

# **Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001**

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# Contents

Abstract.....	1
Introduction .....	2
Reconnaissance and Detailed Phases.....	2
Topical Investigations .....	2
Purpose and Scope.....	3
Acknowledgments .....	4
Sampling, Processing, and Analytical Methods .....	4
1995–96 Bi-National Monitoring .....	4
1996 Grab Sample from the Salton Sea .....	6
1998 Samples from Eleven Sites in the Salton Sea.....	6
1999 Samples from Two Cores in the Salton Sea .....	6
2001 Samples from Nine Sites in and near the Salton Sea .....	8
Data and Discussion .....	8
1995–96 Bi-National Monitoring .....	8
1996 Grab Sample from the Salton Sea .....	10
1998 Samples from Eleven Sites in the Salton Sea.....	10
1999 Samples from Two Cores in the Salton Sea .....	11
2001 Samples from Nine Sites in and near the Salton Sea .....	12
Summary and Conclusions .....	13
References Cited .....	13
Tables .....	17

# Figures

Figure 1.	Map showing location of Salton Sea Basin and surrounding area .....	5
Figure 2.	Map showing location of sampling sites in the Salton Sea and at adjacent river mouths .....	7

# Tables

Table 1. Organochlorine compound concentrations in bed material from the New and the Lower Colorado Rivers, 1995.....	18
Table 2. Organochlorine compound concentrations in bed material from the New River, 1996.....	19
Table 3. Organochlorine compound concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995.....	20
Table 4. Extractable organic compound concentrations in bed material from the New and the Lower Colorado Rivers, 1995.....	21
Table 5. Extractable organic compound concentrations in bed material from the New River, 1996.....	23
Table 6. Extractable organic compound concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995.....	25
Table 7. Element concentrations in bed material from the New and the Lower Colorado Rivers, 1995.....	27
Table 8. Element concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995.....	28
Table 9. Element concentrations in surficial bottom sediment from near the center of the north subbasin of the Salton Sea, California, May 31, 1996.....	29
Table 10. Location of 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	30
Table 11. Particle-size distribution in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	31
Table 12. Field data for bottom water and surficial sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	32
Table 13. Chemical data for bottom water from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	33
Table 14. Water-column field measurements from 11 sampling sites in the Salton Sea, California.....	34
Table 15. Nutrient concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, July 20–22, 1998.....	36
Table 16. Element concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	37
Table 17. Organochlorine compound concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	38
Table 18. Aromatic hydrocarbon concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998.....	39
Table 19. Nutrient concentrations in a sediment core from Site 9 in the Salton Sea, California, April 26, 1999.....	41
Table 20. Nutrient concentrations in a sediment core from Site 10 in the Salton Sea, California, April 27, 1999.....	42
Table 21. Element concentrations in a sediment core from Site 9 in the Salton Sea, California, April 26, 1999.....	43
Table 22. Element concentrations in a sediment core from Site 10 in the Salton Sea, California, April 27, 1999.....	44
Table 23. Concentration, fine (clay plus silt) fraction, and calcium carbonate content of suspended sediment from nine sites in the Salton Sea area, California, October 23–28, 2001.....	45
Table 24. Element concentrations in suspended sediment from river outlets and nearby areas of the Salton Sea, California, October 23–28, 2001.....	46
Table 25. Element enrichment ratios in lacustrine suspended sediment in comparison with riverine suspended sediment from the Salton Sea area, California, October 23–28, 2001.....	47

# Conversion Factors, Datums, and Abbreviations

## CONVERSION FACTORS

Multiply	By	To obtain
centimeter (cm)	3.937	inch
liter (L)	33.82	ounce, fluid
liter per second (L/s)	15.85	gallon per minute
gram (g)	0.03527	ounce, avoirdupois
meter (m)	3.281	foot
meter (m)	1.094	yard
millimeter (mm)	0.03937	inch

Temperature in degrees Celsius ( $^{\circ}\text{C}$ ) may be converted to degrees Fahrenheit ( $^{\circ}\text{F}$ ) as follows:

$$^{\circ}\text{F} = 1.8 \text{ }^{\circ}\text{C} + 32.$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius ( $\mu\text{S}/\text{cm}$  at  $25^{\circ}\text{C}$ ).

**Concentrations of chemical constituents** in water are given either in milligrams per liter (mg/L) or micrograms per liter ( $\mu\text{g}/\text{L}$ ).

## DATUMS

**Vertical coordinate information** is referenced to the National Geodetic Vertical Datum of 1929 (NGVD of 1929); **horizontal coordinate information** is referenced to the North American Datum of 1927 (NAD 27).

## ABBREVIATIONS

Al	aluminum
As	arsenic
C	carbon
cm	centimeter
$^{137}\text{Cs}$	cesium-137
DDE	1,1-Dichloro-2,2bis( <i>p</i> -chlorophenylethene)
DDT	1,1,1-Trichloro-2,2bis( <i>p</i> -chlorophenylethane)
DO	dissolved oxygen
EDI	equal-discharge-increment (method)
g	gram
g/L	gram per liter
Fe	iron
ft	foot
$^{210}\text{Pb}$	lead-210

L	liter
L/min	liter per minute
m	meter
N	nitrogen
Na	sodium
NIB	Northerly International Boundary
P	phosphorus
PCB	polychlorinated biphenyl
PCN	polychlorinated naphthalene
$r^2$	coefficient of determination (correlation coefficient squared)
$^{226}\text{Ra}$	radium-226
ROE	dissolved solids as residue on evaporation at 108°C
S	sulfur
Se	selenium
$\mu\text{g/g}$	micrograms per gram
$\mu\text{g/L}$	micrograms per liter
$\mu\text{m}$	micrometer

Organizations

DOI	U.S. Department of the Interior
IBWC	International Boundary and Water Commission
NIWQP	DOI National Irrigation Water Quality Program
NWIS	USGS National Water Information System
NWQL	USGS National Water-Quality Laboratory
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

# Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

By Roy A. Schroeder

## Abstract

The primary purpose of this report is to present all chemical data from the Salton Sea area collected by the U.S. Geological Survey between 1995 and 2001. The data were collected primarily for the Department of the Interior's National Irrigation Water Quality Program (NIWQP). The report also contains a brief summary and citation to investigations done for the NIWQP between 1992 and 1995. The NIWQP began studies in the Salton Sea area in 1986 to evaluate effects on the environment from potential toxins, especially selenium, in irrigation-induced drainage. This data report is a companion to several reports published from the earlier studies and to interpretive publications that make use of historical and recent data from this area.

Data reported herein are from five collection studies. Water, bottom material, and suspended sediment collected in 1995–96 from the New River, the lower Colorado River, and the All-American Canal were analyzed for elements, semi-volatile (extractable) organic compounds, and organochlorine compounds. Sufficient suspended sediment for chemical analyses was obtained by tangential-flow filtration.

A grab sample of surficial bottom sediment collected from near the deepest part of the Salton Sea in 1996 was analyzed for 44 elements and organic and inorganic carbon. High selenium concentration confirmed the effective transfer (sequestration) of selenium into the bottom sediment. Similar

grab samples were collected 2 years later (1998) from 11 locations in the Salton Sea and analyzed for elements, as before, and also for nutrients, organochlorine compounds, and polycyclic aromatic hydrocarbons. Nutrients were measured in bottom water, and water-column profiles were obtained for pH, conductance, temperature, and dissolved oxygen. Element and nutrient concentrations were obtained in 1999 from cores at 2 of the above 11 sites, in the north subbasin of the Salton Sea. The most-recent study reported herein was done in 2001 and contains element data on suspended material isolated by continuous-flow centrifugation on samples collected in transects extending out from the Whitewater, the Alamo, and the New Rivers into the Salton Sea.

Chemical data on suspended sediment and bottom material from tributary rivers and the Salton Sea itself show that many insoluble constituents, including selenium and DDE, are concentrated in the fine-grained, organic- and carbonate-rich bottom sediment from deep areas near the center of the Salton Sea. Data also show that selenium and arsenic are markedly enriched in seston (plankton, partially-degraded algal detritus, and mineral matter that compose suspended particulates in the lake) collected just below the water surface in the Salton Sea. This result indicates that bio-concentration in primary producers in the water column provides an important pathway whereby high selenium residues accumulate in fish and fish-eating birds at the Salton Sea.



## 2 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

### Introduction

In response to concerns about irrigation-induced water-quality problems and their potential effects on biota, the U.S. Department of the Interior (DOI) began a study in the Salton Sea area, California, in 1986. The study was part of the DOI National Irrigation Water Quality Program (NIWQP) to assess irrigation-induced contamination from natural sources; selenium (Se) was the contaminant most frequently exceeding the criterion for protection of wildlife. On the basis of screening criteria at approximately 600 irrigation project areas, the NIWQP initiated reconnaissance investigations at 26 locations in the western United States (Engberg and others, 1998). This was followed by detailed investigations at several of the reconnaissance locations where results indicated the need for further study. Where results of these detailed investigations warranted, NIWQP began to develop and implement remediation activities with management of the NIWQP transferred from the DOI to the U.S. Bureau of Reclamation (USBR). The Salton Sea area reconnaissance investigation was done during 1986–87, and the detailed investigation was done during 1988–90. Due to an increasing recognition of a broad range of environmental problems in the Salton Sea area, NIWQP did not proceed to a remediation phase, but rather conducted selected topical investigations and took an active advisory role to other agencies that were involved in environmental issues at the Salton Sea. The results of the reconnaissance, detailed, and topical investigations have been reported in a number of publications listed in the “Reconnaissance and Detailed Phases” section of this report. This report contains tables of data collected by the U.S. Geological Survey (USGS) between 1995 and 2001 that are primarily from chemical analyses of suspended sediment and bottom material.

### Reconnaissance and Detailed Phases

In the reconnaissance phase of NIWQP investigations in the Salton Sea area, surface water, bottom sediment, and biota were analyzed for trace elements and pesticides. Results were reported by Schroeder and others (1988) and Setmire and others (1990).

In the detailed phase of NIWQP investigations, surface water, drain water, ground water, soil, and biota were analyzed for trace elements and pesticides. Nutrient and

isotopic data also were obtained from the water samples. Results were reported by Schroeder and others (1991, 1993), Setmire and others (1993), Michel and Schroeder (1994), Schroeder (1996), and Setmire and Schroeder (1998).

### Topical Investigations

Several topical investigations were done in the Salton Sea area beginning in 1992 with support provided by the NIWQP and supplemented, in some cases, with the support and participation of other agencies.

An as yet unexplained die-off of about 150,000 eared grebes occurred at the Salton Sea early in 1992. The NIWQP collected water from rivers and several surface drainage channels near their outlets to the Salton Sea and from the Salton Sea itself for analysis of pesticides during a period of several days in late March/early April 1992 to evaluate their possible role in the die-off. The period of sampling was characterized by heavy rainfall contributing to high surface runoff. Samples were analyzed in the USGS National Water-Quality Laboratory (NWQL) in Denver by extraction on solid-phase cartridges followed by gas chromatography/mass spectrometry or high-pressure liquid chromatography. The methods were being developed and tested in the laboratory at this time and were subsequently approved and adopted for analysis of pesticides as Schedules 2001 and 2050 (Timme, 1994). The pattern and concentration of pesticides found were not unusual in comparison with results obtained in early (Eccles, 1979) and later (De Vlaming and others, 2000, and Crepeau and others, 2002) pesticide studies in the area.

The U.S. Fish and Wildlife Service (USFWS) collected additional DDT-metabolite and selenium data on several important fish and wildlife species during 1992–94 to quantify the biological effects documented during the reconnaissance and detailed phases of the NIWQP studies from 1986 to 1990. The results were reported by Bennett (1998) who concluded that colonial-nesting water birds are at risk of reduced reproduction from DDE-induced eggshell thinning, that black-necked stilts exhibit a modest reproductive depression owing to selenium, that the endangered desert pupfish are at risk of reproduction failure owing to selenium, and that selenium in fish is at levels that make them hazardous food items for fish-eating birds. Subsequent investigations by others have noted environmental hazards other than only selenium and DDE.

The NIWQP funded the USFWS and USBR to collect water, bottom sediment, and transplanted *Corbicula* (Asiatic river clams) in irrigation-drainage channels for selenium analysis and conducted a survey during 1994–95 of wildlife use of drainage channels in the Imperial Valley, which is located between the International Boundary and the south end of the Salton Sea (Setmire and others, 1998). The median selenium concentration in bottom sediment from drains was found to be 0.5 µg/g dry weight—a little more than double the median in farm soils—and to be correlated ( $r^2 = 0.55$ ) with clay plus silt content reflecting the expected association of higher trace-element concentrations with finer particles. The transplanted clams proved to be an unsuitable surrogate for selenium levels in the drains because they had already accumulated high selenium residues of almost 10 µg/g in the Lower Colorado River from where they were obtained. Clams transplanted by the USGS into the New River, in which selenium concentrations are known to increase between the aqueous border and the Salton Sea, also failed to confirm this trend because of nearly complete mortality in the low-oxygen reach near the border and theft of the cage containing the clams from a site downstream near the Salton Sea. Finally, biological surveys indicated that surface drains provide an important habitat to a variety of birds and wildlife. Detailed results of the biological surveys in the drains were reported by Clary and others (1997).

The NIWQP funded the USGS and USBR in 1997 to evaluate the potential for nanofiltration to remove selenium from subsurface drain water in field-scale experiments. Nanofiltration membranes reject molecules larger than about 400 daltons (atomic mass units) and exhibit a preferred rejection for multivalent ions over univalent ions, hence the membranes were expected to remove the divalent selenate ion that predominates in drain water. Results using drain water obtained from three farm sumps in Imperial Valley showed that nanofiltration membranes were capable of selectively removing more than 95 percent of the selenium from drain water having total dissolved-solids concentrations of 5.4 to 12.4 g/L (Kharaka and others, 2000), although the method requires substantial investment in energy, capital equipment, and ongoing maintenance.

Setmire (2002) evaluated a more passive alternative that attempted to use microbial reduction of selenium in subsurface drain water. The water was routed through coarse gravel that filled a covered (with heavy plastic) surface-drainage channel; however, the method proved ineffective because the organic carbon in subsurface drain water is so refractory that anoxic conditions never ensued.

The selenium concentration in a grab sample of surficial bottom sediment collected in 1996 from near the center of the Salton Sea was found to be 9.3 µg/g (Setmire and Schroeder, 1998)—many times higher than in soils and surface drains and about 3 times higher than in a single composite sample collected from the south-central part of the Salton Sea during the reconnaissance investigation (Setmire and others, 1990). That result led to the subsequent collection of bottom material and suspended sediment from the Salton Sea and rivers in the basin during the next few years and their analysis for selenium, as well as for almost 50 elements and a variety of pesticides and industrial organic priority pollutants. The results of sampling in the Salton Sea in 1998 and 1999 were used by Schroeder and Orem (2000) [the abstract in Schroeder and Orem (2000) incorrectly quotes selenium concentrations in micrograms per kilogram—the correct units are micrograms per gram] and Schroeder and others (2002) to conclude that nearly all the selenium discharged by rivers and drains to the Salton Sea continues to reside in its bottom sediment, that only about one-third of the nitrogen discharged to the Salton Sea has been lost, that phosphorus is by far the limiting macronutrient in the Salton Sea, and that precipitation of calcite and gypsum is causing a somewhat slower increase in the lake's salinity than would be expected solely on the basis of inputs. Anderson and Amrhein (2002) concluded that volatilization of ammonia from the moderately alkaline lake is the predominant mechanism of nitrogen loss with only minor amounts of loss by denitrification.

