± 0	45 ± 2	0.29 ± 0.00	17,000 ± 0	1,200 ± 0

C-035047

C—035046

C-035048

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Lanthanum (µg/g) ICP–MS	Lead (µg/g) ICP–MS	Lithium (µg/g) ICP–MS	Lutetium (µg/g) ICP–MS	Magnesium (µg/g) ICP–AES	Manganese (µg/g) ICP–AES
Spring Cr.–Weir	12/11/96	1/1	2.0 ± 0.1	76 ± 1	17 ± 0	0.63 ± 0.05	15,000 ± 200	450 ± 10
Spring Cr.–Weir	05/28/97	1/1	< 0.6 ± 0	100 ± 0	7.0 ± 1.0	0.050 ± 0.006	< 100 ± 0	< 20 ± 1
Spring Cr.–Road	01/02/97	1/1	2.5 ± 0.1	49 ± 2	16 ± 1	0.35 ± 0.02	12,000 ± 1,000	240 ± 30
Spring Cr. arm	07/12/96	1/1	8.4 ± 0.5	10 ± 0	14 ± 2	0.34 ± 0.02	39,000 ± 0	3,200 ± 0
Spring Cr. arm	11/20/96	1/1	12 ± 1	47 ± 3	17 ± 2	2.1 ± 0.0	5,500 ± 0	2,100 ± 0
Spring Cr. arm	12/11/96	1/1	45 ± 0	62 ± 0	9.3 ± 0.8	3.1 ± 0.1	3,400 ± 200	990 ± 30
Spring Cr. arm	05/28/97	1/1	9.2 ± 0.4	9.3 ± 0.4	34 ± 1	0.31 ± 0.01	65,000 ± 2,000	970 ± 30
Colusa Basin Drain	06/06/97	1/1	14 ± 0	18 ± 0	72 ± 0	0.30 ± 0.02	22,000 ± 1,000	1,500 ± 100
Yolo Bypass	01/07/97	1/1	16 ± 0	22 ± 0	59 ± 1	0.44 ± 0.00	25,000 ± 1,000	1,000 ± 0

C—035047

C-035049

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Mercury (µg/g) CV–AFS	Molybdenum (µg/g) ICP–MS	Neodymium (µg/g) ICP–MS	Nickel (µg/g) ICP–MS	Potassium (µg/g) ICP–AES-ax	Praseodymium (µg/g) ICP–MS
Sac. R.–Shasta	07/12/96	1/1	0.19 ± 0.01	< 4 ± 0.4	10 ± 0	80 ± 1	4,300 ± 100	2.0 ± 0.1
Sac. R.–Shasta	11/19/96	1/1	0.45 ± 0.00	< 10 ± 2	23 ± 1	98 ± 2	4,100 ± 400	4.7 ± 0.2
Sac. R.–Shasta	12/12/96	1/1	0.63 ± 0.02	(7) ± 0.6	(1) ± 0.1	(60) ± 14	(< 1,000) ± 0	(0.3) ± 0.03
Sac. R.–Shasta	05/29/97	1/1	0.17 ± 0.00	< 3 ± 0.2	12 ± 0	220 ± 0	6,600 ± 100	2.4 ± 0.0
Sac. R.–Keswick	07/11/96	1/1	0.31 ± 0.01	< 6 ± 0.2	15 ± 0	98 ± 4	5,600 ± 100	3.1 ± 0.1
Sac. R.–Keswick	11/21/96	1/1	0.50 ± 0.01	< 3 ± 0.1	12 ± 0	76 ± 1	5,700 ± 200	2.1 ± 0.0
Sac. R.–Keswick	12/11/96	1/1	0.87 ± 0.03	< 8 ± 4	37 ± 1	127 ± 0	6,400 ± 400	6.7 ± 0.5
Sac. R.–Keswick	01/02/97	1/1	0.62 ± 0.01	4.1 ± 0.1	9.9 ± 0.2	110 ± 0	6,800 ± 300	1.9 ± 0.0
Sac. R.–Keswick	05/28/97	1/1	0.24 ± 0.02	< 3 ± 0.3	15 ± 0	800 ± 20	6,000 ± 100	3.3 ± 0.1
Sac. R.–Bend Br.	07/11/96	1/1	0.22 ± 0.01	< 4 ± 0.3	11 ± 0	83 ± 0	5,500 ± 200	2.2 ± 0.0
Sac. R.–Bend Br.	09/20/96	1/1	0.26 ± 0.03	< 3 ± 0	17 ± 0	130 ± 0	12,000 ± 0	4.0 ± 0.1
Sac. R.–Bend Br.	11/22/96	1/1	0.43 ± 0.02	< 10 ± 1	13 ± 0	200 ± 0	13,000 ± 2,000	2.8 ± 0.1
Sac. R.–Bend Br.	12/12/96	1/1	0.19 ± 0.03	< 3 ± 0.2	20 ± 0	250 ± 0	15,000 ± 0	4.6 ± 0.1
Sac. R.–Bend Br.	01/03/97	1/1	0.24 ± 0.01	< 3 ± 0	17 ± 1	160 ± 0	12,000 ± 1,000	4.0 ± 0.1
Sac. R.–Bend Br.	05/30/97	1/2	0.20 ± 0.02	< 3 ± 0	16 ± 0	790 ± 10	5,800 ± 100	3.5 ± 0.0
Sac. R.–Bend Br.	05/30/97	2/2	0.20 ± 0.01	< 3 ± 0.1	10 ± 0	780 ± 10	5,600 ± 100	2.1 ± 0.1
Sac. R.–Colusa	07/16/96	1/1	0.22 ± 0.01	< 3 ± 0.1	11 ± 0	98 ± 1	6,900 ± 100	2.2 ± 0.1
Sac. R.–Colusa	09/25/96	1/1	0.30 ± 0.02	< 10 ± 0	13 ± 0	92 ± 3	13,000 ± 0	2.7 ± 0.1
Sac. R.–Colusa	11/13/96	1/1	0.45 ± 0.02	< 3 ± 0.1	12 ± 0	99 ± 2	8,000 ± 0	2.5 ± 0.0
Sac. R.–Colusa	12/16/96	1/1	0.20 ± 0.02	< 2 ± 0.47	11 ± 1	168 ± 1	4,900 ± 200	2.3 ± 0.1
Sac. R.–Colusa	01/04/97	1/1	0.23 ± 0.02	< 3 ± 0.2	15 ± 0	140 ± 0	15,000 ± 0	3.5 ± 0.0
Sac. R.–Colusa	06/03/97	1/1	0.22 ± 0.01	< 3 ± 0.1	14 ± 0	430 ± 0	9,200 ± 200	3.1 ± 0.1
Sac. R.–Verona	07/18/96	1/1	0.30 ± 0.01	< 3 ± 0.1	12 ± 0	120 ± 0	9,400 ± 100	2.6 ± 0.1
Sac. R.–Verona	09/26/96	1/1	0.58 ± 0.01	< 4 ± 0.6	16 ± 0	120 ± 0	14,000 ± 0	3.5 ± 0.1
Sac. R.–Verona	11/14/96	1/1	0.25 ± 0.02	< 5 ± 1.9	11 ± 0	130 ± 0	8,900 ± 200	2.3 ± 0.1
Sac. R.–Verona	12/18/96	1/1	0.24 ± 0.02	< 2 ± 0.61	9.8 ± 0.2	165 ± 2	6,400 ± 400	2.1 ± 0.1
Sac. R.–Verona	06/04/97	1/1	0.23 ± 0.00	< 2 ± 0.1	17 ± 1	240 ± 0	9,500 ± 100	4.1 ± 0.0
Sac. R.–Freeport	07/17/96	1/1	na ± na	(3) ± 0.3	(3) ± 0	(100) ± 0	na ± na	(0.7) ± 0.03
Sac. R.–Freeport	09/24/96	1/1	na ± na	(4) ± 0.3	(4) ± 0.2	(80) ± 2	(< 500) ± 0	(0.9) ± 0.01
Sac. R.–Freeport	11/12/96	1/1	0.29 ± 0.02	< 4 ± 0.3	15 ± 0	120 ± 0	8,900 ± 200	3.3 ± 0.0
Sac. R.–Freeport	12/17/96	1/1	0.25 ± 0.01	< 3 ± 0.2	15 ± 0	160 ± 0	8,900 ± 0	3.3 ± 0.0
Sac. R.–Freeport	01/06/97	1/2	0.14 ± 0.01	< 3 ± 0.1	33 ± 0	130 ± 0	15,000 ± 0	8.4 ± 0.0
Sac. R.–Freeport	01/06/97	2/2	0.19 ± 0.01	< 3 ± 0.4	31 ± 0	120 ± 0	12,000 ± 0	7.7 ± 0.2
Sac. R.–Freeport	06/05/97	1/1	0.18 ± 0.00	< 3 ± 0.1	18 ± 0	220 ± 0	9,700 ± 0	3.9 ± 0.0
Sac. R.–Freeport, dup	06/05/97	1/1	0.26 ± 0.01	< 3 ± 0.1	14 ± 0	220 ± 10	8,400 ± 100	3.2 ± 0.1
Spring Cr.–Weir	12/11/96	1/1	2.7 ± 0.1	8.9 ± 2.8	8.2 ± 0.3	37 ± 7	6,300 ± 500	1.3 ± 0.1

C—035048

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Mercury (µg/g) CV–AFS	Molybdenum (µg/g) ICP–MS	Neodymium (µg/g) ICP–MS	Nickel (µg/g) ICP–MS	Potassium (µg/g) ICP–AES-ax	Praseodymium (µg/g) ICP–MS
Spring Cr.–Weir	05/28/97	1/1	0.28 ± 0.01	20 ± 2	< 0.5 ± 0.04	60 ± 8	< 1,000 ± 0	< 0.1 ± 0
Spring Cr.–Road	01/02/97	1/1	3.8 ± 0.1	8.5 ± 0.2	4.8 ± 0.2	53 ± 0	7,400 ± 500	0.96 ± 0.02
Spring Cr. arm	07/12/96	1/1	0.41 ± 0.05	< 8 ± 0.6	13 ± 1	240 ± 0	4,100 ± 300	2.4 ± 0.1
Spring Cr. arm	11/20/96	1/1	0.49 ± 0.03	< 9 ± 0.8	45 ± 1	140 ± 10	2,700 ± 1,000	7.5 ± 0.3
Spring Cr. arm	12/11/96	1/1	0.97 ± 0.08	< 5 ± 0.3	127 ± 5	100 ± 9	< 900 ± 300	21 ± 0
Spring Cr. arm	05/28/97	1/1	0.25 ± 0.02	< 4 ± 0.1	11 ± 1	2,100 ± 0	3,400 ± 100	2.5 ± 0.1
Colusa Basin Drain	06/06/97	1/1	0.097 ± 0.019	< 3 ± 0	15 ± 0	170 ± 0	13,000 ± 0	3.6 ± 0.0
Yolo Bypass	01/07/97	1/1	0.34 ± 0.02	< 3 ± 0.1	18 ± 0	170 ± 0	16,000 ± 0	4.1 ± 0.1

C-035050
C—035049

Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Rhenium (µg/g) ICP–MS	Rubidium (µg/g) ICP–MS	Samarium (µg/g) ICP–MS	Silica (µg/g) ICP–AES	Silver (µg/g) ICP–MS	Sodium (µg/g) ICP–AES
Sac. R.–Shasta	07/12/96	1/1	< 0.01 ± 0.004	4.9 ± 0.1	3.3 ± 0.1	420,000 ± 40,000	< 2 ± 0.2	9,100 ± 600
Sac. R.–Shasta	11/19/96	1/1	< 0.03 ± 0.006	32 ± 1	5.5 ± 0.2	740,000 ± 20,000	< 4 ± 0.8	12,000 ± 1,000
Sac. R.–Shasta	12/12/96	1/1	(< 0.02) ± 0.002	(20) ± 2	(0.6) ± 0.08	nd ± nd	(4) ± 0.5	(70,000) ± 2,000
Sac. R.–Shasta	05/29/97	1/1	< 0.009 ± 0.0013	16 ± 0	3.5 ± 0.0	440,000 ± 30,000	< 1 ± 0.3	3,000 ± 300
Sac. R.–Keswick	07/11/96	1/1	< 0.02 ± 0.003	19 ± 1	3.9 ± 0.1	580,000 ± 10,000	< 2 ± 0.2	17,000 ± 1,000
Sac. R.–Keswick	11/21/96	1/1	< 0.01 ± 0	8.6 ± 0.7	4.9 ± 0.1	590,000 ± 50,000	< 1 ± 0.1	12,000 ± 1,000
Sac. R.–Keswick	12/11/96	1/1	< 0.01 ± 0.00	18 ± 0	12 ± 1	470,000 ± 9,000	< 2 ± 0	4,500 ± 200
Sac. R.–Keswick	01/02/97	1/1	< 0.008 ± 0.0004	5.8 ± 0.5	3.6 ± 0.1	510,000 ± 70,000	< 1 ± 0	5,900 ± 100
Sac. R.–Keswick	05/28/97	1/1	< 0.009 ± 0.0012	33 ± 0	4.1 ± 0.1	410,000 ± 20,000	< 1 ± 0.4	2,700 ± 100
Sac. R.–Bend Br.	07/11/96	1/1	< 0.01 ± 0.002	6.4 ± 0.2	3.1 ± 0.1	480,000 ± 50,000	< 2 ± 0.2	14,000 ± 1,000
Sac. R.–Bend Br.	09/20/96	1/1	< 0.009 ± 0.0011	48 ± 0	4.5 ± 0.1	450,000 ± 20,000	< 1 ± 0.1	11,000 ± 1,000
Sac. R.–Bend Br.	11/22/96	1/1	< 0.04 ± 0.017	30 ± 0	3.7 ± 0.3	780,000 ± 30,000	< 5 ± 0.3	14,000 ± 1,000
Sac. R.–Bend Br.	12/12/96	1/1	< 0.009 ± 0.0034	78 ± 0	5.2 ± 0.0	510,000 ± 50,000	< 1 ± 0.3	8,400 ± 600
Sac. R.–Bend Br.	01/03/97	1/1	< 0.008 ± 0.0012	24 ± 1	4.7 ± 0.3	520,000 ± 80,000	< 1 ± 0.1	5,900 ± 0
Sac. R.–Bend Br.	05/30/97	1/2	< 0.009 ± 0.0014	25 ± 0	4.2 ± 0.0	420,000 ± 20,000	< 1 ± 0.1	3,100 ± 200
Sac. R.–Bend Br.	05/30/97	2/2	< 0.009 ± 0.0017	5.7 ± 0.3	3.0 ± 0.1	520,000 ± 70,000	< 1 ± 0.2	3,600 ± 200
Sac. R.–Colusa	07/16/96	1/1	< 0.009 ± 0.0014	8.0 ± 0.5	3.1 ± 0.2	460,000 ± 40,000	< 1 ± 0.1	10,000 ± 1,000
Sac. R.–Colusa	09/25/96	1/1	< 0.03 ± 0.011	36 ± 1	3.2 ± 0.2	490,000 ± 60,000	< 5 ± 0.2	40,000 ± 5,000
Sac. R.–Colusa	11/13/96	1/1	< 0.009 ± 0.0009	16 ± 0	3.4 ± 0.1	720,000 ± 40,000	< 1 ± 0.1	16,000 ± 1,000
Sac. R.–Colusa	12/16/96	1/1	0 ± 0	8.0 ± 1.2	3.0 ± 0.2	510,000 ± 15,000	< 2 ± 0.19	9,100 ± 400
Sac. R.–Colusa	01/04/97	1/1	< 0.008 ± 0.0013	27 ± 0	4.0 ± 0.1	470,000 ± 30,000	< 1 ± 0.4	8,200 ± 400
Sac. R.–Colusa	06/03/97	1/1	< 0.01 ± 0.0018	20 ± 1	3.9 ± 0.0	710,000 ± 50,000	< 1 ± 0.3	15,000 ± 1,000
Sac. R.–Verona	07/18/96	1/1	< 0.01 ± 0.0032	16 ± 1	3.2 ± 0.1	510,000 ± 50,000	< 1 ± 0.2	13,000 ± 1,000
Sac. R.–Verona	09/26/96	1/1	< 0.01 ± 0.004	56 ± 1	3.9 ± 0.1	500,000 ± 50,000	< 2 ± 0.2	29,000 ± 3,000
Sac. R.–Verona	11/14/96	1/1	< 0.01 ± 0.002	23 ± 1	2.6 ± 0.2	570,000 ± 10,000	< 2 ± 1.6	8,200 ± 500
Sac. R.–Verona	12/18/96	1/1	0 ± 0	8.3 ± 0.6	2.6 ± 0.1	480,000 ± 7,000	< 2 ± 0.29	7,600 ± 400
Sac. R.–Verona	06/04/97	1/1	< 0.008 ± 0.0007	33 ± 0	4.4 ± 0.2	440,000 ± 50,000	< 1 ± 0.1	5,400 ± 500
Sac. R.–Freeport	07/17/96	1/1	(0.04) ± 0.005	(40) ± 1	(1) ± 0.06	(400,000) ± 0	(< 1) ± 0.1	(10,000) ± 0
Sac. R.–Freeport	09/24/96	1/1	(0.05) ± 0.006	(30) ± 2	(1) ± 0.1	(400,000) ± 0	(< 1) ± 0.1	(10,000) ± 0
Sac. R.–Freeport	11/12/96	1/1	< 0.01 ± 0.002	24 ± 0	3.5 ± 0.1	500,000 ± 60,000	< 2 ± 0.1	6,000 ± 700
Sac. R.–Freeport	12/17/96	1/1	< 0.009 ± 0.0036	15 ± 0	3.6 ± 0.1	470,000 ± 10,000	< 1 ± 0.2	7,600 ± 500
Sac. R.–Freeport	01/06/97	1/2	< 0.009 ± 0.0006	65 ± 1	7.4 ± 0.1	530,000 ± 80,000	< 1 ± 0.1	9,500 ± 500
Sac. R.–Freeport	01/06/97	2/2	< 0.008 ± 0.0035	24 ± 0	6.4 ± 0.2	450,000 ± 10,000	< 1 ± 0.2	8,700 ± 200
Sac. R.–Freeport	06/05/97	1/1	< 0.009 ± 0.0032	30 ± 0	4.3 ± 0.1	470,000 ± 0	< 1 ± 0.3	6,200 ± 400
Sac. R.–Freeport, dup	06/05/97	1/1	< 0.009 ± 0.0025	21 ± 1	3.4 ± 0.1	470,000 ± 0	< 1 ± 0.1	5,800 ± 300

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Rhenium (µg/g) ICP–MS	Rubidium (µg/g) ICP–MS	Samarium (µg/g) ICP–MS	Silica (µg/g) ICP–AES	Silver (µg/g) ICP–MS	Sodium (µg/g) ICP–AES
Spring Cr.–Weir	12/11/96	1/1	< 0.01 ± 0.01	5.0 ± 0.3	3.5 ± 0.2	380,000 ± 2,000	< 8 ± 4.21	4,300 ± 100
Spring Cr.–Weir	05/28/97	1/1	< 0.02 ± 0.015	10 ± 2	< 0.1 ± 0.02	< 200,000 ± 20,000	< 7 ± 2.28	< 5,000 ± 200
Spring Cr.–Road	01/02/97	1/1	< 0.02 ± 0.002	8.2 ± 0.4	1.8 ± 0.1	270,000 ± 30,000	4.4 ± 1.2	< 6,000 ± 800
Spring Cr. arm	07/12/96	1/1	< 0.02 ± 0.006	16 ± 1	3.7 ± 0.1	340,000 ± 30,000	< 3 ± 0.8	13,000 ± 1,000
Spring Cr. arm	11/20/96	1/1	< 0.03 ± 0.013	5.8 ± 0.4	19 ± 0	390,000 ± 20,000	< 4 ± 0.2	< 8,000 ± 400
Spring Cr. arm	12/11/96	1/1	< 0.01 ± 0	1.5 ± 0.2	46 ± 1	230,000 ± 8,000	< 2 ± 0	9,000 ± 300
Spring Cr. arm	05/28/97	1/1	< 0.01 ± 0.001	21 ± 1	3.2 ± 0.1	370,000 ± 10,000	< 2 ± 0.1	< 3,000 ± 100
Colusa Basin Drain	06/06/97	1/1	< 0.009 ± 0.0007	43 ± 1	3.9 ± 0.0	450,000 ± 30,000	< 1 ± 0	4,800 ± 400
Yolo Bypass	01/07/97	1/1	< 0.009 ± 0.0011	44 ± 1	4.7 ± 0.1	450,000 ± 50,000	< 1 ± 0.1	5,800 ± 100

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Strontium (µg/g) ICP–MS	Terbium (µg/g) ICP–MS	Thallium (µg/g) ICP–MS	Thorium (µg/g) ICP–MS	Thulium (µg/g) ICP–MS	Tin (µg/g) ICP–MS
Sac. R.–Shasta	07/12/96	1/1	93 ± 1	0.62 ± 0.02	0.25 ± 0.03	3.3 ± 0.0	0.25 ± 0.02	200 ± 30
Sac. R.–Shasta	11/19/96	1/1	85 ± 1	1.0 ± 0.0	0.20 ± 0.01	3.4 ± 0.1	0.33 ± 0.00	160 ± 0
Sac. R.–Shasta	12/12/96	1/1	(70) ± 6	(0.2) ± 0.01	(0.6) ± 0.03	(2) ± 0.2	(0.1) ± 0.01	(300) ± 0
Sac. R.–Shasta	05/29/97	1/1	78 ± 1	0.71 ± 0.10	0.33 ± 0.01	4.2 ± 0.1	0.29 ± 0.04	71 ± 2
Sac. R.–Keswick	07/11/96	1/1	120 ± 0	0.64 ± 0.02	0.20 ± 0.02	3.4 ± 0.1	0.24 ± 0.00	9.9 ± 0.2
Sac. R.–Keswick	11/21/96	1/1	50 ± 1	1.3 ± 0.1	0.27 ± 0.03	2.7 ± 0.1	0.53 ± 0.07	360 ± 10
Sac. R.–Keswick	12/11/96	1/1	61 ± 3	2.5 ± 0.5	0.37 ± 0.03	4.8 ± 0.2	0.98 ± 0.04	313 ± 12
Sac. R.–Keswick	01/02/97	1/1	44 ± 1	0.95 ± 0.18	0.72 ± 0.03	2.3 ± 0.0	0.43 ± 0.07	59 ± 6
Sac. R.–Keswick	05/28/97	1/1	68 ± 0	0.79 ± 0.10	0.26 ± 0.00	4.3 ± 0.1	0.31 ± 0.04	120 ± 0
Sac. R.–Bend Br.	07/11/96	1/1	130 ± 0	0.54 ± 0.02	0.22 ± 0.01	2.9 ± 0.0	0.21 ± 0.00	210 ± 30
Sac. R.–Bend Br.	09/20/96	1/1	150 ± 0	0.82 ± 0.13	0.38 ± 0.01	5.7 ± 0.1	0.30 ± 0.05	58 ± 1
Sac. R.–Bend Br.	11/22/96	1/1	59 ± 5	0.75 ± 0.03	0.33 ± 0.10	4.4 ± 0.2	0.34 ± 0.01	83 ± 3
Sac. R.–Bend Br.	12/12/96	1/1	96 ± 2	0.78 ± 0.00	0.51 ± 0.01	6.1 ± 0.3	0.31 ± 0.03	36 ± 1
Sac. R.–Bend Br.	01/03/97	1/1	91 ± 2	0.76 ± 0.02	0.57 ± 0.02	6.4 ± 0.0	0.36 ± 0.05	48 ± 1
Sac. R.–Bend Br.	05/30/97	1/2	72 ± 0	0.80 ± 0.10	0.25 ± 0.01	4.7 ± 0.1	0.32 ± 0.04	110 ± 0
Sac. R.–Bend Br.	05/30/97	2/2	72 ± 1	0.56 ± 0.01	0.25 ± 0.01	3.8 ± 0.0	0.25 ± 0.01	270 ± 10
Sac. R.–Colusa	07/16/96	1/1	110 ± 0	0.55 ± 0.02	0.28 ± 0.03	3.7 ± 0.0	0.23 ± 0.01	170 ± 30
Sac. R.–Colusa	09/25/96	1/1	320 ± 10	0.54 ± 0.02	0.23 ± 0.06	3.1 ± 0.1	0.21 ± 0.00	640 ± 90
Sac. R.–Colusa	11/13/96	1/1	85 ± 2	0.80 ± 0.02	0.31 ± 0.01	3.4 ± 0.1	0.28 ± 0.04	110 ± 10
Sac. R.–Colusa	12/16/96	1/1	76 ± 4	0.52 ± 0.10	0.39 ± 0.04	3.6 ± 0.2	0.24 ± 0.01	14 ± 0
Sac. R.–Colusa	01/04/97	1/1	100 ± 0	0.73 ± 0.11	0.60 ± 0.02	5.4 ± 0.1	0.33 ± 0.05	54 ± 1
Sac. R.–Colusa	06/03/97	1/1	94 ± 1	0.79 ± 0.07	0.28 ± 0.03	4.9 ± 0.3	0.30 ± 0.04	100 ± 0
Sac. R.–Verona	07/18/96	1/1	140 ± 0	0.53 ± 0.02	0.28 ± 0.01	4.3 ± 0.0	0.23 ± 0.00	190 ± 40
Sac. R.–Verona	09/26/96	1/1	270 ± 0	0.63 ± 0.01	0.31 ± 0.02	4.8 ± 0.1	0.26 ± 0.01	230 ± 40
Sac. R.–Verona	11/14/96	1/1	92 ± 3	0.39 ± 0.02	0.33 ± 0.01	3.4 ± 0.1	0.16 ± 0.01	48 ± 1
Sac. R.–Verona	12/18/96	1/1	77 ± 1	0.45 ± 0.08	0.37 ± 0.01	3.4 ± 0.1	0.21 ± 0.00	11 ± 1
Sac. R.–Verona	06/04/97	1/1	94 ± 1	0.79 ± 0.11	0.34 ± 0.03	5.7 ± 0.2	0.29 ± 0.04	60 ± 3
Sac. R.–Freeport	07/17/96	1/1	(170) ± 0	(0.2) ± 0	(0.3) ± 0.02	(1) ± 0.1	(0.06) ± 0.007	(30) ± 0
Sac. R.–Freeport	09/24/96	1/1	(100) ± 0	(0.2) ± 0.02	(0.2) ± 0	(1) ± 0.3	(0.09) ± 0.005	(90) ± 0
Sac. R.–Freeport	11/12/96	1/1	95 ± 2	0.59 ± 0.01	0.35 ± 0.05	4.1 ± 0.1	0.22 ± 0.01	140 ± 0
Sac. R.–Freeport	12/17/96	1/1	91 ± 4	0.50 ± 0.02	0.42 ± 0.03	4.7 ± 0.0	0.22 ± 0.01	12 ± 1
Sac. R.–Freeport	01/06/97	1/2	180 ± 0	1.0 ± 0.2	0.61 ± 0.00	21 ± 0	0.34 ± 0.07	49 ± 1
Sac. R.–Freeport	01/06/97	2/2	170 ± 0	0.84 ± 0.06	0.59 ± 0.01	17 ± 0	0.28 ± 0.01	< 4 ± 0.6
Sac. R.–Freeport	06/05/97	1/1	100 ± 0	0.63 ± 0.00	0.34 ± 0.01	5.4 ± 0.1	0.24 ± 0.00	17 ± 0
Sac. R.–Freeport, dup	06/05/97	1/1	94 ± 1	0.55 ± 0.01	0.34 ± 0.03	4.2 ± 0.1	0.21 ± 0.01	13 ± 1

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Strontium (µg/g) ICP–MS	Terbium (µg/g) ICP–MS	Thallium (µg/g) ICP–MS	Thorium (µg/g) ICP–MS	Thulium (µg/g) ICP–MS	Tin (µg/g) ICP–MS
Spring Cr.–Weir	12/11/96	1/1	15 ± 0	0.82 ± 0.22	0.55 ± 0.05	2.4 ± 0.0	0.48 ± 0.03	220 ± 2
Spring Cr.–Weir	05/28/97	1/1	10 ± 2	0.050 ± 0.005	0.40 ± 0.00	< 0.3 ± 0.47	0.040 ± 0.011	60 ± 2
Spring Cr.–Road	01/02/97	1/1	25 ± 0	0.46 ± 0.09	0.50 ± 0.03	1.7 ± 0.0	0.28 ± 0.05	190 ± 0
Spring Cr. arm	07/12/96	1/1	130 ± 0	0.69 ± 0.03	0.11 ± 0.03	1.8 ± 0.0	0.24 ± 0.02	19 ± 1
Spring Cr. arm	11/20/96	1/1	33 ± 3	4.9 ± 0.3	0.16 ± 0.05	3.5 ± 0.2	1.7 ± 0.0	730 ± 50
Spring Cr. arm	12/11/96	1/1	20 ± 1	10 ± 2	0.14 ± 0.01	2.5 ± 0.2	3.4 ± 0.0	320 ± 0
Spring Cr. arm	05/28/97	1/1	49 ± 1	0.59 ± 0.01	0.19 ± 0.01	3.5 ± 0.0	0.23 ± 0.02	24 ± 0
Colusa Basin Drain	06/06/97	1/1	120 ± 0	0.66 ± 0.10	0.44 ± 0.01	5.6 ± 0.1	0.26 ± 0.03	53 ± 2
Yolo Bypass	01/07/97	1/1	100 ± 0	0.84 ± 0.14	0.57 ± 0.04	6.9 ± 0.0	0.37 ± 0.07	63 ± 2

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Titanium (µg/g) ICP–AES	Uranium (µg/g) ICP–MS	Vanadium (µg/g) ICP–AES	Ytterbium (µg/g) ICP–MS	Yttrium (µg/g) ICP–MS	Zinc (µg/g) ICP–AES
Sac. R.–Shasta	07/12/96	1/1	3,400 ± 0	1.8 ± 0.1	150 ± 0	2.0 ± 0.1	16 ± 0	430 ± 20
Sac. R.–Shasta	11/19/96	1/1	3,300 ± 0	3.0 ± 0.3	220 ± 0	3.1 ± 0.2	27 ± 0	770 ± 40
Sac. R.–Shasta	12/12/96	1/1	(4,000) ± 0	(4) ± 0.1	(300) ± 0	(1) ± 0	(5) ± 0.5	(1,000) ± 0
Sac. R.–Shasta	05/29/97	1/1	3,800 ± 100	2.0 ± 0.1	160 ± 0	2.4 ± 0.0	15 ± 0	300 ± 30
Sac. R.–Keswick	07/11/96	1/1	3,200 ± 0	1.9 ± 0.2	130 ± 0	2.1 ± 0.1	18 ± 0	450 ± 10
Sac. R.–Keswick	11/21/96	1/1	3,900 ± 300	1.9 ± 0.1	270 ± 10	4.2 ± 0.1	26 ± 0	950 ± 60
Sac. R.–Keswick	12/11/96	1/1	3,580 ± 40	3.3 ± 0.2	267 ± 3	6.6 ± 0.2	57 ± 2	1,500 ± 30
Sac. R.–Keswick	01/02/97	1/1	3,300 ± 0	2.5 ± 0.1	330 ± 0	3.5 ± 0.0	21 ± 0	1,100 ± 0
Sac. R.–Keswick	05/28/97	1/1	3,400 ± 200	2.0 ± 0.0	170 ± 10	2.5 ± 0.0	19 ± 0	380 ± 30
Sac. R.–Bend Br.	07/11/96	1/1	3,200 ± 0	1.6 ± 0.0	130 ± 10	1.7 ± 0.1	15 ± 0	390 ± 20
Sac. R.–Bend Br.	09/20/96	1/1	4,000 ± 200	2.1 ± 0.0	170 ± 10	2.3 ± 0.1	19 ± 0	200 ± 10
Sac. R.–Bend Br.	11/22/96	1/1	4,000 ± 0	2.3 ± 0.0	200 ± 0	2.9 ± 0.1	22 ± 1	580 ± 10
Sac. R.–Bend Br.	12/12/96	1/1	3,800 ± 0	2.8 ± 0.1	180 ± 0	2.8 ± 0.2	23 ± 0	400 ± 0
Sac. R.–Bend Br.	01/03/97	1/1	4,300 ± 0	2.8 ± 0.1	230 ± 0	2.8 ± 0.0	20 ± 0	250 ± 10
Sac. R.–Bend Br.	05/30/97	1/2	3,500 ± 200	1.9 ± 0.0	170 ± 10	2.5 ± 0.1	19 ± 0	380 ± 20
Sac. R.–Bend Br.	05/30/97	2/2	3,500 ± 0	1.9 ± 0.1	160 ± 10	1.9 ± 0.0	15 ± 0	380 ± 10
Sac. R.–Colusa	07/16/96	1/1	3,500 ± 0	1.6 ± 0.1	140 ± 0	1.8 ± 0.0	14 ± 0	260 ± 0
Sac. R.–Colusa	09/25/96	1/1	2,400 ± 100	1.8 ± 0.2	120 ± 20	1.7 ± 0.1	15 ± 0	220 ± 20
Sac. R.–Colusa	11/13/96	1/1	3,400 ± 100	2.0 ± 0.0	150 ± 10	2.0 ± 0.0	16 ± 0	320 ± 20
Sac. R.–Colusa	12/16/96	1/1	4,500 ± 120	2.2 ± 0.2	210 ± 5	1.9 ± 0.0	12 ± 0	270 ± 10
Sac. R.–Colusa	01/04/97	1/1	5,000 ± 300	2.6 ± 0.0	240 ± 10	2.7 ± 0.1	16 ± 0	180 ± 10
Sac. R.–Colusa	06/03/97	1/1	3,800 ± 200	1.9 ± 0.1	170 ± 10	2.4 ± 0.1	18 ± 0	290 ± 20
Sac. R.–Verona	07/18/96	1/1	4,300 ± 0	2.0 ± 0.1	160 ± 10	1.7 ± 0.0	14 ± 0	280 ± 10
Sac. R.–Verona	09/26/96	1/1	4,100 ± 0	2.3 ± 0.1	180 ± 10	2.0 ± 0.1	17 ± 0	210 ± 20
Sac. R.–Verona	11/14/96	1/1	5,000 ± 0	2.4 ± 0.0	190 ± 0	1.4 ± 0.1	10 ± 0	290 ± 10
Sac. R.–Verona	12/18/96	1/1	4,700 ± 10	2.6 ± 0.0	209 ± 2	1.6 ± 0.0	9.5 ± 0.2	220 ± 10
Sac. R.–Verona	06/04/97	1/1	4,000 ± 100	2.2 ± 0.1	180 ± 10	2.2 ± 0.0	17 ± 0	220 ± 20
Sac. R.–Freeport	07/17/96	1/1	(4,000) ± 100	(2) ± 0.1	(170) ± 0	(0.4) ± 0.02	(4) ± 0.1	(300) ± 0
Sac. R.–Freeport	09/24/96	1/1	(2,000) ± 0	(2) ± 0.1	(100) ± 0	(0.6) ± 0.02	(7) ± 0.1	(500) ± 10
Sac. R.–Freeport	11/12/96	1/1	4,300 ± 100	2.6 ± 0.1	180 ± 0	2.1 ± 0.0	16 ± 0	310 ± 10
Sac. R.–Freeport	12/17/96	1/1	4,700 ± 0	2.6 ± 0.0	210 ± 0	1.9 ± 0.1	15 ± 0	200 ± 10
Sac. R.–Freeport	01/06/97	1/2	4,900 ± 100	5.6 ± 0.0	180 ± 10	2.6 ± 0.1	21 ± 0	140 ± 10
Sac. R.–Freeport	01/06/97	2/2	4,700 ± 100	6.2 ± 0.0	170 ± 0	2.5 ± 0.0	19 ± 0	130 ± 10
Sac. R.–Freeport	06/05/97	1/1	4,100 ± 0	2.7 ± 0.1	170 ± 0	2.3 ± 0.0	18 ± 0	220 ± 10
Sac. R.–Freeport, dup	06/05/97	1/1	3,900 ± 0	2.7 ± 0.0	170 ± 0	2.0 ± 0.0	14 ± 0	210 ± 0

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Titanium (µg/g) ICP–AES	Uranium (µg/g) ICP–MS	Vanadium (µg/g) ICP–AES	Ytterbium (µg/g) ICP–MS	Yttrium (µg/g) ICP–MS	Zinc (µg/g) ICP–AES
Spring Cr.–Weir	12/11/96	1/1	2,400 ± 10	1.2 ± 0.0	117 ± 3	3.6 ± 0.0	14 ± 1	460 ± 20
Spring Cr.–Weir	05/28/97	1/1	900 ± 10	0.50 ± 0.01	< 3 ± 2.8	0.40 ± 0.02	3.0 ± 0.4	100 ± 10
Spring Cr.–Road	01/02/97	1/1	1,800 ± 200	0.78 ± 0.04	93 ± 10	2.3 ± 0.2	12 ± 0	120 ± 10
Spring Cr. arm	07/12/96	1/1	1,000 ± 0	1.5 ± 0.2	78 ± 1	2.1 ± 0.1	22 ± 1	280 ± 20
Spring Cr. arm	11/20/96	1/1	2,100 ± 0	4.3 ± 0.1	140 ± 0	15 ± 1	130 ± 10	2,600 ± 100
Spring Cr. arm	12/11/96	1/1	1,400 ± 50	6.1 ± 0.1	91 ± 2	21 ± 1	229 ± 10	4,900 ± 70
Spring Cr. arm	05/28/97	1/1	2,300 ± 100	1.9 ± 0.1	160 ± 10	2.0 ± 0.1	17 ± 0	340 ± 30
Colusa Basin Drain	06/06/97	1/1	4,300 ± 100	1.8 ± 0.0	190 ± 0	2.1 ± 0.1	15 ± 0	170 ± 20
Yolo Bypass	01/07/97	1/1	4,900 ± 200	2.9 ± 0.0	250 ± 10	2.9 ± 0.0	19 ± 0	180 ± 20

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Zirconium (µg/g) ICP–MS
Sac. R.–Shasta	07/12/96	1/1	230 ± 0
Sac. R.–Shasta	11/19/96	1/1	< 400 ± 0
Sac. R.–Shasta	12/12/96	1/1	(1,000) ± 200
Sac. R.–Shasta	05/29/97	1/1	250 ± 0
Sac. R.–Keswick	07/11/96	1/1	410 ± 0
Sac. R.–Keswick	11/21/96	1/1	510 ± 0
Sac. R.–Keswick	12/11/96	1/1	200 ± 7
Sac. R.–Keswick	01/02/97	1/1	240 ± 0
Sac. R.–Keswick	05/28/97	1/1	200 ± 0
Sac. R.–Bend Br.	07/11/96	1/1	160 ± 0
Sac. R.–Bend Br.	09/20/96	1/1	170 ± 0
Sac. R.–Bend Br.	11/22/96	1/1	660 ± 30
Sac. R.–Bend Br.	12/12/96	1/1	200 ± 0
Sac. R.–Bend Br.	01/03/97	1/1	250 ± 0
Sac. R.–Bend Br.	05/30/97	1/2	200 ± 0
Sac. R.–Bend Br.	05/30/97	2/2	230 ± 0
Sac. R.–Colusa	07/16/96	1/1	190 ± 0
Sac. R.–Colusa	09/25/96	1/1	< 400 ± 10
Sac. R.–Colusa	11/13/96	1/1	280 ± 0
Sac. R.–Colusa	12/16/96	1/1	214 ± 1
Sac. R.–Colusa	01/04/97	1/1	270 ± 0
Sac. R.–Colusa	06/03/97	1/1	610 ± 0
Sac. R.–Verona	07/18/96	1/1	180 ± 0
Sac. R.–Verona	09/26/96	1/1	170 ± 0
Sac. R.–Verona	11/14/96	1/1	< 200 ± 0
Sac. R.–Verona	12/18/96	1/1	210 ± 10
Sac. R.–Verona	06/04/97	1/1	190 ± 0
Sac. R.–Freeport	07/17/96	1/1	(200) ± 0
Sac. R.–Freeport	09/24/96	1/1	(100) ± 10
Sac. R.–Freeport	11/12/96	1/1	170 ± 0
Sac. R.–Freeport	12/17/96	1/1	190 ± 10
Sac. R.–Freeport	01/06/97	1/2	200 ± 0
Sac. R.–Freeport	01/06/97	2/2	200 ± 0
Sac. R.–Freeport	06/05/97	1/1	180 ± 0
Sac. R.–Freeport, dup	06/05/97	1/1	180 ± 0
Spring Cr.–Weir	12/11/96	1/1	200 ± 11

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Table A5-2. Concentrations of selected elements in suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Zirconium (µg/g) ICP–MS
Spring Cr.–Weir	05/28/97	1/1	< 200 ± 0
Spring Cr.–Road	01/02/97	1/1	< 300 ± 0
Spring Cr. arm	07/12/96	1/1	< 300 ± 0
Spring Cr. arm	11/20/96	1/1	< 400 ± 10
Spring Cr. arm	12/11/96	1/1	74 ± 4
Spring Cr. arm	05/28/97	1/1	< 100 ± 0
Colusa Basin Drain	06/06/97	1/1	180 ± 0
Yolo Bypass	01/07/97	1/1	270 ± 0

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples

[Br., Bridge; Cr., Creek; dup, duplicate; R., River; Sac., Sacramento. Split replicate (1/2), first number identifies which replicate was analyzed, second number represents number of replicate samples. mm/dd/yy, month/day/year; na, not analyzed; µg/g, microgram per gram; < , less than the indicated detection limit]

Site	Date (mm/dd/yy)	Split replicate	Aluminum µg/g (dry weight)				Antimony µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	4,800 ± 100	8,700 ± 100	38,000 ± 0	51,500 ± 200	< 0.2 ± 0.0	< 0.2 ± 0.0	0.8 ± 0.1	1.0 ± 0.3
Sac. R.-Keswick	01/02/97	1/1	4,500 ± 100	4,700 ± 700	45,000 ± 2,000	54,200 ± 2,800	< 0.2 ± 0.0	< 0.2 ± 0.0	3.3 ± 0.3	3.5 ± 0.5
Sac. R.-Keswick	05/28/97	1/1	4,500 ± 0	7,300 ± 300	89,000 ± 0	100,800 ± 300	< 0.2 ± 0.0	< 0.2 ± 0.0	1.0 ± 0.1	1.2 ± 0.3
Sac. R.-Bend Br.	12/12/96	1/1	3,100 ± 100	3,800 ± 100	64,000 ± 1,000	70,900 ± 1,200	< 0.2 ± 0.1	< 0.2 ± 0.1	1.4 ± 0.0	1.6 ± 0.2
Sac. R.-Bend Br.	01/03/97	1/1	4,400 ± 100	5,300 ± 300	62,000 ± 1,000	71,700 ± 1,400	< 0.2 ± 0.0	< 0.2 ± 0.1	1.7 ± 0.1	1.9 ± 0.3
Sac. R.-Bend Br.	05/30/97	1/1	4,600 ± 100	6,900 ± 0	na	na	< 0.2 ± 0.0	< 0.2 ± 0.0	na	na
Sac. R.-Colusa	12/16/96	1/1	3,200 ± 0	4,400 ± 500	51,000 ± 0	58,600 ± 500	< 0.2 ± 0.1	< 0.2 ± 0.0	1.0 ± 0.0	1.2 ± 0.2
Sac. R.-Colusa	01/04/97	1/2	3,600 ± 100	3,300 ± 300	71,000 ± 2,000	77,900 ± 2,400	< 0.2 ± 0.0	< 0.1 ± 0.0	1.6 ± 0.0	1.8 ± 0.2
Sac. R.-Colusa	01/04/97	2/2	3,800 ± 100	5,700 ± 500	97,000 ± 1,000	106,500 ± 1,600	< 0.2 ± 0.1	< 0.2 ± 0.0	1.7 ± 0.1	1.9 ± 0.3
Sac. R.-Colusa	06/03/97	1/1	3,900 ± 0	4,100 ± 800	81,000 ± 0	89,000 ± 800	< 0.2 ± 0.0	< 0.2 ± 0.1	1.1 ± 0.0	1.3 ± 0.2
Sac. R.-Verona	06/04/97	1/1	2,700 ± 0	4,400 ± 600	62,000 ± 0	69,100 ± 600	< 0.2 ± 0.0	< 0.2 ± 0.1	0.8 ± 0.0	1.0 ± 0.2
Sac. R-Freeport	12/17/96	1/1	3,800 ± 200	4,300 ± 200	56,000 ± 2,000	64,100 ± 2,400	< 0.2 ± 0.0	< 0.2 ± 0.0	1.7 ± 0.1	1.9 ± 0.3
Sac. R-Freeport	01/06/97	1/1	6,000 ± 100	7,200 ± 700	64,000 ± 1,000	77,200 ± 1,800	< 0.2 ± 0.1	< 0.2 ± 0.0	1.0 ± 0.0	1.2 ± 0.2
Sac. R-Freeport	06/05/97	1/1	3,100 ± 100	4,500 ± 900	51,000 ± 2,000	58,600 ± 3,000	< 0.2 ± 0.0	< 0.2 ± 0.1	0.8 ± 0.0	1.0 ± 0.2
Sac. R-Freeport, dup.	06/05/97	1/1	3,500 ± 200	3,900 ± 1,000	51,000 ± 1,000	58,400 ± 2,200	< 0.2 ± 0.4	< 0.2 ± 0.0	0.9 ± 0.0	1.3 ± 0.4
Spring Cr.-Road	01/02/97	1/1	1,700 ± 200	3,000 ± 600	70,000 ± 1,000	74,700 ± 1,800	1.8 ± 0.2	2.2 ± 0.1	9.1 ± 0.1	13 ± 0
Spring Cr.-Weir	05/28/97	1/1	5,900 ± 0	5,700 ± 800	18,000 ± 1,000	29,600 ± 1,800	< 2 ± 0.0	< 1 ± 0	< 0.8 ± 0.3	< 4 ± 2
Spring Creek Arm	05/28/97	1/1	4,400 ± 0	6,700 ± 400	73,000 ± 1,000	84,100 ± 1,400	< 0.2 ± 0.0	< 0.2 ± 0.0	1.8 ± 0.1	2.0 ± 0.3
Yolo Bypass	01/07/97	1/1	4,100 ± 200	6,700 ± 400	91,000 ± 6,000	101,800 ± 6,600	< 0.2 ± 0.0	< 0.2 ± 0.0	2.1 ± 0.0	2.3 ± 0.2
Colusa Basin Drain	06/06/97	1/1	2,800 ± 400	4,700 ± 600	70,000 ± 1,000	77,500 ± 2,000	< 0.2 ± 0.0	< 0.2 ± 0.0	1.4 ± 0.1	1.6 ± 0.3

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Barium µg/g (dry weight)				Cadmium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	210 ± 0	17 ± 0	93 ± 0	320 ± 0	0.7 ± 0.1	< 0.08 ± 0.03	< 0.08 ± 0.04	0.8 ± 0.2
Sac. R.-Keswick	01/02/97	1/1	140 ± 0	13 ± 0	360 ± 30	513 ± 30	3.9 ± 0.0	0.2 ± 0.1	0.2 ± 0.0	4.3 ± 0.1
Sac. R.-Keswick	05/28/97	1/1	180 ± 10	14 ± 1	250 ± 0	444 ± 11	0.7 ± 0.0	< 0.07 ± 0.08	< 0.08 ± 0.14	0.8 ± 0.1
Sac. R.-Bend Br.	12/12/96	1/1	140 ± 0	10 ± 0	490 ± 10	640 ± 10	0.6 ± 0.1	< 0.07 ± 0.02	0.1 ± 0.3	0.8 ± 0.3
Sac. R.-Bend Br.	01/03/97	1/1	220 ± 0	14 ± 0	420 ± 0	654 ± 0	0.5 ± 0.1	< 0.07 ± 0.12	0.2 ± 0.1	0.8 ± 0.3
Sac. R.-Bend Br.	05/30/97	1/1	180 ± 0	12 ± 0	na	na	0.6 ± 0.1	< 0.07 ± 0.03	na	na
Sac. R.-Colusa	12/16/96	1/1	200 ± 10	11 ± 0	280 ± 0	491 ± 10	0.6 ± 0.1	< 0.08 ± 0.11	0.1 ± 0.3	0.9 ± 0.4
Sac. R.-Colusa	01/04/97	1/2	200 ± 0	10 ± 1	520 ± 0	730 ± 1	0.3 ± 0.1	< 0.05 ± 0.08	< 0.06 ± 0.03	0.4 ± 0.2
Sac. R.-Colusa	01/04/97	2/2	220 ± 10	16 ± 1	700 ± 20	936 ± 31	0.3 ± 0.1	< 0.07 ± 0.05	< 0.08 ± 0.06	0.4 ± 0.2
Sac. R.-Colusa	06/03/97	1/1	180 ± 0	10 ± 1	330 ± 0	520 ± 1	0.9 ± 0.0	< 0.07 ± 0.07	< 0.08 ± 0.10	1.0 ± 0.1
Sac. R.-Verona	06/04/97	1/1	170 ± 0	10 ± 0	280 ± 0	460 ± 0	0.7 ± 0.0	< 0.07 ± 0.08	0.07 ± 0.00	0.8 ± 0.1
Sac. R-Freeport	12/17/96	1/1	220 ± 0	15 ± 0	270 ± 0	505 ± 0	0.3 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.5 ± 0.2
Sac. R-Freeport	01/06/97	1/1	250 ± 0	20 ± 0	440 ± 0	710 ± 0	< 0.2 ± 0.0	< 0.07 ± 0.02	< 0.07 ± 0.04	< 0.3 ± 0.2
Sac. R-Freeport	06/05/97	1/1	180 ± 0	11 ± 0	220 ± 10	411 ± 10	0.6 ± 0.1	0.6 ± 0.6	0.2 ± 0.2	1.4 ± 0.9
Sac. R-Freeport, dup.	06/05/97	1/1	200 ± 3	10 ± 0	160 ± 0	370 ± 3	0.8 ± 0.6	0.1 ± 0.1	0.2 ± 0.2	1.1 ± 0.9
Spring Cr.-Road	01/02/97	1/1	5.3 ± 0.2	3.3 ± 0.3	230 ± 0	239 ± 1	< 0.4 ± 0.2	< 0.2 ± 0.1	0.2 ± 0.3	< 1 ± 0.6
Spring Cr.-Weir	05/28/97	1/1	16 ± 0	12 ± 3	83 ± 5	111 ± 8	< 0.9 ± 0.00	< 0.5 ± 0.6	< 0.6 ± 0.6	< 3 ± 1.3
Spring Creek Arm	05/28/97	1/1	140 ± 20	11 ± 1	190 ± 0	341 ± 21	0.7 ± 0.1	< 0.07 ± 0.16	0.09 ± 0.09	0.9 ± 0.3
Yolo Bypass	01/07/97	1/1	240 ± 0	14 ± 0	670 ± 40	924 ± 40	0.2 ± 0.0	< 0.07 ± 0.07	0.1 ± 0.0	0.4 ± 0.1
Colusa Basin Drain	06/06/97	1/1	290 ± 0	14 ± 0	360 ± 0	664 ± 0	0.4 ± 0.1	< 0.07 ± 0.00	< 0.08 ± 0.02	0.5 ± 0.2

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Calcium µg/g (dry weight)				Chromium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	7,200 ± 200	290 ± 0	690 ± 30	8,180 ± 230	10 ± 0.5	19 ± 3	130 ± 0	159 ± 4
Sac. R.-Keswick	01/02/97	1/1	4,200 ± 100	< 50 ± 12	1,200 ± 0	5,425 ± 125	10 ± 4	11 ± 1	92 ± 1	113 ± 6
Sac. R.-Keswick	05/28/97	1/1	5,400 ± 300	250 ± 40	2,400 ± 0	8,050 ± 340	16 ± 1	60 ± 8	320 ± 0	396 ± 9
Sac. R.-Bend Br.	12/12/96	1/1	3,900 ± 100	340 ± 10	4,800 ± 100	9,040 ± 210	24 ± 7	54 ± 5	230 ± 0	308 ± 12
Sac. R.-Bend Br.	01/03/97	1/1	5,800 ± 100	360 ± 20	4,300 ± 100	10,460 ± 220	22 ± 3	42 ± 5	190 ± 0	254 ± 8
Sac. R.-Bend Br.	05/30/97	1/1	5,400 ± 100	260 ± 0	na	na	19 ± 1	68 ± 0	na	na
Sac. R.-Colusa	12/16/96	1/1	4,600 ± 200	530 ± 60	4,400 ± 0	9,530 ± 260	11 ± 2	32 ± 2	140 ± 0	183 ± 4
Sac. R.-Colusa	01/04/97	1/2	5,100 ± 0	260 ± 20	4,700 ± 0	10,060 ± 20	10 ± 0	20 ± 9	170 ± 0	200 ± 9
Sac. R.-Colusa	01/04/97	2/2	5,900 ± 300	460 ± 40	6,100 ± 0	12,460 ± 340	6.1 ± 1.3	26 ± 2	190 ± 10	222 ± 13
Sac. R.-Colusa	06/03/97	1/1	5,200 ± 0	150 ± 60	3,600 ± 0	8,950 ± 60	14 ± 1	31 ± 10	200 ± 0	245 ± 11
Sac. R.-Verona	06/04/97	1/1	4,500 ± 0	180 ± 40	2,700 ± 0	7,380 ± 40	8.3 ± 0.9	25 ± 4	120 ± 0	153 ± 5
Sac. R-Freeport	12/17/96	1/1	6,000 ± 100	530 ± 0	6,000 ± 100	12,530 ± 200	11 ± 1	33 ± 3	200 ± 0	244 ± 4
Sac. R-Freeport	01/06/97	1/1	4,500 ± 200	390 ± 10	9,200 ± 0	14,090 ± 210	6.7 ± 2.0	16 ± 4	130 ± 0	153 ± 6
Sac. R-Freeport	06/05/97	1/1	4,900 ± 0	190 ± 60	2,800 ± 100	7,890 ± 160	9.3 ± 2.9	24 ± 6	120 ± 10	153 ± 19
Sac. R-Freeport, dup.	06/05/97	1/1	5,300 ± 90	140 ± 70	3,200 ± 0	8,640 ± 160	11 ± 3	20 ± 4	140 ± 0	171 ± 7
Spring Cr.-Road	01/02/97	1/1	< 100 ± 10	< 100 ± 10	820 ± 10	920 ± 110	9.4 ± 1.8	12 ± 10	31 ± 6	52 ± 18
Spring Cr.-Weir	05/28/97	1/1	< 400 ± 0	< 400 ± 200	< 1,000 ± 620	< 1,920 ± 960	< 30 ± 4	44 ± 39	< 50 ± 13	84 ± 79
Spring Creek Arm	05/28/97	1/1	3,100 ± 300	230 ± 20	4,300 ± 0	7630 ± 320	38 ± 2	150 ± 10	640 ± 0	828 ± 12
Yolo Bypass	01/07/97	1/1	5,600 ± 100	500 ± 130	4,500 ± 200	10,600 ± 430	9.1 ± 2.9	42 ± 15	200 ± 0	251 ± 18
Colusa Basin Drain	06/06/97	1/1	6,400 ± 0	310 ± 40	1,800 ± 0	8,510 ± 40	8.4 ± 1	27 ± 6	140 ± 10	175 ± 17

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C—035060

Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Cobalt µg/g (dry weight)				Copper µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	5.4 ± 0.1	3.1 ± 0.0	10 ± 1	19 ± 1	67 ± 1	12 ± 3	63 ± 0	142 ± 4
Sac. R.-Keswick	01/02/97	1/1	15 ± 0	2.1 ± 0.1	8.6 ± 0.4	26 ± 1	550 ± 10	67 ± 11	140 ± 0	757 ± 21
Sac. R.-Keswick	05/28/97	1/1	10 ± 0	4.8 ± 0.0	18 ± 2	33 ± 2	58 ± 4	15 ± 2	63 ± 1	136 ± 7
Sac. R.-Bend Br.	12/12/96	1/1	12 ± 0	4.2 ± 0.1	10 ± 1	26 ± 1	120 ± 0	25 ± 1	39 ± 0	184 ± 1
Sac. R.-Bend Br.	01/03/97	1/1	12 ± 1	3.9 ± 0.1	12 ± 0	28 ± 1	72 ± 2	18 ± 2	63 ± 1	153 ± 5
Sac. R.-Bend Br.	05/30/97	1/1	8.5 ± 0.1	5.9 ± 0.2	na	na	64 ± 1	18 ± 4	na	na
Sac. R.-Colusa	12/16/96	1/1	12 ± 1	3.4 ± 0.1	7.7 ± 1.0	23 ± 2	65 ± 3	18 ± 2	33 ± 0	116 ± 5
Sac. R.-Colusa	01/04/97	1/2	12 ± 0	2.9 ± 0.1	10 ± 0	25 ± 0	36 ± 3	9.7 ± 0.8	51 ± 0	97 ± 4
Sac. R.-Colusa	01/04/97	2/2	13 ± 0	4.0 ± 0.0	11 ± 1	28 ± 1	37 ± 2	18 ± 3	55 ± 1	110 ± 6
Sac. R.-Colusa	06/03/97	1/1	8.7 ± 0.3	3.4 ± 0.2	12 ± 0	24 ± 1	70 ± 1	12 ± 4	49 ± 1	131 ± 6
Sac. R.-Verona	06/04/97	1/1	7.4 ± 0.6	3.4 ± 0.1	8.8 ± 0.7	20 ± 1	46 ± 2	11 ± 2	34 ± 0	91 ± 4
Sac. R-Freeport	12/17/96	1/1	11 ± 0	4.5 ± 0.0	11 ± 1	27 ± 1	57 ± 4	17 ± 2	49 ± 0	123 ± 6
Sac. R-Freeport	01/06/97	1/1	11 ± 0	3.0 ± 0.1	13 ± 1	27 ± 1	29 ± 2	16 ± 3	65 ± 1	110 ± 6
Sac. R-Freeport	06/05/97	1/1	7.6 ± 0.7	3.4 ± 0.0	8.8 ± 1.0	20 ± 2	59 ± 2	14 ± 4	34 ± 1	107 ± 7
Sac. R-Freeport, dup.	06/05/97	1/1	8.5 ± 0.2	2.9 ± 0.0	10 ± 1	21 ± 1	66 ± 10	17 ± 6	44 ± 1	127 ± 17
Spring Cr.-Road	01/02/97	1/1	1.2 ± 0.1	0.8 ± 0.1	5.3 ± 0.8	7.3 ± 1.0	38 ± 4	37 ± 10	160 ± 0	235 ± 14
Spring Cr.-Weir	05/28/97	1/1	1.1 ± 0.0	1.6 ± 0.2	< 5 ± 2	5 ± 3	120 ± 0	36 ± 12	39 ± 1	195 ± 13
Spring Creek Arm	05/28/97	1/1	21 ± 0	11.0 ± 0.0	37 ± 0	69 ± 0	120 ± 1	25 ± 6	78 ± 0	223 ± 7
Yolo Bypass	01/07/97	1/1	11 ± 0	4.1 ± 0.1	13 ± 0	28 ± 0	42 ± 2	22 ± 1	67 ± 1	131 ± 4
Colusa Basin Drain	06/06/97	1/1	7.9 ± 0.0	3.7 ± 0.0	8.4 ± 0.5	20 ± 1	31 ± 5	9 ± 1	30 ± 0	70 ± 6

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C—035061

Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Iron µg/g (dry weight)				Lead µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	5,800 ± 200	7,400 ± 1,000	60,000 ± 1,000	73,200 ± 2,200	5.8 ± 0.2	1.9 ± 0.3	4.1 ± 0.4	12 ± 1
Sac. R.-Keswick	01/02/97	1/1	20,000 ± 0	6,800 ± 400	56,000 ± 1,000	82,800 ± 1,400	18 ± 0	2.7 ± 0.1	21 ± 1	42 ± 1
Sac. R.-Keswick	05/28/97	1/1	6,400 ± 300	8,200 ± 700	61,000 ± 1,000	75,600 ± 2,000	4.6 ± 0.2	1.5 ± 0.2	3.7 ± 0.1	10 ± 1
Sac. R.-Bend Br.	12/12/96	1/1	6,100 ± 100	6,800 ± 400	48,000 ± 1,000	60,900 ± 1,500	8.5 ± 0.3	2.1 ± 0.2	7.6 ± 1.5	18 ± 2
Sac. R.-Bend Br.	01/03/97	1/1	8,500 ± 200	8,400 ± 300	60,000 ± 1,000	76,900 ± 1,500	12 ± 2	2.5 ± 0.2	8.0 ± 0.1	23 ± 2
Sac. R.-Bend Br.	05/30/97	1/1	8,400 ± 100	8,600 ± 1,000	na	na	8.5 ± 0.2	1.7 ± 0.3	na	na
Sac. R.-Colusa	12/16/96	1/1	7,100 ± 300	7,900 ± 700	41,000 ± 0	56,000 ± 1,000	11 ± 3	1.9 ± 0.3	3.9 ± 0.3	17 ± 4
Sac. R.-Colusa	01/04/97	1/2	7,500 ± 100	5,400 ± 400	56,000 ± 0	68,900 ± 500	9.0 ± 0.2	1.9 ± 0.1	5.2 ± 0.2	16 ± 1
Sac. R.-Colusa	01/04/97	2/2	6,200 ± 300	9,000 ± 200	64,000 ± 0	79,200 ± 500	9.1 ± 0.2	3.2 ± 0.3	5.9 ± 0.2	18 ± 1
Sac. R.-Colusa	06/03/97	1/1	10,000 ± 0	4,900 ± 1,000	49,000 ± 0	63,900 ± 1,000	11 ± 0	1.0 ± 0.0	2.8 ± 0.5	15 ± 1
Sac. R.-Verona	06/04/97	1/1	7,000 ± 100	6,100 ± 600	40,000 ± 1,000	53,100 ± 1,700	14 ± 4	1.5 ± 0.3	3.1 ± 0.3	19 ± 5
Sac. R-Freeport	12/17/96	1/1	9,600 ± 0	8,300 ± 800	56,000 ± 1,000	73,900 ± 1,800	14 ± 1	3.0 ± 0.3	6.6 ± 0.5	24 ± 2
Sac. R-Freeport	01/06/97	1/1	6,400 ± 200	7,500 ± 800	57,000 ± 0	70,900 ± 1,000	12 ± 0	3.6 ± 0.1	12 ± 0	28 ± 0
Sac. R-Freeport	06/05/97	1/1	8,100 ± 200	6,200 ± 1,000	39,000 ± 0	53,300 ± 1,200	13 ± 0	2.1 ± 0.8	3.3 ± 0.2	18 ± 1
Sac. R-Freeport, dup.	06/05/97	1/1	10,000 ± 10,000	4,900 ± 1,200	47,000 ± 0	61,900 ± 11,200	13 ± 3	1.2 ± 0.2	3.2 ± 0.2	17 ± 3
Spring Cr.-Road	01/02/97	1/1	120,000 ± 0	24,000 ± 0	60,000 ± 0	204,000 ± 0	13 ± 1	1.7 ± 0.5	27 ± 1	42 ± 3
Spring Cr.-Weir	05/28/97	1/1	280,000 ± 100	29,000 ± 6,000	15,000 ± 0	324,000 ± 6,100	66 ± 0	1.5 ± 0.9	4.4 ± 0.8	72 ± 2
Spring Creek Arm	05/28/97	1/1	8,800 ± 200	10,000 ± 1,000	72,000 ± 0	90,800 ± 1,200	4.1 ± 0.3	1.0 ± 0.2	2.6 ± 0.3	7.7 ± 0.8
Yolo Bypass	01/07/97	1/1	7,000 ± 0	8,500 ± 1,300	65,000 ± 0	80,500 ± 1,300	10 ± 0	2.5 ± 0.3	7.7 ± 0.2	20 ± 1
Colusa Basin Drain	06/06/97	1/1	6,000 ± 0	6,800 ± 200	49,000 ± 0	61,800 ± 200	9.5 ± 0	0.9 ± 0.5	3.6 ± 0.2	14 ± 1

