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Total Selenium and Selenium Species in Irrigation Drain Inflows to the Salton Sea, California, April and July 2007

Open-File Report 2007–1347

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

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By Thomas W. May, Michael J. Walther, Michael K. Saiki, and
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Conversion Factors

Multiply	By	To obtain
	Length	
millimeter)	0.03937	inch (in.)
micrometer (µm)	0.0000393	inch (in.)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
milliliter (mL)	0.034	ounce, fluid (fl. oz)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
milligram (mg)	0.000035	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 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).

Total Selenium and Selenium Species in Irrigation Drain Inflows to the Salton Sea, California, April and July 2007

By Thomas W. May, Michael J. Walther, Michael K. Saiki, and William G. Brumbaugh

Abstract

This report presents the results for two sampling periods during a 4-year monitoring survey to provide a characterization of selenium concentrations in selected irrigation drains flowing into the Salton Sea, California. Total selenium, selenium species, and total suspended solids were determined in water samples, and total selenium was determined 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. Total selenium concentrations in water for both sampling periods ranged from 1.43 to 47.1 micrograms per liter, predominately as selenate, which is typical of waters leached out of selenium-contaminated marine shales under alkaline and oxidizing conditions. Total selenium concentrations ranged from 0.88 to 20.2 micrograms per gram in biota, and from 0.15 to 28.9 micrograms per gram in detritus and sediment.

Introduction

Monitoring surveys are being conducted for 4 years to provide a profile of selenium concentrations in selected irrigation drain inflows to the Salton Sea, California. The objective is to determine total selenium, selenium species, and total suspended solids in water samples, and total selenium in sediment, detritus, and biota that include algae, plankton, midge larvae (family, *Chironomidae*), and two fish species—western mosquitofish (*Gambusia affinis*) and sailfin molly (*Poecilia latipinna*). In addition, sediments are analyzed for percent total organic carbon and particle size. The results described in this report were obtained by the U.S. Geological Survey (USGS) Columbia Environmental Research Center (CERC) and Western Fisheries Research Center (WFRC) during April and July 2007.

Methods

Field Collection and Preservation

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

Unfiltered Water: Each total selenium water sample 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 4 degrees Celsius (~4 ^{o}C), and kept in the dark during transport to the USGS-CERC. 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 ^{o}C) during transport to the USGS-CERC.

Filtered Water: Water for selenium speciation was filtered using a Geotech® peristaltic pump that was 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; 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 was 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-CERC. 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 sampled. At each sampling point, 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 for a drain, enough sediment to fill a 250-mL container was collected and mixed to form a composite sample. An aliquot of the composite was then placed into a 120- and 500-mL polypropylene container. All containers were placed on ice in the field. Samples were chilled (~4 ^{0}C) during transport to the USGS-CERC.

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: Western mosquitofish and sailfin molly composite samples were collected with seine nets and minnow traps; sampled material 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: If available, 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; after draining off 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 that are the subject of this report were received in six shipments and were collected by personnel of the USGS-WFRC. Shipments were received by the Environmental Chemistry Branch Inorganic Section (henceforth referred to as "the lab" in this report) of the USGS-CERC shortly after collection to meet the 7-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 19–21, 2007, received by the lab on April 24, 2007, and contained 13 TSS water samples, 1 TOC sediment sample, and 1 total selenium sediment sample. The samples were assigned USGS-CERC batch number 1354 and USGS-CERC sample identification numbers 39247–39261.

The second set of samples was collected from April 19–24, 2007, received by the lab on April 26, 2007, and contained 7 TSS water samples, 19 total selenium sediment samples, and 18 TOC sediment samples. The samples were assigned USGS-CERC batch number 1355 and USGS-CERC sample identification numbers 39262– 39305.

The third set of samples was collected from April 24–28, 2007, received by the lab on May 1, 2007, and contained 11 TSS water samples, 12 TOC sediment samples, and 11 total selenium water samples. The samples were assigned USGS-CERC batch number 1357 and USGS-CERC sample identification numbers 39313–39346.

The fourth set of samples was collected from April 17–May 7, 2007, and received by the lab on May 8, 2007, and contained 48 total selenium water samples and 17 dissolved selenium water samples. The samples were assigned USGS-CERC batch number 1360 and USGS-CERC sample identification numbers 39371–39435.

The fifth set of samples was collected during April 17–May 3, 2007, received by the lab on May 24, 2007, and contained 36 fish samples, 21 algae samples, 21 invertebrate samples, 21 detritus samples, 21 plankton samples, and 15 particulate samples. The samples were assigned USGS-CERC batch number 1364 and USGS-CERC sample identification numbers 39503–39637.

The sixth set of samples was collected from July 12–13, 2007, received by the lab on July 17, 2007, and contained 31 TSS water samples and 62 total selenium water samples. The samples were assigned USGS-CERC batch number 1375 and USGS-CERC sample identification numbers 39247–39261.

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 further reduced 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 and 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 HCl to dissolve the ash and 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 5 mL of concentrated HCl were placed in a 25-mL borosilicate test tube and heated to 120–125 °C in a well incubator block for 2–3 hours. After cooling, the liquid was transferred into a 60-mL polyethylene bottle and the final volume was adjusted to 50 mL with DI water; 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 ealier for total selenium in water. The same procedure was conducted on clean filters, which served as blanks.

