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Total Selenium and Selenium Species in Irrigation Drain Inflows to the Salton Sea, California, April and July 2008

Open-File Report 2009–1011

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

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Conversion Factors

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
micrometer	0.0000393	inch (in.)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
milliliter (mL)	.034	ounce, fluid (fl. oz)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
milligram (mg)	.000035	ounce (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Concentrations of chemical constituents in solid materials are given in micrograms per gram (µg/g) dry weight.

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Abstract

This report presents the results for two sampling periods (April 2008 and July 2008) during a 4-year monitoring program to characterize selenium concentrations in selected irrigation drains flowing into the Salton Sea, California. Total selenium, selenium species (dissolved selenite, selenate, organoselenium), and total suspended solids were determined in water samples and total selenium was determined in water column particulates and in sediment, detritus, and biota that included algae, plankton, midge larvae (family, Chironomidae), and two fish species—western mosquitofish (*Gambusia affinis*) and sailfin molly (*Poecilia latipinna*). In addition, sediments were analyzed for percent total organic carbon and particle size. Mean total selenium concentrations in water for both sampling periods ranged from 1.93 to 44.2 micrograms per liter, predominately as selenate, which is typical of waters where selenium is leached out of selenium-containing marine shales and associated soils under alkaline and oxidizing conditions. Total selenium concentrations (micrograms per gram dry weight) ranged as follows: algae, 0.75 to 3.39; plankton, 0.88 to 4.03; midges, 2.52 to 44.3; fish, 3.37 to 18.9; detritus, 1.11 to 13.6; sediment, 0.11 to 8.93.

Introduction

Monitoring surveys are being conducted by the U.S. Geological Survey (USGS) for 4 years to provide a profile of selenium concentrations in selected irrigation drain inflows to the Salton Sea, California. To accomplish this goal, total selenium, selenium species (dissolved selenite, selenate, organoselenium), and total suspended solids were determined in water samples and total selenium in water column particulates and in sediment, detritus, and biota that included algae, plankton, midge larvae (family, Chironomidae), and two fish species—western mosquitofish (*Gambusia affinis*) and sailfin molly (*Poecilia latipinna*). In addition, sediments were analyzed for percent total organic carbon and particle size. The results in this report were derived from samples collected during April 2008 and July 2008.

Methods

Field Collection and Preservation

The USGS sampling team used the laboratory at the U.S. Fish and Wildlife Service Sonny Bono Salton Sea National Wildlife Refuge (henceforth referred to as "the Refuge") for certain aspects of sample processing and for preparing samples for shipment during field trips to irrigation drains.

Unfiltered Water: Each water sample to be analyzed for total selenium was poured through a 1-millimeter (mm) polypropylene sieve attached to a 1-liter (L) pre-cleaned borosilicate glass bottle. Upon collection, the water sample was acidified to less than pH 2 with 6 normal (N) hydrochloric acid (HCl), chilled to approximately four degrees Celsius (~4 °C), and kept in the dark during transport to the USGS. Each water sample intended for analysis of total suspended solids (TSS) was poured through a 1-mm polypropylene sieve attached to a pre-cleaned wide-mouth 1-L polypropylene bottle. The TSS samples were chilled (~4 °C) during transport to the USGS.

Filtered Water: Water for selenium speciation was filtered using a Geotech® peristaltic pump equipped with a standard pumphead and high-capacity 0.45 micrometer (µm) filter capsule certified for trace-element background. All tubing was acid-cleaned silicone and a new length was used at each site and for the blank. At each site, 1 L of deionized (DI) water was filtered through the filter capsule followed by site water. The first 200 milliliters (mL) of site water eluant were discarded, then 1 L of eluant was collected in an acid-cleaned 1-L borosilicate glass bottle, acidified, and stored as described earlier for unfiltered water.

Particulates: A polycarbonate Geotech® 142-mm plate filter apparatus was used with a 142-mm 0.4-µm polycarbonate filter. At each site, 0.5 L of DI water was filtered through the plate filter, followed by up to 1 L of site water; after volume notation, the filtrate was discarded. Each filter was placed in a pre-cleaned plastic petri dish (150 mm x 15 mm) with the particulate side up and sealed with its corresponding cover for freezer storage and transport to the USGS. The plate filtration unit was rinsed with 0.1 percent nitric acid (HNO_3), followed by a DI water rinse after sampling was completed at each site.

Sediment: Five sampling points for sediment collection were identified along the length of each drain. At each sampling point, the uppermost two to six cm of sediment was collected with a stainless steel dredge. The dredge was cleared of mud and rinsed with site water while used within a drain. At a new site, the dredge was rinsed with DI water followed by site water before the first sample was collected. From each of the five sampling points, enough sediment to fill a 250-mL container was collected and mixed to form a composite sample (1,250-mL total). An aliquot of this composite was then placed into a 120- and a 500-mL polypropylene container for each drain sampled. All containers were placed on ice in the field. Samples were chilled (~4 °C) during transport to the USGS.

Midge Larvae and Detritus: An insect sweep net was used to collect samples of midge larvae and detritus, which were then sorted and hand-picked with plastic tweezers in a polypropylene sieve, and stored temporarily in a plastic food-storage container on ice. After rinsing with DI water, samples were wrapped in plastic wrap, stored in separate plastic bags, and frozen.

Fish: Composite samples of western mosquitofish and sailfin molly were collected with seine nets and minnow traps; sampled fish from each site was stored temporarily in a plastic food-storage container on ice. Upon return to the Refuge lab, the whole-body fish were measured for standard length, weighed, and rinsed with DI water. Each fish composite sample (n=36) was wrapped in plastic wrap and placed into a plastic bag and frozen.

Algae and Plankton: Algae were collected from floating masses or scraped from sticks and rocks at each drain site and stored temporarily in a sealable plastic food-storage container on ice. Following collection, the material was rinsed with DI water, wrapped with plastic wrap, stored in a sealable plastic bag, and frozen. Plankton was collected with a tow net and after draining site water, each sample was rinsed three times with DI water. The plankton and the DI rinsing water were placed in a 120-mL polypropylene container. Collected samples were stored on ice in the field and frozen immediately upon return to the Refuge.

Sampling History

The irrigation drain monitoring samples collected by USGS personnel were received in six shipments by the Environmental Chemistry Branch Inorganic Section (henceforth referred to as "the lab") of the USGS shortly after collection to meet the seven-day holding time specified for TSS in water and the 14-day holding time for total organic carbon (TOC) in sediments.

The first set of samples was collected from April 10 to 13, 2008, received by the lab on April 15, 2008, and contained 18 TSS water samples, 20 water samples for total selenium, and 4 water samples for total dissolved selenium. The samples were assigned USGS batch number 1451 and USGS sample identification numbers 42156 to 42197.

The second set of samples was collected from April 10 to 15, 2008, received by the lab on April 17, 2008, and contained 10 TSS water samples, 12 total selenium water samples, 8 total dissolved selenium water samples, and 12 sediment samples for TOC and particle size analysis (PSA). The samples were assigned USGS batch number 1452 and USGS sample identification numbers 42198 to 42239.

The third set of samples was collected from April 10 to 19, 2008, received by the lab on April 22, 2008, and contained 3 TSS water samples, 16 total selenium water samples, 5 total dissolved selenium water samples, 31 total selenium sediment samples, 19 TOC/PSA sediment samples, and 17 particulate selenium filter samples. The samples were assigned USGS batch number 1453 and USGS sample identification numbers 42240 to 42330.

