SEDIMENT QUALITY IN EVAPORATION BASINS USED FOR THE DISPOSAL OF AGRICULTURAL SUBSURFACE DRAINAGE WATER IN THE SAN JOAQUIN VALLEY, CALIFORNIA

1988 AND 1989

California Regional Water Quality Control Board
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EXECUTIVE SUMMARY

During June 1988 and June 1989, Regional Board staff conducted water and sediment quality surveys of agricultural evaporation basins in the Tulare Lake Basin area. The surveyed facilities are used to store and evaporate agricultural subsurface drainage water. Twenty-eight evaporation basins exist in and near the Tulare Lake Basin. These basins are located from the Bakersfield area in the south to near Gustine in the north. The 28 facilities cover 7,170 acres (2,900 hectares) with basin sizes ranging from 10 to 1,800 acres (5 to 730 hectares). Six of the basins were inactive during the surveys.

Sediment samples were collected from the upper 7 cm (0 - 3 inch) layer of each basin cell bottom that contained or had contained subsurface drainage water. Sediment analyses included trace elements such as arsenic, selenium, molybdenum, and uranium, as well as percent composition of minerals and total organic carbon. During 1988, sediment was collected from 95 separate locations and in 1989, from 90 locations.

Water quality sample results are included in a companion report entitled, *Water Quality in Agricultural Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California 1988 and 1989 (Chilcott et al, 1990)*. Three previous surveys between 1985 and 1987, were conducted for the same study area. These survey results are published in two reports, *Water and Sediment Quality in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California* (Westcot et al, 1988a) and *Uranium Levels in Water in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California* (Westcot et al, 1988b). The water and sediment quality data will be used to evaluate the need for regulatory actions in relation to the Porter-Cologne Water Quality Control Act, including Chapter 15 requirements and the requirements of the Toxic Pits Cleanup Act of 1984 (TPCA).

The trace element concentrations in the sediment from the basins varied widely. Elements were compared to three geologic backgrounds to determine elevated concentrations: a baseline, a California average, and data from Pond 2 at Kesterson Reservoir. The baseline was derived from concentrations in soils of the western United States (Shacklette et al, 1984). The California average sediment concentrations were determined by the University of California, (Pettygrove and Asano, 1984). The values for Kesterson Reservoir, Pond 2, represent an environment of known wildlife impacts and were determined by the U.S. Geological Survey (Fujii, 1988).

A comparison was possible for 15 of the 25 elements analyzed. Only the geometric means of molybdenum and boron greatly exceeded means for the comparison data. However, for three additional elements, the high end of the evaporation pond concentration range far exceeded those of the comparisons. The three elements included arsenic, selenium, and uranium. These three elements in addition to molybdenum, boron and vanadium, which were found in highly elevated concentrations in the water column (Chilcott et al, 1990), are discussed in this report.

Arsenic concentrations ranged from 1.38 to 188 mg/Kg in the pond sediment. Although the geometric mean of 8.74 mg/Kg did not greatly exceed the baseline mean of 5.5 mg/Kg or the Kesterson value of <10 mg/Kg, the higher pond sediment concentrations did exceed the highest baseline arsenic concentration of 97 mg/Kg. Approximately 60% of the basin acreage had concentrations less than the Kesterson background of <10 mg/Kg. Only four basins contained concentrations exceeding 25 mg/Kg. Two of these four basins had average concentrations near 100 mg/Kg. These two basins are located in the Goose Lake Bed area.

Molybdenum concentrations in the basin sediments consistently exceeded the baseline sediment values. The lowest value for the pond sediment, 1.30 mg/Kg, is higher than the mean for the soils of the western states (0.85 mg/Kg). The highest detected sediment molybdenum concentration, 283 mg/Kg, greatly exceeds the highest baseline value of 7.0 mg/Kg. Molybdenum concentrations appear to be increasing in the basin sediments over time. Between 1986 and 1989, the percentage of acreage with concentrations <7 mg/Kg (the maximum baseline) dropped from 54% to roughly 20%. The percent of basin acreages with concentrations exceeding 50 mg/Kg has remained fairly constant over the period of time these surveys have been conducted (approximately 15%). The one consistency in the sites with elevated molybdenum concentrations was that the cells were approaching dryness.