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Lithium µg/g (dry weight)				Magnesium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	2.3 ± 0.4	7.1 ± 0.0	27 ± 2	36 ± 2	3,200 ± 100	3,700 ± 100	2,000 ± 100	8,900 ± 300
Sac. R.-Keswick	01/02/97	1/1	1.3 ± 0.3	3.4 ± 0.2	20 ± 2	25 ± 3	1,700 ± 0	2,400 ± 0	6,200 ± 500	10,300 ± 500
Sac. R.-Keswick	05/28/97	1/1	2.3 ± 0.5	5.1 ± 0.3	28 ± 1	35 ± 2	3,900 ± 200	7,200 ± 600	23,000 ± 0	34,100 ± 800
Sac. R.-Bend Br.	12/12/96	1/1	2.8 ± 0.6	6.5 ± 0.3	36 ± 2	45 ± 3	3,000 ± 100	5,900 ± 200	24,000 ± 0	32,900 ± 300
Sac. R.-Bend Br.	01/03/97	1/1	3.1 ± 0.7	8.3 ± 0.0	42 ± 6	53 ± 7	3,100 ± 0	4,100 ± 100	14,000 ± 0	21,200 ± 100
Sac. R.-Bend Br.	05/30/97	1/1	1.9 ± 0.3	6.0 ± 0.2	na	na	4,100 ± 100	7,900 ± 0	na	na
Sac. R.-Colusa	12/16/96	1/1	2.4 ± 0.7	6.1 ± 0.4	34 ± 6	43 ± 7	2,400 ± 100	3,800 ± 100	13,000 ± 0	19,200 ± 200
Sac. R.-Colusa	01/04/97	1/2	2.5 ± 0.0	6.1 ± 0.2	47 ± 0	56 ± 0	2,700 ± 0	2,200 ± 100	14,000 ± 0	18,900 ± 100
Sac. R.-Colusa	01/04/97	2/2	2.4 ± 0.0	8.4 ± 0.4	54 ± 3	65 ± 3	2,500 ± 100	3,500 ± 100	20,000 ± 0	26,000 ± 200
Sac. R.-Colusa	06/03/97	1/1	1.8 ± 0.0	5.2 ± 0.0	31 ± 2	38 ± 2	3,600 ± 100	4,000 ± 800	16,000 ± 0	23,600 ± 900
Sac. R.-Verona	06/04/97	1/1	1.4 ± 0.1	6.0 ± 0.4	29 ± 1	36 ± 2	2,400 ± 0	3,200 ± 100	10,000 ± 0	15,600 ± 100
Sac. R-Freeport	12/17/96	1/1	2.0 ± 0.2	5.9 ± 0.3	38 ± 2	46 ± 3	2,700 ± 100	3,900 ± 0	12,000 ± 0	18,600 ± 100
Sac. R-Freeport	01/06/97	1/1	2.3 ± 0.5	4.1 ± 0.2	31 ± 2	37 ± 3	1,700 ± 0	1,900 ± 200	8,500 ± 100	12,100 ± 300
Sac. R-Freeport	06/05/97	1/1	1.7 ± 0.1	6.4 ± 0.6	26 ± 1	34 ± 2	2,600 ± 0	3,000 ± 500	7,900 ± 0	13,500 ± 500
Sac. R-Freeport, dup.	06/05/97	1/1	2.3 ± 1.3	5.0 ± 0.6	33 ± 0	40 ± 2	3,300 ± 70	2,600 ± 600	7,200 ± 0	13,100 ± 670
Spring Cr.-Road	01/02/97	1/1	< 0.7 ± 0.1	1.4 ± 0.6	9.5 ± 1.4	11 ± 2	340 ± 0	1,100 ± 200	11,000 ± 0	12,440 ± 200
Spring Cr.-Weir	05/28/97	1/1	< 2 ± 0	4.3 ± 3.1	< 8 ± 1	9 ± 8	98 ± 0	1,700 ± 300	2,700 ± 300	4,498 ± 600
Spring Creek Arm	05/28/97	1/1	1.8 ± 0.0	5.6 ± 0.3	25 ± 1	32 ± 1	6,300 ± 0	15,000 ± 0	46,000 ± 1,000	67,300 ± 1,000
Yolo Bypass	01/07/97	1/1	2.9 ± 0.2	8.2 ± 0.7	51 ± 2	62 ± 3	2,700 ± 0	3,800 ± 700	17,000 ± 0	23,500 ± 700
Colusa Basin Drain	06/06/97	1/1	2.7 ± 0.2	9.7 ± 1.2	51 ± 0	63 ± 1	3,600 ± 0	3,600 ± 300	13,000 ± 0	20,200 ± 300

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Manganese µg/g (dry weight)				Mercury µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	300 ± 0	55 ± 3	190 ± 10	545 ± 13	< 0.05 ± 0.02	< 0.09 ± 0.04	< 0.05 ± 0.02	< 0.2 ± 0.1
Sac. R.-Keswick	01/02/97	1/1	730 ± 0	41 ± 2	330 ± 40	1,101 ± 42	< 0.05 ± 0.03	< 0.08 ± 0.05	0.2 ± 0.1	0.3 ± 0.2
Sac. R.-Keswick	05/28/97	1/1	370 ± 0	49 ± 2	230 ± 20	649 ± 22	< 0.05 ± 0.02	< 0.09 ± 0.08	< 0.04 ± 0.06	< 0.3 ± 0.1
Sac. R.-Bend Br.	12/12/96	1/1	630 ± 0	33 ± 1	510 ± 60	1,173 ± 61	< 0.05 ± 0.02	< 0.09 ± 0.17	< 0.05 ± 0.02	< 0.3 ± 0.2
Sac. R.-Bend Br.	01/03/97	1/1	590 ± 20	36 ± 2	570 ± 10	1,196 ± 32	< 0.05 ± 0.01	< 0.09 ± 0.03	< 0.04 ± 0.01	< 0.2 ± 0.1
Sac. R.-Bend Br.	05/30/97	1/1	340 ± 10	32 ± 2	na	na	< 0.05 ± 0.02	< 0.08 ± 0.02	na	na
Sac. R.-Colusa	12/16/96	1/1	730 ± 30	29 ± 1	370 ± 40	1,129 ± 71	< 0.05 ± 0.03	< 0.09 ± 0.03	< 0.05 ± 0.02	< 0.2 ± 0.1
Sac. R.-Colusa	01/04/97	1/2	470 ± 20	29 ± 1	510 ± 10	1,009 ± 31	< 0.04 ± 0.00	< 0.07 ± 0.05	0.07 ± 0.00	0.1 ± 0.1
Sac. R.-Colusa	01/04/97	2/2	500 ± 0	38 ± 1	580 ± 30	1,118 ± 31	< 0.05 ± 0.01	< 0.09 ± 0.05	< 0.04 ± 0.02	< 0.2 ± 0.1
Sac. R.-Colusa	06/03/97	1/1	670 ± 10	33 ± 0	240 ± 30	943 ± 40	< 0.05 ± 0.02	0.09 ± 0.22	0.06 ± 0.00	0.2 ± 0.2
Sac. R.-Verona	06/04/97	1/1	700 ± 0	26 ± 1	240 ± 10	966 ± 11	< 0.05 ± 0.02	< 0.08 ± 0.03	< 0.04 ± 0.00	< 0.2 ± 0.1
Sac. R-Freeport	12/17/96	1/1	990 ± 0	120 ± 0	350 ± 40	1,460 ± 40	< 0.05 ± 0.01	< 0.09 ± 0.00	0.05 ± 0.02	0.1 ± 0.1
Sac. R-Freeport	01/06/97	1/1	710 ± 0	37 ± 1	420 ± 40	1,167 ± 41	< 0.05 ± 0.03	< 0.08 ± 0.03	< 0.04 ± 0.03	< 0.2 ± 0.1
Sac. R-Freeport	06/05/97	1/1	860 ± 10	28 ± 1	240 ± 20	1,128 ± 31	< 0.05 ± 0.01	< 0.09 ± 0.06	< 0.04 ± 0.06	< 0.2 ± 0.1
Sac. R-Freeport, dup.	06/05/97	1/1	920 ± 24	27 ± 3	260 ± 20	1,207 ± 47	< 0.05 ± 0.20	< 0.08 ± 0.06	0.1 ± 0.02	0.3 ± 0.2
Spring Cr.-Road	01/02/97	1/1	74 ± 3	25 ± 4	190 ± 10	289 ± 17	< 0.1 ± 0.0	0.7 ± 0.3	0.2 ± 0.10	1.0 ± 0.5
Spring Cr.-Weir	05/28/97	1/1	68 ± 10	72 ± 15	56 ± 3	196 ± 28	< 0.4 ± 0.02	< 0.6 ± 0.7	< 0.3 ± 0.2	< 2 ± 0.9
Spring Creek Arm	05/28/97	1/1	610 ± 50	34 ± 1	340 ± 20	984 ± 71	< 0.05 ± 0.01	< 0.09 ± 0.07	< 0.04 ± 0.03	< 0.2 ± 0.1
Yolo Bypass	01/07/97	1/1	540 ± 0	32 ± 2	520 ± 20	1,092 ± 22	< 0.05 ± 0.02	< 0.09 ± 0.01	< 0.04 ± 0.03	< 0.2 ± 0.1
Colusa Basin Drain	06/06/97	1/1	1,000 ± 10	26 ± 1	310 ± 20	1,336 ± 31	< 0.05 ± 0.02	< 0.09 ± 0.05	0.05 ± 0.06	< 0.3 ± 0.1

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Nickel µg/g (dry weight)				Silica (as SiO_2) µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	32 ± 1	53 ± 1	140 ± 10	225 ± 12	12,000 ± 0	19,000 ± 0	490,000 ± 10,000	521,000 ± 10,000
Sac. R.-Keswick	01/02/97	1/1	14 ± 1	14 ± 2	64 ± 1	92 ± 4	11,000 ± 0	9,200 ± 1,100	460,000 ± 20000	480,200 ± 21,100
Sac. R.-Keswick	05/28/97	1/1	99 ± 2	160 ± 0	510 ± 30	769 ± 32	8,900 ± 100	14,000 ± 0	420,000 ± 10000	442,900 ± 10,100
Sac. R.-Bend Br.	12/12/96	1/1	39 ± 0	46 ± 2	120 ± 0	205 ± 2	7,000 ± 300	10,000 ± 400	510,000 ± 10000	527,000 ± 10,700
Sac. R.-Bend Br.	01/03/97	1/1	26 ± 1	32 ± 1	100 ± 0	158 ± 2	7,300 ± 100	11,000 ± 0	510,000 ± 10000	528,300 ± 10,100
Sac. R.-Bend Br.	05/30/97	1/1	97 ± 4	200 ± 10	na	na	12,000 ± 0	17,000 ± 0	na	na
Sac. R.-Colusa	12/16/96	1/1	26 ± 0	30 ± 1	69 ± 6	125 ± 7	6,600 ± 200	11,000 ± 1,000	440,000 ± 10000	457,600 ± 11,200
Sac. R.-Colusa	01/04/97	1/2	20 ± 0	20 ± 0	84 ± 1	124 ± 1	6,500 ± 0	6,900 ± 600	470,000 ± 10000	483,400 ± 10,600
Sac. R.-Colusa	01/04/97	2/2	19 ± 1	26 ± 1	91 ± 3	136 ± 5	5,900 ± 300	12,000 ± 1,000	540,000 ± 0	557,900 ± 1,300
Sac. R.-Colusa	06/03/97	1/1	69 ± 6	91 ± 2	260 ± 10	420 ± 18	9,100 ± 100	11,000 ± 0	460,000 ± 50000	480,100 ± 50,100
Sac. R.-Verona	06/04/97	1/1	26 ± 1	52 ± 0	130 ± 0	208 ± 1	7,300 ± 100	12,000 ± 1,000	340,000 ± 10000	359,300 ± 11,100
Sac. R-Freeport	12/17/96	1/1	25 ± 1	34 ± 0	100 ± 10	159 ± 11	8,100 ± 100	12,000 ± 1,000	540,000 ± 20000	560,100 ± 21,100
Sac. R-Freeport	01/06/97	1/1	14 ± 0	20 ± 1	82 ± 8	116 ± 9	8,600 ± 100	10,000 ± 1,000	500,000 ± 10000	518,600 ± 11,100
Sac. R-Freeport	06/05/97	1/1	25 ± 1	46 ± 0	110 ± 10	181 ± 11	6,800 ± 0	11,000 ± 2,000	390,000 ± 10000	407,800 ± 12,000
Sac. R-Freeport, dup.	06/05/97	1/1	38 ± 0.9	44 ± 3	140 ± 10	222 ± 14	11,000 ± 400	10,000 ± 2,000	450,000 ± 20000	471,000 ± 22,400
Spring Cr.-Road	01/02/97	1/1	< 1 ± 0	< 7 ± 2	< 30 ± 10	< 38 ± 19	3,300 ± 300	6,600 ± 1,300	310,000 ± 20000	319,900 ± 21,600
Spring Cr.-Weir	05/28/97	1/1	< 3 ± 10	< 20 ± 10	< 100 ± 30	< 130 ± 66	7,700 ± 0	22,000 ± 2,000	< 500,000 ± 40000	279,700 ± 252,000
Spring Creek Arm	05/28/97	1/1	250 ± 0	450 ± 0	1,300 ± 0	2,000 ± 0	13,000 ± 100	16,000 ± 0	400,000 ± 10000	429,000 ± 10,100
Yolo Bypass	01/07/97	1/1	24 ± 1	34 ± 1	120 ± 0	178 ± 2	6,100 ± 0	12,000 ± 2,000	480,000 ± 20000	498,100 ± 22,000
Colusa Basin Drain	06/06/97	1/1	16 ± 0	38 ± 0	87 ± 1	141 ± 1	5,500 ± 0	15,000 ± 2,000	400,000 ± 10000	420,500 ± 12,000

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Strontium µg/g (dry weight)				Thallium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	40 ± 1	3.4 ± 0.1	9 ± 0	53 ± 1	0.04 ± 0.01	< 0.04 ± 0.00	0.3 ± 0.0	0.4 ± 0.0
Sac. R.-Keswick	01/02/97	1/1	24 ± 1	1.3 ± 0.2	14 ± 1	39 ± 2	0.05 ± 0.01	< 0.03 ± 0.01	0.6 ± 0.0	0.7 ± 0.0
Sac. R.-Keswick	05/28/97	1/1	30 ± 1	2.0 ± 0	29 ± 1	61 ± 2	0.03 ± 0.01	< 0.03 ± 0.01	0.2 ± 0.0	0.2 ± 0.0
Sac. R.-Bend Br.	12/12/96	1/1	24 ± 1	2.0 ± 0.1	48 ± 4	74 ± 5	0.03 ± 0.02	< 0.03 ± 0.00	0.4 ± 0.0	0.4 ± 0.0
Sac. R.-Bend Br.	01/03/97	1/1	39 ± 1	2.9 ± 0.2	50 ± 2	92 ± 3	0.04 ± 0.01	< 0.04 ± 0.01	0.5 ± 0.0	0.6 ± 0.0
Sac. R.-Bend Br.	05/30/97	1/1	30 ± 0	2.5 ± 0.2	na	na	0.03 ± 0.01	< 0.03 ± 0.01	na	na
Sac. R.-Colusa	12/16/96	1/1	34 ± 1	2.7 ± 0	47 ± 1	84 ± 2	0.03 ± 0.01	< 0.04 ± 0.01	0.3 ± 0.0	0.4 ± 0.0
Sac. R.-Colusa	01/04/97	1/2	46 ± 0	2.8 ± 0.1	49 ± 2	98 ± 2	0.03 ± 0.01	< 0.03 ± 0.01	0.5 ± 0.0	0.5 ± 0.0
Sac. R.-Colusa	01/04/97	2/2	50 ± 1	4.0 ± 0.2	69 ± 1	123 ± 2	0.09 ± 0.01	< 0.03 ± 0.01	0.5 ± 0.0	0.6 ± 0.0
Sac. R.-Colusa	06/03/97	1/1	35 ± 3	2.4 ± 0	46 ± 2	83 ± 5	< 0.02 ± 0.01	< 0.03 ± 0.00	0.2 ± 0.1	0.2 ± 0.1
Sac. R.-Verona	06/04/97	1/1	33 ± 1	2.3 ± 0.3	37 ± 0	72 ± 1	< 0.02 ± 0.01	< 0.03 ± 0.01	0.3 ± 0.0	0.3 ± 0.0
Sac. R-Freeport	12/17/96	1/1	40 ± 0	3.9 ± 0.3	53 ± 3	97 ± 3	0.03 ± 0.01	< 0.04 ± 0.00	0.4 ± 0.0	0.5 ± 0.0
Sac. R-Freeport	01/06/97	1/1	35 ± 1	5.9 ± 0.5	94 ± 2	135 ± 4	0.05 ± 0.01	< 0.03 ± 0.00	0.5 ± 0.0	0.6 ± 0.0
Sac. R-Freeport	06/05/97	1/1	34 ± 0	2.3 ± 0.1	33 ± 1	69 ± 1	< 0.02 ± 0	< 0.03 ± 0.00	0.3 ± 0.0	0.3 ± 0.0
Sac. R-Freeport, dup.	06/05/97	1/1	42 ± 1	2.3 ± 0.2	38 ± 1	82 ± 2	< 0.02 ± 0.1	< 0.03 ± 0.01	0.3 ± 0.0	0.4 ± 0.1
Spring Cr.-Road	01/02/97	1/1	< 1 ± 0	< 0.4 ± 0.4	14 ± 1	15 ± 2	< 0.05 ± 0.01	< 0.08 ± 0.02	0.4 ± 0.0	0.5 ± 0.1
Spring Cr.-Weir	05/28/97	1/1	< 4 ± 0	< 1 ± 0	< 5 ± 0	< 10 ± 5	< 0.2 ± 0	< 0.3 ± 0.0	< 0.2 ± 0.1	< 0.7 ± 0.4
Spring Creek Arm	05/28/97	1/1	18 ± 0	1.5 ± 0.1	26 ± 1	46 ± 1	0.03 ± 0.01	< 0.03 ± 0.00	0.2 ± 0.0	0.2 ± 0.0
Yolo Bypass	01/07/97	1/1	49 ± 1	3.3 ± 0.2	50 ± 1	102 ± 2	0.03 ± 0.01	< 0.03 ± 0.00	0.6 ± 0.0	0.6 ± 0.0
Colusa Basin Drain	06/06/97	1/1	71 ± 2	3.0 ± 0.2	36 ± 0	110 ± 2	< 0.02 ± 0.01	< 0.03 ± 0.00	0.3 ± 0.0	0.3 ± 0.0

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Thorium µg/g (dry weight)				Titanium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	< 0.01 ± 0.00	1.8 ± 0.0	0.5 ± 0.0	2.3 ± 0.0	21 ± 2	120 ± 0	4,300 ± 100	4,441 ± 102
Sac. R.-Keswick	01/02/97	1/1	< 0.01 ± 0.00	0.9 ± 0.0	0.7 ± 0.0	1.6 ± 0.0	7 ± 0	40 ± 4	3,300 ± 0	3,347 ± 4
Sac. R.-Keswick	05/28/97	1/1	< 0.01 ± 0.00	1.6 ± 0.0	2.3 ± 0.1	3.9 ± 0.1	20 ± 1	82 ± 1	3,400 ± 100	3,502 ± 102
Sac. R.-Bend Br.	12/12/96	1/1	< 0.01 ± 0.00	1.4 ± 0.0	3.7 ± 0.3	5.1 ± 0.3	11 ± 1	52 ± 3	3,500 ± 100	3,563 ± 104
Sac. R.-Bend Br.	01/03/97	1/1	0.03 ± 0.00	2.5 ± 0.1	2.9 ± 0.2	5.4 ± 0.3	18 ± 2	58 ± 3	4,500 ± 100	4,576 ± 105
Sac. R.-Bend Br.	05/30/97	1/1	< 0.01 ± 0.00	1.6 ± 0.0	na	na	23 ± 0	83 ± 0	na	na
Sac. R.-Colusa	12/16/96	1/1	< 0.01 ± 0.00	1.4 ± 0.1	2.0 ± 0.1	3.4 ± 0.2	13 ± 1	61 ± 3	3,600 ± 0	3,674 ± 4
Sac. R.-Colusa	01/04/97	1/2	< 0.01 ± 0.00	2.0 ± 0.1	3.7 ± 0.0	5.7 ± 0.1	18 ± 2	42 ± 3	4,900 ± 0	4,960 ± 5
Sac. R.-Colusa	01/04/97	2/2	0.01 ± 0.00	2.4 ± 0.0	3.9 ± 0.2	6.3 ± 0.2	17 ± 2	74 ± 4	5,500 ± 0	5,591 ± 6
Sac. R.-Colusa	06/03/97	1/1	< 0.01 ± 0.00	0.9 ± 0.1	3.6 ± 0.1	4.5 ± 0.2	17 ± 0	54 ± 0	3,700 ± 0	3,771 ± 0
Sac. R.-Verona	06/04/97	1/1	< 0.01 ± 0.00	1.4 ± 0.1	2.8 ± 0.1	4.2 ± 0.2	13 ± 1	48 ± 3	3,300 ± 0	3,361 ± 4
Sac. R-Freeport	12/17/96	1/1	< 0.01 ± 0.00	2.2 ± 0.1	2.7 ± 0.0	4.9 ± 0.1	13 ± 1	50 ± 5	4,900 ± 0	4,963 ± 6
Sac. R-Freeport	01/06/97	1/1	0.07 ± 0.01	7.7 ± 0.1	5.8 ± 0.1	14 ± 0	49 ± 1	150 ± 10	4,700 ± 0	4,899 ± 11
Sac. R-Freeport	06/05/97	1/1	< 0.01 ± 0.00	1.4 ± 0.1	2.1 ± 0.3	3.5 ± 0.4	16 ± 1	51 ± 7	3,400 ± 0	3,467 ± 8
Sac. R-Freeport, dup.	06/05/97	1/1	< 0.01 ± 0.05	1.5 ± 0.0	1.7 ± 0.1	3.2 ± 0.1	20 ± 9	43 ± 7	3,900 ± 0	3,963 ± 16
Spring Cr.-Road	01/02/97	1/1	0.05 ± 0.02	0.5 ± 0.1	0.9 ± 0.1	1.5 ± 0.2	47 ± 2	66 ± 5	1,800 ± 0	1,913 ± 7
Spring Cr.-Weir	05/28/97	1/1	< 0.1 ± 0.0	0.6 ± 0.2	0.4 ± 0.1	1.1 ± 0.4	< 7 ± 1	220 ± 10	380 ± 50	604 ± 64
Spring Creek Arm	05/28/97	1/1	< 0.01 ± 0.00	1.7 ± 0.0	2.0 ± 0.1	3.7 ± 0.1	16 ± 1	68 ± 2	2,200 ± 100	2,284 ± 103
Yolo Bypass	01/07/97	1/1	0.01 ± 0.01	2.5 ± 0.0	5.0 ± 0.1	7.5 ± 0.1	19 ± 1	75 ± 14	5,400 ± 0	5,494 ± 15
Colusa Basin Drain	06/06/97	1/1	< 0.01 ± 0.00	1.9 ± 0.0	3.8 ± 0.0	5.7 ± 0.0	9 ± 1	34 ± 1	4,000 ± 0	4,043 ± 2

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Uranium µg/g (dry weight)				Vanadium µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum	Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	0.7 ± 0.0	0.4 ± 0.0	1.0 ± 0.1	2.1 ± 0.1	31 ± 1	12 ± 1	130 ± 0	173 ± 2
Sac. R.-Keswick	01/02/97	1/1	0.6 ± 0.1	0.4 ± 0.0	1.6 ± 0.1	2.6 ± 0.2	67 ± 3	10 ± 0	260 ± 0	337 ± 3
Sac. R.-Keswick	05/28/97	1/1	0.7 ± 0.0	0.4 ± 0.0	0.9 ± 0.1	2.0 ± 0.1	30 ± 2	10 ± 0	130 ± 0	170 ± 2
Sac. R.-Bend Br.	12/12/96	1/1	0.3 ± 0.0	0.2 ± 0.0	1.6 ± 0.0	2.1 ± 0.0	19 ± 2	6.3 ± 0.2	150 ± 0	175 ± 2
Sac. R.-Bend Br.	01/03/97	1/1	0.5 ± 0.0	0.3 ± 0.0	2.4 ± 0.1	3.2 ± 0.1	26 ± 2	8.0 ± 0.3	210 ± 0	244 ± 2
Sac. R.-Bend Br.	05/30/97	1/1	0.5 ± 0.0	0.3 ± 0.0	na	na	33 ± 2	11 ± 0	na	na
Sac. R.-Colusa	12/16/96	1/1	0.3 ± 0.0	0.2 ± 0.0	1.4 ± 0.0	1.9 ± 0.0	24 ± 2	8.2 ± 0.3	140 ± 0	172 ± 2
Sac. R.-Colusa	01/04/97	1/2	0.4 ± 0.0	0.2 ± 0.0	2.1 ± 0.1	2.7 ± 0.1	22 ± 1	4.9 ± 0.1	210 ± 0	237 ± 1
Sac. R.-Colusa	01/04/97	2/2	0.4 ± 0.0	0.3 ± 0.0	2.2 ± 0.0	2.9 ± 0.0	18 ± 2	8.4 ± 0.4	230 ± 0	256 ± 2
Sac. R.-Colusa	06/03/97	1/1	0.3 ± 0.0	0.4 ± 0.0	1.1 ± 0.0	1.8 ± 0.0	38 ± 2	5.2 ± 0.1	130 ± 0	173 ± 2
Sac. R.-Verona	06/04/97	1/1	0.4 ± 0.0	0.4 ± 0.0	1.1 ± 0.0	1.9 ± 0.0	26 ± 2	6.5 ± 0.6	110 ± 0	143 ± 3
Sac. R-Freeport	12/17/96	1/1	0.6 ± 0.0	0.4 ± 0.0	1.8 ± 0.1	2.8 ± 0.1	33 ± 3	7.8 ± 0	180 ± 0	221 ± 3
Sac. R-Freeport	01/06/97	1/1	1.5 ± 0.0	1.3 ± 0.1	2.8 ± 0.1	5.6 ± 0.2	21 ± 2	11 ± 0	150 ± 0	182 ± 2
Sac. R-Freeport	06/05/97	1/1	0.5 ± 0.0	0.4 ± 0.0	1.0 ± 0.0	1.9 ± 0.0	26 ± 1	7.1 ± 0.2	110 ± 0	143 ± 1
Sac. R-Freeport, dup.	06/05/97	1/1	0.6 ± 0.3	0.5 ± 0.0	1.3 ± 0.1	2.4 ± 0.4	36 ± 4	5.7 ± 0.6	130 ± 0	172 ± 5
Spring Cr.-Road	01/02/97	1/1	0.1 ± 0.0	0.1 ± 0.0	0.4 ± 0.1	0.6 ± 0.1	42 ± 1	9.4 ± 1.3	87 ± 2	138 ± 4
Spring Cr.-Weir	05/28/97	1/1	0.3 ± 0.0	0.2 ± 0.1	< 0.5 ± 0.1	0.8 ± 0.4	49 ± 1	< 8 ± 1	< 20 ± 6	63 ± 15
Spring Creek Arm	05/28/97	1/1	0.7 ± 0.0	0.3 ± 0.1	0.7 ± 0.0	1.7 ± 0.1	26 ± 2	11 ± 0	130 ± 0	167 ± 2
Yolo Bypass	01/07/97	1/1	0.6 ± 0.0	0.3 ± 0.0	2.3 ± 0.0	3.2 ± 0.0	28 ± 2	9.2 ± 0.1	240 ± 0	277 ± 2
Colusa Basin Drain	06/06/97	1/1	0.1 ± 0.0	0.1 ± 0.0	1.4 ± 0.0	1.6 ± 0.0	17 ± 2	4.4 ± 0.1	150 ± 0	171 ± 2

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Table A5-3. Concentrations of selected elements in sequentially extracted suspended colloid samples—*Continued*

Site	Date (mm/dd/yy)	Split replicate	Zinc µg/g (dry weight)			
			Reducible	Oxidizable	Residual	Sum
Sac. R.-Shasta	05/29/97	1/1	160 ± 0	26 ± 3	100 ± 10	286 ± 13
Sac. R.-Keswick	01/02/97	1/1	750 ± 20	100 ± 10	230 ± 40	1,080 ± 70
Sac. R.-Keswick	05/28/97	1/1	220 ± 0	28 ± 2	98 ± 6	346 ± 8
Sac. R.-Bend Br.	12/12/96	1/1	220 ± 0	33 ± 4	86 ± 10	339 ± 14
Sac. R.-Bend Br.	01/03/97	1/1	99 ± 3	28 ± 2	110 ± 0	237 ± 5
Sac. R.-Bend Br.	05/30/97	1/1	210 ± 0	40 ± 10	na	na
Sac. R.-Colusa	12/16/96	1/1	100 ± 5	25 ± 2	73 ± 6	198 ± 13
Sac. R.-Colusa	01/04/97	1/2	36 ± 1	18 ± 3	96 ± 2	150 ± 6
Sac. R.-Colusa	01/04/97	2/2	36 ± 1	19 ± 2	110 ± 0	165 ± 3
Sac. R.-Colusa	06/03/97	1/1	140 ± 10	19 ± 3	79 ± 30	238 ± 43
Sac. R.-Verona	06/04/97	1/1	70 ± 3	26 ± 4	63 ± 5	159 ± 12
Sac. R-Freeport	12/17/96	1/1	76 ± 2	24 ± 3	84 ± 6	184 ± 11
Sac. R-Freeport	01/06/97	1/1	22 ± 1	15 ± 2	86 ± 13	123 ± 16
Sac. R-Freeport	06/05/97	1/1	77 ± 5	29 ± 5	110 ± 3	216 ± 13
Sac. R-Freeport, dup.	06/05/97	1/1	86 ± 5	20 ± 3	76 ± 5	182 ± 13
Spring Cr.-Road	01/02/97	1/1	< 9 ± 0	24 ± 10	65 ± 5	94 ± 20
Spring Cr.-Weir	05/28/97	1/1	< 30 ± 0	< 60 ± 9	21 ± 4	66 ± 49
Spring Creek Arm	05/28/97	1/1	200 ± 2	32 ± 1	76 ± 2	308 ± 5
Yolo Bypass	01/07/97	1/1	40 ± 2	21 ± 0	120 ± 10	181 ± 12
Colusa Basin Drain	06/06/97	1/1	26 ± 3	24 ± 4	88 ± 2	138 ± 9

C-035070
C—035069

Appendix 6. Particulate Size Distribution in Colloid and Sediment Samples

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry.

Table A6-2. Particulate size distribution of streambed sediment samples.

C —0 3 5 0 7 0

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Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry

[All samples analyzed at 90° goniometer setting. Br., Bridge; Cr., Creek; d, diameter; nm, namometer; RMS, root mean squared; R., River; Sac., Sacramento. % <, percent less than]

Sac. R.–Shasta		Sac. R.–Keswick		Sac. R.–Bend Br.		Sac. R.–Colusa		Sac. R.–Verona		Spring Cr. arm	
July 1996		July 1996		July 1996		July 1996		July 1996		July 1996	
Mean (nm): 323.		Mean (nm): 222.		Mean (nm): 462.		Mean (nm): 326.		Mean (nm): 671.		Mean (nm): 466.	
Variance: 2.326		Variance: 3.03		Variance: 6.115		Variance: 4.696		Variance: 5.893		Variance: 1.67	
Skew: 4.106		Skew: 4.178		Skew: 5.07		Skew: 5.239		Skew: 4.439		Skew: 6.817	
RMS: 0.005		RMS: 0.00697		RMS: 0.00566		RMS: 0.00609		RMS: 0.00713		RMS: 0.00553	
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
118	14	35	0	102	14	67	2	128	15	183	12
144	28	42	5	134	29	89	18	169	31	240	26
174	48	51	12	177	49	117	39	223	48	317	53
212	65	62	22	233	66	154	57	294	64	417	72
257	80	76	32	307	81	202	73	387	79	550	87
312	94	92	43	404	95	267	89	509	94	724	98
379	94	111	57	532	95	351	91	671	94	954	98
460	94	135	67	701	95	463	93	884	94	1,256	98
558	94	164	76	923	95	610	95	1,165	94	1,655	98
677	94	199	82	1,216	95	803	96	1,535	94	2,180	98
822	94	242	87	1,602	95	1,058	96	2,021	94	2,872	98
998	94	294	91	2,111	95	1,394	96	2,662	94	3,783	98
1,212	94	356	91	2,781	96	1,836	96	3,507	95	4,983	100
1,471	95	433	92	3,663	97	2,418	97	4,619	96		
1,786	97	525	92	4,825	98	3,186	99	6,085	98		
2,168	98	638	93	6,356	99	4,196	99	8,016	99		
2,632	99	774	94	8,373	100	5,528	100	10,559	100		
3,195	100	940	94			7,282	100	13,909	100		
		1,141	96								
		1,385	97								
		1,682	98								
		2,042	99								
		1,479	100								
		3,009	100								

C—035071

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Sac. R.–Shasta		Sac. R.–Keswick		Sac. R.–Bend Br.		Sac. R.–Colusa		Sac. R.–Verona		Sac. R.–Freeport	
Sept. 1996		Sept. 1996		Sept. 1996		Sept. 1996		Sept. 1996		Sept. 1996	
Mean (nm):	186.	Mean (nm):	219.	Mean (nm):	427.	Mean (nm):	316.	Mean (nm):	232.	Mean (nm):	407.
Variance:	1.321	Variance:	1.432	Variance:	1.491	Variance:	0.913	Variance:	0.327	Variance:	0.923
Skew:	3.208	Skew:	4.134	Skew:	3.566	Skew:	2.504	Skew:	2.238	Skew:	1.9
RMS:	0.00659	RMS:	0.00516	RMS:	0.00372	RMS:	0.00329	RMS:	0.0062	RMS:	4.33
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
68	10	92	14	144	0	138	13	147	12	101	1
78	20	110	30	173	2	159	26	160	29	116	4
89	31	130	44	207	24	183	40	174	49	132	9
101	42	155	58	248	46	211	54	190	66	150	17
116	54	185	73	297	67	243	70	206	78	171	26
132	66	220	88	356	89	280	86	224	85	195	37
150	74	262	91	427	90	323	88	249	85	222	50
171	80	312	93	511	91	372	89	276	85	253	60
195	84	372	94	612	92	428	89	305	85	289	68
222	87	443	94	733	92	494	89	337	85	329	74
253	90	527	94	878	92	569	89	373	86	375	78
289	90	627	94	1,052	92	655	89	413	87	428	79
329	90	747	95	1,260	93	843	90	456	91	488	79
375	91	889	96	1,510	94	948	93	505	94	556	79
428	91	1,059	97	1,808	96	1,067	95	558	96	633	80
488	92	1,261	98	2,166	98	1,201	98	617	98	722	82
556	93	1,501	99	2,595	99	1,351	99	683	99	823	85
634	94	1,788	100	3,108	100	1,520	100	755	100	938	88
722	96									1,069	92
823	97									1,219	95
939	98									1,389	97
1,070	99									1,584	99
1,219	100									1,805	100
1,390	100									2,058	100

C-035072
C-035073

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Spring Cr. arm		Sac. R.–Shasta		Sac. R.–Keswick		Sac. R.–Bend Br.		Sac. R.–Colusa		Sac. R.–Verona	
Sept. 1996		Nov. 1996		Nov. 1996		Nov. 1996		Nov. 1996		Nov. 1996	
Mean (nm): 362.		Mean (nm): 741.		Mean (nm): 575.		Mean (nm): 357.		Mean (nm): 936.		Mean (nm): 366.	
Variance: 2.376		Variance: 2.319		Variance: 3.63		Variance: 2.341		Variance: 0.983		Variance: 0.289	
Skew: 3.786		Skew: 4.202		Skew: 5.72		Skew: 4.003		Skew: 0.719		Skew: 0.17	
RMS: 0.0104		RMS: 0.0055		RMS: 0.0108		RMS: 0.00418		RMS: 0.00419		RMS: 0.0108	
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
125	14	276	13	179	13	128	14	66	2	122	6
152	29	335	28	236	28	156	29	76	4	135	13
184	47	407	49	311	50	189	48	87	7	151	23
224	64	494	66	409	69	230	64	100	11	168	31
272	79	599	81	539	84	279	79	116	15	186	38
330	93	728	94	710	97	339	93	133	20	207	44
400	93	883	94	935	97	411	93	153	26	231	44
486	93	1,073	94	1,232	97	499	93	176	31	257	44
590	93	1,302	94	1,623	97	606	93	203	36	286	44
716	93	1,581	94	2,138	97	736	93	234	41	318	44
869	93	1,919	94	2,816	97	893	93	269	46	354	45
1,055	93	2,330	94	3,710	97	1,084	93	310	49	394	46
1,281	94	2,828	95	4,887	98	1,317	94	357	52	438	62
1,555	95	3,433	96	6,437	99	1,598	95	411	55	488	75
1,888	97	4,168	97	8,479	100	1,940	97	473	57	543	84
2,292	98	5,060	98			2,356	98	544	58	604	91
2,783	99	6,143	99			2,860	99	626	59	672	96
3,378	100	7,458	100			3,472	100	779	59	748	100
								905	59		
								1,051	59		
								1,221	63		
								1,418	69		
								1,647	75		
								1,913	84		
								2,221	91		
								2,580	96		
								2,996	100		

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C—035073

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Sac. R.–Freeport		Sac. R.–Shasta		Sac. R.–Keswick		Sac. R.–Bend Br.		Sac. R.–Colusa		Sac. R.–Verona	
Nov. 1996		Dec. 1996		Dec. 1996		Dec. 1996		Dec. 1996		Dec. 1996	
Mean (nm): 1322.		Mean (nm): 723.		Mean (nm): 1027.		Mean (nm): 966.		Mean (nm): 743.		Mean (nm): 653.	
Variance: 1.922		Variance: 1.851		Variance: 2.361		Variance: 0.707		Variance: 2.379		Variance: 1.843	
Skew: 2.311		Skew: 3.954		Skew: 3.884		Skew: 1.182		Skew: 3.715		Skew: 3.953	
RMS: 0.00021		RMS: 0.00807		RMS: 0.0063		RMS: 0.00737		RMS: 0.00754		RMS: 0.00757	
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
206	4	291	13	361	14	240	15	252	15	262	15
245	10	349	27	438	29	291	30	306	30	313	31
292	17	418	48	532	47	353	47	372	47	375	47
347	26	501	66	646	64	429	63	451	62	450	63
414	36	600	80	784	79	521	78	548	77	539	78
492	49	719	93	952	93	632	93	665	92	645	94
586	59	861	93	1,156	93	767	93	808	92	773	94
698	67	1,032	93	1,403	93	931	93	981	92	926	94
831	73	1,236	93	1,704	93	1,131	93	1,190	92	1,109	94
990	78	1,480	93	2,068	93	1,373	93	1,445	92	1,329	94
1,178	81	1,773	93	2,511	93	1,667	93	1,754	92	1,591	94
1,403	81	2,124	93	3,048	93	2,023	93	2,130	92	1,906	94
1,671	81	2,544	94	3,701	94	2,456	94	2,586	93	2,284	95
1,989	82	3,048	95	4,493	95	2,982	95	3,139	95	2,735	95
2,369	83	3,651	97	5,454	96	3,620	97	3,811	96	3,277	97
2,820	85	4,373	98	6,621	98	4,395	98	4,626	98	3,925	98
3,358	87	5,238	99	8,039	99	5,335	99	5,616	99	4,702	99
3,998	91	6,275	100	9,759	100	6,477	100	6,818	100	5,632	100
4,761	94										
5,669	96										
6,750	98										
8,037	99										
9,569	100										

C-035074
C-035075

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Sac. R.–Freeport		Spring Cr.–Weir		Spring Cr. arm		Sac. R.–Keswick		Sac. R.–Bend Br.		Sac. R.–Colusa	
Dec. 1996		Dec. 1996		Dec. 1996		Jan. 1997		Jan. 1997		Jan. 1997	
Mean (nm): 437.		Mean (nm): 965.		Mean (nm): 605.		Mean (nm): 781.		Mean (nm): 590.		Mean (nm): 1190.	
Variance: 0.38		Variance: 2.341		Variance: 2.359		Variance: 3.475		Variance: 0.543		Variance: 0.744	
Skew: 0.585		Skew: 3.974		Skew: 3.42		Skew: 5.085		Skew: 1.146		Skew: 2.901	
RMS: 0.00218		RMS: 0.00412		RMS: 0.0157		RMS: 0.00393		RMS: 0.0019		RMS: 0.0022	
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
160	7	344	15	197	12	142	1	187	4	569	10
177	18	418	30	240	25	187	4	208	9	651	22
196	30	507	47	291	48	246	25	231	16	744	35
217	40	615	63	353	66	324	45	256	25	851	51
240	48	747	78	429	79	426	62	284	34	973	68
266	52	907	93	521	91	562	79	316	45	1,113	88
300	52	1,101	93	632	91	740	84	351	53	1,273	90
339	52	1,337	93	767	91	975	88	389	58	1,456	90
392	53	1,623	93	931	91	1,284	92	432	62	1,665	90
437	55	1,970	93	1,131	91	1,691	94	480	64	1,905	90
488	59	2,392	93	1,373	91	2,228	96	533	65	2,178	90
544	65	2,904	93	1,666	91	2,935	96	592	65	2,491	90
607	72	3,525	94	2,023	92	3,866	96	657	66	2,849	92
678	80	4,279	95	2,456	94	5,093	97	730	69	3,259	93
756	88	5,195	97	2,982	96	6,709	98	811	72	3,727	95
844	94	6,307	98	3,620	97	8,838	99	900	77	4,262	97
941	98	9,657	99	4,394	99	11,642	100	999	81	4,875	98
1,051	100	9,295	100	5,335	100			1,110	86	5,575	100
								1,232	91		
								1,368	95		
								1,519	97		
								1,687	99		
								1,873	100		
								2,080	100		

C-035076

C—035075

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Sac. R.–Freeport		Spring Cr.–Road		Yolo Bypass		Sac. R.–Verona		Sac. R.–Shasta		Sac. R.–Keswick	
Jan. 1997		Jan. 1997		Jan. 1997		June 1997		May 1997		May 1997	
Mean (nm):	509.	Mean (nm):	749.	Mean (nm):	573.	Mean (nm):	388.	Mean (nm):	281.	Mean (nm):	389.
Variance:	1.188	Variance:	0.567	Variance:	0.634	Variance:	1.834	Variance:	1.544	Variance:	0.452
Skew:	2.537	Skew:	1.065	Skew:	4.874	Skew:	3.992	Skew:	4.373	Skew:	3.318
RMS:	0.01	RMS:	0.00061	RMS:	0.00342	RMS:	0.0113	RMS:	0.0028	RMS:	0.00288
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
152	5	175	1	129	2	156	15	114	1	222	11
174	12	196	2	170	17	187	30	136	18	250	23
200	21	220	5	224	39	224	47	163	39	281	37
230	31	248	10	296	57	269	63	195	58	317	53
264	42	278	16	389	74	322	79	234	77	357	71
302	55	312	25	513	89	386	93	280	94	402	92
347	65	351	35	676	91	462	93	336	94	452	93
398	73	394	44	890	93	554	93	402	94	510	93
457	79	443	53	1,172	95	663	93	482	94	574	93
525	83	498	60	1,544	96	765	93	577	94	647	93
602	85	559	64	2,034	96	952	93	692	94	728	93
691	86	628	65	2,680	96	1,140	93	828	94	820	93
793	86	705	65	3,530	97	1,366	94	992	95	924	94
911	86	792	66	4,650	98	1,636	95	1,189	96	1,041	95
1,045	87	890	68	6,126	99	1,960	97	1,424	97	1,172	96
1,200	89	1,000	70	8,069	100	2,347	98	1,706	98	1,320	98
1,377	91	1,123	74			2,812	99	2,043	99	1,487	99
1,580	93	1,262	81			3,368	100	2,448	100	1,675	100
1,814	96	1,418	87								
2,082	97	1,593	92								
2,339	99	1,789	95								
2,742	99	2,010	98								
3,147	100	2,258	100								
		2,537	100								

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C-035077

Table A6-1. Particulate size distribution of Sacramento River colloid samples as determined by photon correlation spectrometry—*Continued*

Sac. R.–Bend Br.		Sac. R.–Colusa		Sac. R.–Freeport		Spring Cr.–Weir		Spring Cr. arm		Colusa Basin Drain	
May 1997		May 1997		May 1997		May 1997		May 1997		May 1997	
Mean (nm): 262.		Mean (nm): 271.		Mean (nm): 432.		Mean (nm): 600.		Mean (nm): 290.		Mean (nm): 668.	
Variance: 0.717		Variance: 1.881		Variance: 0.213		Variance: 3.191		Variance: 1.552		Variance: 0.723	
Skew: 1.491		Skew: 3.746		Skew: –0.016		Skew: 3.505		Skew: 3.355		Skew: 2.833	
RMS: 0.00365		RMS: 0.00275		RMS: 0.00332		RMS: 0.0029		RMS: 0.0074		RMS: 0.00196	
d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d	d(nm)	% < d
62	0	105	14	137	4	105	7	95	1	327	11
71	3	126	30	150	10	128	16	114	2	372	23
81	7	151	47	166	17	155	27	136	24	424	37
92	14	181	63	183	22	188	38	163	46	484	52
105	23	217	78	201	27	228	50	195	68	551	70
120	35	260	93	222	29	277	63	234	89	628	89
136	46	311	93	249	29	337	72	280	91	716	90
156	55	372	93	282	30	409	79	336	91	817	90
177	62	446	93	314	32	496	84	402	91	931	90
202	67	534	93	349	35	602	87	482	91	1,061	90
230	70	640	93	388	41	731	89	577	91	1,209	90
263	70	767	93	431	50	887	89	692	91	1,378	90
299	72	918	94	479	60	1,077	89	828	92	1,571	91
341	74	1,100	95	533	71	1,308	89	992	94	1,791	93
389	77	1,318	96	592	82	1,588	90	1,189	96	2,041	95
443	81	1,579	98	658	90	1,928	91	1,424	97	2,327	96
505	85	1,891	99	732	96	2,340	93	1,706	99	2,652	98
576	90	2,265	100	813	100	2,841	95	2,043	100	3,023	100
656	94					3,449	97				
748	97					4,187	98				
853	99					5,083	99				
972	100					6,171	100				
1,108	100					7,492	100				

C-035078

C—035077

Table A6-2. Particulate size distribution of streambed sediment samples

[Numbers denote percent finer than size indicated; Br., Bridge; R., River; Sac., Sacramento. mm, millimeter; mm/dd/yyyy, month/day/year]

Particulate Size	Site								
	Sac. R.–Rodeo Park	Sac. R.–Chum Creek	Sac. R.–Balls Ferry	Sac. R.–Bend Br.	Sac. R.–Tehama	Sac. R.–Colusa	Sac. R.–Verona	Sac. R.–Freeport	Cottonwood Creek
	Date Sampled (mm/dd/yyyy)								
	10/23/1996	10/22/1996	10/22/1996	10/22/1996	10/23/1996	11/14/1996	11/13/1996	11/15/1996	10/23/1996
16.0 mm	100	100	100	90	100	100	100	100	100
8.0 mm	100	94	98	60	100	100	100	100	98
4.0 mm	99	92	91	47	100	100	100	100	96
2.0 mm	97	90	85	37	99	100	100	100	94
1.0 mm	94	89	80	35	97	100	100	100	92
0.5 mm	91	87	74	33	96	100	99	99	89
0.25 mm	75	70	52	22	91	99	93	91	74
0.125 mm	35	25	12	8	74	74	43	71	46
0.062 mm	10	6	3	3	44	36	11	31	35
0.031 mm	7	4	2	2	31	23	7	19	32
0.016 mm	4	3	2	1	18	14	5	12	23
0.008 mm	3	2	1	1	13	9	4	9	15
0.004 mm	2	2	1	1	9	7	2	7	10
0.002 mm	2	1	1	1	7	5	2	5	8
0.001 mm	1	1	0	0	5	3	1	4	6
0.0005 mm	1	1	0	0	4	2	0	2	4
0.00025 mm	0	0	0	0	2	0	0	1	2

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Appendix 7. Trace-Element Data in Caddisfly Larvae

Table A7-1. Dry tissue weight and metal concentration data for caddisfly larvae.

Table A7-2. Dry tissue weight and metal concentration data for standard reference materials processed concurrently with caddisfly samples.

Table A7-3. Metal mass balance of body fractions prepared from caddisfly samples collected from the Sacramento River and Cottonwood Creek.

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Table A7-1. Dry tissue weight and metal concentration data for caddisfly larvae

[Br., bridge; c, cytosol sample; Cr., creek; p, pellet sample; wb, whole body sample; s, spiked sample; R., River. Sac., Sacramento. Results given are the dry weight of tissue and raw concentrations of the tissue digest. Conversion to metal concentrations in the original tissue requires application of conversion factors (not given) that account for dilutions during sample preparation. Cytosolic and pellet concentrations were obtained from the same 7 milliliter subsample of the whole tissue homogenate, whereas the subsample for the whole body samples was usually 4–5 milliliters. µg, microgram; g, gram]

Station	Sample	Dry weight (g)	Aluminum (µg/sample)	Cadmium (µg/sample)	Copper (µg/sample)	Iron (µg/sample)	Lead (µg/sample)	Zinc (µg/sample)
Sac. R.–Rodeo	SRRH1wb	0.1365	163 ± 7	0.28 ± 0.01	4.7 ± 0.1	177 ± 0	0.17 ± 0.00	22 ± 0
	SRRH2wb	0.1371	169 ± 9	0.30 ± 0.01	5.6 ± 0.1	219 ± 0	0.17 ± 0.00	23 ± 0
	SRRH3wb	0.1285	166 ± 8	0.29 ± 0.00	4.8 ± 0.0	193 ± 0	0.17 ± 0.00	23 ± 0
	SRRH4wb	0.1431	145 ± 1	0.30 ± 0.00	4.8 ± 0.0	186 ± 0	0.17 ± 0.01	27 ± 4
	SRRH1c	0.0500	1.2 ± 0.2	0.18 ± 0.01	2.8 ± 0.0	6 ± 1	0.033 ± 0.002	11 ± 0
	SRRH2c	0.0502	1.5 ± 0.2	0.16 ± 0.00	2.7 ± 0.0	6 ± 1	0.038 ± 0.002	11 ± 0
	SRRH3c	0.0484	1.2 ± 0.2	0.17 ± 0.00	2.8 ± 0.0	6 ± 0	0.030 ± 0.002	11 ± 0
	SRRH4c	0.0470	1.5 ± 0.2	0.16 ± 0.00	2.6 ± 0.0	3 ± 0	0.025 ± 0.000	11 ± 1
	SRRH1p	0.1030	151 ± 13	0.13 ± 0.00	1.6 ± 0.0	175 ± 10	0.11 ± 0.00	13 ± 2
	SRRH2p	0.1168	206 ± 25	0.20 ± 0.00	3.7 ± 0.1	304 ± 0	0.21 ± 0.01	18 ± 1
	SRRH3p	0.1145	182 ± 16	0.20 ± 0.00	3.3 ± 0.3	286 ± 11	0.27 ± 0.00	18 ± 1
	SRRH4p	0.1283	172 ± 7	0.19 ± 0.00	3.5 ± 0.3	244 ± 0	0.19 ± 0.01	18 ± 1
Sac. R.–Churn Cr.	SRAH1wb	0.1081	149 ± 14	0.10 ± 0.00	4.2 ± 0.0	227 ± 0	0.13 ± 0.01	17 ± 0
	SRAH2wb	0.1108	141 ± 15	0.11 ± 0.00	4.0 ± 0.0	222 ± 0	0.14 ± 0.00	18 ± 0
	SRAH3wb	0.1086	147 ± 5	0.11 ± 0.00	4.0 ± 0.1	228 ± 0	0.14 ± 0.00	18 ± 1
	SRAH4wb	0.1090	154 ± 0	0.10 ± 0.00	4.3 ± 0.1	229 ± 0	0.14 ± 0.00	17 ± 1
	SRAH1wb/s	0.1070	166 ± 5	0.50 ± 0.00	14 ± 0	225 ± 0	1.0 ± 0.0	27 ± 2
	SRAH1c	0.0383	0.88 ± 0.46	0.064 ± 0.005	2.3 ± 0.0	7 ± 1	0.018 ± 0.002	11 ± 0
	SRAH2c	0.0380	0.96 ± 0.49	0.062 ± 0.001	2.4 ± 0.0	5 ± 3	0.019 ± 0.001	11 ± 0
	SRAH3c	0.0372	0.97 ± 0.08	0.059 ± 0.001	2.1 ± 0.0	7 ± 1	0.015 ± 0.002	9.9 ± 0.5
	SRAH4c	0.0378	0.87 ± 0.11	0.055 ± 0.003	2.3 ± 0.0	6 ± 2	0.015 ± 0.001	10 ± 0
	SRAH1p	0.1024	235 ± 2	0.059 ± 0.001	2.7 ± 0.0	287 ± 20	0.16 ± 0.00	15 ± 0
	SRAH2p	0.1076	219 ± 1	0.067 ± 0.003	3.1 ± 0.0	312 ± 0	0.16 ± 0.00	16 ± 0
	SRAH3p	0.1033	207 ± 6	0.063 ± 0.001	2.9 ± 0.0	310 ± 0	0.18 ± 0.00	16 ± 0
	SRAH4p	0.1041	210 ± 2	0.060 ± 0.002	2.6 ± 0.1	312 ± 0	0.16 ± 0.00	15 ± 0

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Table A7-1. Dry tissue weight and metal concentration data for caddisfly larvae—*Continued*

Station	Sample	Dry weight (g)	Aluminum (µg/sample)	Cadmium (µg/sample)	Copper (µg/sample)	Iron (µg/sample)	Lead (µg/sample)	Zinc (µg/sample)
Sac. R.– Balls Ferry	SRBFH1wb	0.1741	223 ± 6	0.16 ± 0.00	3.9 ± 0.0	209 ± 17	0.18 ± 0.00	30 ± 1
	SRBFH2wb	0.1694	218 ± 7	0.13 ± 0.00	4.3 ± 0.1	237 ± 0	0.16 ± 0.00	28 ± 1
	SRBFH3wb	0.1762	218 ± 16	0.13 ± 0.00	4.5 ± 0.0	136 ± 4	0.15 ± 0.00	31 ± 0
	SRBFH4wb	0.1926	243 ± 7	0.14 ± 0.00	4.7 ± 0.0	270 ± 0	0.15 ± 0.00	32 ± 0
	SRBFH5wb	0.1614	216 ± 2	0.11 ± 0.00	4.0 ± 0.0	274 ± 16	0.14 ± 0.00	27 ± 1
	SRBFH6wb	0.1466	192 ± 3	0.11 ± 0.00	3.8 ± 0.0	220 ± 15	0.15 ± 0.01	25 ± 0
	SRBFH1c	0.0335	0.99 ± 0.10	0.069 ± 0.004	1.2 ± 0.0	6 ± 0	0.024 ± 0.002	7.8 ± 0.4
	SRBFH2c	0.0414	1.1 ± 0.1	0.051 ± 0.002	1.5 ± 0.0	7 ± 3	0.019 ± 0.001	10 ± 0
	SRBFH3c	0.0330	1.2 ± 0.3	0.039 ± 0.000	1.2 ± 0.0	6 ± 0	0.015 ± 0.002	8.1 ± 0.0
	SRBFH4c	0.0322	0.99 ± 0.24	0.040 ± 0.002	1.2 ± 0.0	5 ± 0	0.013 ± 0.003	8.1 ± 0.3
	SRBFH5c	0.0379	0.91 ± 0.13	0.042 ± 0.004	1.4 ± 0.0	7 ± 0	0.016 ± 0.001	9.9 ± 0.8
	SRBFH6c	0.0380	0.98 ± 0.24	0.051 ± 0.004	1.5 ± 0.0	6 ± 0	0.015 ± 0.001	10 ± 0
	SRBFH1p	0.0992	192 ± 3	0.061 ± 0.003	1.8 ± 0.0	248 ± 10	0.19 ± 0.00	16 ± 0
	SRBFH2p	0.0948	188 ± 2	0.045 ± 0.002	1.7 ± 0.0	237 ± 0	0.12 ± 0.00	13 ± 1
	SRBFH3p	0.1009	171 ± 4	0.049 ± 0.002	1.7 ± 0.1	232 ± 0	0.12 ± 0.00	13 ± 0
	SRBFH4p	0.1004	191 ± 1	0.047 ± 0.001	1.8 ± 0.0	211 ± 10	0.11 ± 0.00	13 ± 1
	SRBFH5p	0.0970	188 ± 8	0.043 ± 0.001	1.8 ± 0.1	194 ± 58	0.12 ± 0.00	12 ± 0
	SRBFH6p	0.1043	187 ± 3	0.049 ± 0.005	1.9 ± 0.0	177 ± 94	0.12 ± 0.00	13 ± 0
Sac. R.– Bend Br.	SRBH1wb	0.1047	206 ± 3	0.12 ± 0.00	3.3 ± 0.0	251 ± 10	0.12 ± 0.01	22 ± 0
	SRBH2wb	0.1042	202 ± 2	0.13 ± 0.00	3.4 ± 0.1	240 ± 0	0.11 ± 0.00	21 ± 1
	SRBH3wb	0.1069	203 ± 2	0.11 ± 0.00	2.9 ± 0.0	118 ± 21	0.11 ± 0.00	22 ± 0
	SRBH4wb	0.1118	221 ± 7	0.13 ± 0.00	3.6 ± 0.1	235 ± 22	0.12 ± 0.00	24 ± 0
	SRBH1wb/s	0.1064	212 ± 0	0.51 ± 0.02	12 ± 0	245 ± 11	1.1 ± 0.0	30 ± 1
	SRBH2wb/s	0.1026	197 ± 5	0.51 ± 0.00	11 ± 0	226 ± 10	1.0 ± 0.0	30 ± 2
	SRBH1c	0.0330	0.47 ± 0.15	0.066 ± 0.002	1.5 ± 0.0	7 ± 0	0.015 ± 0.001	9.2 ± 0.2
	SRBH2c	0.0310	0.42 ± 0.06	0.062 ± 0.003	1.5 ± 0.0	7 ± 0	0.012 ± 0.001	8.8 ± 0.2
	SRBH3c	0.0248	0.42 ± 0.16	0.044 ± 0.002	1.0 ± 0.0	5 ± 0	0.007 ± 0.000	6.7 ± 0.1
	SRBH4c	0.0323	0.49 ± 0.15	0.062 ± 0.004	1.4 ± 0.0	6 ± 0	0.025 ± 0.003	9.0 ± 0.1
	SRBH1c/s	0.0331	1.1 ± 0.2	0.26 ± 0.00	3.4 ± 0.1	4 ± 1	0.21 ± 0.00	11 ± 0
	SRBH2c/s	0.0320	1.5 ± 0.0	0.27 ± 0.00	3.3 ± 0.1	7 ± 0	0.20 ± 0.00	11 ± 0
	SRBH1p	0.1077	235 ± 11	0.069 ± 0.002	2.1 ± 0.0	215 ± 43	0.14 ± 0.00	15 ± 0
	SRBH2p	0.0975	269 ± 1	0.078 ± 0.004	2.4 ± 0.0	341 ± 0	0.15 ± 0.00	16 ± 0
	SRBH3p	0.1010	273 ± 9	0.076 ± 0.001	2.5 ± 0.0	273 ± 91	0.16 ± 0.00	16 ± 0
	SRBH4p	0.1102	253 ± 14	0.087 ± 0.002	2.7 ± 0.0	298 ± 33	0.16 ± 0.01	18 ± 0
	SRBH1p/s	0.1012	275 ± 2	0.46 ± 0.00	12 ± 0	283 ± 111	1.1 ± 0.1	26 ± 0
	SRBH2p/s	0.0983	255 ± 16	0.46 ± 0.01	12 ± 0	334 ± 0	1.1 ± 0.0	25 ± 0

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Table A7-1. Dry tissue weight and metal concentration data for caddisfly larvae—*Continued*