## Purpose and Scope

The purpose of this report is to present all data collected from the Salton Sea area by the USGS for the NIWQP during 1995–2001 and to cite and comment briefly on those studies done with the USBR and USFWS for the NIWQP after 1992. The data presented include numerous chemical analyses not used and therefore not previously published in the interpretive report by Schroeder and others (2002). Some explanation and interpretation of the data are included in this report. Most of those later analyses were on suspended sediment and bottom material, and therefore a comprehensive understanding of those results benefits from presentation herein of similar analyses of suspended sediment and bottom material done in 1995–96 at rivers within the area for the International Boundary and Water Commission (IBWC) and funded by the U.S. Environmental Protection Agency (USEPA).

## 4 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

### Acknowledgments

The USBR, through the NIWQP, provided most of the support for this study. Funds also were contributed by the USGS for preparation of reports and for nutrient analyses on samples collected in 1999; by the California Regional Water Quality Control Board (Colorado River Basin Region), making it possible to supplement pesticide analyses with inorganic data on suspended-sediment samples collected in 2001; and by the USEPA for collection and analysis of data from a bi-national study of rivers in 1995–96. Technical reviews were provided by Larry LeBlanc and Frank Rinella, both of USGS.

### Sampling, Processing, and Analytical Methods

Data reported herein were obtained from five collection studies. The studies are listed below in chronological order:

1. Bi-national monitoring of bottom material and suspended sediment from surface water in the Salton Sea area collected in 1995–96.
2. A single grab sample of surficial bottom sediment collected from the Salton Sea in 1996.
3. Grab samples of surficial bottom sediment collected from 11 sites in the Salton Sea in 1998.
4. Core samples of sediment collected from selected subbottom depths in two cores from two of the above 11 sites in the Salton Sea in 1999.
5. Suspended-sediment samples collected from offshore, nearshore, and river outlet sites at the Salton Sea in 2001.

All samples were collected by the USGS. Results of analyses done by the NWQL can be accessed from the USGS National Water Information System (NWIS) computerized archival-storage and data-dissemination system at <http://waterdata.usgs.gov>

### 1995–96 Bi-National Monitoring

Water, bottom material, and suspended sediment were collected in 1995–96 from rivers and drainage channels in California, Arizona, and Mexico for an IBWC bi-national monitoring program funded by the USEPA. Samples were analyzed by the NWQL, and all results from these six sites can be obtained from the International Water and Boundary Commission (2003). This report contains chemical data for

bottom material and suspended sediment from three sites on the New River (in Mexicali just south of the border, in Calexico just north of the border, and at the river's outlet to the Salton Sea); from the All-American Canal at the point where Colorado River water is diverted for (almost entirely) agricultural irrigation and for domestic use in the Salton Sea area; and from the Colorado River at the Northerly International Boundary (NIB) a short distance north of the border, near Yuma ([fig. 1](#)). Only the data from the solid-phase samples from these sites are included in this report because these data, rather than data from aqueous media, are pertinent to a more complete understanding of the bottom-material and suspended-sediment chemical data that were collected in subsequent years for the NIWQP. (Data from a sixth site, the Yuma Main Drain in Arizona, are not included in this report because the site is outside the Salton Sea study area.)

Samples of composite water with suspended sediment were obtained using the equal-discharge-increment (EDI) method in which depth-integrated samples were obtained from five locations (each representing 20 percent of total flow) in the stream's cross section. A large volume of water (up to about 100 L) was obtained from each site by pumping with a submersible pump through Teflon tubing to glass carboys pre-cleaned with sodium hydroxide, hydrochloric acid, acetone, methanol, and de-ionized water. The carboys were transported to the office for immediate tangential (also called cross-flow) filtration to isolate suspended sediment for subsequent chemical analysis. The isolation method, like nanofiltration and reverse osmosis, is an ultrafiltration technique that removes smaller particles than are removed by microfiltration through a 0.45- $\mu\text{m}$  membrane—the method that is usually used for analysis of dissolved constituents. Theoretical aspects of ultrafiltration are discussed by Yuan and Zydny (2000). Operation of the Dorr-Oliver unit and materials used in this study are described by Leenheer and others (1989). Regenerated (deacetylated) cellulose membranes with a pore size of 0.005  $\mu\text{m}$ , corresponding to a nominal molecular weight cut-off of about 30,000 daltons, were used. Solid-phase material was removed from the membrane by externally hand-massaging the membranes inserted into Teflon® bags with a small amount of filtrate from the sample. The sediment was further concentrated by centrifugation and subsequently processed and analyzed in the same way as was bottom material.

Bottom material was collected using an Ekman dredge. The dredge was deployed in areas where obstructions in the stream favored the accumulation of fine-grained sediment, and only the top 2 to 3 cm (recent accumulation) of sediment recovered was used.



Figure 1. Map showing Location of Salton Sea Basin and surrounding area.

## 6 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

Element analyses on the suspended sediment and bottom material were done through the NWQL in the USGS Analytical Facility in Denver using methods described by Arbogast (1996) and Briggs and Meier (1999). Organochlorine compounds, which include legacy pesticides such as DDT and its metabolites, and industrial organic compounds were analyzed by gas-chromatographic methods described by Foreman and others (1995) and Furlong and others (1996), respectively. Filtration as long as 24 hours was required to isolate sufficient suspended sediment for analysis at some sites, and even then the amount available was so small that reporting limits for organic compounds were higher than for bottom material.

### 1996 Grab Sample from the Salton Sea

A single sample of surficial bottom sediment from the Salton Sea collected on May 31, 1996, was obtained from an area a short distance north of the topographic divide between the north and south subbasins in the lake, and therefore from near the deepest part of the lake ([fig. 2](#)). The sediment was collected with an Ekman dredge and the top 2 to 3 cm of muck was removed from the box dredge for chemical analysis. Element analyses were done in the USGS Analytical Facility in Denver using methods described by Arbogast (1996) and Briggs and Meier (1999) and are nearly identical to those used in the reconnaissance phase of NIWQP studies, except that the earlier analyses were done on only the silt and clay fraction isolated by sieving in the field in order to provide a data set that could be compared between different locations (Severson and others, 1987). The effect of not sieving is negligible in this case because the sand component is small from interior parts of the Salton Sea, as noted in the data presented in the “2001 Samples from Nine Sites” section later in this report. Lead-210 ( $^{210}\text{Pb}$ ), radium-226 ( $^{226}\text{Ra}$ ), and cesium-137 ( $^{137}\text{Cs}$ ) also were analyzed by the NWQL to determine whether these radionuclides could be used to date cores that represent sediment accumulated during the 100-year history of the Salton Sea.

### 1998 Samples from Eleven Sites in the Salton Sea

Bottom-sediment, water-column, and bottom-water grab samples were collected from 11 sites in the Salton Sea during July 20–22, 1998, to determine the spatial distribution of physical and chemical characteristics. The locations of the 11 sites ([fig. 2](#)) were chosen to represent the range in depositional environments and to span lake depths from shallow (4.6 m) to medium (9 m) to deep (14–15 m). Shallow

depths were sampled in the deltas at each of the five largest streams that discharge to the Salton Sea (Sites 3, 4, 5, 8, and 11). Deep sites were sampled in four locations—in the center of the north (Site 9) and south (Site 1) lake subbasins, in the saddle between the subbasins (Site 7), and near the center of the south subbasin (Site 2). The remaining two locations (Sites 6 and 10, at medium depth) that were sampled are from the coalesced delta between the Alamo and the New Rivers and between the Whitewater River delta and the lake's north subbasin, respectively.

Sediment samples were collected and analyzed for elements in the same manner as was the grab sample obtained in 1996. Grain-size distribution was determined at the USGS Sediment Laboratory in Salinas, California, using sieves for the coarse (sand) fraction and hydrometers for the fine (silt and clay) fraction as described by Guy (1969). Legacy pesticides (organochlorine compounds) and industrial organic compounds were analyzed by gas-chromatographic methods described by Foreman and others (1995) and Furlong and others (1996), respectively. Dissolved oxygen (DO), pH, specific conductance at 25 degrees Celsius (surrogate for salinity or residue on evaporation), and temperature were determined electrometrically by lowering a Hydrolab<sup>TM</sup> containing appropriate probes (sensors) through the water column. Bottom-water samples were collected at each site using a Van Dorn sampler lowered to within about 30 cm of the sediment-water interface. The samples were filtered through a 0.45- $\mu\text{m}$ -membrane capsule (silver membrane for analysis of dissolved organic carbon) and analyzed at the NWQL for macronutrients and alkalinity using methods described by Fishman (1993) and precision and reporting (detection) limits listed by Timme (1994 and 1995).

### 1999 Samples from Two Cores in the Salton Sea

Several cores were obtained from Sites 9 and 10 ([fig. 2](#)) on April 25 and 27, 1999, respectively, in the north subbasin of the Salton Sea using a Benthos gravity corer lowered off the bow of a Boston Whaler. Macronutrients in sediment sections and pore water extracted from the cores and in the overlying water column were analyzed at William H. Orem's USGS laboratory in Reston, Virginia, using methods described by Schroeder and others (2002), who also give complete details on processing of the samples and information on analytical precision. Elements were analyzed in core sections at the USGS Analytical Facility in Denver, Colorado, using methods described in the “1996 Grab Sample from the Salton Sea” section earlier in this report.



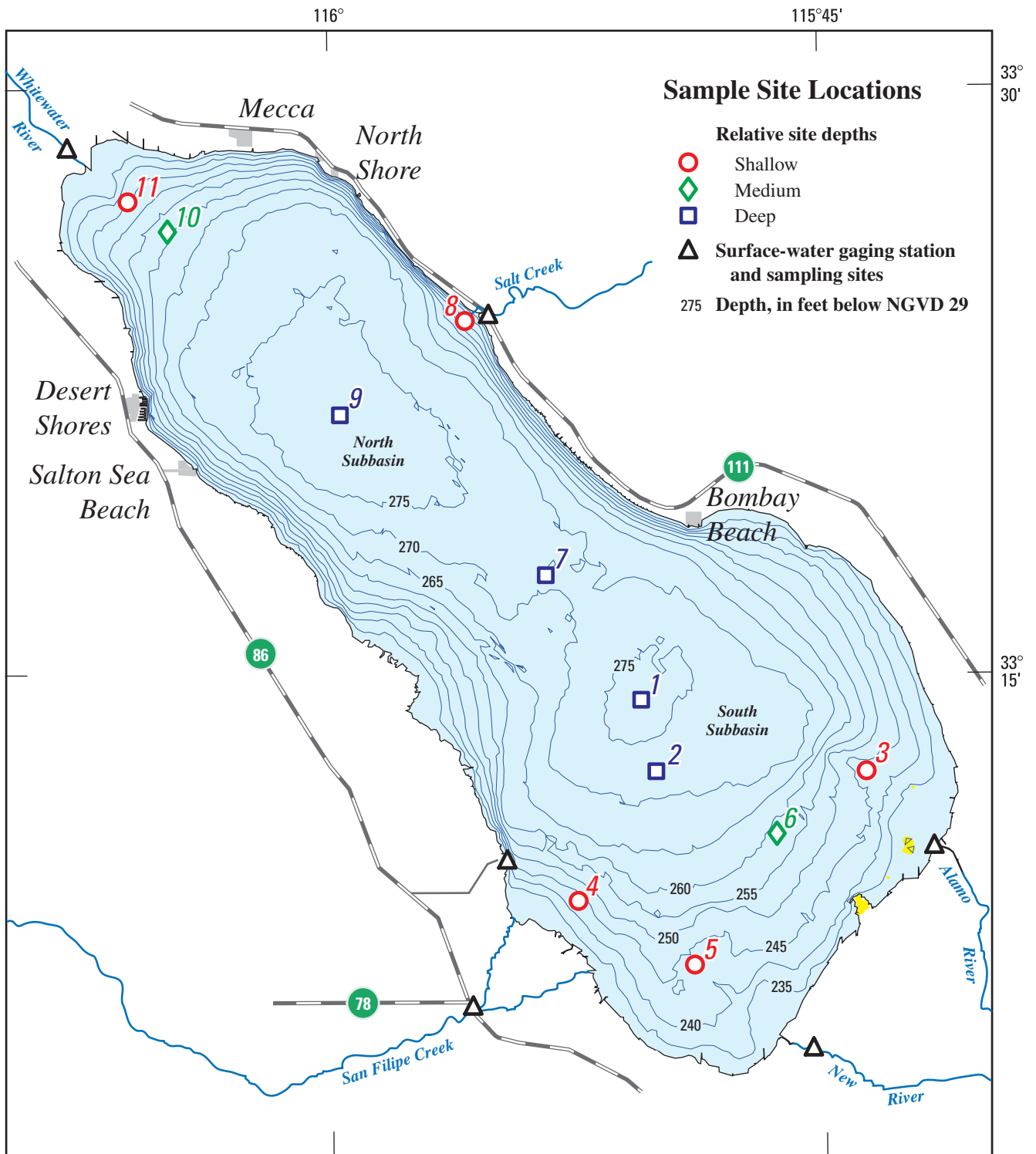


Figure 2. Map showing location of sampling sites in the Salton Sea and at adjacent river mouths. (NGVD 29, National Geodetic Vertical Datum of 1929)

## 8 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

### 2001 Samples from Nine Sites in and near the Salton Sea

The USGS obtained samples for pesticide analyses from nine locations in and near the Salton Sea during October 23–28, 2001, as part of a cooperative study done with the California Regional Water Quality Control Board (LeBlanc and others, 2002). Element concentrations were analyzed for suspended sediment in those samples, for the NIWQP, using methods described in the “1996 Grab Samples from the Salton Sea” section earlier in this report. Samples were obtained at three locations along transects extending from river outlets into the Salton Sea where water depth was about 4.6 m (15 ft) (river delta) for the Alamo, the New, and the Whitewater Rivers. The offshore delta sites are at the same location as Sites 3, 5, and 11 that were sampled in 1998 (fig. 2). The nearshore sites were selected to be as close (within about 100 m) as a boat could safely navigate to each river's mouth. Finally, samples from the three largest rivers themselves were collected at established USGS gaging stations off bridges near the Alamo, the New, and the Whitewater River outlets to the Salton Sea. Water depth ranged from about 1 to about 1.5 m (3 to 5 ft) at the river and nearshore sites.

Because of the need for large volumes of water (up to 1,000 L) to obtain sufficient suspended material from offshore areas of the open Salton Sea, single-bowl continuous-flow centrifugation was used for dewatering (Rees and others, 1991). In the method, samples for isolation of suspended sediment can be processed at least 10 times faster than using tangential-flow membrane filtration. However, although comparable, the two methods are not identical in their efficacy. Whereas tangential-flow filtration obtains virtually complete removal of suspended sediment, continuous-flow centrifugation delivers varying recoveries depending on the composition and size of the suspended sediment. The collection efficiencies for the Westphalia continuous-flow centrifuge was evaluated by Horowitz and others (1989), and on the basis of their findings the centrifuge was operated in this study to process samples at a rate of 2 L/min.

Samples were obtained by pumping large volumes of water into 20-liter stainless-steel cans. The cans had been cleaned with acetone, methanol, and organic-free de-ionized water. The pump intake was placed about mid-depth in the river and within about 1 m (3 ft) of the surface in the Salton Sea. The cleaning process and use of stainless-steel cans was designed for the pesticide portion of this study and may not be ideal for a few of the trace elements, although the data themselves do not reveal any obvious evidence for significant contamination of the samples. Concentration of suspended sediment and the percent fine (less than 62- $\mu$ m particle size) fraction were determined at the USGS Sediment Laboratory

in Salinas, California, using methods described by Guy (1969). Elements were analyzed in the isolated (dewatered) suspended-sediment concentrate at the USGS Analytical Facility in Denver, Colorado, using methods already described above.