Basin sediment selenium concentrations ranged from <0.05 mg/Kg to 15 mg/Kg. The geometric mean for all basins was 0.52 mg/Kg, slightly higher than the average for soils of the western states (0.23 mg/Kg) but considerably lower than the concentration measured at Kesterson Pond 2 (5.2 mg/Kg). During the 1988 and 1989 surveys, roughly 80% of the basin acreage represented values within the baseline range of <0.1 to 4.3 mg/Kg. Only nine of 183 analyses exceeded the maximum baseline value of 4.3 mg/Kg. Seven of these analyses exceeded the Kesterson value and occurred consistently at the Sumner Peck Basins and in 1989, the Sam Andrews Basin.

Soil sediment uranium concentrations were only analyzed during the 1989 survey. Values ranged from 1 to 290 mg/Kg with a basin geometric mean concentration of 9.33 mg/Kg uranium which exceeds the highest concentration (7.9 mg/Kg) found in soils of the western states. Approximately half of the basin acreage contained less than 10 mg/Kg uranium with only 10% of the ponded acreage containing greater than 50 mg/Kg uranium in the sediment.

During the 1988 and 1989 surveys, pond sediment boron ranged from 18.9 to 472 mg/Kg with a geometric mean of 112 mg/Kg. The baseline mean for soils of the western states is reported at 23 mg/Kg with the highest value being reported at 300 mg/Kg. Only two basins contained sediment boron levels exceeding 300 mg/Kg. In contrast, only one sample contained boron at a concentration less than the baseline mean of 23 mg/Kg. This sample contained 19 mg/Kg boron.

Basin sediment vanadium concentrations ranged from 11 to 180 mg/Kg with a geometric mean of 56 mg/Kg. The range and mean are below the baseline vanadium range of 7 to 500 mg/Kg and mean of 70 mg/Kg for soils of the western states.

The evaporation basins in the lower San Joaquin Valley are located on soils derived primarily from three different geologic units: alluvial fan, basin trough, and lake bed. Some of the trace elements such as boron, uranium, and selenium appear to have a fairly close relationship between sediment concentration and geologic setting, while others have a less defined association.

For boron, the lowest value and lowest geometric mean were found in the lake bed setting. However, this setting had the highest variability with a range of 19 to 472 mg/Kg. The highest geometric mean was found in the alluvial fan area, with an intermediate range in the basin trough area. The alluvial fan areas are derived from marine sediments and are known areas of boron enrichment.

Uranium had an inverse relationship to boron. The lower values were found in the alluvial fan area, while the higher concentrations and the highest geometric mean were in basin trough sediments.

Molybdenum appears to follow the same pattern as uranium with the exception of one site. The highest molybdenum sediment concentration, 280 mg/Kg, was located on alluvial fan material. The next highest value in the alluvial fan area is 42 mg/Kg. Excluding the one high concentration of 280 mg/Kg from the data base results in the lowest calculated geometric mean for alluvial fan sediments and the highest overall concentrations for lake bed sediments. This high value anomaly may be due to the fact that the sampled site occurs close to the boundary between two geologic units.

The highest selenium concentrations and geometric mean were found in the alluvial fan deposits. The highest variability (0.23 to 15 mg/Kg) was also found in the alluvial fan setting. The lowest concentrations and lowest variability (0.05 to 0.95 mg/Kg) were found in the basin trough area.

Arsenic also had the lowest geometric mean and the lowest range in the basin trough setting. The highest geometric mean was found in the lake bed setting. However, the highest concentration (180 mg/Kg) was found in the alluvial fan area. The two basins containing the highest sediment arsenic concentrations occur in borderline areas between alluvial fans and basin troughs with one basin additionally influenced by the Goose Lake Bed.

Four additional studies were conducted during the 1988 and 1989 surveys. These special studies included: reviewing sediment concentration as water travels through an in-series basin system where water is transferred cell by cell until final concentration; conducting transects across individual cells within selected basins to determine spacial sample variability; analyzing the potential accumulation of uranium by-products; and evaluating selected cells' potential to exceed hazardous waste soluble threshold limit concentrations as defined in Sections 66900 and 66699, Title 22, California Code of Regulations.