Station	Sample	Dry weight (g)	Aluminum (µg/sample)	Cadmium (µg/sample)	Copper (µg/sample)	Iron (µg/sample)	Lead (µg/sample)	Zinc (µg/sample)
Sac. R.–Tehama	SRTH1wb	0.1124	250 ± 3	0.073 ± 0.001	2.9 ± 0.0	315 ± 11	0.15 ± 0.00	18 ± 0
	SRTH2wb	0.1095	235 ± 3	0.072 ± 0.000	3.0 ± 0.0	329 ± 22	0.14 ± 0.00	17 ± 0
	SRTH3wb	0.1021	222 ± 2	0.070 ± 0.002	2.6 ± 0.0	306 ± 20	0.12 ± 0.00	17 ± 0
	SRTH4wb	0.1099	216 ± 4	0.074 ± 0.000	2.7 ± 0.0	286 ± 11	0.13 ± 0.00	18 ± 0
	SRTH1wb/s	0.1130	264 ± 7	0.46 ± 0.01	12 ± 0	305 ± 23	1.0 ± 0.0	27 ± 0
	SRTH2wb/s	0.1119	230 ± 2	0.47 ± 0.00	12 ± 0	325 ± 11	1.0 ± 0.0	27 ± 0
	SRTH3wb/s	0.1091	215 ± 2	0.47 ± 0.01	12 ± 0	284 ± 11	1.1 ± 0.0	27 ± 1
	SRTH4wb/s	0.1115	225 ± 0	0.47 ± 0.01	12 ± 0	256 ± 11	1.0 ± 0.0	27 ± 0
	SRTH1c	0.0386	0.73 ± 0.07	0.043 ± 0.001	1.4 ± 0.0	7 ± 2	0.021 ± 0.003	8.7 ± 0.0
	SRTH2c	0.0381	0.52 ± 0.13	0.039 ± 0.001	1.4 ± 0.0	6 ± 0	0.016 ± 0.002	8.7 ± 0.4
	SRTH3c	0.0376	0.63 ± 0.09	0.038 ± 0.002	1.3 ± 0.0	6 ± 1	0.018 ± 0.001	8.9 ± 0.5
	SRTH4c	0.0338	0.67 ± 0.07	0.037 ± 0.002	1.2 ± 0.0	5 ± 1	0.012 ± 0.003	8.5 ± 0.4
	SRTH1p	0.1297	338 ± 6	0.059 ± 0.002	2.7 ± 0.0	571 ± 26	0.21 ± 0.01	18 ± 0
	SRTH2p	0.1349	329 ± 7	0.064 ± 0.001	2.8 ± 0.0	540 ± 0	0.21 ± 0.01	19 ± 0
	SRTH3p	0.1207	325 ± 1	0.051 ± 0.002	2.6 ± 0.1	519 ± 0	0.19 ± 0.00	17 ± 0
	SRTH4p	0.1280	311 ± 1	0.056 ± 0.002	2.6 ± 0.0	461 ± 13	0.19 ± 0.00	18 ± 1
Cottonwood Cr.	SRCCH1wb	0.1149	162 ± 8	0.006 ± 0.001	1.6 ± 0.0	184 ± 34	0.064 ± 0.001	12 ± 1
	SRCCH2wb	0.1141	145 ± 1	0.009 ± 0.001	1.7 ± 0.0	217 ± 34	0.068 ± 0.002	13 ± 1
	SRCCH3wb	0.1102	152 ± 2	0.009 ± 0.001	1.6 ± 0.0	231 ± 11	0.068 ± 0.002	13 ± 0
	SRCCH4wb	0.1089	174 ± 3	0.004 ± 0.002	1.6 ± 0.0	218 ± 11	0.072 ± 0.002	12 ± 0
	SRCCH5wb	0.1163	137 ± 0	0.007 ± 0.003	1.7 ± 0.0	198 ± 12	0.061 ± 0.002	14 ± 0
	SRCCH1wb/s	0.1073	155 ± 0	0.41 ± 0.00	11 ± 0	193 ± 11	0.93 ± 0.03	21 ± 1
	SRCCH2wb/s	0.1136	139 ± 0	0.39 ± 0.00	10 ± 0	227 ± 23	0.99 ± 0.01	22 ± 0
	SRCCH1c	0.0395	0.39 ± 0.10	0.008 ± 0.001	0.83 ± 0.02	8 ± 1	0.007 ± 0.001	7.5 ± 0.2
	SRCCH2c	0.0406	0.30 ± 0.06	0.009 ± 0.001	0.82 ± 0.02	9 ± 0	0.004 ± 0.002	6.8 ± 0.3
	SRCCH3c	0.0403	0.38 ± 0.09	0.007 ± 0.001	0.78 ± 0.02	8 ± 0	0.007 ± 0.001	6.7 ± 0.3
	SRCCH4c	0.0380	0.33 ± 0.10	0.007 ± 0.002	0.71 ± 0.01	8 ± 1	0.005 ± 0.002	6.1 ± 0.2
	SRCCH5c	0.0391	0.42 ± 0.08	0.007 ± 0.001	0.74 ± 0.02	6 ± 0	< 0.003 ± 0.001	6.2 ± 0.1
	SRCCH1p	0.1058	165 ± 0	< 0.003 ± 0.002	1.1 ± 0.0	296 ± 0	0.083 ± 0.001	8.2 ± 0.2
	SRCCH2p	0.1073	180 ± 1	0.002 ± 0.002	1.3 ± 0.0	311 ± 0	0.081 ± 0.001	9.7 ± 0.5
	SRCCH3p	0.1058	181 ± 4	< 0.003 ± 0.001	1.2 ± 0.0	307 ± 0	0.083 ± 0.003	8.5 ± 0.0
	SRCCH4p	0.1059	197 ± 1	< 0.003 ± 0.001	1.3 ± 0.1	275 ± 42	0.082 ± 0.001	9.4 ± 0.0
	SRTH1wb	0.1124	250 ± 3	0.073 ± 0.001	2.9 ± 0.0	315 ± 11	0.15 ± 0.00	18 ± 0
	SRTH2wb	0.1095	235 ± 3	0.072 ± 0.000	3.0 ± 0.0	329 ± 22	0.14 ± 0.00	17 ± 0
	SRTH3wb	0.1021	222 ± 2	0.070 ± 0.002	2.6 ± 0.0	306 ± 20	0.12 ± 0.00	17 ± 0
	SRCCH5p	0.1105	168 ± 7	< 0.003 ± 0.001	1.3 ± 0.1	298 ± 0	0.078 ± 0.001	10 ± 1

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Table A7-2. Dry tissue weight and metal concentration data for standard reference materials processed concurrently with caddisfly samples

[NIST, National Institute of Standards and Technology; SRM, Standard Reference Material. Results given are the dry weight of tissue and raw concentrations of the tissue digest. Conversion to metal concentrations in the original tissue requires application of conversion factors (not given) that account for dilutions during sample preparation. Certified concentration values reported by the NIST for SRM 1566a–Oyster tissue and SRM 50–Albacore tuna are presented in Table 22. g, gram; µg, microgram]

Standard	Dry weight (g)	Aluminum (µg/sample)	Cadmium (µg/sample)	Copper (µg/sample)	Iron (µg/sample)	Lead (µg/sample)	Zinc (µg/sample)
NIST SRM 1566A-1	0.3941	53 ± 1	1.7 ± 0.0	25 ± 0	205 ± 4	0.18 ± 0.01	335 ± 0
NIST SRM 1566A-2	0.4010	50 ± 2	1.7 ± 0.0	24 ± 0	205 ± 20	0.13 ± 0.01	321 ± 20
NIST SRM 1566A-3	0.4133	59 ± 0	1.8 ± 0.0	27 ± 0	227 ± 4	0.14 ± 0.00	335 ± 4
NIST SRM 1566A-4	0.4342	61 ± 1	1.9 ± 0.0	25 ± 0	221 ± 13	0.16 ± 0.00	365 ± 17
NIST SRM 1566A-5	0.4125	57 ± 1	1.9 ± 0.0	26 ± 0	206 ± 8	0.14 ± 0.01	338 ± 4
NIST SRM 50-1	0.3540	2.7 ± 0.1	0.026 ± 0.003	1.1 ± 0.0	19 ± 1	0.21 ± 0.00	4.9 ± 0.4
NIST SRM 50-2	0.4242	3.0 ± 0.0	0.018 ± 0.001	1.3 ± 0.0	22 ± 1	0.29 ± 0.00	6.1 ± 0.1
NIST SRM 50-3	0.3798	2.7 ± 0.1	0.017 ± 0.001	1.2 ± 0.0	20 ± 0	0.21 ± 0.00	5.5 ± 0.1
NIST SRM 50-4	0.4340	2.2 ± 0.2	0.021 ± 0.001	1.2 ± 0.0	22 ± 0	0.17 ± 0.00	5.7 ± 0.3
NIST SRM 50-5	0.4430	2.0 ± 0.1	0.043 ± 0.001	1.4 ± 0.0	24 ± 1	0.17 ± 0.00	5.8 ± 0.5

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Table A7-3. Metal mass balance of body fractions prepared from caddisfly samples collected from the Sacramento River and Cottonwood Creek

[Results reported as percentage recovery from cytosol and pellet relative to concentration in whole body, for example, $100 \times (M_c + M_p)/ M_{wb}$, where (M) is the metal concentration, subscript c is the cytosol fraction, subscript p is the pellet fraction, and subscript wb is the whole body; na, not analyzed; Br., Bridge; Cr., creek; R., River; Sac., Sacramento]

Station	Sample	Aluminum	Cadmium	Copper	Iron	Lead	Zinc
Sac. R.–Rodeo	SRRH1	67	97	84	74	66	92
	SRRH2	88	101	95	102	111	104
	SRRH3	79	108	107	109	131	104
	SRRH4	86	99	106	95	95	88
Sac. R.–Churn Cr.	SRAH1	113	106	101	93	102	128
	SRAH2	112	100	115	103	95	125
	SRHA3	101	95	104	100	103	118
	SRHA4	98	98	97	100	92	122
Sac. R.–Balls Ferry	SRBFH1	99	130	114	141	147	113
	SRBFH2	99	102	101	119	105	110
	SRBFH3	91	103	97	204	111	100
	SRBFH4	102	107	107	105	114	109
	SRBFH5	100	106	107	85	116	109
	SRBFH6	98	109	105	84	94	108
Sac. R.–Bend Br.	SRBH1	82	110	102	65	99	101
	SRBH2	95	102	106	105	111	107
	SRBH3	96	116	119	172	115	103
	SRBH4	82	107	102	94	121	100
Sac. R.–Tehama	SRTH1	78	105	101	106	94	105
	SRTH2	80	105	100	96	97	115
	SRTH3	84	96	107	99	105	109
	SRTH4	83	93	99	94	93	104
Cottonwood Cr.	SRCCH1	73	na	101	119	104	111
	SRCCH2	89	116	103	107	91	106
	SRCCH3	85	na	102	98	97	98
	SRCCH4	81	na	102	94	88	107
	SRCCH5	88	na	98	111	na	95
Statistical results:							
Median		88	105	102	100	102	107
Average		90	105	103	106	104	107
Standard Deviation		11	8	7	28	16	9

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Appendix 8. Plots of Dissolved and Colloidal Metal Concentrations

Figure A8-1. Plots of calcium (Ca) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-2. Plots of cerium (Ce) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-3. Plots of cobalt (Co) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-4. Plots of chromium (Cr) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-5. Plots of gadolinium (Gd) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-6. Plots of potassium (K) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentration. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-7. Plots of manganese (Mn) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-8. Plots of nickel (Ni) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-9. Plots of antimony (Sb) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

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Figure A8-10. Plots of uranium (U) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

Figure A8-11. Plots of vanadium (V) concentration in relation to distance (broken scale) from the Sacramento River mouth, California. *A.* Equivalent colloid concentrations *B.* Dissolved (ultrafiltrate) concentrations. Yolo Bypass sample shown instead of Freeport for January 1997; site names in bold are mainstem sites and those in italics are tributary sites.

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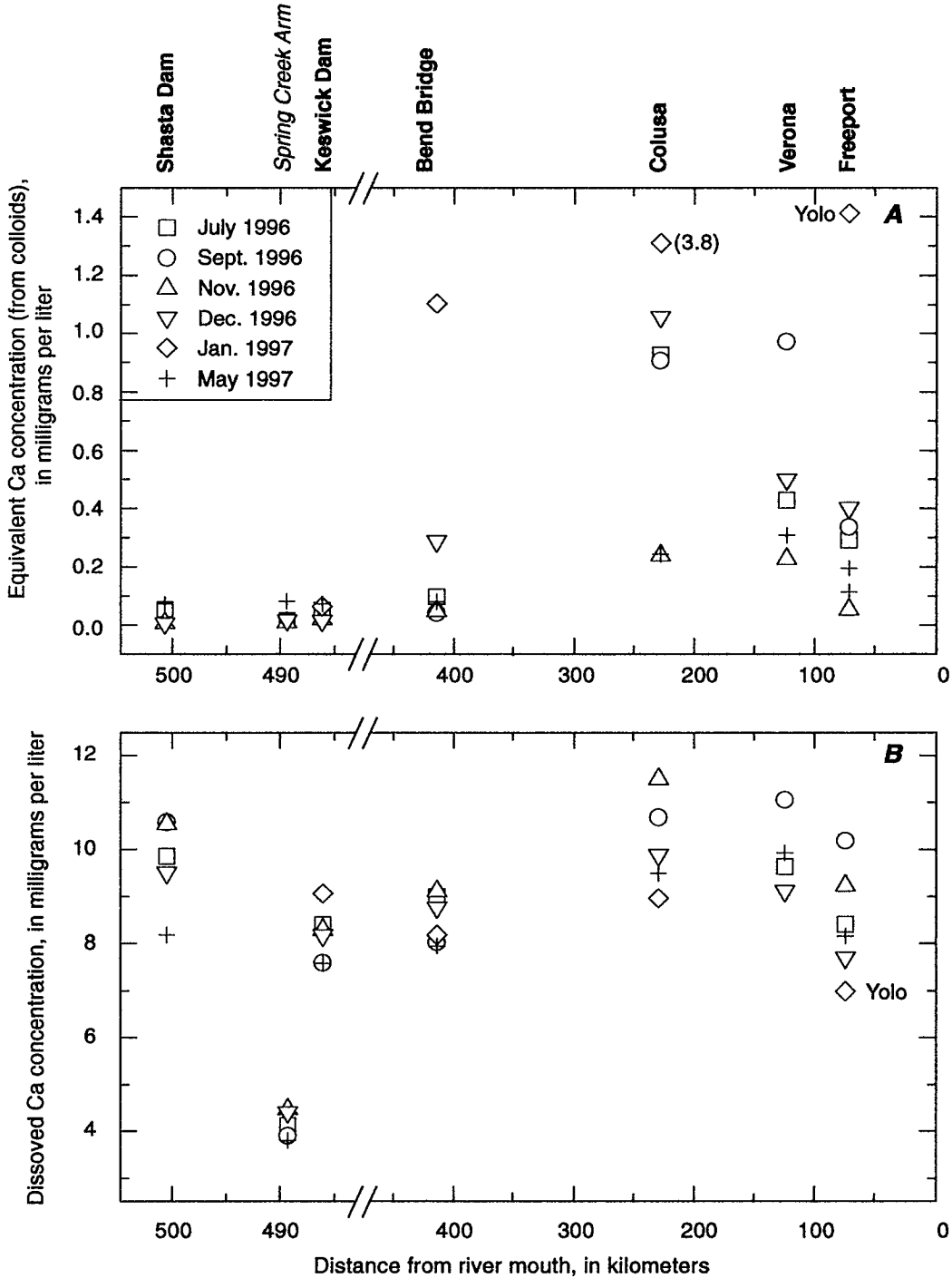

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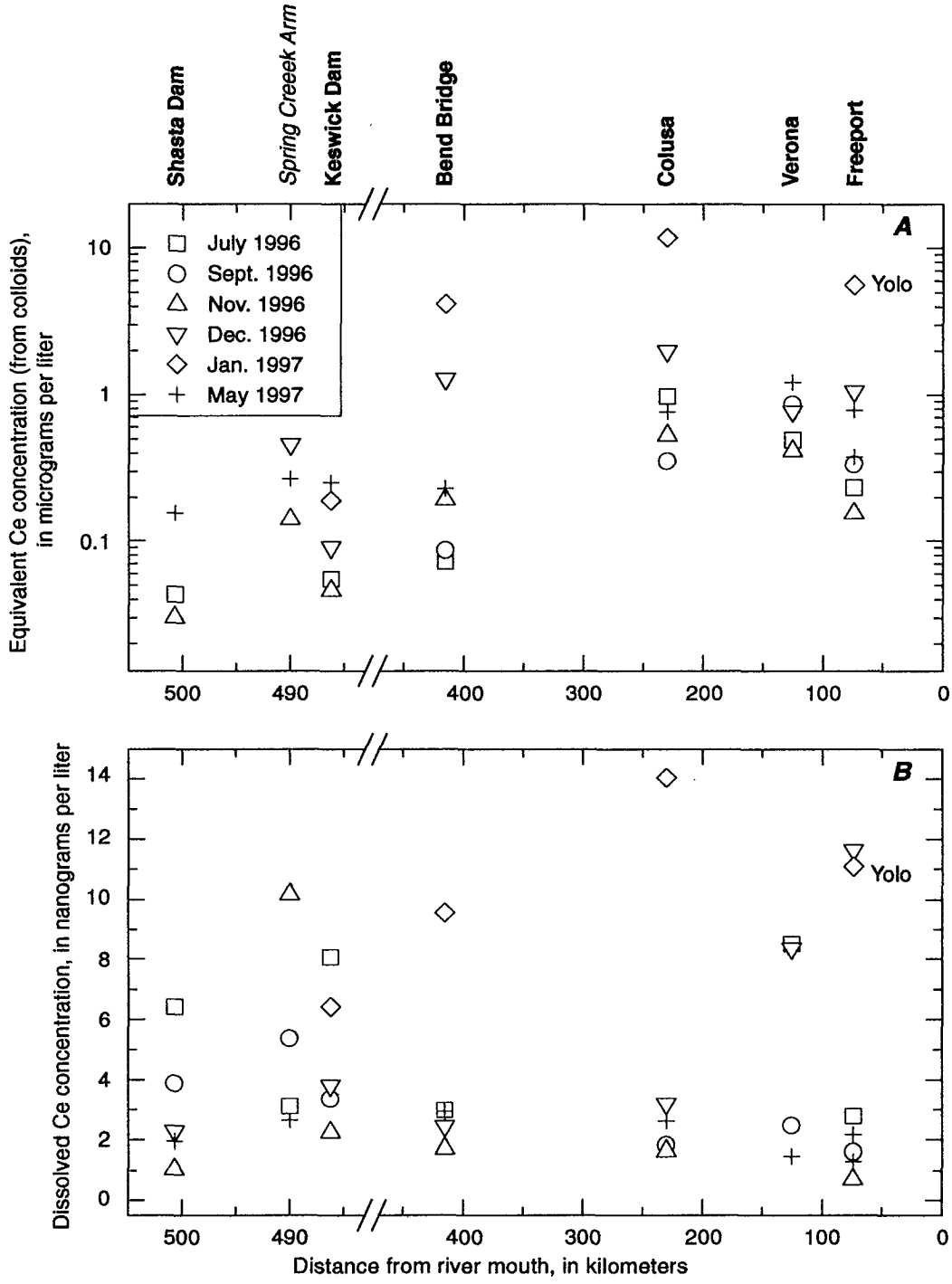

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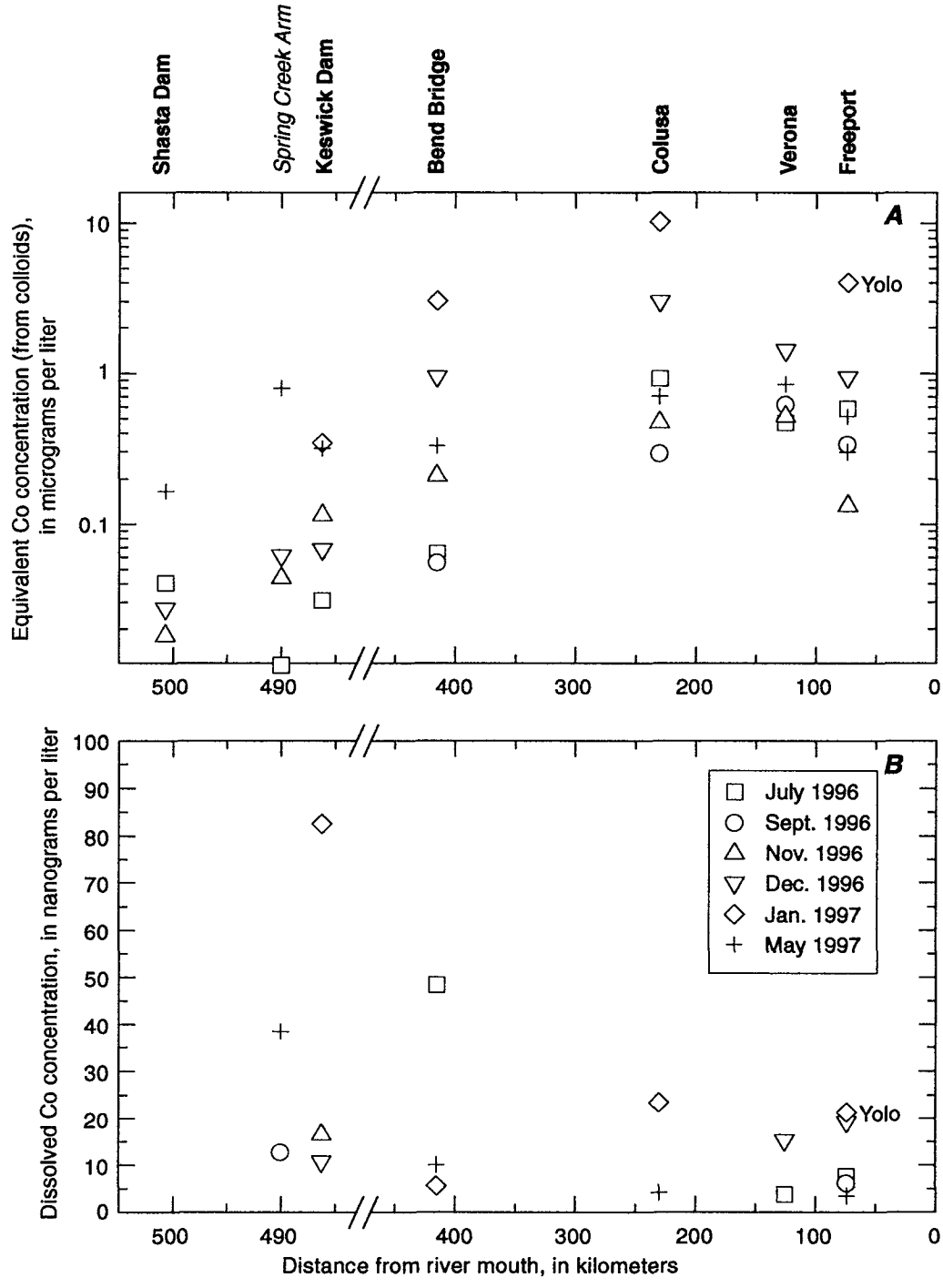

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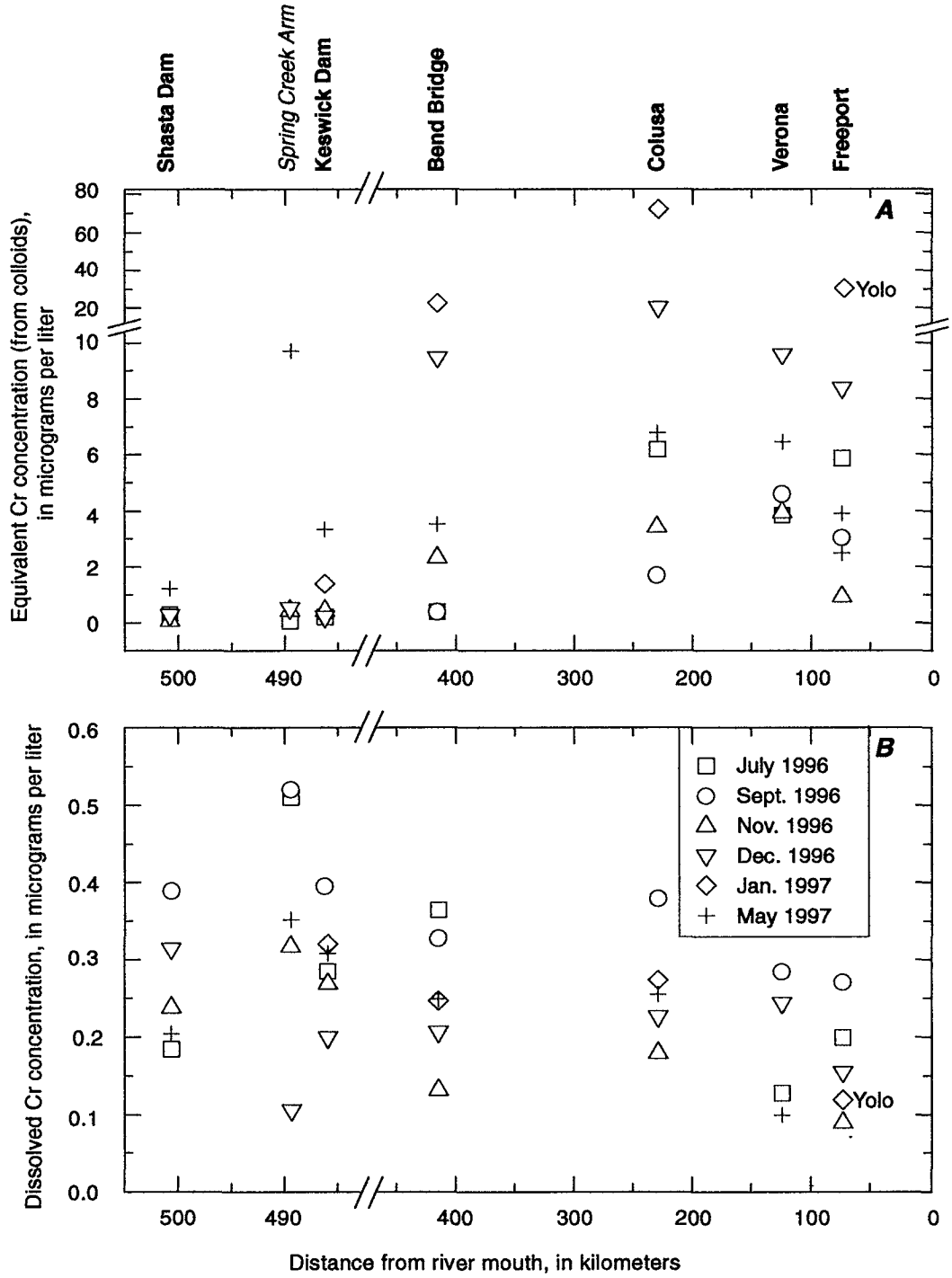

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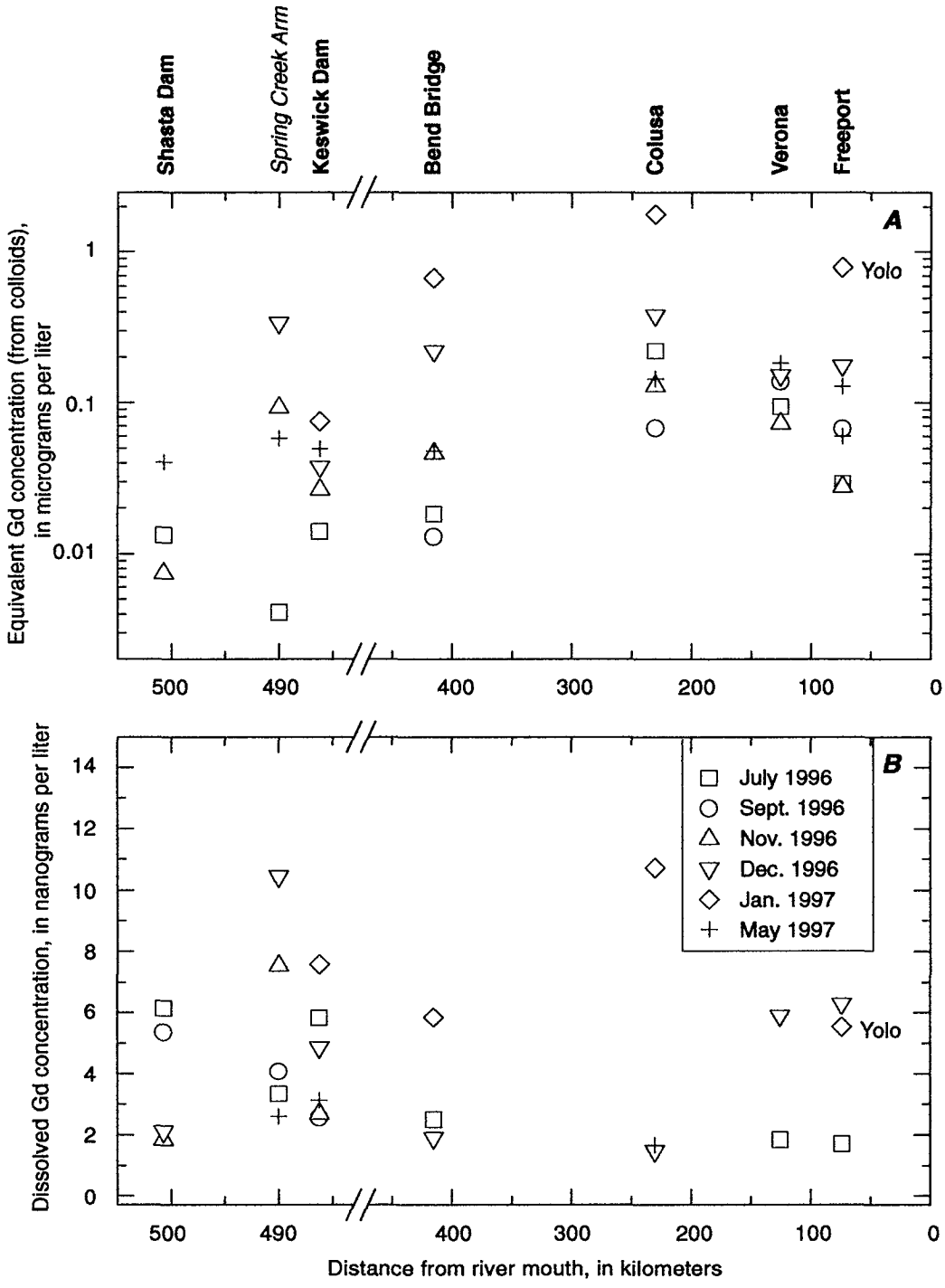

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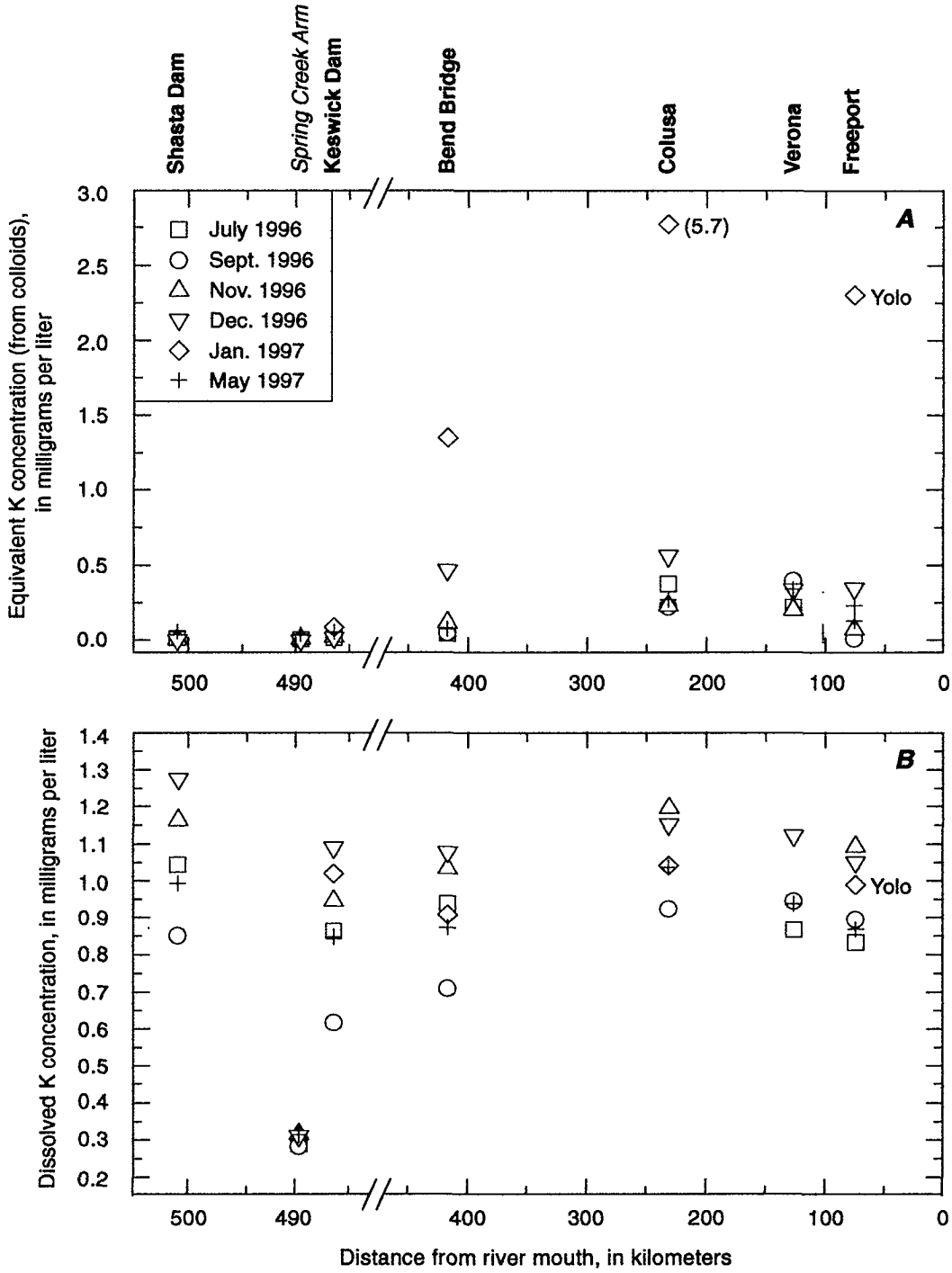

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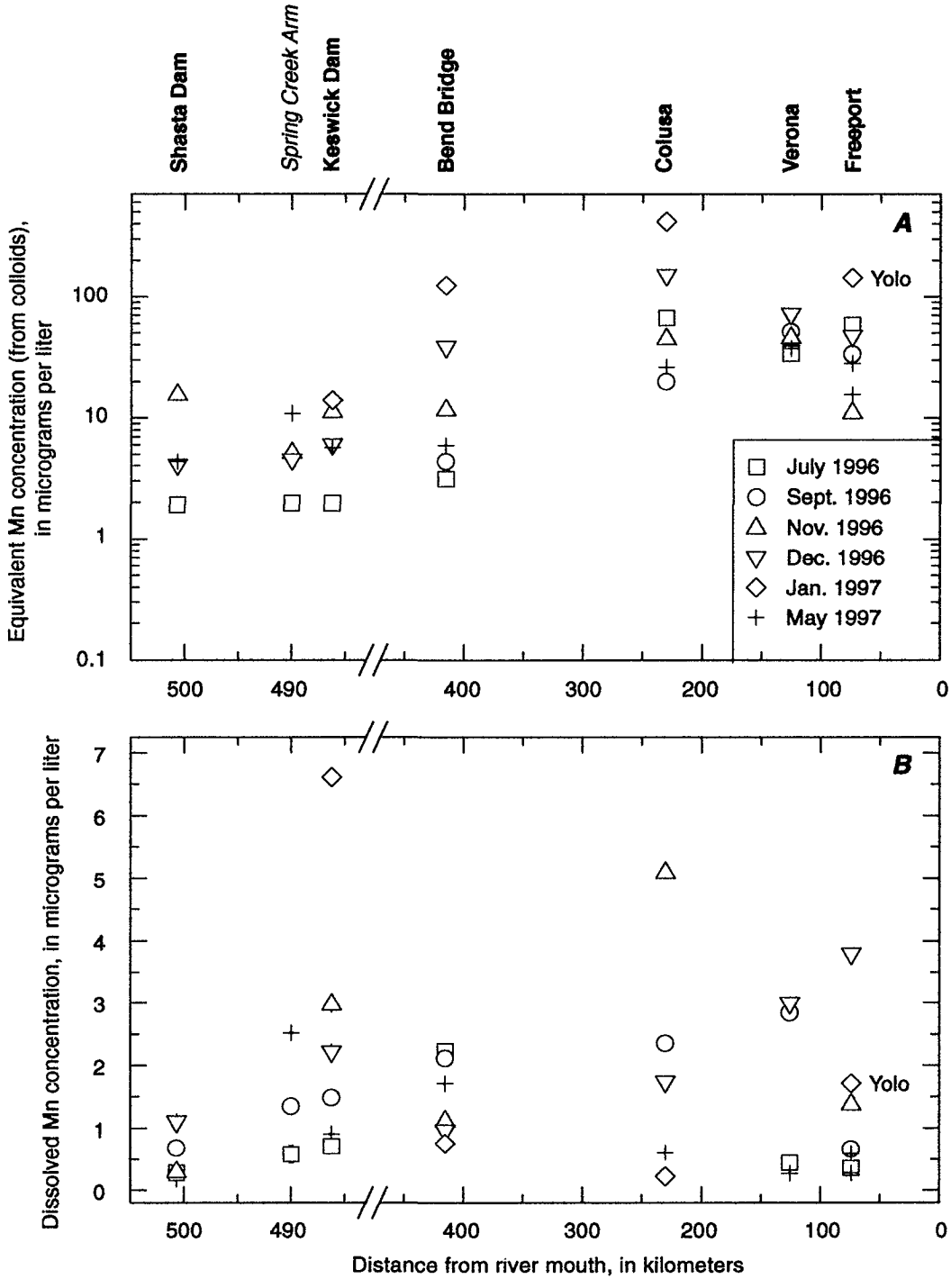

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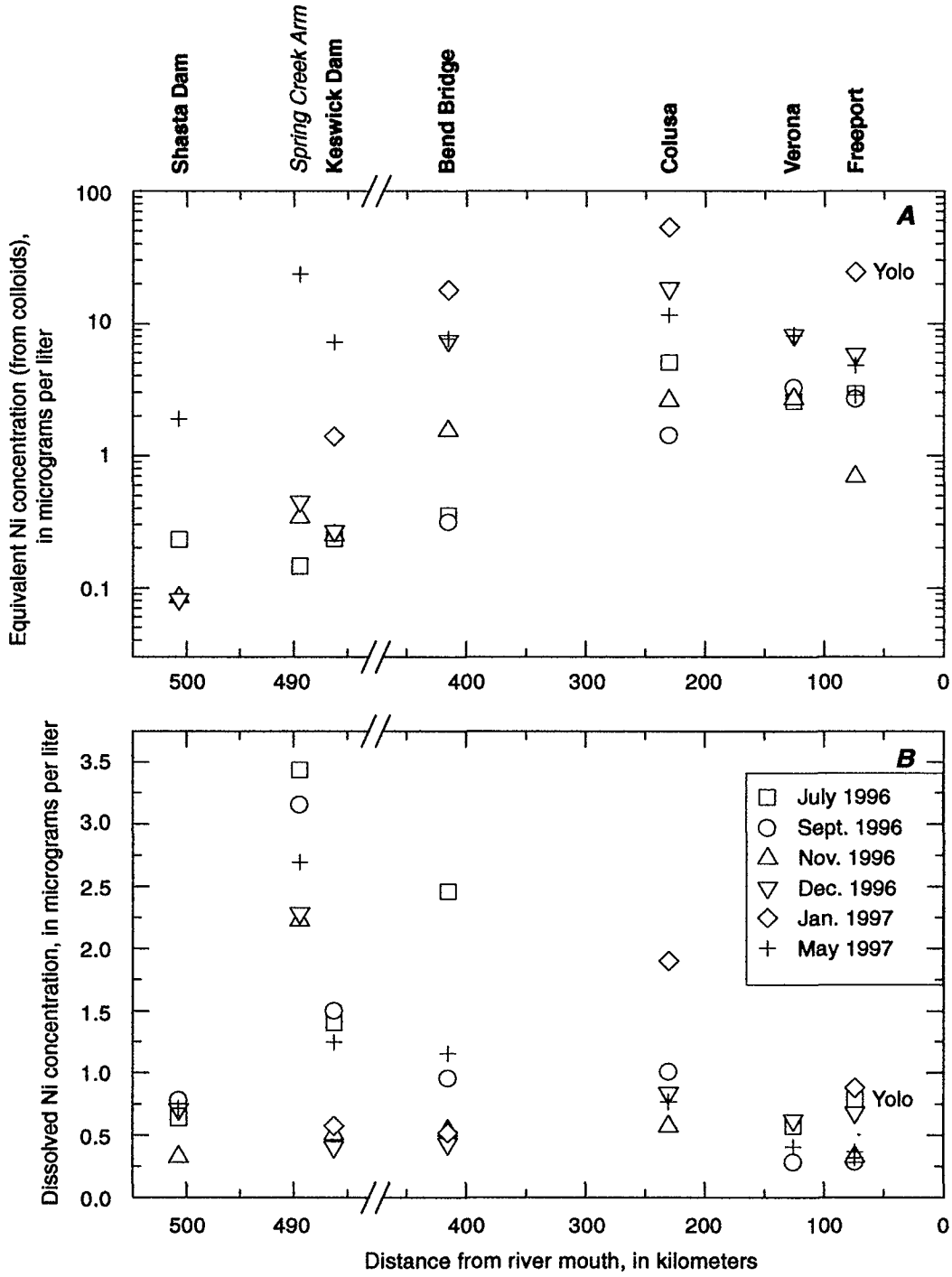

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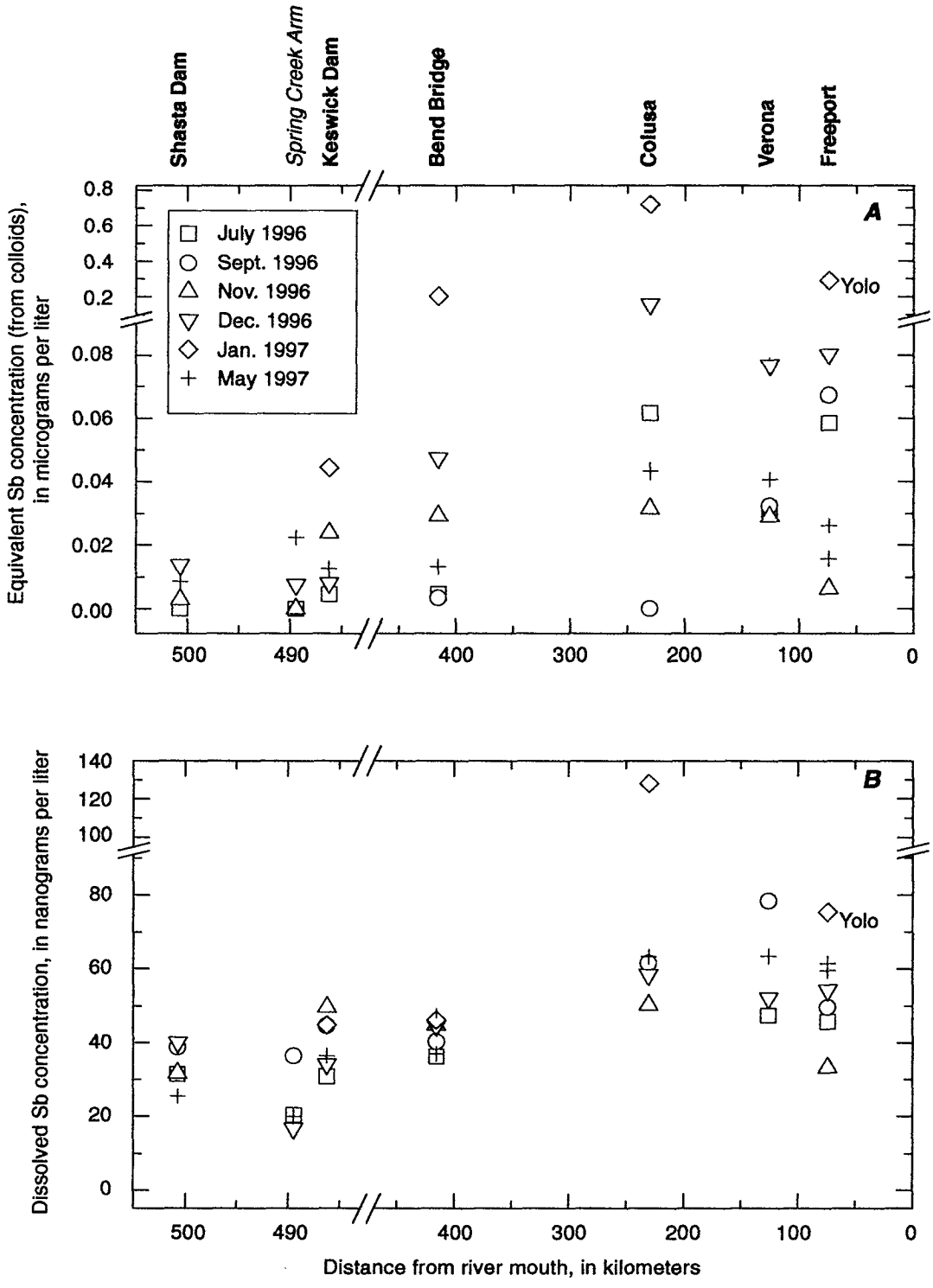

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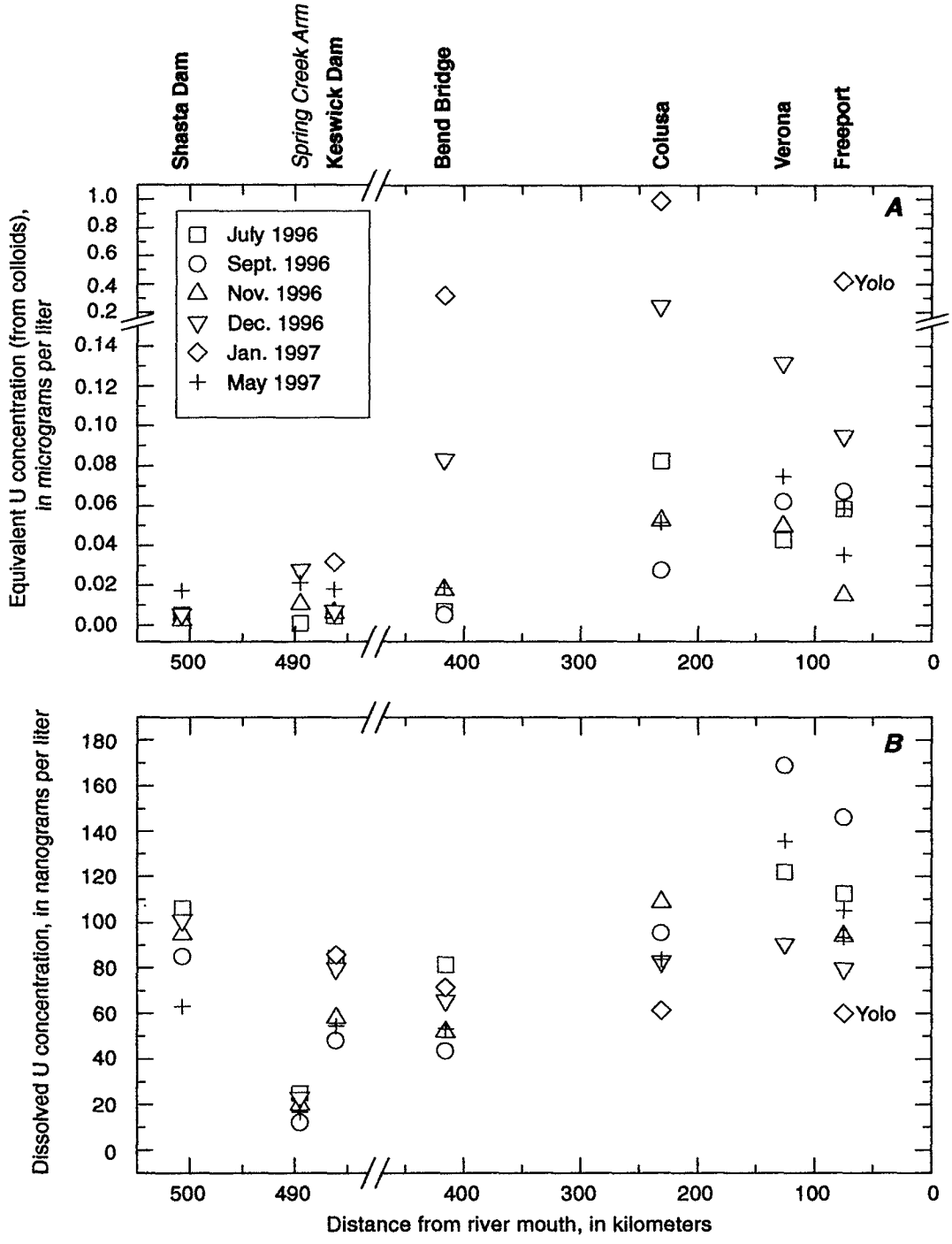

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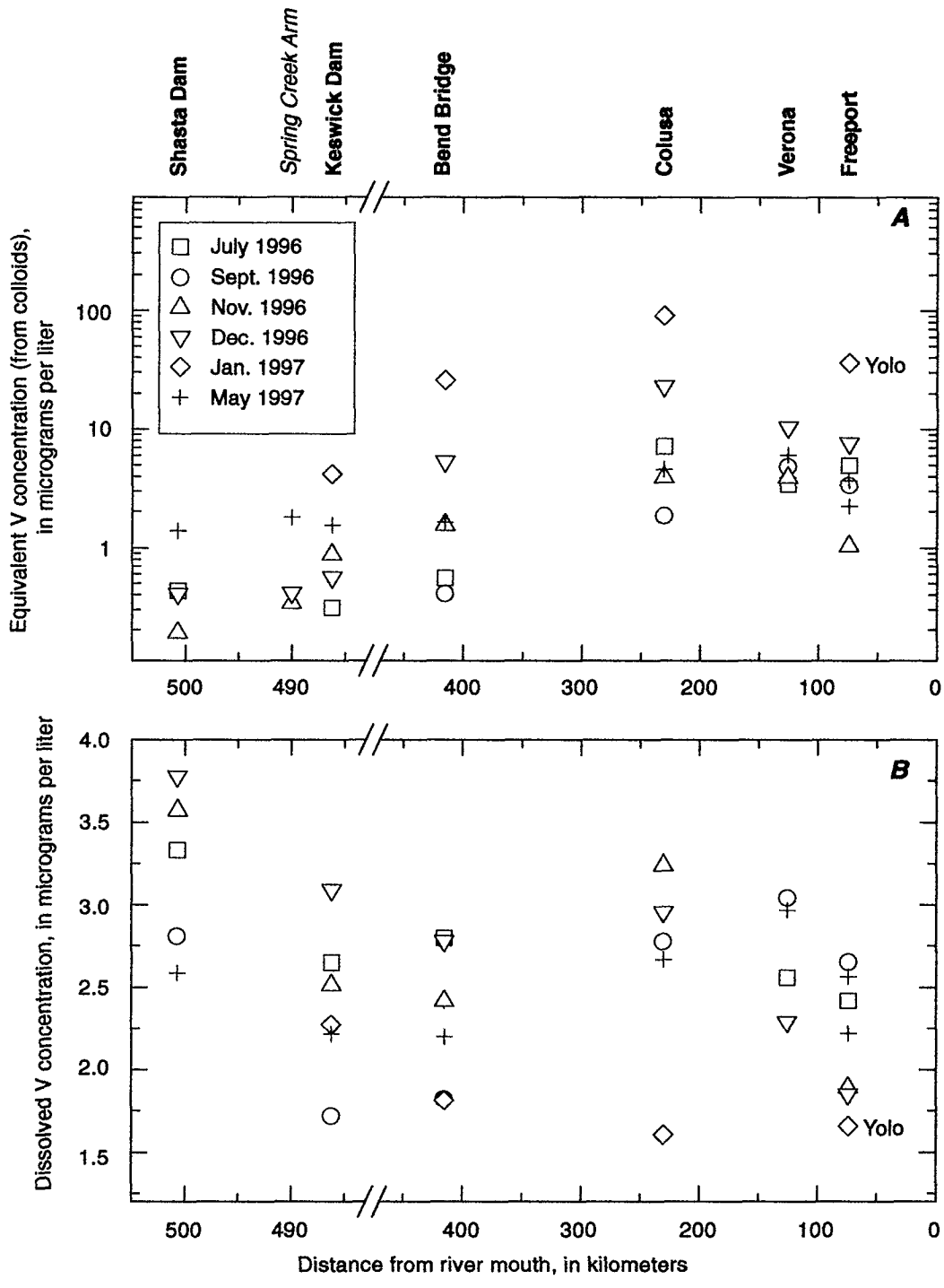

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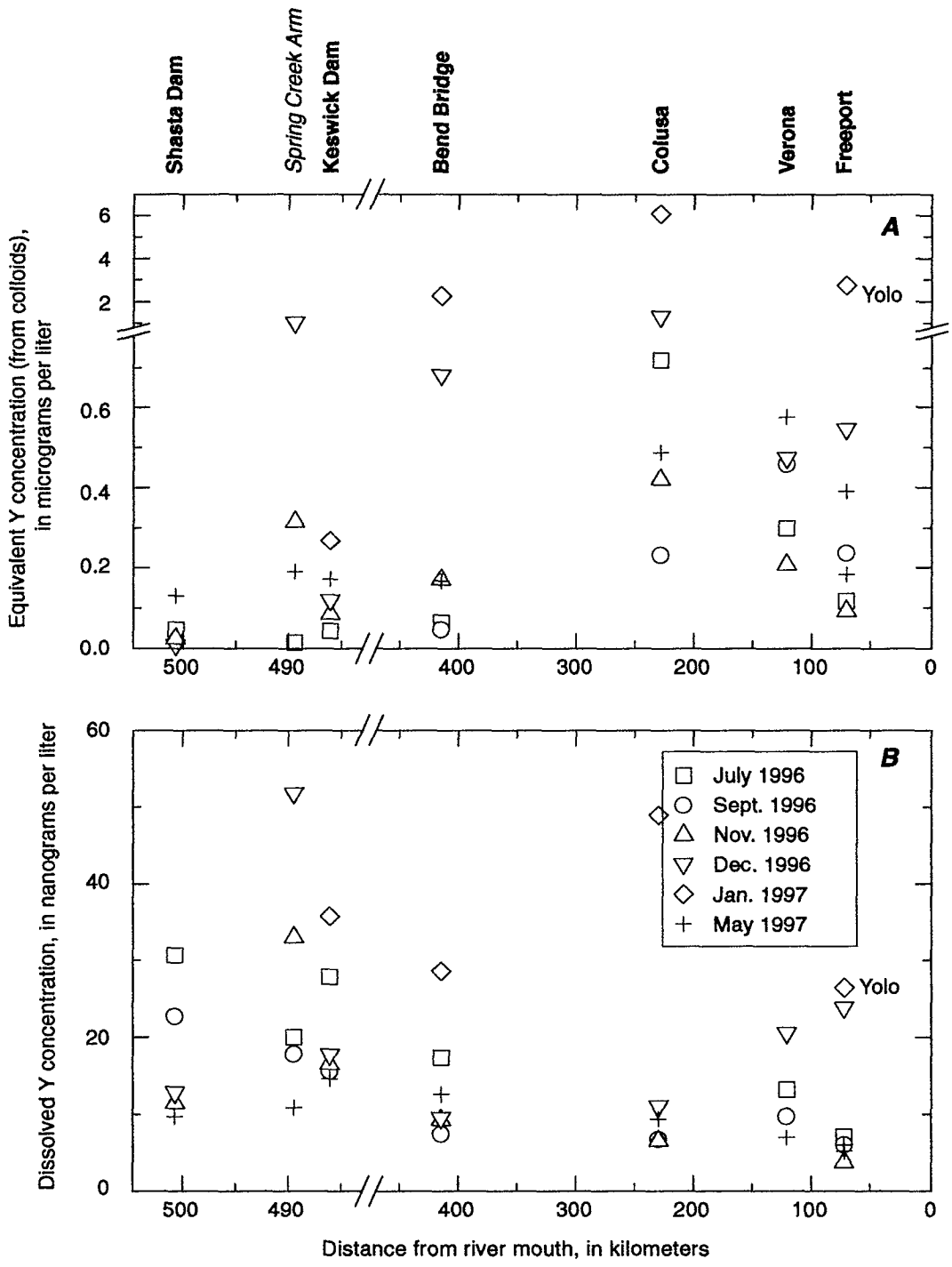

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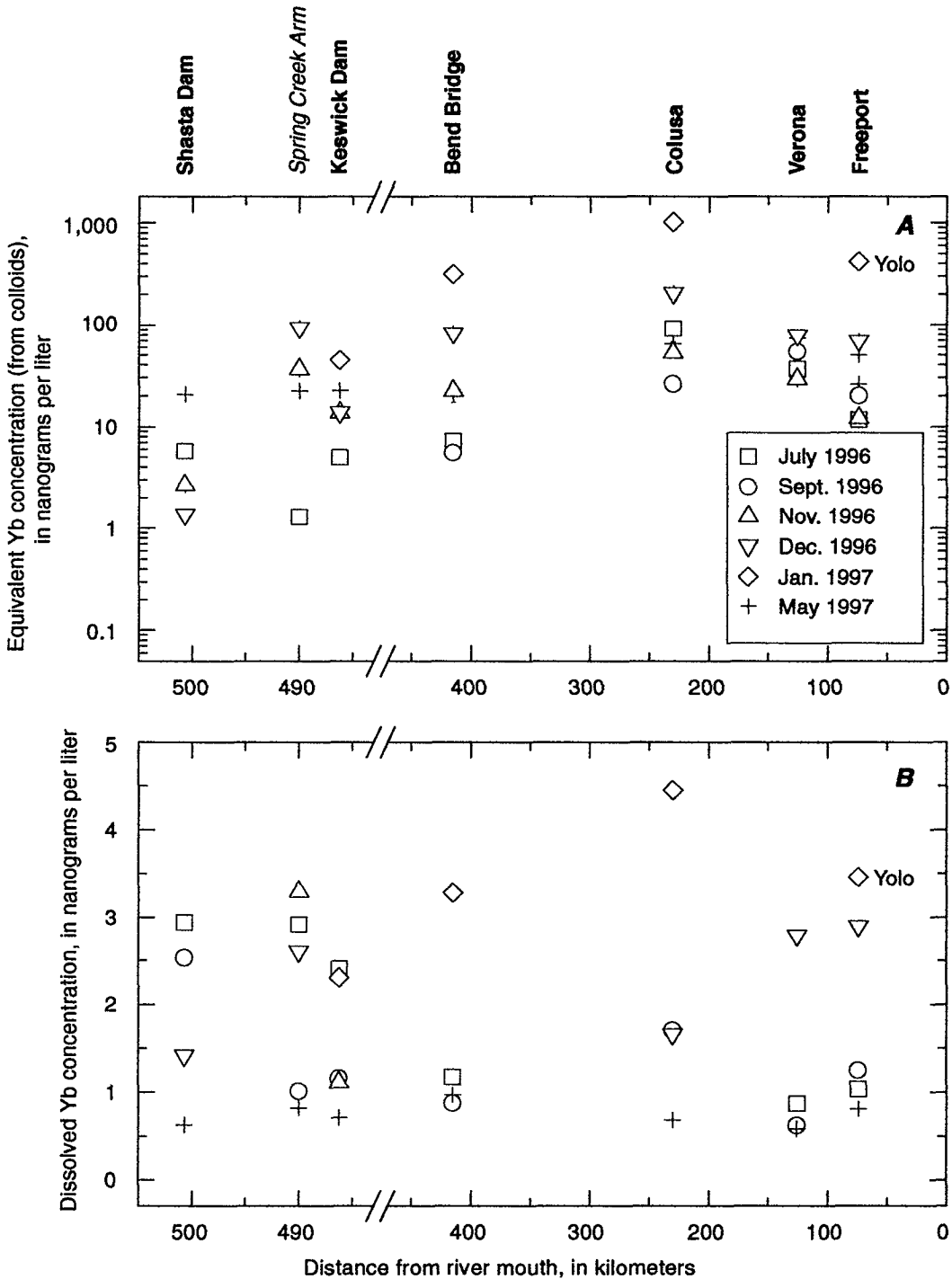

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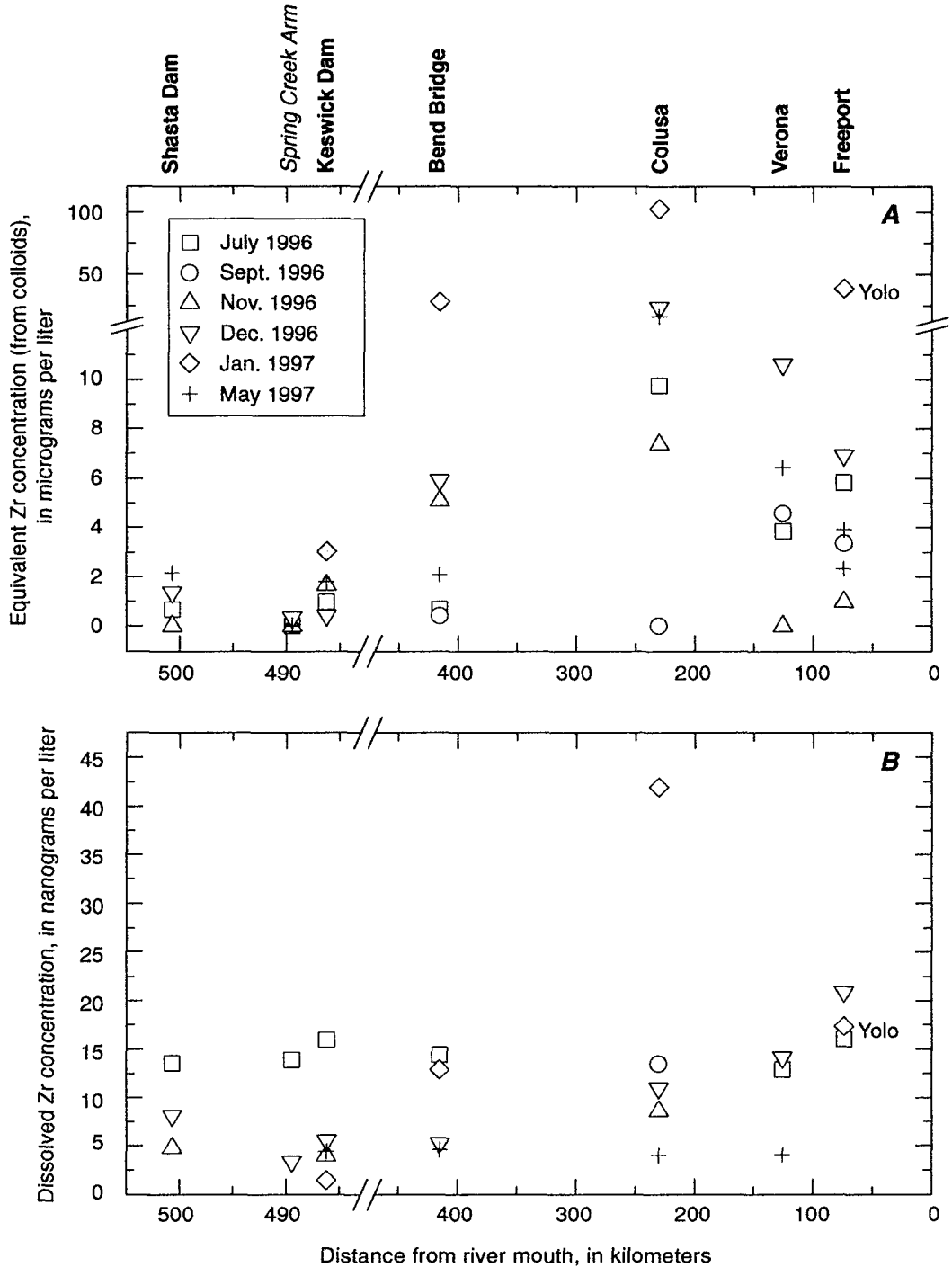

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Volume 2: Interpretation of Metal Loads

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
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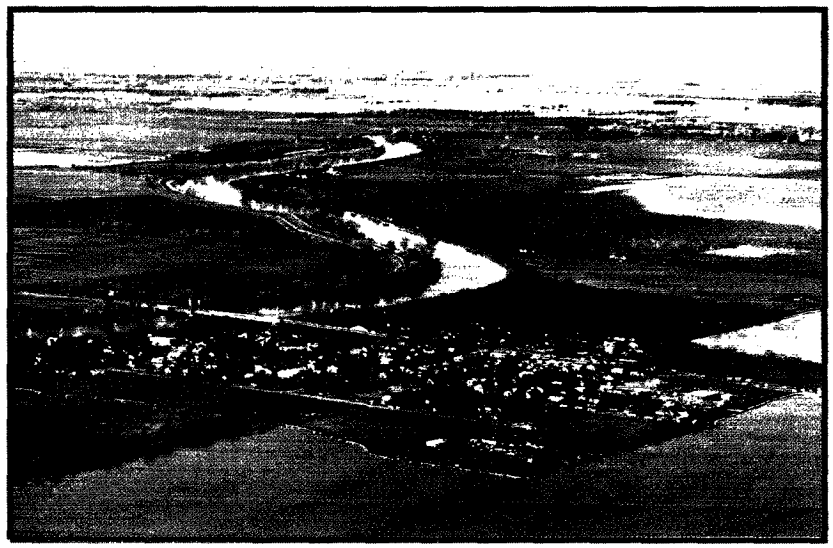
California State Water Resources Control Board
U.S. Environmental Protection Agency
U.S. Department of Commerce, National Marine Fisheries Service

Water-Resources Investigations Report 00-4002



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Meridian and the Sacramento River
Aerial photo, altitude of 1,000 feet, Sutter County, California
Nikon 4004, 80 mm — 200 mm zoom lens f/2.8, color
January 7, 1997 © Rand Schaal

Metals Transport in the Sacramento River, California, 1996–1997

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Volume 2: Interpretation of Metal Loads

Charles N. Alpers, Ronald C. Antweiler, Howard E. Taylor,
Peter D. Dileanis, *and* Joseph L. Domagalski

U.S. GEOLOGICAL SURVEY

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For additional information write to:

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FOREWORD

The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policymakers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission.