Biota, Detritus, and Sediment: An ~0.25-gram (g) aliquant of each dried sample was subjected to a HNO_3–$Mg(NO_3)_2$ ashing procedure followed by HCl reduction for the determination of selenium. The steps in the procedure are the same as those described above for total selenium in water. Digestates were diluted to ~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 1 hour with HCl to 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 1.0 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 Suspended Solids: Upon arrival at the USGS-CERC, 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 pre-washed 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 non-homogeneous 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 1 hour in a 103–105 °C oven and cooled to room temperature in a dessicator; filter and residue were weighed to the nearest 0.0001 g. Drying, cooling, and weighing of the filter were repeated until the weight difference was less than (<) 4 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.

Particle-size Analysis: Sediment samples designated for particle size analysis (PSA) were transferred to the USGS-CERC Ecology Branch upon arrival. The method requires use of a Bouyoucos hydrometer, adapted from American Society of 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 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 followed by insertion of the hydrometer 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;
percent 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 (UIC, 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, reacting 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 (%T). As the %T increases, the titration current is automatically activated to electrochemically generate base at a rate proportional to the %T (approximately 1,500 µg carbon/minute). When the solution returns to its original color (original %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 Normal sulfuric acid. Any inorganic carbonates are 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:

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

Quality Assurance

Samples were processed through the preparative and analytical flow scheme in 14 analytical blocks for selenium, 2 blocks for TSS, and 1 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 determination included a reference solution, duplicates, and replicates. Quality control for sediment PSA and TOC included duplicates and replicates.

Results

Total Selenium: Total selenium concentrations [micrograms per liter, (µg/L)] in unfiltered water samples for the April 2007 samples are listed in table 1. Mean selenium concentrations were most elevated in water from drain Trifolium Storm (47.1) followed by drain Q (15.9). The lowest mean selenium concentration was from drain S (1.57). Data for the July 2007 samples are listed in table 2. Mean selenium concentrations were again highest in Trifolium Storm (30.9) followed by Trifolium 18 (17.2). The lowest mean selenium concentration was from Trifolium 14 and T (1.43).

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 2007 sampling are presented in table 3. 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, 1984). Speciation revealed that selenium in the sampled drains exists predominately as selenate (85 to 95 percent) followed by selenite (5 to 15 percent), typical of waters where selenium is leached out of selenium-contaminated marine shales under alkaline and oxidizing conditions.

Total Suspended Solids: TSS concentrations (mg/L) in unfiltered water collected during the April and July 2007 samplings are presented in table 4. TSS concentrations ranged from a high of 429 (Z Spill) to a low of 16.6 (San Felipe Wash).

Biota: Percent moisture and concentrations of selenium [micrograms per gram (µg/g) dry weight] in biota [algae, plankton, midge larvae, western mosquitofish (*Gambusia affinis*), and sailfin molly (*Poecilia latipinna*)] are presented in table 5. Selenium concentration ranges for each matrix were as follows: algae, 0.88 to 5.74; plankton, 1.40 to 17.0; midges, 3.18 to 13.4; fish, 3.85 to 20.2.

Table 1. Total selenium concentrations in duplicates of unfiltered irrigation drain water samples, Salton Sea, California, April 2007.

[USGS, U.S. Geological Survey; 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	Collection date	Total selenium concentration			SD
				Rep 1 (µg/L)	Rep 2 (µg/L)	Mean (µg/L)	
39417	BLANK-1	---	05/08/07	< 0.10	---	---	---
39418	BLANK-2	---	05/08/07	< 0.10	---	---	---
39415	BLNDWATSE08	---	04/19/07	5.73	---	---	---
39416	BLNDWATSE08B	---	04/27/07	3.47	---	---	---
39413, 39414	LKLNWATSE	Lack & Linsey Pond	04/20/07	4.12	4.27	4.19	0.11
39371, 39372	NLD1WATSE	Niland 1	04/23/07	2.94	2.75	2.85	0.14
39373, 39374	NLD2WATSE	Niland 2	04/24/07	3.03	3.05	3.04	0.01
39375, 39376	NLD3WATSE	Niland 3	04/24/07	2.07	2.02	2.04	0.04
39377, 39378	NLD4WATSE	Niland 4	04/24/07	1.91	2.06	1.98	0.11
nc[1]	OOOOWATSE	O	---	---	---	---	---
39389, 39390	PPPPWATSE	P	04/27/07	3.50	3.45	3.48	0.04
nc[1]	POEDWATSE	Poe Rd	---	---	---	---	---
39391, 39392	PUMCWATSE	Pumice	04/21/07	7.04	6.86	6.95	0.13
39387, 39388	QQQQWATSE	Q	04/27/07	15.7	16.1	15.9	0.22
39385, 39386	RRRRWATSE	R	04/27/07	2.84	2.80	2.82	0.03
39383, 39384	SSSSWATSE	S	04/27/07	1.60	1.53	1.57	0.05
39399, 39400	SFWHWATSE	San Felipe Wash	04/19/07	2.81	2.82	2.82	0.01
nc[1]	TTTTWATSE	T	---	---	---	---	---
39407, 39408	TR01WATSE	Trifolium 1	04/26/07	4.04	3.96	4.00	0.05
39411, 39412	TR12WATSE	Trifolium 12	04/26/07	3.66	3.59	3.63	0.05
39405, 39406	TR13WATSE	Trifolium 13	04/21/07	5.76	5.60	5.68	0.11
nc[1]	TR14WATSE	Trifolium 14	---	---	---	---	---
nc[1]	TR18WATSE	Trifolium 18	---	---	---	---	---
39403, 39404	TR19WATSE	Trifolium 19	04/20/07	3.11	3.13	3.12	0.01
39395, 39396	FT20WATSE	Former Trifolium 20	04/19/07	5.76	5.83	5.80	0.05
nc[1]	TR20WATSE	Trifolium 20	---	---	---	---	---
39397, 39398	TR22WATSE	Trifolium 22	04/19/07	7.8	7.5	7.6	0.20
39401, 39402	TR23WATSE	Trifolium 23	04/19/07	4.02	3.63	3.83	0.28
39409, 39410	TRSTWATSE	Trifolium Storm	04/26/07	47.3	46.9	47.1	0.26
39381, 39382	UUUUWATSE	U	04/24/07	2.17	2.07	2.12	0.07
39393, 39394	VLO5WATSE	Vail 5	04/26/07	4.36	6.33	5.35	1.40
39379, 39380	WWWWWATSE	W	04/24/07	4.15	3.87	4.01	0.20
nc[1]	ZSPLWATSE	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 2007.