Following trace elements, sediment concentrations through an in-series basin demonstrated some trends but also pointed out many inconsistencies. Boron, molybdenum, nickel, and uranium all appear to become more concentrated in the sediment as the pond cells progress in-series to final evaporation. However, in a number of instances, the highest, as well as the lowest sediment trace element concentrations, fell within the mid-range cell and not in either the inflow or final cells. The reasons for the inconsistencies are unexplained.

During surveys conducted in 1987 and 1989, separate sediment samples were collected across the center of selected cells within three basins. The transects were conducted to determine if grab samples collected at the edge of a cell were representative of the sediment concentrations throughout the cell. Results from the transects were variable for different basins and cells. In some cases, selenium concentrations could show a 3-fold increase based on cell sample location (i.e., 14 mg/Kg selenium, as compared to 49 mg/Kg selenium). Yet in other locations, the variability appeared insignificant with a selenium range of 0.88 mg/Kg to 1.09 mg/Kg and a standard deviation for split samples of 0.37 mg/Kg. All the elements sampled showed deviation based on sample location. The extent of the deviation depended more upon the basin sampled than the element itself. Most grab samples collected appeared to under-estimate the cells' average concentration with the notable exception of grab samples collected at a basin on Lake Bed deposits. Grab samples from the edge of the basin on Lake Bed deposits, all overestimated the average cell concentration. The past history of wetting and drying of each cell appeared to influence the relative sediment concentrations within that cell. Areas where water historically has remained the longest (or ponded up) during the cell's drying cycle contained the highest sediment concentrations for elements known to remain in the water column--notably arsenic, selenium, molybdenum, and uranium.

The radiological scan, conducted on the sediments collected during the 1989 survey, demonstrated that the pond sediments are in gross disequilibrium with respect to uranium and radium. With sediment, uranium concentrations ranging from 1 mg/Kg to 290 mg/Kg, a proportionally high level of radium (a uranium by-product), was expected. Radium is of concern due to its easy incorporation into bone leading to malignancies (Schroeder et al, 1988).

Calculated radium levels in the pond sediments did not exceed 6.9 pCi/gm. A scan of gross gamma-equivalent uranium (a measure of the expected uranium activity based on daughter products present) confirmed the low levels reported. These findings support both the similar disequilibrium between uranium and radium found in the water column (Chilcott et al, 1990) and the assumption that radium does not readily travel with groundwater uranium due to radium's limited mobility (Levinson and Coetzee, 1978).

Although the total arsenic and selenium sediment concentrations had not exceeded the Hazardous Waste limit threshold for solid material, there was concern that some sediment may exceed the Hazardous Waste soluble threshold limit. Therefore, 24 samples of known elevated arsenic and selenium concentrations were analyzed using the waste extraction techniques (WET) as defined in Section 66700, Title 22, California Code of Regulations. None of the results exceeded the soluble threshold limits of 5 mg/L and 1 mg/L for arsenic and selenium, respectively. However, three basins did approach the limits. These basins were Lost Hills Ranch and Carmel Ranch for arsenic and Sumner Peck for selenium. Sediment from the three basins will continue to be monitored using the WET to determine any concentration changes.

BACKGROUND

In early 1985, the State Water Resources Control Board found the evaporation and disposal of agricultural subsurface drainage water in Kesterson Reservoir to be hazardous to the environment and ordered the site cleaned up. The principal concern was the trace element selenium which was linked to waterfowl deaths and deformities at the site; however, data presented in the hearings also showed elevated levels of chromium, copper, nickel, zinc, and other trace elements in the drainage water entering Kesterson Reservoir. Concern was also expressed at the hearings that other sites within the San Joaquin Valley that were being used to store and evaporate agricultural subsurface drainage water were creating similar hazards to the environment.