## Data and Discussion

Data obtained by the USGS in the Salton Sea area between 1995 and 2001 are presented at the end of this report in tables 1–25. Some of these results, along with historical data, were used in the interpretive report on the Salton Sea published for the NIWQP by Schroeder and others (2002) and in the poster presented by Schroeder and Orem (2000). Additional data are presented herein to provide the NIWQP with a comprehensive publication for dissemination of all information on water-quality investigations in the Salton Sea area collected by the USGS.

### 1995–96 Bi-National Monitoring

Chemical concentrations in bottom sediment and suspended sediment from five sites collected in 1995–96 for the IBWC bi-national monitoring program are presented in tables 1–8. Latitude and longitude (North American Datum of 1927) of the five sites is listed below and general locations can be identified by reference to [figure 1](#).

Station Description	Station Location
New River at Mexicali	32°39'45"N 115°29'45"W
New River at Calexico	32°39'57"N 115°30'08"W
New River at outlet to the Salton Sea	33°06'17"N 115°39'49"W
All-American Canal at diversion from the Colorado River	32°52'17"N 114°28'47"W
Colorado River at Northerly International Boundary (NIB)	32°43'07"N 114°43'05"W

The Colorado River and All-American Canal serve as “background” sites for the New River because the Colorado River is virtually the only source of water used in the Imperial and the Mexicali Valleys that compose the south end of the Salton Sea Basin. Agricultural runoff from these two valleys contributes most of the water to the New River although Mexicali, in the Mexicali Valley, which has a population of nearly 1,000,000 and numerous industries, is a major source of urban contaminants, particularly in the upstream southern reach of the New River.

Organochlorine compound concentrations are given in tables 1–3, at the end of this report. The recovery percentage of three surrogate compounds added to the sample at the laboratory prior to extraction and analysis is listed at the top of the table. Note that reporting limits are generally lower for bed material than for suspended sediment because of the much smaller amount of suspended sediment that was obtained at most of the sites. Matrix effects also produce higher reporting limits, particularly at sites where samples are highly anaerobic or contain large amounts of organic matter. In some cases, this results in concentrations reported as estimated and designated with the letter “E” next to the value. (Similar limitations apply to all analyses of organic compounds reported in subsequent tables.)

As expected, only a few of the organochlorine compounds analyzed for were detected. DDT and (or) its metabolites, which were expected on the basis of their historical use and the previous detection of DDT in the area (Eccles, 1979), were found. Comparison of organochlorine concentrations in bed material (tables 1 and 2) with concentrations on suspended sediment at the same time and site, especially in the New River, illustrates an important general principle—contaminant concentrations are several-fold higher on suspended sediment. The New River is a fast-flowing stream with very few obstructions that can provide depositional environments. Hence, the bottom material consists almost entirely of medium and coarse sand, and the suspended sediment consists almost entirely of clay, silt, and fine sand. Smaller particles have more surface area, and typically more organic carbon, per unit mass and hence can adsorb greater amounts of contaminants. This makes suspended sediment an especially good medium to assess contaminant sources although, unfortunately, the collection of sufficient material for analysis typically requires considerable processing time and expensive equipment.

Concentrations of extractable (semi-volatile) organic compounds are given in tables 4–6. Patterns displayed between sites are very similar to those shown by the organochlorine compounds, although the pattern is more difficult to discern because detection limits are 10 to 50 times higher for mass-spectrometric analysis of extractable compounds than for the electron-capture detection of organochlorines. Comparing concentrations of 2,6-dimethylnaphthalene, a compound in high abundance, shows the patterns of clearly higher concentrations in suspended sediment than in bed material, and highest

concentrations at the boundary sites on the New River (Mexicali and Calexico) suggesting a predominantly urban source in Mexico for this contaminant. Contaminant concentrations in the New River are reduced as the river flows to the Salton Sea by the discharge of suspended sediment in tail water that carries eroded agricultural soils. The eroded soils, in effect, “dilute” the urban contaminants in suspended sediment and bottom material.

Numerous (as many as several dozen) molecular fragments and a few compounds were tentatively identified (not listed herein) by comparison of mass-spectral information obtained during the analysis of semi-volatile organic compounds to a computerized library of mass spectra for known compounds (Mike Schroeder, USGS NWQL, written commun., 1995). Most of the molecular fragments likely are produced by the partial degradation of “natural” biological compounds. Sterols, which were among the organic compounds identified in highest concentration, also are natural products; however, the fact that their concentrations were highest in the New River at Mexicali and at Calexico suggests a municipal-and domestic-wastewater origin as well. Additional analytical work would be needed to confirm these results.

Data on elements in tables 7 and 8 show that the same effect also exists for several trace elements (“heavy” metals such as lead, nickel, and zinc) commonly associated with large urban centers. Selenium shows the same spatial pattern in the New River, where concentrations in bed material decrease from 1.2  $\mu\text{g/g}$  near the border (in Mexicali and Calexico) to 0.2  $\mu\text{g/g}$  at the river's outlet to the Salton Sea (table 7). This pattern is opposite that shown by the river water itself, in which median aqueous concentration increased downstream from 1.6  $\mu\text{g/L}$  at Calexico to 4.2  $\mu\text{g/L}$  at the outlet in 1998–99 (Schroeder and others, 1993, table 5). (Unfortunately, sufficient material for selenium analyses of suspended sediment was not available.) It appears that the same reducing conditions that sequester selenium in bottom sediments of the Salton Sea (Schroeder and others, 2002) may also remove selenium to bottom sediment in the New River near the border. Discharge of large amounts of municipal and industrial wastewater in Mexicali results in very low dissolved oxygen and highly anaerobic bottom material for some distance downstream from the border, but by the time the river reaches the outlet to the Salton Sea, dissolved oxygen levels have recovered and bottom sediment from the top few centimeters is oxic.



## 10 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

Evaluating whether a specific sample of bed material or suspended sediment is contaminated is confounded by the complicating effect of particle size on concentration. There are three ways in which the evaluation can be done in the Salton Sea and rivers or drains that discharge to the lake. One is to compare measured concentrations with values at “background” sites, such as the All-American Canal and the Colorado River at the NIB. Depositional areas suitable for collection of bottom material can be readily found in the Colorado River near the river's bank, in oxbows, and near islands. The All-American Canal at its diversion from the Colorado River is concrete lined and thus it has no bed material. However, bed material at this site was taken from depositional basins where suspended sediment is allowed to settle out prior to discharge of water into the canal. Therefore, the bed material from this site contains a fair amount of fines—certainly more than in the New River. However, the comparison is not perfect insofar as material in the Colorado River is from recent erosion whereas soils and sediment in the Salton Sea Basin originated from erosion a long time ago.

A second method of testing against natural background levels is to compare trace-element concentrations with values in soils from the area. Analyses exist for shallow soil from 15 fields in the Imperial Valley and for deep cores from 3 locations in the Imperial Valley (Schroeder and others, 1993, tables 11–15). A third method that can be used to test for elevated concentrations is to compare element ratios using a “normalizing” constituent, such as aluminum. This method is discussed in more detail later in the “2001 Samples from Nine Sites in and near the Salton Sea” section of this report.

### 1996 Grab Sample from the Salton Sea

The NIWQP reconnaissance survey found that selenium concentration in water from the Salton Sea is only 1 µg/L, far less than the concentration in rivers and surface-drainage channels that discharge to the Salton Sea (Setmire and others, 1990, fig. 11). However, selenium residues in fish and fish-eating birds (Schroeder and others, 1993, table 22) are markedly elevated relative to the low aqueous concentration. There was some early evidence that the “missing” selenium might reside in sediment accumulating at the bottom of the Salton Sea. In the reconnaissance survey a concentration of 3.3 µg/g was measured in a single composite sample of surficial bottom sediment taken from an arc midway between the south shore and deepest part of the south subbasin in the lake (Setmire and others, 1990, table 14); and concentrations measured in the detailed NIWQP study ranged from 0.2 to 2.5 µg/g in bottom sediment from the Alamo River Delta in the Salton Sea.

For these reasons, it was anticipated that highest concentrations of selenium should exist in the deepest parts of the lake far away from the influence of large rivers and the

coarse material they discharge to the lake, and this hypothesis was confirmed by a single sample collected from near the center of the north subbasin in 1996. The results of element analysis given in table 9 show a selenium concentration of 9.3 µg/g, far higher than concentrations previously reported in soil and bottom material from rivers and surface drainage channels. The bottom material from this location was observed to be a greenish-gray muck with high organic content and gelatinous consistency.

The grab sample from the top 2 to 3 cm is estimated, by Schroeder and others (2002) from data based on discontinuities in the profiles of selected chemical constituents in cores, to represent sediment accumulated during the previous 10 to 15 years. Therefore, the low activity for <sup>210</sup>Pb and nondetectable activity for <sup>137</sup>Cs in very young sediment where activities should be highest indicate that these radionuclides are unlikely to be useful for dating cores that span the entire depositional history in the Salton Sea unless large amounts of sediment and substantial processing methods are used for their analysis.

### 1998 Samples from Eleven Sites in the Salton Sea

Results from water-quality profiles and surficial (top 2–3 cm) bottom sediment from 11 sites in the Salton Sea are given in tables 10–18 and the locations of the sites are shown in [figure 2](#). An extensive discussion of results obtained from these samples and from two cores collected the following year has been published by Schroeder and others (2002); therefore these tables are discussed only briefly in this data report.

The latitude and longitude of the 11 sites (North American Datum of 1927) and a brief description of the location of each site relative to the three major rivers and the two subbasins within the Salton Sea are given in table 10. The particle-size distribution in the surficial bottom sediment is given in table 11, and a brief visual description of the sediment and depth below water surface to the sediment is given in table 12.

Also given in table 12 are data for four field-measured constituents (temperature, pH, dissolved molecular oxygen, and specific conductance) for bottom-water samples collected with a bottom-water sampler at each site. Water-quality concentrations for 10 additional constituents measured by the NWQL are given in table 13. Profiles in the water column for the four field constituents are listed in table 14. The in situ data in table 14 are reported exactly as recorded by a Hydrolab instrument as it was lowered through the water column to permit comparison with a high degree of precision from different depths at each site, although it is recognized that the values overstate the accuracy, especially for specific conductance.

Measured concentrations and calculated atom ratios for nutrients in the bottom sediment are given in table 15. Precision information from replicate analyses also is provided in the table. Inorganic carbon (not shown) can be calculated by subtracting values for organic carbon from values for total carbon. Inorganic carbon (calcium carbonate) concentration is lowest at Site 11 and highest at Site 9. Organic content can be obtained by multiplying organic carbon values times an assumed value of 2, and this yields a range in organic content from 0.4 percent (Site 3) to 13.7 percent (Site 1). Concentrations of 45 elements in bottom sediment are given in table 16, and they show the spatial pattern also evident as noted above for calcium carbonate and organic carbon: highest concentrations occur in the finest sediment that accumulates in the deepest parts of the Salton Sea. For example, selenium exhibits the expected spatial pattern with concentrations about 10 times higher in deeper areas near the center of the Salton Sea than at the shallow sites.

Caution is advised in interpreting the data for a few of the elements. For example, arsenic data in table 16 are provided by two analytical methods: inductively-coupled-plasma mass spectroscopy and hydride-generation atomic-absorption spectrometry—hydride generation is believed to yield the more reliable concentrations. Sulfur (S) exists as reduced inorganic and organic sulfides, perhaps as elemental sulfur itself, as gypsum, and as dissolved sulfate in interstitial water; considerable additional work would be needed to distinguish between these various forms. All concentrations in bottom sediment are reported in micrograms per gram dry sediment weight, and the process of drying the sediment for analytical processing incorporates dissolved salts present in the wet sediment. The effect of dissolved salts on solid-phase analyses is negligible for nearly all elements but is especially likely for sodium (Na) because of its high aqueous concentration in the Salton Sea. Corrections cannot be made here because the laboratory did not report both wet and dry weight, but a rough estimate of the effect can be made using plausible assumptions. Dissolved Na concentration is about 11 g/L in the Salton Sea (Schroeder, 1996), which would contribute about 10,000  $\mu\text{g/g}$  to the dry sediment if water constitutes 90 percent by volume of the wet sediment—a value that seems reasonable for grab samples on the basis of dry bulk density near the sediment–water interface that is reported by Schroeder and others (2002, fig. 9) for two cores.

Organochlorine compound concentrations are given in table 17. For those compounds that are present, the concentrations exhibit a pattern similar to organic carbon and trace elements with highest concentrations occurring in the finest, organic-rich sediment from the deepest parts of the lake. Of particular interest is the finding of readily detected concentrations of DDE in interior parts of the Salton Sea, with concentrations somewhat higher in the north than in the south subbasin, just as for selenium. These results suggest that DDE profiles could be used to date cores in the Salton Sea using the method illustrated in reservoirs by Van Metre and others (1997).

Concentrations of aromatic hydrocarbons in bottom sediment are given in table 18. 2,6-Dimethylnaphthalene is the compound with highest measured concentrations, as also was found in bed material from the New River. A number of isomers of aromatic compounds that cannot be specifically identified from mass-spectral information are listed in table 18. Their notation is expressed by the number of carbon (C) atoms attached to the aromatic ring followed by the designated fragment's molecular weight. Only a few non-target molecules were identified by comparison to a library of mass-spectral patterns, and quality of match to the library standards was not high.

### 1999 Samples from Two Cores in the Salton Sea

Carbon (C), nitrogen (N), and phosphorus (P) nutrient concentrations are given for cores from Site 9, in the center of the north subbasin, and from Site 10, midway between the center of the north subbasin and the Whitewater River Delta (fig. 2), in tables 19 and 20, respectively. Element concentrations in cores from the same two sites are given in tables 21 and 22. Schroeder and others (2002) suggested, on the basis of non-uniform profiles for the data from Site 10 (note especially how selenium and organic carbon concentrations increase sharply just below 20 cm), that the record was not continuous, either because of slumping at the site or because of artifacts induced during the coring process itself.

Attempts to date these cores using  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  were unsuccessful because of low concentrations of these isotopes, as expected on the basis of results from the grab sample obtained in 1996. Dry bulk density in cores from both sites is given by Schroeder and others (2002, fig. 9) and nutrient profiles in pore water and the overlying water column are given by Schroeder and others (2002, fig. 10).

## 2001 Samples from Nine Sites in and near the Salton Sea

Data for suspended sediment are given in tables 23–25. Sites in transects extending out from each of the three major rivers into the Salton Sea are designated as “Outlet, Nearshore, and Offshore” in the tables. Abundant sunshine, very light winds, and high temperatures characterized the sampling period in late October 2001. Therefore, the water surface was “glassy” for much of the time, making it likely that the suspended material obtained from the Salton Sea was from riverine transport and (or) biological production in the water column and not from re-suspension of bottom material.

Concentrations of suspended sediment given in table 23 show the expected patterns: much higher concentrations in the Alamo and the New Rivers than in the smaller Whitewater River, and much lower concentrations in interior parts of the Salton Sea than in the rivers. The proportion present as fines, less than 62- $\mu$ m diameter, is about the same (about 80 percent) in suspended material from the rivers and the Salton Sea, despite much lower water velocities in the lake. Although only a small amount of the very fine clastic (mineral) sediment of river origin survives transport very far into the lake, plankton and aggregates of organic-rich seston are continually being produced within the Salton Sea itself, and they are comparatively large. Additional data in table 23 show that suspended particulate matter in the Salton Sea contains negligible amounts of calcium carbonate, despite evidence for precipitation of substantial amounts of the mineral in bottom sediment from the Salton Sea (Schroeder and others, 2002). Anderson and Amrhein (2002) report a similar finding and conclude that calcium carbonate formation occurs within the bottom sediment as opposed to in the water column.