One of the greatest challenges faced by water-resources scientists is acquiring reliable information that will guide the use and protection of the Nation's water resources. That challenge is being addressed by Federal, State, interstate, and local water-resource agencies and by many academic institutions. These organizations are collecting water-quality data for a host of purposes that include: compliance with permits and water-supply standards; development of remediation plans for specific contamination problems; operational decisions on industrial, wastewater, or water-supply facilities; and research on factors that affect water quality. An additional need for water-quality information is to provide a basis on which regional- and national-level policy decisions can be based. Wise decisions must be based on sound information. As a society we need to know whether certain types of water-quality problems are isolated or ubiquitous, whether there are significant differences in conditions among regions, whether the conditions are changing over time, and why these conditions change from place to place and over time. The information can be used to help determine the efficacy of existing water-quality policies and to help analysts determine the need for and likely consequences of new policies.

To address these needs, the U.S. Congress appropriated funds in 1986 for the USGS to begin a pilot program in seven project areas to develop and refine the National Water-Quality Assessment (NAWQA) Program. In 1991, the USGS began full implementation of the program. The NAWQA Program builds upon an existing base of water-quality studies of the USGS, as well as those of other Federal, State, and local agencies. The objectives of the NAWQA Program are to:

- Describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers.
- Describe how water quality is changing over time.
- Improve understanding of the primary natural and human factors that affect water-quality conditions.

This information will help support the development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies to protect, use, and enhance water resources.

The goals of the NAWQA Program are being achieved through ongoing and proposed investigations of 59 of the Nation's most important river basins and aquifer systems, which are referred to as study units. These study units are distributed throughout the Nation and cover a diversity of hydrogeologic settings. More than two-thirds of the Nation's freshwater use occurs within the 59 study units and more than two-thirds of the people served by public water-supply systems live within their boundaries.

National synthesis of data analysis, based on aggregation of comparable information obtained from the study units, is a major component of the program. This effort focuses on selected water-quality topics using nationally consistent information. Comparative studies will explain differences and similarities in observed water-quality conditions among study areas and will identify changes and trends and their causes. The first topics addressed by the national synthesis are pesticides, nutrients, volatile organic compounds, and aquatic biology. Discussions on these and other water-quality topics will be published in periodic summaries of the quality of the Nation's ground and surface water as the information becomes available.

This report is an element of the comprehensive body of information developed as part of the NAWQA Program. The program depends heavily on the advice, cooperation, and information from many Federal, State, interstate, Tribal, and local agencies and the public. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch

Robert M. Hirsch
Chief Hydrologist

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CONVERSION FACTORS, VERTICAL DATUM, ACRONYMS and ABBREVIATIONS, and CHEMICAL ELEMENTS

Conversion Factors

Multiply	By	To obtain
acre-foot (acre-ft)	1,233	kiloliter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic foot per second (ft^3/s)	28.32	liter per second
cubic yard (yd^3)	0.7646	cubic meter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
pound	0.4536	kilogram
square mile (mi^2)	2.590	square kilometer
short ton	0.9072	megagram (metric ton)

Temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F=1.8(°C)+32.$$

Vertical Datum

Sea level: In this paper, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Acronyms and Abbreviations

(Additional information given in parentheses)

µg, microgram
µg/L, microgram per liter
µm, micrometer

kg/d, kilogram per day
km, kilometer
L, liter
m^3/s, cubic meter per second
mL, milliliter
mm, millimeter
ng, nanogram
ng/L, nanogram per liter
nm, nanometer

Br., Bridge
CMP, Coordinated Monitoring Program
CVP, Central Valley Project
EPA, U.S. Environmental Protection Agency
MOU, Memorandum of Understanding
NAWQA, National Water-Quality Assessment (Program)

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NMWL, Nominal Molecular Weight Limit
NWQL, National Water Quality Laboratory
ROD, Record of Decision
SCDD, Spring Creek Debris Dam
SCPP, Spring Creek Power Plant
SRM, standard reference material
USGS, U.S. Geological Survey

Elements and Compounds

Elements

Al, aluminum
Cd, cadmium
Co, cobalt
Cr, chromium
Cu, copper
Fe, iron
Hg, mercury
Ni, nickel
Pb, lead
Y, yttrium
Zn, zinc

Compounds

HCl, hydrochloric acid
HF, hydrofluoric acid
HNO_3, nitric acid

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Metals Transport in the Sacramento River, California, 1996–1997: Volume 2. Interpretation of Metal Loads

Charles N. Alpers, Ronald C. Antweiler, Howard E. Taylor, Peter D. Dileanis, *and* Joseph L. Domagalski

Executive Summary

Transport of metals in the Sacramento River from Shasta Dam to Freeport was evaluated for the period July 1996 through June 1997 using an approach that quantified the dissolved and colloidal concentrations and corresponding loads of metals at six mainstem sites during six sampling periods. Two of the sampling periods (December 1996 and January 1997) took place during relatively high-flow conditions, whereas the other four sampling periods (July, September, and November 1996 and May–June 1997) took place during lower flow conditions. The water year corresponding to the duration of this study was unusual for northern California in that precipitation was concentrated primarily in December and January with an extremely dry period from February to April. The overall precipitation for the year was close to long-term averages; however, severe flooding took place in early January 1997 at several locations in the Sacramento River watershed. Approximately 70 percent of total annual discharge at the two farthest downstream sampling locations (Sacramento River at Freeport and Yolo Bypass at Interstate 80) took place during the 3-month period December 1996 through February 1997. Because of increased transport of suspended sediment and higher total metal concentrations in water during this wet period, the proportion of annual metal loads transported was significantly greater than 70 percent.

The proportions of cadmium, copper, lead, and zinc loads that are exported from the Sacramento River to the San Francisco Bay and the Sacramento–San Joaquin Delta estuary (hereinafter referred to as the Bay–Delta), and that are associated with the mineralized areas upstream of Keswick Dam, were estimated by comparing metal loads at Keswick Dam with those at the site(s) sampled farthest downstream, generally the Sacramento River at Freeport (and the Yolo Bypass, when flowing). The results are highly dependent on the flow regime. The following proportions of mineralization-related trace-metal loads were observed (percentages represent dissolved plus colloidal loads at Keswick Dam divided by the sum of dissolved and colloidal loads at Freeport and the Yolo Bypass). During moderately high flows in December 1996, percentages were cadmium, 87 percent; copper, 35 percent; lead, 10 percent; and zinc, 51 percent. During flood conditions in early January 1997, percentages were cadmium, 22 percent; copper, 11 percent; lead, 2 percent; and zinc, 15 percent. During irrigation drainage season from rice fields during May–June 1997, percentages were cadmium, 53 percent; copper, 42 percent; lead, 20 percent; and zinc, 75 percent. These estimates must be qualified by the following factors. First, metal loads at Colusa in December 1996 and at Verona during May–June 1997 generally exceeded those determined at Freeport during those sampling periods. Therefore, the above percentages represent maximum estimates of the apparent total proportion of metals from mineralized areas upstream of Keswick Dam. Second, the Sacramento River was sampled at Tower Bridge

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instead of at Freeport during January 1997 for logistics reasons.

Available data suggest that trace-metal loads from agricultural drainage may be significant during certain flow conditions. However, additional studies are needed before definitive conclusions can be drawn. Load data for sampling periods during July and September 1996 and during May–June 1997 show increases of dissolved and colloidal copper and colloidal zinc between Colusa and Verona, the reach of the Sacramento River along which the Colusa Basin Drain, the Sacramento Slough, and other agricultural return flows are tributaries. Monthly sampling of these two agricultural drains by the U.S. Geological Survey's National Water-Quality Assessment Program shows seasonal variations in metal concentrations. For example, "dissolved" (0.45-micrometer filtrate) copper concentrations in National Water-Quality Assessment Program samples from the Colusa Basin Drain reached 6 micrograms per liter in May 1996 and 3 to 4 micrograms per liter in June 1997; "dissolved" copper in the Sacramento Slough reached a maximum of 4 micrograms per liter in December 1996. To put the copper loads associated with agricultural drainage in perspective, the total (dissolved plus colloidal) load of copper from the Colusa Basin Drain in June 1997 was 18 kilograms per day, whereas the copper load in Spring Creek, which drains the inactive mines on Iron Mountain, was 20 kilograms per day during the same sampling period. In contrast, during the January 1997 flood, the copper load in Spring Creek was about 1,100 kilograms per day and the copper load in the Yolo Bypass was about 7,300 kilograms per day. These data clearly indicate that the majority of copper and zinc loads during the January 1997 flood entered the Sacramento River upstream of Colusa and upstream of the influence of most intense agricultural drainage return flows in the Sacramento River Watershed.

This study has demonstrated that some trace metals of environmental significance (cadmium, copper, and zinc) in the Sacramento River are transported largely in dissolved form at upstream sites (below Shasta Dam, below Keswick Dam, and at Bend Bridge) proximal to the mineralized areas of the West Shasta and East Shasta mining districts. In the acidic water of Spring Creek, cadmium, copper, and zinc are transported almost exclusively in dissolved form. In contrast, these trace metals are transported largely in colloidal form at downstream sites (Colusa, Verona, Freeport, and Yolo Bypass). Aluminum, iron, and lead were observed to be transported predominantly in the colloidal phase at all mainstem Sacramento River sampling sites during all sampling periods in this study. Despite continuous water treatment that has removed 85 to 90 percent of the cadmium, copper, and zinc from the mine drainage at Iron Mountain, Spring Creek remains an important source of these metals to the Sacramento River system.

Abstract

Metals transport in the Sacramento River, northern California, from July 1996 to June 1997 was evaluated in terms of metal loads from samples of water and suspended colloids that were collected on up to six occasions at 13 sites in the Sacramento River Basin. Four of the sampling periods (July, September, and November 1996; and May–June 1997) took place during relatively low-flow conditions and two sampling periods (December 1996 and January 1997) took place during high-flow and flooding conditions, respectively. This study focused primarily on loads of cadmium, copper, lead, and zinc, with secondary emphasis on loads of aluminum, iron, and mercury.

Trace metals in acid mine drainage from abandoned and inactive base-metal mines, in the East and West Shasta mining districts, enter the Sacramento River system in predominantly dissolved form into both Shasta Lake and Keswick Reservoir. The proportion of trace metals that was dissolved (as opposed to colloidal) in samples collected at Shasta and Keswick dams decreased in the order zinc ≈ cadmium > copper > lead. At four sampling sites on the Sacramento River—71, 256, 360, and 412 kilometers downstream of

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Keswick Dam—trace-metal loads were predominantly colloidal during both high- and low-flow conditions. The proportion of total cadmium, copper, lead, and zinc loads transported to San Francisco Bay and the Sacramento–San Joaquin Delta estuary (referred to as the Bay–Delta) that is associated with mineralized areas was estimated by dividing loads at Keswick Dam by loads 412 kilometers downstream at Freeport and the Yolo Bypass. During moderately high flows in December 1996, mineralization-related total (dissolved + colloidal) trace-metal loads to the Bay–Delta (as a percentage of total loads measured downstream) were cadmium, 87 percent; copper, 35 percent; lead, 10 percent; and zinc, 51 percent. During flood conditions in January 1997 loads were cadmium, 22 percent; copper, 11 percent; lead, 2 percent; and zinc, 15 percent. During irrigation drainage season from rice fields (May–June 1997) loads were cadmium, 53 percent; copper, 42 percent; lead, 20 percent; and zinc, 75 percent. These estimates must be qualified by the following factors: (1) metal loads at Colusa in December 1996 and at Verona in May–June 1997 generally exceeded those determined at Freeport during those sampling periods. Therefore, the above percentages represent maximum estimates of the apparent total proportion of metals from mineralized areas upstream of Keswick Dam; and (2) for logistics reasons, the Sacramento River was sampled at Tower Bridge instead of at Freeport during January 1997.

Available data suggest that trace metal loads from agricultural drainage may be significant during certain flow conditions in areas where metals such as copper and zinc are added as agricultural amendments. Copper loads for sampling periods in July and September 1996 and in May–June 1997 show increases of dissolved and colloidal copper and in colloidal zinc between Colusa and Verona, the reach of the Sacramento River along which the Colusa Basin Drain, the Sacramento Slough, and other agricultural return flows are tributaries. Monthly sampling of these two agricultural drains by the USGS National Water-Quality Assessment Program shows seasonal variations in metal concentrations, reaching maximum concentrations of 4 to 6 micrograms per liter in "dissolved" (0.45-micrometer filtrate) copper concentrations in May 1996, December 1996, and June 1997. The total (dissolved plus colloidal) load of copper from the Colusa Basin Drain in June 1997 was 18 kilograms per day, whereas the copper load in Spring Creek, which drains the inactive mines on Iron Mountain, was 20 kilograms per day during the same sampling period. For comparison, during the January 1997 flood, the copper load in Spring Creek was about 1,100 kilograms per day and the copper load in the Yolo Bypass was about 7,300 kilograms per day. The data clearly indicate that most copper and zinc loads during the January 1997 flood entered the Sacramento River upstream of Colusa, and upstream of the influence of the most intense agricultural drainage return flows in the Sacramento River watershed.

This study has demonstrated that some trace metals of environmental significance (cadmium, copper, and zinc) in the Sacramento River are transported largely in dissolved form at upstream sites (below Shasta Dam, below Keswick Dam, and at Bend Bridge) proximal to the mineralized areas of the West Shasta and East Shasta mining districts. In contrast, these trace metals are transported largely in colloidal form at downstream sites (Colusa, Verona, Freeport, and Yolo Bypass). Aluminum, iron, and lead were observed to be transported predominantly in the colloidal phase at all mainstem Sacramento River sampling sites during all sampling periods in this study. Despite continuous water treatment, which has removed 85 to 90 percent of the cadmium, copper, and zinc from the mine drainage at Iron Mountain, Spring Creek remains a significant source of these metals to the Sacramento River system.

Introduction

The Sacramento River is the largest river in California in length (327 mi or 526 km) and discharge (mean annual runoff of 16,960,000 acre-ft per year; Anderson and others, 1997). The river is of critical

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importance to the economy of the state because it supplies irrigation water to farms of the Central Valley (the Sacramento Valley as shown in fig. 1 and the San Joaquin Valley, not shown), provides the greatest source of fresh water to San Francisco Bay and the Sacramento–San Joaquin Delta estuary (collectively referred to hereinafter as the Bay–Delta), and provides drinking water to millions of urban residents in both northern and southern California. Although the water quality of the Sacramento River is generally suitable for most uses, the river is impacted by mine drainage, urban runoff, point sources, and nonpoint sources such as agricultural runoff (California State Water Resources Control Board, 1992). The major water-quality impairments in the Sacramento River are attributed to metals and pesticides, although the causes of some aquatic toxicity in the watershed remain undetermined (Larsen, 1998).

One major source of metals to the Sacramento River is drainage from inactive mines in the Iron Mountain area of the West Shasta mining district. During mining and smelting activities from the 1880s to the 1960s, the acid mine drainage from Iron Mountain discharged directly to Spring Creek, a tributary to the Sacramento River upstream of Redding. The hydrology of the Sacramento River in the area upstream of Redding is affected considerably by several aspects of the Central Valley Project (CVP). Key features of the CVP and years completed are Shasta Dam, 1943–1945; Keswick Dam, 1950; Whiskeytown Lake, 1963; and the Spring Creek Power Plant (SCPP), 1963. The Spring Creek Debris Dam (SCDD) was completed in 1963 to prevent siltation in the tail race of the SCPP, and also to regulate the acid mine drainage in Spring Creek, which was a known threat to aquatic life (U.S. Environmental Protection Agency, 1992). At least 30 fish kills during the period 1940–1969 near Redding were associated with metal-rich, acid drainage from Iron Mountain by way of Spring Creek (Nordstrom and others, 1977). Limited treatment of Iron Mountain mine drainage to remove copper (Cu) by iron (Fe) cementation was done from the 1970s until the early 1990s, with variable success. An emergency lime-neutralization plant was required by the U.S. Environmental Protection Agency during 3 to 4 months of the wet season from 1989 to 1994. Since November 1994, the most concentrated acid discharges from the mines at Iron Mountain have been treated year-round by lime neutralization, removing about 85 percent of the copper and about 90 percent of the zinc (Zn) and cadmium (Cd) compared with untreated loads (Richard Sugarek, U.S. Environmental Protection Agency, written commun., 1997).

Despite the ongoing water treatment at Iron Mountain, a significant reach of the Sacramento River—more than 200 river mi downstream of Keswick Dam—may be affected by elevated trace metal concentrations as a result of significant runoff events of acid mine drainage by way of Spring Creek. The Bureau of Reclamation manages releases of water from Spring Creek Reservoir under a 1980 Memorandum of Understanding (MOU) with several other agencies. Under the MOU, the primary goal of water management in the Spring Creek area has been to achieve compliance with water-quality standards for metals at a point immediately downstream of Keswick Dam. Compliance usually has been achieved by mixing water from Spring Creek Reservoir with water from Shasta Lake released from Shasta Dam and from Whiskeytown Lake, which flows into Keswick Reservoir by way of the Spring Creek Power Plant (fig. 2). On several occasions since 1963, the water level in Spring Creek Reservoir has exceeded the spillway elevation, causing uncontrolled release of acidic water to Keswick Reservoir and occasionally exceeding water-quality standards at Keswick Dam. The impacts of such metal releases on aquatic life in Keswick Reservoir and the Sacramento River below Keswick Dam have been documented to some extent in terms of acute toxicity to fish (U.S. Environmental Protection Agency, 1992). However, much less is known regarding the chronic impacts of metals on ecosystems or the downstream impacts and transport of the metals from mine drainage in this area.

Metals such as cadmium, copper, lead (Pb), and zinc enter Keswick Reservoir as part of the acid mine drainage from Spring Creek. Prior to part-time lime neutralization in 1989, the acid water of Spring Creek below the SCDD had pH values generally less than 3. During 1994–1998, pH values in Spring Creek below the SCDD have been commonly between 4 and 5. Where the Spring Creek waters mix with near-neutral, dilute waters of Keswick Reservoir, the pH rises to near 7 and the metals are partially to completely redistributed in the form of suspended colloids or other solid forms composed primarily of hydrous iron and aluminum oxides (Nordstrom and others, 1999). These solids and associated metals, and remaining dissolved metals, can be transported out of Keswick Reservoir

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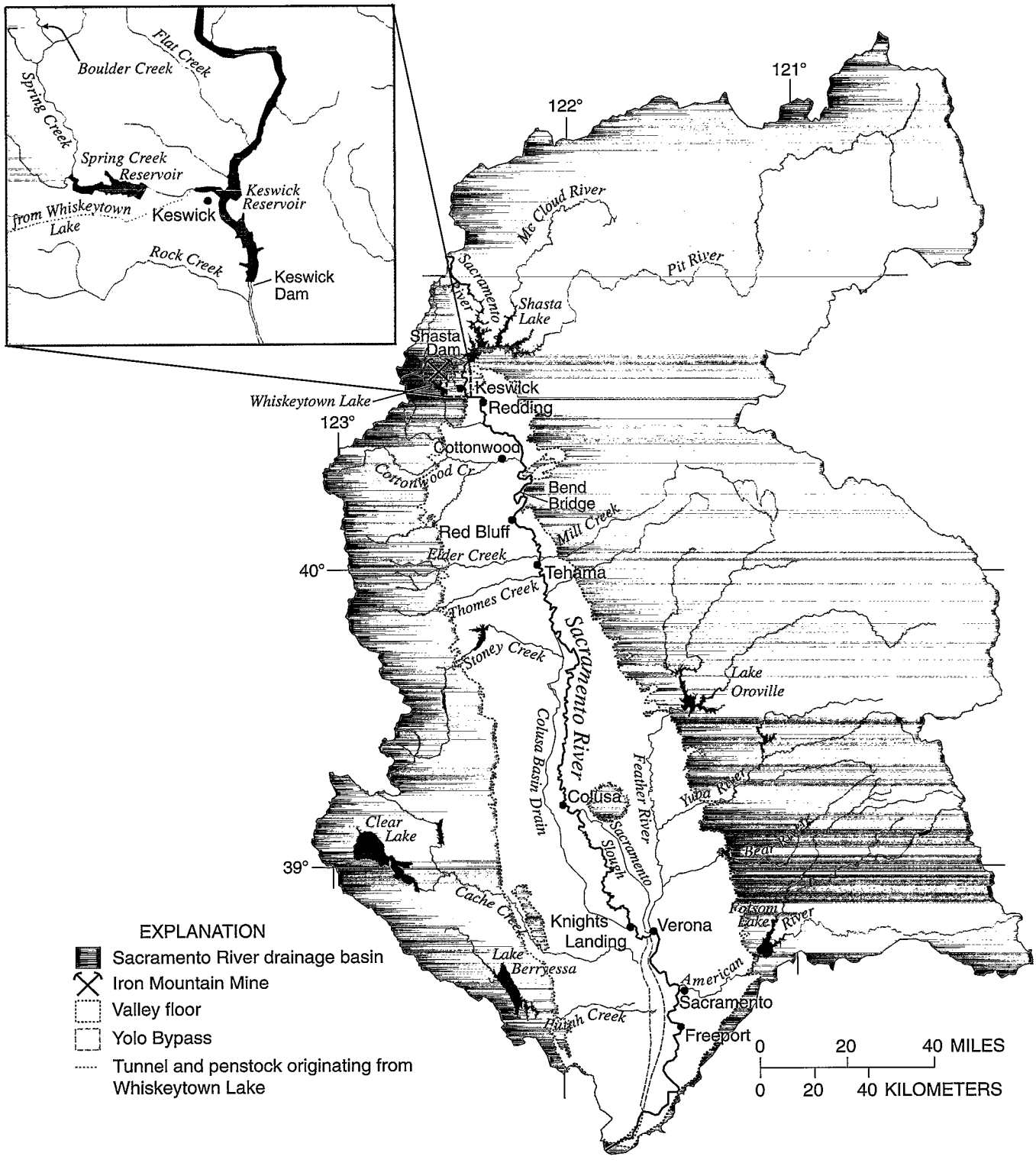

Figure 1. Location map of Sacramento River watershed, California.

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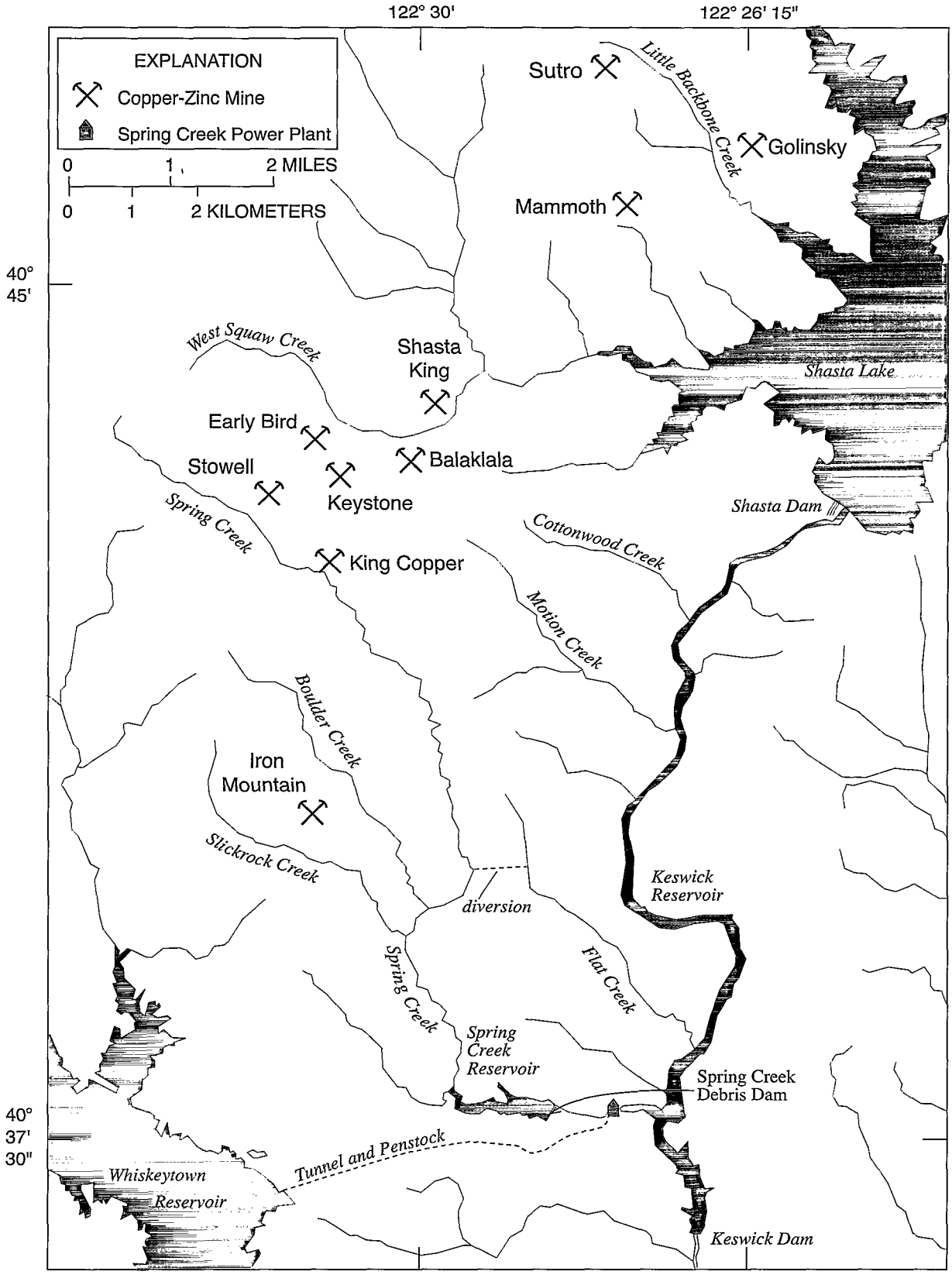

Figure 2. Location map of West Shasta mining district, Shasta County, California.

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and into the Sacramento River, and then transported toward the Bay–Delta. In sufficiently high concentrations, the metals can be toxic to aquatic life; numerous fish kills have occurred in the reach of the Sacramento River below Keswick Reservoir. Monitoring programs for metals downstream of Keswick Reservoir have been designed primarily for the assessment of compliance with water-quality standards. Water samples collected by other federal and state agencies (and their contractors) for metal analyses have included both unfiltered and filtered samples. Unfiltered (whole water) samples typically have been subjected to total recoverable analysis (an incomplete digestion). Sample filtration typically is done using conventional 0.45-μm pore-size filters. Colloidal forms of metal are known to pass through conventional 0.45 μm pore-size filters (Kimball and others, 1995; Church and others, 1997). Therefore, neither the fate nor the transport of colloidal metals have been addressed quantitatively in these sampling programs. Knowledge of the fate of the colloidal metals is crucial in understanding sources of metals and how far downstream metals from mine drainage are transported, and in distinguishing metals originating from mine drainage from those with other sources, such as agricultural or urban runoff.

Previous Work and Related Ongoing Studies

One of the more extensive monitoring programs for metals in the Sacramento River Watershed is located in Sacramento County and is called the Coordinated Monitoring Program (CMP). Participating agencies in the CMP are the Sacramento Regional County Sanitation District (a cooperating agency on this study), the Sacramento County Water Agency, and the City of Sacramento. This program began in 1991 (Larry Walker Associates and Brown and Caldwell, 1994). Sampling sites were chosen on the Sacramento River both upstream and downstream of the City of Sacramento. The American River, just below Folsom Dam (fig.1) and just before the confluence with the Sacramento River, also was sampled. Another comprehensive monitoring program in the watershed, the Sacramento River Watershed Program, is administered by the Sacramento Regional County Sanitation District and is designed to assess toxicity of metals and pesticides to aquatic organisms in the Sacramento River and to quantify metal loads to the Bay–Delta.

The California Regional Water Quality Control Board (hereinafter called the Regional Water Board) has recently completed a study of metal concentrations and loads in the Sacramento River system (Connor and Clark, 1999) on the basis of sampling during 1993–1995. That study showed that metal loads were greatest during wet-season run-off conditions. Studies of aquatic toxicity by the Regional Water Board (Connor and others, 1994; Larsen, 1998; Larsen and others, 1998) on the basis of water sampling during 1993–1997 indicate that metals generally did not cause toxicity to aquatic organisms downstream of Shasta Dam. However, in the Upper Sacramento River, upstream of Shasta Lake (fig. 1), these studies found that nickel (Ni) caused toxicity to *Ceriodaphnia dubia*.

Trace metals are monitored in the Sacramento River Basin as part of the United States Geological Survey's (USGS) National Water-Quality Assessment (NAWQA) Program (Domagalski and others, 1998). An intensive period of monthly sampling for that program occurred from February 1996 to February 1998 at 12 sites in the Sacramento River Basin, including 4 sites on the Sacramento River: Bend Bridge, Colusa, Verona, and Freeport (fig. 1). A less intensive period of monthly sampling at only the Freeport site has continued since March 1998. Water samples from the NAWQA Program taken for analysis of trace metals are filtered through 0.45-μm pore-size capsule (Gelman) filters. The detection limit for most trace metal determinations using the standard methods of the USGS's National Water Quality Laboratory (NWQL) during the intensive sampling period was 1 μg/L. Although barely suitable for some metals, such as copper and zinc, this relatively high detection limit commonly result in nondetections for many trace metals of interest in filtered samples, including cadmium and lead.

Studies of metal transport in other watersheds have provided important information regarding the role of colloids, especially in other waterbodies that receive metal-rich, acidic drainage from historic mining areas. Extensive colloid transport of metals was documented in the upper Arkansas River, downstream of Leadville, Colorado (Kimball and others, 1995). Similar effects were seen in a detailed study of metal transport in the upper Animas Basin, which includes Silverton, Colorado (Church and others, 1997).

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Purpose and Scope

Because of limitations in trace metal detection limits of the USGS's standard NAWQA protocols and the relatively limited extent of the NAWQA sampling network in the Sacramento River watershed, the present study was designed to assess metals transport in the Sacramento River. Water samples were taken during six sampling periods between July 1996 and June 1997, and were processed using tangential-flow ultrafiltration techniques to separate colloidal solids from the aqueous phase, resulting in better estimates for dissolved metals. A related report (Volume 1 [Alpers and others, 2000]) describes the methods and the quality assurance and quality control aspects of the USGS metals transport study, and gives the results of metal concentration data. The present report (Volume 2) contains interpretations of metals transport in the Sacramento River system in terms of metal loads. The metal loads are computed for dissolved and colloidal fractions of the water, as well as for whole-water samples using a partial digestion related to total-recoverable metals (Alpers and others, 2000).

The scope of this report (Volume 2) is limited to interpretation of loads for six metals: aluminum (Al), cadmium, copper, iron, lead, and zinc. Information from this study on mercury (Hg) loads in the Sacramento River watershed are discussed in a separate report (David Roth, U.S. Geological Survey, written commun., 1999). Another companion report from this study (Cain and others, 2000) describes metal bioaccumulation in caddisfly larvae taken from five sampling sites on the Sacramento River between Keswick Dam and Tehama plus a site on a tributary, Cottonwood Creek (fig. 1). The chemistry of streambed sediments from these six sites was documented in a previous report (Alpers and others, 2000).

Appendix 1 of this report contains tables of data with loads of selected metals (Al, Cd, Cu, Fe, Pb, Hg, and Zn) in dissolved form, colloidal form, and whole water (total recoverable analyses). In Appendix 2, metal loads at each sampling point are compared with the sum of the loads at Freeport and the Yolo Bypass. Tables of load data used in mass balance calculations are given in Appendix 3 (Spring Creek arm of Keswick Reservoir) and Appendix 4 (Keswick Reservoir). Other appendixes include plots of dissolved and colloidal loads for miscellaneous metals (Appendix 5) and hydrographs for selected sampling periods showing variations in discharge in relation to the time of sampling (Appendix 6).

Acknowledgments

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Computation of Metal Loads

The instantaneous load of a given constituent transported by a river is the product of the concentration of that constituent at a given time and the instantaneous discharge of the river at that same time. In practice, it is usually difficult, if not impossible, to obtain truly instantaneous water-quality samples and discharge measurements, but most river systems do not change appreciably over the course of

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a day; so, what is commonly calculated is an average load expressed in kilograms per day (kg/d). The assumptions made by this approach are that both the concentration of the constituent and the discharge of the river remain relatively constant for the day in which the measurements are made. The actual formula is:

$$\text{Load (kg/d)} = \text{Concentration } (\mu g/L) \times \text{Discharge } (m^3/s) \times 0.0864 \quad (1)$$

Discharge

The flow regime of the Sacramento River is highly seasonal, in response to the mediterranean climate of northern California. The wet season in the watershed ranges typically from November to May, with snowmelt occurring normally during April through June; warm rains earlier in the winter have been known to cause extensive melting associated with extremely high discharge such as the New Year's flood of 1997 (Hunrichs and others, 1998). The six sampling periods for the present study were chosen to span a variety of flow conditions. The sampling periods in July, September, and November 1996 and during May–June 1997 occurred during relatively low-flow conditions whereas the sampling periods during December 1996 and January 1997 were during high-flow conditions (fig. 3).

Discharge in the Sacramento River and its major tributaries is managed for the purposes of flood control, irrigation, and aquatic habitat. Several water diversions affecting the Sacramento River cause significant seasonal changes in the flow regime. Diversions for agricultural use include the Tehama–Colusa and Glenn–Colusa canals (fig. 3). Return flows from irrigation on the western side of the Sacramento River are collected in the Colusa Basin Drain (figs. 1 and 3), which enters the Sacramento River downstream of Colusa and upstream of the confluence of the Sacramento River with the Feather River. On the eastern side of the valley, agricultural return flows are collected in the Sacramento Slough (figs. 1 and 3). The agricultural diversions are most active during irrigation season, typically May through October. Flood control diversions in the Sacramento River system include the Sutter and Yolo bypasses, which are typically most active during December through April (figs. 3*D*, 3*E*).

As a result of the various diversions and water management practices, the flow regime on the Sacramento River was somewhat different during each of the six sampling periods in this study. The diagrams in figure 3 indicate the relative discharge of the Sacramento River and its tributaries and a distributary (the Yolo Bypass) for each of the sampling periods. During all six sampling periods, the discharge of the Sacramento River decreased between Red Bluff and Colusa. During low-flow conditions this decrease was primarily because of agricultural diversions, whereas during high-flow conditions this decrease resulted from flood-control diversions.

Dissolved Loads

Tables of load data (Appendix 1) were calculated according to the formula in Equation (1) using the concentration and discharge data from Alpers and others (2000). Dissolved loads were computed using concentration data from the tangential-flow ultrafiltrates that were derived using 10,000 daltons, or Nominal Molecular Weight Limit (NMWL) membranes, equivalent to an effective pore-size diameter of 0.005 μm (Millipore Corporation, 1993). Other studies typically have measured concentrations using 0.45-μm pore-size filters, which tend to yield higher values than the ultrafilters.

Conventional filtrates were also produced using a 0.45-μm pore-size capsule filter (Gelman) and a 0.40-μm pore-size membrane filter (Nuclepore). Metal concentrations in these conventional filtrates were generally higher than those observed in the ultrafiltrates, especially for such elements as aluminum, iron, and lead, which are associated with fine-grained colloids. It is very important to recognize these differences if the "dissolved" data reported here are to be compared with "dissolved" loads based on conventional filtrates from other studies.

Colloidal Loads

Colloidal loads were calculated in a manner similar to that used for dissolved loads, by multiplying the discharge of the river or creek by the equivalent colloid concentration of the constituent. The equivalent colloid concentration is directly analogous to the dissolved concentration of a constituent; both use units of micrograms per liter (or milligrams per liter), and both represent the mass of the constituent present per unit volume of water. The dissolved concentration represents the amount of the constituent

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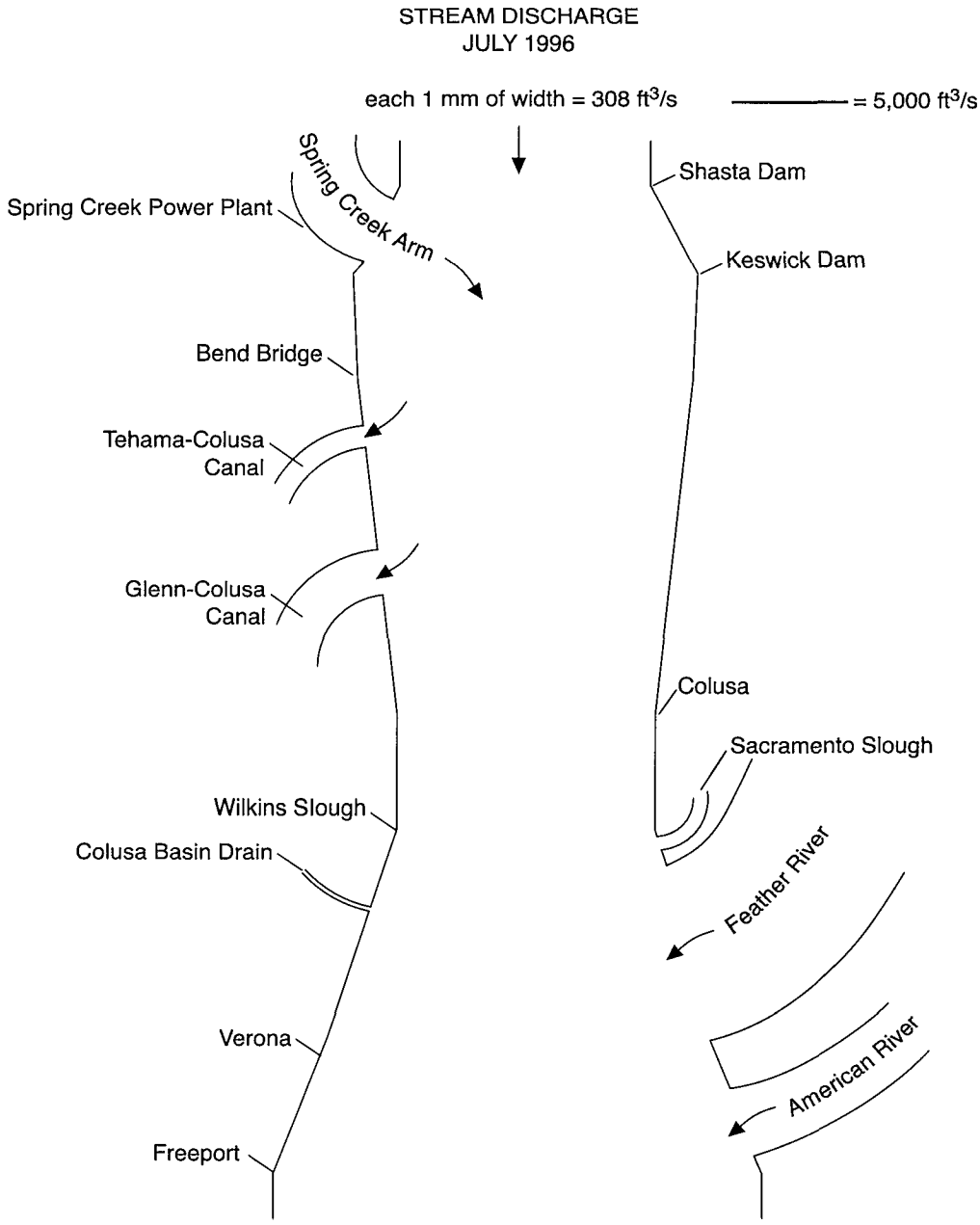

Figure 3*A*. Diagram showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the July 11–18, 1996 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

that is dissolved, whereas the equivalent colloid concentration represents the amount of the constituent that is contained in or on the colloids. The equivalent colloid concentration of a constituent in a colloidal sample (in micrograms per liter) was computed as the product of the suspended colloid concentration (in milligrams per liter) and the concentration of the constituent of interest in the colloid sample (in micrograms per milligram). The method used to calculate the suspended colloid concentration using aluminum concentrations in colloidal and whole water samples is described by Alpers and others (2000). The colloidal loads in Appendix 1 of this report were calculated using Eq. 1, where the concentration is the

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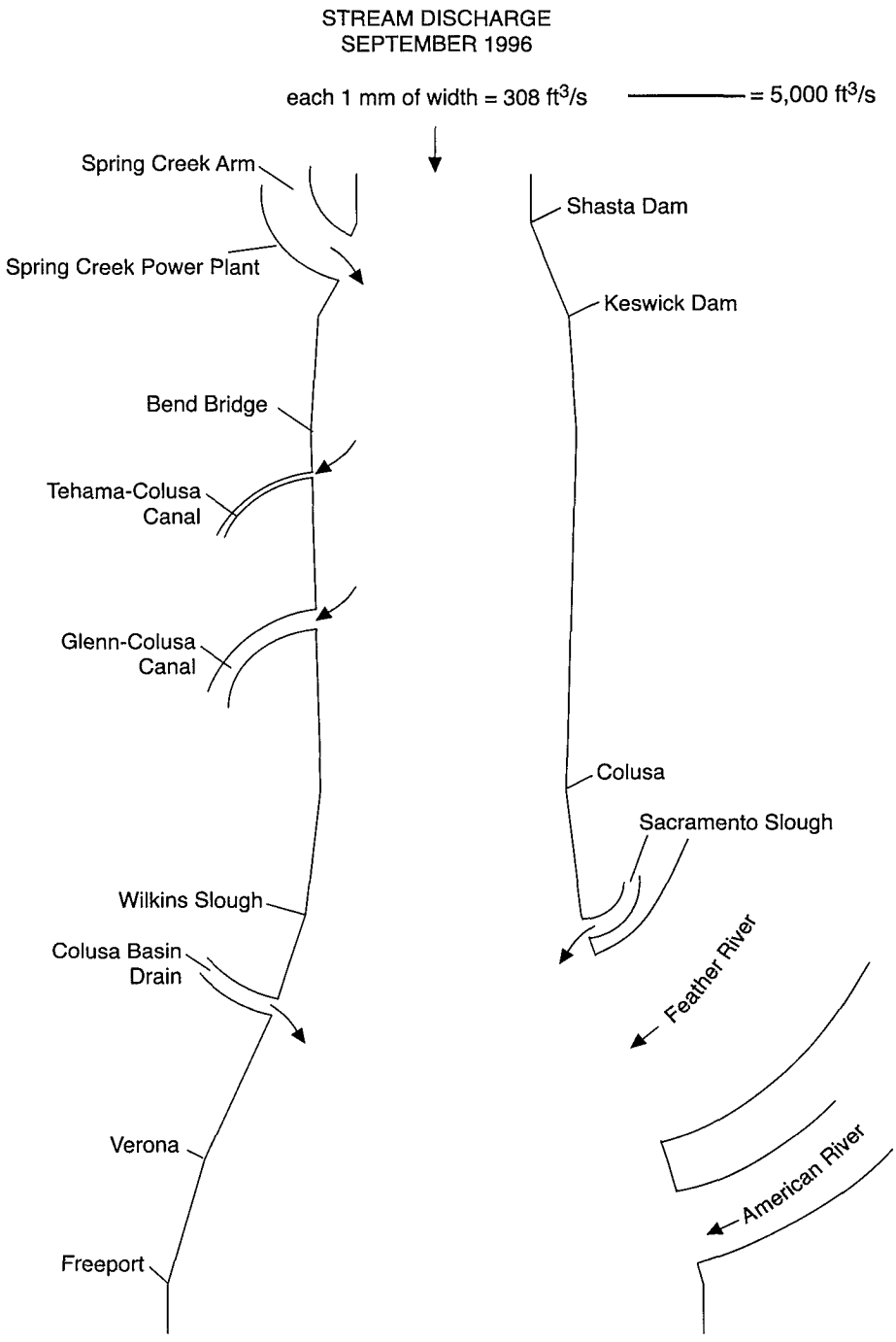

Figure 3*B*. Diagram showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the September 18–26, 1996 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

equivalent colloid concentration, equal to the product of colloid concentration and the concentration of the constituent associated with the colloids, using data listed in Appendix 5 of Alpers and others (2000).

For colloid samples with speciation data from sequential extractions, the speciated colloid loads were calculated in exactly the same way as described above, substituting the speciation concentration data

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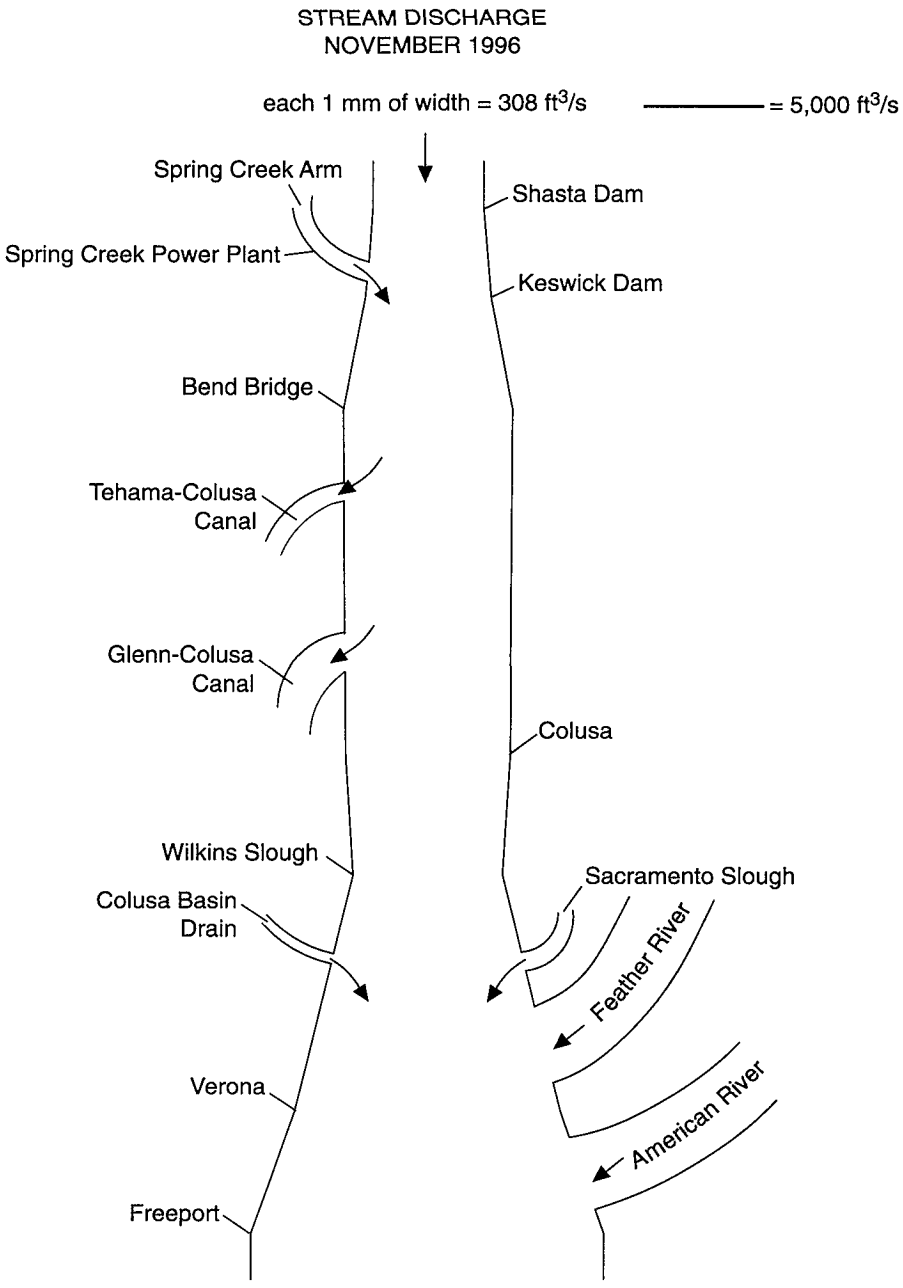

Figure 3C. Diagram showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the November 12–22, 1996 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

(Appendix 5 in Alpers and others, 2000) for the concentration of the constituent in the colloid sample.

Transport Plots

The bar plots in figures 4 through 9 display the dissolved and colloidal loads of Al, Cd, Cu, Fe, Pb, and Zn (respectively) for mainstem Sacramento River sampling sites, during each of the six sampling periods, in downstream order from left to right. These plots have a break in the y-axis, about two-thirds of the distance from the x-axis, above which the scale changes from linear to logarithmic. The bars that cross this axis break are also broken, so that it is easy to distinguish the points plotted on the logarithmic scale. The reason for this construction is that the loads for each metal typically varied over three to four orders of magnitude between the smallest and largest

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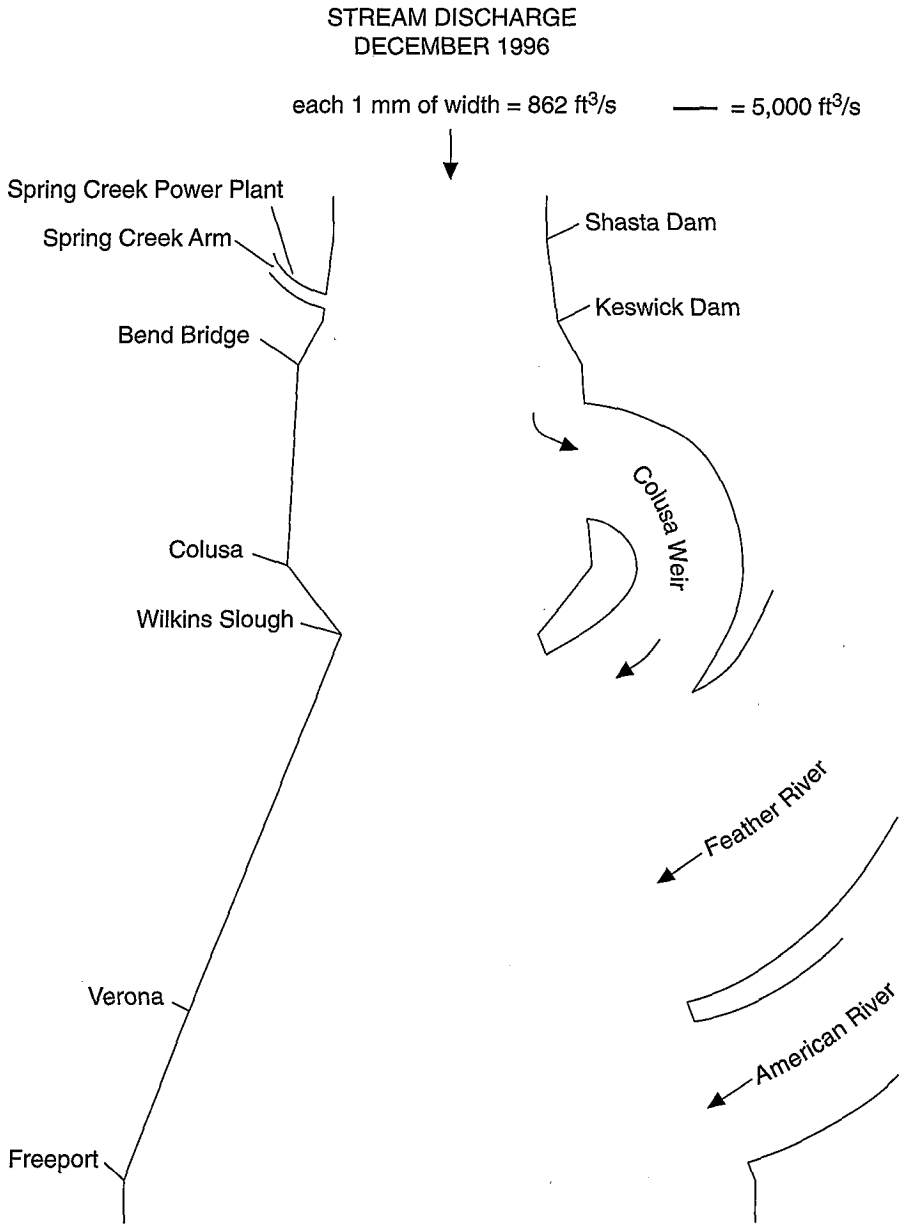

Figure 3*D*. Diagrams showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the December 11–18, 1996 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

measurements. To make direct comparisons between the low-discharge sampling periods (for example, November 1996) and the high-discharge period of January 1997, the broken axis, linear-log plot was chosen.

A complementary group of plots (figs. 10 through 15) shows the transport for each element with a set of six graphs, one for each sampling period. On these graphs, the measured (or estimated) discharges, the calculated concentrations of suspended colloids, and the metal concentrations in the colloid concentrates are shown. Superimposed on each of these graphs is a series of stacked bar graphs denoting the dissolved and colloidal metal loads for each site on a linear scale. The overall heights of the bars are proportional to the total (dissolved plus colloidal) metal load, with the number above the bar denoting the value of the total load, in kilograms per day. It is important to note that each of the six graphs for a given element may have a different vertical scale for each of the three parameters plotted. Whereas figures 4 through 9 compare the various loads at different times

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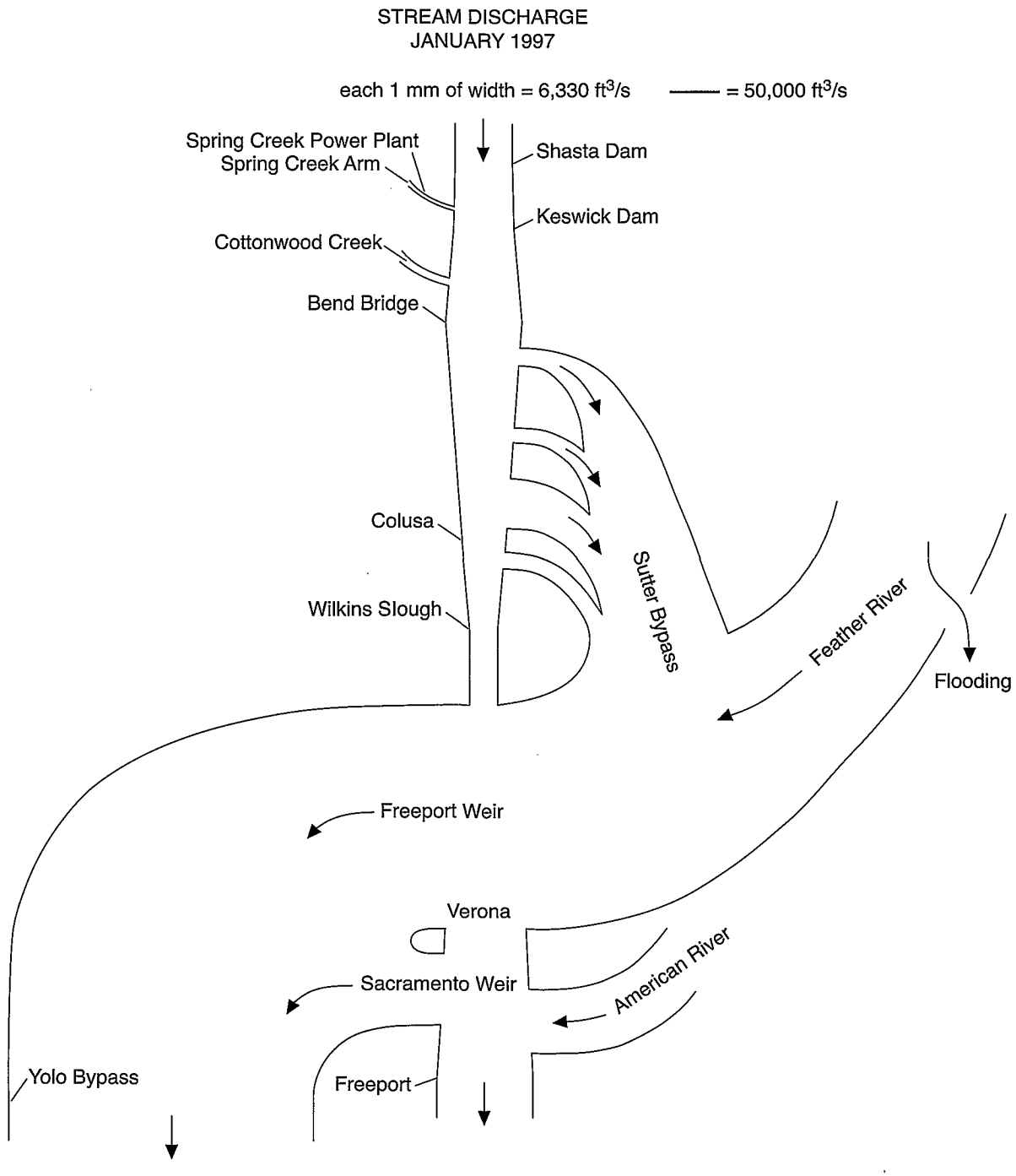

Figure 3*E*. Diagrams showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the January 2–8, 1997 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

of year, figures 10 through 15 show how the loads varied with discharge and colloid concentration, and how the proportion of dissolved loads varied with time and site. The trends and features of these transport graphs are discussed further in later sections of this report.

Load graphs for several other trace elements (chromium [Cr], cobalt [Co], nickel, and yttrium [Y]) are provided for general information in Appendix 5 of this report. The various features of the plots for these other elements are not discussed in this report.

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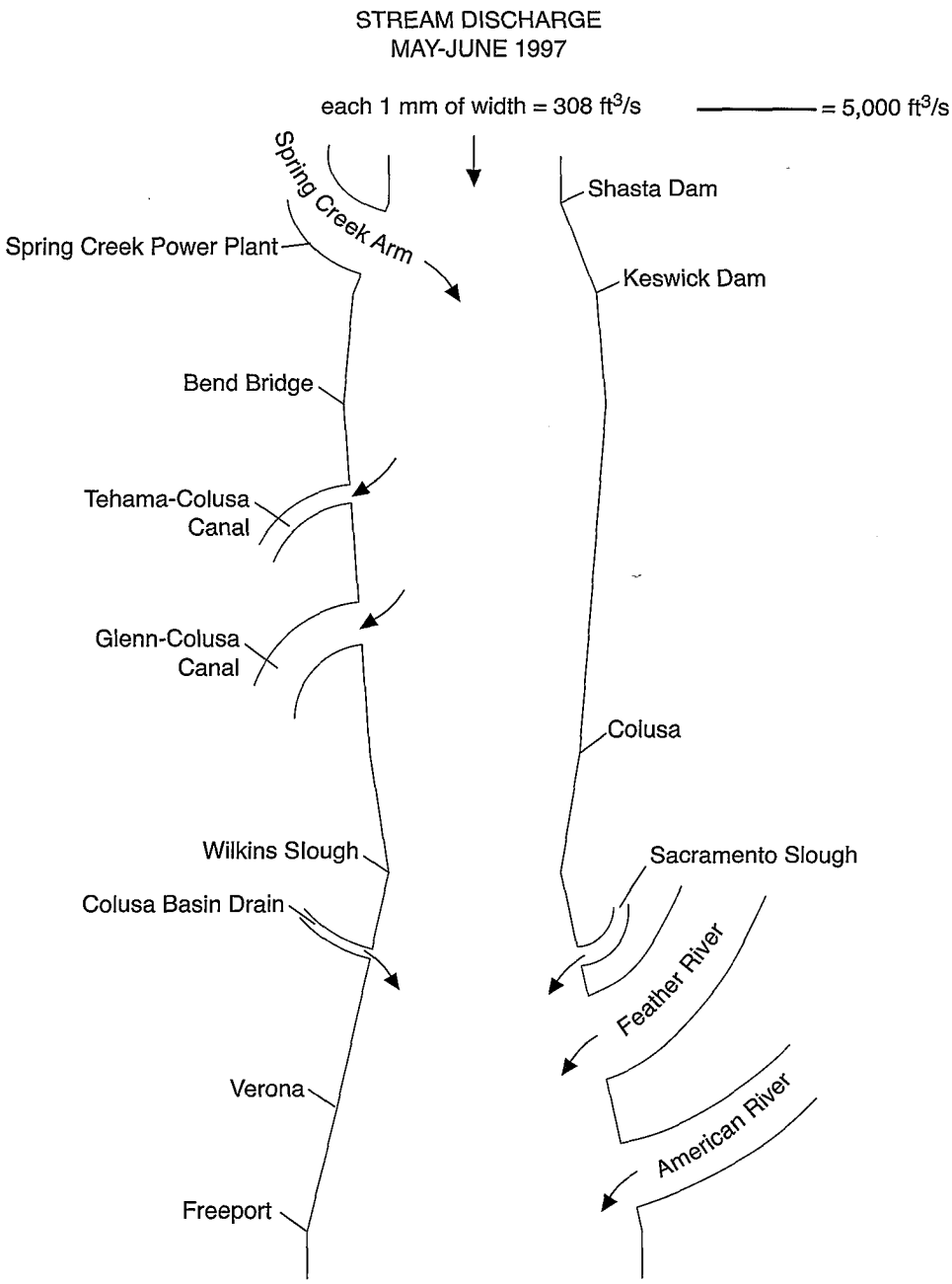

Figure 3F. Diagrams showing magnitude of mean discharge in the Sacramento River, California, relative to major tributaries and diversions during the May 28–June 6, 1997 sampling period. The width of the river is proportional to discharge. ft^3/s, cubic feet per second; mm, millimeter.