The fourth set of samples was collected from April 16 to 25, 2008, received by the lab on May 14, 2008, and contained 42 fish samples, 21 algae samples, 20 midge samples, 21 detritus samples, and 21 plankton samples. The samples were assigned USGS batch number 1459 and USGS sample identification numbers 42631 to 42755.

The fifth set of samples was collected from July 10 to 13, 2008, received by the lab on July 15, 2008, and contained 16 TSS water samples and 24 total selenium water samples. The samples were assigned USGS batch number 1478 and USGS sample identification numbers 43185 to 43224.

The sixth set of samples was collected from July 13 to 15, 2008, received by the lab on July 17, 2008, and contained 14 TSS water samples and 36 total selenium water samples. The samples were assigned USGS batch number 1479 and USGS sample identification numbers 43225 to 43274.

Homogenization and Lyophilization

Frozen fish samples were minced with a small ceramic knife before freeze drying. Particulates, biota, detritus, and sediment samples were lyophilized in a Virtis Genesis® 35EL freeze dryer and percent moisture was determined as part of the lyophilization process; however, percent moisture was not determined for plankton samples, because the sample matrix included DI water. After lyophilization, all midge larvae, detritus, plankton, algae, and fish samples were homogenized by grinding with a glass rod against the container surface. Dried sediment was placed into a plastic bag, sealed, and then pulverized by using a rolling pin on the plastic bag to produce a coarse powder product. Dried filters containing particulates did not require any additional homogenization after freeze drying.

Chemical Procedures

Total Selenium in Water: Before analysis, all water samples were stored in the dark at ~4 °C. For the subsequent determination of total selenium in filtered and unfiltered samples, a 20-mL aliquot of each acidified water sample was

subjected to an HNO_3–magnesium nitrate [$Mg(NO_3)_2$] ashing procedure, followed by treatment with HCl. The ashing procedure consisted of three steps: boiling with HNO_3 for solubilization and partial oxidation, ashing at 500 °C with $Mg(NO_3)_2$ to complete the oxidation and decompose remaining organic matter, and heating with 20 mL of 50 percent (v/v) HCl to dissolve the ash and chemically reduce selenium to the selenite (Se^{+4}) oxidation state required for detection by hydride generation atomic absorption spectrophotometry. Following reduction, digestates were diluted to ~100 mL with DI water, yielding a final acid matrix of 10 percent HCl.

Selenite + Selenate in Water: Ten mL of filtered water and five mL of concentrated HCl were placed in a 25-mL borosilicate test tube and heated to about 130 °C in a well incubator block for three to four hours. After cooling, the liquid was transferred into a 125-mL polyethylene bottle, and the final volume was adjusted to 50 mL with DI water. The final matrix was 10 percent HCl.

Filtered Particulates: A dried filter containing particulates was rolled up, cut into pieces, and the entire filter was put into a 100-mL glass beaker. The filter was then subjected to the ashing procedure as described earlier for total selenium in water. The same procedure was conducted on clean filters, which served as blanks.

Biota, Detritus, and Sediment: An approximately 0.25-gram (g) aliquant of each dried sample was subjected to a HNO_3–$Mg(NO_3)_2$ ashing procedure, followed by HCl chemical reduction of selenate to selenite for the determination of selenium. The steps in the procedure were the same as those described above for total selenium in water. Digestates were diluted to about 100 mL with DI water, yielding a final acid matrix of 10 percent HCl.

Instrumental Analysis

Total Selenium: Total selenium was determined in all ashed samples by flow injection hydride generation atomic absorption spectrophotometry (FIHGAAS). In this procedure, the digestate is mixed with an HCl-carrier solution and then reduced by sodium tetrahydridoborate that has been stabilized with sodium hydroxide. Selenium in the sample is converted to volatile hydrogen selenide and transferred with argon carrier gas into a heated quartz cell mounted on an atomic absorption spectrophotometer for decomposition into atomic vapor and measurement.

Selenite in Water: An aliquot of each filtered water sample was analyzed directly by FIHGAAS after acidification to 10 percent HCl.

Selenate and Selenite in Water: Filtered water samples were subjected to heating for one hour with 50 percent HCl to chemically reduce the selenate species to selenite. Samples prepared in this manner were analyzed directly by FIHGAAS to provide selenate + selenite concentrations. The selenate concentration was calculated by difference using the formula:

$$\text{selenate} = (\text{selenate} + \text{selenite}) - \text{selenite}. \quad (1)$$

Particulate Selenium in Water: Selenium associated with filtered particulates was determined by analyzing ashed filters by FIHGAAS. The mass of selenium in micrograms for the particulates was divided by the volume of water filtered for each drain site (0.5 or 1 L) to produce a microgram per liter concentration.

Dissolved Organic Selenium in Water: Dissolved organic selenium was estimated using the following formula:

$$\text{dissolved organic selenium} = \text{total dissolved selenium} - (\text{selenate} + \text{selenite}). \quad (2)$$

Total dissolved selenium is defined as the analysis of filtered water for total selenium.

Total Suspended Solids: Upon arrival at the lab, all TSS samples were transferred to the Ecology Branch for TSS analysis. Total suspended solids were analyzed with methods recommended by the American Public Health Association (1998). Samples were brought to room temperature and mixed with a magnetic stirrer and subsequent manual inversions of the sample container. The sample was measured into a graduated cylinder, poured into a filtration apparatus, and filtered through a ProWeigh® glass fiber filter. The samples were prewashed three times in DI water, dried at 105 °C, and weighed to the nearest 0.1 milligram (mg). Sample volume varied to yield a dried residue between 2.5 and 200 mg. For each volume of sample used, an equal volume of DI water also was filtered for a blank determination. After filtering, large or nonhomogeneous materials were removed from the filter and the filter was rinsed with three 10-mL aliquots of DI water. Filters were then dried for at least one hour in a 103 to 105 °C oven and cooled to room temperature in a desiccator, then filter and residue were weighed to the nearest 0.1 mg. Drying, cooling, and weighing of the filter were repeated until the weight difference was less than (<) four percent or 0.5 mg, whichever was less. The average of these weights was used to determine the constant weight of the filter and residue, which was then corrected for any weight gain or loss of the blank. After subtracting the filter weight, this blank corrected dried residue in milligrams was divided by the sample volume in liters to yield TSS in milligrams per liter (mg/L).

Particle-Size Analysis: Sediment samples designated for PSA were transferred to the USGS Ecology Branch upon arrival. The method requires use of a Bouyoucos hydrometer, adapted from American Society for Testing and Materials (2003). Wet sediment was sieved through a 2-mm sieve to remove any particles larger than coarse sand and then dried at 60 °C using a convectional drying oven. Approximately 100 g of dried sediment was mixed with 250 mL of DI water and 100 mL of a 50 mg/L sodium hexametaphosphate solution. A stir bar was then added and the mixture was stirred with a magnetic stirring plate. After calibrating the hydrometer, the suspended sediment mixture was transferred to a sedimentation cylinder and the volume adjusted to 1 L with DI water. After allowing for thermal equilibration, the temperature was recorded. Cylinder contents were then thoroughly

mixed, and the hydrometer was inserted into the suspension. The meniscus reading was taken after 30 seconds and the hydrometer was removed and dried. After 120 minutes, the hydrometer was reinserted and the meniscus read again. All hydrometer meniscus readings were corrected by adjusting +0.25 for each degree above 18 °C and -0.25 for each degree below 18 °C. Percent fractions were determined as follows:

grams sand = sediment dry weight – (corrected 30 second reading – corrected calibration); percent sand = grams sand/sediment dry weight x 100;

grams clay = sediment dry weight – (corrected 120 minute reading – corrected calibration); percent clay = grams clay/sediment dry weight x 100; andpercent silt = 100 – (percent sand + percent clay).