[USGS, U.S. Geological Survey; ID, identification; Rep, field replicate; µg/L, micrograms per liter; SD, standard deviation; <, less than]

USGS ID	Field ID	Drain	Collection date	Total selenium concentration			SD
				Rep 1 (µg/L)	Rep 2 (µg/L)	Mean (µg/L)	
39852	BLANK-1	---	07/17/07	< 0.19		---	---
39853	BLANK-2	---	07/17/07	< 0.19		---	---
39820	BLNDWATSE09B	---	07/12/07	1.45	---	---	---
39849	BLNDWATSE09A	---	07/12/07	10.1	---	---	---
39818,39819	LKLNWATSE09	Lack & Linsey Pond	07/12/07	4.06	4.16	4.11	0.07
39821,39822	NLD1WATSE09	Niland 1	07/13/07	2.29	2.20	2.24	0.06
39823,39824	NLD2WATSE09	Niland 2	07/13/07	2.43	2.48	2.46	0.03
39825,39826	NLD3WATSE09	Niland 3	07/13/07	2.21	2.72	2.46	0.36
39827,39828	NLD4WATSE09	Niland 4	07/13/07	2.05	1.95	2.00	0.07
39845,39846	OOOOWATSE09	O	07/13/07	3.77	3.84	3.81	0.05
39841,39844	PPPPWATSE09	P	07/13/07	2.6	2.7	2.6	0.03
39802,39803	POEDWATSE09	Poe Rd	07/12/07	4.64	4.58	4.61	0.04
39847,39848	PUMCWATSE09	Pumice	07/13/07	5.13	5.18	5.15	0.04
39842,39843	QQQQWATSE09	Q	07/13/07	8.62	8.70	8.66	0.06
39839,39840	RRRRWATSE09	R	07/13/07	3.93	3.94	3.93	0.01
39837,39838	SSSSWATSE09	S	07/13/07	2.17	2.13	2.15	0.03
39796,39797	SFWHWATSE09	San Felipe Wash	07/12/07	2.11	2.26	2.18	0.11
39835,39836	TTTTWATSE09	T	07/13/07	1.45	1.40	1.43	0.03
39812,39813	TR01WATSE09	Trifolium 1	07/12/07	4.25	4.09	4.17	0.11
39816,39817	TR12WATSE09	Trifolium 12	07/12/07	6.7	7.0	6.9	0.20
39808,39809	TR13WATSE09	Trifolium 13	07/12/07	3.53	3.34	3.44	0.13
39810,39811	TR14WATSE09	Trifolium 14	07/12/07	1.39	1.47	1.43	0.06
39800,39801	TR18WATSE09	Trifolium 18	07/12/07	17.7	16.6	17.2	0.80
39804,39805	TR19WATSE09	Trifolium 19	07/12/07	1.84	1.71	1.77	0.09
39792,39793	FT20WATSE09	Former Trifolium 20	07/12/07	5.78	5.84	5.81	0.04
39806,39807	TR20WATSE09	Trifolium 20	07/12/07	4.2	4.1	4.1	0.07
39794,39795	TR22WATSE09	Trifolium 22	07/12/07	9.3	9.4	9.4	0.06
39798,39799	TR23WATSE09	Trifolium 23	07/12/07	3.9	3.8	3.8	0.04
39814,39815	TRSTWATSE09	Trifolium Storm	07/12/07	31.3	30.4	30.9	0.62
39833,39834	UUUUWATSE09	U	07/13/07	1.83	1.91	1.87	0.06
39850,39851	VLO5WATSE09	Vail 5	07/13/07	2.97	2.94	2.96	0.02
39831,39832	WWWWWATSE09	W	07/13/07	4.29	4.35	4.32	0.04
39829,39830	ZSPLWATSE09	Z Spill	07/13/07	5.33	4.34	4.83	0.70

Table 3. Total dissolved selenium, dissolved selenium species, and particulate selenium concentrations in filtered irrigation drain water samples, Salton Sea, April 2007.