Total Recoverable Loads

Total recoverable loads that are based on partial digestions of whole-water samples were calculated in a similar manner to the loads for dissolved and colloidal data. The whole-water concentrations and discharge measurements were taken from Appendices 3 and 4 of the report by Alpers and others (2000). The computed total recoverable (whole-water) loads are tabulated in Appendix 1 of this report.

Metal concentrations from total recoverable analyses of whole-water samples and the sum of the

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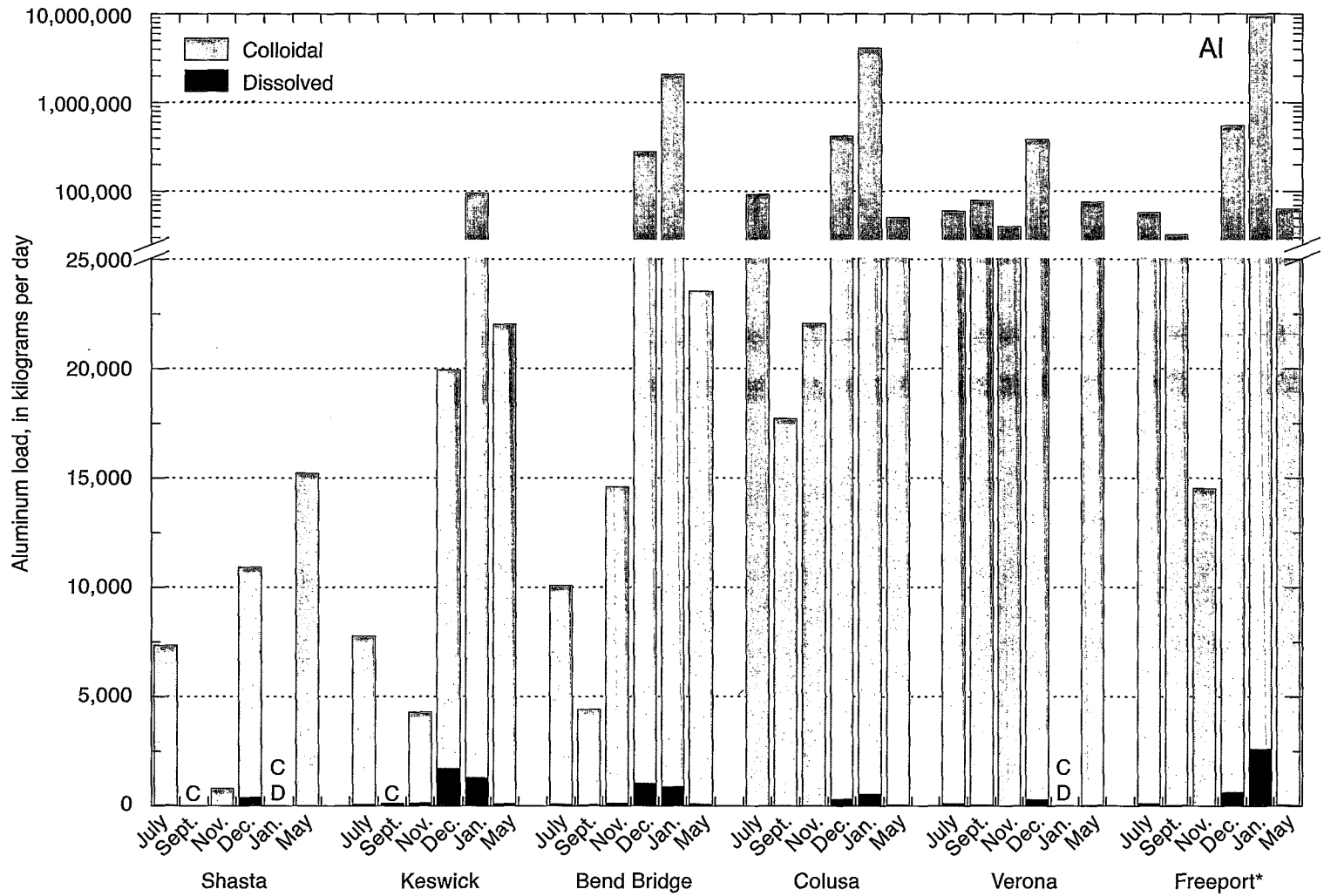

Figure 4. Plot of dissolved and colloidal aluminum loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Al, aluminum; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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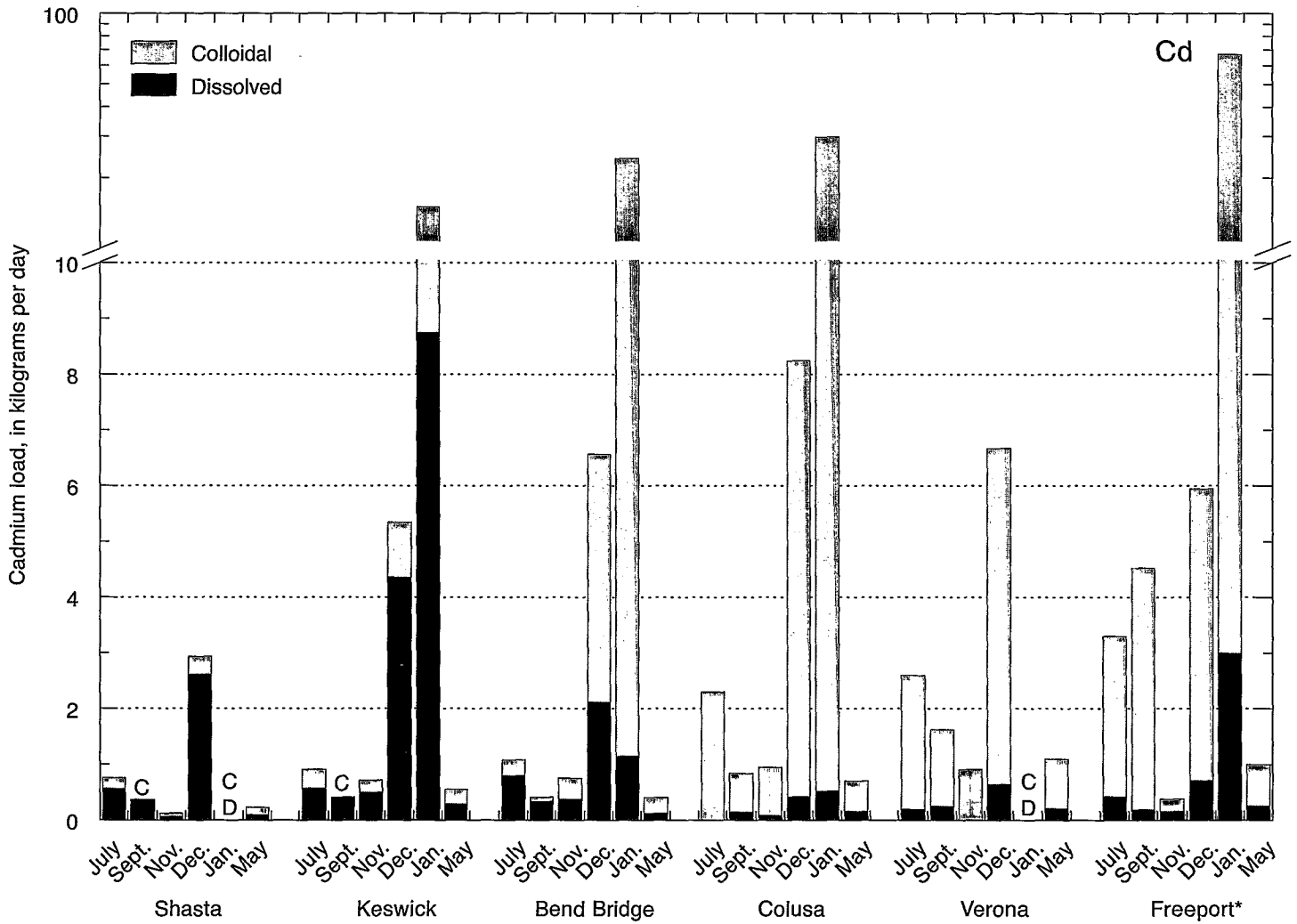

Figure 5. Plot of dissolved and colloidal cadmium loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Cd, cadmium; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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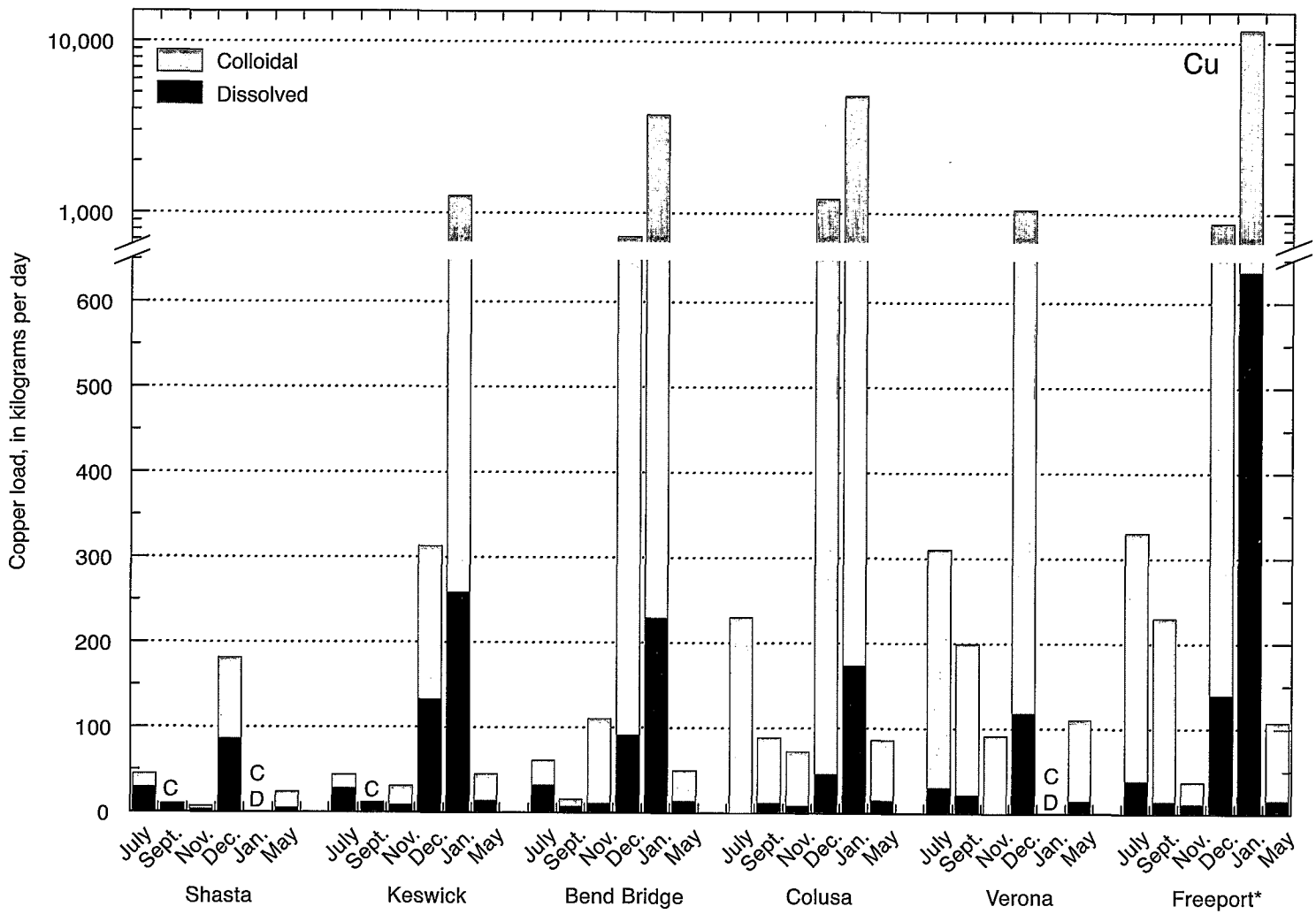

Figure 6. Plot of dissolved and colloidal copper loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Cu, copper; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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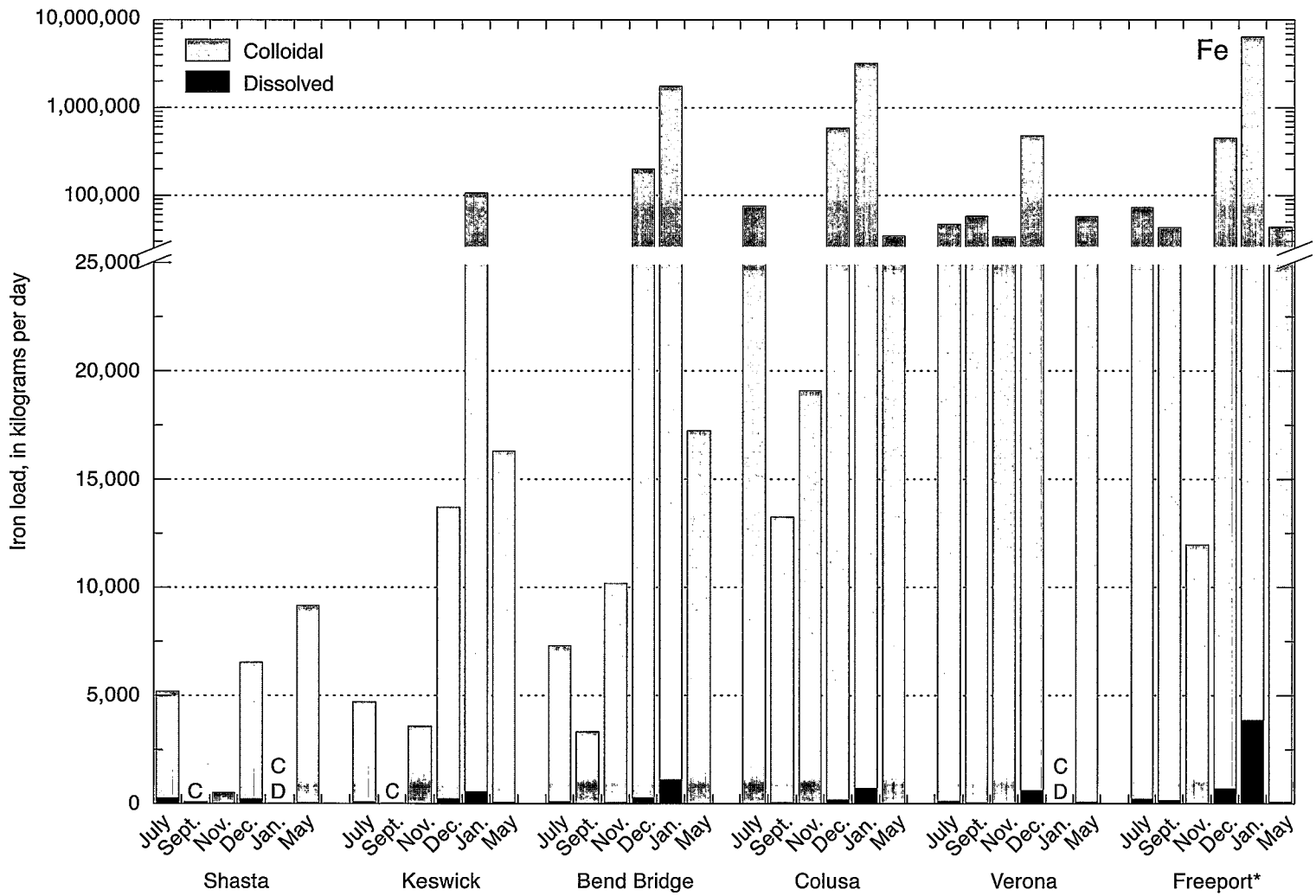

Figure 7. Plot of dissolved and colloidal iron loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Fe, iron; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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Figure 8. Plot of dissolved and colloidal lead loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Pb, lead; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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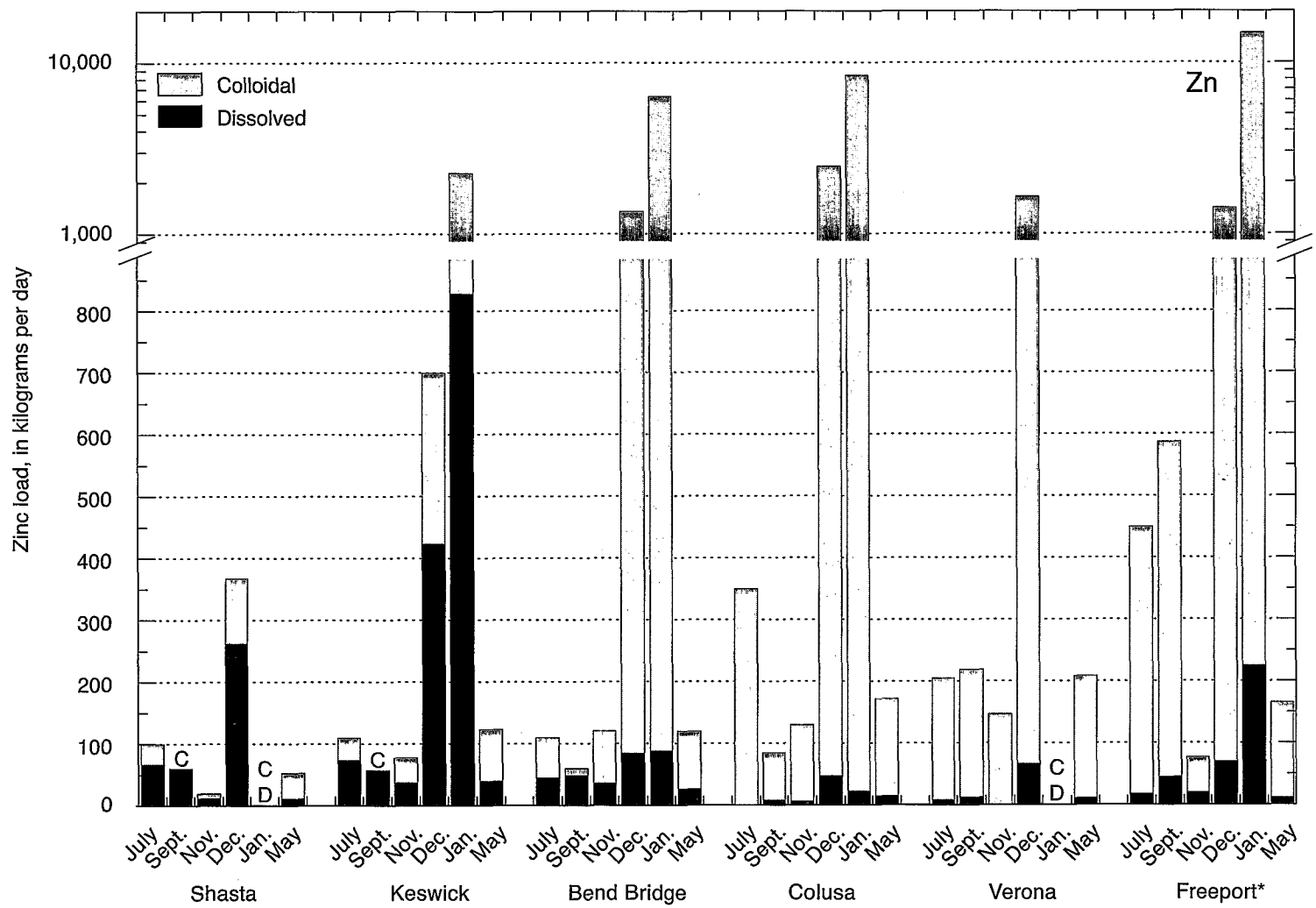

Figure 9. Plot of dissolved and colloidal zinc loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California. Zn, zinc; C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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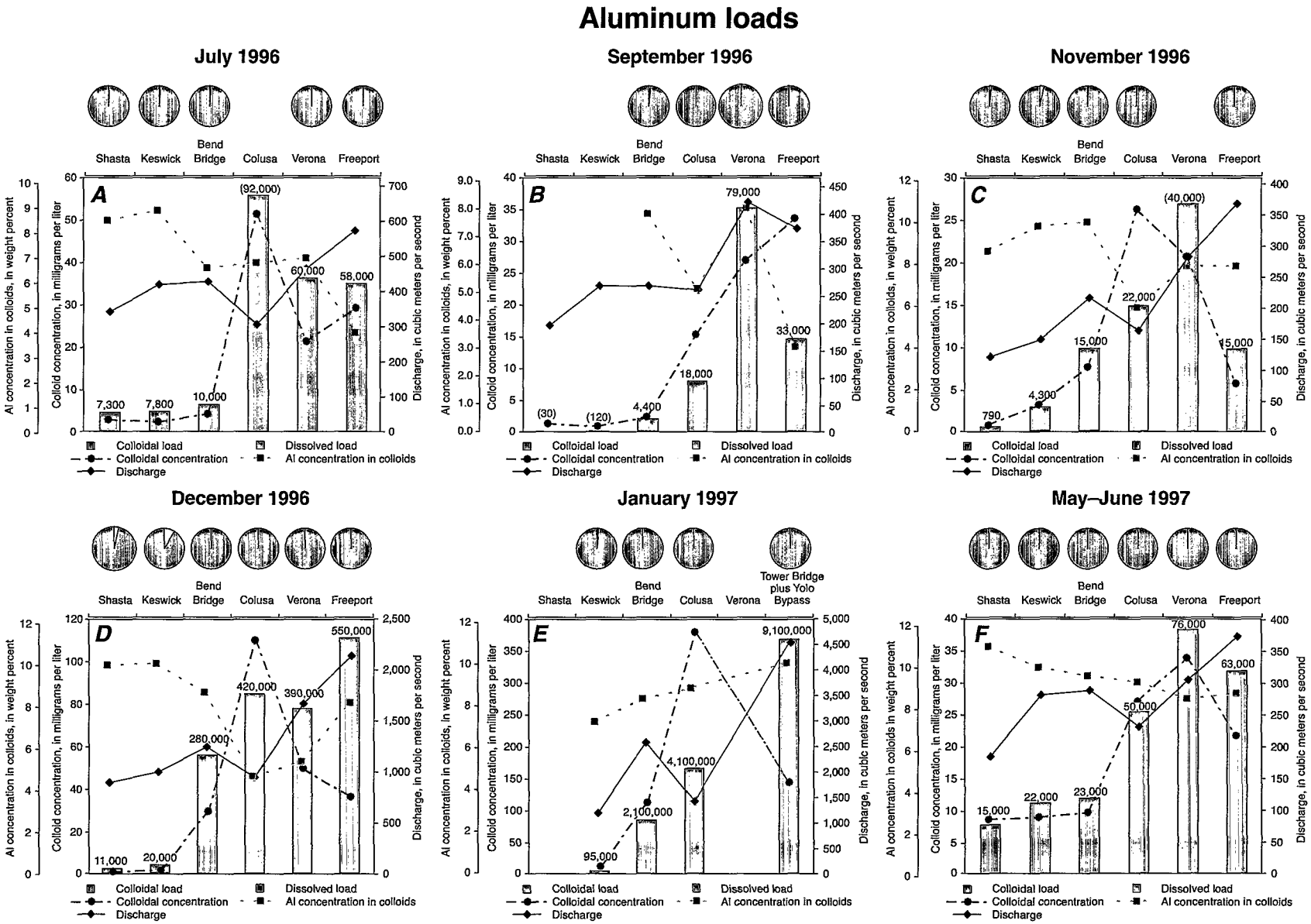

Figure 10. Plots of dissolved and colloidal aluminum loads, colloid concentration, aluminum concentration in colloids, and discharge, Sacramento River, California for *A.* July 1996, *B.* September 1996, *C.* November 1996, *D.* December 1996, *E.* January 1997, and *F.* May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Al concentration in colloids" represents the aluminum concentration in the colloids, in weight percent (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.

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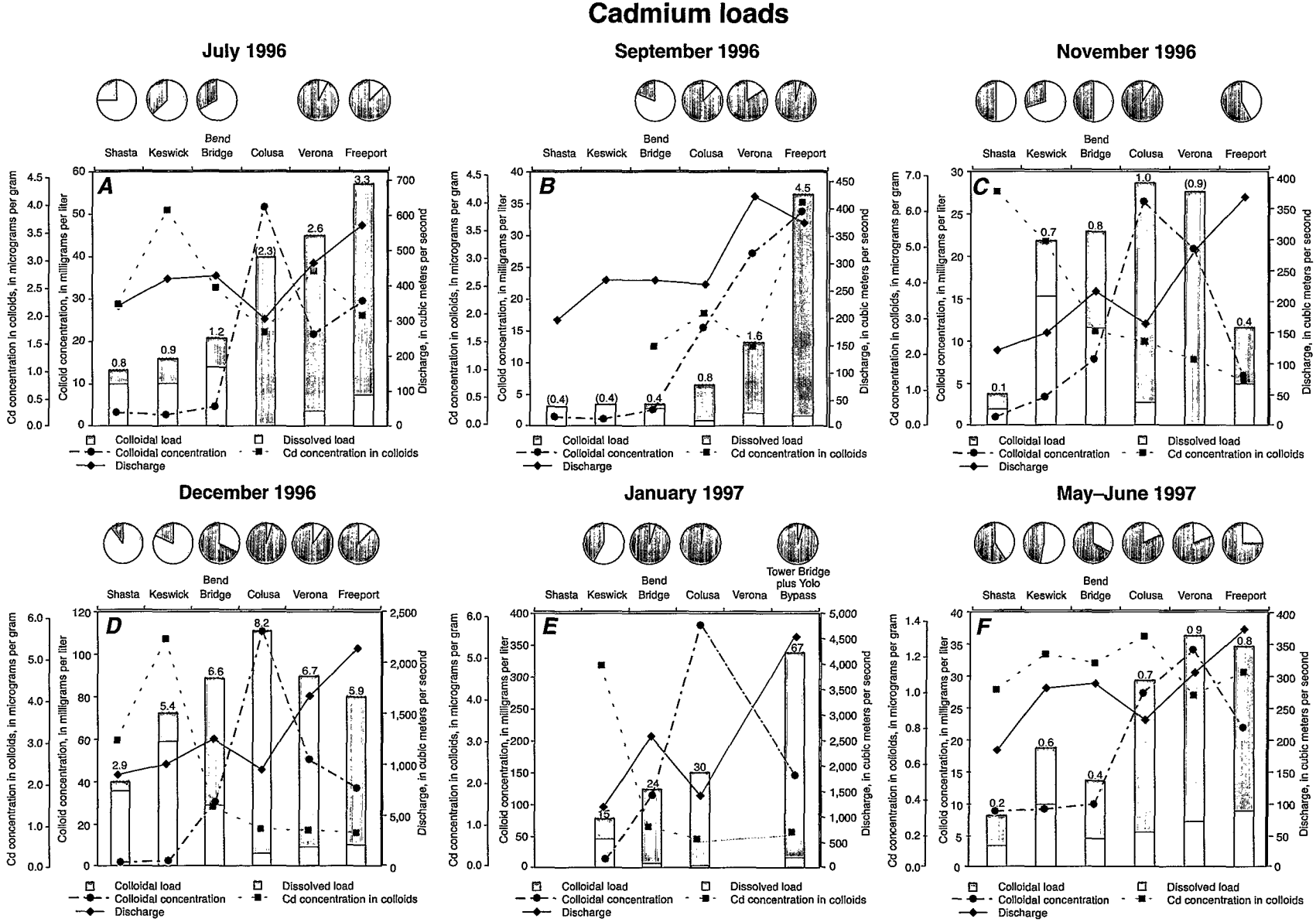

Figure 11. *Plots of dissolved and colloidal cadmium loads, colloid concentration, cadmium concentration in colloids, and discharge, Sacramento River, California for A. July 1996, B. September 1996, C. November 1996, D. December 1996, E. January 1997, and F. May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Cd concentration in colloids" represents the cadmium concentration in the colloids, in micrograms per gram (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.*

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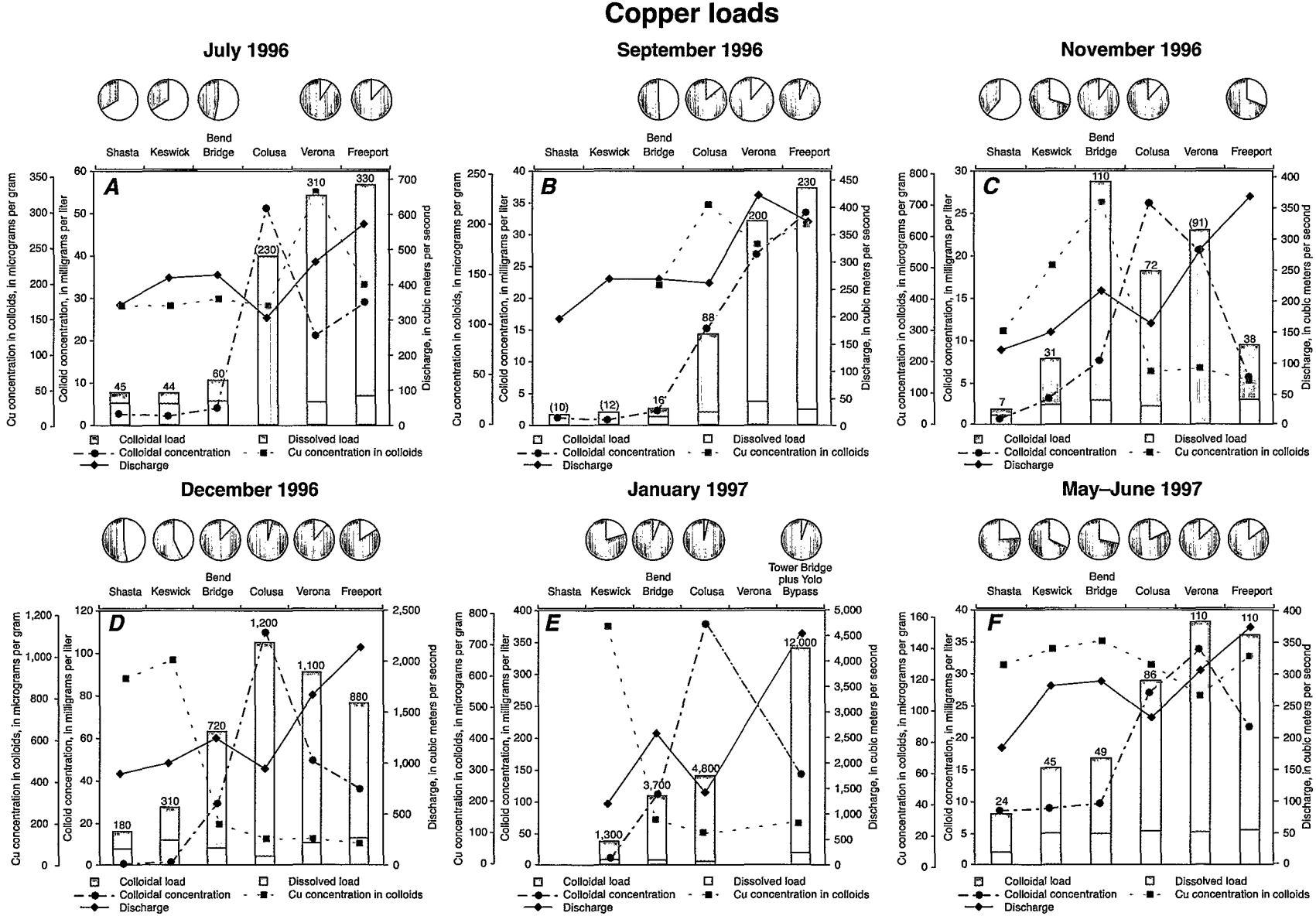

Figure 12. Plots of dissolved and colloidal copper loads, colloid concentration, copper concentration in colloids, and discharge, Sacramento River, California for *A.* July 1996, *B.* September 1996, *C.* November 1996, *D.* December 1996, *E.* January 1997, and *F.* May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Cu concentration in colloids" represents the copper concentration in the colloids, in micrograms per gram (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.

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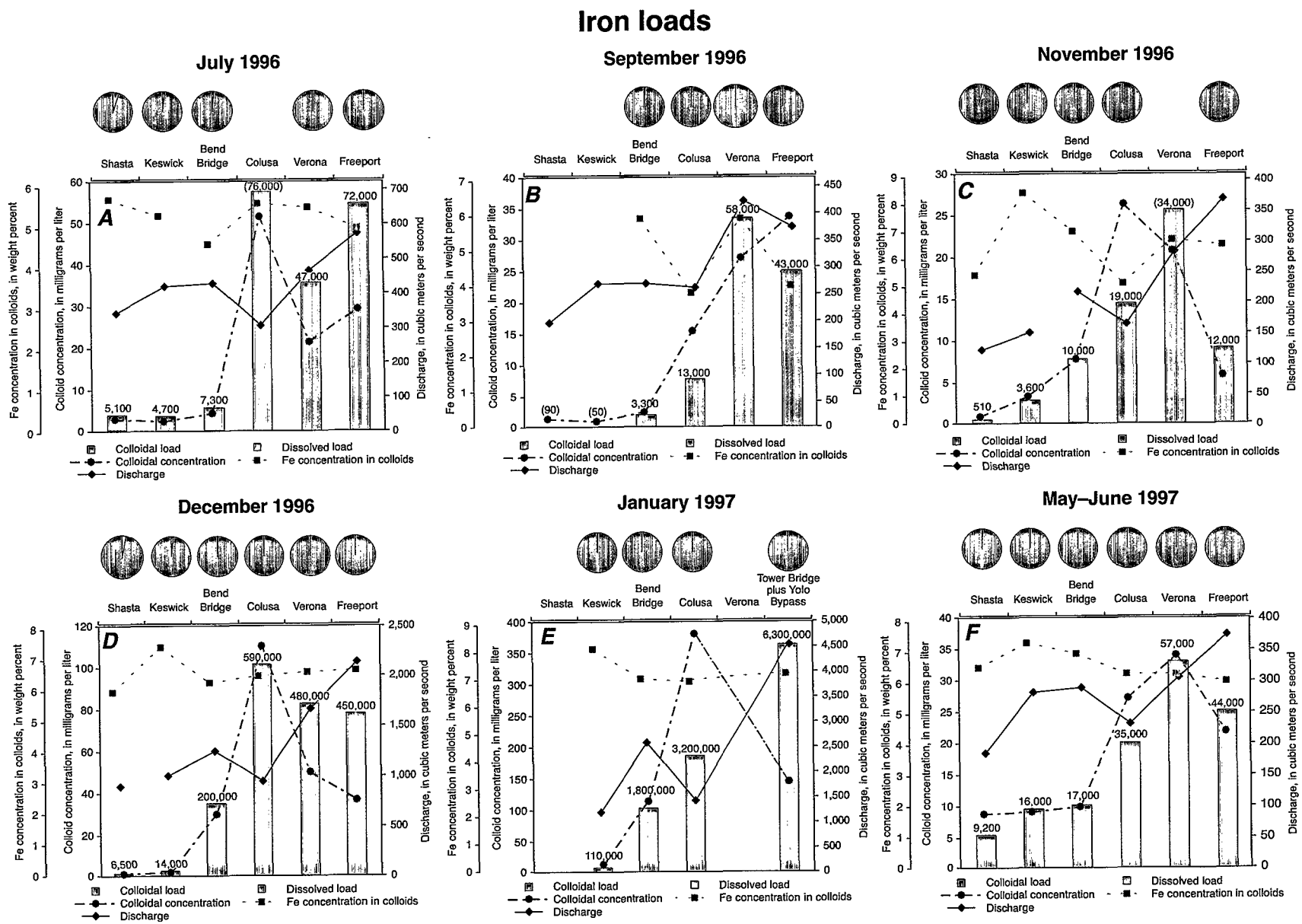

Figure 13. Plots of dissolved and colloidal iron loads, colloid concentration, iron concentration in colloids, and discharge, Sacramento River, California for *A.* July 1996, *B.* September 1996, *C.* November 1996, *D.* December 1996, *E.* January 1997, and *F.* May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available) based on dissolved concentration below detection limit). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Fe concentration in colloids" represents the iron concentration in the colloids, in weight percent (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.

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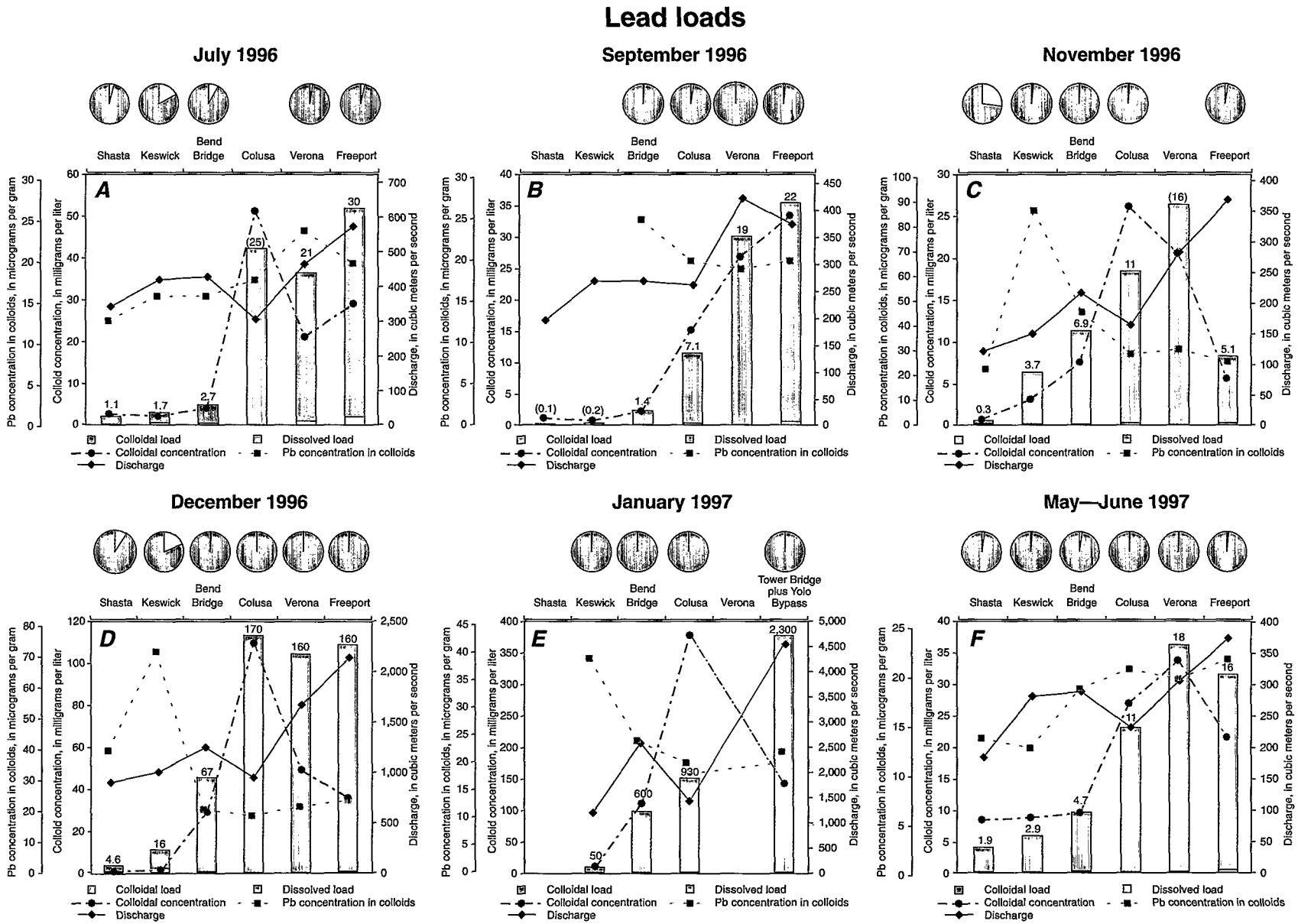

Figure 14. Plots of dissolved and colloidal lead loads, colloid concentration, lead concentration in colloids, and discharge, Sacramento River, California for *A.* July 1996, *B.* September 1996, *C.* November 1996, *D.* December 1996, *E.* January 1997, and *F.* May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Pb concentration in colloids" represents the lead concentration in the colloids, in micrograms per gram (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.

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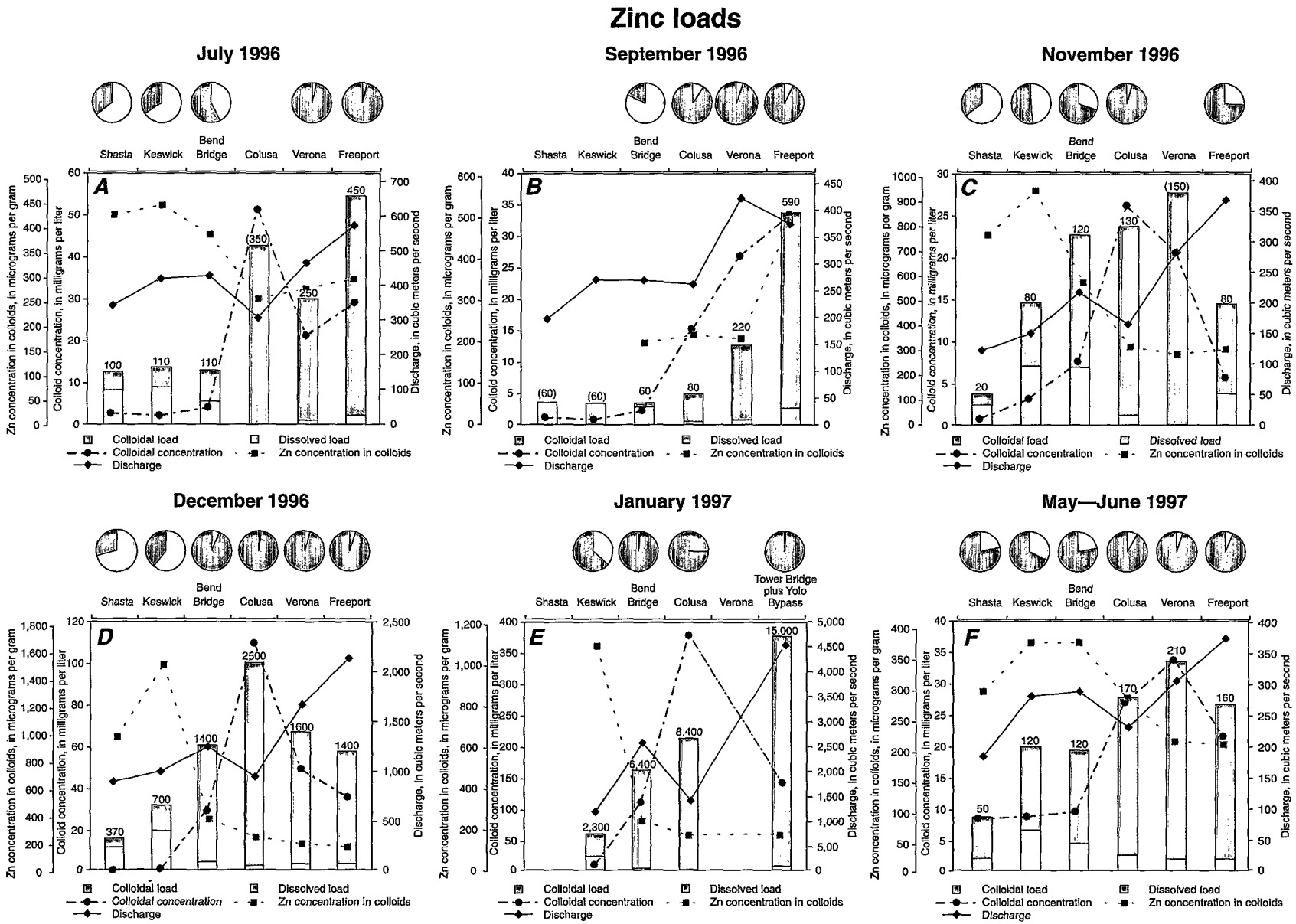

Figure 15. Plots of dissolved and colloidal zinc loads, colloid concentration, zinc concentration in colloids, and discharge, Sacramento River, California for *A.* July 1996, *B.* September 1996, *C.* November 1996, *D.* December 1996, *E.* January 1997, and *F.* May–June 1997. Color scheme: blue, dissolved; yellow, colloidal. Bars represent dissolved and colloidal loads (missing bars indicate that either no sample was taken or that no data are available.) Sums of dissolved and colloidal loads, in kilograms per day, are given at tops of bars (parentheses around numbers indicate colloidal load where no dissolved data are available). Pie charts represent proportions of dissolved and colloidal loads. "Colloid concentration" represents the amount of colloids in water, in milligrams per liter. "Zn concentration in colloids" represents the zinc concentration in the colloids, in micrograms per gram (dry weight). Note: In some cases, vertical scales are not the same for all sampling periods.

equivalent concentrations of the colloids plus the dissolved concentrations were shown to have strong positive correlations for most constituents (Alpers and others, 2000). Because constituent loads are directly proportional to concentrations, the correlations of total-recoverable loads with the sum of colloidal and dissolved loads are identical to the correlations among similar concentrations. Thus, in general, total recoverable (whole-water) loads correlate well with the sum of the dissolved and colloidal loads discussed above.

However, there are three probable causes for those cases where there are systematic differences between the total recoverable (whole-water) loads and the sum of the colloidal and dissolved loads. First, the colloid material was obtained from larger samples that were probably more representative of the river than the smaller samples collected for whole-water determinations. The whole-water samples were 250 mL subsamples taken from 8 to 15 L of water collected in churns, whereas samples collected for the isolation of colloidal material generally were 50 to 100 L of river water per sample. Second, the total recoverable digestion procedure on whole-water samples is a partial digestion involving a hydrochloric acid (HCl) extraction that followed field preservation with nitric acid (HNO_3), a procedure that does not completely dissolve recalcitrant minerals. In contrast, the colloidal material was completely decomposed using an HCl–HNO_3–HF (HF is hydrofluoric acid) total digestion procedure (Alpers and others, 2000). Finally, the whole-water samples may have contained both silt- and sand-sized material in addition to colloidal material, because they were subsampled prior to size separation. Sand and silt would be (at most) minor components of the colloidal samples because the 25-L carboys containing the colloid samples were allowed to settle at least one hour prior to sample filtration.

Colloid Speciation Data

There were three sampling periods for which metals speciation data from colloids were collected using sequential extraction techniques: December 1996, January 1997, and May–June 1997. The sequential extractions consisted first of a chemical reduction step with HCl-acidified hydroxylamine hydrochloride designed to remove metals weakly bound to the sediment and those associated with iron or manganese oxide coatings. This fraction is referred to as the "reducible phase." The residue from this extraction was treated with a potassium persulfate solution to oxidize any organic coatings or organic particles. This fraction is referred to as the "oxidizable phase." Finally, an HCl–HNO_3–HF acid microwave digestion, identical to that used for total digestions, was performed on the residue from the oxidizable phase extraction. This fraction is termed the "residual phase."

The speciated loads of cadmium, copper, lead, and zinc based on sequential extraction of colloid concentrates are represented graphically in figures 16 *(A–D)*, 17 *(A–D)*, and 18 *(A–D)* for December 1996, January 1997, and May–June 1997, respectively. Each figure has two sets of pie charts and a map of the Sacramento River area; the set in red and blue displays the relative proportion of dissolved and colloidal loads to the total load, similar to the pie charts in figures 10 through 15. However, the pie charts in figures 16 through 18 differ from those in figures 10 through 15 in that the areas of the pies in figures 16 through 18 are proportional to the constituent load at each site, and they show available data from tributaries.

The second set of pie charts colored orange, green, and yellow on figures 16 through 18 represent the proportions of the constituent colloidal load that were associated with reducible, oxidizable, and residual phases, as just described. Similar to the red and blue pie charts showing dissolved and colloidal loads, the areas of the pies showing colloidal speciation are proportional to the total colloidal loads. These plots show how the various forms of the metals change with downstream transport, both proportionally and in absolute quantity. The trends on these graphs are discussed in later sections of this report.

Uncertainties in Metal Loads

Uncertainties in metal-load data consist of a combination of uncertainties from the concentration data and the discharge data that are multiplied together to compute the loads. Uncertainties in concentration data arise from variations in both accuracy and precision. The accuracy of trace element data in this study was determined using frequent analysis of standard reference materials (SRM) and spike recoveries, both of which show accuracy consistent with the project's data quality objectives (Alpers and others, 2000). Replicate laboratory determinations were used to

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estimate analytical precision. For analyses in concentration ranges greater than ten times the detection limit, variability in precision generally was less than 5 percent of the amount present. In the concentration range less than ten times the detection limit, deter-minations are less precise and, therefore, the uncertainties are greater. In this study, with regard to the metals of principal concern (Al, Cd, Cu, Fe, Pb, and Zn) the detection limit was important only for dissolved samples, that is the ultrafiltrates that passed through 10,000 NMWL tangential-flow ultrafilters (equivalent to 0.005-μm pore-size diameter). Dissolved aluminum, cadmium, iron, and lead concentrations at some localities were near the detection limits; therefore, the analytical uncertainties associated with dissolved loads for these constituents are relatively high, perhaps as high as 50 percent. Dissolved copper and zinc concentrations were generally greater than ten times the detection limits, so the analytical uncertainties associated with dissolved copper and zinc concentrations are much lower, probably in the range of 3 to 5 percent. This variance does not take into account the potential problems related to the collection of a representative field sample. The estimation of the magnitude of that variability is beyond the scope of this study.

Colloids were freeze dried and digested prior to analysis. Analytical uncertainties in colloid analyses come from the digestion methods and the fact that aluminum analyses were used as a basis for converting the solid concentrations to equivalent colloid concentrations (Alpers and others, 2000). On the basis of precision data from replicate analyses, it is estimated that the analytical uncertainty on colloid analyses is about 5 percent for most elements, which is consistent with the reporting of most concentration data to two decimal places.

The other major component of uncertainty in the calculated metal loads is the uncertainty in stream discharge data. Most samples were collected at, or close to, stream gaging stations operated by the USGS. River stage (elevation of the water surface) is continuously recorded at each gage, and instantaneous discharge measurements are made at the site during the year, including critical times of very high or very low flows. These instantaneous measurements of gage height and discharge are used to determine a stage-discharge relationship (rating) for each station. The rating is used with the continuous gage height record to develop a continuous record of discharge. The accuracy of discharge records at these sites is dependent on the stability of the stage-discharge relation and the accuracy of instantaneous measurements of stage and discharge used to develop the rating. The daily mean discharges from gaged sites used in this report are considered accurate to within 10 percent of the discharge 95 percent of the time (Rockwell and others, 1998).

The Colusa Basin Drain site was not gaged, so discharge was measured at the time of sample collection using current meter methods described by Rantz and others (1982). Considering the channel characteristics of this site, measurements are typically accurate to within 5 percent of the measured flow (Sauer and Meyer, 1992).

Discharge measurements for the Sacramento River below Shasta Dam and below Keswick Dam were determined from outflow records for Shasta and Keswick dams. Release rates from Shasta Dam, Keswick Dam, and the Spring Creek Power Plant (SCPP) were provided by the Bureau of Reclamation. Accuracy of the data from Shasta Dam, Keswick Dam, and the SCPP is believed to be within 2 percent of the recorded values (Valerie Ungvari, Bureau of Reclamation, oral commun., November 17, 1999). Discharge from the Spring Creek arm of Keswick Reservoir was determined by adding flows released from the SCPP and flows from the gaging station on Spring Creek. Uncertainty is likely between 2 and 10 percent, depending on relative flows from the two sources.

Combining the information about uncertainty from the concentration and discharge data, the minimum uncertainty is 10 to 15 percent, with approximately half of the uncertainty from concentration measurements and half from the discharge estimates. This would be consistent with reporting all metal loads to one significant figure. This minimum uncertainty relates to the accuracy of the loads. Because the precision of the loads is considered better than the accuracy, loads are presented in this report with two significant figures so that relative comparisons can be made.

Discussion of Spatial and Temporal Variations in Metal Loads

The observations that follow focus mainly on four trace elements: cadmium, copper, lead, and zinc. In addition, variations in iron and aluminum loads are described; these two elements are major components

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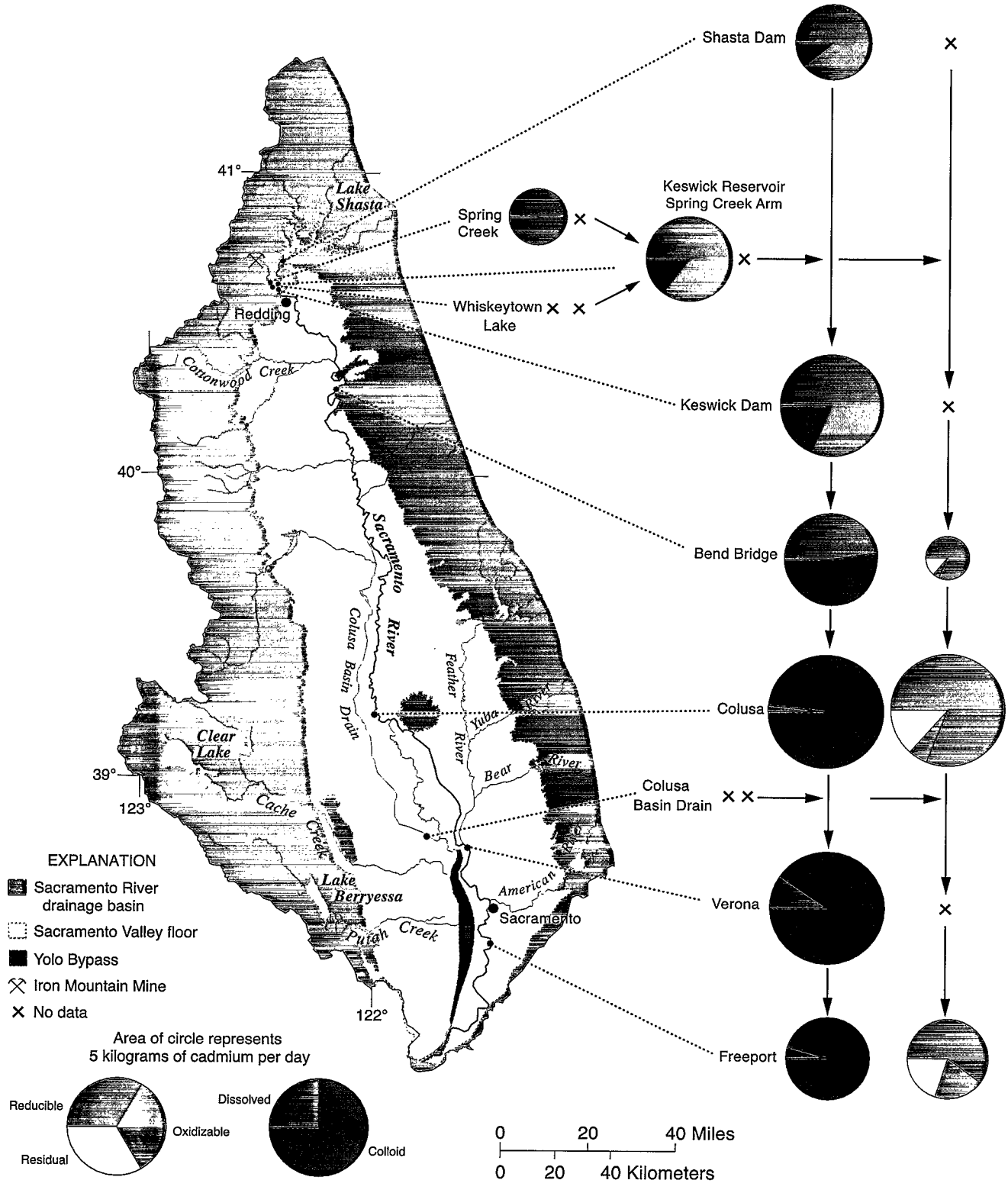

Figure 16*A*. Distribution and speciation of colloidal cadmium loads during December 1996, Sacramento River, California, and selected tributaries.

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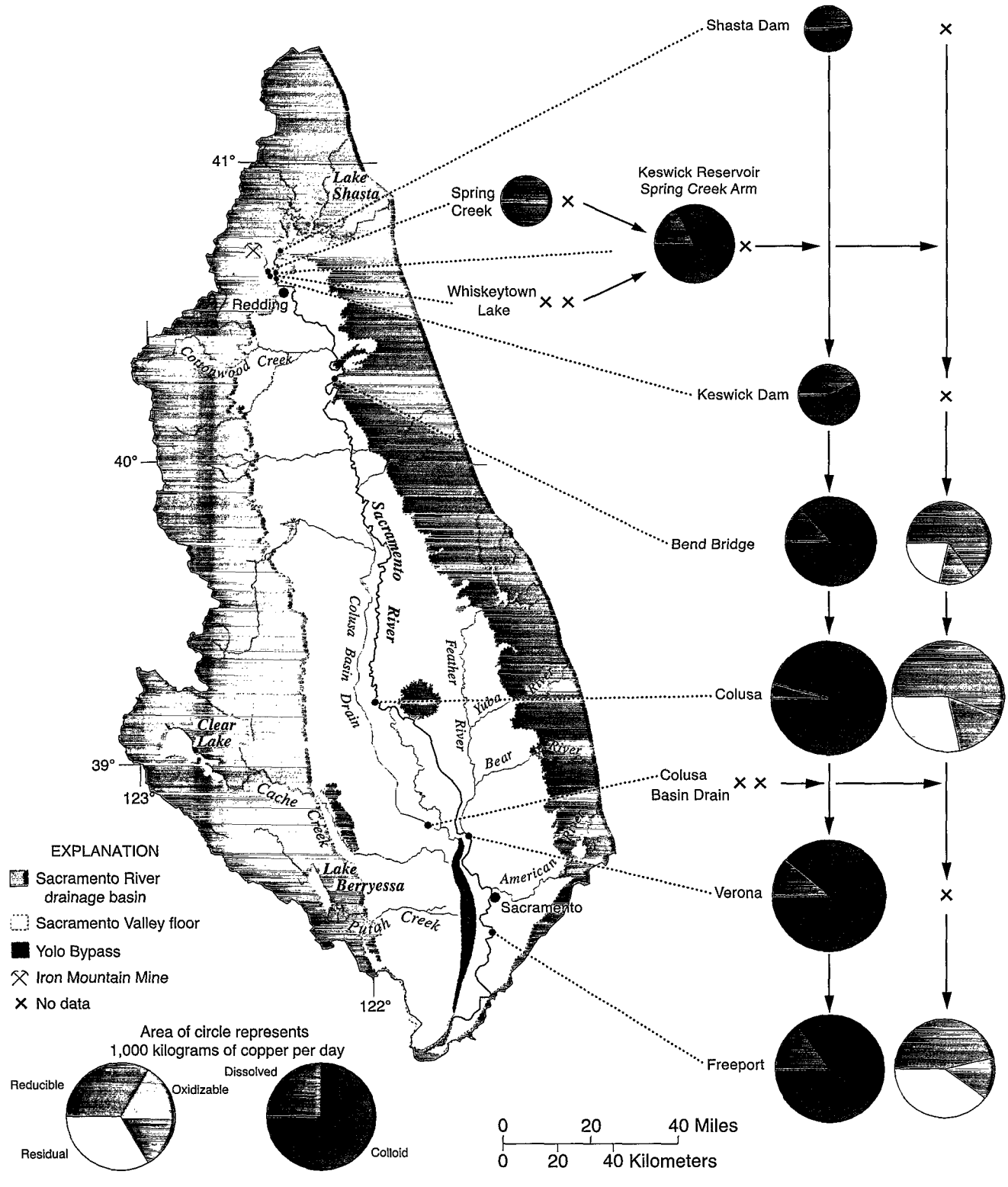

Figure 16*B*. Distribution and speciation of colloidal copper loads during December 1996, Sacramento River, California, and selected tributaries.

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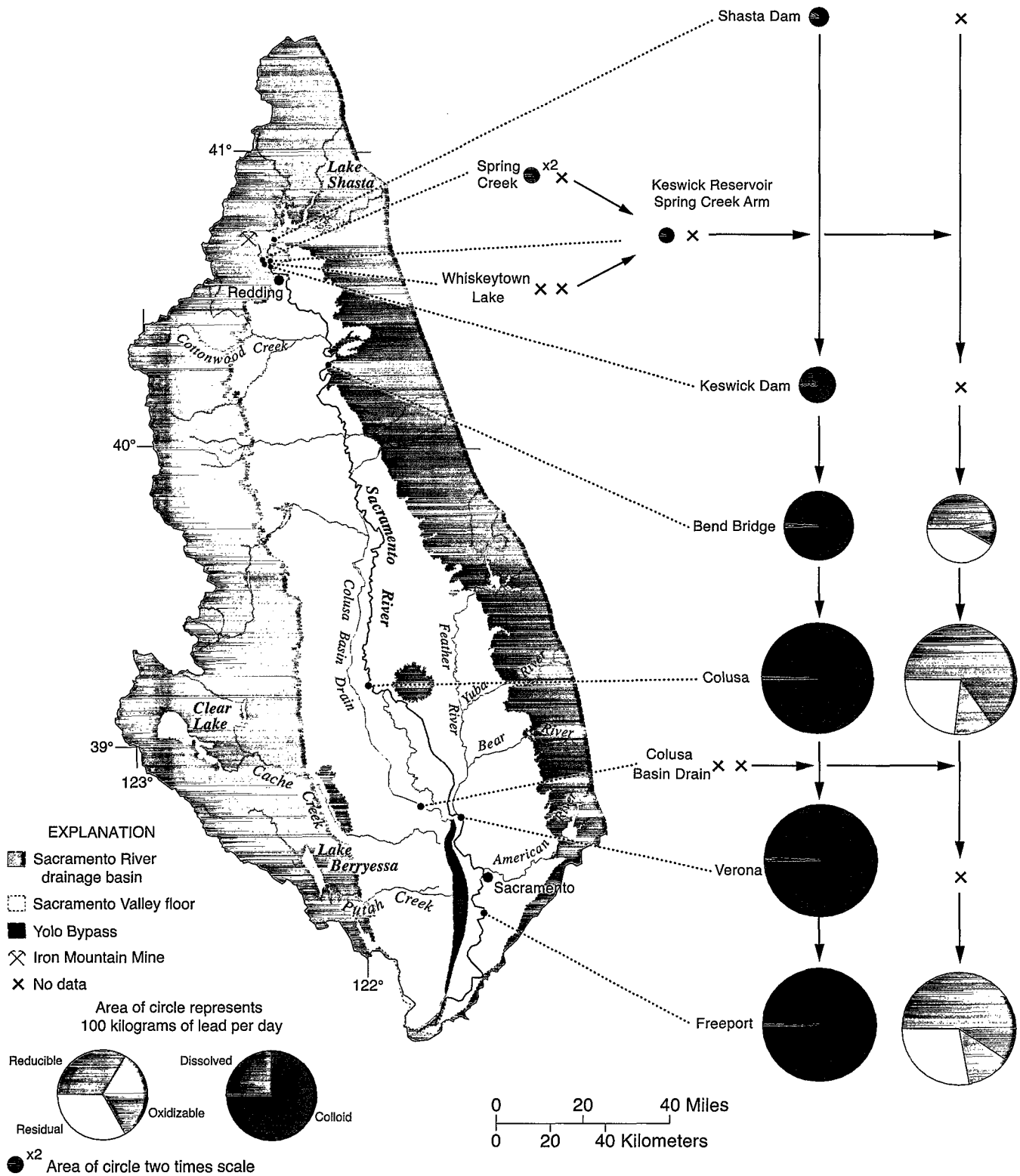

Figure 16*C*. Distribution and speciation of colloidal lead loads during December 1996, Sacramento River, California, and selected tributaries.