Total Organic Carbon: TOC was determined with a Universal Instruments Corporation (UIC) Model 5014 Coulometer that determines carbon in any carbon dioxide (CO_2) containing gas stream (Universal Instruments Corporation, 1999). The coulometer is used as a detector with different carbon front-end units and can detect carbon in the range of 0.01 micrograms (µg) to 100 mg. The coulometer cell is filled with a proprietary solution containing monoethanolamine and a colorimetric pH indicator. Platinum (cathode) and silver (anode) electrodes are positioned in the cell. The cell assembly is then placed in the coulometer cell compartment between a light source and a photodetector in the coulometer. As a CO_2 gas stream passes into the cell, the CO_2 is quantitatively absorbed and reacts with the monoethanolamine to form a titratable acid. This acid causes the color indicator to fade. A photodetector monitors the change in the color of the solution as a percent transmittance (percent T). As the percent T increases, the titration current automatically is activated to electrochemically generate base at a rate proportional to the percent T (approximately 1,500 µg carbon/minute). When the solution returns to its original color (original percent T), the current stops.

For TOC analysis, total carbon (TC, µg/mg) and total inorganic carbon (TIC, µg/mg) are determined. Total carbon is determined by combustion of weighed sediments at 925 °C. In TIC analysis, weighed sediments are exposed to heated 2 N sulfuric acid. Any inorganic carbonates are chemically reduced to mineral components and CO_2 gas. The gas is carried in high purity oxygen to the coulometer cell, where it is measured by the procedure described above. Percent TOC is calculated as follows:

$$\text{Percent TOC} = [(TC - TIC)/1000] \times 100 \quad (3)$$

Quality Assurance

Samples were processed through the preparative and analytical flow scheme in 11 analytical blocks for selenium, two blocks for TSS, and one block each for PSA and TOC. Each block was assigned a block initiation date (BID) used to identify samples and quality-control samples/materials prepared and analyzed collectively as a unit. For samples analyzed by atomic absorption for total selenium, pre-digestion quality-control included digestion blanks, replicates, spikes, and reference solutions. Analytical quality-control for selenium included calibration verification solutions, replicate analyses, and analysis spikes. Quality-control for the TSS, PSA, and TOC determinations included reference materials, duplicates, and replicates.

Results

Total Selenium: Total selenium concentrations [micrograms per liter, (µg/L)] in unfiltered water samples for the April 2008 samples are listed in table 1 at the back of this report. Mean selenium concentrations were most elevated in water from Trifolium Storm drain (44.2), followed by Q drain (7.56). The lowest mean selenium concentration was from Niland 1 drain (1.93). Data for the July 2008 samples are listed in table 2 at the back of this report. Mean selenium concentrations were highest again in Trifolium Storm drain (44.9), followed by Poe Road drain (26.5), and Trifolium 18 drain (23.6). The lowest mean selenium concentration was from Trifolium 14 drain (1.19).

Total Dissolved Selenium and Selenium Species: Dissolved selenite, dissolved selenate, dissolved organic selenium, total dissolved selenium, and particulate selenium concentrations (µg/L) from filtered water samples collected during the April 2008 sampling are presented in table 3 at the back of this report. The dissolved organic selenium fraction is assumed to include seleno-amino acids and dissolved seleno-peptides, Se(0) as a pseudo-dissolved microcolloid, and inorganic Se(-II) species (Cutter and Bruland, 1984). Speciation measurements revealed that selenium in the sampled drains exists predominately as selenate (70 to 93 percent) followed by selenite (7 to 30 percent), typical of waters where selenium is leached out of selenium-containing marine shales and associated soils under alkaline and oxidizing conditions.

Total Suspended Solids: TSS concentrations (mg/L) in unfiltered water collected during the April 2008 and July 2008 samplings are presented in table 4 at the back of this report. TSS concentrations ranged from a high of 1560 (W drain) to a low of 5.10 (Poe Road drain) for the April 2008 collection, and a high of 911 (W drain) to a low of 3.70 (Trifolium Storm drain) for the July 2008 collection.

Biota: Percent moisture and concentrations of selenium [micrograms per gram (µg/g) dry weight] in biota (algae, plankton, midge larvae, western mosquitofish, and sailfin molly) are presented in table 5 at the back of this report. Selenium concentration ranges for each matrix were as follows: algae, 0.75 to 3.39; plankton, 0.88 to 4.03; midges, 3.20 to 44.3; and fish, 3.37 to 18.9.

Detritus and Sediment: Percent moisture and selenium concentrations (µg/g dry weight) in detritus and sediment are presented in table 6 at the back of this report. Selenium in detritus ranged from 1.11 to 13.6 and from 0.11 to 8.93 in sediment. The particle size analyses of sediments, expressed as percent sand, silt, and clay, are presented in table 7 at the back of this report. Percent sand ranged from 3.4 to 86.0; percent silt from 5.4 to 56.4; and percent clay from 8.6 to 68.5. Percent TOC in sediments is given in table 8 (at the back of this report) and ranged from 0.13 to 5.51.

Quality Control Results

Calibration Verification: During the selenium determinations, a calibration verification solution (Spex Claritas PPT®; Cat No. CLSe2-2Y) was analyzed at the beginning and end of each analytical run. Calibration was considered acceptable if the check solution was within plus or minus 10 percent of the actual concentration (3 µg/L), which was achieved during all analyses.

Reference Materials: Recoveries of selenium from QC Plus + Trace Metals Quality Control Standard [n=6 (6 samples)] and National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1640 Trace Elements in Natural Water (n=5) averaged 103 percent. Recoveries of selenium from NIST SRM 2704 Buffalo River sediment (n=1) and National Research Council of Canada (NRCC) SRM PACS-1 marine sediment (n=1) were 100 percent. The International Atomic Energy Agency (IAEA) copepod reference material MA-A-1 (n= 3) and the Institute for Reference Materials and Measurements Certified Reference Material (CRM) 414 Trace Elements in Plankton (n=2) all exhibited selenium recoveries of 100 percent. Recoveries of selenium in NRCC CRM DORM-2 dogfish muscle (n=2) and IAEA CRM 407 whole-body fish (n=1) averaged 100 and 91 percent, respectively. Recoveries of TSS from a TSS reference solution (Environmental Resource Associates Hardness Wastewater Standard 507; n=5) were 100 percent. The recovery of total carbon from a carbon reference material (Environmental Resource Associates Nutrients in Soil 542; n=1) was 100 percent. Recoveries of percent sand, silt, and clay from a CERC research sediment material ranged from 90 to 103 percent.