[USGS, U.S. Geological Survey; ID, identification; Rep, replicate; $[Se_{03}]^{-2}$, 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 high uncertainty and are presented for information purposes only]

USGS ID	Field ID	Drain	Rep number	Collection date	Dissolved $[Se0_3]^{-2}$ (µg/L)	Calculated dissolved[1] $[Se0_4]^{-2}$ (µg/L)	Calculated dissolved[2] organic Se (µg/L)	Measured total dissolved Se (µg/L)	Measured particulate[3] Se (µg/L)	Calculated total[4] Se (µg/L)
39434	BLANK-1	---	1	05/07/07	< 0.03	< 0.10	---	< 0.10	0.003	---
39435	BLANK-2	---	2	05/07/07	< 0.03	< 0.10	---	< 0.10	0.003	---
39433,39629	BLIND	---	---	04/20/07	1.17	22.7	0.00	23.6	0.11	23.7
39423,39636	OOOOWATSE	O	1	04/28/07	0.49	3.27	0.24	4.00	0.10	4.10
39424,39637	OOOOWATSE	O	2	04/28/07	0.48	3.41	0.21	4.10	0.11	4.22
39427,39623	POEDWATSE	Poe Rd	1	04/17/07	0.50	7.8	0.98	9.23	0.019	9.2
39428,39624	POEDWATSE	Poe Rd	2	04/17/07	0.50	7.4	1.81	9.72	0.015	9.7
39421,39634	TTTTWATSE	T	1	04/27/07	0.16	1.67	0.00	1.04	0.030	1.07
39422,39635	TTTTWATSE	T	2	04/27/07	0.16	0.70	0.23	1.10	0.032	1.13
39431,39630	TR14WATSE	Trifolium 14	1	04/21/07	0.36	1.94	0.00	2.20	0.067	2.26
39432,39631	TR14WATSE	Trifolium 14	2	04/21/07	0.39	1.47	0.29	2.14	0.066	2.20
39425,39627	TR18WATSE	Trifolium 18	1	04/20/07	1.12	22.3	0.37	23.7	0.13	23.9
39426,39628	TR18WATSE	Trifolium 18	2	04/20/07	1.10	22.4	0.56	24.1	0.091	24.2
39429,39625	TR20WATSE	Trifolium 20	1	04/20/07	0.74	3.70	1.34	5.78	0.075	5.85
39430,39626	TR20WATSE	Trifolium 20	2	04/20/07	0.77	3.78	1.40	5.95	0.077	6.03
39419,39632	ZSPLWATSE	Z Spill	1	04/23/07	0.51	2.56	0.17	3.23	0.039	3.27
39420,39633	ZSPLWATSE	Z Spill	2	04/23/07	0.56	2.43	0.17	3.15	0.038	3.19

[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 ($[Se0_4]^{-2}$ + $[Se0_3]^{-2}$).

[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 2007.

[USGS, U.S. Geological Survey; ID, identification; TSS, total suspended solids; mg/L, milligram per liter]

Field ID	Drain	April, 2007		July, 2007	
		USGS ID	TSS (mg/L)	USGS ID	TSS (mg/L)
BLNDWATSS	Blind A	39258	13.0	39790	23.2
BLNDWATSS	Blind B	39268	154	39775	471
LKLNWATSS	Lack & Linsey Pond	39257	28.7	39774	66.2
NLD1WATSS	Niland 1	39262	66.7	39776	252
NLD2WATSS	Niland 2	39263	99.2	39777	143
NLD3WATSS	Niland 3	39264	204	39778	275
NLD4WATSS	Niland 4	39265	110	39779	144
OOOOWATSS	O	39316	167	39788	156
PPPPWATSS	P	39315	322	39787	157
POEDWATSS	Poe Rd	39252	29.1	39766	68.7
PUMCWATSS	Pumice	39250	89.7	39789	230
QQQQWATSS	Q	39314	142	39786	103
RRRRWATSS	R	39313	156	39785	138
SSSSWATSS	S	39320	61.8	39784	68.7
SFWHWATSS	San Felipe Wash	39249	9.00	39763	16.6
TTTTWATSS	T	39321	53.6	39783	78.5
TR01WATSS	Trifolium 1	39318	30.8	39771	55.7
TR12WATSS	Trifolium 12	39319	188	39773	369
TR13WATSS	Trifolium 13	39255	50.2	39769	100
TR14WATSS	Trifolium 14	39256	126	39770	44.2
TR18WATSS	Trifolium 18	39251	12.6	39765	50.2
TR19WATSS	Trifolium 19	39253	30.3	39767	58.1
FT20WATSS	Former Trifolium 20	39247	2.40	39761	21.9
TR20WATSS	Trifolium 20	39254	25.6	39768	46.4
TR22WATSS	Trifolium 22	39248	89.0	39762	72.5
TR23WATSS	Trifolium 23	39259	30.2	39764	66.3
TRSTWATSS	Trifolium Storm	39317	25.9	39772	38.5
UUUUWATSS	U	39322	83.5	39782	65.3
VLO5WATSS	Vail 5	39323	480	39791	26.3
WWWWWATSS	W	39267	641	39781	233
ZSPLWATSS	Z Spill	39266	25.7	39780	429

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2007.