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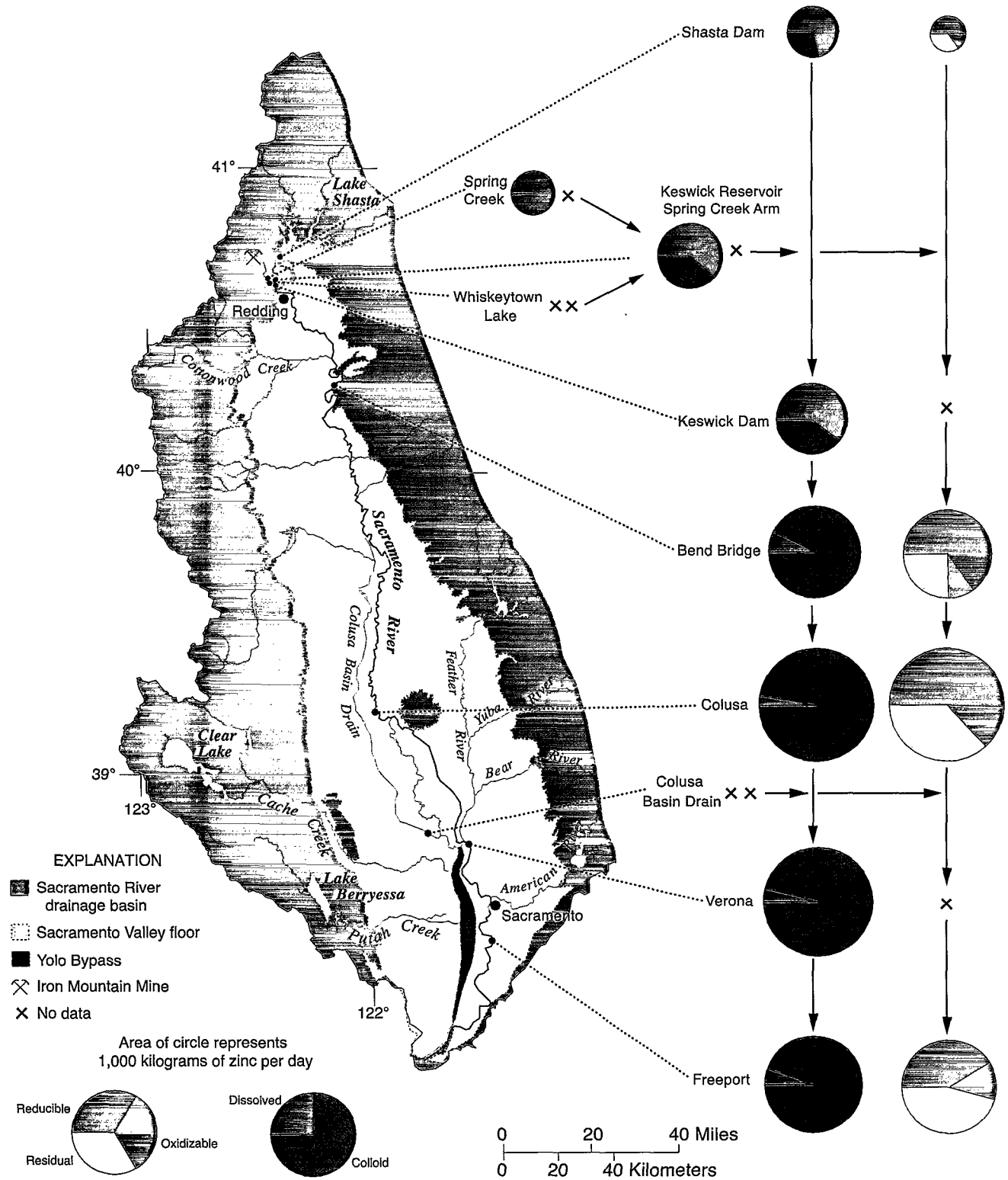

Figure 16*D*. Distribution and speciation of colloidal zinc loads during December 1996, Sacramento River, California, and selected tributaries.

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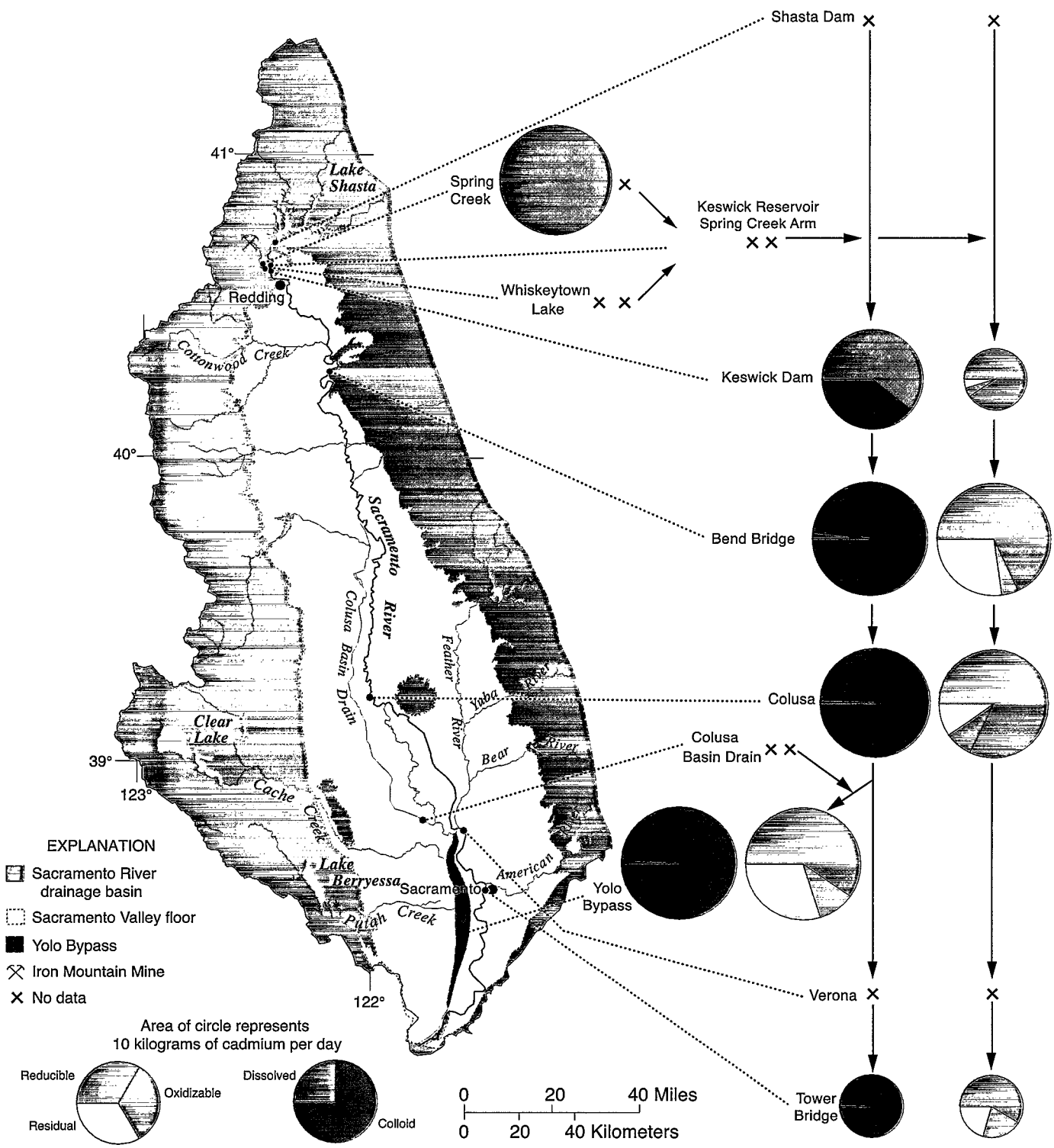

Figure 17*A*. Distribution and speciation of colloidal cadmium loads during January 1997, Sacramento River, California, and selected tributaries.

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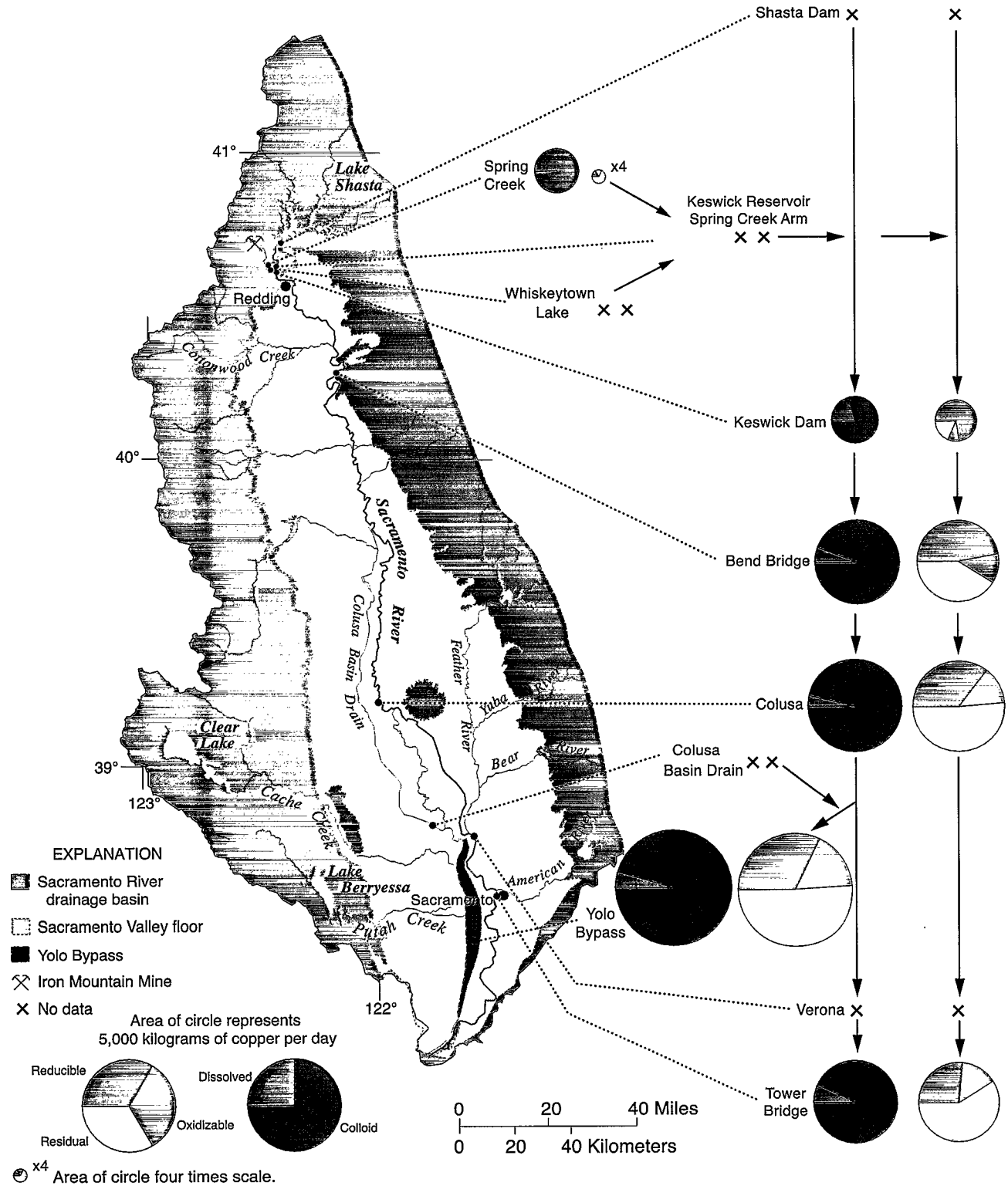

Figure 17*B*. Distribution and speciation of colloidal copper loads during January 1997, Sacramento River, California, and selected tributaries.

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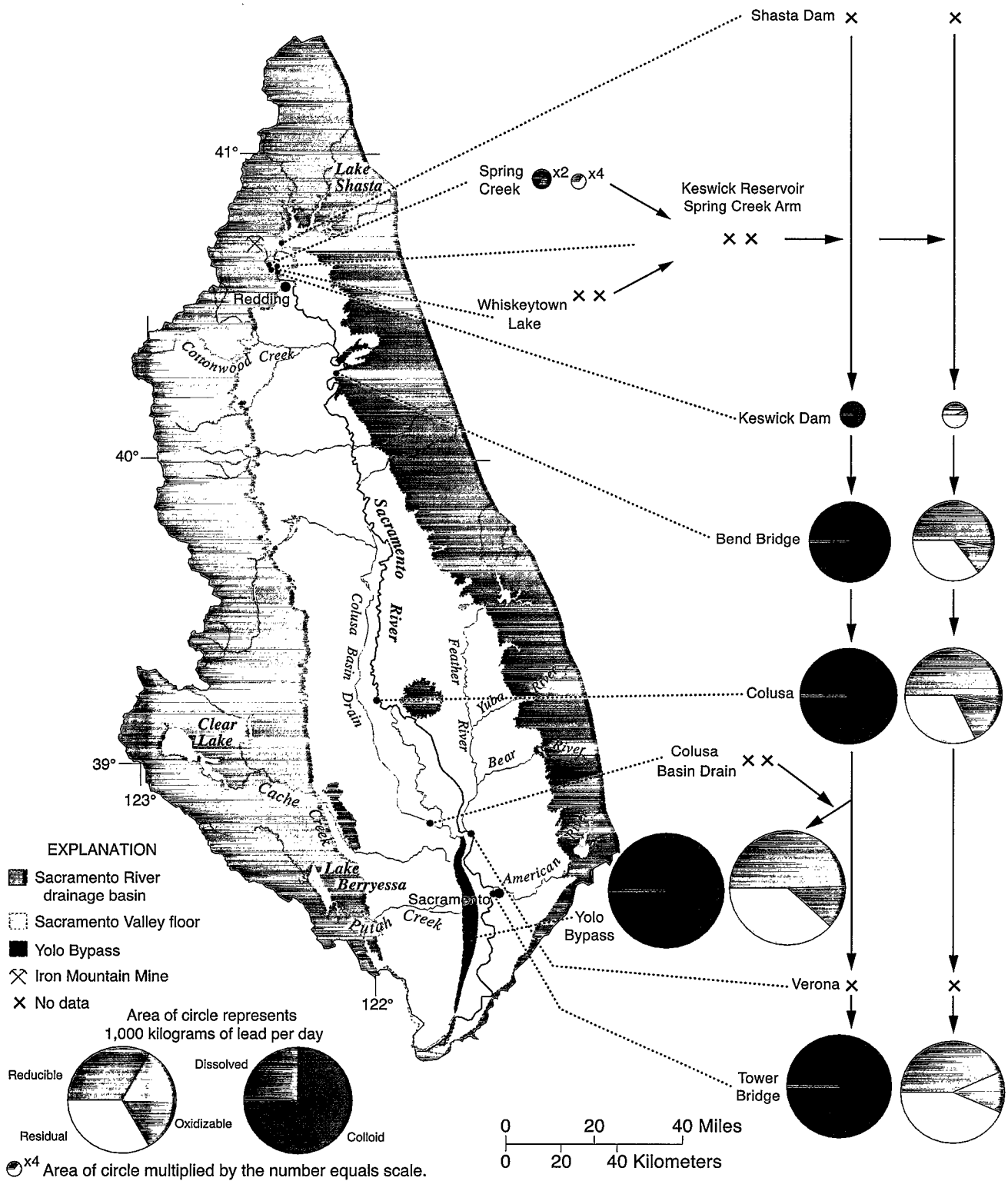

Figure 17*C.* Distribution and speciation of colloidal lead loads during January 1997, Sacramento River, California, and selected tributaries.

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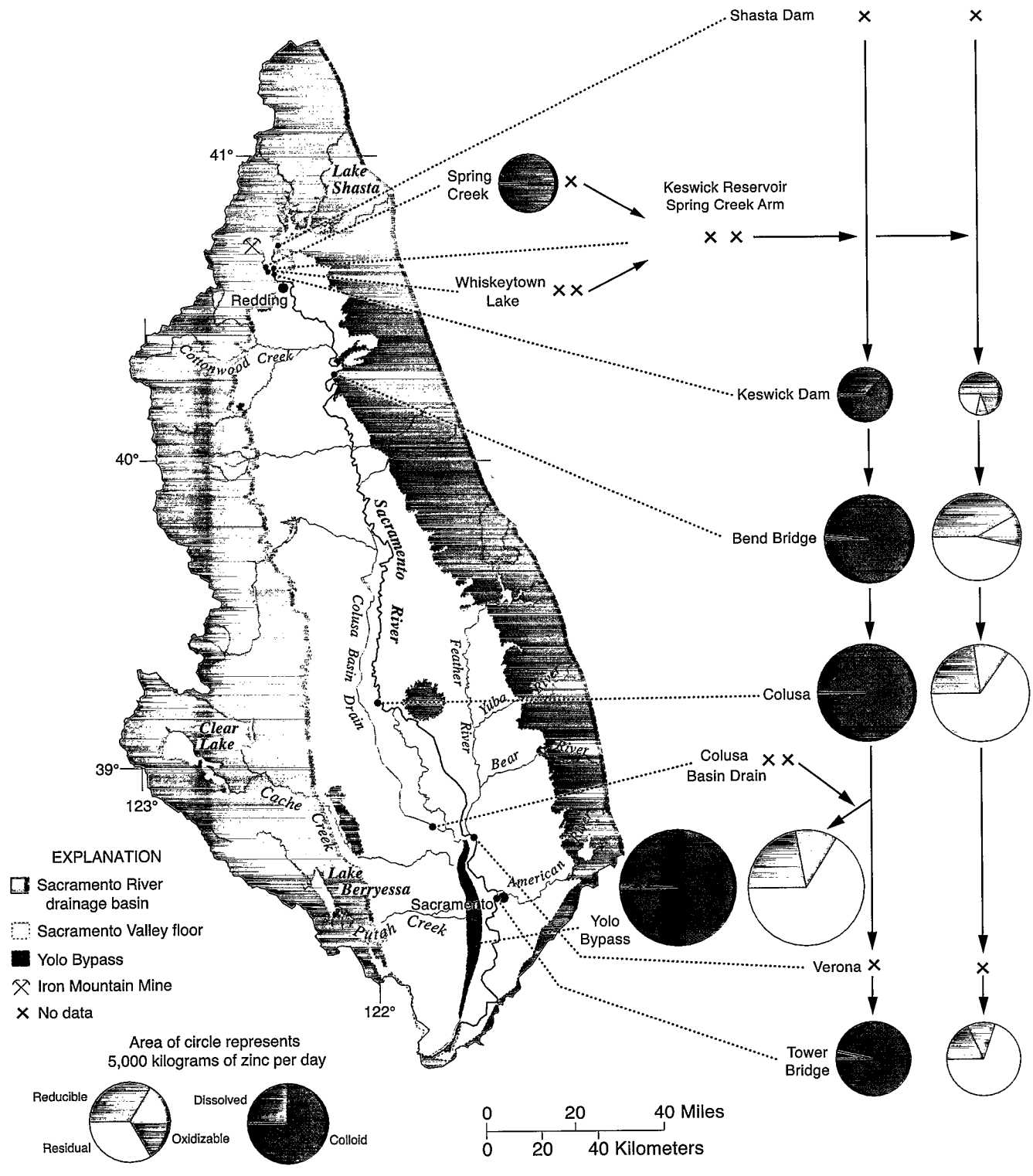

Figure 17*D*. Distribution and speciation of colloidal zinc loads during January 1997, Sacramento River, California, and selected tributaries.

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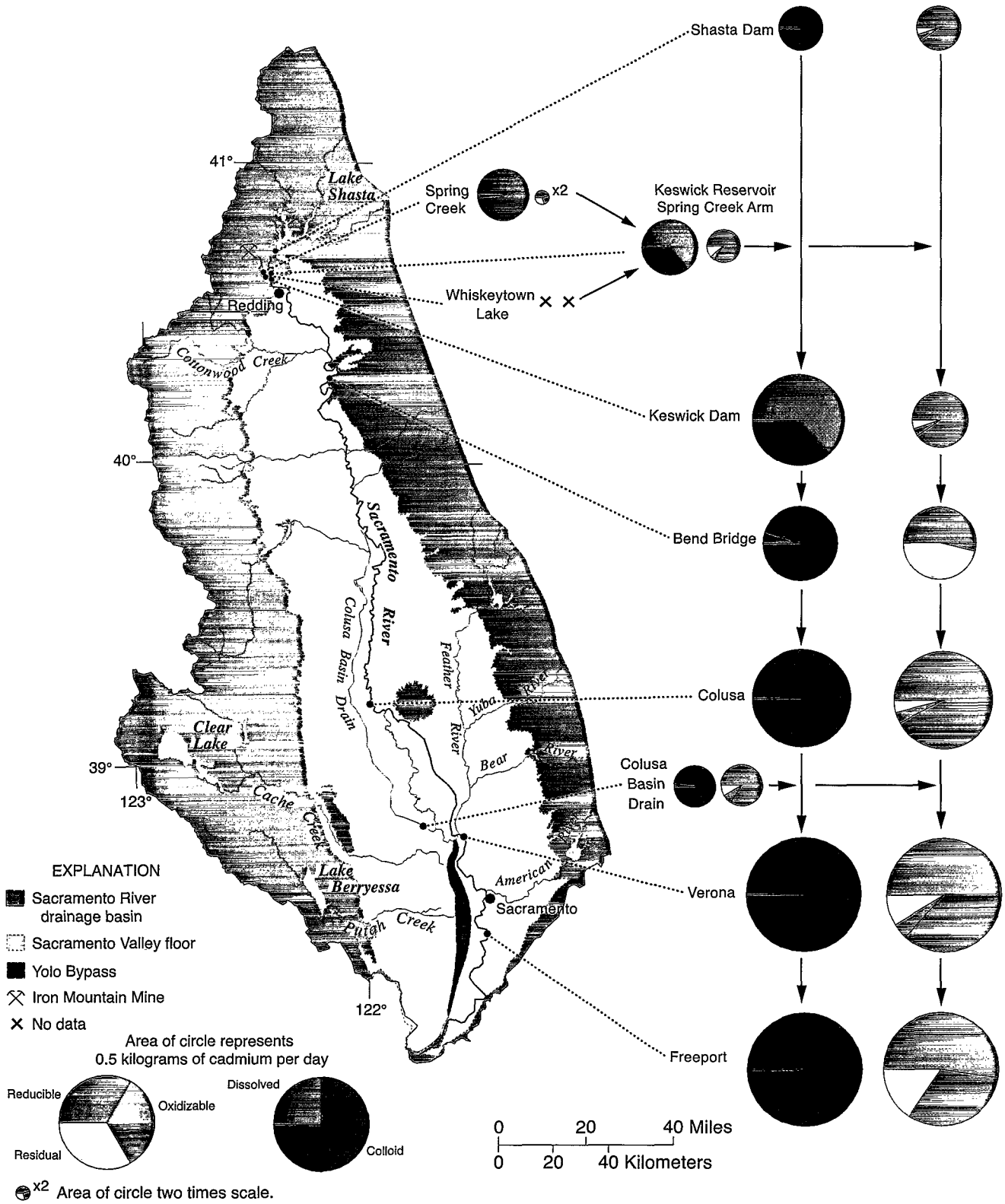

Figure 18A. Distribution and speciation of colloidal cadmium loads during May–June 1997, Sacramento River, California, and selected tributaries.

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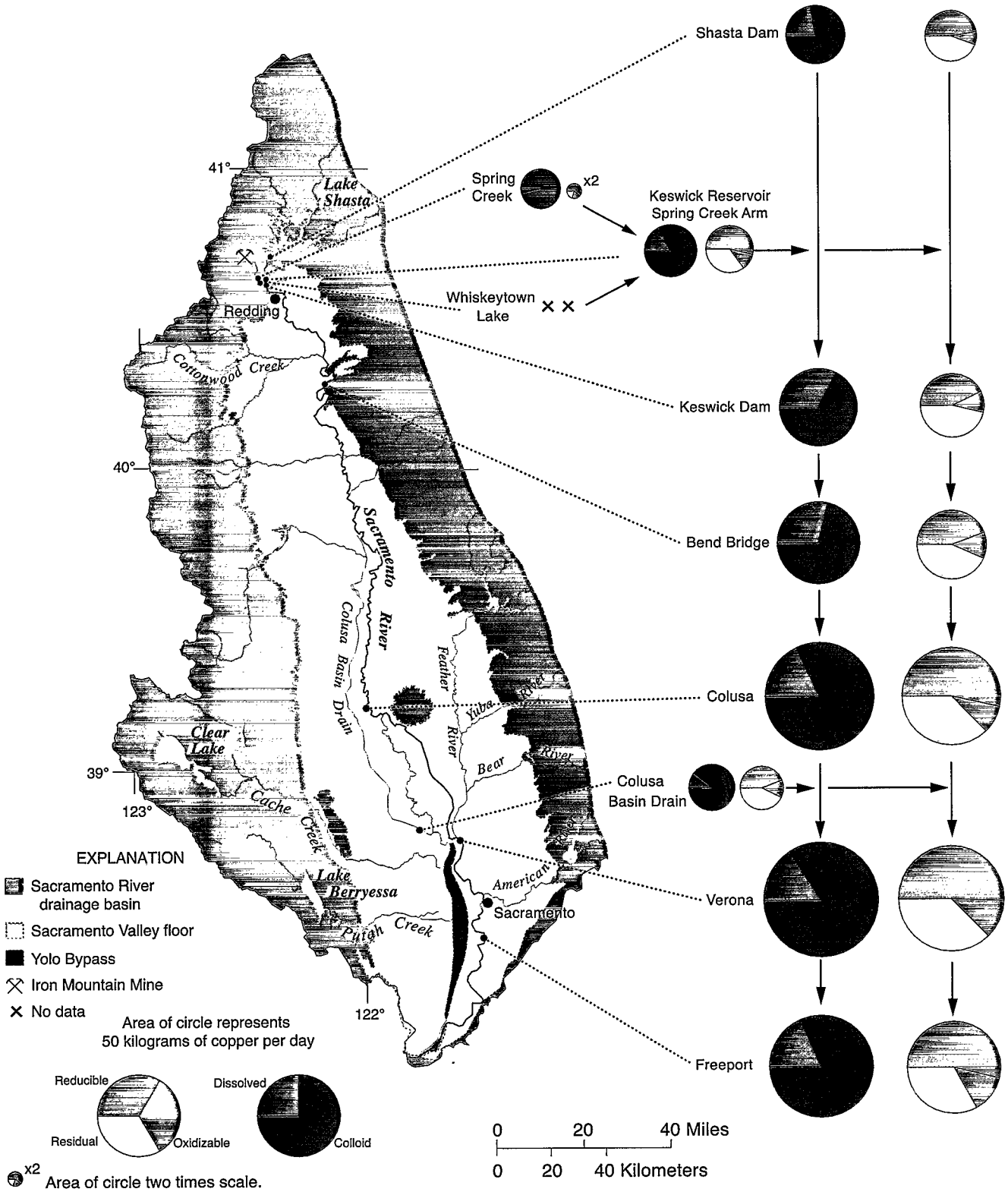

Figure 18*B*. Distribution and speciation of colloidal copper loads during May–June 1997, Sacramento River, California, and selected tributaries.

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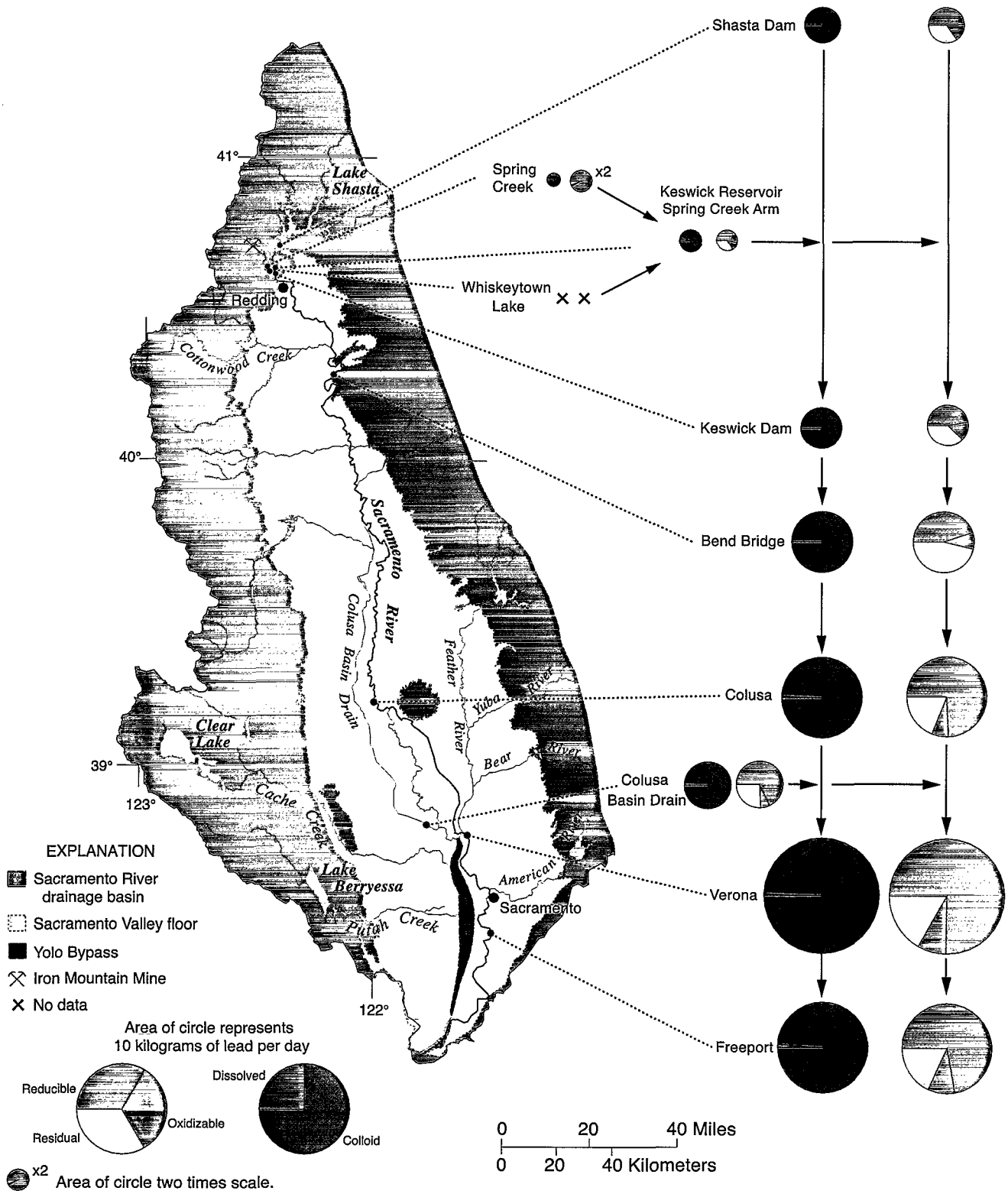

Figure 18*C*. Distribution and speciation of colloidal lead loads during May–June 1997, Sacramento River, California, and selected tributaries.

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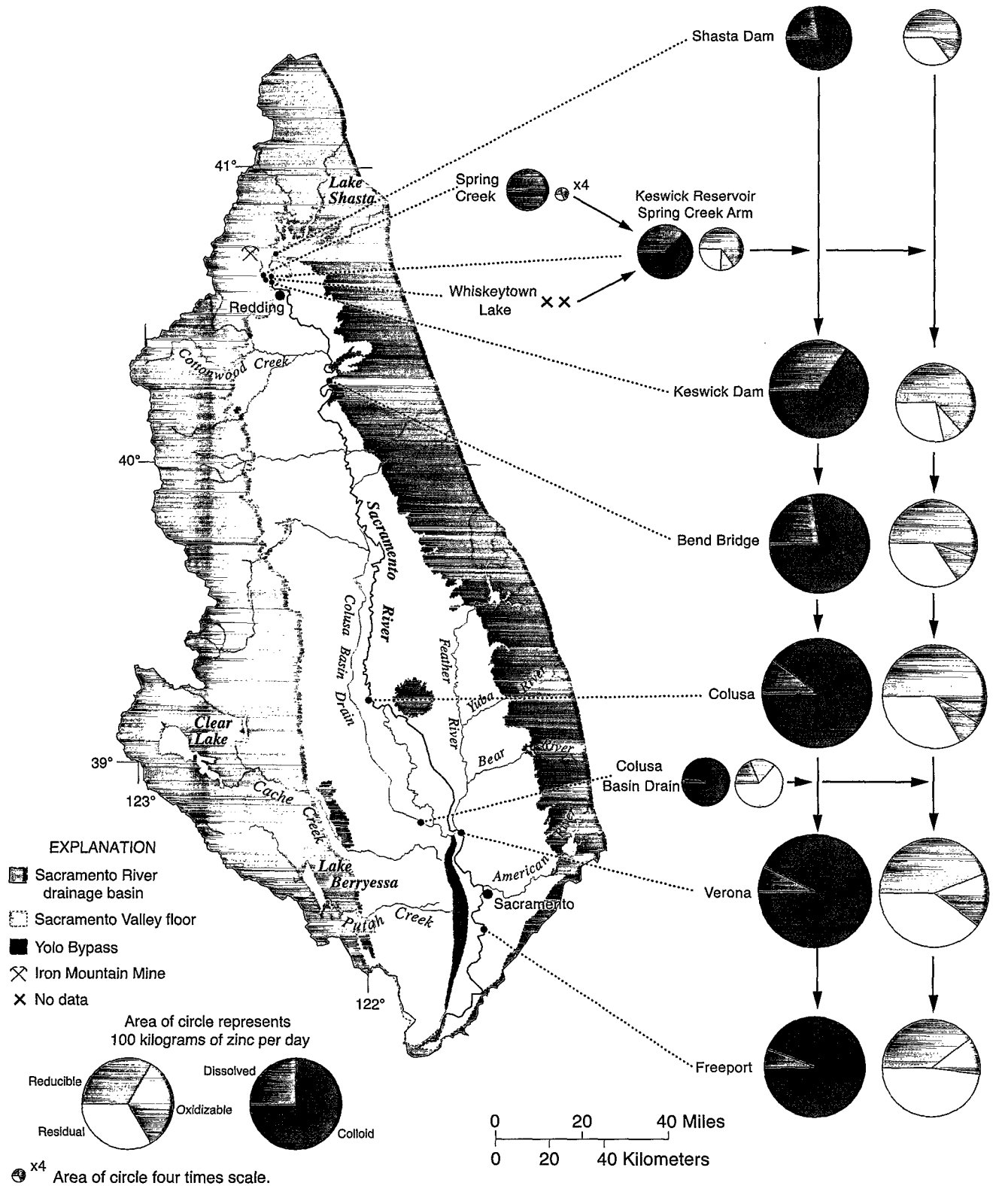

Figure 18*D*. Distribution and speciation of colloidal zinc loads during May–June 1997, Sacramento River, California, and selected tributaries.

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in colloids and are likely to play an important role in controlling trace metal distribution. Spatial and temporal variations in mercury loads for concurrent samples are described elsewhere (David Roth, U.S. Geological Survey, written commun., 1999), although dissolved and colloidal mercury loads for each sampling period are tabulated in Appendix 1 of this report (table A1-7). Other trace metals of environmental concern such as nickel are discussed briefly.

Temporal Variations in Dissolved and Colloidal Loads

The greatest metal loads carried by the Sacramento River during this study are associated with the January 1997 sampling period (figs. 4 through 9) because of a combination of highest discharge and highest colloid concentrations (figs. 10 through 15). Metal loads during the December 1996 sampling period were consistently the second largest of the six sampling periods. In general, January 1997 metal loads exceeded those of all of the other sampling periods, except December 1996, by a factor of 20 to 30, and exceeded December 1996 loads by a factor of 3 to 4. For example, at Colusa during sampling in early January 1997, the Sacramento River was transporting 30 kg of cadmium per day, 8,400 kg of zinc per day, and 4,800 kg of copper per day. In mid-December 1996, the corresponding loads were 8.2 kg of cadmium per day, 2,500 kg of zinc per day and 1,200 kg of copper per day. As discussed in more detail in a later section, the other four sampling periods took place during lower-flow conditions, with correspondingly lower metal transport rates at Colusa: less than 3 kg of cadmium per day, less than 400 kg of zinc per day, and less than 300 kg of copper per day.

In contrast to the large differential between metal loads during January 1997 and other sampling periods, discharges during January 1997 at most sampling sites were only about twice the discharges in December 1996 and only up to about ten times the discharges for the other four, lower-flow sampling periods. Suspended colloidal concentrations (that is, the mass of colloids being carried in the river per unit volume) followed similar patterns to discharge. On average, suspended colloid concentrations were about 3 to 4 times higher in January 1997 than in December 1996 and 3 to 10 times the concentrations during any of the other four sampling periods.

About 70 percent of the total annual discharge of the Sacramento River system (measured at Freeport and the Yolo Bypass; fig. 1) during the water year July 1996 to June 1997 occurred from December 1, 1996 to February 28, 1997 (Alpers and others, 2000). Periodic measurements of suspended sediment concentration at Freeport showed a positive correlation with discharge (fig. 19). Increased discharge and increased suspended sediment concentrations (including colloids) resulted in substantially larger metal loads during the high-flow periods. These observations indicate that for the water year during which the study was made (July 1, 1996 through June 30, 1997), most of metals in the Sacramento River were transported during a relatively short period of time, during highest flow conditions.

Among the four sampling periods during lower-flow conditions (July, September, and November 1996 and May–June 1997), the period with the highest loads varied among the sampling sites. In relation to the upstream sampling sites at Shasta Dam, Keswick Dam, and Bend Bridge, the loads of cadmium, copper, lead, and zinc during July 1996 generally were higher than the loads during the other lower-flow sampling periods. At the downstream sampling sites Verona and Freeport, the September 1996 loads for these metals generally were the highest among the four lower-flow sampling periods. At Colusa, the four lower-flow sampling periods showed similar loads for each of these trace metals, with the exception that lead and zinc loads were lowest among these four sampling periods during September 1996 (figs. 8 and 9), whereas copper loads were highest during September 1996 (fig. 6). Iron loads at Colusa also were at a minimum in September 1996 (fig. 7); therefore, the higher copper loads during this sampling period likely were not associated with iron-rich colloids.

Spring Creek was sampled during three of the sampling periods (December 1996, January 1997, and May–June 1997), during which the temporal variability of metals loads was similar to that observed at the mainstem Sacramento River sites. For Spring Creek, January 1997 loads were much greater than those of December 1996, which in turn surpassed those of May–June 1997 for Al, Cd, Cu, Fe, Pb, and Zn (Appendix 1). The major contrast between Spring Creek and the mainstem river sites was the magnitude of the temporal variability. Spring Creek loads in January 1997 tended to exceed loads in December 1996 by factors of 5 to 12, and by factors of more than

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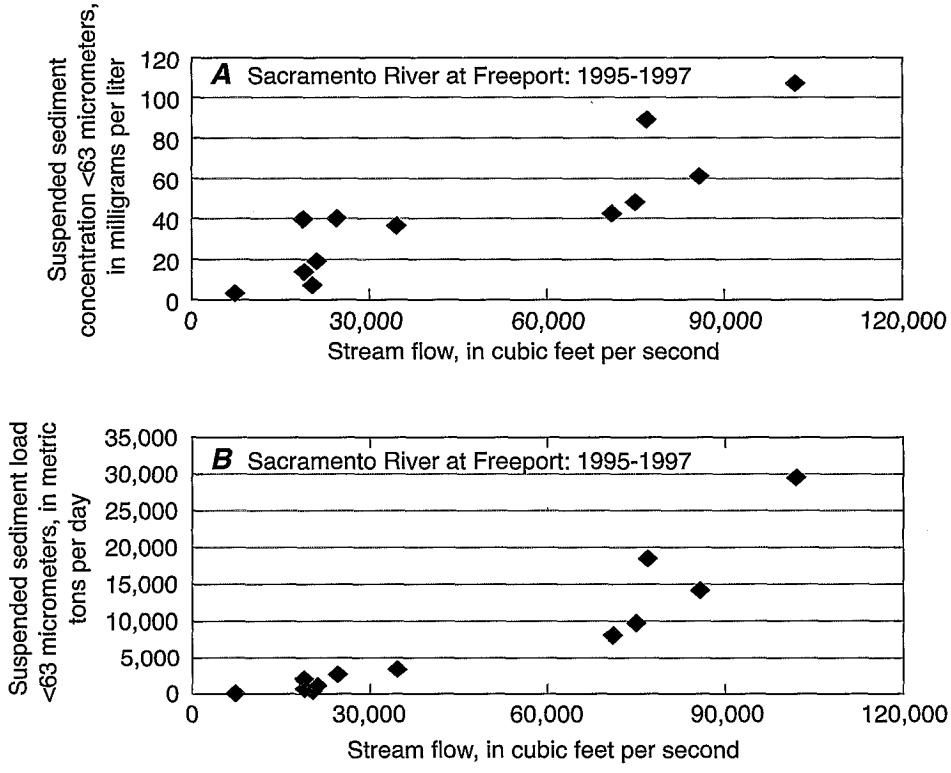

Figure 19. Plots of suspended sediment concentration (*A*) and load (*B*) versus stream flow at Freeport, California, July 1995 through June 1997.

100 compared with loads in May–June 1997. These differences were caused by high flows from Spring Creek Reservoir during the January 1997 floods. A contributing factor to this effect was the fact that a diversion of Upper Spring Creek above the Boulder Creek confluence into Flat Creek (fig. 2) was not operative during early January 1997, because the floods had washed out a bridge on Iron Mountain Road. Therefore, the flows to Spring Creek Reservoir were increased by several hundred cubic feet per second, contributing to a spill condition. On January 2, 1997 the daily average flow from the Spring Creek Debris Dam (SCDD) was 750 ft^3/s, including releases from the gates within the dam plus the flow over the spillway.

Water from Whiskeytown Lake, which is diverted into the Spring Creek arm of Keswick Reservoir through the Spring Creek Power Plant (SCPP, fig. 2), was sampled on two occasions for this study (December 1996 and May–June 1997). Although no samples for colloidal material were collected, total recoverable analyses of whole-water samples collected at these times can serve as proxies for colloidal plus dissolved analyses. The trends seen throughout the rest of the watershed concerning the dominance in loads during December 1996 over May–June 1997 are not observed in the water samples from Whiskeytown Lake; May–June 1997 loads for aluminum and iron were considerably higher than December 1996 loads (Appendix 1), despite the fact that discharge on the sampling date of May 29, 1997 was 2,720 ft^3/s versus 3,900 ft^3/s on December 11, 1996 (Alpers and others, 2000). Trace metal loads from Whiskeytown Reservoir generally were much lower than the metal loads from Spring Creek, as discussed in a later section of this report (Mass Balance and Metal Transport in Keswick Reservoir).

Temporal variations in the relative proportion of dissolved and colloidal loads were markedly different for Spring Creek compared with the mainstem Sacramento River sites. During two of the three sampling periods at Spring Creek (December 1996 and January 1997), the dissolved load was greater than 50 percent of the total for lead, aluminum, and iron; during the May–June 1997 trip, the loads in Spring Creek were less than 50 percent dissolved for these metals. For cadmium, copper, and zinc, the proportion of the load in Spring Creek that was dissolved was greater than 95 percent for all three sampling periods. In contrast, at the Shasta Dam and Keswick Dam

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sampling sites, the proportions of the metal load from dissolved copper were approximately 50 (±25) percent for all six sampling periods (fig. 12), although the site below Shasta Dam was not sampled in January 1997.

During the January 1997 sampling period, almost all of the Al, Cd, Cu, Fe, Pb, Hg, and Zn loads were associated with colloids at all of the downstream mainstem Sacramento River sites (from Bend Bridge to Freeport) (figs. 4–15; David Roth, U.S. Geological Survey, written commun., 1999). These results were due to the much higher total colloidal concentrations combined with the higher discharge during this extremely high-flow period. The only site for which more than 10 percent of the cadmium, copper, and zinc loads was dissolved during the January 1997 sampling period was the site below Keswick Dam (the site below Shasta Dam was not sampled during January 1997). In contrast, cadmium, copper, and zinc had considerably higher proportions of dissolved loads during other sampling periods (including December 1996) at the downstream sites (figs. 5, 6, and 9). This was not observed for lead, iron, and aluminum, for which the dissolved proportion of the load was relatively small regardless of the time of year (figs. 4, 7, and 8).

Cadmium, Copper, and Zinc

As noted earlier, the highest cadmium loads observed in this study were during the January 1997 sampling period, followed by the December 1996 period (fig. 5). Cadmium loads at the upstream sites, including Shasta Dam and Keswick Dam and, to a lesser extent, Bend Bridge, had a large dissolved component; for all six sampling periods, more than 50 percent of the cadmium load below Keswick Dam was in dissolved form (figs. 5 and 11). Downstream mainstem sampling sites invariably showed a decline in the proportion of dissolved cadmium.

With regard to cadmium loads, there is a clear impact on the Sacramento River system from Spring Creek during certain flow regimes (figs. 5 and 11). Spring Creek carries the acid drainage from the mines at Iron Mountain and enters Keswick Reservoir about 2 mi upstream of Keswick Dam (fig. 2). Depending on the flow regime, a significant proportion of the cadmium load may come from Shasta Lake and its tributaries. During the July, September, and December 1996 sampling periods, the cadmium load below Shasta Dam was more than 50 percent of the cadmium load below Keswick Dam. (There are no data from this study regarding colloidal cadmium transport from Shasta Lake for either the September 1996 or January 1997 sampling periods.) Finally, except for one sampling point during one sampling period (below Keswick Dam, May–June 1997), total cadmium loads uniformly increased between the Shasta Dam site and the Colusa site; during the July 1996, September 1996, and January 1997 sampling periods, cadmium loads continued to increase downriver to Freeport. In summary, there appear to be inputs of cadmium to the Sacramento River system both above Shasta Dam and above Keswick Dam that are primarily related to mine drainage; these were apparently the dominant inputs during the sampling periods in November and December 1996 and May–June 1997. During the sampling period of January 1997, the flood conditions caused transport of abundant colloidal material below Keswick Dam that dominated cadmium transport.

The decreases in cadmium transport observed along the flow path between the Colusa and Freeport sites during the November 1996, December 1996, and May–June 1997 sampling periods are likely related to large decreases in overall colloidal concentration (fig. 11). Figures 16 through 18 demonstrate that greater than 50 percent of the colloidal cadmium occurs in a reducible phase such as hydrous iron and manganese oxides, and that this proportion does not change in a systematic way either spatially or temporally.

Generally, the patterns described above for cadmium are similar to those for zinc (figs. 9 and 15). The greatest zinc loads occurred during the December 1996 and January 1997 sampling periods; upriver sites (especially Keswick Dam) showed zinc transport to have a large dissolved component, usually greater than 50 percent (fig. 15). Zinc loads at Shasta Dam were greater than 50 percent of the loads at Keswick Dam for July 1996 and December 1996 (no data for Shasta Dam in September 1996 or January 1997). Total zinc loads tended to increase uniformly between Shasta Dam and Colusa. As with cadmium, zinc transport increased continually between Keswick Dam and Freeport during the September 1996 and January 1997 sampling periods. Decreases in loads of zinc (and most other metals) between Colusa and Freeport for some sampling periods are apparently related to the anomalously high colloidal concentrations observed consistently at Colusa (figs. 10–15).

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Processes responsible for the consistent increase in the concentrations of colloids at Colusa relative to sampling sites immediately upstream and downstream remain unknown. There are no anthropogenic causes of fine-grained sediment, such as construction activity, that are known to have been active during the study period, nor is there much activity from industrial sites, agricultural drainage, or municipal sewage treatment plants in the vicinity. Also, there are no major tributary streams in the reach of the Sacramento River immediately upstream of Colusa. A longitudinal profile of riverbed elevation in the Sacramento River (fig. 20) indicates that the gradient near Colusa is significantly lower than at Bend Bridge, the closest upstream sampling station. This change in slope could have led, over many years, to deposition of fine-grained sediments on the streambed in the area upstream of Colusa. Levees for flood control regulate the river in the immediate vicinity of Colusa. A linear, engineered streambed would have higher water velocities, leading to increased sheer stresses that would cause the resuspension of fine-grained sediments from the river channel.

Some differences between zinc and cadmium speciation in colloids are evident in the data for samples collected during December 1996 and January 1997 (figs. 16*A*, 16*D*, 17*A*, and 17*D*). Colloidal zinc during high flow tended to have a much higher proportion in the residual phase than in the reducible phase, especially at downriver sites. Inspection of the zinc/cadmium ratios for dissolved and colloidal analyses in which both elements were detected (fig. 21*A*) reveals that dissolved zinc/cadmium ratios are consistently lower than colloidal zinc/cadmium ratios for sites both upstream and downstream of Redding. The zinc/cadmium ratios in dissolved samples range from 40 to 210. Box illustrations defining the probability distribution of 25 to 75 percent of the data for dissolved samples (fig. 21*A*) range from about 50 to 100 for sites downstream of Redding and from about 100 to 410 for sites upstream of Redding, with most (19 of 27 samples) in the range of 70 to 150. In contrast, the zinc/cadmium ratios in colloidal samples had an overall range from about 100 to 410. The probability distribution for 25 to 75 percent of the data fall within the range of 150 to 260 for downstream sites and about 190 to 320 for upstream sites. Thus, there is a clear and consistent pattern of higher zinc/cadmium ratios in colloids relative to the dissolved component. The pattern holds true at individual sample sites as well. These differences are consistent with laboratory data that indicate that zinc will adsorb to sediment preferentially to cadmium at a given pH (Dzombak and

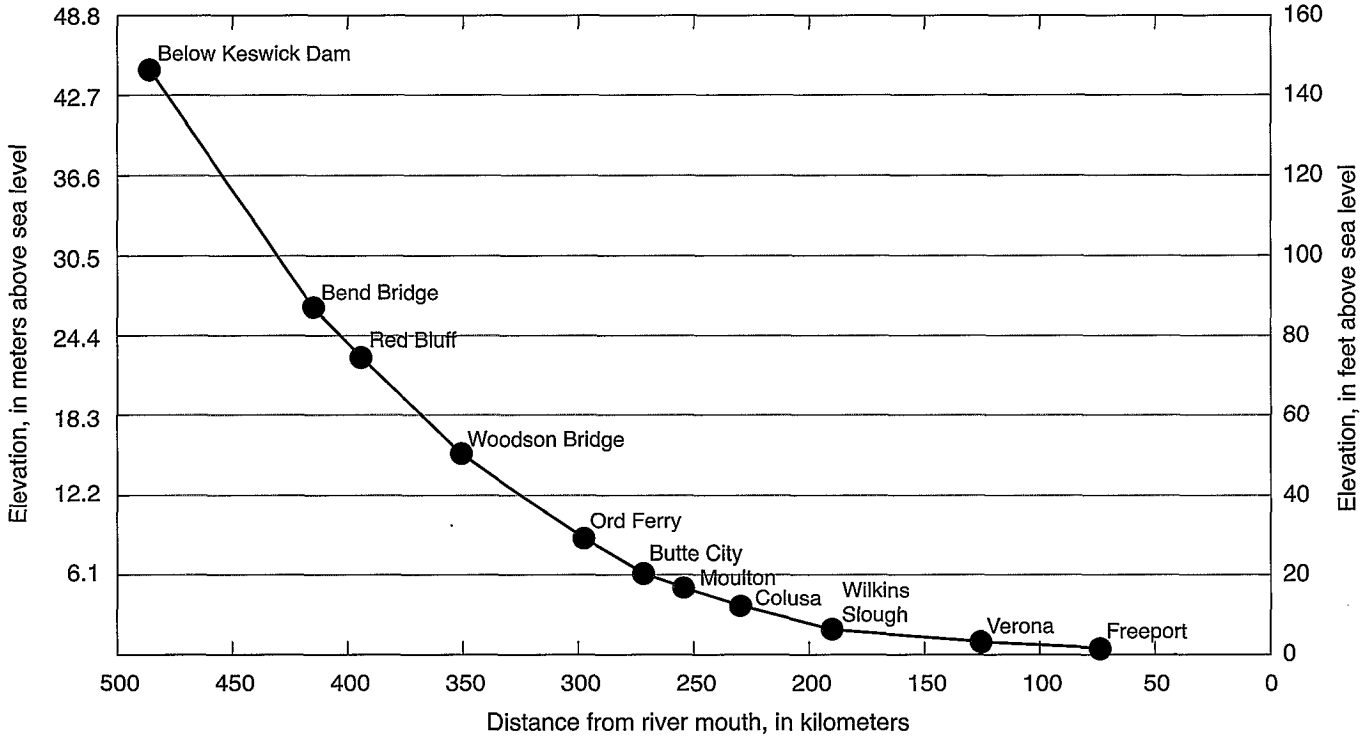

Figure 20. Graph showing elevation of streambed in relation to distance from river mouth, Keswick Dam to Freeport, Sacramento River, California.

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Morel, 1990; Smith, 1999). Although there are some apparent trends of zinc/cadmium ratios in colloids and dissolved components with distance, there are not a sufficient number of dissolved cadmium determinations above the detection limit to warrant quantitative analysis.

The zinc/cadmium ratios observed in colloids from the Sacramento River are consistent with massive sulfide deposits as a source (Hamlin and Alpers, 1996). Seal and others (in press) have compiled data for mine drainage and natural acid rock drainage from six different types of massive sulfide deposits, showing that the zinc/cadmium ratio does not change appreciably among these types of deposits in various geologic settings. Also, the zinc/cadmium ratio in average crustal rocks is in a similar range (approximately 50 to 200; Clark, 1924), therefore, this ratio is not a definitive tracer for mining-related metal sources.

Temporal and spatial trends in copper loads show some similarities to those for zinc and cadmium loads. For example, the December 1996 and January 1997 sampling periods during high flow account for the highest copper loads described at all sites on the river. Also, the proportion of dissolved copper was always greatest at upriver sites, however the proportions did not decrease with distance downriver in the same ways as they did for cadmium and zinc loads (compare the pie graphs in fig. 12 with those in figs. 11 and 15). Finally, as with zinc, the reducible fraction of copper generally accounted for about 50 percent of the total colloidal copper (figs. 16*B*, 17*B*, and 18*B*), but this proportion decreased as copper in the residual phase increased downstream during the January 1997 sampling period (fig. 17*B*).

Variations in zinc/copper ratios for dissolved and colloidal components show contrasting patterns at sites upstream and downstream of Redding (fig. 21*B*). At the upstream sites, zinc/copper ratios in the dissolved component are consistently higher than those in the colloidal phase. The 25 to 75 percent probability range for dissolved zinc/copper in upstream sites is from about 2.3 to 4.2, whereas the corresponding box range for colloidal zinc/copper in upstream sites is from about 1.1 to 2.2 (fig. 21*B*). This relation is consistent with preferential adsorption of copper relative to zinc onto suspended matter at a given pH (Dzomback and Morel, 1990; Smith, 1999). However, at the sampling sites downstream of Redding, the relation of the zinc/copper ratio between dissolved and colloidal components is reversed from that observed upstream. The 25 to 75 percent probability range for zinc/copper in the dissolved component for downstream sites is about 0.5 to 1.3, whereas the corresponding range for zinc/copper in the colloidal component is 1.5 to 2.1. The contrasting behavior of the zinc/copper ratio at the downstream sites may be caused by aqueous complexation of copper by dissolved organic carbon, a process that does not affect zinc to the same degree (Stumm and Morgan, 1996). Concentrations of dissolved organic carbon tend to increase with distance downstream in the Sacramento River (Alpers and others, 2000), which may play a role in the partitioning of copper and zinc between the dissolved and colloidal components.

The adsorption and desorption behavior of zinc and copper were investigated in laboratory studies using sediment samples from the Spring Creek arm of Keswick Reservoir (Coston and others, 1998; Nordstrom and others, 1999). The presence of schwertmannite, a sulfate-bearing ferric oxyhydroxide, likely causes a shift to adsorption at lower pH for a given amount of available surface area, relative to synthetic sulfate-free hydrous ferric oxides such as ferrihydrite (Coston and others, 1998; Webster and others, 1998). In the Sacramento River and Keswick Reservoir systems, the partitioning of cadmium, copper, and zinc between dissolved and colloidal phases appears to show some consistent relations between ambient field data and laboratory studies. The investigation of these relations is the focus of ongoing research by the USGS.

The ranges of zinc/copper ratios for the dissolved and colloidal components from the Sacramento River are consistent with an important source of these metals being primarily from the mineralized areas of the West Shasta mining district. The compilation by Seal and others (in press) indicates that drainage from different types of massive sulfide deposits exhibits a wide range of zinc/copper ratios. The deposits in the East Shasta and West Shasta mining districts are considered to be of the Noranda-type (Franklin and others, 1998), which typically have zinc/copper ratios between 1 and about 20 (Seal and others, in press).

Lead, Aluminum, and Iron

The transport behavior of lead is distinct from that of cadmium, copper, and zinc. The proportion of dissolved lead load is uniformly negligible, except for occasional observations at the sampling sites below

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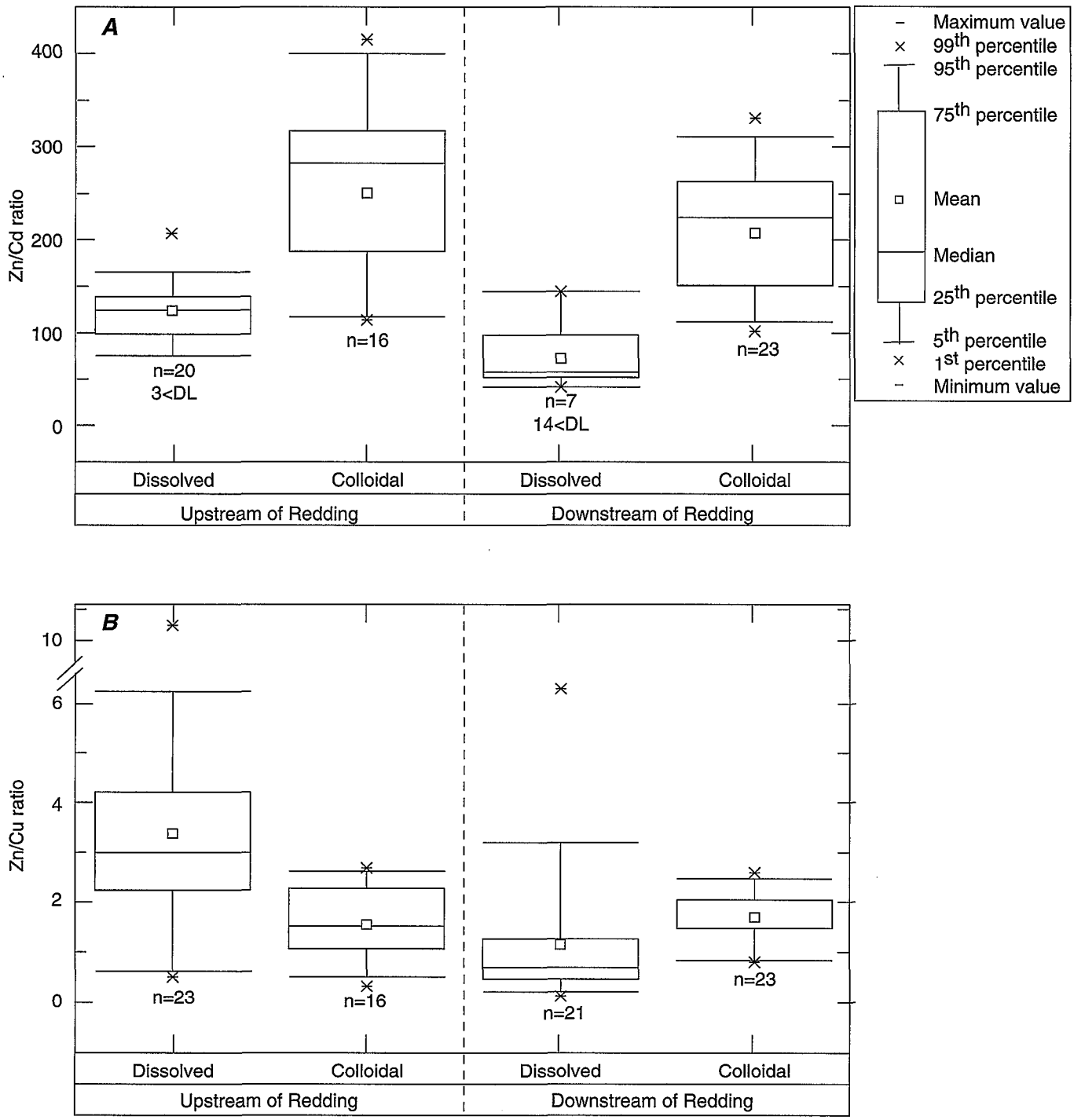

Figure 21. Probability box illustrations showing distribution of (*A*) Zn/Cd and (*B*) Zn/Cu data in dissolved and colloidal samples taken July 1996 through June 1997, Sacramento River, California. <DL, less than detection limit; n, number of observations greater than the detection limit. Cd, cadmium; Cu, copper; Zn, zinc.

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Keswick Dam and Shasta Dam. Almost all of the lead carried in the river is associated with suspended (colloidal) sediments (figs. 8 and 14). Also, in comparison with cadmium, copper, and zinc, the ratio of the transport below Keswick Dam to that at Freeport (plus the Yolo Bypass) is much smaller (compare the upriver pie charts for lead with those for cadmium, copper, or zinc in figures 16–18, and see Appendix 1, table A1-5 and Appendix 2, table A2-5.). This smaller ratio indicates that there are probably other, more significant sources of lead in the Sacramento River watershed besides the mined areas upstream of Keswick Dam. Lead isotope data (Alpers and others, 2000) also are consistent with this interpretation.