Analytical and Method Precision: Instrumental precision for selenium as determined by repeated analysis of a standard throughout the run for each block (n=11) was less than five percent relative standard deviation (RSD). Relative percent differences (RPDs) between field duplicates (n=72) of either unfiltered or filtered water samples analyzed for selenium or selenium species mostly were ≤(less than or equal) 12 (n=66), but five of these duplicates exhibited greater RPDs of 14, 16, 17, 37, 49. All of the five greatest RPDs were associated with relatively low selenium concentrations (< 5 µg/L). RSDs for triplicate field samples of detritus (n=7), algae (n=7), plankton (n=7), midge larvae (n=7), and whole-body fish (n=14) analyzed for selenium were as follows: algae, 1.6 to 17 percent; plankton, 8.4 to 45 percent; detritus, 8.3 to 78 percent; midge larvae, 1.5 to 18 percent; and whole-body fish, 0.8 to 57 percent. Once again, many of the greatest RSDs were associated with low selenium concentrations, but in some instances greater variation apparently reflected greater natural variation of selenium in certain sample matrices, for example detritus and plankton). RSDs for whole-body fish were all <20 percent, except for one mosquitofish replicate (7.6, 7.6, and 18.9 µg/g selenium; 57 percent RSD). The outlier value of 18.9 µg/g was confirmed with another analysis of the sample, which produced a selenium concentration of 21.1 µg/g. Laboratory method precision for triplicate (n=20) preparation and analysis of samples for selenium was ≤16 percent RSD. Method duplicates of the various matrices produced RPDs as follows: detritus, 0.1 percent; water, 2.4 and 7.6 percent; sediment (n=8), 0.4 to 8.5 percent. A method duplicate of the plankton matrix resulted in an RPD of 10 percent. Instrumental precision was based on duplicate analysis of sample digestates from each sample matrix, which resulted in RPDs <4 percent. Duplicate analysis of water samples for TSS (n=5) resulted in RPDs ranging from 0.8 to 25 percent, whereas triplicate analysis for TSS (n=4) resulted in RSDs <19 percent. The duplicate analysis of three drain sediments for PSA resulted in RPDs <9 percent for the fractions, except for one clay fraction that exhibited a higher RPD of 37 percent. Triplicate analyses of a drain sediment for PSA resulted in RSDs <5 percent for the fractions. The duplicate analysis of 10 drain sediments for TOC resulted in RPDs 6.4 to 25 percent for 7 drains, but higher RPDs of 33, 52, and 60 percent for three drains, presumably because of both low TOC levels (<1 percent) and the natural heterogeneity of the drain sediment.

Spikes: Recoveries of selenium [selenite (Se^{+4}), selenate (Se^{+6}), or selenomethionine] spiked into filter blanks (n=2) and water samples (n=20) ranged from 87 to 105 percent, averaging 98 percent. Recoveries of selenium spiked into sediment (n=4), detritus (n=4), and biota (n=10) ranged from 95 to 107 percent, averaging 101 percent. Recoveries of selenium spikes added to water during analysis (n=16) ranged from 99 to 110 percent, averaging 105 percent. Analysis spikes of sediment (n=3), filtered particulates (n=2), detritus (n=2), and biota (n=10) ranged from 91 to 110 percent, averaging 103 percent.

Blank Equivalent Concentrations: Blank equivalent concentrations (BECs) were computed for selenium for each matrix and for TSS blanks analyzed with each set of drain water samples. BECs for water and filter particulates were less than their respective method detection limits (MDLs). BECs (µg/g) for detritus, sediment, and all biota were greater than their respective MDLs (µg/g); however, BECs were inconsequential when compared to the lowest selenium concentrations in the samples of each matrix. The BECs and corresponding MDLs were as follows: detritus, 0.10 compared to 0.01; sediment, 0.035 compared to 0.010; fish, 0.044 compared to 0.007; algae, 0.041 compared to 0.029; midge, 0.036 compared to 0.029; plankton, 0.051 compared to 0.008. These BECs are

considered inconsequential relative to the lowest selenium concentrations in the samples of each matrix. BECs for TSS were less than their respective MDLs. TSS sample data were corrected for procedural blanks, whereas total selenium sample data were not blank corrected.

Instrument Detection, Method Detection, and Method Quantitation Limits: The FIHGAAS instrument detection limit for selenium was 0.02 and 0.033 µg/L, and 0.04 mg for TSS. MDLs for each matrix for selenium were computed for each analytical block (n=15) using the formula:

$$3(SD_b^2 + SD_s^2)^{1/2} \quad (4)$$

where

SD_b = standard deviation of a blank (n=3); and
SD_s = standard deviation of a low level sample or spiked sample (n=3).

Calculated MDLs were: water, 0.05 to 0.18 µg/L; filtered particulates, 0.004 µg/L; sediment, 0.01 µg/g dry weight; algae, 0.029 µg/g dry weight; midge larvae, 0.029 µg/g dry weight; plankton, 0.008 µg/g dry weight; detritus, 0.01 µg/g dry weight; and whole-body fish, 0.007 µg/g dry weight. Method quantitation limits (MQLs) for each matrix were calculated as 3.3 x MDLs. Method detection limits for TSS were 19.2 and 3.01 mg/L and MQLs were 63.3 and 9.95 mg/L. Overall, quality-control results for the study were within acceptable limits as specified by USGS.

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Tables

Table 1. Total selenium concentrations in duplicates of unfiltered irrigation drain water samples, Salton Sea, California, April 2008.

[ID, identification; Rep, field replicate; µg/L, microgram per liter; SD, standard deviation; ---, no data; <, less than; nc, not collected]

USGS ID	Field ID	Drain name/ID	Collection date	Total selenium concentration			SD
				Rep 1 (µg/L)	Rep 2 (µg/L)	Mean (µg/L)	
42307	BLANK-1	---	04/22/08	< 0.10	---	---	---
42308	BLANK-2	---	04/22/08	< 0.10	---	---	---
42230	BLNDWATSE12	---	04/11/08	4.57	---	---	---
42231	BLNDWATSE12B	---	04/14/08	2.35	---	---	---
42303,42304	LKLNWATSE12	Lack & Linsey Pond	04/19/08	2.16	1.96	2.06	0.14
42174,42175	NLD1WATSE12	Niland 1	04/11/08	1.86	1.99	1.93	0.09
42176,42177	NLD2WATSE12	Niland 2	04/11/08	4.83	4.88	4.85	0.03
42178,42179	NLD3WATSE12	Niland 3	04/11/08	2.21	2.24	2.22	0.02
42180,42181	NLD4WATSE12	Niland 4	04/11/08	3.35	3.42	3.38	0.05
nc[1]	OOOOWATSE12	O	---	---	---	---	---
42188,42189	PPPPWATSE12	P	04/10/08	2.88	2.67	2.78	0.15
nc[1]	POEDWATSE12	Poe Rd	---	---	---	---	---
42301,42302	PUMCWATSE12	Pumice	04/12/08	5.45	5.62	5.53	0.12
42186,42187	QQQQWATSE12	Q	04/10/08	7.80	7.32	7.56	0.34
42184,42185	RRRRWATSE12	R	04/10/08	3.00	2.77	2.89	0.17
42182,42183	SSSSWATSE12	S	04/10/08	2.75	2.84	2.80	0.06
42226,42227	SFWHWATSE12	San Felipe Wash	04/14/08	2.18	2.30	2.24	0.08
nc[1]	TTTTWATSE12	T	---	---	---	---	---
42293,42294	TR01WATSE12	Trifolium 1	04/15/08	5.18	5.37	5.27	0.13
42295,42296	TR12WATSE12	Trifolium 12	04/19/08	4.07	4.17	4.12	0.07
42297,42298	TR13WATSE12	Trifolium 13	04/19/08	5.56	5.50	5.53	0.04
nc[1]	TR14WATSE12	Trifolium 14	---	---	---	---	---
nc[1]	TR18WATSE12	Trifolium 18	---	---	---	---	---
42220,42221	TR19WATSE12	Trifolium 19	04/13/08	6.05	5.94	6.00	0.08
42222,42223	FT20WATSE12	Former Trifolium 20	04/14/08	3.04	3.04	3.04	0.00
nc[1]	TR20WATSE12	Trifolium 20	---	---	---	---	---
42224,42225	TR22WATSE12	Trifolium 22	04/14/08	3.15	3.75	3.45	0.42
42228,42229	TR23WATSE12	Trifolium 23	04/14/08	3.92	3.82	3.87	0.07
42299,42300	TRSTWATSE12	Trifolium Storm	04/15/08	44.6	43.7	44.2	0.60
42192,42193	UUUUWATSE12	U	04/10/08	2.39	2.33	2.36	0.04
42305,42306	VL05WATSE12	Vail 5	04/15/08	4.15	4.03	4.09	0.08
42190,42191	WWWWWATSE12	W	04/12/08	3.92	4.02	3.97	0.07
nc[1]	ZSPLWATSE12	Z Spill	---	---	---	---	---