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain	Moisture (percent)	Selenium (µg/g dry weight)
39548	OOOOALGTSE08A	algae	O	68.3	1.99
39549	OOOOALGTSE08B	algae	O	67.3	1.67
39550	OOOOALGTSE08C	algae	O	71.4	1.57
39545	POEDALGTSE08A	algae	Poe	75.3	1.07
39546	POEDALGTSE08B	algae	Poe	78.3	1.03
39547	POEDALGTSE08C	algae	Poe	81.8	0.88
39539	TTTTALGTSE08A	algae	T	71.6	1.97
39540	TTTTALGTSE08B	algae	T	69.6	2.63
39541	TTTTALGTSE08C	algae	T	68.9	2.50
39551	TR14ALGTSE08A	algae	Trifolium 14	75.7	2.40
39552	TR14ALGTSE08B	algae	Trifolium 14	73.2	2.19
39553	TR14ALGTSE08C	algae	Trifolium 14	72.7	2.48
39557	TR18ALGTSE08A	algae	Trifolium 18	81.9	5.63
39558	TR18ALGTSE08B	algae	Trifolium 18	82.4	5.74
39559	TR18ALGTSE08C	algae	Trifolium 18	83.4	5.41
39542	TR20ALGTSE08A	algae	Trifolium 20	78.2	1.33
39543	TR20ALGTSE08B	algae	Trifolium 20	60.6	2.01
39544	TR20ALGTSE08C	algae	Trifolium 20	63.5	1.75
39554	ZSPLALGTSE08A	algae	Z Spill	64.3	1.56
39555	ZSPLALGTSE08B	algae	Z Spill	70.1	1.53
39556	ZSPLALGTSE08C	algae	Z Spill	69.7	1.45
39611	OOOONPTSE08A	plankton	O	---	1.97
39612	OOOONPTSE08B	plankton	O	---	2.05
39613	OOOONPTSE08C	plankton	O	---	2.29
39608	POEDNPTSE08A	plankton	Poe	---	1.45
39609	POEDNPTSE08B	plankton	Poe	---	2.04
39610	POEDNPTSE08C	plankton	Poe	---	2.08
39602	TTTTNPTSE08A	plankton	T	---	4.80
39603	TTTTNPTSE08B	plankton	T	---	1.52
39604	TTTTNPTSE08C	plankton	T	---	1.40
39614	TR14NPTSE08A	plankton	Trifolium 14	---	4.27
39615	TR14NPTSE08B	plankton	Trifolium 14	---	4.32
39616	TR14NPTSE08C	plankton	Trifolium 14	---	4.41
39620	TR18NPTSE08A	plankton	Trifolium 18	---	15.5
39621	TR18NPTSE08B	plankton	Trifolium 18	---	17.0
39622	TR18NPTSE08C	plankton	Trifolium 18	---	11.9
39605	TR20NPTSE08A	plankton	Trifolium 20	---	3.34
39606	TR20NPTSE08B	plankton	Trifolium 20	---	2.55

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2007.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain	Moisture (percent)	Selenium (µg/g dry weight)
39607	TR20NPTSE08C	plankton	Trifolium 20	---	2.41
39617	ZSPLNPTSE08A	plankton	Z Spill	---	2.08
39618	ZSPLNPTSE08B	plankton	Z Spill	---	2.75
39619	ZSPLNPTSE08C	plankton	Z Spill	---	3.41
39569	OOOOCHITSE08A	midge	O	81.8	4.36
39570	OOOOCHITSE08B	midge	O	82.2	3.76
39571	OOOOCHITSE08C	midge	O	83.1	4.79
39566	POEDCHITSE08A	midge	Poe	75.8	4.76
39567	POEDCHITSE08B	midge	Poe	71.3	3.69
39568	POEDCHITSE08C	midge	Poe	74.6	4.53
39560	TTTTCHITSE08A	midge	T	83.8	5.39
39561	TTTTCHITSE08B	midge	T	83.8	4.58
39562	TTTTCHITSE08C	midge	T	83.9	5.21
39572	TR14CHITSE08A	midge	Trifolium 14	82.7	7.42
39573	TR14CHITSE08B	midge	Trifolium 14	80.8	6.86
39574	TR14CHITSE08C	midge	Trifolium 14	82.5	7.25
39578	TR18CHITSE08A	midge	Trifolium 18	84.1	12.7
39579	TR18CHITSE08B	midge	Trifolium 18	87.9	13.4
39580	TR18CHITSE08C	midge	Trifolium 18	87.0	13.2
39563	TR20CHITSE08A	midge	Trifolium 20	84.4	9.29
39564	TR20CHITSE08B	midge	Trifolium 20	84.3	8.52
39565	TR20CHITSE08C	midge	Trifolium 20	84.0	8.29
39575	ZSPLCHITSE08A	midge	Z Spill	78.6	3.56
39576	ZSPLCHITSE08B	midge	Z Spill	81.9	3.18
39577	ZSPLCHITSE08C	midge	Z Spill	81.6	3.43
39519	OOOOGMBTSE08A	mosquitofish	O	76.8	5.66
39520	OOOOGMBTSE08B	mosquitofish	O	77.0	5.53
39521	OOOOGMBTSE08C	mosquitofish	O	76.9	5.70
39522	OOOOSLMTSE08A	sailfin molly	O	76.4	3.85
39513	POEDGMBTSE08A	mosquitofish	Poe	76.7	8.35
39514	POEDGMBTSE08B	mosquitofish	Poe	76.6	8.78
39515	POEDGMBTSE08C	mosquitofish	Poe	77.7	9.49
39516	POEDSLMTSE08A	sailfin molly	Poe	80.4	10.3
39517	POEDSLMTSE08B	sailfin molly	Poe	79.8	9.71
39518	POEDSLMTSE08C	sailfin molly	Poe	79.6	9.73
39503	TTTTGMBTSE08A	mosquitofish	T	76.9	4.78
39504	TTTTGMBTSE08B	mosquitofish	T	76.2	4.62

Table 5. Selenium concentrations in biota samples collected from Salton Sea irrigation drains, April 2007.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; ---, no data]