Water and sediment quality surveys were conducted in December 1986 and June 1987 by the Central Valley Regional Water Quality Control Board (RWQCB). The purpose and results of the survey are discussed in detail in *Water and Sediment Quality in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California*, (Westcot et al, 1988a) and *Uranium Level in Water in Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California* (Westcot et al, 1988b). Primarily, the information was used to begin the determination of baseline concentrations of selected elements in the basins and evaluate the concentrations as related to Chapter 15 of the California Code of Regulations (CCR), Title 23, Sections 2510-2601 and the Hazardous Waste Criteria found in CCR, Title 22, Section 66699 as it applies to the Toxics Pits Cleanup Act of 1984 (TPCA).

The surveys indicated that TPCA no longer appears to be a concern for the majority of the ponds. However, since the surveys, numerous adverse reproductive effects, including elevated rates of teratogenesis, reduced hatchability, and complete reproductive failure, have been reported for waterbirds using selected evaporation basins.

This report documents follow-up sediment quality surveys conducted by staff during 1988 and 1989 to characterize sediment quality in the basins and define the present concentration of selenium and other trace elements found in the basins. The study area and field and laboratory methods used are described in the following sections along with a discussion of existing levels of selected constituents in the basins. Water quality results from the 1988 and 1989 surveys are discussed in a companion report *Water Quality of Agricultural Evaporation Basins Used for the Disposal of Agricultural Subsurface Drainage Water in the San Joaquin Valley, California 1988 to 1989*, (Chilcott et al, 1990).

An additional survey conducted by staff in 1990, will be presented in a separate report.

STUDY AREA

There are presently 28 separate evaporation basins in different hydrogeologic areas of the San Joaquin Valley. The locations of these basins range from Gustine in the north to near Bakersfield in the south. The greatest concentration of basins lies along the edges of the former Tulare Lake Bed (Figure 1). Most of the evaporation basins (23) are privately-owned and serve individual farms. These twenty-three sites, however, make up only 55 percent of