[1]Drain was one of seven selected for intensive sampling (see table 3).

Table 2. Total selenium concentrations in duplicates of unfiltered irrigation drain water samples, Salton Sea, California, July 2008.

[ID, identification; Rep, field replicate; µg/L, micrograms per liter; SD, standard deviation; <, less than]

USGS ID	Field ID	Drain name/ID	Collection date	Total selenium concentration			SD
				Rep 1 (µg/L)	Rep 2 (µg/L)	Mean (µg/L)	
43239	Blank 1	---		< 0.14	---	---	---
43240	Blank 2	---		< 0.14	---	---	---
43241	BLNDWATSE13	---	07/14/08	45.8	---	---	---
43242	BLNDWATSE13B	---	07/14/08	1.52	---	---	---
43243,43244	LKLNWATSE13	Lack & Linsey Pond	07/12/08	3.82	3.95	3.89	0.09
43245,43246	NLD1WATSE13	Niland 1	07/15/08	1.93	1.98	1.96	0.04
43247,43248	NLD2WATSE13	Niland 2	07/15/08	5.5	5.2	5.34	0.16
43249,43250	NLD3WATSE13	Niland 3	07/15/08	2.30	2.49	2.40	0.13
43251,43252	NLD4WATSE13	Niland 4	07/15/08	1.62	1.90	1.76	0.20
43253,43254	OOOOWATSE13	O	07/13/08	3.10	2.89	3.00	0.15
43255,43256	PPPPWATSE13	P	07/13/08	3.15	3.02	3.09	0.09
43223,43224	POEDWATSE13	Poe Rd	07/10/08	26.4	26.6	26.5	0.13
43257,43258	PUMCWATSE13	Pumice	07/14/08	3.56	3.63	3.59	0.05
43259,43260	QQQQWATSE13	Q	07/14/08	4.97	4.87	4.92	0.07
43261,43262	RRRRWATSE13	R	07/14/08	2.77	2.74	2.76	0.02
43263,43264	SSSSWATSE13	S	07/14/08	3.72	3.74	3.73	0.01
43221,43222	SFWHWATSE13	San Felipe Wash	07/12/08	1.55	0.93	1.24	0.43
43265,43266	TTTTWATSE13	T	07/14/08	4.06	3.87	3.97	0.13
dry1	TR01WATSE13	Trifolium 1	---	---	---	---	---
43201,43202	TR12WATSE13	Trifolium 12	07/10/08	8.36	8.50	8.43	0.10
43203,43204	TR13WATSE13	Trifolium 13	07/10/08	3.34	3.15	3.25	0.14
43205,43206	TR14WATSE13	Trifolium 14	07/10/08	0.97	1.41	1.19	0.31
43207,43208	TR18WATSE13	Trifolium 18	07/10/08	24.0	23.3	23.6	0.47
43209,43210	TR19WATSE13	Trifolium 19	07/11/08	2.63	2.52	2.58	0.08
43217,43218	FT20WATSE13	Former Trifolium 20	07/12/08	7.12	7.25	7.18	0.09
43211,43212	TR20WATSE13	Trifolium 20	07/11/08	3.67	3.55	3.61	0.09
43213,43214	TR22WATSE13	Trifolium 22	07/12/08	10.0	10.2	10.1	0.08
43215,43216	TR23WATSE13	Trifolium 23	07/12/08	3.42	3.30	3.36	0.08
43219,43220	TRSTWATSE13	Trifolium Storm	07/11/08	46.8	43.1	44.9	2.64
43267,43268	UUUUWATSE13	U	07/14/08	1.63	1.45	1.54	0.12
43269,43270	VL05WATSE13	Vail 5	07/14/08	4.31	4.54	4.43	0.16
43271,43272	WWWWWATSE13	W	07/14/08	3.74	3.42	3.58	0.22
43273,43274	ZSPLWATSE13	Z Spill	07/15/08	3.11	3.15	3.13	0.02

[1]Drain was dry; no water collections were possible.

Table 3. Total dissolved selenium, dissolved selenium species, and particulate selenium concentrations in filtered irrigation drain water samples, Salton Sea, April 2008.

[ID, identification; Rep, replicate; $[Se0_3]^{-2}$, selenite; $[Se0_4]^{-2}$, selenate; Se, selenium; µg/L, micrograms per liter; ---, no data; <, less than; bold italicized values are greater than method quantification limit, but less than method detection limit; these values have higher uncertainty]

USGS ID	Field ID	Drain name/ID	Rep	Collection date	Dissolved $[Se0_3]^{-2}$ (µg/L)	[1]Calculated dissolved $[Se0_4]^{-2}$ (µg/L)	[2]Calculated dissolved organic Se (µg/L)	Measured total dissolved Se (µg/L)	[3]Measured particulate Se (µg/L)	[4]Calculated total Se (µg/L)
42311,42329	BLNKWADSE12	---	1	04/16/08	< 0.05	< 0.09	---	< 0.10	< 0.004	---
42312,42330	BLNKWADSE12B	---	2	04/16/08	< 0.05	< 0.09	---	< 0.10	< 0.004	---
42313,42328	BLNDWADSE12	---	---	04/11/08	0.45	3.89	0.00	4.24	0.057	4.30
42238,42322	OOOOWADSE12	O	1	04/12/08	0.49	3.34	0.21	4.04	0.084	4.12
42239,42323	OOOOWADSE12B	O	2	04/12/08	0.55	3.48	0.20	4.23	0.084	4.31
42234,42316	POEDWADSE12	Poe Rd	1	04/13/08	0.57	6.72	1.23	8.52	0.021	8.54
42235,42317	POEDWADSE12B	Poe Rd	2	04/13/08	0.55	6.57	1.18	8.30	0.020	8.32
42194,42324	TTTTWADSE12	T	1	04/12/08	0.57	1.05	0.16	1.77	0.081	1.85
42195,42325	TTTTWADSE12B	T	2	04/12/08	0.62	1.16	0.09	1.87	0.063	1.93
42309,42320	TR14WADSE12	Trifolium 14	1	04/15/08	0.46	3.3	0.00	3.57	0.043	3.61
42310,42321	TR14WADSE12B	Trifolium 14	2	04/15/08	0.46	2.8	0.18	3.47	0.022	3.49
42232,42318	TR18WADSE12	Trifolium 18	1	04/12/08	1.95	24.6	3.31	29.8	0.11	29.9
42233,42319	TR18WADSE12B	Trifolium 18	2	04/12/08	2.03	25.2	2.25	29.4	0.10	29.6
42236,42314	TR20WADSE12	Trifolium 20	1	04/13/08	0.50	1.53	0.10	2.13	0.026	2.16
42237,42315	TR20WADSE12B	Trifolium 20	2	04/13/08	0.56	1.36	0.00	1.92	0.061	1.98
42196,42326	ZSPLWADSE12	Z Spill	1	04/11/08	0.46	4.29	0.38	5.14	0.064	5.21
42197,42327	ZSPLWADSE12B	Z Spill	2	04/11/08	0.50	4.08	0.59	5.16	0.081	5.24

[1]Calculated dissolved $[Se0_4]^{-2}$ = measured ($[Se0_4]^{-2}$ + $[Se0_3]^{-2}$) - measured $[Se0_3]^{-2}$.