Element concentrations in suspended sediment are given in table 24. Organic content, based on assuming an organic matter to organic carbon ratio of 2, increases from 2–7 percent in the rivers to 60–80 percent at offshore sites in the Salton Sea. Nearshore sites at the mouth of the Alamo and the New Rivers are still predominantly composed of sediment from these rivers, because of their comparatively large discharge. This contrasts with the Whitewater River, which has a much smaller concentration of suspended sediment and much lower discharge; because of these conditions, the Whitewater River's influence is no longer apparent even at the nearshore site.

Concentrations in suspended particulate matter of lacustrine origin as opposed to riverine origin are higher, or comparable, for only a few constituents—sodium (Na), phosphorus (P), arsenic (As), and selenium (Se). Concentrations for most constituents are lower because of

“dilution” by the huge amount of organic matter in particulates produced within the Salton Sea itself. Enrichment ratios, rather than concentrations, provide a way to more easily compare data of this type by normalizing to a single constituent, in this case aluminum (Al), and thereby determine which constituents are preferentially enriched in biological organisms. The method has been used by the author in several applications and is described in more detail by Schroeder (1985, 1994, 1995; and Schroeder and others, 1989). In this case, validity depends on the assumption that Al is contained solely within the mineral component with none in the organic component. Averaged (mean) enrichment ratios in table 25 are calculated as the element-to-Al ratio at offshore (and nearshore at the Whitewater River) sites divided by the same element-to-Al ratio at river (and nearshore for the Alamo and the New Rivers) sites.

Enrichment ratios in table 25 segregate into four groups based on values. One element, thallium (Tl), has an enrichment ratio of much less than 1, suggesting possible leaching in the Salton Sea—although it is noted that concentrations are very low for this element and therefore the calculation yields poor precision. Those elements associated with aluminosilicate minerals with no biological function, such as the rare-earth elements, have enrichment ratios of about 1 (they are not enriched at all). Elements in the third group, most of which have known biological roles, have enrichment ratios that are about an order of magnitude higher than 1. And finally, a few elements such as Se and As have enrichment ratios two orders of magnitude higher and are so enriched as to have concentrations themselves that are equal or higher in the lake's suspended particulates than in the river's suspended sediment. It had previously been thought that bottom sediment provided the substrate whereby high Se residues are attained at higher trophic levels because the aqueous Se concentration is so low in the Salton Sea. This study's finding of high Se concentrations in the lake's organic-rich seston (plankton, degraded algal detritus, and mineral matter) suggest that incorporation of Se occurs in the plankton that inhabit the photic zone.

There are a few notable exceptions to the simple explanation of enrichment ratios given above. Sodium (Na) is highly enriched in the lake's particulates. This is probably because its dewatered particulates obtained from the centrifuge still contain a substantial contribution of the element from the Salton Sea's water itself. Iron (Fe) is another element that does not follow the expected enrichment pattern. It has many known biochemical functions, yet is not enriched in the Salton Sea. It is possible that high concentrations of the element and its role in precipitation of sulfides are factors that complicate the anticipated pattern.

There are a couple of additional elements for which data are not available in this study that could provide important information. Sulfur (S) has many geochemical properties similar to those of Se; however, it was not analyzed because its occurrence as insoluble sulfates and sulfides complicates interpretation. Nitrogen (N) is not analyzed in the USGS laboratory that did these multiple-element scans. Ratios of organic C to N in the suspended sediment could be useful in ascertaining the source of Salton Sea particulates—bacterial, algal, or partly degraded biological matter produced within the lake (autochthonous), or highly mineralized terrestrial organic matter (allochthonous)—insofar as the C/N ratio would increase in the order that these potential sources are listed.

## Summary and Conclusions

All the rivers run into the sea, yet the sea is not full (adapted from Ecclesiastes 1:7). This biblical verse expresses the fundamental paradigm that controls the chemical evolution of the 100-year-old Salton Sea because it is a closed-basin lake located in a desert. Soluble chemicals that flow into the Salton Sea accumulate in the water, increasing its salinity; and insoluble constituents accumulate in the bottom sediment. In order to better understand the effect of chemical constituents in the Salton Sea, chemical data were collected by the USGS for five studies in the Salton Sea area between 1995 and 2001. These data, along with historical data, were used by Schroeder and others in an interpretive report published in 2002. This report presents additional chemical data that were not included in the interpretive report.

Considerable effort was expended to obtain chemical data on suspended sediment and bottom material from tributary rivers and the Salton Sea itself. These data show that many insoluble constituents, including selenium and DDE, are concentrated in the fine-grained, organic- and carbonate-rich bottom sediment from deep areas near the center of the Salton Sea. Data also show that selenium and arsenic are markedly enriched in seston (plankton, partially-degraded algal detritus, and mineral matter that compose suspended particulates in the lake) collected just below the water surface in the Salton Sea. This result indicates that bio-concentration in primary producers in the water column provides an important pathway whereby high selenium residues accumulate in fish and fish-eating birds at the Salton Sea.

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## 14 Trends In Streamflow and Comparisons with Instream Flows in the Lower Puyallup River Basin, Washington

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## **Tables**



## 18 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 1.** Organochlorine compound concentrations in bed material from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per kilogram, dry weight; *d*<sub>6</sub>, synthetic compound containing 6 deuterium atoms; NIB, Northerly International Boundary; E indicates concentration is estimated; <, less than]

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
<i>α,d</i> <sub>6</sub> -HCH, surrogate, in percent	85	79	75	87	86
Octachlorobiphenyl, surrogate, in percent	65	75	82	86	92
Biphenyl, 3,5-dichloro surrogate, in percent	81	60	74	64	73
<i>cis</i> -Nonachlor	E1.2	<1	<1	<1	<1
<i>trans</i> -Nonachlor	4.1	1.6	<1	<1	<1
Oxychlordane	<1	<1	<1	<1	<1
Aldrin	<1	<1	<1	<1	<1
<i>cis</i> -Chlordane	5.1	1.9	<1	<1	<1
<i>trans</i> -Chlordane	5.4	2	<1	<1	<1
Chloroneb	<11	<5	<5	<5	<5
DCPA (Dachtal)	<5	<5	<5	<5	<5
<i>o,p'</i> -DDD	<3	<1	<1	<1	<1
<i>p,p'</i> -DDD	E16	<6	<1	<1	<1
<i>o,p'</i> -DDE	<1	<1	<1	<1	<1
<i>p,p'</i> -DDE	12	9.6	1.8	<1	<1
<i>o,p'</i> -DDT	<2	<2	<2	<2	<2
<i>p,p'</i> -DDT	E25	<2	<2	<2	<2
Dieldrin	<1	<1	<1	<1	<1
Endosulfan I ( <i>α</i> )	<1	<1	<1	<1	<1
Endrin	<2	<2	<2	<2	<2
<i>α</i> -HCH	<1	<1	<1	<1	<1
<i>β</i> -HCH	<1	<1	<1	<1	<1
Heptachlor	<1	<1	<1	<1	<1
Heptachlor epoxide	<1	<1	<1	<1	<1
Hexachlorobenzene	<2	<1	<1	<1	<1
Isodrin	<1	<1	<1	<1	<1
Lindane ( <i>γ</i> -HCH)	<1	<1	<1	<1	<1
<i>o,p'</i> -Methoxychlor	<5	<5	<5	<5	<5
<i>p,p'</i> -Methoxychlor	<5	<5	<5	<5	<5
Mirex	<1	<1	<1	<1	<1
<i>cis</i> -Permethrin	<25	<5	<5	<5	<5
<i>trans</i> -Permethrin	<5	<5	<5	<5	<5
Toxaphene	<200	<200	<200	<200	<200
PCBs, total	<50	<50	<50	<50	<50
Pentachloroanisole	<1	<1	<1	<1	<1
Sample dry weight, in grams	25	25	25	25	25

**Table 2.** Organochlorine compound concentrations in bed material from the New River, 1996

[Concentrations in micrograms per kilogram, dry weight; *d*<sub>6</sub>, synthetic compound containing 6 deuterium atoms; E indicates concentration is estimated; <, less than]

Compound	New River at		
	Mexicali April 11	Calexico April 10	Salton Sea April 9
$\alpha$ , <i>d</i> <sub>6</sub> -HCH, surrogate, in percent	84	74	80
Octachlorobiphenyl, surrogate, in percent	59	60	76
Biphenyl, 3,5-dichloro surrogate, in percent	36	46	48
<i>cis</i> -Nonachlor	<2	<1.6	<1
<i>trans</i> -Nonachlor	4.6	3.6	<1
Oxychlordane	<1	<1	<1
Aldrin	<1	<1	<1
<i>cis</i> -Chlordane	8.4	6.1	<1
<i>trans</i> -Chlordane	9.7	6.8	<1
Chloroneb	<5	<5	<5
DCPA (Dachtal)	<5	<5	<5
<i>o,p'</i> -DDD	<3	<2	<1
<i>p,p'</i> -DDD	E24	E18	E1.6
<i>o,p'</i> -DDE	<1	<1	<1
<i>p,p'</i> -DDE	19	18	20
<i>o,p'</i> -DDT	<2	<2	<2
<i>p,p'</i> -DDT	<2	7.8	<2
Dieldrin	<1	<1	<2
Endosulfan I ( $\alpha$ )	<1	<1	<1
Endrin	<2	<2	<2
$\alpha$ -HCH	<1	<1	<1
$\beta$ -HCH	<1	<1	<1
Heptachlor	<1	<1	<1
Heptachlor epoxide	<1	<1	<1
Hexachlorobenzene	<4.1	<3	<1
Isodrin	<1	<1	<1
Lindane ( $\gamma$ -HCH)	<1	<1	<1
<i>o,p'</i> -Methoxychlor	<5	<5	<5
<i>p,p'</i> -Methoxychlor	<5	<5	<5
Mirex	<1	<1	<1
<i>cis</i> -Permethrin	<53	<5	6.7
<i>trans</i> -Permethrin	<17	<5.7	<5
Toxaphene	<200	<200	<200
PCBs, total	200	150	<50
Pentachloroanisole	<1	<1	<1
Sample dry weight, in grams	15.8	20.7	23.4

## 20 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 3.** Organochlorine compound concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per kilogram, dry weight; *d*<sub>6</sub>, synthetic compound containing 6 deuterium atoms; NIB, Northerly International Boundary; E indicates concentration is estimated; <, less than]

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
<i>α</i> , <i>d</i> <sub>6</sub> -HCH, surrogate, in percent	77	80	81	86	85
Octachlorobiphenyl, surrogate, in percent	79	75	77	94	91
Biphenyl, 3,5-dichloro surrogate, in percent	67	85	76	93	93
<i>cis</i> -Nonachlor	E21	<10	<2	<10	<1
<i>trans</i> -Nonachlor	62	<10	<2	<10	<1
Oxychlordane	<14	<10	<2	<10	<1
Aldrin	<14	<10	<2	<10	<1
<i>cis</i> -Chlordane	69	E20	<2	<10	<1
<i>trans</i> -Chlordane	75	<10	<2	<10	<1
Chloroneb	<70	<50	<10	<50	<5
DCPA (Dachtal)	<70	<50	32	<50	<5
<i>o,p'</i> -DDD	<14	<10	<2	<10	<1
<i>p,p'</i> -DDD	E120	E25	<2	<10	<1
<i>o,p'</i> -DDE	<14	<10	<2	<10	<1
<i>p,p'</i> -DDE	81	49	43	E2.4	1.1
<i>o,p'</i> -DDT	<28	<20	<4	<20	<2
<i>p,p'</i> -DDT	130	<20	4.8	<20	<2
Dieldrin	<14	<10	<2	<10	<1
Endosulfan I ( <i>α</i> )	<14	<10	<2	<10	<1
Endrin	<28	<20	<4	<20	<2
<i>α</i> -HCH	<14	<10	<2	<10	<1
<i>β</i> -HCH	<14	<10	<2	<10	<1
Heptachlor	<14	<10	<2	<10	<1
Heptachlor epoxide	<14	<10	<2	<10	<1
Hexachlorobenzene	<14	<10	<2	<10	<1
Isodrin	<14	<10	<2	<10	<1
Lindane ( <i>γ</i> -HCH)	<14	<10	<2	<10	<1
<i>o,p'</i> -Methoxychlor	<70	<50	<10	<50	<5
<i>p,p'</i> -Methoxychlor	<70	<50	<10	<50	<5
Mirex	<14	<10	<2	<10	<1
<i>cis</i> -Permethrin	<70	<50	<10	<50	<5
<i>trans</i> -Permethrin	<70	<50	<10	<50	<5
Toxaphene	<2,800	<2,000	<400	<1,000	<200
PCBs, total	<700	<500	<100	<100	<50
Pentachloroanisole	<14	<10	<2	<10	<1
Sample dry weight, in grams	1.9	2.5	11.5	1.6	25

**Table 4.** Extractable organic compound concentrations in bed material from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per kilogram, dry weight;  $d_{14}$  and  $d_5$ , synthetic compound containing 14 and 5 deuterium atoms, respectively; NIB, Northerly International Boundary; E indicates concentration is estimated; <, less than]

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
$d_{14}$ -Terphenyl, surrogate, in percent	100	110	95	78	110
2-Fluorobiphenyl, surrogate, in percent	71	59	75	64	67
$d_5$ -Nitrobenzene, surrogate, in percent	76	65	62	68	130
Hexachlorobenzene	<50	<50	<50	<50	<50
Di- <i>n</i> -butyl phthlate	95	87	E38	E22	<50
Di- <i>n</i> -octyl phthlate	450	150	<50	<50	<50
Diethyl phthlate	E15	E13	<50	E9	<50
Dimethyl phthlate	E18	<50	<50	<50	<50
Pyrene	170	220	<50	<50	<50
1-Methylpyrene	52	E49	<50	<50	<50
Benzo[ <i>a</i> ]Pyrene	<50	89	<50	<50	<50
Indeno[1,2,3- <i>cd</i> ] pyrene	<50	110	<50	<50	<50
2,2'-Biquinoline	<50	<50	<50	<50	<50
Quinoline	<50	<50	<50	<50	<50
Phenanthridine	<50	E18	<50	<50	<50
Isoquinoline	<50	E21	<50	<50	<50
2,4-Dinitrotoluene	<50	<50	<50	<50	<50
2,6-Dinitrotoluene	<50	<50	<50	<50	<50
Benzo[ <i>k</i> ]fluoranthene	87	92	<50	<50	<50
1-Methyl-9H-fluorene	60	E19	<50	<50	<50
9H-Fluorene	E17	E11	<50	<50	<50
Isophorone	<50	<50	<50	<50	<50
<i>bis</i> (2-Chloroethoxy)methane	<50	<50	<50	<50	<50
Naphthalene	E18	E25	<50	<50	<50
1,2-Dimethylnaphthalene	<50	<5	<50	<50	<50
1,6-Dimethylnaphthalene	99	E27	<50	<50	<50
2,3,6-Trimethylnaphthalene	74	E18	<50	<50	<50
2,6-Dimethylnaphthalene	210	76	<50	<50	<50
2-Chloronaphthalene	<50	<50	<50	<50	<50
Benzo[ <i>g,h,i</i> ] perylene	<50	61	<50	<50	<50
Phenanthrene	87	110	<50	<50	<50
1-Methylphenanthrene	150	61	<50	<50	<50
4H-Cyclopenta[ <i>def</i> ] phenanthrene	<50	E44	<50	<50	<50
Phenol	E27	E16	E6	E21	110
3,5-Xylenol	<50	<50	<50	<50	<50
4-Chloro-3-methylphenol	<50	<50	<50	<50	<50
C8-Alkylphenol	<50	<50	<50	<50	<50
<i>bis</i> (2-Ethylhexyl) phthalate	1,800	1,700	130	58	<50
Butylbenzyl phthlate	120	97	E37	E27	<50
Acenaphthylene	<50	E8	<50	<50	<50
Acenaphthene	<50	E7	<50	<50	<50
Acridine	<50	<50	<50	<50	<50
N-Nitrosodi- <i>n</i> -propylamine	<50	<50	<50	<50	<50
N-Nitrosodiphenylamine	<50	<50	<50	<50	<50