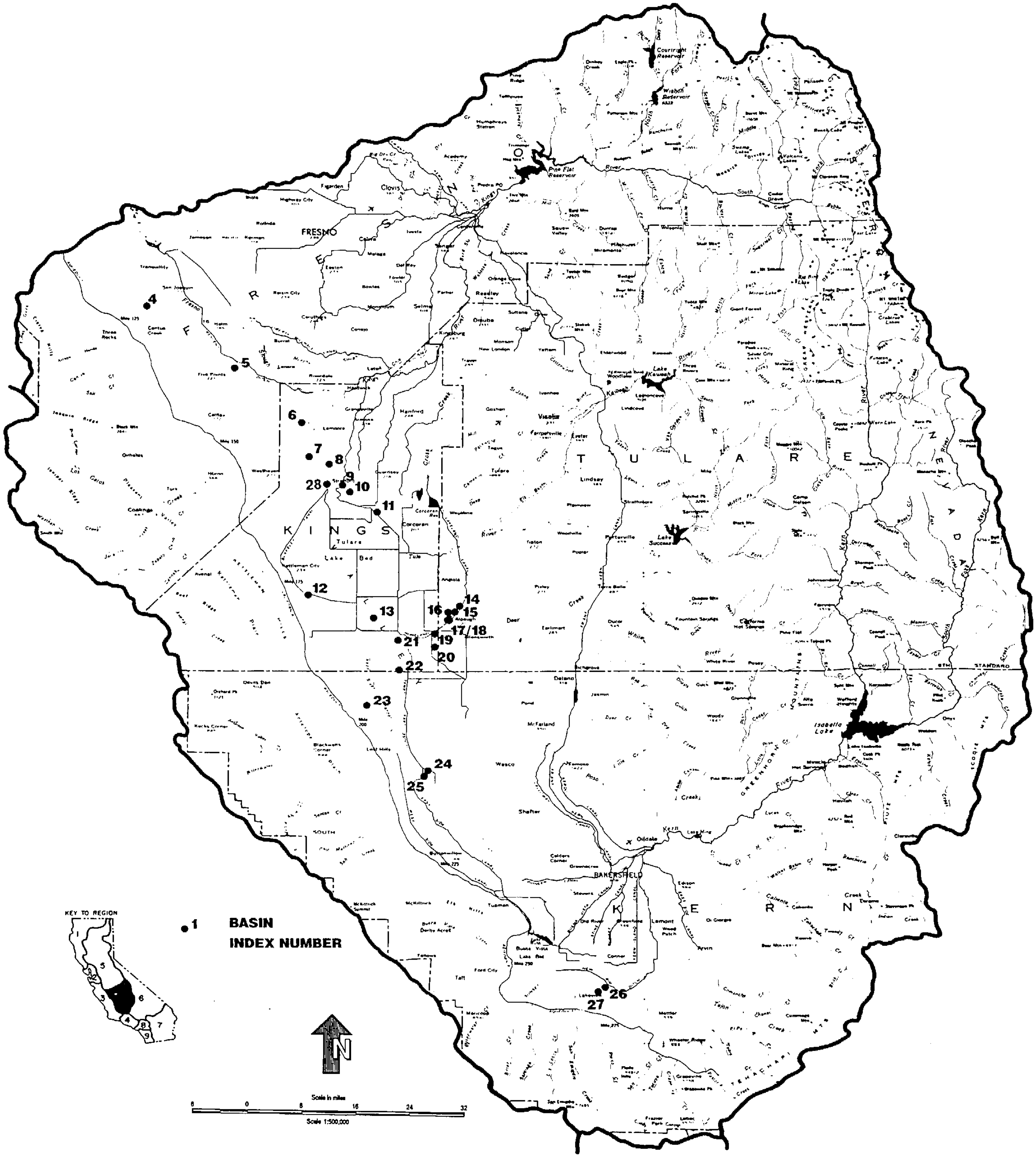


FIG. 1. LOCATION OF AGRICULTURAL EVAPORATION BASINS IN THE TULARE BASIN.

the ponded acreage. The remaining 45 percent of the ponded acreage is operated by two drainage districts. Present facilities cover a total of 7,170 acres, with basin sizes ranging from 10 to 1,800 acres; however, six of the facilities are currently inactive (Table 1). The remaining 22 facilities have 80 individual cells and 46 inlets which result in a large variability in water quality. An additional 10,000 to 20,000 acres of evaporation basins are in various stages of planning and development in the San Joaquin Valley. Further development is being delayed by environmental concerns.

The San Joaquin Valley evaporation basins consist of three types:

1. In-Series

   Multiple cells within a basin.
   Single or multiple inflow points from drainage collection systems.
   Increasingly concentrated water is routed to succeeding sells.
   Last cell or cells serve as final evaporation and salt deposition site.

2. Unicellular-wet

   Single-celled basin which does not evaporate to dryness.

3. Unicellular-dry

   Single-celled basin which evaporates to dryness each year.

Some basins are combinations of these three types due to operation and location of the inlets to the basin.

FIELD SURVEYS AND DATA COLLECTION

Past inspections of each evaporation basin were conducted from 1 to 3 December 1986 and from 8 to 11 June 1987 (Westcot et al, 1988). Current inspections were conducted on 7 and 8 June 1988 and on 6 and 7 June 1989. Not all basins were accessible or contained water during each survey period. Waterfowl use on the date of inspection was recorded along with field measurements of water depth, water temperature, and pH for each cell and inlet at the evaporation basin site.

Sediment samples were collected as a composite from the 0 to 7 cm (0 to 3 inch) layer for each evaporation cell that contained or had contained subsurface drainage water. Most cells contained several layers within this 0 to 7 cm depth including an organic muck layer. This organic-rich layer was often in an anaerobic condition or caused the sediments immediately under this layer to be anaerobic. This organic-rich layer was included as part of the bottom accumulations samples.

Samples were collected from each basin at the point of water sample collection. The sediment was collected using a plastic scoop which had been rinsed in the basin water prior to insertion in the bottom muck. Approximately 200 grams of sediment was spooned into a plastic freezer bag, the excess air expelled from the container, and the sample double bagged in a second freezer bag. Each sample was then stored on ice.