[2]Calculated dissolved Organic Se = measured total dissolved Se - measured ($[Se0_4]^{-2}$ + $[Se03]^{-2}$).

[3]Measured particulate Se = µg of Se in filtered particulates divided by volume of site water filtered.

[4]Calculated total Se = measured particulate Se + measured total dissolved Se.

Table 4. Total suspended solids concentrations in unfiltered Salton Sea irrigation drain water samples, April and July 2008.

[ID, identification; TSS, total suspended solids; mg/L, milligram per liter; bold and italicized values are less than the method quantitationlimit and have high uncertainty]

Field ID	Drain name/ID	April 2008		July 2008	
		USGS ID	TSS (mg/L)	USGS ID	TSS (mg/L)
BLNDWATSS12a	Blind A	42170	1,680.	43198	114.
BLNDWATSS12b	Blind B	42206	***24.***	43225	595.
LKLNWATSS	Lack & Linsey Pond	42242	***42.***	43197	30.
NLD1WATSS	Niland 1	42156	95.	43226	202.
NLD2WATSS	Niland 2	42157	183.	43227	430.
NLD3WATSS	Niland 3	42158	164.	43228	389.
NLD4WATSS	Niland 4	42159	218.	43229	90.
OOOOWATSS	O	42168	181.	43199	88.
PPPPWATSS	P	42167	123.	43200	284.
POEDWATSS	Poe Rd	42171	5.1	43190	34.
PUMCWATSS	Pumice	42169	134.	43230	36.
QQQQWATSS	Q	42166	110.	43231	157.
RRRRWATSS	R	42165	121.	43232	55.
SSSSWATSS	S	42164	122.	43233	22.
SFWHWATSS	San Felipe Wash	42200	***55.***	43187	32.
TTTTWATSS	T	42163	122.	43234	63.
TR01WATSS	Trifolium 1	42204	126.	dry[1]	dry[1]
TR12WATSS	Trifolium 12	42241	131.	43196	42.
TR13WATSS	Trifolium 13	42240	***58.***	43193	27.
TR14WATSS	Trifolium 14	42203	***32.***	43194	63.
TR18WATSS	Trifolium 18	42173	***20.***	43189	14.
TR19WATSS	Trifolium 19	42172	***50.***	43191	***9.9***
FT20WATSS	Former Trifolium 20	42198	***35.***	43185	***4.4***
TR20WATSS	Trifolium 20	42202	***43.***	43192	84.
TR22WATSS	Trifolium 22	42199	***30.***	43186	65.
TR23WATSS	Trifolium 23	42201	72.	43188	102.
TRSTWATSS	Trifolium Storm	42205	***8.0***	43195	***3.7***
UUUUWATSS	U	42162	***55.***	43235	129.
VLO5WATSS	Vail 5	42207	178.	43236	38.
WWWWWATSS	W	42161	1,560.	43237	911.
ZSPLWATSS	Z Spill	42160	104.	43238	47.

[1]Trifolium 1 drain was dry at time of collection.

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2008.

[ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain name/ID	Moisture (percent)	Selenium (µg/g dry weight)
42682	OOOOALGTSE12A	algae	O	63.9	3.18
42683	OOOOALGTSE12B	algae	O	61.3	3.39
42684	OOOOALGTSE12C	algae	O	63.4	3.31
42679	POEDALGTSE12A	algae	Poe	88.4	0.78
42680	POEDALGTSE12B	algae	Poe	87.9	0.77
42681	POEDALGTSE12C	algae	Poe	90.5	0.75
42673	TTTTALGTSE12A	algae	T	84.7	0.84
42674	TTTTALGTSE12B	algae	T	85.7	1.03
42675	TTTTALGTSE12C	algae	T	85.8	0.94
42685	TR14ALGTSE12A	algae	Trifolium 14	84.1	1.01
42686	TR14ALGTSE12B	algae	Trifolium 14	87.0	0.80
42687	TR14ALGTSE12C	algae	Trifolium 14	85.1	1.13
42691	TR18ALGTSE12A	algae	Trifolium 18	89.2	0.82
42692	TR18ALGTSE12B	algae	Trifolium 18	89.4	0.97
42693	TR18ALGTSE12C	algae	Trifolium 18	88.3	0.80
42676	TR20ALGTSE12A	algae	Trifolium 20	82.9	1.57
42677	TR20ALGTSE12B	algae	Trifolium 20	82.9	1.67
42678	TR20ALGTSE12C	algae	Trifolium 20	84.9	1.61
42688	ZSPLALGTSE12A	algae	Z Spill	78.3	1.60
42689	ZSPLALGTSE12B	algae	Z Spill	79.9	1.71
42690	ZSPLALGTSE12C	algae	Z Spill	79.6	1.71
42744	OOOONPTSE12A	plankton	O	---	2.56
42745	OOOONPTSE12B	plankton	O	---	1.81
42746	OOOONPTSE12C	plankton	O	---	0.96
42741	POEDNPTSE12A	plankton	Poe	---	1.05
42742	POEDNPTSE12B	plankton	Poe	---	2.24
42743	POEDNPTSE12C	plankton	Poe	---	2.06
42735	TTTTNPTSE12A	plankton	T	---	0.88
42736	TTTTNPTSE12B	plankton	T	---	1.19
42737	TTTTNPTSE12C	plankton	T	---	1.19
42747	TR14NPTSE12A	plankton	Trifolium 14	---	2.71
42748	TR14NPTSE12B	plankton	Trifolium 14	---	2.56
42749	TR14NPTSE12C	plankton	Trifolium 14	---	2.29
42753	TR18NPTSE12A	plankton	Trifolium 18	---	2.80
42754	TR18NPTSE12B	plankton	Trifolium 18	---	3.90
42755	TR18NPTSE12C	plankton	Trifolium 18	---	4.03
42738	TR20NPTSE12A	plankton	Trifolium 20	---	3.09
42739	TR20NPTSE12B	plankton	Trifolium 20	---	3.05
42740	TR20NPTSE12C	plankton	Trifolium 20	---	2.73
42750	ZSPLNPTSE12A	plankton	Z Spill	---	1.67
42751	ZSPLNPTSE12B	plankton	Z Spill	---	2.35
42752	ZSPLNPTSE12C	plankton	Z Spill	---	1.62