USGS ID	Field ID	Matrix	Drain	Moisture (percent)	Selenium (µg/g dry weight)
39505	TTTTGMBTSE08C	mosquitofish	T	79.1	4.69
39506	TTTTSLMTSE08A	sailfin molly	T	71.7	4.72
39507	TTTTSLMTSE08B	sailfin molly	T	72.4	4.65
39523	TR14GMBTSE08A	mosquitofish	Trifolium 14	76.6	5.57
39524	TR14GMBTSE08B	mosquitofish	Trifolium 14	77.0	5.50
39525	TR14GMBTSE08C	mosquitofish	Trifolium 14	78.5	5.66
39526	TR14SLMTSE08A	sailfin molly	Trifolium 14	74.8	4.23
39527	TR14SLMTSE08B	sailfin molly	Trifolium 14	75.8	4.29
39528	TR14SLMTSE08C	sailfin molly	Trifolium 14	75.9	4.51
39535	TR18GMBTSE08C	mosquitofish	Trifolium 18	76.8	20.2
39536	TR18SLMTSE08A	sailfin molly	Trifolium 18	75.4	13.8
39537	TR18SLMTSE08B	sailfin molly	Trifolium 18	75.1	13.8
39538	TR18SLMTSE08C	sailfin molly	Trifolium 18	74.8	12.8
39508	TR20GMBTSE08A	mosquitofish	Trifolium 20	74.0	5.97
39509	TR20GMBTSE08B	mosquitofish	Trifolium 20	74.2	6.21
39510	TR20GMBTSE08C	mosquitofish	Trifolium 20	74.0	5.90
39511	TR20SLMTSE08A	sailfin molly	Trifolium 20	73.3	5.38
39512	TR20SLMTSE08B	sailfin molly	Trifolium 20	71.9	4.86
39529	ZSPLGMBTSE08A	mosquitofish	Z Spill	77.6	5.38
39530	ZSPLGMBTSE08B	mosquitofish	Z Spill	77.1	5.71
39531	ZSPLSLMTSE08A	sailfin molly	Z Spill	77.3	5.03
39532	ZSPLSLMTSE08B	sailfin molly	Z Spill	75.2	4.74

Detritus and Sediment: Percent moisture and selenium concentrations (µg/g dry weight) in detritus and sediment are presented in table 6. Selenium in detritus ranged from 2.64 to 28.9 and in sediment from 0.15 to 7.02. The particle size analyses of sediments, expressed as percent sand, silt, and clay, are presented in table 7. Percent TOC in sediments is given in table 8 and ranged from 0.3 to 3.6.

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=8 (8 samples)] and National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1640 Trace Elements in Natural Water (n=7) ranged from 91 to 106 percent. Recoveries of selenium from NIST SRM 2704 Buffalo River sediment (n=1) and National Research Council Canada (NRCC) SRM PACS-1 marine sediment (n=1) were 99 and 100 percent. The International Atomic Energy Agency (IAEA) copepod reference material MA-A-1 (n= 4) and the Institute for Reference Materials and Measurements Certified Reference Material (CRM) 414 Trace Elements in Plankton (n=4) all exhibited selenium recoveries of 100 percent. Recoveries of selenium in NRCC CRM DORM-2 dogfish muscle (n=1) and IAEA CRM 407 whole-body fish (n=1) were 100 and 92 percent. Recoveries of TSS from a TSS reference solution (Environmental Resource Associates Hardness Wastewater Standard 507; n=5) were 100 percent. Recoveries of total carbon from a carbon reference material (n=9) ranged from 89 to 158 percent and averaged 101 percent; recoveries of total inorganic carbon from calcium carbonate (n=13) ranged from 59 to 97 percent and averaged 90 percent.

Analytical and Method Precision: Instrumental precision for selenium as determined by repeated analysis of a standard throughout the run for each block (n=14) was less than 7 percent relative standard deviation (RSD). Relative percent differences (RPDs) between field duplicates (n=74) of unfiltered and filtered water samples analyzed for selenium or selenium species were mostly ≤ (less than or equal) 10, but 5 duplicates exhibited greater RPDs of 21, 21, 22, 37, and 72. Field duplicates of fish (n=4) produced RPDs ranging from 1.4 to 10, and field duplicates of filtered particulates ranged from 2.0 to 38 RPD. Relative standard deviations for triplicate field samples of detritus (n=7), algae (n=7), plankton (n=7), midge larvae (n=7), and whole-body fish (n=9) analyzed for selenium were as follows: algae, 3.0 to 20 percent; plankton, 1.6 to 75 percent; detritus, 1.3 to 33 percent; midge larvae, 2.8 to 13 percent; and whole-body fish, 1.4 to 6.8 percent. Laboratory method precision for triplicate (n=20) preparation and analysis of samples for selenium were <7 percent RSD, except for two triplicates that were 14 and 29 percent. Method duplicates of detritus analyzed for selenium had RPDs of 1.1 and 5.0 percent. Duplicate analysis of water samples for TSS (n=8) resulted in RPDs ranging from 0.3 to 44 percent, whereas triplicate analysis for TSS (n=4) resulted in RSDs <8 percent. Duplicate analyses of sediments (n=3) for PSA resulted in RPDs ranging from 0.9 to 13 percent, and triplicate analyses of sediments (n=2) and a sediment control material for PSA resulted in RSDs ≤13 percent for the fractions. Duplicate analyses of sediments (n=6) for TOC resulted in RPDs ranging from 8.6 to 44 percent; triplicate analyses of sediments (n=2) resulted in RSDs of 18 and 46 percent.