The proportion of lead in the reducible phase of the colloids was almost always greater than or equal to about 50 percent, as was the case for copper and zinc (figs. 16–18). The reducible lead fraction in colloids was occasionally as high as 75 percent; for example at the Colusa and Verona sites during May–June 1997. The only time at which lead associated with the reducible phase was less than 50 percent of the total colloidal lead was during the January 1997 sampling period (at the mainstem sites below Keswick Dam and at Tower Bridge).

The quantities of transported aluminum and iron were similar in magnitude to each other, and the spatial and temporal variations of these two metals had similar characteristics. As with lead, practically all the aluminum transported in the Sacramento River was colloidal, except below Shasta and Keswick dams during certain sampling periods (fig. 10); a similar pattern was obtained for iron (fig. 13). A major difference between lead and aluminum speciation is that practically all of the colloidal aluminum is associated with the residual phase, whereas colloidal lead tends to be associated with the reducible phase, suggesting a close affinity for hydrous iron oxides.

Iron tended to behave similarly to aluminum at most sampling sites, with the majority of the colloidal iron (80 to 90 percent) in the residual phase. As expected, the colloid samples collected at Spring Creek, in the Spring Creek arm of Keswick Reservoir, and below Keswick Dam were exceptions to this behavior in that they had a substantial proportion of iron in the reducible phase. The iron speciation and loading data appear to indicate that Iron Mountain mine and Spring Creek are not the predominant sources of iron to the Sacramento River. The transformation of dissolved iron in Spring Creek into particulate forms of ferric iron occurs by two related mechanisms, the oxidation of ferrous iron to ferric iron and the subsequent hydrolysis of the ferric iron (Nordstrom and Alpers, 1999a). Ferrous iron actively oxidizes in the Spring Creek Reservoir, contributing abundant hydrous ferric oxide colloids to Spring Creek. The acidic water of Spring Creek carries some soluble ferric iron, which precipitates by hydrolysis caused by neutralization on mixing with dilute waters in Keswick Reservoir from both Whiskeytown Lake and Shasta Lake.

Discussion of Transport and Fate of Metals from Various Sources

The purpose of this section is to discuss the spatial variation of metal loads in the context of known and suspected metal sources. The discussion is divided into both known sources from abandoned and inactive mines in the Shasta region, mostly upstream of Keswick Dam (Nordstrom and others, 1977), and less known sources downstream of Keswick Dam. The section on Keswick Reservoir includes some analysis of metal mass balance in the Spring Creek arm of the reservoir and in the reservoir as a whole.

Copper-Zinc-Lead Mines in the Shasta Region

Volcanogenic massive sulfide deposits of the East Shasta and West Shasta mining districts are important sources of trace metals to the Sacramento River system and its tributaries. This section describes these sources and discusses available data from other studies on associated metal loads, for comparison with data generated in this study.

Mines Draining into Shasta Lake and Its Tributaries

The East Shasta mining district includes the abandoned Bully Hill and Rising Star mines, which drain into Town Creek and Horse Creek, respectively. Mineralization in the East Shasta mining district is hosted by Permian and Triassic strata, with an age of approximately 200 to 300 million years (Albers and Bain, 1985). Town Creek and Horse Creek are relatively small tributaries to Shasta Lake in its northeast corner. Copper loads were estimated to be 1.8 kg/d from the Bully Hill mine and 2.3 kg/d from the Rising Star on an annualized average basis, from periodic monitoring (Dennis Heiman, Regional Water

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Quality Control Board, Central Valley Region, written commun., 1998).

Acidic drainage from several of the copper-zinc mines of the West Shasta mining district flows into Shasta Lake by way of two tributaries: Little Backbone Creek and West Squaw Creek (fig. 2). Mineralization in the West Shasta mining district is Devonian age (about 400 million years old), and consists of massive sulfides hosted by hydrothermally altered rhyolite and greenstone with minimal neutralizing capacity. The Mammoth, Golinsky, and Sutro mines in the Little Backbone Creek watershed are estimated to contribute copper loads of 32, 0.5, and 0.05 kg/d, respectively, on an annual basis, as indicated by periodic monitoring (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998). In the West Squaw Creek drainage, the contribution of copper loads from the Balaklala, Keystone, Shasta King, and Early Bird mines are estimated to be 9, 1.1, 0.5, and 0.05 kg/d, respectively (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998).

The total copper loads to Shasta Lake from the mines mentioned above is estimated to be about 50 kg/d, averaged throughout the year (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998). The Regional Water Board advises that "* * * these are estimated loading rates based on periodic monitoring and * * * the actual discharge rate varies seasonally within any one year and between years based on annual precipitation" (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998).

At the sampling site below Shasta Dam, the transport rate of total copper that is based on the sum of dissolved and colloidal loads (Appendix 1, table A1-3) ranged from 7 to greater than or equal to 180 kg/d. The comparable copper loads that are based on total recoverable analyses of unfiltered waters samples were approximately twice as high, ranging from 14 to 320 kg/d (Appendix 1, table A1-3). However, no sample was collected from the site below Shasta Dam for the present study during the period of highest flow in January 1997. Sampling by the Regional Water Board during January 1997 indicates a total recoverable copper concentration of 8.2 μg/L. (Total recoverable concentrations are based on a partial digestion of unfiltered water samples using nitric and hydrochloric acids at pH < 2.) Combining this value with an average discharge for January 1997 of 41,600 ft^3/s results in an estimated average total recoverable copper load of 830 kg/d during this month of high discharge.

The data from this study, from the previous study by Nordstrom and others (1977), and from the monitoring data of the Regional Water Board indicate that abandoned mines are the source of a significant proportion of the copper loads to Shasta Lake. By analogy with data gathered for this study at Spring Creek, it is expected that copper, cadmium, zinc, and other trace metals are transported predominantly in dissolved form in acidic waters, for example, with pH values less than 5, such as the drainage from the other inactive and abandoned mines in the Shasta region. The relatively high proportions of dissolved cadmium, copper, and zinc in water samples taken during this study below Shasta Dam are consistent with the interpretation that the abandoned mines are a significant source of these metals.

Mines Draining into Keswick Reservoir and Its Tributaries

The copper–zinc massive sulfide deposits at Iron Mountain (fig. 2) are the largest in the East Shasta and West Shasta mining districts. The overall premining size of the massive sulfide deposits at Iron Mountain is estimated at 23 million metric tons, occurring in five segments of an originally continuous lens that was displaced by normal faulting (Albers, 1985). Between the 1880s and the 1960s, about half of this tonnage was mined by underground and surface methods. Several adits remain open within Iron Mountain, serving as drains that have kept most of the unmined massive sulfide deposits in the unsaturated zone. Ready access of atmospheric oxygen and infiltrating meteoric water has resulted in optimal conditions for generation of acid mine drainage (Nordstrom and Alpers, 1995), producing some of the highest metal concentrations ever recorded in mine effluent (Nordstrom and others 1991; U.S. Environmental Protection Agency, 1992; Nordstrom and Alpers, 1995; 1999a,b; Nordstrom and others, 2000).

Prior to 1989, treatment of the metal-rich, acid drainage from Iron Mountain consisted solely of copper cementation plants operated intermittently on Boulder and Slickrock creeks. These plants, which were of variable effectiveness, used scrap iron to precipitate copper (U.S. Environmental Protection

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Agency, 1992). Average metal loads in Spring Creek, downstream of the Spring Creek Debris Dam (SCDD) for the nine-year period between 1977 and 1985, were estimated as follows from Bureau of Reclamation data; copper, 350 kg/d and zinc, 1,400 kg/d (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998). In perspective, these metal loads were more than twice the combined loads from the 28 next largest inactive mines in northern California and made Iron Mountain the largest discharger of metals to surface waters in the nation (U.S. Environmental Protection Agency, 1992).

Between 1989 and 1994, lime neutralization of the most concentrated adit discharges at Iron Mountain was carried out during three to four months of each wet season. Beginning in November 1994, year-round operation of a lime-neutralization plant has been removing about 85 percent of the copper loads and about 90 percent of the cadmium and zinc loads. The average metal loads leaving Iron Mountain between 1994 and 1997 were estimated to have been 52 kg copper per day and 45 kg zinc per day (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998). This average copper load is roughly equivalent to the total load of copper from mine discharges into Shasta Lake, as described earlier.

The EPA has issued a Record of Decision (ROD) that mandates additional water treatment at the Iron Mountain site (U.S. Environmental Protection Agency, 1997). Specifically, the ROD calls for construction of a dam along Slickrock Creek, which drains the southwestern slope of Iron Mountain (fig. 2). Estimates by the EPA indicate that the successful implementation of the remediation measures in the 1997 ROD will result in significant additional reduction of copper and zinc loads draining from Iron Mountain in Spring Creek.

Mass Balance and Metal Transport in Keswick Reservoir

Two different formulations of mass balance are computed using data from this study to evaluate metal transport processes in Keswick Reservoir. The first formulation involves comparison of the sum of two major inputs to the Spring Creek arm of Keswick Reservoir (Spring Creek and Whiskeytown Lake at the Spring Creek Power Plant [SCPP]) with a width- and depth-integrated sample of the Spring Creek arm. The second approach compares inputs and outputs from Keswick Reservoir, using the Spring Creek arm sample to represent the combined contribution of Spring Creek and the SCPP. The various metal loads from Spring Creek arm are combined with the loads from the site below Shasta Dam and Flat Creek (when available) for comparison with the loads from the outfall from Keswick Reservoir below Keswick Dam.

Mass Balance in the Spring Creek Arm of Keswick Reservoir

A width- and depth-integrated sample was taken in the Spring Creek arm during five of the six sampling periods for this study (all periods except January 1997). Spring Creek itself was sampled during three periods: December 1996, January 1997, and May–June 1997. Whiskeytown Lake was sampled only on two occasions for this study (December 1996 and May–June 1997), and on neither occasion was a colloid sample taken. Nevertheless, a mass balance for the Spring Creek arm was attempted for both the December 1996 and May–June 1997 periods.

Appendix 3 displays seven tables (one for each element of interest—Al, Cd, Cu, Fe, Pb, Hg, and Zn) that document input loads to the Spring Creek arm of Keswick Reservoir in terms of dissolved, colloidal, dissolved plus colloidal, and whole-water (total recoverable) loads. The sum of Spring Creek and Whiskeytown Lake loads is then compared with the actual loads observed in the Spring Creek arm of Keswick Reservoir. The comparisons at the bottom of tables A3-1 through A3-7 in the section "Mass balance, Spring Creek arm" are expressed as percentages of the loads in the Spring Creek arm of Keswick Reservoir. These data indicate that the balance is closer for the May–June 1997 data set than for the December 1996 data set. The balances for iron and aluminum total recoverable whole-water loads using the May–June 1997 data set are approximately 100 percent, suggesting conservative transport of these elements from the mixing zone (where the acid water from Spring Creek mixes into Keswick Reservoir) to the Spring Creek arm sampling point, located only a few hundred meters downstream (see Alpers and others, 2000). However, for reasons outlined earlier in this report, total recoverable concentration data determined from whole-water samples often underrepresent the total load for elements such as iron and aluminum that occur in phases that do not dissolve completely during the total recoverable extraction procedure. The lack of colloid data for the Spring Creek Power Plant input precludes the quantitative analysis of colloid mass balance in this part of the system.

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The "dissolved + colloid" category shows balance factors less than 100 percent for the seven metals considered in detail, on both sets of Spring Creek arm samples (December 1996 and May–June 1997), indicating more output than input on these occasions (Appendix 3). Several explanations for these data are possible: (1) possible additional, unsampled input sources of metals to Keswick Reservoir, (2) remobilization of fine-grained sediments, (3) desorption of metals from fine-grained sediments, (4) sampling under nonsteady-state conditions, and (5) errors in flow measurements. Of these, item 2 is a strong possibility. More than 250,000 yd^3 of fine-grained, metal-rich sediment have been shown to occur in the Spring Creek arm of Keswick Reservoir (Nordstrom and others, 1999). These sediments have been observed to be mobilized under conditions of fluctuating water levels in Keswick Reservoir and may be scoured by flows from the Spring Creek Power Plant (John Spitzley, CH2M Hill, oral commun., 1998).

Overall Mass Balance in Keswick Reservoir

Appendix 4 compares metal load data for inputs to Keswick Reservoir and the outfall from the reservoir at Keswick Dam, with the Spring Creek arm sample used as a proxy for the contributions from Spring Creek and the Spring Creek Power Plant. Aluminum and iron balances are nearly 100 percent for the May–June data set for both whole-water and "dissolved + colloid" loads (tables A4-1 and A4-4). Balances for trace metals of most environmental concern in Keswick Reservoir (cadmium, copper, and zinc) indicate a range of values both above and below 100 percent. These results indicate the difficulty and uncertainty in computing mass balances from single instantaneous measurements of concentration and discharge. A much more sound approach would be to integrate samples over longer time intervals, such as the duration of a storm event or on a monthly basis. Three of the four sampling periods with adequate data for the instantaneous calculations show apparent copper attenuation (balance values > 100 percent) despite the fact that iron and aluminum transport for the same periods indicate little to no precipitation of these major elements. The apparent copper attenuation effect could be caused by increased sorption of copper during transport through Keswick Reservoir.

Zinc and cadmium loads for the mass balance behaved quite similarly to each other, the one exception being some apparent attenuation of cadmium more than zinc during November 1996. Both cadmium and zinc were attenuated less than copper, which is consistent with overall patterns of metal transport (figs. 5, 6, 9, 11, 12, and 15–18) and their chemical properties (Dzombak and Morel, 1990; Smith, 1999).

An overall hypothesis that is broadly consistent with the data from this study is that the cadmium, copper, and zinc loads at Shasta Dam are roughly half of the corresponding values at Keswick Dam throughout all sampling periods. The contribution from Spring Creek was minimal in July and September 1996, so the Shasta Dam contribution was proportionally higher during these periods; however, the overall pattern of metal loads is consistent with the hypothesis. The instantaneous total (dissolved plus colloidal) copper loads at Shasta Dam ranged from 7 kg/d (November 1996) to 180 kg/d (December 1996), with no data available for January 1997. Total recoverable (whole-water) loads ranged from 14 kg/d to 320 kg/d. These data are in an appropriate range to be consistent with the Regional Water Board's estimate of 50 kg/d for an annualized average copper contribution from the mines above Shasta Lake (Dennis Heiman, Regional Water Quality Control Board, Central Valley Region, written commun., 1998).

Metal Sources Downstream of Keswick Dam

In this section, spatial variations in metal loads in the Sacramento River are described to identify river reaches with likely metal sources. The discussion is organized into two subsections. The first describes tributaries in the reach between Keswick Dam and Colusa, and the second describes the reach between Colusa and Freeport (including the Yolo Bypass). The second subsection is further subdivided into sections on metal contributions from agricultural drainage and urban runoff.

Tributaries Between Keswick Dam and Colusa

Although no water samples were collected for this study from tributaries between Keswick Dam and Colusa, the data collected from the mainstem Sacramento River samples clearly indicate that such tributaries and(or) other pollution sources make significant contributions to metal loads in the watershed. Copper and lead loads both increased consistently and substantially between Keswick Dam

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and Colusa during each sampling period; a single exception was an apparent decrease in copper load between Bend Bridge and Colusa during November 1996 (fig.12). In addition, lead isotope data (Alpers and others, 2000) indicate that sources of lead other than the massive sulfide mineralization upstream of Keswick Dam tend to dominate lead transport in the Sacramento River downstream of Bend Bridge, near Red Bluff (fig. 1).

During some sampling periods, the load increases were more dramatic between Keswick Dam and Bend Bridge, and during others, between Bend Bridge and Colusa, suggesting that multiple tributaries are involved and that the nature of the contributions is highly variable and perhaps seasonal in nature. In all cases, the increased copper and lead loads are associated exclusively with colloidal forms as opposed to dissolved metals (figs. 12 and 14).

A tributary that may be responsible for increasing metal loads between Keswick Dam and Bend Bridge is Cottonwood Creek (fig. 1). Sampling of Cottonwood Creek (at Interstate 5) by the Regional Water Board revealed the following elevated concentrations of total recoverable copper: 16 and 25 µg/L on April 2, 1996 and June 3, 1996, respectively, with less than 1 to 2 µg/L "dissolved" copper in 0.45-µm filtrates (Regional Water Quality Control Board, Central Valley Region, written commun., 1998). Total recoverable zinc was also elevated in the Cottonwood Creek samples, with concentrations of 24 and 52 µg/L, respectively, on the two sampling dates mentioned earlier. Some other tributaries draining the west side of the Sacramento Valley between Redding and Colusa are Clear Creek, Elder Creek, Thomes Creek, and Stoney Creek (some are shown on fig. 1). Very limited water-quality data are available for these creeks, especially during high flow. Additional monitoring on some of these tributaries is planned by the California Department of Water Resources.

Another tributary in this area for which elevated copper concentrations have been reported is Cow Creek, one of several tributaries draining the east side of the Sacramento Valley between Redding and Red Bluff. Samples taken from Cow Creek (at Dersch Road) during April and June, 1996 showed 5.2 and 6 µg/L of copper, respectively (Regional Water Quality Control Board–Central Valley Region, written commun., 1998). The same samples contained 16 to about 170 µg/L of zinc. Some of the massive sulfide mineralization and inactive/abandoned mines in the East Shasta mining district (for example, near the town of Ingot, California) are in the Little Cow Creek drainage, a tributary to Cow Creek (Nordstrom and others, 1977; Alpers and others, 2000).

Tributaries Between Colusa and Freeport

The principal tributaries to the Sacramento River between Colusa and Freeport are agricultural drains such as the Colusa Basin Drain and the Sacramento Slough, and major rivers including the Feather and American rivers. In addition, there are several smaller tributaries that convey urban runoff.

Agricultural Drainage

Sampling periods in July and September 1996 and in May–June 1997 showed increases of dissolved and colloidal copper loads, and also in colloidal zinc loads in the Sacramento River between Colusa and Verona. This is the reach in which the Colusa Basin Drain and the Sacramento Slough and other agricultural return flows enter the river (fig. 1). Copper transport from rice fields may be significant because large quantities of copper sulfate and other forms of copper are applied from May through June each year to control algae in the flooded fields.

Metal loads from agricultural drainage were evaluated for this study by means of a single sample from the Colusa Basin Drain during rice-field draining in early June 1997. The Colusa Basin Drain is estimated to represent about one-third of the agricultural drainage in the Sacramento Valley. Concentrations of copper in whole-water samples from the Colusa Basin Drain were 16–17 µg/L; 0.45-µm filtrates had about 3 µg/L, and 0.005-µg-equivalent ultrafiltrates had 1.3 µg/L (Alpers and others, 2000). Dissolved organic carbon was relatively high (4.8 mg/L) in the water sample from the Colusa Basin Drain, suggesting that the dissolved copper in the ultrafiltrate may be organically complexed. The sequential extraction data indicate that about half of the colloidal copper from the Colusa Basin Drain sample was extracted in the reducible fraction, similar to other samples from the watershed (fig. 18*B*) and that only a small fraction is oxidizable, suggesting that any organically complexed copper is not manifested to a great extent in the colloids. However, it is possible that some copper associated with organic matter is removed in the first (reducible) step of the sequential extraction procedure. Additional work would be needed to resolve this point.

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Biweekly monitoring of the Colusa Basin Drain by the NAWQA Program using 0.45-µm filtrates showed increased copper concentrations during the growing season relative to the rest of the year, reaching 6 µg/L in May 1996 and 3 to 4 µg/L in June 1997. Copper concentrations in 0.45-µm filtrates from the Sacramento Slough reached a maximum of 4 µg/L in December 1996. However, more studies of copper in agricultural drainage are needed before any significant conclusions can be reached.

The total (dissolved plus colloidal) loads of copper from the Colusa Basin Drain in the May–June 1997 sampling period were 18 kg/d, representing 19 percent of the total copper load at Freeport during that sampling period (tables A1-3 and A2-3). For comparison, the copper loads in the Spring Creek arm of Keswick Reservoir were 20 kg/d during the same sampling period, and the total (dissolved plus colloidal) copper load below Keswick Dam was 45 kg/d, representing 42 percent of the load at Freeport (tables A1-3 and A2-3). In contrast, the copper load of Spring Creek during the January 1997 flood was about 1,100 kg/d, and the load in the Yolo Bypass was about 7,700 kg/d (table A1-3). On an annual basis, most of copper and zinc loads appear to enter the Sacramento River upriver of Colusa, which is upstream of the influence of most intense agricultural drainage return flows in the Sacramento River watershed. This apparent increase in metal loading is primarily related to the consistent increase in colloid concentration between Bend Bridge and Colusa (figs. 12 and 15), which remains unexplained.

Urban Runoff

Urban runoff can be an important source of metals to surface waters. For example, the Rhine River at the Dutch-German border contained elevated concentrations of As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn that were reduced dramatically between 1975 and 1985 (Holland and Petersen, 1995). Awareness is increasing of nonpoint source problems associated with metals in urban settings, such as the use of copper in brake pads.

Although no sampling sites in this study were dedicated to urban runoff, the USGS's NAWQA Program sampled Arcade Creek in the City of Sacramento on a monthly basis for 2 years as an indicator site for urban runoff. Somewhat elevated concentrations of copper, lead, nickel, and zinc were observed in 0.45-µm filtrates, however metals were not analyzed in unfiltered samples.

Concentration profiles of lead in sediment and lead in colloids shown in the Volume 1 report from this study (Alpers and others, 2000) indicate an increase in lead concentrations downstream of Colusa. The most likely source of this increase is urban runoff, possibly related to atmospheric (wet and dry) deposition. Lead isotope data (Alpers and others, 2000) indicate a distinctly radiogenic source for the colloidal lead sampled from the Sacramento River at Tower Bridge in January 1997. During that high-flow condition, most of the water in the mainstem Sacramento River was derived from the American River, and the majority of the flow from the Sacramento River upstream of Colusa was diverted into the Yolo Bypass. Therefore, the anomalously radiogenic lead isotopes are probably related to granitic source rocks in the American River drainage, although anthropogenic sources for this lead have not been ruled out.

Summary and Conclusions

The transport of metals in the Sacramento River from Shasta Dam to Freeport was evaluated from July 1996 through June 1997 using an approach that quantified the dissolved and colloidal concentrations and corresponding loads of metals at six sites on the Sacramento River during six sampling periods. Although the water year corresponding to this study was unusual in that most precipitation fell during December and January, a major flood occurred in January, and it was very dry from February to May, so the overall amount of precipitation was close to that expected for a normal year. Most discharge in the river occurred during the 3-month period of December 1996 through February 1997, and a higher proportion of the total annual metal fluxes or loads took place during the same time frame because of the increased transport of suspended sediment and associated higher metal concentrations associated with high flow. In a more typical wet season, the increased discharge and metal fluxes would occur over a longer period, for example December through April or May.

The mineralized area upstream of Keswick Dam is an important source of various metals, especially cadmium, to the lower Sacramento River and the Bay–Delta. This was determined by comparing the metal loads at the sampling site below Keswick Dam with those measured in the Sacramento River at Freeport and the Yolo Bypass. However, it was also determined that the loads, during the period of this

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study, were highly dependent on the flow regime. For example, the proportions of mineralization-related trace-metal loads (percentages representing dissolved plus colloidal loads at Keswick Dam divided by the sum of dissolved and colloidal loads at Freeport and the Yolo Bypass, when flowing) observed during moderately high flows in December 1996 were: cadmium, 87 percent; copper, 35 percent; lead, 10 percent; and zinc, 51 percent. During the flood conditions of early January 1997, the percentages were: cadmium, 22 percent; copper, 11 percent; lead, 2 percent; and zinc, 15 percent. During the irrigation drainage season of May through June 1997, the percentages were: cadmium, 53 percent; copper, 42 percent; lead, 20 percent; and zinc, 75 percent. These estimates must be qualified by the following factors. First, metal loads at Colusa in December 1996 and at Verona in May–June 1997 generally exceeded those determined at Freeport at that time; therefore, the above percentages represent maximum estimates of the proportion of metals from mineralized areas upstream of Keswick Dam. Second, for logistics reasons, the Sacramento River was sampled at Tower Bridge instead of Freeport during January 1997. However, no other significant input of water to the Sacramento River, other than irrigation return flows, occurs between Tower Bridge and Freeport. The results indicate the importance of the mineralized areas for the transport of cadmium, copper, and zinc, but also show that lead must enter the Sacramento River mainly from other areas, as confirmed by lead isotope analyses. The results also indicate that the mineralized areas upstream of Keswick Dam are the source of a significant amount of metals to the lower Sacramento River; however, other areas along the river also must contribute significant amounts especially during extreme high-flow conditions.

The available data suggest that trace-metal loads from agricultural drainage may be significant during the growing season, but that more studies are needed before a definitive conclusion can be reached. Copper transport from rice fields may be significant because large amounts of copper sulfate and other forms of copper are applied from May through June each year to control algae in the flooded fields. Metal loads for sampling periods in July and September 1996 and in May–June 1997 showed increases of dissolved and colloidal copper and also in colloidal zinc in the Sacramento River between Colusa and Verona, the river reach along which the Colusa Basin Drain and the Sacramento Slough and other agricultural return flows enter the river. Also, water-quality sampling by the NAWQA Program shows that copper concentrations in 0.45 µm-filtered water samples from the Colusa Basin Drain are elevated during the period of copper application to the fields relative to the rest of the year. To put the copper loads associated with agricultural drainage in perspective, the total (dissolved plus colloidal) loads of copper from the Colusa Basin Drain in June 1997 were 18 kg/d, representing about 19 percent of the total copper load at Freeport, whereas the copper loads from Iron Mountain by way of the Spring Creek arm of Keswick Reservoir were 20 kg/d during the same sampling period, and the copper load below Keswick Dam represented about 42 percent of the total (dissolved plus colloidal) copper load at Freeport. In contrast to these relatively low-flow conditions, the copper load of Spring Creek during the January 1997 flood was about 1,100 kg/d and the copper load in the Yolo Bypass was about 7,700 kg/d. On an annual basis, most of copper and zinc loads appear to enter the Sacramento River upriver of Colusa, which is upstream of the influence of most intense agricultural drainage return flows in the Sacramento River watershed. Some of the metal loads are clearly from well known, mining-related sources of cadmium, copper, and zinc above Keswick Dam; however, large increases in metal loads associated with elevated colloid concentrations at Colusa remain unexplained.

This study has demonstrated that some trace metals of environmental significance (cadmium, copper, and zinc) in the Sacramento River are transported largely in dissolved form at upstream sites (below Shasta Dam, below Keswick Dam, and at Bend Bridge) proximal to the mineralized areas of the West Shasta and East Shasta mining districts. Despite continuous water treatment that has removed 85 to 90 percent of the cadmium, copper, and zinc from the mine drainage at Iron Mountain since 1994, Spring Creek remains an important source of these metals to the Sacramento River system. In the acidic water of Spring Creek, cadmium, copper, and zinc are transported almost exclusively in dissolved form. In contrast, these trace metals are transported largely in colloidal form at downstream sites (Colusa, Verona,

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Freeport, and Yolo Bypass). Aluminum, iron, and lead were observed to be transported predominantly in the colloidal phase at all mainstem Sacramento River sampling sites during all sampling periods in this study.

Speciation of metals on the colloid particles, which is based on sequential chemical extractions, showed that metals are variably distributed among reducible, oxidizable, and residual phases. Further research is needed to address the biological significance of metals associated with these phases in the Sacramento River system.

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Appendix 1. Tables of Data Comparing Metal Loads in Dissolved Form, Colloidal Form, and Whole Water

Table A1-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples

Table A1-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples

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Table A1-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in kilograms per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; Sac., Sacramento; SCPP, Spring Creek Power Plant; R., River; TR, total recoverable analysis. ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	48	33	10	400	NA	27
	Colloid	7,300	NA	780	≥11,000	NA	15,000
	Dissolved + Colloid	7,300	NC	790	≥11,000	NC	15,000
	Whole Water, TR	5,900	1,500	550	7,400	NA	6,500
Sac R.–Keswick	Dissolved	75	120	140	1,700	1,300	100
	Colloid	7,700	NA	4200	18,000	94,000	22,000
	Dissolved + Colloid	7,800	NC	4,300	20,000	95,000	22,000
	Whole Water, TR	6,200	1,700	3,000	14,000	62,000	9,400
Sac R.–Bend Br.	Dissolved	77	60	130	1,000	880	89
	Colloid	10,000	4,400	14,000	280,000	2,100,000	23,000
	Dissolved + Colloid	10,000	4,400	15,000	280,000	2,100,000	23,000
	Whole Water, TR	8,400	3,300	10,000	190,000	1,300,000	10,000
Sac R.–Colusa	Dissolved	NA	34	24	310	540	51
	Colloid	92,000	18,000	22,000	420,000	4,100,000	50,000
	Dissolved + Colloid	NA	18,000	22,000	420,000	4,100,000	50,000
	Whole Water, TR	74,000	13,000	15,000	280,000	2,600,000	21,000
Sac R.–Verona	Dissolved	120	41	NA	300	NA	44
	Colloid	60,000	79,000	40,000	390,000	NA	76,000
	Dissolved + Colloid	60,000	79,000	NA	390,000	NC	76,000
	Whole Water, TR	48,000	58,000	28,000	260,000	NA	31,000
Sac R.–Freeport	Dissolved	110	41	25	620	[1]1,500	63
	Colloid	≥58,000	≥33,000	15,000	550,000	[1]3,700,000	63,000
	Dissolved + Colloid	≥58,000	≥33,000	15,000	550,000	[1]3,700,000	63,000
	Whole Water, TR	46,000	24,000	10,000	370,000	[1]2,300,000	26,000
Flat Cr.	Dissolved	NA	NA	NA	0.83	NA	0.0039
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	8.8	NA	0.017
Spring Cr.–Weir	Dissolved	NA	NA	NA	1,200	NA	97
	Colloid	NA	NA	NA	290	NA	84
	Dissolved + Colloid	NC	NC	NC	1,500	NC	180
	Whole Water, TR	NA	NA	NA	1,400	NA	130
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	4,200	NA
	Colloid	NA	NA	NA	NA	2,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	6,200	NC
	Whole Water, TR	NA	NA	NA	NA	5,500	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	21	NA	16
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	310	NA	2,800
Spring Cr. arm	Dissolved	25	46	130	580	NA	82
	Colloid	130	NA	860	4,600	NA	6,600
	Dissolved + Colloid	160	NC	990	5,100	NC	6,600
	Whole Water, TR	130	190	720	3,600	NA	2,900

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Table A1-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	1
	Colloid	NA	NA	NA	NA	NA	16,000
	Dissolved + Colloid	NC	NC	NC	NC	NC	16,000
	Whole Water, TR	NA	NA	NA	NA	NA	6,500
Yolo Bypass	Dissolved	NA	NA	NA	NA	1,100	NA
	Colloid	NA	NA	NA	NA	5,600,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	5,600,000	NC
	Whole Water, TR	NA	NA	NA	NA	3,600,000	NA
Freeport + Yolo Bypass	Dissolved	110	41	25	620	2,600	63
	Colloid	58,000	33,000	15,000	550,000	9,300,000	63,000
	Dissolved + Colloid	58,000	33,000	15,000	551,000	9,300,000	63,000
	Whole Water, TR	46,000	24,000	10,000	370,000	5,900,000	26,000

[1]Samples collected at Tower Bridge in January 1997.

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C-035172

Table A1-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in grams per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	570	370	60	2,600	NA	≤96
	Colloid	190	NA	59	≥320	NA	140
	Dissolved + Colloid	760	NC	120	≥2,900	NC	≤230
	Whole Water, TR	960	650	160	5,400	NA	390
Sac R.–Keswick	Dissolved	580	410	500	4,400	8,800	290
	Colloid	340	NA	220	980	6,300	260
	Dissolved + Colloid	910	NC	720	5,300	15,000	550
	Whole Water, TR	1,000	730	1,200	8,300	21,000	530
Sac R.–Bend Br.	Dissolved	800	340	380	2,100	1,200	130
	Colloid	390	78	380	4,500	23,000	270
	Dissolved + Colloid	1,200	420	760	6,600	24,000	410
	Whole Water, TR	1,200	690	1,200	9,200	25,000	860
Sac R.–Colusa	Dissolved	NA	150	87	420	530	≤160
	Colloid	2,300	690	860	7,800	29,000	710
	Dissolved + Colloid	NA	840	950	8,200	30,000	≤870
	Whole Water, TR	1,900	780	450	7,800	26,000	710
Sac R.–Verona	Dissolved	≤200	250	NA	650	NA	≤210
	Colloid	2,400	1,400	910	6,000	NA	870
	Dissolved + Colloid	≤2,600	1,600	NC	6,700	NC	≤1,100
	Whole Water, TR	2,200	1,500	860	6,100	NA	1,000
Sac R.–Freeport	Dissolved	420	≤190	≤160	720	[1]≤1,100	≤260
	Colloid	≥2,900	≥4,300	220	5,200	[1]19,000	770
	Dissolved + Colloid	≥3,300	≥4,500	≤380	5,900	[1]≤20,000	≤1,000
	Whole Water, TR	2,000	990	600	10,000	[1]17,000	840
Flat Cr.	Dissolved	NA	NA	NA	3.8	NA	0.18
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	5.0	NA	0.31
Spring Cr.–Weir	Dissolved	NA	NA	NA	1,700	NA	140
	Colloid	NA	NA	NA	4.2	NA	1.3
	Dissolved + Colloid	NC	NC	NC	1,700	NC	150
	Whole Water, TR	NA	NA	NA	1,800	NA	160
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	18,000	NA
	Colloid	NA	NA	NA	NA	16	NA
	Dissolved + Colloid	NC	NC	NC	NC	18,000	NC
	Whole Water, TR	NA	NA	NA	NA	17,000	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	84	NA	≤27
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	≤93	NA	88
Spring Cr. arm	Dissolved	73	68	310	3,200	NA	110
	Colloid	10	NA	56	540	NA	89
	Dissolved + Colloid	83	NC	370	3,800	NC	200
	Whole Water, TR	≤59	130	510	4,800	NA	270

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Table A1-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	≤7
	Colloid	NA	NA	NA	NA	NA	86
	Dissolved + Colloid	NC	NC	NC	NC	NC	≤94
	Whole Water, TR	NA	NA	NA	NA	NA	55
Yolo Bypass	Dissolved	NA	NA	NA	NA	1,600	NA
	Colloid	NA	NA	NA	NA	45,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	47,000	NC
	Whole Water, TR	NA	NA	NA	NA	39,000	NA
Freeport + Yolo Bypass	Dissolved	420	240	160	900	≤3,000	260
	Colloid	2,900	4,300	220	5,200	64,000	770
	Dissolved + Colloid	3,300	4,500	380	6,100	≤67,000	1,000
	Whole Water, TR	2,000	990	600	10,000	56,000	840

[1]Samples collected at Tower Bridge in January 1997.

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Table A1-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in kilograms per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	30	10	4.3	87	NA	5.6
	Colloid	15	NA	2.7	≥95	NA	18
	Dissolved + Colloid	44	NC	7.0	≥180	NC	24
	Whole Water, TR	55	27	14	320	NA	27
Sac R.–Keswick	Dissolved	29	12	9.2	130	260	14
	Colloid	15	NA	22	180	1,000	31
	Dissolved + Colloid	43	NC	31	310	1,300	45
	Whole Water, TR	56	40	56	670	1,400	48
Sac R.–Bend Br.	Dissolved	32	7.7	11	92	230	14
	Colloid	28	7.8	100	640	3,500	34
	Dissolved + Colloid	61	15	110	730	3,700	49
	Whole Water, TR	63	43	80	870	3,200	55
Sac R.–Colusa	Dissolved	NA	12	8.5	46	170	16
	Colloid	230	76	64	1,200	4,700	71
	Dissolved + Colloid	NA	89	72	1,200	4,800	86
	Whole Water, TR	140	64	39	820	4,300	75
Sac R.–Verona	Dissolved	31	22	NA	120	NA	15
	Colloid	280	180	91	930	NA	99
	Dissolved + Colloid	310	200	NC	1,100	NC	110
	Whole Water, TR	130	140	87	720	NA	110
Sac R.–Freeport	Dissolved	39	15	12	140	[1]280	16
	Colloid	≥290	≥220	26	740	[1]4,000	91
	Dissolved + Colloid	≥330	≥230	37	880	[1]4,300	110
	Whole Water, TR	130	88	68	930	[1]3,200	91
Flat Cr.	Dissolved	NA	NA	NA	0.081	NA	0.0016
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.30	NA	0.0063
Spring Cr–Weir	Dissolved	NA	NA	NA	210	NA	11
	Colloid	NA	NA	NA	1.4	NA	0.63
	Dissolved + Colloid	NC	NC	NC	210	NC	12
	Whole Water, TR	NA	NA	NA	200	NA	12
Spring Cr–Road	Dissolved	NA	NA	NA	NA	1,100	NA
	Colloid	NA	NA	NA	NA	6.7	NA
	Dissolved + Colloid	NC	NC	NC	NC	1,100	NC
	Whole Water, TR	NA	NA	NA	NA	1,100	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	6.2	NA	2.7
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	11	NA	11
Spring Cr. arm	Dissolved	10	2.9	7.8	91	NA	3.6
	Colloid	0.77	NA	21	430	NA	16
	Dissolved + Colloid	10	NC	28	520	NC	20
	Whole Water, TR	5.6	8.9	40	480	NA	22

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Table A1-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	1.6
	Colloid	NA	NA	NA	NA	NA	17
	Dissolved + Colloid	NC	NC	NC	NC	NC	18
	Whole Water, TR	NA	NA	NA	NA	NA	15
Yolo Bypass	Dissolved	NA	NA	NA	NA	360	NA
	Colloid	NA	NA	NA	NA	7,300	NA
	Dissolved + Colloid	NC	NC	NC	NC	7,700	NC
	Whole Water, TR	NA	NA	NA	NA	6,600	NA
Freeport + Yolo Bypass	Dissolved	39	15	12	140	640	16
	Colloid	290	220	26	740	11,000	91
	Dissolved + Colloid	330	240	38	880	12,000	110
	Whole Water, TR	130	88	68	930	9,800	91

[1]Samples collected at Tower Bridge in January 1997.

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Table A1-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in kilograms per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	270	93	21	220	NA	41
	Colloid	4,900	NA	490	≥6,300	NA	9,100
	Dissolved + Colloid	5,200	NC	510	≥6,500	NC	9,200
	Whole Water, TR	4,100	930	490	6,400	NA	5,500
Sac R.–Keswick	Dissolved	77	45	27	230	550	70
	Colloid	4,600	NA	3,600	13,000	110,000	16,000
	Dissolved + Colloid	4,700	NC	3,600	14,000	110,000	16,000
	Whole Water, TR	4,200	1,200	3,200	14,000	84,000	9,400
Sac R.–Bend Br.	Dissolved	110	33	55	280	1,100	≤25
	Colloid	7,200	3,300	10,000	200,000	1,800,000	17,000
	Dissolved + Colloid	7,300	3,300	10,000	200,000	1,800,000	≤17,000
	Whole Water, TR	6,600	3,100	12,000	220,000	1,600,000	9,900
Sac R.–Colusa	Dissolved	NA	61	36	180	720	22
	Colloid	76,000	13,000	19,000	590,000	3,200,000	35,000
	Dissolved + Colloid	NA	13,000	19,000	590,000	3,200,000	35,000
	Whole Water, TR	62,000	13,000	12,000	320,000	2,900,000	24,000
Sac R.–Verona	Dissolved	110	60	NA	610	NA	78
	Colloid	47,000	58,000	34,000	480,000	NA	57,000
	Dissolved + Colloid	47,000	58,000	NA	480,000	NC	57,000
	Whole Water, TR	42,000	58,000	27,000	280,000	NA	37,000
Sac R.–Freeport	Dissolved	220	150	32	690	[1]1,600	75
	Colloid	≥72,000	≥43,000	12,000	450,000	[1]2,300,000	44,000
	Dissolved + Colloid	≥73,000	≥44,000	12,000	450,000	[1]2,300,000	44,000
	Whole Water, TR	42,000	22,000	13,000	410,000	[1]1,900,000	28,000
Flat Cr.	Dissolved	NA	NA	NA	0.10	NA	0.30
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	6.2	NA	1.2
Spring Cr.–Weir	Dissolved	NA	NA	NA	480	NA	14
	Colloid	NA	NA	NA	340	NA	1,100
	Dissolved + Colloid	NC	NC	NC	820	NC	1,100
	Whole Water, TR	NA	NA	NA	690	NA	45
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	24,000	NA
	Colloid	NA	NA	NA	NA	5,200	NA
	Dissolved + Colloid	NC	NC	NC	NC	29,000	NC
	Whole Water, TR	NA	NA	NA	NA	27,000	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	21	NA	19
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	380	NA	3,700
Spring Cr. arm	Dissolved	10	19	13	71	NA	31
	Colloid	140	NA	820	3,300	NA	6,600
	Dissolved + Colloid	150	NC	830	3,300	NC	6,700
	Whole Water, TR	≤200	≤280	760	2,000	NA	3,700

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Table A1-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	3.9
	Colloid	NA	NA	NA	NA	NA	14,000
	Dissolved + Colloid	NC	NC	NC	NC	NC	14,000
	Whole Water, TR	NA	NA	NA	NA	NA	8,300
Yolo Bypass	Dissolved	NA	NA	NA	NA	2,400	NA
	Colloid	NA	NA	NA	NA	4,100,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	4,100,000	NC
	Whole Water, TR	NA	NA	NA	NA	4,200,000	NA
Freeport + Yolo Bypass	Dissolved	220	150	32	690	4,000	75
	Colloid	72,000	43,000	12,000	450,000	6,400,000	44,000
	Dissolved + Colloid	72,000	43,000	12,000	451,000	6,400,000	44,000
	Whole Water, TR	42,000	22,000	13,000	410,000	6,100,000	28,000

[1]Samples collected at Tower Bridge in January 1997.

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Table A1-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in kilograms per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	≤0.13	0.10	≤0.10	0.42	NA	≤0.10
	Colloid	1.1	NA	0.21	≥4.2	NA	1.9
	Dissolved + Colloid	≤1.2	NC	≤0.30	≥4.6	NC	≤2.0
	Whole Water, TR	1.7	0.56	0.27	9.0	NA	1.8
Sac R.–Keswick	Dissolved	0.29	0.21	≤0.11	3.0	0.52	≤0.15
	Colloid	1.4	NA	3.7	13	51	2.9
	Dissolved + Colloid	1.7	NC	≤3.8	16	52	≤3.0
	Whole Water, TR	2.8	1.0	3.8	25	55	2.6
Sac R.–Bend Br.	Dissolved	0.22	0.08	0.22	0.63	0.80	≤0.15
	Colloid	2.5	1.4	6.7	67	600	4.6
	Dissolved + Colloid	2.7	1.5	6.9	67	600	≤4.7
	Whole Water, TR	3.5	1.7	7.8	98	500	4.0
Sac R.–Colusa	Dissolved	NA	0.15	0.17	0.53	0.72	0.11
	Colloid	24	6.9	11	170	930	11
	Dissolved + Colloid	NC	7.1	11	170	930	11
	Whole Water, TR	19	4.0	3.5	260	950	7.7
Sac R. –Verona	Dissolved	0.50	≤0.15	NA	1.1	NA	0.15
	Colloid	21	19	16	160	NA	18
	Dissolved + Colloid	21	19	NA	160	NC	18
	Whole Water, TR	16	15	9.3	200	NA	13
Sac R.–Freeport	Dissolved	1.1	0.30	0.24	≤1.1	[1]1.5	0.21
	Colloid	≥29	≥22	4.8	160	[1]1,100	15
	Dissolved + Colloid	≥30	≥22	5.1	160	[1]1,100	16
	Whole Water, TR	18	9.1	4.4	200	[1]1,000	12
Flat Cr.	Dissolved	NA	NA	NA	≤0.00033	NA	≤0.000010
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.0052	NA	0.000093
Spring Cr.–Weir	Dissolved	NA	NA	NA	0.54	NA	0.074
	Colloid	NA	NA	NA	0.23	NA	0.21
	Dissolved + Colloid	NC	NC	NC	0.77	NC	0.29
	Whole Water, TR	NA	NA	NA	0.67	NA	0.092
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	6.8	NA
	Colloid	NA	NA	NA	NA	1.4	NA
	Dissolved + Colloid	NC	NC	NC	NC	8.2	NC
	Whole Water, TR	NA	NA	NA	NA	8.3	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	≤0.086	NA	≤0.020
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.58	NA	0.77
Spring Cr. arm	Dissolved	≤0.052	≤0.086	≤0.025	0.084	NA	0.047
	Colloid	0.040	NA	0.40	2.8	NA	0.69
	Dissolved + Colloid	≤0.093	NC	≤0.43	2.9	NC	0.74
	Whole Water, TR	0.20	0.22	0.37	2.6	NA	0.55

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Table A1-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.012
	Colloid	NA	NA	NA	NA	NA	3.5
	Dissolved + Colloid	NC	NC	NC	NC	NC	3.6
	Whole Water, TR	NA	NA	NA	NA	NA	2.6
Yolo Bypass	Dissolved	NA	NA	NA	NA	4.9	NA
	Colloid	NA	NA	NA	NA	1,200	NA
	Dissolved + Colloid	NC	NC	NC	NC	1,200	NC
	Whole Water, TR	NA	NA	NA	NA	1,400	NA
Freeport + Yolo Bypass	Dissolved	1.1	0.30	0.28	1.1	6.4	0.21
	Colloid	29	22	4.8	160	2,300	15
	Dissolved + Colloid	30	22	5.1	160	2,300	15
	Whole Water, TR	18	9.1	4.4	200	2,400	12

[1]Samples collected at Tower Bridge in January 1997.

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C-035180

Table A1-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in grams per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	27	≤9.7	6.3	85	NA	19
	Colloid	16	NA	4.1	≥67	NA	24
	Dissolved + Colloid	43	NC	10	≥150	NC	43
	Whole Water, TR	24	≤6.8	9.5	67.0	NA	38
Sac R.–Keswick	Dissolved	33	≤8.1	14	75	≤32	18
	Colloid	26	NA	21	160	810	53
	Dissolved + Colloid	59	NC	35	230	≤840	71
	Whole Water, TR	41	18	30	140	810	88
Sac R.–Bend Br.	Dissolved	33	≤9.3	15	97	≤120	26
	Colloid	35	15	62	610	6,100	48
	Dissolved + Colloid	68	≤24	78	710	≤6,200	74
	Whole Water, TR	59	29	63	730	2,100	71
Sac R.–Colusa	Dissolved	NA	≤9.0	11	57	140	11
	Colloid	290	110	170	1,800	11,000	120
	Dissolved + Colloid	NC	110	180	1,800	11,000	130
	Whole Water, TR	170	38	34	840	9,900	91
Sac R.–Verona	Dissolved	39	19.0	NA	130	NA	24
	Colloid	260	570	120	1,700	NA	210
	Dissolved + Colloid	300	590	NC	1,800	NC	230
	Whole Water, TR	180	180	44	1,000	NA	130
Sac R.–Freeport	Dissolved	41	≤13	22	160	[1]160	32
	Colloid	NA	NA	54	1,700	[1]4,600	130
	Dissolved + Colloid	NC	NC	76	1,800	[1]4,800	160
	Whole Water, TR	210	76	49	1,800	[1]6,700	160
Flat Cr.	Dissolved	NA	NA	NA	0.029	NA	0.0036
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.090	NA	0.0069
Spring Cr.–Weir	Dissolved	NA	NA	NA	0.69	NA	0.045
	Colloid	NA	NA	NA	8.0	NA	0.60
	Dissolved + Colloid	NC	NC	NC	8.7	NC	0.64
	Whole Water, TR	NA	NA	NA	6.6	NA	0.22
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	1.9	NA
	Colloid	NA	NA	NA	NA	110	NA
	Dissolved + Colloid	NC	NC	NC	NC	110	NC
	Whole Water, TR	NA	NA	NA	NA	83	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	8.7	NA	4.3
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	9.1	NA	19
Spring Cr. arm	Dissolved	5.7	≤3.1	2.8	≤4.6	NA	16
	Colloid	1.7	NA	4.2	44	NA	19
	Dissolved + Colloid	7.4	NC	7.0	≤49	NC	34
	Whole Water, TR	7.7	5.5	4.1	33	NA	27

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Table A1-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.91
	Colloid	NA	NA	NA	NA	NA	19
	Dissolved + Colloid	NC	NC	NC	NC	NC	20
	Whole Water, TR	NA	NA	NA	NA	NA	11
Yolo Bypass	Dissolved	NA	NA	NA	NA	440	NA
	Colloid	NA	NA	NA	NA	19,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	20,000	NC
	Whole Water, TR	NA	NA	NA	NA	18,000	NA
Freeport + Yolo Bypass	Dissolved	41	13	22	160	600	32
	Colloid	NA	NA	54	1,700	24,000	130
	Dissolved + Colloid	NC	NC	NC	1,900	24,000	160
	Whole Water, TR	210	76	49	1,800	25,000	160

[1]Samples collected at Tower Bridge in January 1997.

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Table A1-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples

[Loads in kilograms per day; Br., Bridge; Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis. ≥, load is greater than or equal to value shown because of incomplete digestion of colloid sample]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	67	61	12	260	NA	11
	Colloid	37	NA	7.0	≥110	NA	41
	Dissolved + Colloid	100	NC	19	≥370	NC	53
	Whole Water, TR	110	94	28	520	NA	47
Sac R.–Keswick	Dissolved	74	57	37	420	830	40
	Colloid	39	NA	40	280	1,400	83
	Dissolved + Colloid	110	NC	77	700	2,300	120
	Whole Water, TR	120	87	110	950	2,700	100
Sac R.–Bend Br.	Dissolved	45	49	36	84	88	27
	Colloid	61	11	84	1,300	6,300	93
	Dissolved + Colloid	110	60	120	1,400	6,400	120
	Whole Water, TR	130	120	180	1,300	5,300	100
Sac R.–Colusa	Dissolved	NA	8.2	6.0	47	23	15
	Colloid	350	76	120	2,400	8,400	160
	Dissolved + Colloid	NC	84	130	2,500	8,400	170
	Whole Water, TR	280	77	64	1,400	7,300	110
Sac R.–Verona	Dissolved	8.1	12	NA	66	NA	11
	Colloid	240	210	150	1,600	NA	200
	Dissolved + Colloid	250	220	NA	1,600	NC	210
	Whole Water, TR	180	200	110	1,100	NA	150
Sac R.–Freeport	Dissolved	18	45	20	70	[1]150	11
	Colloid	≥430	≥540	57	1,300	[1]4,700	150
	Dissolved + Colloid	≥450	≥590	77	1,400	[1]4,800	170
	Whole Water, TR	170	110	100	1,500	[1]4,000	110
Flat Cr.	Dissolved	NA	NA	NA	0.34	NA	0.018
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.71	NA	0.019
Spring Cr.–Weir	Dissolved	NA	NA	NA	270	NA	21
	Colloid	NA	NA	NA	1.4	NA	0.21
	Dissolved + Colloid	NC	NC	NC	270	NC	21
	Whole Water, TR	NA	NA	NA	230	NA	22
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	2,600	NA
	Colloid	NA	NA	NA	NA	3.5	NA
	Dissolved + Colloid	NC	NC	NC	NC	2,600	NC
	Whole Water, TR	NA	NA	NA	NA	2,800	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	8.9	NA	1.7
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	10.0	NA	7.1
Spring Cr. arm	Dissolved	5.0	14	40	360	NA	14
	Colloid	1.1	NA	22	220	NA	25
	Dissolved + Colloid	6.2	NA	62	580	NC	39
	Whole Water, TR	6.0	22	74	600	NA	32

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Table A1-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples—*Continued*

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.37
	Colloid	NA	NA	NA	NA	NA	33
	Dissolved + Colloid	NC	NC	NC	NC	NC	34
	Whole Water, TR	NA	NA	NA	NA	NA	23
Yolo Bypass	Dissolved	NA	NA	NA	NA	79	NA
	Colloid	NA	NA	NA	NA	10,000	NA
	Dissolved + Colloid	NC	NC	NC	NC	10,000	NC
	Whole Water, TR	NA	NA	NA	NA	9,700	NA
Freeport + Yolo Bypass	Dissolved	18	45	20	70	229	11
	Colloid	430	540	57	1,300	14,700	150
	Dissolved + Colloid	450	590	77	1,400	15,000	160
	Whole Water, TR	170	110	100	1,500	13,700	110

[1]Samples collected at Tower Bridge in January 1997.

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Appendix 2. Tables of Data Comparing Metal Loads Relative to Loads at Freeport and in the Yolo Bypass

Table A2-1. Aluminum loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-2. Cadmium loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-3. Copper loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-4. Iron loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-5. Lead loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-6. Mercury loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

Table A2-7. Zinc loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

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Table A2-1. *Aluminum loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples*

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.-Shasta	Dissolved	0.44	0.80	0.40	0.65	NA	0.43
	Colloid	NA	NA	0.052	0.020	NA	0.24
	Dissolved + Colloid	0.13	NA	0.053	0.020	NA	0.24
	Whole Water, TR	0.13	0.06	0.055	0.020	NA	0.25
Sac R.-Keswick	Dissolved	0.68	2.9	5.6	2.7	0.50	1.6
	Colloid	NA	NA	0.28	0.033	0.010	0.35
	Dissolved + Colloid	0.13	NA	0.29	0.036	0.010	0.35
	Whole Water, TR	0.13	0.071	0.30	0.038	0.011	0.36
Sac R.-Bend Br.	Dissolved	0.70	1.5	5.2	1.6	0.34	1.4
	Colloid	NA	NA	0.93	0.51	0.23	0.37
	Dissolved + Colloid	0.17	0.13	1.0	0.51	0.23	0.38
	Whole Water, TR	0.18	0.14	1.0	0.51	0.22	0.38
Sac R.-Colusa	Dissolved	NA	0.83	0.96	0.50	0.21	0.81
	Colloid	NA	NA	1.5	0.76	0.44	0.79
	Dissolved + Colloid	NA	0.54	1.5	0.76	0.44	0.79
	Whole Water, TR	1.6	0.54	1.5	0.76	0.44	0.81
Sac R.-Verona	Dissolved	1.1	1.0	NA	0.48	NA	0.70
	Colloid	NA	NA	2.7	0.71	NA	1.2
	Dissolved + Colloid	1.0	2.4	NA	0.71	NA	1.2
	Whole Water, TR	1.0	2.4	2.8	0.70	NA	1.2
Sac R.-Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.58	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.40	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.40	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.39	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.0013	NA	0.000062
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.000024	NA	0.00000065
Spring Cr.-Weir	Dissolved	NA	NA	NA	1.9	NA	1.5
	Colloid	NA	NA	NA	0.00053	NA	0.0013
	Dissolved + Colloid	NA	NA	NA	0.0027	NA	0.0029
	Whole Water, TR	NA	NA	NA	0.0038	NA	0.0050
Spring Cr.-Road	Dissolved	NA	NA	NA	NA	1.6	NA
	Colloid	NA	NA	NA	NA	0.00022	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.00067	NA
	Whole Water, TR	NA	NA	NA	NA	0.00093	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.034	NA	0.25
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.00084	NA	0.11
Spring Cr. arm	Dissolved	0.23	1.1	5.2	0.94	NA	1.3
	Colloid	NA	NA	0.057	0.0084	NA	0.10
	Dissolved + Colloid	0.0028	NA	0.066	0.0093	NA	0.10
	Whole Water, TR	0.0028	0.0079	0.072	0.010	NA	0.11
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.017
	Colloid	NA	NA	NA	NA	NA	0.25
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.25
	Whole Water, TR	NA	NA	NA	NA	NA	0.25
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.42	NA
	Colloid	NA	NA	NA	NA	0.60	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.60	NA
	Whole Water, TR	NA	NA	NA	NA	0.39	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-2. Cadmium loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	1.4	1.5	0.51	2.9	NA	0.37
	Colloid	NA	NA	0.27	0.062	NA	0.18
	Dissolved + Colloid	0.23	NA	0.37	0.48	NA	0.22
	Whole Water, TR	0.48	0.66	0.27	0.54	NA	0.46
Sac R.–Keswick	Dissolved	1.4	1.7	3.1	4.9	2.8	1.1
	Colloid	NA	NA	1.0	0.19	0.10	0.34
	Dissolved + Colloid	0.27	NA	1.9	0.87	0.22	0.53
	Whole Water, TR	0.50	0.74	2.0	0.83	0.38	0.63
Sac R.–Bend Br.	Dissolved	1.9	1.4	2.4	2.3	0.45	0.65
	Colloid	NA	NA	1.7	0.87	0.36	0.35
	Dissolved + Colloid	0.36	0.09	2.0	1.1	0.37	0.42
	Whole Water, TR	0.60	0.70	2.0	0.92	0.45	1.02
Sac R.–Colusa	Dissolved	NA	0.75	0.54	0.59	0.22	0.62
	Colloid	NA	NA	3.9	1.5	0.45	0.92
	Dissolved + Colloid	NA	0.19	2.5	1.4	0.45	0.84
	Whole Water, TR	0.95	0.79	0.75	0.78	0.46	0.85
Sac R.–Verona	Dissolved	0.48	1.0	NA	0.88	NA	0.81
	Colloid	NA	NA	4.1	1.2	NA	1.1
	Dissolved + Colloid	0.78	0.35	NA	1.1	NA	1.1
	Whole Water, TR	1.1	1.5	1.4	0.61	NA	1.2
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.35	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.30	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.30	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.30	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.0042	NA	0.00069
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.00050	NA	0.00037
Spring Cr.–Weir	Dissolved	NA	NA	NA	1.9	NA	0.54
	Colloid	NA	NA	NA	0.0008	NA	0.0017
	Dissolved + Colloid	NA	NA	NA	0.28	NA	0.15
	Whole Water, TR	NA	NA	NA	0.18	NA	0.19
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	5.8	NA
	Colloid	NA	NA	NA	NA	0.00025	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.27	NA
	Whole Water, TR	NA	NA	NA	NA	0.30	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.093	NA	0.10
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.0093	NA	0.10
Spring Cr. arm	Dissolved	0.17	0.28	1.9	3.6	NA	0.42
	Colloid	NA	NA	0.25	0.10	NA	0.12
	Dissolved + Colloid	0.025	NA	0.97	0.62	NA	0.19
	Whole Water, TR	0.030	0.13	0.85	0.48	NA	0.32
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.028
	Colloid	NA	NA	NA	NA	NA	0.11
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.091
	Whole Water, TR	NA	NA	NA	NA	NA	0.065
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.65	NA
	Colloid	NA	NA	NA	NA	0.70	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.70	NA
	Whole Water, TR	NA	NA	NA	NA	0.70	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-3. Copper loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	0.77	0.65	0.36	0.62	NA	0.35
	Colloid	NA	NA	0.10	0.13	NA	0.20
	Dissolved + Colloid	0.13	NA	0.18	0.20	NA	0.22
	Whole Water, TR	0.42	0.31	0.21	0.34	NA	0.30
Sac R.–Keswick	Dissolved	0.74	0.80	0.77	0.93	0.41	0.88
	Colloid	NA	NA	0.85	0.24	0.088	0.34
	Dissolved + Colloid	0.13	NA	0.82	0.35	0.11	0.42
	Whole Water, TR	0.43	0.45	0.82	0.72	0.14	0.53
Sac R.–Bend Br.	Dissolved	0.82	0.51	0.92	0.66	0.36	0.88
	Colloid	NA	NA	3.8	0.86	0.31	0.37
	Dissolved + Colloid	0.19	0.064	2.9	0.83	0.31	0.46
	Whole Water, TR	0.48	0.49	1.2	0.94	0.33	0.60
Sac R.–Colusa	Dissolved	NA	0.80	0.71	0.33	0.27	1.0
	Colloid	NA	NA	2.5	1.6	0.42	0.78
	Dissolved + Colloid	NA	0.38	1.9	1.4	0.40	0.80
	Whole Water, TR	1.1	0.73	0.57	0.88	0.44	0.82
Sac R.–Verona	Dissolved	0.79	1.5	NA	0.86	NA	0.94
	Colloid	NA	NA	3.5	1.3	NA	1.1
	Dissolved + Colloid	0.94	0.85	NA	1.3	NA	1.0
	Whole Water, TR	1.0	1.6	1.3	0.8	NA	1.2
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.44	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.35	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.36	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.33	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.00058	NA	0.00010
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.00032	NA	0.000069
Spring Cr.–Weir	Dissolved	NA	NA	NA	1.5	NA	0.69
	Colloid	NA	NA	NA	0.0019	NA	0.0069
	Dissolved + Colloid	NA	NA	NA	0.24	NA	0.11
	Whole Water, TR	NA	NA	NA	0.22	NA	0.13
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	1.7	NA
	Colloid	NA	NA	NA	NA	0.00059	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.092	NA
	Whole Water, TR	NA	NA	NA	NA	0.11	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.044	NA	0.17
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.012	NA	0.12
Spring Cr. arm	Dissolved	0.25	0.19	0.65	0.65	NA	0.23
	Colloid	NA	NA	0.81	0.58	NA	0.18
	Dissolved + Colloid	0.030	NA	0.74	0.59	NA	0.19
	Whole Water, TR	0.043	0.10	0.59	0.52	NA	0.24
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.10
	Colloid	NA	NA	NA	NA	NA	0.19
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.17
	Whole Water, TR	NA	NA	NA	NA	NA	0.16
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.56	NA
	Colloid	NA	NA	NA	NA	0.65	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.64	NA
	Whole Water, TR	NA	NA	NA	NA	0.67	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-4. Iron loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in *dissolved, colloid, and whole water samples*

[Br., Bridge; Cr., Creek; NA, not analyzed; Sac., Sacramento; R., SCPP, Spring Creek Power Plant; River; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	1.2	0.62	0.66	0.32	NA	0.55
	Colloid	NA	NA	0.041	0.014	NA	0.21
	Dissolved + Colloid	0.071	NA	0.042	0.014	NA	0.21
	Whole Water, TR	0.10	0.042	0.038	0.016	NA	0.20
Sac R.–Keswick	Dissolved	0.35	0.30	0.84	0.33	0.14	0.93
	Colloid	NA	NA	0.30	0.029	0.017	0.36
	Dissolved + Colloid	0.07	NA	0.30	0.031	0.017	0.36
	Whole Water, TR	0.10	0.05	0.25	0.034	0.014	0.34
Sac R.–Bend Br.	Dissolved	0.50	0.22	1.7	0.41	0.28	0.33
	Colloid	NA	NA	0.83	0.44	0.28	0.39
	Dissolved + Colloid	0.10	0.076	0.83	0.44	0.28	0.39
	Whole Water, TR	0.16	0.14	0.92	0.54	0.26	0.35
Sac R.–Colusa	Dissolved	NA	0.41	1.1	0.26	0.18	0.29
	Colloid	NA	NA	1.6	1.3	0.50	0.80
	Dissolved + Colloid	NA	0.30	1.6	1.3	0.50	0.79
	Whole Water, TR	1.5	0.59	0.92	0.78	0.48	0.86
Sac R.–Verona	Dissolved	0.50	0.40	NA	0.88	NA	1.0
	Colloid	NA	NA	2.8	1.1	NA	1.3
	Dissolved + Colloid	0.65	1.3	NA	1.1	NA	1.3
	Whole Water, TR	1.0	2.6	2.1	0.7	NA	1.3
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.40	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.36	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.36	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.31	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.00014	NA	0.0040
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.000015	NA	0.000043
Spring Cr.–Weir	Dissolved	NA	NA	NA	0.70	NA	0.19
	Colloid	NA	NA	NA	0.00076	NA	0.025
	Dissolved + Colloid	NA	NA	NA	0.0018	NA	0.025
	Whole Water, TR	NA	NA	NA	0.0017	NA	0.0016
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	6.0	NA
	Colloid	NA	NA	NA	NA	0.00081	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.0045	NA
	Whole Water, TR	NA	NA	NA	NA	0.0044	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.030	NA	0.25
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.00093	NA	0.13
Spring Cr. arm	Dissolved	0.045	0.13	0.41	0.10	NA	0.41
	Colloid	NA	NA	0.068	0.0073	NA	0.15
	Dissolved + Colloid	0.0021	NA	0.069	0.0073	NA	0.15
	Whole Water, TR	0.0048	0.013	0.058	0.0049	NA	0.13
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.052
	Colloid	NA	NA	NA	NA	NA	0.32
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.32
	Whole Water, TR	NA	NA	NA	NA	NA	0.30
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.60	NA
	Colloid	NA	NA	NA	NA	0.64	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.64	NA
	Whole Water, TR	NA	NA	NA	NA	0.69	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-5. Lead loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	0.12	0.32	0.34	0.38	NA	0.46
	Colloid	NA	NA	0.044	0.026	NA	0.13
	Dissolved + Colloid	0.040	NA	0.059	0.029	NA	0.13
	Whole Water, TR	0.094	0.062	0.061	0.045	NA	0.15
Sac R.–Keswick	Dissolved	0.26	0.73	0.39	2.7	0.092	0.71
	Colloid	NA	NA	0.77	0.081	0.022	0.19
	Dissolved + Colloid	0.056	NA	0.75	0.10	0.023	0.20
	Whole Water, TR	0.16	0.11	0.86	0.13	0.023	0.22
Sac R.–Bend Br.	Dissolved	0.20	0.37	1.0	0.57	0.16	0.71
	Colloid	NA	NA	1.4	0.42	0.26	0.29
	Dissolved + Colloid	0.090	0.067	1.4	0.42	0.26	0.30
	Whole Water, TR	0.19	0.19	1.8	0.49	0.21	0.33
Sac R.–Colusa	Dissolved	NA	0.50	0.68	0.48	0.11	0.67
	Colloid	NA	NA	2.3	1.1	0.40	0.73
	Dissolved + Colloid	NA	0.32	2.2	1.1	0.40	0.79
	Whole Water, TR	1.1	0.44	0.80	1.3	0.40	0.64
Sac R.–Verona	Dissolved	0.45	0.5	NA	1.3	NA	0.86
	Colloid	NA	NA	3.3	1.0	NA	1.2
	Dissolved + Colloid	0.70	0.85	NA	1.0	NA	1.2
	Whole Water, TR	0.89	1.6	2.1	1.0	NA	1.1
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.23	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.48	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.48	1.1
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.42	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.00030	NA	0.000048
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.000026	NA	0.0000078
Spring Cr.–Weir	Dissolved	NA	NA	NA	0.49	NA	0.35
	Colloid	NA	NA	NA	0.0014	NA	0.014
	Dissolved + Colloid	NA	NA	NA	0.0048	NA	0.019
	Whole Water, TR	NA	NA	NA	0.0034	NA	0.0077
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	1.1	NA
	Colloid	NA	NA	NA	NA	0.00061	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.0036	NA
	Whole Water, TR	NA	NA	NA	NA	0.0035	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.078	NA	0.10
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.0029	NA	0.064
Spring Cr. arm	Dissolved	0.047	0.29	0.089	0.076	NA	0.22
	Colloid	NA	NA	0.083	0.018	NA	0.046
	Dissolved + Colloid	0.0031	NA	0.085	0.018	NA	0.049
	Whole Water, TR	0.011	0.024	0.084	0.013	NA	0.046
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.057
	Colloid	NA	NA	NA	NA	NA	0.23
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.24
	Whole Water, TR	NA	NA	NA	NA	NA	0.22
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.77	NA
	Colloid	NA	NA	NA	NA	0.52	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.52	NA
	Whole Water, TR	NA	NA	NA	NA	0.58	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-6. Mercury loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	0.66	0.75	0.29	0.53	NA	0.59
	Colloid	NA	NA	0.076	0.039	NA	0.18
	Dissolved + Colloid	NA	NA	0.13	0.081	NA	0.27
	Whole Water, TR	0.11	0.089	0.19	0.037	NA	0.24
Sac R.–Keswick	Dissolved	0.80	0.62	0.64	0.47	0.053	0.56
	Colloid	NA	NA	0.39	0.094	0.034	0.41
	Dissolved + Colloid	NA	NA	0.46	0.12	0.035	0.44
	Whole Water, TR	0.20	0.24	0.61	0.08	0.033	0.55
Sac R.–Bend Br.	Dissolved	0.80	0.72	0.68	0.61	0.20	0.81
	Colloid	NA	NA	1.1	0.36	0.26	0.37
	Dissolved + Colloid	NA	NA	1.0	0.38	0.26	0.46
	Whole Water, TR	0.28	0.38	1.3	0.41	0.09	0.44
Sac R.–Colusa	Dissolved	NA	0.69	0.50	0.36	0.23	0.34
	Colloid	NA	NA	3.1	1.1	0.47	0.92
	Dissolved + Colloid	NA	NA	2.4	1.0	0.45	0.80
	Whole Water, TR	0.81	0.50	0.69	0.47	0.40	0.57
Sac R.–Verona	Dissolved	0.95	1.5	NA	0.8	NA	0.75
	Colloid	NA	NA	2.2	1.0	NA	1.6
	Dissolved + Colloid	NA	NA	NA	1.0	NA	1.4
	Whole Water, TR	0.86	2.4	0.9	0.6	NA	0.81
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.27	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.19	1.0
	Dissolved + Colloid	NA	NA	1.0	1.0	[1]0.20	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.27	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.00018	NA	0.00011
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.000050	NA	0.000043
Spring Cr.–Weir	Dissolved	NA	NA	NA	0.0043	NA	0.0014
	Colloid	NA	NA	NA	0.0047	NA	0.0046
	Dissolved + Colloid	NA	NA	NA	0.0047	NA	0.0040
	Whole Water, TR	NA	NA	NA	0.0037	NA	0.0014
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	0.0032	NA
	Colloid	NA	NA	NA	NA	0.0047	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.0045	NA
	Whole Water, TR	NA	NA	NA	NA	0.0034	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.054	NA	0.13
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.0051	NA	0.12
Spring Cr. arm	Dissolved	0.14	0.24	0.13	0.029	NA	0.50
	Colloid	NA	NA	0.078	0.026	NA	0.15
	Dissolved + Colloid	NA	NA	0.092	0.026	NA	0.21
	Whole Water, TR	0.037	0.072	0.084	0.018	NA	0.17
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.028
	Colloid	NA	NA	NA	NA	NA	0.15
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.12
	Whole Water, TR	NA	NA	NA	NA	NA	0.069
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.73	NA
	Colloid	NA	NA	NA	NA	0.81	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.83	NA
	Whole Water, TR	NA	NA	NA	NA	0.73	NA

[1]Samples collected at Tower Bridge in January 1997.