## 22 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 4.** Extractable organic compound concentrations in bed material from the New and the Lower Colorado Rivers, 1995—Continued

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
Anthracene	E34	E24	<50	<50	<50
2-Methylanthracene	120	E35	<50	<50	<50
Benz[ <i>a</i> ]anthracene	84	110	<50	<50	<50
9,10-Anthraquinone	<50	<50	<50	<50	<50
1,2,4-Trichlorobenzene	<50	E28	<50	<50	<50
1,2-Dichlorobenzene	E6	E21	<50	<50	<50
1,3-Dichlorobenzene	<50	<50	<50	<50	<50
1,4-Dichlorobenzene	160	86	<50	<50	<50
Azobenzene	<50	<50	<50	<50	<50
Nitrobenzene	<50	<50	<50	<50	<50
Pentachloronitrobenzene	<50	<50	<50	<50	<50
Carbazole	<50	E18	<50	<50	<50
Chrysene	110	120	<50	<50	<50
3-Methylphenol	<50	300	<50	<50	<50
Dibenzothiophene	<50	<50	<50	<50	<50
4-Bromophenylphenylether	<50	<50	<50	<50	<50
4-Chlorophenylphenylether	<50	<50	<50	<50	<50
Benzo[ <i>b</i> ]fluoranthene	90	89	<50	<50	<50
Pentachloroanisole	<50	<50	<50	<50	<50
Dibenz[ <i>a,h</i> ]anthracene	<50	<50	<50	<50	<50
Fluoranthene	150	220	<50	<50	<50
2-Chlorophenol	<50	<50	<50	<50	<50
Benzo[ <i>c</i> ]cinnoline	<50	<50	<50	<50	<50
Sample dry weight, in grams	25	25	25	25	25

**Table 5.** Extractable organic compound concentrations in bed material from the New River, 1996

[Concentrations in micrograms per kilogram, dry weight;  $d_{14}$  and  $d_5$ , synthetic compound containing 14 and 5 deuterium atoms; E indicates concentration is estimated; <, less than]

Compound	New River at		
	Mexicali April 11	Calxico April 10	Salton Sea April 9
$d_{14}$ -Terphenyl, surrogate, in percent	96	67	120
2-Fluorobiphenyl, surrogate, in percent	83	90	72
$d_5$ -Nitrobenzene, surrogate, in percent	86	130	66
Hexachlorobenzene	<4.1	<3	<1
Di- <i>n</i> -butyl phthlate	110	110	87
Di- <i>n</i> -octyl phthlate	E600	E750	E41
Diethyl phthlate	E39	E44	E34
Dimethyl phthlate	<50	<50	<50
Pyrene	100	290	E35
1-Methylpyrene	E46	67	E20
Benzo[ <i>a</i> ]pyrene	62	160	<50
Indeno[1,2,3- <i>cd</i> ] pyrene	<50	<50	<50
2,2'-Biquinoline	<50	<50	E41
Quinoline	<50	<50	<50
Phenanthridine	<50	<50	<50
Isoquinoline	<50	<50	E23
2,4-Dinitrotoluene	<50	<50	<50
2,6-Dinitrotoluene	<50	<50	<50
Benzo[ <i>k</i> ]fluoranthene	53	150	<50
1-Methyl-9H-fluorene	<50	E44	<50
9H-Fluorene	E29	E33	E19
Isophorone	<50	<50	<50
<i>bis</i> (2-Chloroethoxy)methane	<50	<50	<50
Naphthalene	E11	53	<50
1,2-Dimethylnaphthalene	E31	E29	<50
1,6-Dimethylnaphthalene	79	110	<50
2,3,6-Trimethylnaphthalene	58	62	<50
2,6-Dimethylnaphthalene	480	690	E26
2-Chloronaphthalene	<50	<50	<50
Benzo[ <i>g,h,i</i> ] perylene	<50	<50	<50
Phenanthrene	58	270	E15
1-Methylphenanthrene	60	90	<50
4H-Cyclopenta[ <i>def</i> ]phenanthrene	<50	<50	<50
Phenol	E25	E24	E10
3,5-Xylenol	<50	<50	<50
4-Chloro-3-methylphenol	<50	<50	<50
C8-Alkylphenol	<50	<50	<50
<i>bis</i> (2-Ethylhexyl) phthalate	E13,000	E14,000	E670
Butylbenzyl phthlate	<50	100	51
Acenaphthylene	<50	E49	<50
Acenaphthene	<50	E21	<50
Acridine	<50	<50	<50
N-Nitrosodi- <i>n</i> -propylamine	<50	<50	<50
N-Nitrosodiphenylamine	<50	<50	<50

## 24 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 5.** Extractable organic compound concentrations in bed material from the New River, 1996—Continued

Compound	New River at		
	Mexicali April 11	Calexico April 10	Salton Sea April 9
Anthracene	E36	E48	E24
2-Methylanthracene	E45	56	E35
Benz[ <i>a</i> ]anthracene	E37	110	E17
9,10-Anthraquinone	<50	120	<50
1,2,4-Trichlorobenzene	<50	<50	<50
1,2-Dichlorobenzene	<50	<50	<50
1,3-Dichlorobenzene	<50	<50	<50
1,4-Dichlorobenzene	<50	94	<50
Azobenzene	<50	<50	<50
Nitrobenzene	<50	<50	<50
Pentachloronitrobenzene	<50	<50	<50
Carbazole	<50	<50	<50
Chrysene	150	200	E25
3-Methylphenol	110	610	E27
Dibenzothiophene	<50	<50	<50
4-Bromophenylphenylether	<50	<50	<50
4-Chlorophenylphenylether	<50	<50	<50
Benzo[ <i>b</i> ]fluoranthene	50	190	<50
Pentachloroanisole	<1	<1	<1
Dibenz[ <i>a,h</i> ]anthracene	<50	<50	<50
Fluoranthene	86	300	E33
2-Chlorophenol	<50	<50	<50
Benzo[ <i>c</i> ]cinnoline	<50	<50	<50
Sample dry weight, in grams	25	25	25

**Table 6.** Extractable organic compound concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per kilogram, dry weight;  $d_{14}$  and  $d_5$ , synthetic compound containing 14 and 5 deuterium atoms; NIB, Northerly International Boundary; E indicates concentration is estimated; <, less than]

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
$d_{14}$ -Terphenyl, surrogate, in percent	150	130	100	95	120
2-Fluorobiphenyl, surrogate, in percent	46	57	72	76	94
$d_5$ -Nitrobenzene, surrogate, in percent	80	84	68	78	93
Hexachlorobenzene	<14	<10	<2	<850	<50
Di- <i>n</i> -butyl phthlate	<3,500	<2,500	210	E610	E47
Di- <i>n</i> -octyl phthlate	7,300	5,600	<50	<850	59
Diethyl phthlate	<3,500	<2,500	<50	<850	E20
Dimethyl phthlate	<700	<500	<50	<850	<50
Pyrene	<3,500	<2,500	<50	<850	<50
1-Methylpyrene	<3,500	<2,500	<50	<850	<50
Benzo[ <i>a</i> ]pyrene	<700	<500	<50	<850	<50
Indeno[1,2,3- <i>cd</i> ] pyrene	<700	<500	<50	<850	<50
2,2'-Biquinoline	<3,500	<2,500	<50	<850	<50
Quinoline	<700	<500	<50	<850	<50
Phenanthridine	<3,500	<2,500	<50	<850	<50
Isoquinoline	<700	<500	<50	<850	<50
2,4-Dinitrotoluene	<3,500	<2,500	<50	<850	<50
2,6-Dinitrotoluene	<3,500	<2,500	<50	<850	<50
Benzo[ <i>k</i> ]fluoranthene	<700	<500	<50	<850	<50
1-Methyl-9H-fluorene	<3,500	<2,500	<50	<850	<50
9H-Fluorene	<3,500	<2,500	<50	<850	<50
Isophorone	<700	<500	<50	<850	<50
<i>bis</i> (2-Chloroethoxy)methane	<700	<500	<50	<850	<50
Naphthalene	<700	<500	<50	<850	<50
1,2-Dimethylnaphthalene	<700	<500	<50	<850	<50
1,6-Dimethylnaphthalene	<700	<500	<50	<850	<50
2,3,6-Trimethylnaphthalene	<3,500	<2,500	<50	<850	<50
2,6-Dimethylnaphthalene	830	1,800	120	280	77
2-Chloronaphthalene	<700	<500	<50	<850	<50
Benzo[ <i>g,h,i</i> ] perylene	<700	<500	<50	<850	<50
Phenanthrene	<3,500	<2,500	<50	<850	<50
1-Methylphenanthrene	<3,500	<2,500	<50	<850	<50
4H-Cyclopenta[ <i>def</i> ]phenanthrene	<3,500	<2,500	<50	<850	<50
Phenol	1,100	1,300	E30	280	E29
3,5-Xylenol	<700	<500	<50	<850	<50
4-Chloro-3-methylphenol	<700	<500	<50	<850	<50
C8-Alkylphenol	<700	<500	<50	<850	<50
<i>bis</i> (2-Ethylhexyl) phthalate	<3,500	<2,500	3,600	6,400	390
Butylbenzyl phthlate	<3,500	<2,500	100	770	E47
Acenaphthylene	<700	<500	<50	<850	<50
Acenaphthene	<3,500	<500	<50	<850	<50
Acridine	<3,500	<2,500	<50	<850	<50
N-Nitrosodi- <i>n</i> -propylamine	<700	<500	<50	<850	<50
N-Nitrosodiphenylamine	<3,500	<2,500	<50	<850	<50



**26 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001**

**Table 6.** Extractable organic compound concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995—Continued

Compound	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
Anthracene	<3,500	<2,500	<50	<850	<50
2-Methylanthracene	<3,500	<2,500	<50	<850	<50
Benz[ <i>a</i> ]anthracene	<3,500	<2,500	<50	<850	<50
9,10-Anthraquinone	<3,500	<2,500	<50	<850	<50
1,2,4-Trichlorobenzene	<700	<500	<50	<850	<50
1,2-Dichlorobenzene	<700	<500	<50	<850	<50
1,3-Dichlorobenzene	<700	<500	<50	<850	<50
1,4-Dichlorobenzene	<700	<500	<50	<850	<50
Azobenzene	<3,500	<2,500	<50	<850	<50
Nitrobenzene	<700	<500	<50	<850	<50
Pentachloronitrobenzene	<3,500	<2,500	<50	<850	<50
Carbazole	<3,500	<2,500	<50	<850	<50
Chrysene	<3,500	<2,500	E49	<850	<50
3-Methylphenol	<700	430	81	<850	E27
Dibenzothiophene	<3,500	<2,500	<50	<850	<50
4-Bromophenylphenylether	<3,500	<2,500	<50	<850	<50
4-Chlorophenylphenylether	<3,500	<2,500	<50	<850	<50
Benzo[ <i>b</i> ]fluoranthene	<700	<500	<50	<850	<50
Pentachloroanisole	<14	<10	<2	<850	<50
Dibenz[ <i>a,h</i> ]anthracene	<700	320	<50	<850	<50
Fluoranthene	<3,500	<2,500	<50	<850	<50
2-Chlorophenol	<700	<500	<50	<850	<50
Benzo[ <i>c</i> ]cinnoline	<3,500	<2,500	<50	<850	<50
Sample dry weight, in grams	1.9	2.5	11.5	1.6	25

**Table 7.** Element concentrations in bed material from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per gram, dry weight; NIB, Northerly International Boundary; <, less than]

Element	Symbol	New River at			All-American Canal June 6	Colorado River at NIB June 13
		Mexicali March 28	Calexico March 25	Salton Sea March 22		
Aluminum	Al	43,000	37,000	42,000	23,000	51,000
Antimony	Sb	1	2	1	0.7	1.2
Arsenic	As	5.8	4.1	2.3	2.6	5
Barium	Ba	560	570	840	410	550
Beryllium	Be	<1	<1	<1	<1	1
Bismuth	Bi	<10	<10	<10	<10	<10
Cadmium	Cd	.4	.3	.1	.1	.1
Calcium	Ca	32,000	25,000	22,000	16,000	30,000
Cerium	Ce	30	22	21	27	59
Chromium	Cr	36	20	9	11	86
Cobalt	Co	13	5	2	2	14
Copper	Cu	560	570	840	3	14
Europium	Eu	<2	<2	<2	<2	<2
Gallium	Ga	9	7	8	5	11
Gold	Au	<8	<8	<8	<8	<8
Holmium	Ho	<4	<4	<4	<4	<4
Iron	Fe	16,000	9,300	5,500	6,900	30,000
Lanthanum	La	18	14	12	16	32
Lead	Pb	45	43	9	11	11
Lithium	Li	20	20	8	8	20
Magnesium	Mg	7,700	4,700	2,300	3,000	9,200
Manganese	Mn	340	210	270	190	550
Mercury	Hg	.35	<.02	<.02	<.02	<.02
Molybdenum	Mo	2	<2	<2	<2	<2
Neodymium	Nd	13	9	9	10	26
Nickel	Ni	51	14	5	4	24
Niobium	Nb	4	<4	<4	<4	10
Phosphorus	P	900	900	500	200	800
Potassium	K	17,000	17,000	15,000	12,000	17,000
Scandium	Sc	4	2	<2	<2	8
Selenium	Se	1.2	1.2	.2	<.1	<.1
Silver	Ag	.9	.5	<.1	.1	.1
Sodium	Na	9,200	9,400	14,000	5,500	13,000
Strontium	Sr	230	210	290	120	300
Sulfur	S	.32	.22	<.05	<.05	<.05
Tantalum	Ta	<40	<40	<40	<40	<40
Thorium	Th	5	4	2	4	9
Tin	Sn	7	5	<5	<10	<10
Titanium	Ti	1,800	1,100	700	800	5,100
Uranium	U	1.9	1.6	.77	1	2.2
Vanadium	V	38	21	11	16	93
Ytterbium	Yb	1	<1	<1	<1	2
Yttrium	Y	10	7	5	6	20
Zinc	Zn	120	81	26	23	57
Organic carbon	OC	11,300	6,800	1,200	400	900
Inorganic carbon	IC	7,100	6,300	3,300	4,500	5,000

## 28 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 8.** Element concentrations in suspended sediment from the New and the Lower Colorado Rivers, 1995

[Concentrations in micrograms per gram, dry weight; NIB, Northerly International Boundary; <, less than]

Element	New River at			All-American Canal June 6	Colorado River at NIB June 13
	Mexicali March 28	Calexico March 25	Salton Sea March 22		
Aluminum	60,000	18,000	79,000	61,000	50,000
Antimony	1	1	1	1	1
Arsenic	15	10	11	14	5
Barium	420	180	500	640	550
Beryllium	1	<1	2	2	1
Bismuth	<.1	<.1	<.1	<.1	<.1
Cadmium	1	2	1	1	0
Calcium	41,000	18,000	51,000	56,000	33,000
Cerium	47	13	64	77	56
Chromium	97	67	100	290	79
Cobalt	11	5	13	13	12
Copper	120	89	38	55	26
Europium	<2	<2	<2	<2	<2
Gallium	14	6	19	17	13
Gold	<8	<8	<8	<8	<8
Holmium	<4	<4	<4	<4	<4
Iron	32,000	11,000	34,000	31,000	29,000
Lanthanum	27	7	36	41	30
Lead	52	70	27	45	14
Lithium	48	15	59	46	23
Magnesium	15,000	20,000	19,000	15,000	9,900
Manganese	940	620	780	1,700	690
Molybdenum	8	6	5	18	1
Neodymium	21	6	28	32	25
Nickel	200	150	53	150	26
Niobium	6	<4	10	9	8
Phosphorus	9,200	65,000	2,000	1,500	900
Potassium	17,000	24,000	21,000	18,000	18,000
Scandium	9	2	11	10	9
Silver	1	3	0	0	0
Sodium	5,500	4,100	5,500	5,700	13,000
Strontium	360	240	320	350	310
Tantalum	<40	<40	<40	<40	<40
Thorium	8	2	12	11	7
Tin	<10	37	<10	<10	<10
Titanium	2,400	600	3,200	2,600	4,600
Uranium	3.1	1.4	3.5	2.5	1.4
Vanadium	79	22	100	75	84
Ytterbium	0	0	0	0	0
Yttrium	15	4	21	22	20
Zinc	350	250	120	150	66