Spikes: Recoveries of selenium [Se^{+4}, selenate (Se^{+6}), or selenomethionine] spiked into filter blanks (n=2) and water samples (n=22) ranged from 91 to 114 percent and averaged 102 percent. Recoveries of selenium spiked into blanks (n=6), sediment (n=4), detritus (n=4), and biota (n=14) ranged from 77 to 134 percent, and averaged 106 percent. Recoveries of selenium spikes added to water during analysis (n=19) ranged from 101 to 109 percent, and averaged 106 percent; analysis spikes of sediment (n=4), filtered particulates (n=2), detritus (n=2), and biota (n=11) ranged from 99 to 106 percent, and averaged 102 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. All BECs were less than or equal to their respective method detection limits. One TSS BEC was above the method detection limit (1.5 mg/L TSS compared to 1.0 mg/L TSS method detection limit). 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 µg/L, and for TSS was 0.10 mg/L. Method detection limits (MDL) for each matrix for selenium were computed as:

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

where

SD_b is standard deviation of a blank (n=3); and

SD_S is standard deviation of a low level sample or spiked sample (n=3).

The results were water, 0.03 to 1.63 µg/L; filtered particulates, 0.002 µg/L; sediment, 0.015 µg/g dry weight; algae, 0.018 µg/g dry weight; midge larvae, 0.057 µg/g dry weight; plankton, 0.012 µg/g dry weight; detritus, 0.033 µg/g dry weight; and whole-body fish, 0.037 µg/g dry weight. Method quantitation limits (MQLs) for each matrix were calculated as 3.3 x MDLs. Method detection limits for TSS were 2.1 and 1.1 mg/L and MQLs were 7.0 and 3.2 mg/L. All quality control

Table 6. Selenium concentrations in detritus and sediment samples collected from Salton Sea irrigation drains, April 2007.

[USGS, U.S. Geological Survey; ID, identification; µg/g, micrograms per gram]

USGS ID	Field ID	Matrix	Drain	Moisture (percent)	Selenium (µg/g dry weight)
39590	OOOODETTSE08A	detritus	O	78.0	4.86
39591	OOOODETTSE08B	detritus	O	79.4	9.27
39592	OOOODETTSE08C	detritus	O	76.2	9.43
39587	POEDDETTSE08A	detritus	Poe	66.8	11.7
39588	POEDDETTSE08B	detritus	Poe	67.7	8.4
39589	POEDDETTSE08C	detritus	Poe	69.6	11.1
39581	TTTTDETTSE08A	detritus	T	77.1	2.71
39582	TTTTDETTSE08B	detritus	T	77.2	2.64
39583	TTTTDETTSE08C	detritus	T	76.4	2.66
39593	TR14DETTSE08A	detritus	Trifolium 14	77.7	6.98
39594	TR14DETTSE08B	detritus	Trifolium 14	77.3	6.41
39595	TR14DETTSE08C	detritus	Trifolium 14	79.9	6.55
39599	TR18DETTSE08A	detritus	Trifolium 18	79.8	26.5
39600	TR18DETTSE08B	detritus	Trifolium 18	81.2	23.6
39601	TR18DETTSE08C	detritus	Trifolium 18	81.9	28.9
39584	TR20DETTSE08A	detritus	Trifolium 20	74.4	9.42
39585	TR20DETTSE08B	detritus	Trifolium 20	77.5	7.87
39586	TR20DETTSE08C	detritus	Trifolium 20	75.0	7.41
39596	ZSPLDETTSE08A	detritus	Z Spill	80.4	5.40
39597	ZSPLDETTSE08B	detritus	Z Spill	81.6	4.29
39598	ZSPLDETTSE08C	detritus	Z Spill	81.2	3.16
39284	BLNDSDTSE08	sediment	Blind	55.0	2.02
39338	BLNDSDTSE08B	sediment	Blind	48.8	1.04
39285	LKLNSDTSE08	sediment	Lack and Lindsay	51.1	1.58
39269	NLD1SDTSE08	sediment	Niland 1	53.6	1.14
39270	NLD2SDTSE08	sediment	Niland 2	52.7	1.15
39271	NLD3SDTSE08	sediment	Niland 3	50.4	0.76
39272	NLD4SDTSE08	sediment	Niland 4	51.4	1.24
39342	OOOOSDTSE08	sediment	O	48.2	0.87
39343	PPPPSDTSE08	sediment	P	50.0	1.05
39260	POEDSDTSE08	sediment	Poe	32.5	0.57
39283	PUMCSDTSE08	sediment	Pumice	47.4	1.03
39344	QQQQSDTSE08	sediment	Q	48.3	1.17
39345	RRRRSDTSE08	sediment	R	26.1	0.38
39336	SSSSSDTSE08	sediment	S	49.2	0.89
39275	SFWHSDTSE08	sediment	San Felipe Wash	31.4	0.61
39337	TTTTSDTSE08	sediment	T	50.4	0.79

Table 6. Selenium concentrations in detritus and sediment samples collected from Salton Sea irrigation drains, April 2007.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, micrograms per gram]

USGS ID	Field ID	Matrix	Drain	Moisture (percent)	Selenium (µg/g dry weight)
39339	TR01SDTSE08	sediment	Trifolium 1	47.6	1.15
39341	TR12SDTSE08	sediment	Trifolium 12	23.2	0.23
39282	TR13SDTSE08	sediment	Trifolium 13	55.1	1.82
39281	TR14SDTSE08	sediment	Trifolium 14	39.5	1.33
39280	TR18SDTSE08	sediment	Trifolium 18	55.3	7.02
39279	TR19SDTSE08	sediment	Trifolium 19	31.1	0.65
39277	FT20SDTSE08	sediment	Former Trifolium 20	23.4	0.15
39278	TR20SDTSE08	sediment	Trifolium 20	60.7	2.03
39276	TR22SDTSE08	sediment	Trifolium 22	57.5	1.42
39274	TR23SDTSE08	sediment	Trifolium 23	48.0	1.23
39340	TRSTSDTSE08	sediment	Trifolium Storm	37.5	0.51
39287	UUUUSDTSE08	sediment	U	58.2	1.25
39346	VL05SDTSE08	sediment	Vail 5	75.8	6.04
39286	WWWWSDTSE08	sediment	W	44.8	0.62
39273	ZSPLSDTSE08	sediment	Z Spill	60.3	1.42

Table 7. Particle size distributions in sediment samples collected from Salton Sea irrigation drains, April 2007.