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Table A2-7. Zinc loads divided by sum of loads at Freeport and in Yolo Bypass, derived from concentrations in dissolved, colloid, and whole water samples

[Br., Bridge; Cr., Creek; NA, not analyzed; R., River; Sac., Sacramento; SCPP, Spring Creek Power Plant; TR, total recoverable analysis]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
Sac R.–Shasta	Dissolved	3.7	1.4	0.60	3.7	NA	1.0
	Colloid	NA	NA	0.12	0.085	NA	0.27
	Dissolved + Colloid	0.22	NA	0.25	0.27	NA	0.33
	Whole Water, TR	0.65	0.85	0.28	0.35	NA	0.43
Sac R.–Keswick	Dissolved	4.1	1.3	1.9	6.0	3.6	3.6
	Colloid	NA	NA	0.70	0.22	0.10	0.55
	Dissolved + Colloid	0.25	NA	1.0	0.51	0.15	0.75
	Whole Water, TR	0.71	0.79	1.1	0.63	0.20	0.91
Sac R.–Bend Br.	Dissolved	2.5	1.1	1.8	1.2	0.38	2.5
	Colloid	NA	NA	1.5	1.0	0.43	0.62
	Dissolved + Colloid	0.25	0.10	1.6	1.0	0.43	0.75
	Whole Water, TR	0.76	1.1	1.8	0.87	0.39	0.91
Sac R.–Colusa	Dissolved	NA	0.18	0.30	0.67	0.10	1.4
	Colloid	NA	NA	2.1	1.8	0.57	1.1
	Dissolved + Colloid	NA	0.14	1.7	1.8	0.56	1.1
	Whole Water, TR	1.6	0.70	0.64	0.93	0.53	1.0
Sac R.–Verona	Dissolved	0.45	0.27	NA	0.94	NA	1.0
	Colloid	NA	NA	2.6	1.2	NA	1.3
	Dissolved + Colloid	0.56	0.38	NA	1.2	NA	1.3
	Whole Water, TR	1.1	1.8	1.1	0.73	NA	1.4
Sac R.–Freeport	Dissolved	1.0	1.0	1.0	1.0	[1]0.66	1.0
	Colloid	NA	NA	1.0	1.0	[1]0.32	1.0
	Dissolved + Colloid	1.0	1.0	1.0	1.0	[1]0.32	1.0
	Whole Water, TR	1.0	1.0	1.0	1.0	[1]0.29	1.0
Flat Cr.	Dissolved	NA	NA	NA	0.0049	NA	0.0016
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.00047	NA	0.00017
Spring Cr.–Weir	Dissolved	NA	NA	NA	3.9	NA	1.9
	Colloid	NA	NA	NA	0.0011	NA	0.0014
	Dissolved + Colloid	NA	NA	NA	0.20	NA	0.13
	Whole Water, TR	NA	NA	NA	0.15	NA	0.20
Spring Cr.–Road	Dissolved	NA	NA	NA	NA	11	NA
	Colloid	NA	NA	NA	NA	0.00024	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.17	NA
	Whole Water, TR	NA	NA	NA	NA	0.20	NA
Whiskeytown Lake at SCPP	Dissolved	NA	NA	NA	0.13	NA	0.15
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NA	NA	NA	NA	NA	NA
	Whole Water, TR	NA	NA	NA	0.0067	NA	0.065
Spring Cr. arm	Dissolved	0.28	0.31	2.0	5.1	NA	1.3
	Colloid	NA	NA	0.39	0.17	NA	0.17
	Dissolved + Colloid	0.014	NA	0.81	0.42	NA	0.24
	Whole Water, TR	0.035	0.20	0.74	0.40	NA	0.29
Colusa Basin Drain	Dissolved	NA	NA	NA	NA	NA	0.034
	Colloid	NA	NA	NA	NA	NA	0.22
	Dissolved + Colloid	NA	NA	NA	NA	NA	0.21
	Whole Water, TR	NA	NA	NA	NA	NA	0.21
Yolo Bypass	Dissolved	NA	NA	NA	NA	0.34	NA
	Colloid	NA	NA	NA	NA	0.68	NA
	Dissolved + Colloid	NA	NA	NA	NA	0.67	NA
	Whole Water, TR	NA	NA	NA	NA	0.71	NA

[1]Samples collected at Tower Bridge in January 1997.

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Appendix 3. Tables of Data Comparing Metal Loads Used in Mass Balance Calculations for the Spring Creek Arm of Keswick Reservoir

Table A3-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

Table A3-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

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Table A3-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake; %, percent]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		1,200	NA	97
	Colloid		290	NA	84
	Dissolved + Colloid		1,500	NC	180
	Whole Water, TR		1,400	NA	130
Spring Cr.–Road	Dissolved		NA	4,200	NA
	Colloid		NA	2,000	NA
	Dissolved + Colloid		NC	6,200	NC
	Whole Water, TR		NA	5,500	NA
Whiskeytown Lake at SCPP	Dissolved		21	NA	16
	Colloid		NA	NA	NA
	Dissolved + Colloid		NC	NC	NC
	Whole Water, TR		310	NA	2,800
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		1,200	NC	113
	Colloid		≥290	NC	≥84
	Dissolved + Colloid		≥1,500	NC	≥180
	Whole Water, TR		1,710	NC	2,900
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		580	NA	82
	Colloid		4,600	NA	6,600
	Dissolved + Colloid		5,100	NC	6,600
	Whole Water, TR		3,600	NA	2,900
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		210%	NC	140%
	Colloid		6.3%	NC	1.3%
	Dissolved + Colloid		29%	NC	2.7%
	Whole Water, TR		48%	NC	100%

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Table A3-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. %, percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		1,700	NA	140
	Colloid		4.2	NA	1.3
	Dissolved + Colloid		1,700	NC	150
	Whole Water, TR		1,800	NA	160
Spring Cr.–Road	Dissolved		NA	18,000	NA
	Colloid		NA	16	NA
	Dissolved + Colloid		NC	18,000	NC
	Whole Water, TR		NA	17,000	NA
Whiskeytown Lake at SCPP	Dissolved		84	NA	≤27
	Colloid		NA	NA	NA
	Dissolved + Colloid		NC	NC	NC
	Whole Water, TR		≤93	NA	88
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		1,800	NC	170
	Colloid		≥4.2	NC	≥1.3
	Dissolved + Colloid		≥1,700	NC	≥150
	Whole Water, TR		1,900	NC	250
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		3,200	NA	110
	Colloid		540	NA	89
	Dissolved + Colloid		3,800	NC	200
	Whole Water, TR		4,800	NA	270
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		56%	NC	150%
	Colloid		0.8%	NC	1.5%
	Dissolved + Colloid		45%	NC	75%
	Whole Water, TR		40%	NC	93%

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Table A3-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		210	NA	11
	Colloid		1.4	NA	0.63
	Dissolved + Colloid		210	NC	12
	Whole Water, TR		200	NA	12
Spring Cr.–Road	Dissolved		NA	1,100	NA
	Colloid		NA	6.7	NA
	Dissolved + Colloid		NC	1,100	NC
	Whole Water, TR		NA	1,100	NA
Whiskeytown Lake at SCPP	Dissolved		6.2	NA	2.7
	Colloid		NA	NA	NA
	Dissolved + Colloid		NC	NC	NC
	Whole Water, TR		11	NA	11
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		220	NC	14
	Colloid		≥1.4	NC	≥0.63
	Dissolved + Colloid		≥220	NC	≥12
	Whole Water, TR		210	NC	23
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		91	NA	4
	Colloid		430	NA	16
	Dissolved + Colloid		520	NC	20
	Whole Water, TR		480	NA	22
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		240%	NC	380%
	Colloid		0.3%	NC	3.9%
	Dissolved + Colloid		42%	NC	60%
	Whole Water, TR		44%	NC	100%

C—035195

C-035196

Table A3-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		480	NA	14
	Colloid		340	NA	1,100
	Dissolved + Colloid		820	NC	1,100
	Whole Water, TR		690	NA	45
Spring Cr.–Road	Dissolved		NA	24,000	NA
	Colloid		NA	5,200	NA
	Dissolved + Colloid		NC	29,000	NC
	Whole Water, TR		NA	27,000	NA
Whiskeytown Lake at SCPP	Dissolved		21	NA	19
	Colloid		NA	NA	NA
	Dissolved + Colloid		NA	NA	NA
	Whole Water, TR		380	NA	3,700
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		500	NC	33
	Colloid		≥340	NC	≥1,100
	Dissolved + Colloid		≥840	NC	≥1,100
	Whole Water, TR		1,070	NC	3,745
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		71	NA	31
	Colloid		3,300	NA	6,600
	Dissolved + Colloid		3,300	NC	6,700
	Whole Water, TR		2,000	NA	3,700
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		710%	NC	110%
	Colloid		10%	NC	17%
	Dissolved + Colloid		25%	NC	16%
	Whole Water, TR		54%	NC	100%

C—035196

C-035197

Table A3-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. % percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		0.54	NA	0.074
	Colloid		0.23	NA	0.21
	Dissolved + Colloid		0.77	NC	0.29
	Whole Water, TR		0.67	NA	0.092
Spring Cr.–Road	Dissolved		NA	6.8	NA
	Colloid		NA	1.4	NA
	Dissolved + Colloid		NC	8.2	NC
	Whole Water, TR		NA	8.3	NA
Whiskeytown Lake at SCPP	Dissolved		≤0.086	NA	≤0.020
	Colloid		NA	NA	NA
	Dissolved + Colloid		NC	NC	NC
	Whole Water, TR		0.58	NA	0.77
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		≤0.63	NC	≤0.094
	Colloid		≥0.23	NC	≥0.21
	Dissolved + Colloid		≥0.86	NC	≥0.31
	Whole Water, TR		1.3	NC	0.86
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		0.084	NA	0.047
	Colloid		2.8	NA	0.69
	Dissolved + Colloid		2.9	NC	0.74
	Whole Water, TR		2.6	NA	0.55
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		750%	NC	200%
	Colloid		8.2%	NC	30%
	Dissolved + Colloid		30%	NC	42%
	Whole Water, TR		48%	NC	160%

C—035197

C-035198

Table A3-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in g/d)			
Spring Cr.–Weir	Dissolved		0.69	NA	0.045
	Colloid		8.0	NA	0.60
	Dissolved + Colloid		8.7	NC	0.64
	Whole Water, TR		6.6	NA	0.22
Spring Cr.–Road	Dissolved		NA	1.9	NA
	Colloid		NA	110	NA
	Dissolved + Colloid		NC	110	NC
	Whole Water, TR		NA	83	NA
Whiskeytown Lake at SCPP	Dissolved		8.7	NA	4.3
	Colloid		NC	NA	NC
	Dissolved + Colloid		8.7	NC	≥4.3
	Whole Water, TR		9.1	NA	19
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in g/d)			
	Dissolved		9.4	NC	4.3
	Colloid		≥8.0	NC	≥0.60
	Dissolved + Colloid		≥17	NC	≥4.9
	Whole Water, TR		16	NC	19
C. Spring Creek arm of Keswick Reservoir		(in g/d)			
	Dissolved		4.6	NA	16
	Colloid		44	NA	19
	Dissolved + Colloid		49	NC	34
	Whole Water, TR		33	NA	27
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		200%	NC	27%
	Colloid		18%	NC	3.2%
	Dissolved + Colloid		36%	NC	15%
	Whole Water, TR		48%	NC	71%

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C-035199

Table A3-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for the Spring Creek arm of Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; SCPP, Spring Creek Power Plant; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site			Sampling Periods		
			Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
Spring Cr.–Weir	Dissolved		270	NA	21
	Colloid		1.4	NA	0.21
	Dissolved + Colloid		270	NA	21
	Whole Water, TR		230	NA	22
Spring Cr.–Road	Dissolved		NA	2,600	NA
	Colloid		NA	3.5	NA
	Dissolved + Colloid		NC	2,600	NC
	Whole Water, TR		NA	2,800	NA
Whiskeytown Lake at SCPP	Dissolved		8.9	NA	1.7
	Colloid		NA	NA	NC
	Dissolved + Colloid		NC	NC	NC
	Whole Water, TR		10	NA	7.1
B. Total inputs to Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		279	NC	23
	Colloid		≥1.4	NC	≥0.21
	Dissolved + Colloid		≥279	NC	≥23
	Whole Water, TR		240	NC	29
C. Spring Creek arm of Keswick Reservoir		(in kg/d)			
	Dissolved		360	NA	14
	Colloid		220	NA	25
	Dissolved + Colloid		580	NC	39
	Whole Water, TR		600	NA	32
D. Mass balance, Spring Creek arm		(B divided by C, in percent)			
	Dissolved		77%	NC	160%
	Colloid		0.64%	NC	0.84%
	Dissolved + Colloid		48%	NC	58%
	Whole Water, TR		40%	NC	91%

C—035199

C-035200

Appendix 4. Tables of Data Comparing Metal Loads Used in Mass Balance Calculations for Keswick Reservoir

Table A4-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

Table A4-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations forKeswick Reservoir

Table A4-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

Table A4-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

Table A4-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

Table A4-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

Table A4-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

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C-035201

Table A4-1. Aluminum loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Keswick Reservoir		(in kg/d)					
Sac. R.–Shasta	Dissolved	48	33	10	400	NA	27
	Colloid	7,300	NA	780	≥11,000	NA	15,000
	Dissolved + Colloid	7,300	NA	790	≥11,000	NC	15,000
	Whole Water, TR	5,900	1,500	550	7,400	NA	6,500
Flat Cr.	Dissolved	NA	NA	NA	0.83	NA	0.0039
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	8.8	NA	0.017
Spring Cr. arm	Dissolved	25	46	130	580	NA	82
	Colloid	130	NA	860	4,600	NA	6,600
	Dissolved + Colloid	160	NC	990	5,100	NC	6,600
	Whole Water, TR	130	190	720	3,600	NA	2,900
B. Total Inputs to Keswick Reservoir		(in kg/d)					
	Dissolved	73	79	140	980	NC	110
	Colloid	7,400	NC	1,600	≥16,000	NC	22,000
	Dissolved + Colloid	7,500	NC	1,800	≥16,000	NC	22,000
	Whole Water, TR	6,000	1,700	1,300	11,000	NC	9,400
C. Output from Keswick Reservoir		(in kg/d)					
Sac. R.–Keswick	Dissolved	75	120	140	1,700	1,300	100
	Colloid	7,700	NA	4,200	18,000	94,000	22,000
	Dissolved + Colloid	7,800	NA	4,300	20,000	96,000	22,000
	Whole Water, TR	6,200	1,700	3,000	14,000	62,000	9,400
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	97%	66%	100%	58%	NC	110%
	Colloid	96%	NC	39%	87%	NC	98%
	Dissolved + Colloid	96%	NC	41%	81%	NC	98%
	Whole Water, TR	97%	99%	42%	79%	NC	100%

C—035201

C-035202

Table A4-2. Cadmium loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[g, grams; d, day. Cr., Creek; R., River; Sac., Sacramento; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 1997	May–June 1997
A. Inputs to Keswick Reservoir		(in g/d)					
Sac. R.–Shasta	Dissolved	570	370	≤82	2,600	NA	≤96
	Colloid	190	NA	59	≥320	NA	140
	Dissolved + Colloid	760	NC	≤140	≥2,900	NA	≤230
	Whole Water, TR	960	650	160	5,400	NA	390
Flat Cr.	Dissolved	NA	NA	NA	3.8	NA	0.18
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	5.0	NA	0.31
Spring Cr. arm	Dissolved	73	68	310	3,200	NA	110
	Colloid	10	NA	56	540	NA	89
	Dissolved + Colloid	83	NC	370	3,800	NC	200
	Whole Water, TR	≤59	130	510	4,800	NA	270
B. Total Inputs to Keswick Reservoir		(in g/d)					
	Dissolved	640	440	390	5,800	NC	210
	Colloid	200	NC	120	≥860	NC	230
	Dissolved + Colloid	840	NC	510	≥6,700	NC	430
	Whole Water, TR	1,000	780	670	10,000	NC	660
C. Output from Keswick Reservoir		(in g/d)					
Sac. R.–Keswick	Dissolved	580	410	500	4,400	8,800	290
	Colloid	340	NA	220	980	6,300	260
	Dissolved + Colloid	910	NA	720	5,300	15,000	550
	Whole Water, TR	1,000	730	1,200	8,300	21,000	530
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	110%	110%	78%	130%	NC	71%
	Colloid	59%	NC	52%	88%	NC	88%
	Dissolved + Colloid	93%	NC	71%	130%	NC	78%
	Whole Water, TR	100%	110%	56%	120%	NC	120%

C—035202

C-035203

Table A4-3. Copper loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[kg, kilogram; d, day; Cr., Creek; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 997	May–June 1997
A. Inputs to Keswick Reservoir		(in kg/d)					
Sac. R.–Shasta	Dissolved	30	10	4.3	87	NA	5.6
	Colloid	15	NA	2.7	≥95	NA	18
	Dissolved + Colloid	44	NC	7.0	≥180	NC	24
	Whole Water, TR	55	27	14	320	NA	27
Flat Cr.	Dissolved	NA	NA	NA	0.081	NA	0.0016
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.30	NA	0.0063
Spring Cr. arm	Dissolved	10	2.9	7.8	91	NA	3.6
	Colloid	0.77	NA	21	430	NA	16
	Dissolved + Colloid	10	NA	28	520	NC	20
	Whole Water, TR	5.6	8.9	40	480	NA	22
B. Total Inputs to Keswick Reservoir		(in kg/d)					
	Dissolved	40	13	12	180	NC	9
	Colloid	16	NA	24	≥530	NC	34
	Dissolved + Colloid	54	NA	35	≥700	NC	44
	Whole Water, TR	61	36	54	800	NC	49
C. Output from Keswick Reservoir		(in kg/d)					
Sac. R.–Keswick	Dissolved	29	12	9.2	130	260	14
	Colloid	15	NA	22	180	1,000	31
	Dissolved + Colloid	43	NC	31	310	1,300	45
	Whole Water, TR	56	40	56	670	1,400	48
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	140%	110%	130%	140%	NC	66%
	Colloid	110%	NC	110%	290%	NC	110%
	Dissolved + Colloid	130%	NC	110%	230%	NC	98%
	Whole Water, TR	110%	90%	100%	120%	NC	100%

C—035203

C-035204

Table A4-4. Iron loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[kg, kilogram; d, day. Cr., Creek; R., River; Sac., Sacramento; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 997	May–June 1997
A. Inputs to Keswick Reservoir		(in kg/d)					
Sac. R.–Shasta	Dissolved	≤270	93	21	220	NA	41
	Colloid	4,900	NA	490	≥6,300	NA	9,100
	Dissolved + Colloid	≤5,100	NA	510	≥6,500	NC	9,200
	Whole Water, TR	4,100	930	490	6,400	NA	5,500
Flat Cr.	Dissolved	NA	NA	NA	0.10	NA	0.30
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	6.2	NA	1.2
Spring Cr. arm	Dissolved	10	19	13	71	NA	31
	Colloid	140	NA	820	3,300	NA	6,600
	Dissolved + Colloid	150	NC	830	3,300	NC	6,700
	Whole Water, TR	≤200	≤280	760	2,000	NA	3,700
B. Total Inputs to Keswick Reservoir		(in kg/d)					
	Dissolved	280	110	34	300	NC	72
	Colloid	5,000	NC	1,300	≥9,600	NC	16,000
	Dissolved + Colloid	5,300	NC	1,300	≥9,800	NC	16,000
	Whole Water, TR	4,300	1,200	1,300	8,400	NC	9,200
C. Output from Keswick Reservoir		(in kg/d					
Sac. R.–Keswick	Dissolved	77	45	27	230	550	70
	Colloid	4,600	NA	3,600	13,000	110,000	16,000
	Dissolved + Colloid	4,700	NA	3,600	14,000	110,000	16,000
	Whole Water, TR	4,200	1,200	3,200	14,000	84,000	9,400
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	360%	250%	130%	130%	NC	100%
	Colloid	110%	NC	36%	74%	NC	98%
	Dissolved + Colloid	110%	NC	37%	70%	NC	99%
	Whole Water, TR	100%	100%	39%	60%	NC	98%

C—035204

C-035205

Table A4-5. Lead loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[kg, kilogram; d, day. Cr., Creek; R., River; Sac., Sacramento; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 997	May–June 1997
A. Inputs to Keswick Reservoir		(in kg/d)					
Sac. R.–Shasta	Dissolved	≤0.13	0.10	≤0.10	0.42	NA	≤0.10
	Colloid	1.1	NA	0.21	≥4.2	NA	1.9
	Dissolved + Colloid	≤1.2	NC	≤0.30	≥4.6	NA	≤2.0
	Whole Water, TR	1.7	0.56	0.27	9.0	NA	1.8
Flat Cr.	Dissolved	NA	NA	NA	0.00033	NA	0.000010
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.0052	NA	0.000093
Spring Cr. arm	Dissolved	≤0.052	≤0.086	≤0.025	0.084	NA	0.047
	Colloid	0.040	NA	0.40	2.8	NA	0.69
	Dissolved + Colloid	≤0.093	NC	≤0.43	2.9	NC	0.74
	Whole Water, TR	0.20	0.22	0.37	2.6	NA	0.55
B. Total Inputs to Keswick Reservoir		(in kg/d)					
	Dissolved	0.18	0.18	0.12	0.50	NC	0.14
	Colloid	1.1	NC	0.61	≥7.0	NC	2.6
	Dissolved + Colloid	1.3	NC	0.73	≥7.5	NC	2.7
	Whole Water, TR	1.9	0.78	0.64	12	NC	2.4
C. Output from Keswick Reservoir		(in kg/d)					
Sac. R.–Keswick	Dissolved	0.29	≤0.22	≤0.11	3.0	≤0.59	≤0.15
	Colloid	1.4	NA	3.7	13	51	2.9
	Dissolved + Colloid	1.7	NA	≤3.8	16	≤52	≤3.0
	Whole Water, TR	2.8	1.0	3.8	25	55	2.6
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	63%	83%	110%	17%	NC	95%
	Colloid	81%	NC	16%	54%	NC	89%
	Dissolved + Colloid	76%	NC	19%	47%	NC	91%
	Whole Water, TR	68%	78%	17%	46%	NC	90%

C—035205

C-035206

Table A4-6. Mercury loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[g, grams; d, day. Cr., Creek; R., River; Sac., Sacramento; NA, not analyzed; NC, not calculated; TR, Total recoverable analysis. %, percent; ≤, load is less than or equal to value shown because of concentration less than detection limit; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 997	May–June 1997
A. Inputs to Keswick Reservoir		(in g/d)					
Sac. R.–Shasta	Dissolved	27	≤9.7	6.3	85	NA	19
	Colloid	16	NA	4.1	≥67	NA	24
	Dissolved + Colloid	43	NC	10	≥150	NC	43
	Whole Water, TR	24	≤6.8	9.5	67	NA	38
Flat Cr.	Dissolved	NA	NA	NA	0.029	NA	0.0036
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.090	NA	0.0069
Spring Cr. arm	Dissolved	5.7	≤3.1	2.8	≤4.6	NA	16
	Colloid	1.7	NA	4.2	44	NA	19
	Dissolved + Colloid	7.4	NC	7.0	≤49	NC	34
	Whole Water, TR	7.7	5.5	4.1	33	NA	27
B. Total Inputs to Keswick Reservoir		(in g/d)					
	Dissolved	33	13	9.1	90	NC	35
	Colloid	18	NC	8.3	≥110	NC	43
	Dissolved + Colloid	50	NC	17	≥200	NC	77
	Whole Water, TR	32	12	14	100	NC	65
C. Output from Keswick Reservoir		(in g/d)					
Sac. R..–Keswick	Dissolved	33	≤8.1	14	75	≤32	18
	Colloid	26	NA	21	160	810	53
	Dissolved + Colloid	59	NA	35	230	≤840	71
	Whole Water, TR	41	18	30	140	810	88
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	99%	160%	65%	120%	NC	190%
	Colloid	68%	NC	40%	69%	NC	81%
	Dissolved + Colloid	85%	NC	49%	87%	NC	110%
	Whole Water, TR	77%	68%	45%	71%	NC	74%

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Table A4-7. Zinc loads derived from concentrations in dissolved, colloid, and whole water samples used in mass balance calculations for Keswick Reservoir

[kg, kilogram; d, day. Cr., Creek; NA, not analyzed; NC, not calculated; R., River; Sac., Sacramento; TR, Total recoverable analysis. %, percent; ≥, load is greater than or equal to value shown because colloids not analyzed from Whiskeytown Lake]

Site		Sampling Periods					
		July 1996	Sept. 1996	Nov. 1996	Dec. 1996	Jan. 997	May–June 1997
A. Inputs To Keswick Reservoir		(in kg/d)					
Sac R.–Shasta	Dissolved	67	61	12	260	NA	11
	Colloid	37	NA	7.0	≥110	NA	41
	Dissolved + Colloid	100	NC	19	≥370	NC	53
	Whole Water, TR	110	94	28	520	NA	47
Flat Cr.	Dissolved	NA	NA	NA	0.34	NA	0.018
	Colloid	NA	NA	NA	NA	NA	NA
	Dissolved + Colloid	NC	NC	NC	NC	NC	NC
	Whole Water, TR	NA	NA	NA	0.71	NA	0.019
Spring Cr. arm	Dissolved	5.0	14	40	360	NA	14
	Colloid	1.1	NC	22	220	NA	25
	Dissolved + Colloid	6.2	NC	62	580	NC	39
	Whole Water, TR	6.0	22	74	600	NA	32
B. Total Inputs to Keswick Reservoir		(in kg/d)					
	Dissolved	72	75	52	620	NC	25
	Colloid	38	NC	29	≥330	NC	66
	Dissolved + Colloid	110	NC	81	≥950	NC	92
	Whole Water, TR	120	120	102	1,100	NC	79
C. Output from Keswick Reservoir		(in kg/d)					
Sac, R.–Keswick	Dissolved	74	57	37	420	830	40
	Colloid	39	NA	40	280	1,400	83
	Dissolved + Colloid	110	NA	77	700	2,300	120
	Whole Water, TR	120	87	110	950	2,700	100
D. Inputs/Output		(B divided by C, in percent)					
	Dissolved	97%	130%	140%	150%	NC	63%
	Colloid	98%	NC	73%	120%	NC	80%
	Dissolved + Colloid	97%	NC	110%	140%	NC	77%
	Whole Water, TR	97%	130%	93%	120%	NC	79%

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Appendix 5. Plots of Metal Loads in Dissolved and Colloidal Forms for Miscellaneous Trace Metals in Water

Figure A5-1. Plot of dissolved and colloidal chromium loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California.

Figure A5-2. Plot of dissolved and colloidal cobalt loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California.

Figure A5-3. Plot of dissolved and colloidal nickel loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California.

Figure A5-4. Plot of dissolved and colloidal yttrium loads, July 1996 to May–June (labeled as May on graph) 1997, Sacramento River, California.

C—0 3 5 2 0 8

C-035209

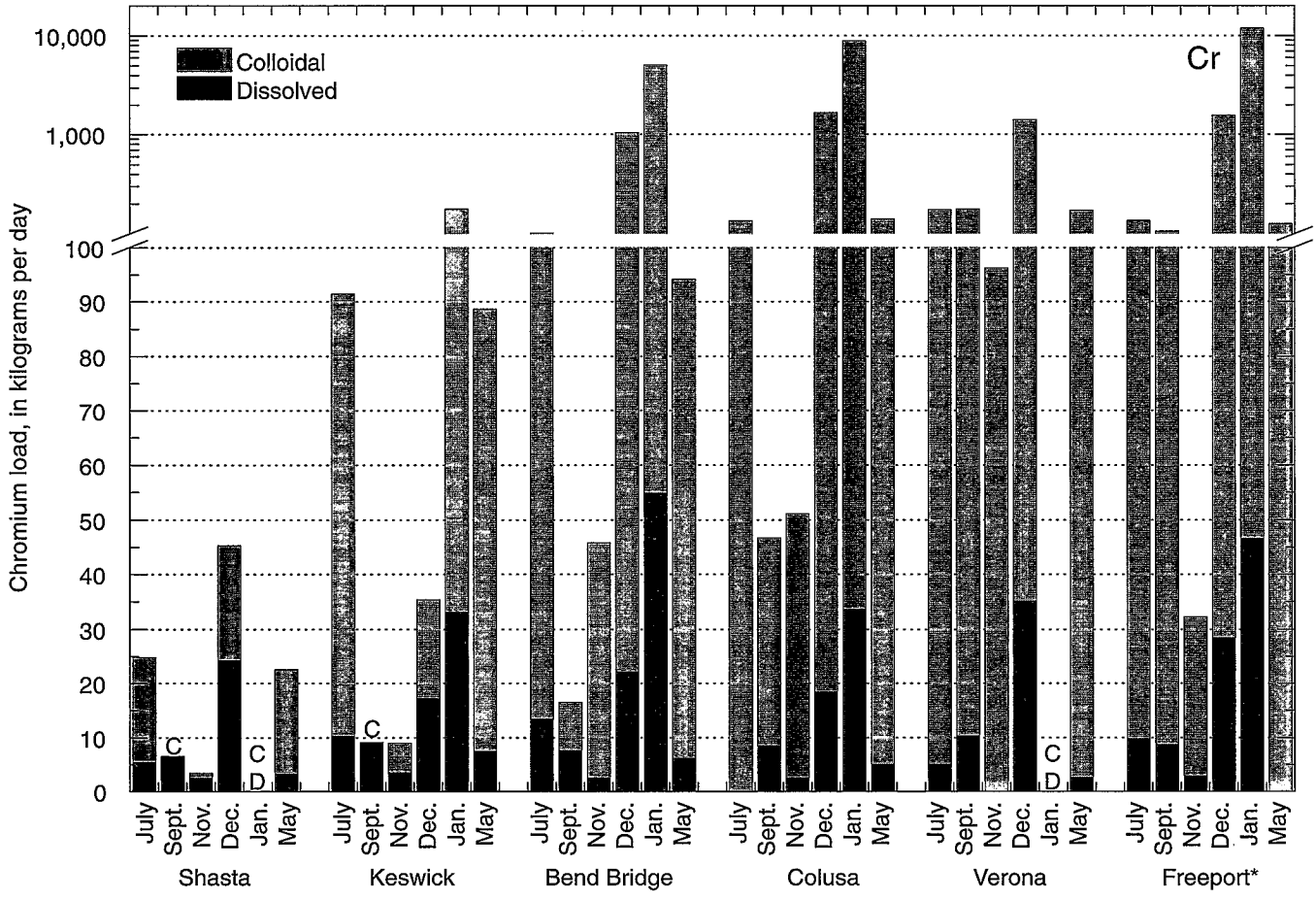

Figure A5-1. Plot of dissolved and colloidal chromium (Cr) loads, July 1996 to May-June (labeled as May on graph) 1997, Sacramento River, California. C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

C — 0 3 5 2 0 9

C-035210

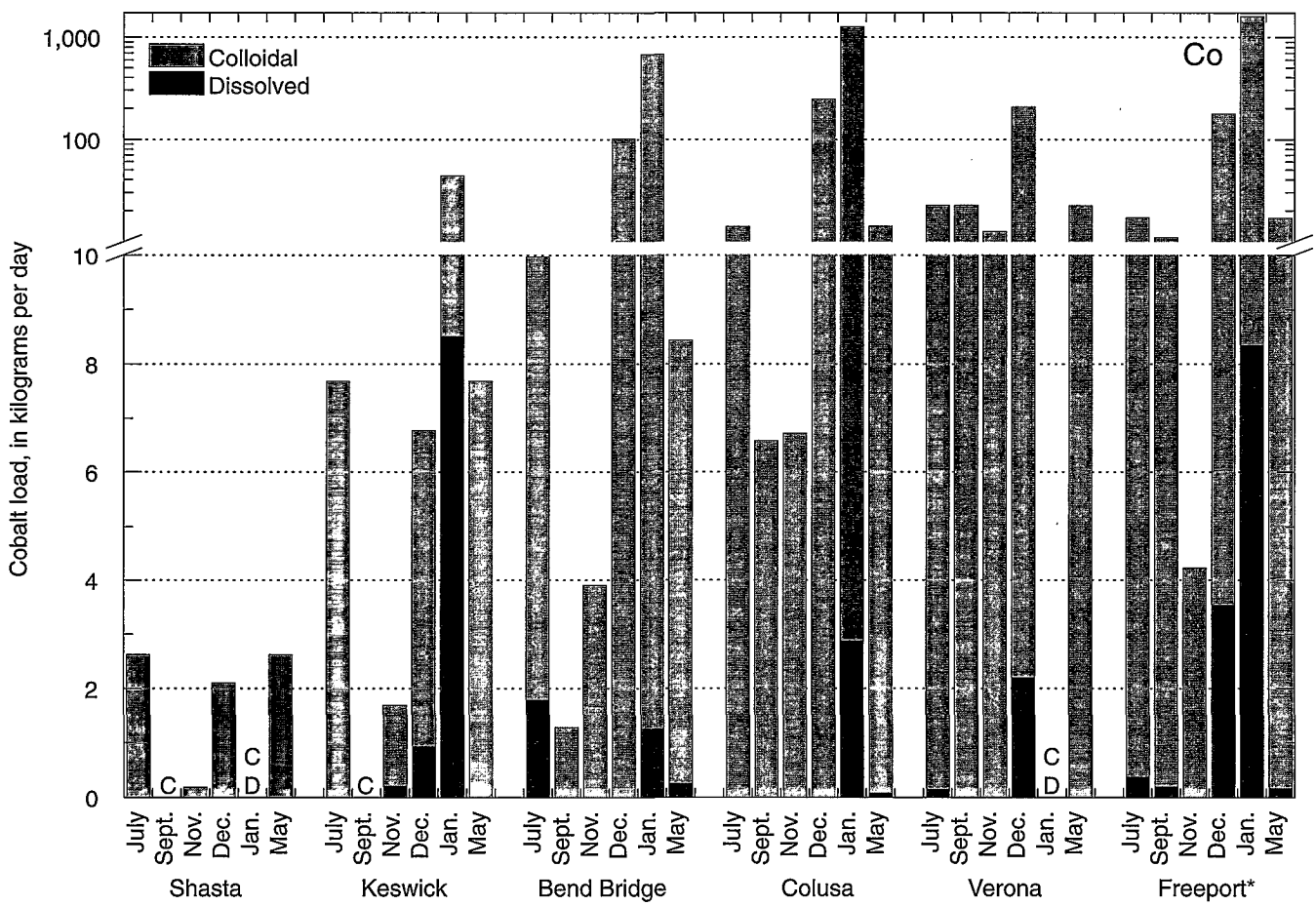

Figure A5-2. Plot of dissolved and colloidal cobalt (Co) loads, July 1996 to May-June (labeled as May on graph) 1997, Sacramento River, California. C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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C-035211

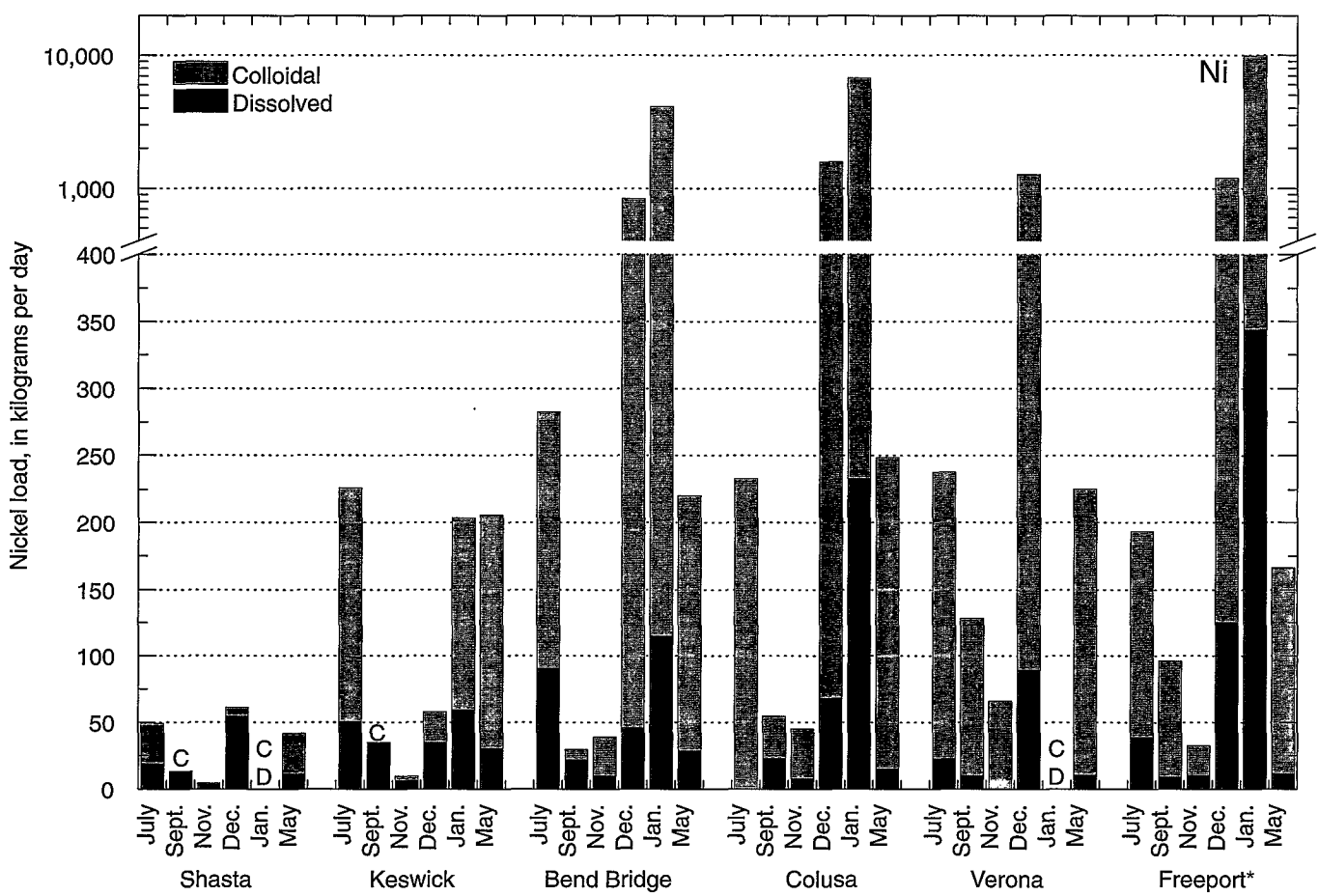

Figure A5-3. Plot of dissolved and colloidal nickel (Ni) loads, July 1996 to May-June (labeled as May on graph) 1997, Sacramento River, California. C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

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C-035212

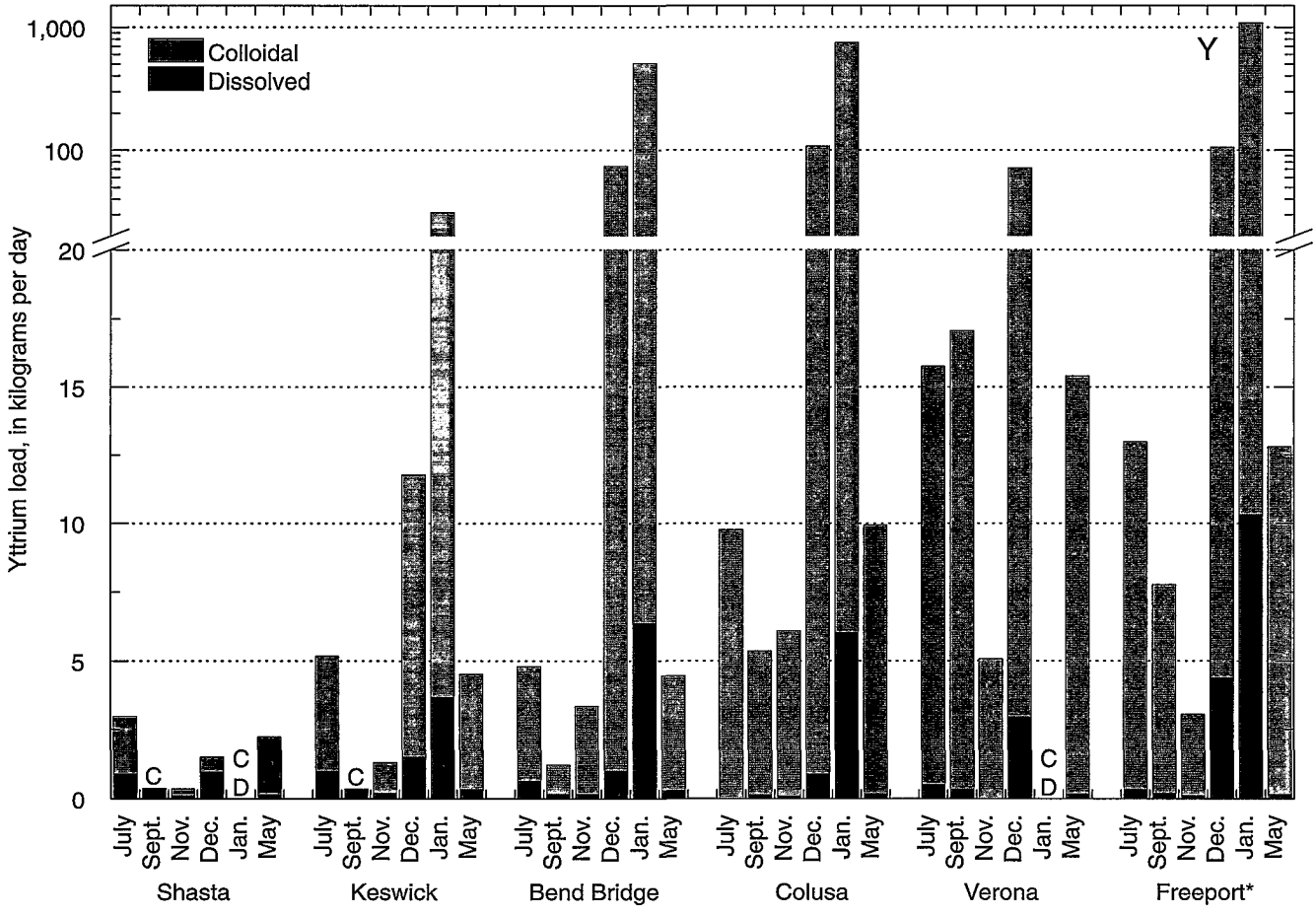

Figure A5-4. Plot of dissolved and colloidal yttrium (Y) loads, July 1996 to May-June (labeled as May on graph) 1997, Sacramento River, California. C, no colloidal load data available; D, no dissolved load data available. Freeport data for January 1997 is the sum of loads from the Sacramento River at Tower Bridge plus the Yolo Bypass.

C—035212

C-035213

Appendix 6. Hydrographs Showing Daily Mean Discharge and Time of Sampling

Figure A6-1. Hydrographs showing daily mean discharge and time of sampling, November 1996, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

Figure A6-2. Hydrographs showing daily mean discharge and time of sampling, December 1996, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

Figure A6-3. Hydrographs showing daily mean discharge and time of sampling, January 1997, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

C—0 3 5 2 1 3

C-035214

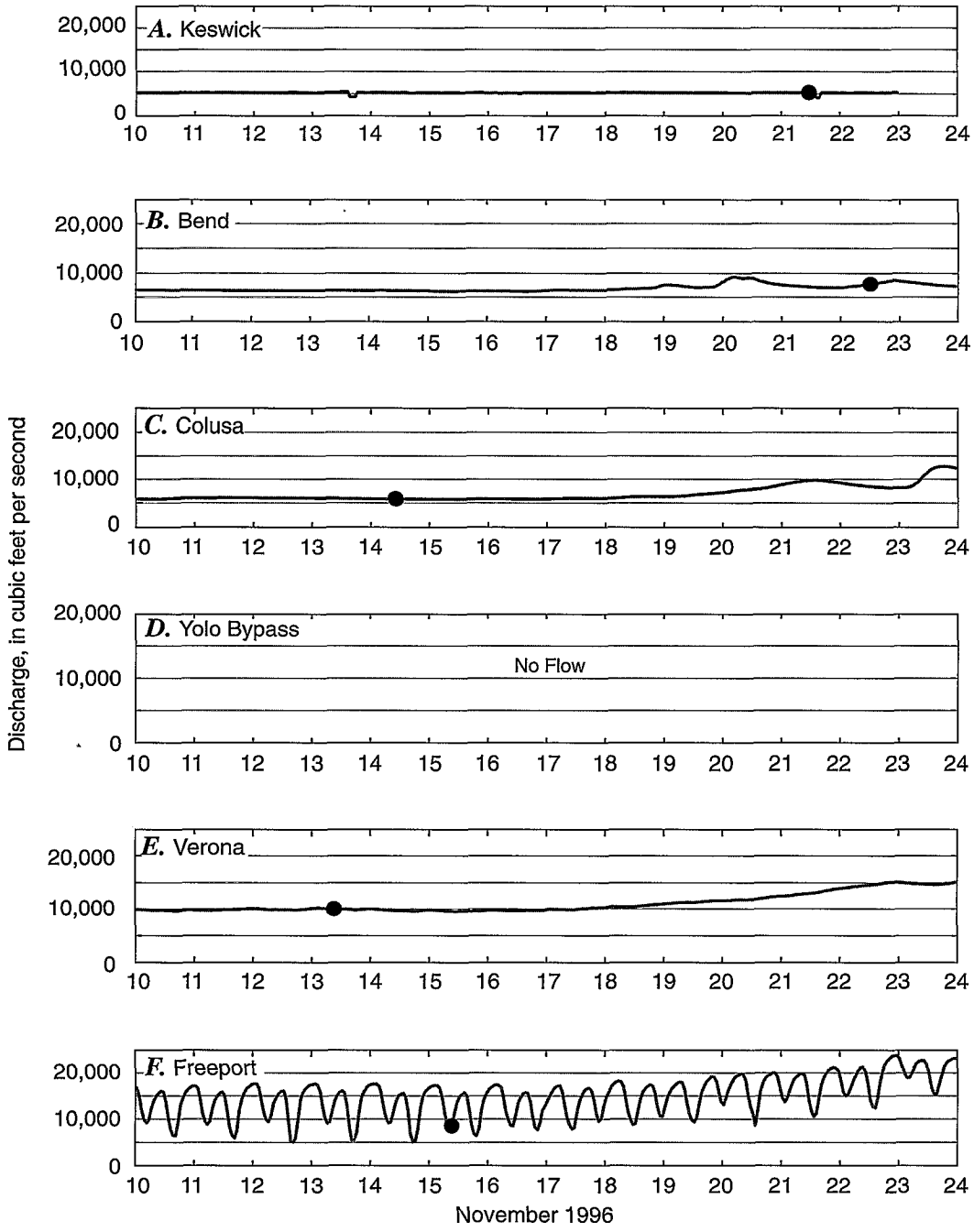

Figure A6-1. Hydrographs showing daily mean discharge and time of sampling, November 1996, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

C — 0 3 5 2 1 4

C-035215

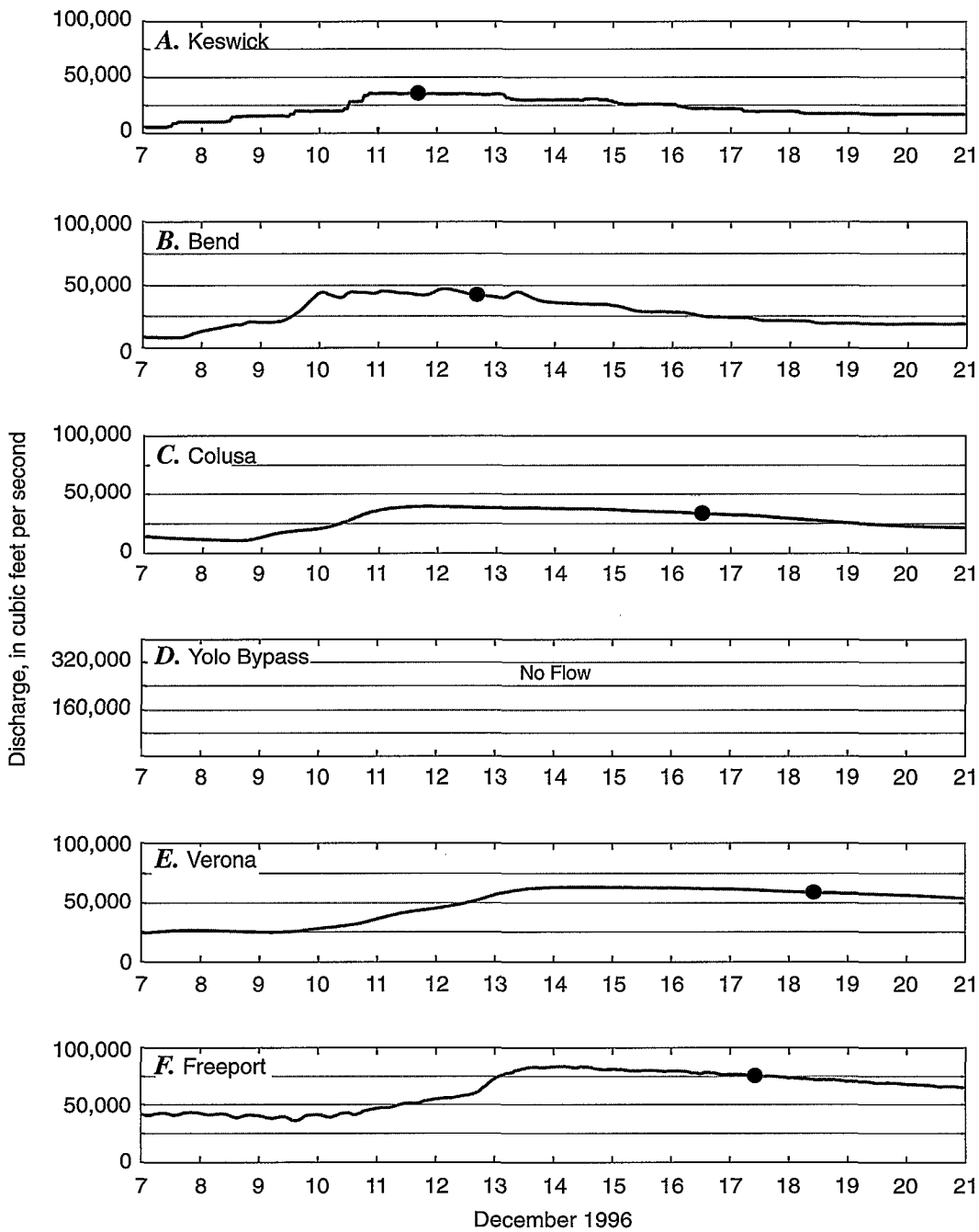

Figure A6-2. Hydrographs showing daily mean discharge and time of sampling, December 1996, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

C—035215

C-035216

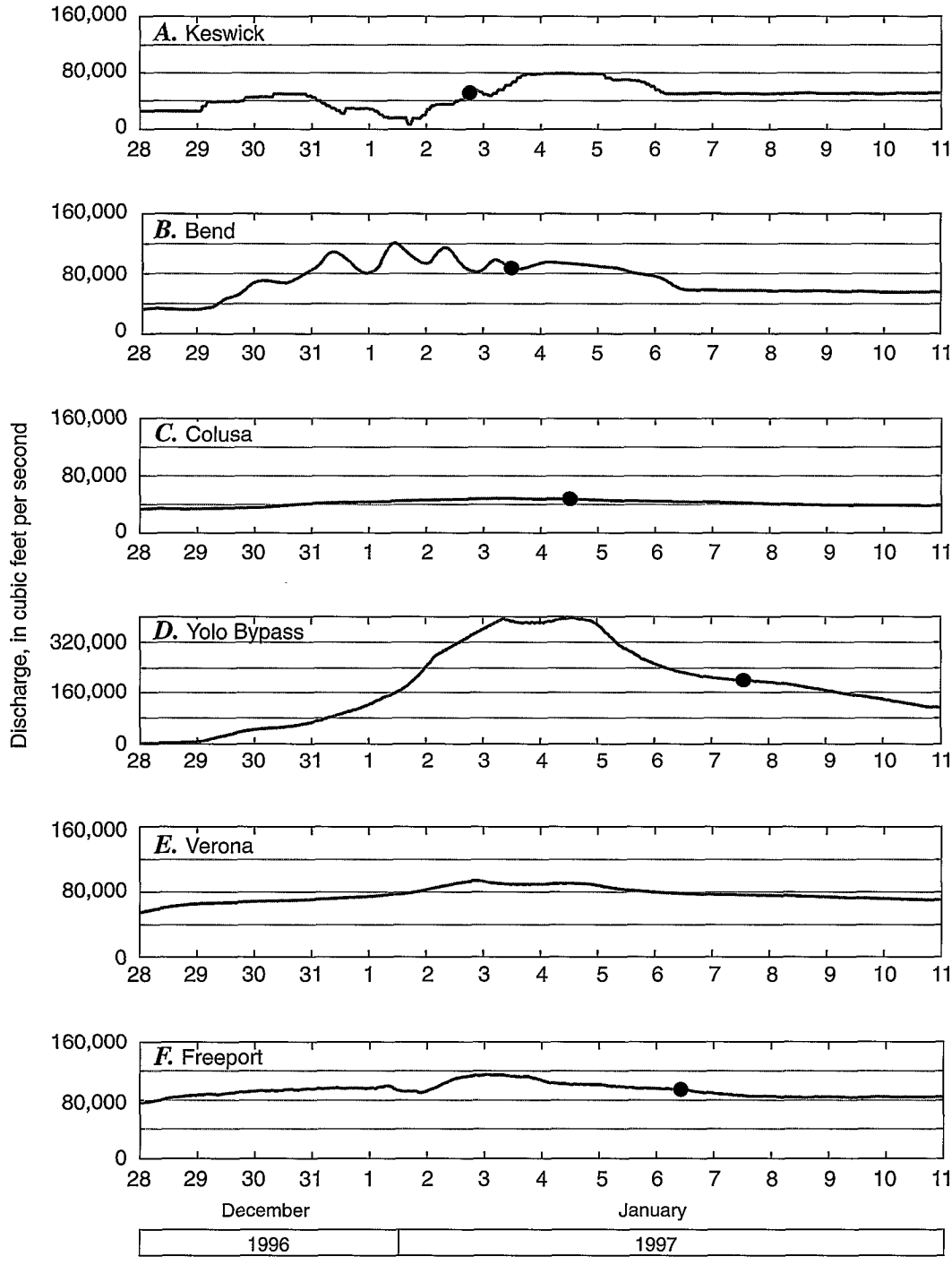

Figure A6-3. Hydrographs showing daily mean discharge and time of sampling, January 1997, Sacramento River, California for *A.* Below Keswick Dam, *B.* Bend Bridge, *C.* Colusa, *D.* Yolo Bypass, *E.* Verona, and *F.* Freeport.

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C — 0 3 5 2 1 6

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