Table 1. Characteristics of Evaporation Basins Located in the San Joaquin Valley

BASIN NUMBER [1]	BASIN NAME	COUNTY	1st YEAR OPERATION	BASIN SIZE (acres)	BASIN TYPE [2]	GEOLOGIC SETTING [3]	CELLS [4]	INLETS [5]
1	Souza	Merced	unknown	10	2	Basin	1	4
2 *	Lindemann	Merced	unknown	100	2	Basin	1	1
3 *	Britz South Dos Palos	Merced	1985	50	1	Basin	2	1
4	Sumner Peck	Fresno	1984	120	1	Alluvial	6	3
5	Britz Deavenport - Five Points	Fresno	1982	20	2	Alluvial	2	1
6	Stone Land Company	Kings	1984	200	2	Basin	3	5
7 *	Carlton Duty	Kings	1983	80	2	Basin	1	2
8	Westlake 1 & 2 (North)	Kings	1984	260	2	Basin	2	3
9	Meyers Ranch	Kings	1983	80	1	Basin	3	1
10	Barbizon Farms	Kings	1985	70	2	Basin	1	2
11	TLDD North	Kings	1974	265	1	Lake	7	1
12	Westlake 3 (South)	Kings	1984	740	1	Lake	6	2
13	Liberty Farms (J-W Farms)	Kings	1981	640	3	Lake	4	5
14	Pryse Farms	Tulare	1985	80	1	Lake	2	1
15	Bowman Farms	Tulare	1981	70	3	Lake	3	2
16	Morris Farms	Tulare	1985	40	3	Lake	1	1
17	Martin Farms	Tulare	1985	15	2	Lake	1	1
18 *	Smith Farms	Tulare	1985	10	3	Lake	1	1
19	Four - J Corporation	Kings	1985	30	3	Lake	1	2
20 *	Nickell	Kings	1985	20	3	Lake	1	1
21	TLDD Hacienda Ranch	Kings	1978	1100	1	Lake	8	1
22	TLDD South	Kings/Kern	1978	1800	1	Lake	11	1
23	Lost Hills (Westfarmers)	Kern	1984	790	1	Alluvial	4	3
24	Carmel Ranch (Willow Creek)	Kern	1972	300	1	Lake	6	3
25	Lost Hills Ranch	Kern	1981	100	1	Lake	3	1
26	Rainbow Ranch (Sam Andrews)	Kern	1983	105	1	Alluvial	4	2
27 *	Chevron Land Company	Kern	1985	65	1	Alluvial	4	2
28 #	Fabry	Kings	unknown	10	2	Basin	1	1

[1] Basin number corresponds to identification numbers used in Figure 1.

[2] Basin Types are: 1) in-series; 2) uni-cellular - remains wet year round; 3) uni-cellular - evaporates to dryness annually (see text for more detail)

[3] Geologic Setting: Site underlain by Alluvial Fan, Basin Trough, or Lake Bed type sedimentary deposits (see text for more detail)

[4] Cells are separate evaporation units. Cells in at least 7 basins are further divided into subcells by windbreaks, levees, or multiple inlets. The total number of cells + subcells is 109.

[5] Multiple inlets may exist within individual cells or basins: see individual site descriptions for further details.

* not currently active

\# not sampled during 1988 or 1989

Sediment transects were taken from selected ponds using a modified brass Eckman bottom dredge to collect the first three inches of pond bottom. After the Eckman was hoisted, drained of water, and emptied, the sample was scraped to expose the middle area which had not come into contact with the brass sampler. Using a plastic spoon, this middle sediment was transferred to a plastic freezer bag. This process was repeated a minimum of three times at each point in the transect. The repetition allowed a composite of each sample location. The Eckman was thoroughly rinsed with pond water before moving to the next point in the transect. The composite of each transect site was double bagged and stored on ice.