**Table 9.** Element concentrations in surficial bottom sediment from near the center of the north subbasin of the Salton Sea, California, May 31, 1996

[Concentrations in micrograms per gram dry sediment weight, except lead-210, radium-226, and cesium-137 activities in picocuries per minute per gram dry sediment weight; <, less than indicated value]

Symbol	Element	Concentration
Al	Aluminum	14,000
Sb	Antimony	<.2
As	Arsenic	5.7
Ba	Barium	200
Be	Beryllium	<1
Bi	Bismuth	<10
Cd	Cadmium	.2
Ca	Calcium	130,000
Ce	Cerium	10
Cr	Chromium	12
Co	Cobalt	8
Cu	Copper	22
Eu	Europium	<2
Ga	Gallium	<4
Au	Gold	<8
Ho	Holmium	<4
Fe	Iron	800
La	Lanthanum	8
Pb	Lead	10
Li	Lithium	50
Mg	Magnesium	20,000
Mn	Manganese	160
Hg	Mercury	<.02
Mo	Molybdenum	94

Symbol	Element	Concentration
Nd	Neodymium	20
Ni	Nickel	13
Nb	Niobium	6
Pb	Phosphorus	1,200
K	Potassium	5,600
Sc	Scandium	2
Se	Selenium	9.3
Ag	Silver	.2
Na	Sodium	100,000
Sr	Strontium	3,600
S	Sulfur	4.38
Ta	Tantalum	<40
Th	Thorium	8.5
Sn	Tin	<10
Ti	Titanium	700
U	Uranium	27
V	Vanadium	67
Yb	Ytterbium	<1
Yb	Yttrium	4
Zn	Zinc	30
OC	Organic carbon	92,400
IC	Inorganic carbon	26,600
<sup>210</sup> Pb	Lead-210	1.2
<sup>226</sup> Ra	Radium-226	<.4
<sup>137</sup> Cs	Cesium-137	<.02

### 30 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 10.** Location of 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[See figure 2 for site locations; latitude and longitude references to North American Datum of 1927]

Site No.	Latitude-longitude	Descriptive location
1	33°16'00"N115°45'30"W	Center of south subbasin
2	33°14'00"N115°45'00"W	Near center of south subbasin
3	33°14'00"N115°38'00"W	In Alamo River Delta
4	33°10'23"N115°47'37"W	In San Felipe Creek Delta
5	33°08'35"N115°43'45"W	In New River Delta
6	33°12'15"N115°41'00"W	In the south subbasin between where the New and the Alamo river deltas coalesce
7	33°19'30"N115°48'40"W	Near center of lake between north and south subbasins
8	33°26'37"N115°51'20"W	In Salt Creek Delta
9	33°24'00"N115°55'30"W	Center of north subbasin
10	33°29'08"N116°01'15"W	Between north subbasin and Whitewater River Delta
11	33°29'58"N116°02'35"W	In Whitewater River Delta

**Table 11.** Particle-size distribution in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[See figure 2 for site locations; weight percent finer than size, in millimeters, indicated; <, less than; —, 100]

Site No.	Gravel	Coarse sand		Medium sand	Fine sand		Silt				Clay	
	4	2	1	0.5	0.25	0.125	0.062	0.031	0.016	0.008	0.004	0.002
1	—	—	—	—	—	100	99	99	97	91	87	86
2	—	96	90	88	87	86	85	85	85	76	70	67
3	—	—	100	95	56	6	1	<1	<1	<1	<1	<1
4	—	—	100	95	86	69	47	39	30	24	22	20
5	—	95	93	92	89	48	24	21	19	16	15	14
6	100	92	90	87	86	84	66	62	56	48	40	33
7	100	91	87	85	84	83	83	81	80	76	66	64
8	100	97	89	80	74	69	67	61	54	46	38	32
9	—	100	97	96	95	95	94	93	93	87	83	81
10	—	—	—	—	100	99	99	97	90	71	57	49
11	—	—	—	—	100	99	97	94	78	57	40	29

### 32 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 12.** Field data for bottom water and surficial sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[See figure 2 for site locations; depth below water surface, in feet; temperature, in degrees Celsius; molecular oxygen, in milligrams per liter; specific conductance, in microsiemens per centimeter at 25 degrees Celsius; color terms are from Goddard and others, 1948; <, less than]

Site No.	Depth	Temperature	pH	Oxygen	Specific conductance	Sediment texture and color
1	48	25.22	7.82	0.1	54,700	Organic muck, 5GY 2/1
2	43	25.49	7.82	.1	54,800	Organic muck, 5GY 2/1
3	15	29.22	8.19	1.1	54,300	Medium fine sand, 5YR–5Y 4/1
4	15	28.74	8.07	<.1	54,800	Sand, silt, and clay, many barnacles, 5Y–5GY 4/1
5	15	29.03	8.15	<.1	54,700	Silty fine sand, some barnacles, 5Y–5GY 4/1
6	30	26.36	7.75	.1	54,500	Muck and silty sand, worm tubes, 5YR–5Y 4/1
7	43	24.77	7.72	.1	54,400	Organic muck, 5Y–5GY 2/1
8	15	31.09	8.33	16	54,600	Sandy, live barnacles and pileworms 5YR–5Y 4/1
9	50	24.10	7.46	.1	54,700	Organic muck, 1 shell (?), white streak 5GY 2/1
10	30	31.06	8.29	15	54,800	Silty clay organic muck, 5GY 2/1
11	15	31.54	8.31	9.3	54,600	Clay, 2-inch wood fragment, grayish black

**Table 13.** Chemical data for bottom water from 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[Dissolved concentrations in milligrams per liter; ROE, dissolved solids as residue on evaporation at 180°C, in milligrams per liter; <, less than indicated value; —, no data]

Site No.	Ammonia as nitrogen	Organic nitrogen	Nitrite as nitrogen	Nitrate as nitrogen	Total phos- phorus	Ortho- phosphate	Organic carbon	Total alkalinity expressed as calcium carbonate	Silica	ROE
1	1.70	3.20	<0.01	0.05	0.031	0.044	44	210	14	43.1
2	1.65	3.05	<.01	<.05	.018	.054	—	210	14	43.1
3	1.11	2.99	.02	.07	.021	.029	42	210	9.7	42.6
4	1.41	2.89	<.01	.05	<.010	.010	42	210	11	42.0
5	1.31	2.89	<.01	<.05	.022	.019	40	210	11	41.3
6	1.84	3.36	<.01	.05	.011	.044	42	210	15	43.1
7	1.80	2.80	<.01	.05	.017	.043	43	210	15	43.2
8	.74	2.96	.04	.08	.016	.024	42	200	7.6	40.8
9	2.19	3.21	<.01	.05	.013	.040	43	220	16	42.5
10	.70	2.90	.03	.11	.018	.028	43	190	7.7	41.2
11	.78	2.92	.03	.09	.011	.027	44	190	7.3	43.1



### 34 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 14.** Water-column field measurements from 11 sampling sites in the Salton Sea, California

[See figure 2 for site locations; date and approximate time of sampling are indicated for each site; depth below water surface, in feet; dissolved-molecular-oxygen concentration, in milligrams per liter; specific conductance, in microsiemens per centimeter at 25 degrees Celsius; water temperature, in degrees Celsius]

Depth	Temperature	pH	Oxygen	Specific conductance
<b>Site 1 - July 20, 1998, at 1230</b>				
0.1	33.17	8.05	6.5	55,800
5.0	30.97	8.07	5.23	56,399
10.8	30.79	8.08	4.05	57,002
15.1	30.67	8.1	4.12	57,311
20.0	30.62	8.11	4.08	57,588
25.9	30.22	8.09	2.65	57,823
30.2	25.65	7.89	2.06	58,229
35.3	25.29	7.7	.21	58,306
39.9	25.26	7.71	.14	58,483
44.8	25.25	7.71	.13	58,556
46.7	25.22	7.71	.12	58,603
<b>Site 2 - July 20, 1998, at 1415</b>				
.9	33.57	8.33	7.79	55,608
5.1	30.85	8.26	8.98	56,419
10.1	30.75	8.24	6.12	56,534
15.1	30.64	8.23	4.88	56,695
20.6	30.55	8.23	4.66	56,922
25.5	30.32	8.22	4.02	57,136
29.9	27.02	7.95	.43	57,270
35.2	25.76	7.88	.21	57,728
39.8	25.5	7.85	.16	57,939
41.7	25.49	7.84	.11	58,008
<b>Site 3 - July 20, 1998, at 1520</b>				
1.0	31.4	8.25	5.96	54,766
5.5	30.43	8.2	5.16	55,517
10.7	29.85	8.12	1.04	55,868
12	29.32	8.07	1.09	56,062
<b>Site 4 - July 21, 1998, at 1000</b>				
.8	30.17	7.74	19.9	55,110
5	30.16	7.9	12.99	55,962
10.1	28.88	7.94	.07	56,803
13.4	28.74	7.97	0	57,287
<b>Site 5 - July 21, 1998, at 1105</b>				
.5	29.56	8.35	3.67	57,488
5.2	29.48	8.35	1.67	57,888
9.9	29.36	8.34	0	58,235
12.8	29.03	8.28	0	58,556
<b>Site 6 - July 21, 1998, at 1215</b>				
.6	30.4	8.46	20	57,741
5.5	30.11	8.45	20	58,021
10.8	30.02	8.45	18.33	58,403
15.8	29.91	8.45	18.26	58,728

**Table 14.** Water-column field measurements from 11 sampling sites in the Salton Sea, California—Continued

Depth	Temperature	pH	Oxygen	Specific conductance
20.3	29.4	8.41	1.53	59,263
25.1	26.46	8.18	0	59,673
28.7	26.36	8.16	.06	59,615
<b>Site 7 - July 21, 1998, at 1345</b>				
.8	31.27	8.53	20	58,145
4.9	31.09	8.52	20	58,482
10.5	30.83	8.51	20	58,850
15.3	30.56	8.5	20	59,163
20	30.45	8.5	20	59,394
25.3	30.22	8.49	20	59,613
30.4	25.25	8.16	.08	59,793
34.9	24.88	8.13	.02	59,855
40.3	24.77	8.12	.09	59,869
<b>Site 8 - July 22, 1998, at 1115</b>				
.8	31.67	8.5	20	57,628
5	31.13	8.47	20	57,847
10.3	31.09	8.46	18.43	58,196
14.7	31.09	8.46	18	58,253
<b>Site 9 - July 22, 1998, at 1220</b>				
.6	32.21	8.61	20	57,429
5	31.02	8.58	20	57,920
10.5	30.87	8.55	20	58,089
15.4	30.83	8.55	20	58,310
20.3	30.11	8.42	.26	58,608
25.2	26.53	8.24	.06	58,913
29.7	25.96	8.21	.22	58,628
35.1	25.02	8.09	.11	58,629
40.3	24.15	8.01	.07	58,571
45.1	24.11	8.01	.07	58,627
47.5	24.1	7.97	.12	58,609
<b>Site 10 - July 22, 1998, at 1340</b>				
.8	32.93	8.61	20	57,981
5.1	31.55	8.54	20	58,755
10.1	31.16	8.5	20	59,314
15.2	31.12	8.5	20	59,374
20	31.12	8.5	16.81	59,344
24.9	31.07	8.5	16.01	59,523
28.5	31.06	8.5	14.7	59,594
<b>Site 11 - July 22, 1998, at 1435</b>				
.7	33.11	8.57	20	57,950
5.2	31.89	8.52	20	59,002
10.1	31.53	8.47	13.8	59,210
13.4	31.54	8.46	9.26	59,392

### 36 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 15.** Nutrient concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, July 20–22, 1998

[See figure 2 for site locations; carbon (C), nitrogen (N), and sulfur (S) concentrations in percent dry sediment weight; phosphorus (P) concentrations in micrograms per gram dry sediment weight; values are for mean ( $\bar{x}$ ), standard deviation ( $\sigma$ ), and number of analyses (n); element ratios are in atoms using organic carbon; <, less than; —, no data]

Site No.	Total carbon			Organic carbon			Nitrogen		
	$\bar{x}$	$\sigma$	n	$\bar{x}$	$\sigma$	n	$\bar{x}$	$\sigma$	n
1	8.662	0.062	2	6.86	0.04	3	0.902	0.022	2
2	8.502	.143	4	6.09	.10	3	.792	.022	4
3	1.321	.218	3	.203	.015	3	.064	.007	3
4	2.044	.176	4	.495	.047	3	.105	.002	4
5	1.723	.195	3	.570	.019	3	.107	.013	3
6	3.666	.036	4	1.93	.079	3	.263	.004	4
7	8.004	.290	4	5.44	.052	2	.665	.039	4
8	4.352	.117	2	1.16	.010	3	.257	.023	2
9	11.408	.085	4	8.40	.188	2	.966	.024	4
10	7.063	.109	5	4.34	.032	3	.506	.021	5
11	2.913	.084	4	2.06	.003	2	.269	.019	4

Site No.	Phosphorus			Sulfur			C/N	C/P	N/P	C/S
	$\bar{x}$	$\sigma$	n	$\bar{x}$	$\sigma$	n				
1	787	—	1	0.786	0.055	2	8.87	225	25.3	23.3
2	651	—	1	1.292	.399	4	8.97	241	26.9	12.6
3	178	14.1	2	<.001	—	3	3.70	29.4	7.95	<542
4	532	7.07	2	.180	.092	4	5.50	24.0	4.36	7.34
5	333	—	1	.028	.048	3	6.21	44.1	7.1	54.3
6	578	—	1	.850	.158	4	8.56	86.1	10.1	6.1
7	669	—	1	1.148	.152	4	9.54	210	22.0	12.6
8	560	9.90	2	.409	.035	2	5.26	53.4	10.1	7.57
9	662	—	1	.866	.280	4	10.1	327	32.3	25.9
10	687	—	1	.915	.422	5	10.0	163	16.3	12.7
11	702	12.0	2	.698	.309	4	8.93	75.7	8.47	7.88

**Table 16.** Element concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[See figure 2 for site locations; element symbols explained in table 7, except for TI, thallium; concentrations in micrograms per gram dry sediment weight; <, less than]