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2008.—Continued

[ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain name/ID	Moisture (percent)	Selenium (µg/g dry weight)
42702	OOOOCHITSE12A	midge	O	83.9	6.15
42703	OOOOCHITSE12B	midge	O	84.0	6.04
42704	OOOOCHITSE12C	midge	O	84.6	5.97
42699	POEDCHITSE12A	midge	Poe	81.3	13.3
42700	POEDCHITSE12B	midge	Poe	81.1	13.1
42701	POEDCHITSE12C	midge	Poe	80.7	14.5
42694	TTTTCHITSE12A	midge	T	80.9	2.52
42695	TTTTCHITSE12B	midge	T	80.8	2.69
42705	TR14CHITSE12A	midge	Trifolium 14	81.5	8.85
42706	TR14CHITSE12B	midge	Trifolium 14	80.9	8.96
42707	TR14CHITSE12C	midge	Trifolium 14	82.3	10.4
42711	TR18CHITSE12A	midge	Trifolium 18	82.7	40.4
42712	TR18CHITSE12B	midge	Trifolium 18	83.4	44.3
42713	TR18CHITSE12C	midge	Trifolium 18	82.9	44.0
42696	TR20CHITSE12A	midge	Trifolium 20	79.3	6.41
42697	TR20CHITSE12B	midge	Trifolium 20	79.7	4.70
42698	TR20CHITSE12C	midge	Trifolium 20	80.5	6.60
42708	ZSPLCHITSE12A	midge	Z Spill	83.0	3.93
42709	ZSPLCHITSE12B	midge	Z Spill	78.9	3.43
42710	ZSPLCHITSE12C	midge	Z Spill	81.5	3.20
42649	OOOOGMBTSE12A	mosquitofish	O	80.8	4.39
42650	OOOOGMBTSE12B	mosquitofish	O	80.9	4.10
42651	OOOOGMBTSE12C	mosquitofish	O	81.0	4.15
42652	OOOOSLMTSE12A	sailfin molly	O	74.6	4.03
42653	OOOOSLMTSE12B	sailfin molly	O	77.1	3.37
42654	OOOOSLMTSE12C	sailfin molly	O	76.8	4.23
42643	POEDGMBTSE12A	mosquitofish	Poe	76.3	7.66
42644	POEDGMBTSE12B	mosquitofish	Poe	75.3	7.66
42645	POEDGMBTSE12C	mosquitofish	Poe	77.3	18.9
42646	POEDSLMTSE12A	sailfin molly	Poe	77.6	5.26
42647	POEDSLMTSE12B	sailfin molly	Poe	77.2	5.34
42648	POEDSLMTSE12C	sailfin molly	Poe	76.5	7.33
42631	TTTTGMBTSE12A	mosquitofish	T	76.1	3.70
42632	TTTTGMBTSE12B	mosquitofish	T	77.0	3.66
42633	TTTTGMBTSE12C	mosquitofish	T	77.3	3.72
42634	TTTTSLMTSE12A	sailfin molly	T	73.4	4.53
42635	TTTTSLMTSE12B	sailfin molly	T	74.1	4.87
42636	TTTTSLMTSE12C	sailfin molly	T	72.8	4.79
42655	TR14GMBTSE12A	mosquitofish	Trifolium 14	76.0	4.02
42656	TR14GMBTSE12B	mosquitofish	Trifolium 14	76.5	4.59
42657	TR14GMBTSE12C	mosquitofish	Trifolium 14	74.1	3.92

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2008.—Continued

[ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain name/ID	Moisture (percent)	Selenium (µg/g dry weight)
42658	TR14SLMTSE12A	sailfin molly	Trifolium 14	72.9	3.91
42659	TR14SLMTSE12B	sailfin molly	Trifolium 14	74.2	3.83
42660	TR14SLMTSE12C	sailfin molly	Trifolium 14	74.6	4.03
42667	TR18GMBTSE12A	mosquitofish	Trifolium 18	73.9	16.3
42668	TR18GMBTSE12B	mosquitofish	Trifolium 18	73.4	16.8
42669	TR18GMBTSE12C	mosquitofish	Trifolium 18	74.0	16.2
42670	TR18SLMTSE12A	sailfin molly	Trifolium 18	71.6	14.3
42671	TR18SLMTSE12B	sailfin molly	Trifolium 18	72.8	16.5
42672	TR18SLMTSE12C	sailfin molly	Trifolium 18	72.3	17.1
42637	TR20GMBTSE12A	mosquitofish	Trifolium 20	78.9	4.75
42638	TR20GMBTSE12B	mosquitofish	Trifolium 20	79.9	4.50
42639	TR20GMBTSE12C	mosquitofish	Trifolium 20	71.3	4.66
42640	TR20SLMTSE12A	sailfin molly	Trifolium 20	73.1	4.14
42641	TR20SLMTSE12B	sailfin molly	Trifolium 20	74.8	4.25
42642	TR20SLMTSE12C	sailfin molly	Trifolium 20	73.1	4.32
42661	ZSPLGMBTSE12A	mosquitofish	Z Spill	75.3	6.07
42662	ZSPLGMBTSE12B	mosquitofish	Z Spill	75.3	5.64
42663	ZSPLGMBTSE12C	mosquitofish	Z Spill	74.8	5.59
42664	ZSPLSLMTSE12A	sailfin molly	Z Spill	74.8	5.43
42665	ZSPLSLMTSE12B	sailfin molly	Z Spill	74.5	4.96
42666	ZSPLSLMTSE12C	sailfin molly	Z Spill	73.2	5.35

Table 6. Selenium concentrations in detritus and sediment samples collected from Salton Sea irrigation drains, April 2008.

[ID, identification; µg/g, micrograms per gram]