[USGS, U.S. Geological Survey; ID, identification; >, greater than; mm, millimeter]

USGS ID	Field ID	Drain	Particle size category			
			> 2 mm (percent)	Sand (percent)	Silt (percent)	Clay (percent)
39303	BLNDSDTOC08	Blind A	3.71	44.5	34.8	17.0
39328	BLNDSDTOC08B	Blind B	0.39	17.5	40.2	41.9
39304	LKLNSDTOC08	Lack & Linsey Pond	13.7	46.9	29.2	10.2
39288	NLD1SDTOC08	Niland 1	0.59	9.29	39.4	50.7
39289	NLD2SDTOC08	Niland 2	0.55	12.9	43.2	43.4
39290	NLD3SDTOC08	Niland 3	1.71	12.1	32.2	53.9
39291	NLD4SDTOC08	Niland 4	0.59	21.3	24.7	53.5
39332	OOOOSDTOC08	O	0.08	21.3	35.2	43.4
39333	PPPPSDTOC08	P	0.59	19.1	37.0	43.3
39261	POEDSDTOC08	Poe Rd	1.29	63.4	19.0	16.3
39302	PUMCSDTOC08	Pumice	2.89	21.8	43.3	32.0
39334	QQQQSDTOC08	Q	0.11	11.5	36.2	52.3
39335	RRRRSDTOC08	R	4.55	54.0	17.4	24.2
39326	SSSSSDTOC08	S	15.4	24.4	30.2	30.0
39294	SFWHSDTOC08	San Felipe Wash	0.57	68.5	18.1	12.8
39327	TTTTSDTOC08	T	0.40	32.3	29.0	38.2
39329	TR01SDTOC08	Trifolium 1	0.12	27.1	32.5	40.3
39331	TR12SDTOC08	Trifolium 12	0.03	58.2	26.9	14.9
39301	TR13SDTOC08	Trifolium 13	5.56	41.5	34.4	18.6
39300	TR14SDTOC08	Trifolium 14	3.27	29.7	37.2	29.9
39299	TR18SDTOC08	Trifolium 18	0.30	64.7	28.3	6.68
39298	TR19SDTOC08	Trifolium 19	1.24	63.9	22.3	12.5
39296	FT20SDTOC08	Former Trifolium 20	0.02	78.3	11.0	10.7
39297	TR20SDTOC08	Trifolium 20	0.74	32.1	42.2	24.9
39295	TR22SDTOC08	Trifolium 22	3.42	33.2	41.1	22.3
39293	TR23SDTOC08	Trifolium 23	18.0	40.8	22.7	18.5
39330	TRSTSDTOC08	Trifolium Storm	0.02	53.0	26.5	20.5
39324	UUUUSDTOC08	U	2.94	15.3	31.5	50.3
39325	VL05SDTOC08	Vail 5	0.42	39.2	53.1	7.23
39305	WWWWSDTOC08	W	0.86	13.7	42.6	42.9
39292	ZSPLSDTOC08	Z Spill	1.58	34.3	39.6	24.5

Table 8. Percent total organic carbon in sediment samples collected from Salton Sea irrigation drains, April 2007.

[USGS, U.S. Geological Survey; ID, identification]

USGS ID	Field ID	Drain	Total organic carbon (percent)
39303	BLNDSDTOC08	Blind	2.1
39328	BLNDSDTOC08 B	Blind B	1.0
39304	LKLNSDTOC08	Lack & Linsey Pond	3.3
39288	NLD1SDTOCO8	Niland 1	1.5
39289	NLD2SDTOC08	Niland 2	1.3
39290	NLD3SDTOC08	Niland 3	0.8
39291	NLD4SDTOC08	Niland 4	3.5
39332	OOOOSDTOC08	O	0.6
39333	PPPPSDTOC08	P	2.3
39261	POEDSDTOC08	Poe	1.0
39302	PUMCSDTOC08	Pumice	1.5
39334	QQQQSDTOC08	Q	0.6
39335	RRRRSDTOC08	R	0.5
39326	SSSSSDTOC08	S	1.9
39294	SFWHSDTOC08	San Felipe Wash	0.7
39327	TTTTSDTOC08	T	0.8
39329	TR01SDTOCO8	Trifolium 1	1.4
39331	TR12SDTOC08	Trifolium 12	0.3
39301	TR13SDTOC08	Trifolium 13	3.0
39300	TR14SDTOC08	Trifolium 14	1.4
39299	TR18SDTOC08	Trifolium 18	2.1
39298	TR19SDTOC08	Trifolium 19	1.0
39296	FT20SDTOC08	Former Trifolium 20	0.5
39297	TR20SDTOC08	Trifolium 20	2.0
39295	TR22SDTOC08	Trifolium 22	2.5
39293	TR23SDTOCO8	Trifolium 23	3.2
39330	TRSTSDTOC08	Trifolium Storm	0.6
39324	UUUUUSDTOC08	U	1.5
39325	VL05SDTOC08	Vail 5	3.6
39305	WWWWSDTOC08	W	0.8
39292	ZSPLSDTOC08	Z Spill	1.9

results for the study were within acceptable limits as specified by USGS-CERC.

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