Element symbols	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
Al	26,000	34,000	20,000	43,000	30,000	22,000	30,000	40,000	16,000	48,000	74,000
Sb	.7	.92	.29	.66	.57	.61	1.1	1.7	.49	.82	.71
As <sup>1</sup>	11	16	4.9	6	5.2	5.8	9.4	10	9	9.6	6
As <sup>2</sup>	8.5	13	5.1	5.3	5.2	5.5	7.6	9	6.4	8	5.6
Ba	230	290	390	540	400	220	260	390	210	410	570
Be	.78	.95	.35	.93	.77	.58	1.1	.99	0.4	1.2	1.6
Bi	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cd	.35	.29	<.1	.18	.11	<.1	.22	.14	.3	.21	.17
Ca	65,000	83,000	50,000	85,000	63,000	38,000	110,000	140,000	110,000	110,000	49,000
Ce	23	32	19	37	28	22	26	41	16	50	75
Cr	27	31	12	32	21	18	28	36	18	45	62
Co	5.6	6.9	1.8	5.6	3.6	3.2	5.9	6.7	5.9	14	20
Cu	17	20	4.3	15	9.6	9.4	16	17	20	40	55
Eu	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.4
Ga	5.9	7.9	3.8	9.8	6.8	5.1	7	9.5	3.8	13	20
Au	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ho	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Fe	12,000	16,000	4,900	1.7	10,000	9,800	14,000	20,000	9,200	32,000	51,000
La	13	18	11	21	16	13	15	24	9	29	44
Pb	11	12	7.5	12	10	8.2	12	12	11	16	22
Li	51	52	9.4	35	22	21	47	43	49	59	65
Mg	19,000	18,000	4,200	11,000	7,600	6,500	17,000	14,000	19,000	21,000	23,000
Mn	220	290	180	330	240	230	290	350	200	560	820
Hg	.04	.04	.02	<.02	.03	<.02	.03	.02	.03	.04	.05
Mo	36	34	.73	1.4	1.4	2	31	2.8	75	27	6.2
Nd	10	14	9.1	18	12	10	12	19	7	22	34
Ni	14	17	4.3	14	9.2	8	16	18	15	25	31
Nb	4	5.5	<4	6.5	4.1	<4	4.7	7.4	<4	10	16
Pb	1,100	980	2,200	580	390	310	890	690	980	960	1,100
K	9,100	11,000	11,000	16,000	14,000	8,100	9,700	13,000	6,600	15,000	22,000
Sc	4.8	5.9	<2	6.1	3.7	3.4	5.3	7	3.2	11	17
Se	8.8	5.8	.58	.9	1	1.5	8	1.8	6.5	11	2.7
Ag	.45	.38	.12	.3	.16	.12	.18	.3	<.1	.47	.79
Na	110,000	57,000	8,600	15,000	12,000	9,700	58,000	23,000	81,000	43,000	36,000
Sr	2,100	2,400	380	790	530	410	2,400	1,200	3,500	1,800	610
S	3.59	3.53	1.35	2.46	2.07	1.48	4.31	5.61	4.58	2.2	1.43
Ta	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.5
Tl	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Th	3.8	5.2	9.2	6.2	4	3.6	4.6	6.4	2.5	9	15
Sn	<1	<1	<1	1.2	<1	<1	<1	1.2	<1	1.2	2.3
Ti	990	1,400	7,300	1,900	1,100	900	1,200	2,000	750	3,300	5,600
U	14	14	2.4	2.7	2.5	3	14	5	20	14	5.3
V	58	73	15	55	33	32	66	57	58	89	120
Yb	<1	<1	<1	1	<1	<1	<1	1.2	<1	1.3	2
Y	7.3	10	6	12	8.6	7.2	8.8	13	5.1	15	23
Zn	41	50	12	54	32	29	45	53	33	88	140

<sup>1</sup>Analyzed by inductively-coupled-plasma mass spectroscopy.

<sup>2</sup>Analyzed by hydride-generation atomic-absorption spectrometry.



**Table 18.** Aromatic hydrocarbon concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998

[See figure 2 for site locations; concentrations in micrograms per kilogram sediment dry weight;  $d_{14}$  and  $d_5$ , synthetic compound containing 14 and 5 deuterium atoms, respectively; E, estimated value; <, less than indicated value; NA, not analyzed; —, no data]

Constituent	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Method blank
Phenol	141	38	E3.8	8.1	5.3	8.7	97.9	29.9	69.3	10.5	15.8	<5
3-Methylphenol	35.3	18.8	<5	6.6	E3.1	7	108	15.3	33.9	E8.2	9.3	<5
C8-Alkylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	E4.5	E2.6	E0.49	E0.79	E0.67	E1.2	E9.3	E1.1	E4.2	E1.6	E1.6	E0.53
C1-128 isomers	615	268	E4.0	17.4	12	40.9	961	42	361	82.1	33.7	<5
2-Ethyl-naphthalene	<20	<10	<5	<5	<5	<5	593	<5	<10	<10	<5	<5
2,6-Dimethyl-naphthalene	628	296	E4.4	38.1	25.1	43.2	1,110	90.4	461	65.8	58.3	<5
1,6-Dimethyl-naphthalene	50.6	22.1	<5	E3.1	E2.5	E3.9	107	6.4	36.3	E5.6	E4.7	<5
C2-128 isomers	708	329	6.8	46	31.1	49.7	1,320	102	519	81.2	68.4	<5
Acenaphthylene	<20	<10	<5	<5	<5	<5	12.5	E1.3	E5.5	<10	<5	<5
1,2-Dimethyl-naphthalene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
Acenaphthene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C3-128 isomers	36.8	14.1	<5	<5	<5	<5	147	10.4	30.9	<10	E3.7	<5
2,3,6-Trimethyl-naphthalene	<20	<10	<5	<5	<5	<5	40.7	<5	<10	<10	E2.4	<5
9H-Fluorene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C4-128 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
1-methyl-9H-fluorene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C1-166 isomers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzothiophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	45.9	<10	<5	<5	<5	<5	<10	<5	<10	<10	E2.1	<5
Anthracene	47.4	<10	<5	<5	<5	12.6	<10	<5	<10	<10	E2.3	<5
Acridine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthridine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9H-Carbazol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C5-128 isomers	<20	<10	<5	<5	<5	<5	<100	<5	<10	<10	<5	<5
C2-166 isomers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylanthracene	<20	<10	<5	<5	<5	<5	<10	E1.9	<10	<10	<5	<5
4,5-Methylene-phenanthrene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C1-178 isomers	<20	<10	<5	<5	<5	<5	57.4	8.6	<10	<10	7.4	<5
1-Methylphenanthrene	E17.2	10.2	<5	<5	<5	E2.6	<10	E2.9	<10	<10	<5	<5
C3-166 isomers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C2-178 isomers	<20	<10	<5	5.7	<5	<5	129	16.5	21.2	<10	6.2	<5
Fluoranthene	E4.0	E2.7	<5	<5	<5	E1.6	12.4	E1.1	E6.2	E2.3	E3.8	<5
Pyrene	E3.4	E2.5	<5	<5	<5	E1.3	15.9	E1.1	E5.2	E2.0	E3.5	<5
C3-178 isomers	<20	<10	<5	<5	<5	<5	50.9	<5	<10	<10	<5	<5
C4-178 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
1-Methylpyrene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C1-202 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C2-202 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C5-178 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
Benz[a]anthracene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	E1.9	<5
Chrysene	<20	<10	<5	<5	<5	<5	<10	E1.2	E4.4	E1.9	E2.6	<5
C3-202 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C1-228 isomers	<20	<10	<5	<5	<5	<5	23.3	<5	<10	<10	<5	<5
C4-202 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5

#### 40 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 18.** Aromatic hydrocarbon concentrations in surficial bottom sediment from 11 sampling sites in the Salton Sea, California, July 20–22, 1998—Continued

Constituent	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Method blank
C5-202 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C2-228 isomers	<20	<10	<5	<5	<5	<5	31.2	<5	<10	<10	<5	<5
Benzo[ <i>b</i> ]fluoranthene	<20	<10	<5	<5	<5	<5	14.9	E2.0	E5.5	<10	E3.1	<5
Benzo[ <i>k</i> ]fluoranthene	<20	<10	<5	<5	<5	<5	<10	E1.4	<10	<10	E2.0	<5
Benzo[ <i>e</i> ]pyrene	<20	<10	<5	<5	<5	<5	<10	E1.9	<10	<10	E2.9	<5
Benzo[ <i>a</i> ]pyrene	<20	<10	<5	<5	<5	<5	<10	E2.1	<10	<10	E2.9	<5
Perylene	<20	<10	<5	<5	E1.5	E2.6	<10	<5	<10	<10	10.2	<5
C1-252 isomers	<20	10.9	<5	<5	<5	<5	126	<5	<10	<10	<5	<5
C3-228 isomers	<20	<10	<5	<5	<5	<5	<50	<5	<10	<10	<5	<5
C2-252 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C4-228 isomers	<20	<10	<5	<5	<5	<5	<20	<5	<10	<10	<5	<5
Benzo[ <i>g,h,i</i> ]perylene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	E2.0	<5
Indeno[1,2,3- <i>cd</i> ]pyrene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	E2.3	<5
Dibenzo[ <i>a,h</i> ]anthracene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C3-252 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C4-252 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
C5-228 isomers	<20	<10	<5	<5	<5	<5	<60	<5	<10	<10	<5	<5
C5-252 isomers	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
Coronene	<20	<10	<5	<5	<5	<5	<10	<5	<10	<10	<5	<5
<i>d</i> <sub>5</sub> -Nitrobenzene, surrogate in percent	56.98	50.34	50.38	60.64	37.39	45.98	62.58	49.76	49.8	48.59	49.63	41.13
2-Fluorobiphenyl, surrogate, in percent	51.48	54.69	47.27	62.12	38.67	56.32	58.68	44.93	50.89	45.36	51.1	47.8
<i>d</i> <sub>14</sub> -Terphenyl, surrogate, in percent	51.94	61.44	59.85	70.4	44.17	61.65	48.21	58.28	56.03	46.71	49.16	49.37
Sample dry weight, in grams	6.50	8.50	31.50	25.80	26.60	15.60	9.46	20.00	6.00	10.00	15.30	—

**Table 19.** Nutrient concentrations in a sediment core from Site 9 in the Salton Sea, California, April 26, 1999

[See figure 2 for site locations; sediment depth in centimeters below lake bottom, concentrations in percent dry sediment weight]

Depth	Total carbon	Organic carbon	Nitrogen	Phosphorus
0-2	10.92±0.49	8.818±0.163	0.942±.042	0.0788
2-4	11.21±.41	8.764±.069	.949±.044	.0744
4-6	10.96±.01	7.764±.287	.844±.001	.0707
6-8	10.72±.32	8.000±.087	.872±.023	.0715
8-10	10.56±.36	7.236±.015	.714±.032	.0643
10-12	8.541±.096	6.058±.120	.583±.011	.0587
12-14	5.794±.113	3.911±.016	.442±.006	.0489
14-16	5.799±.369	3.610±.071	.512±.032	.0536
16-18	3.162±.165	1.815±.110	.280±.011	.0537
18-20	2.181±.000	.868±.021	.160±.002	.0580
20-22	2.042±.008	.684±.001	.126±.013	.0558
22-24	1.968±.020	.858±.005	.156±.001	.0584
24-26	1.245±.065	.794±.030	.142±.005	.0588±.0006
26-28	1.652±.020	.982±.018	.168±.004	.0601
28-30	2.606±.040	.838±.058	.164±.001	.0516
30-32	.861±.040	.464±.008	.091±.010	.0121
32-24	1.928±.008	1.148±.060	.165±.001	.0227
34-36	3.266±.038	1.556±.062	.181±.019	.0408
36-38	2.678±.028	1.006±.006	.160±.004	.0448
38-40	2.804±.011	.940±.007	.154±.004	.0479
40-42	2.676±.028	.786±.003	.134±.008	.0464
42-44	2.559±.032	.686±.000	.130±.001	.0455
44-46	2.607±.026	.588±.000	.122±.004	.0610
46-48	2.342±.045	.580±.009	.118±.004	.0576
48-50	2.443±.048	.598±.004	.122±.004	.0565
50-52	2.303±.062	.575±.008	.121±.004	.0527



## 42 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 20.** Nutrient concentrations in a sediment core from Site 10 in the Salton Sea, California, April 27, 1999

[See figure 2 for site locations; sediment depth in centimeters below lake bottom, concentrations in percent dry sediment weight]

Depth	Total carbon	Organic carbon	Nitrogen	Phosphorus
0–2	6.230±0.443	3.577±0.093	0.464±0.046	0.0650
2–4	5.654±.038	3.291±.113	.420±.008	.0690
4–6	4.550±.076	2.742±.042	.362±.013	.0709
6–8	3.150±.086	1.893±.026	.265±.014	.0696
8–10	2.000±.048	1.172±.018	.182±.004	.0716
10–12	1.918±.090	1.164±.009	.165±.017	.0704
12–14	1.480±.001	.929	.146±.001	.0684
14–16	1.264±.117	.728±.071	.118±.002	.0756
16–18	7.533±.082	3.460±.080	.378±.011	.0639±.0008
18–20	6.707±.143	2.886±.117	.336±.001	.0632
20–22	3.822±.230	1.488±.020	.218±.008	.0608
22–24	2.316±.020	.795±.050	.144±.001	.0609
24–26	2.022±.018	1.198±.046	.165±.001	.0614
26–28	1.727±.000	1.127±.048	.152±.011	.0632
28–30	1.750±.078	1.078±.059	.108±.004	.0675
30–32	2.412±.024	1.212	.146±.006	.0619
32–34	2.736±.006	1.094±.001	.140±.001	.0619
34–36	4.065±.018	1.162±.011	.162±.002	.0638

**Table 21.** Element concentrations in a sediment core from Site 9 in the Salton Sea, California, April 26, 1999

[See figure 2 for site locations; element symbols explained in table 7, except for Tl, thallium; TC, total carbon; concentrations in micrograms per gram dry sediment weight, except boldface values in percent; <, less than]