USGS ID	Field ID	Matrix	Drain name/ID	Moisture (percent)	Selenium (µg/g dry weight)
42723	OOOODETTSE12A	detritus	O	80.0	4.16
42724	OOOODETTSE12B	detritus	O	82.2	4.33
42725	OOOODETTSE12C	detritus	O	83.7	5.09
42720	POEDDETTSE12A	detritus	Poe	83.9	5.79
42721	POEDDETTSE12B	detritus	Poe	78.9	7.81
42722	POEDDETTSE12C	detritus	Poe	78.3	8.52
42714	TTTTDETTSE12A	detritus	T	79.6	1.11
42715	TTTTDETTSE12B	detritus	T	77.6	4.10
42716	TTTTDETTSE12C	detritus	T	77.4	1.68
42726	TR14DETTSE12A	detritus	Trifolium 14	84.7	11.1
42727	TR14DETTSE12B	detritus	Trifolium 14	86.4	1.60
42728	TR14DETTSE12C	detritus	Trifolium 14	83.3	5.61
42732	TR18DETTSE12A	detritus	Trifolium 18	77.6	6.3
42733	TR18DETTSE12B	detritus	Trifolium 18	82.9	11.9
42734	TR18DETTSE12C	detritus	Trifolium 18	83.2	13.6
42717	TR20DETTSE12A	detritus	Trifolium 20	81.1	2.04
42718	TR20DETTSE12B	detritus	Trifolium 20	81.7	2.24
42719	TR20DETTSE12C	detritus	Trifolium 20	78.5	3.66
42729	ZSPLDETTSE12A	detritus	Z Spill	72.8	5.46
42730	ZSPLDETTSE12B	detritus	Z Spill	74.1	4.63
42731	ZSPLDETTSE12C	detritus	Z Spill	77.3	5.05
42262	BLNDSDTSE12A	sediment	Blind	56.4	3.44
42288	BLNDSDTSE12B	sediment	Blind	59.7	1.30
42285	LKLNSDTSE12	sediment	Lack and Lindsay	47.4	1.93
42289	NLD1SDTSE12	sediment	Niland 1	56.8	1.26
42290	NLD2SDTSE12	sediment	Niland 2	51.4	0.88
42291	NLD3SDTSE12	sediment	Niland 3	49.7	0.80
42292	NLD4SDTSE12	sediment	Niland 4	56.0	0.77
42263	OOOOSDTSE12	sediment	O	53.7	0.97
42264	PPPPSDTSE12	sediment	P	45.8	0.74
42278	POEDSDTSE12	sediment	Poe	22.3	0.41
42286	PUMCSDTSE12	sediment	Pumice	38.6	0.70
42265	QQQQSDTSE12	sediment	Q	42.8	2.05
42266	RRRRSDTSE12	sediment	R	43.5	0.61
42267	SSSSSDTSE12	sediment	S	51.3	0.89
42273	SFWHSDTSE12	sediment	San Felipe Wash	36.1	1.05
42268	TTTTSDTSE12	sediment	T	53.5	0.76
42281	TR01SDTSE12	sediment	Trifolium 1	43.6	1.10
42284	TR12SDTSE12	sediment	Trifolium 12	29.6	0.49
42283	TR13SDTSE12	sediment	Trifolium 13	42.3	1.62
42282	TR14SDTSE12	sediment	Trifolium 14	59.7	3.31
42279	TR18SDTSE12	sediment	Trifolium 18	60.4	8.93
42277	TR19SDTSE12	sediment	Trifolium 19	43.4	1.36
42275	FT20SDTSE12	sediment	Former Trifolium 20	21.1	0.11
42276	TR20SDTSE12	sediment	Trifolium 20	33.9	1.35
42274	TR22SDTSE12	sediment	Trifolium 22	53.1	1.11
42272	TR23SDTSE12	sediment	Trifolium 23	41.4	0.76
42280	TRSTSDTSE12	sediment	Trifolium Storm	48.9	1.25
42269	UUUUSDTSE12	sediment	U	50.5	0.36
42287	VL05SDTSE12	sediment	Vail 5	73.3	5.87
42270	WWWWSDTSE12	sediment	W	34.8	0.48
42271	ZSPLSDTSE12	sediment	Z Spill	46.2	0.83

Table 7. Particle size distributions in sediment samples collected from Salton Sea irrigation drains, April 2008.

[ID, identification; >, greater than; mm, millimeter]

USGS ID	Field ID	Drain name/ID	Particle size category			
			> 2 mm (percent)	Sand (percent)	Silt (percent)	Clay (percent)
42261	BLNDSDTOC12a	Blind a	2.58	23.2	45.6	28.6
42208	BLNDSDTOC12b	Blind b	0.07	6.0	42.9	51.1
42258	LKLNSDTOC12	Lack & Linsey Pond	5.41	48.9	34.2	11.5
42216	NLD1SDTOC12	Niland 1	0.03	6.7	43.1	50.2
42217	NLD2SDTOC12	Niland 2	0.06	7.7	39.8	52.5
42218	NLD3SDTOC12	Niland 3	0.05	5.3	27.8	66.9
42219	NLD4SDTOC12	Niland 4	0.02	4.7	26.8	68.5
42244	OOOOSDTOC12	O	0.05	3.5	35.6	60.9
42209	PPPPSDTOC12	P	0.19	18.4	28.3	53.1
42251	POEDSDTOC12	Poe Rd	0.30	62.9	19.5	17.3
42259	PUMCSDTOC12	Pumice	0.04	18.2	54.5	27.2
42210	QQQQSDTOC12	Q	0.72	32.8	34.9	31.6
42211	RRRRSDTOC12	R	0.09	30.2	33.7	36.1
42212	SSSSSDTOC12	S	1.16	11.8	31.0	56.1
42246	SFWHSDTOC12	San Felipe Wash	0.43	48.6	36.4	14.6
42213	TTTTSDTOC12	T	0.09	15.7	32.0	52.2
42254	TR01SDTOC12	Trifolium 1	0.14	11.6	29.7	58.5
42257	TR12SDTOC12	Trifolium 12	0.05	37.5	40.1	22.3
42256	TR13SDTOC12	Trifolium 13	1.59	43.7	36.5	18.3
42255	TR14SDTOC12	Trifolium 14	1.56	19.5	47.8	31.1
42252	TR18SDTOC12	Trifolium 18	0.18	57.5	32.7	9.6
42250	TR19SDTOC12	Trifolium 19	1.56	48.2	39.9	10.4
42248	FT20SDTOC12	Former Trifolium 20	0.00	86.0	5.4	8.6
42249	TR20SDTOC12	Trifolium 20	0.97	38.3	31.2	29.5
42247	TR22SDTOC12	Trifolium 22	0.44	23.8	41.2	34.5
42245	TR23SDTOC12	Trifolium 23	13.0	47.5	20.2	19.3
42253	TRSTSDTOC12	Trifolium Storm	0.02	11.3	39.9	48.8
42214	UUUUSDTOC12	U	0.00	3.9	33.3	62.8
42260	VL05SDTOC12	Vail 5	4.94	51.0	32.6	11.4
42243	WWWWSDTOC12	W	0.15	10.1	56.4	33.3
42215	ZSPLSDTOC12	Z Spill	5.34	23.3	27.2	44.2

Table 8. Percent total organic carbon in sediment samples collected from Salton Sea irrigation drains, April 2008.

[ID, identification]

USGS ID	Field ID	Drain name/ID	Total organic carbon (percent)
42261	BLNDSDTOC12a	Blind a	2.46
42208	BLNDSDTOC12b	Blind b	0.82
42258	LKLNSDTOC12	Lack & Linsey Pond	3.81
42216	NLD1SDTOC12	Niland 1	1.00
42217	NLD2SDTOC12	Niland 2	0.58
42218	NLD3SDTOC12	Niland 3	0.45
42219	NLD4SDTOC12	Niland 4	0.50
42244	OOOOSDTOC12	O	0.41
42209	PPPPSDTOC12	P	0.63
42251	POEDSDTOC12	Poe Rd	0.22
42259	PUMCSDTOC12	Pumice	0.65
42210	QQQQSDTOC12	Q	0.73
42211	RRRRSDTOC12	R	0.75
42212	SSSSSDTOC12	S	0.60
42246	SFWHSDTOC12	San Felipe Wash	0.80
42213	TTTTSDTOC12	T	0.71
42254	TR01SDTOC12	Trifolium 1	1.70
42257	TR12SDTOC12	Trifolium 12	0.72
42256	TR13SDTOC12	Trifolium 13	1.38
42255	TR14SDTOC12	Trifolium 14	2.28
42252	TR18SDTOC12	Trifolium 18	1.91
42250	TR19SDTOC12	Trifolium 19	0.40
42248	FT20SDTOC12	Former Trifolium 20	0.29
42249	TR20SDTOC12	Trifolium 20	1.08
42247	TR22SDTOC12	Trifolium 22	0.84
42245	TR23SDTOC12	Trifolium 23	1.28
42253	TRSTSDTOC12	Trifolium Storm	0.19
42214	UUUUSDTOC12	U	0.33
42260	VL05SDTOC12	Vail 5	5.51
42243	WWWWSDTOC12	W	0.13
42215	ZSPLSDTOC12	Z Spill	0.49

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Director, USGS Columbia Environmental Research Center
4200 New Haven Road
Columbia, MO 65201
(573) 875–5399

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