Element symbols	Sediment depth, in centimeters below lake bottom									
	0-2	2-4	6-8	10-12	14-16	18-20	22-24	26-28	30-32	34-36
Al	<b>1.8</b>	<b>1.4</b>	<b>2.4</b>	<b>3.5</b>	<b>6</b>	<b>3.5</b>	<b>0.44</b>	<b>5.8</b>	<b>5.8</b>	<b>6.1</b>
Sb	.36	.27	.32	.34	.9	.58	.99	1.6	1.5	1.2
As	8.8	6	7	5.4	8.9	6.9	29	16	13	12
Ba	280	220	310	430	450	390	54	480	530	480
Be	.31	.51	.54	1.1	2	.82	.25	1.6	2.1	1.9
Bi	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cd	.38	.4	.61	.4	.41	.4	.33	.29	.21	.15
Ca	<b>13</b>	<b>14</b>	<b>11</b>	<b>11</b>	<b>6.9</b>	<b>13</b>	<b>16</b>	<b>6.6</b>	<b>6.6</b>	<b>6.2</b>
Ce	18	15	22	30	50	35	5.1	44	44	46
Cr	24	20	29	32	51	29	9.2	49	52	52
Co	7.2	5.6	9.3	8.6	9.2	5.9	1.2	7.9	8.1	8.6
Cu	21	16	31	27	34	43	3.9	40	28	24
Eu	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ga	4	2.8	5.2	7.6	13	7.6	1	12	13	15
Au	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ho	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fe	<b>.89</b>	<b>.65</b>	<b>1.1</b>	<b>1.4</b>	<b>2.7</b>	<b>1.8</b>	<b>.27</b>	<b>2.5</b>	<b>2.8</b>	<b>2.4</b>
La	8.6	7.1	11	15	26	17	2.5	22	23	25
Pb	13	12	13	12	15	8.2	<1	12	12	10
Li	59	54	73	77	110	62	44	160	160	150
Mg	<b>2.3</b>	<b>2</b>	<b>2.6</b>	<b>2.4</b>	<b>2.9</b>	<b>2.4</b>	<b>3.2</b>	<b>3.3</b>	<b>3.3</b>	<b>3.1</b>
Mn	250	160	280	340	360	310	50	370	350	270
Hg	.05	.06	.06	.06	.05	.04	.02	.03	.02	.02
Mo	100	87	84	47	29	27	130	49	10	2.9
Nd	8.1	7	11	14	24	17	2.4	22	21	23
Ni	21	17	22	23	25	19	14	22	23	25
Nb	<4	<4	<4	4.9	8	5.4	<4	7.3	7.5	8.4
P	<b>.11</b>	<b>.081</b>	<b>.072</b>	<b>.057</b>	<b>.065</b>	<b>.06</b>	<b>.015</b>	<b>.047</b>	<b>.053</b>	<b>.07</b>
K	<b>.79</b>	<b>.63</b>	<b>.94</b>	<b>1.1</b>	<b>2</b>	<b>1.2</b>	<b>.2</b>	<b>2</b>	<b>2.1</b>	<b>2</b>
Sc	3.6	2.8	4.5	6.3	10	6.7	<2	9.2	9.6	9.8
Se	9.7	9	11	15	6.1	2.1	.45	1	.96	.55
Ag	.17	.12	.22	.38	.74	.44	<.1	.69	.73	.34
Na	<b>10</b>	<b>9.1</b>	<b>8.6</b>	<b>5.4</b>	<b>3.8</b>	<b>1.9</b>	<b>1.1</b>	<b>3.1</b>	<b>3.4</b>	<b>2.9</b>
Sr	4,800	4,400	3,900	2,000	570	2,400	14,000	1,200	630	450
S	<b>4.58</b>	<b>7.55</b>	<b>4.75</b>	<b>5.3</b>	<b>3.68</b>	<b>9.52</b>	<b>15.2</b>	<b>3.35</b>	<b>3.17</b>	<b>2.84</b>
Ta	<1	<1	<1	<1	1.2	<1	<1	1.1	1	1.4
Tl	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Th	3.2	2.6	4.2	5.6	8.8	5.6	<1	8	8.1	8.3
Sn	<1	<1	1.3	1.5	2.3	1.4	<1	2.2	2.4	2.4
U	28	22	23	13	10	12	16	17	5.7	4.1
V	65	52	64	69	90	47	8	92	100	100
Yb	<1	<1	<1	<1	1.7	1	<1	1.5	1.5	1.6
Y	6.1	5	8	10	17	11	1.8	14	16	15
Zn	38	25	43	48	73	50	5.1	70	70	72
OC	<b>8.12</b>	<b>6.47</b>	<b>5.97</b>	<b>3.99</b>	<b>1.42</b>	<b>.69</b>	<b>.39</b>	<b>.95</b>	<b>.64</b>	<b>.52</b>
TC	<b>11</b>	<b>8.41</b>	<b>8.45</b>	<b>5.88</b>	<b>2.85</b>	<b>1.1</b>	<b>1.39</b>	<b>2.69</b>	<b>2.61</b>	<b>2.51</b>
IC	<b>2.88</b>	<b>1.94</b>	<b>2.48</b>	<b>1.89</b>	<b>1.43</b>	<b>.41</b>	<b>1</b>	<b>1.74</b>	<b>1.97</b>	<b>1.99</b>

#### 44 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 22.** Element concentrations in a sediment core from Site 10 in the Salton Sea, California, April 27, 1999

[See figure 2 for site locations; element symbols explained in table 7, except for Tl, thallium; TC, total carbon; concentrations in micrograms per gram dry sediment weight, except boldface values in percent; <, less than]

Element symbols	Sediment depth, in centimeters below lake bottom								
	2–4	6–8	10–12	14–16	18–20	22–24	26–28	30–32	34–36
Al	<b>4.4</b>	<b>6.3</b>	<b>7.8</b>	<b>8.3</b>	<b>8.7</b>	<b>3.9</b>	<b>6.6</b>	<b>8.2</b>	<b>7.5</b>
Sb	.7	1.1	1.5	.99	.7	.71	.78	1.2	.81
As	9.2	12	14	8.5	6.3	4.7	8.8	9.4	6.8
Ba	400	500	610	620	740	440	550	650	720
Be	1.7	1.8	2.3	2.5	2.1	1.2	2.2	2.6	2.5
Bi	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cd	.57	.17	.11	.1	<1	.2	.24	.16	.12
<b>Ca</b>	<b>12</b>	<b>8.5</b>	<b>4.7</b>	<b>4</b>	<b>3.9</b>	<b>18</b>	<b>9.7</b>	<b>4.3</b>	<b>6.7</b>
Ce	41	60	74	81	84	39	65	84	72
Cr	42	57	67	73	76	40	57	75	64
Co	13	18	23	25	24	9.7	15	25	20
Cu	39	56	68	76	120	38	40	74	51
Eu	<1	1.1	1.4	1.5	1.6	<1	1.2	1.5	1.4
Ga	11	17	22	24	24	9.4	17	25	21
Au	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ho	<1	<1	1	1	1	<1	<1	1	<1
<b>Fe</b>	<b>2.8</b>	<b>4.1</b>	<b>5.4</b>	<b>5.8</b>	<b>5.9</b>	<b>2.3</b>	<b>3.9</b>	<b>5.8</b>	<b>4.9</b>
La	20	30	38	41	43	19	34	42	38
Pb	20	19	21	23	22	13	17	22	17
Li	60	74	88	93	75	44	67	92	69
<b>Mg</b>	<b>2.1</b>	<b>2.2</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>1.8</b>	<b>2.2</b>	<b>2.5</b>	<b>2.3</b>
Mn	520	760	910	930	1,100	560	640	870	1,000
Hg	.1	.07	.08	.08	.04	.05	.07	.06	.05
Mo	27	17	6	3.9	2.6	16	5.7	5.3	4.3
Nd	19	27	34	37	38	18	30	37	35
Ni	26	32	36	37	38	28	32	38	34
Nb	8.2	13	16	17	18	6.7	11	18	16
<b>P</b>	<b>.09</b>	<b>.092</b>	<b>.09</b>	<b>.091</b>	<b>.1</b>	<b>.076</b>	<b>.076</b>	<b>.085</b>	<b>.098</b>
<b>K</b>	<b>1.4</b>	<b>1.8</b>	<b>2.3</b>	<b>2.3</b>	<b>2.5</b>	<b>1.2</b>	<b>1.9</b>	<b>2.4</b>	<b>2.4</b>
Sc	9.9	15	18	19	19	8	14	19	16
Se	8.1	7.3	1.7	.88	.34	9.9	4.6	1.7	2.7
Ag	1.3	1.6	1.8	2	1.8	.7	1.2	1.8	1.4
<b>Na</b>	<b>5.6</b>	<b>3.4</b>	<b>2.9</b>	<b>2.8</b>	<b>2.7</b>	<b>2.8</b>	<b>2.4</b>	<b>2.6</b>	<b>2.5</b>
Sr	1,800	1,300	580	440	390	2,800	960	440	660
<b>S</b>	<b>2.54</b>	<b>1.89</b>	<b>1.49</b>	<b>1.4</b>	<b>1.13</b>	<b>1.78</b>	<b>1.35</b>	<b>1.39</b>	<b>1.12</b>
Ta	<1	1.6	1.8	1.8	1.6	<1	1.4	1.8	1.7
Tl	<1	<1	<1	<1	<1	<1	<1	<1	<1
Th	8	13	16	17	17	7.1	13	18	15
Sn	2	3	3.1	3.2	3.3	2.6	2.7	3.3	3
U	14	14	6.5	4.9	3.4	14	9.4	6.1	7.5
V	78	100	130	140	130	64	95	130	110
Yb	1.2	1.8	2.2	2.4	2.5	1	1.8	2.3	2.3
Y	13	19	25	25	26	12	19	25	24
Zn	75	110	140	160	170	68	100	160	130
<b>OC</b>	<b>4.58</b>	<b>2.86</b>	<b>1.27</b>	<b>1.12</b>	<b>.95</b>	<b>3.6</b>	<b>2.24</b>	<b>1.2</b>	<b>.81</b>
<b>TC</b>	<b>7.49</b>	<b>4.83</b>	<b>2.13</b>	<b>1.77</b>	<b>1.48</b>	<b>8.48</b>	<b>3.58</b>	<b>1.96</b>	<b>2.25</b>
<b>IC</b>	<b>2.91</b>	<b>1.97</b>	<b>.86</b>	<b>.65</b>	<b>.53</b>	<b>4.88</b>	<b>1.34</b>	<b>.76</b>	<b>1.44</b>

**Table 23.** Concentration, fine (clay plus silt) fraction, and calcium carbonate content of suspended sediment from nine sites in the Salton Sea area, California, October 23–28, 2001

[mg/L, milligrams per liter; —, not analyzed]

Site	Concentration (mg/L)	Fines (percent)	Calcium carbonate (percent)
Alamo River Outlet	418	80	14.2
Alamo River Nearshore	255	88	15
Alamo River Offshore	35	76	.5
New River Outlet	245	97	13.3
New River Nearshore <sup>1</sup>	145	48	12.5
New River Nearshore <sup>2</sup>	89	70	—
New River Offshore	43	86	.17
Whitewater River Outlet	72	82	9.2
Whitewater River Nearshore	39	66	.17
Whitewater River Offshore	21	79	.17

<sup>1</sup>Sample obtained from near surface.

<sup>2</sup>Sample obtained from near bottom.

## 46 Chemical Data for Detailed Studies of Irrigation Drainage in the Salton Sea Area, California, 1995–2001

**Table 24.** Element concentrations in suspended sediment from river outlets and nearby areas of the Salton Sea, California, October 23–28, 2001

[Element symbols explained in table 7, except TI, thallium; concentrations in micrograms per gram dry sediment weight, except boldface values in percent; —, not analyzed; <, less than]

Element symbols	Alamo River			New River			Whitewater River		
	Outlet	Nearshore	Offshore	Outlet	Nearshore	Offshore	Outlet	Nearshore	Offshore
Al	<b>7.8</b>	<b>8.4</b>	<b>0.46</b>	<b>6.7</b>	<b>6.8</b>	<b>0.14</b>	<b>7.9</b>	<b>0.13</b>	<b>0.11</b>
Sb	.71	.82	.2	.76	.62	.02	.62	.02	<.02
As	8.3	9.2	17	9.1	9.1	30	11	27	27
Ba	490	460	34	520	480	19	630	14	13
Be	1.9	2.1	.18	2	1.8	.04	2	.03	.03
Bi	<.005	<.005	<.005	.17	.12	<.005	.84	.1	<.005
Cd	.4	.44	.18	.45	.4	.12	.36	.15	.09
<b>Ca</b>	<b>5.5</b>	<b>5.8</b>	<b>1.2</b>	<b>5.1</b>	<b>4.8</b>	<b>.88</b>	<b>5.5</b>	<b>.51</b>	<b>.54</b>
Ce	63	71	3.4	67	62	1.2	85	.7	.8
Cr	120	70	60	57	110	28	83	7.9	8.2
Co	10	11	2.8	9.9	9.5	4.5	19	5.9	4.5
Cu	28	34	16	37	31	18	69	7.9	8
Eu	—	—	—	—	—	—	—	—	—
Ga	15	17	.91	15	14	.27	21	.27	.27
Au	—	—	—	—	—	—	—	—	—
Ho	—	—	—	—	—	—	—	—	—
<b>Fe</b>	<b>2.9</b>	<b>3.3</b>	<b>.2</b>	<b>3</b>	<b>2.6</b>	<b>.071</b>	<b>5.2</b>	<b>.056</b>	<b>.051</b>
La	33	37	2.2	35	32	.7	45	.5	.5
Pb	22	24	27	23	23	15	27	2.5	1.9
Li	44	51	22	46	43	15	44	12	15
<b>Mg</b>	<b>2</b>	<b>2.1</b>	<b>.42</b>	<b>2.1</b>	<b>2</b>	<b>.36</b>	<b>2.3</b>	<b>.4</b>	<b>.45</b>
Mn	670	700	250	650	740	140	1,200	170	120
Hg	.04	.04	.06	.07	.07	.05	.08	.03	.04
Mo	6.3	1.3	3	2.5	6.5	2.3	4.1	1.1	1
Nd	—	—	—	—	—	—	—	—	—
Ni	51	34	22	30	43	11	36	6	6
Nb	18	20	<2	17	12	<2	26	<2	<2
<b>P</b>	<b>.11</b>	<b>.13</b>	<b>.48</b>	<b>.2</b>	<b>.24</b>	<b>.54</b>	<b>.29</b>	<b>.6</b>	<b>.55</b>
<b>K</b>	<b>2</b>	<b>2.1</b>	<b>.42</b>	<b>2.1</b>	<b>2</b>	<b>.36</b>	<b>2.3</b>	<b>.4</b>	<b>.45</b>
Sc	11	12	.9	11	9.5	<.3	16	<.3	<.3
Se	.7	1	8.7	1	1.4	16	1	14	11
Ag	<3	<3	<3	<3	<3	<3	<3	<3	<3
<b>Na</b>	<b>.54</b>	<b>.52</b>	<b>6.4</b>	<b>.6</b>	<b>1.6</b>	<b>4.6</b>	<b>1.3</b>	<b>3.8</b>	<b>4.7</b>
Sr	320	340	230	320	280	200	500	150	140
S	—	—	—	—	—	—	—	—	—
Ta	—	—	—	—	—	—	—	—	—
Tl	.62	.68	.01	.65	.61	<.003	.77	<.003	<.003
Th	11	12	.52	11	10	.18	15	.13	.09
Sn	—	—	—	—	—	—	—	—	—
Ti	3,100	3,600	170	3,400	3,000	50	6,200	50	40
U	3	3.6	5.7	3.3	3	4.7	4.4	1.2	1.2
V	78	90	16	80	69	23	110	17	16
Yb	—	—	—	—	—	—	—	—	—
Y	23	25	1.6	27	30	0.5	26	<0.3	0.3
Zn	86	100	92	120	100	62	190	27	27
<b>OC</b>	<b>.9</b>	<b>1.2</b>	<b>30</b>	<b>1.7</b>	<b>2.7</b>	<b>39</b>	<b>3.6</b>	<b>39</b>	<b>38</b>
<b>IC</b>	<b>1.7</b>	<b>1.8</b>	<b>.06</b>	<b>1.6</b>	<b>1.5</b>	<b>.02</b>	<b>1.1</b>	<b>.02</b>	<b>.02</b>

**Table 25.** Element enrichment ratios in lacustrine suspended sediment in comparison with riverine suspended sediment from the Salton Sea area, California, October 23–28, 2001

[\*, value not calculated because too many concentrations below detection limit; —, no data]

Element	Symbol	Enrichment
Antimony	Sb	3
Arsenic	As	120
Barium	Ba	1.5
Beryllium	Be	1.2
Bismuth	Bi	*
Cadmium	Cd	14
Calcium	Ca	6.2
Cerium	Ce	.8
Chromium	Cr	11
Cobalt	Co	15
Copper	Cu	14
Europium	Eu	—
Gallium	Ga	.9
Gold	Au	—
Iron	Fe	1
Lanthanum	La	.9
Lead	Pb	19
Lithium	Li	15
Magnesium	Mg	16
Manganese	Mn	8
Mercury	Hg	30
Molybdenum	Mo	18
Neodymium	Nd	—
Nickel	Ni	31
Niobium	Nb	*
Phosphorus	P	140
Potassium	K	8.1
Scandium	Sc	~1.3
Selenium	Se	550
Silver	Ag	*
Sodium	Na	210
Strontium	Sr	21
Sulfur	S	—
Tantalum	Ta	—
Thallium	Tl	.3
Thorium	Th	.7
Tin	Sn	—
Titanium	Ti	.7
Uranium	U	40
Vanadium	V	8.8
Ytterbium	Yb	—
Yttrium	Y	1
Zinc	Zn	18
Organic carbon	OC	690
Inorganic carbon	IC	.8