To process for analyses, each sediment sample was transferred to a 500 ml polyethylene, widemouth jar using disposable wooden tongue depressors. The samples were then stirred and air-dried in a ventilated area. When the samples were dry (approximately one day to two weeks), they were sent to the analyzing laboratory where each was ground to 200 mesh, homogenized, and analyzed. The two laboratories utilized during the surveys were the soils laboratory at Colorado State University (CSU) in Fort Collins, and Natural Resources Laboratory (NRL) in Golden, Colorado. Analyses conducted on the sediments are listed in Table 2. Complete analyses conducted by each of the respective laboratories and the corresponding detection limits are listed at the beginning of Appendix A. In

Table 2. Analyses Performed on Evaporation Pond Sediments, 1986 through 1989

TRACE ELEMENTS	MINERALS	OTHER
Aluminum	Boron	Arsenic Extract (WET)
Arsenic	Calcium	Selenium Extract (WET)
Barium	Magnesium	Boron Extract (WET)
Cadmium	Sodium	% Saturation
Chromium	Potassium	% Total Organic Carbon
Copper	Phosphorous	equivalent uranium
Iron		equivalet thorium
Lead		equivalent gross gamma uranium
Manganese		percent potassium
Mercury		
Molybdenum		
Nickel		
Selenium		
Strontium		
Titanium		
Uranium		
Vanadium		
Zinc		

general, CSU conducted general mineral, trace element, and total organic carbon analyses while NRL analyzed for total uranium. During the 1989 survey, CSU also conducted a waste extraction test (WET) for boron, selenium, and arsenic and NRL ran a full radiological scan for equivalent uranium (eU), equivalent thorium (eTh), gross gamma uranium [eU(GG)], and percent potassium (%K). Information from the radiologic data can be used to calculate activity of radium using the following equations (Levinson and Coetzee, 1978)

$$\text{Ra-226 (pCi/gm)} = \text{eU (ppm)} \times 0.334$$

$$\text{Ra-228 (pCi/gm)} = \text{eTh (ppm)} \times 0.110$$

(assumes Th-228/Ra-228 in equilibrium)

Where pCi/gm is equal to picocuries per gram with one curie equaling a unit of activity which in turn equals 2.22×10^{12} decays per minute.

A quality control and quality assurance program was conducted during each survey. Ten percent blind duplicate samples were submitted to each laboratory. In addition, the laboratories used internal duplicates, spikes, and standards during analyses. Reported results fall within quality assurance tolerance guidelines for sediment analysis and are on file at the Sacramento RWQCB office.

RESULTS

Results for all the individual sediment analyses are listed by evaporation basin in appendices A, B, and C. Appendix A lists mineral percentages for the sediments while Appendices B and C list trace elements and radiologic results, respectively. Data for total organic carbon, uranium, and results for the boron waste extraction technique (WET) tests are included in Appendix B.

General

Sediment samples were collected from 95 locations in 1988 and 90 locations in 1989. The geometric means and ranges for the pond sediments were compared to three geologic backgrounds: a baseline, a California average, and data from pond 2 at Kesterson Reservoir (Table 3). The baseline was derived from concentrations found in soils of the western United States as described by Shacklette et al (1984). The California average sediment concentrations were determined by Pettygrove and Asano (1984). The values for Kesterson Reservoir, Pond 2, represent an environment of known wildfowl deformities. The actual information was collected by the U.S. Bureau of Reclamation and presented in a report by the U.S. Geological Survey (Fujii, 1988).

For the 15 elements for which a comparison was possible, only the geometric means of molybdenum and boron greatly exceeded means for the comparison data. However, for three additional elements, the high end of the evaporation pond concentration range far exceeded those of the comparisons. The three elements included arsenic, selenium, and uranium. These three elements, in addition to molybdenum, boron and vanadium, were found in highly elevated concentrations in the water column (Chilcott et al, 1990). All five will be discussed in this report.

Table 3. 1988 and 1989 Evaporation Pond Sediment Concentrations Compared to Three Geologic Backgrounds

ELEMENT	BASINS	BASELINE geometric mean (ppm) (range)	CA MEAN	KR2
Arsenic	8.74 (1.38 - 181)	5.5 (<.01 - 97)		<10
Barium	148 (22.5 - 477)	580 (70 - 5000)		820
Boron	112 (18.9 - 472)	23 (<20 - 300)		
Cadmium	0.45 (<1.0 - 4.0)		0.34	<2
Chromium	39.3 (7.52 - 246)	41 (3.0 - 2000)	15.4	45
Copper	18 (2.28 - 50.4)	21 (2 - 300)	14.6	9
Lead	8.57 (<5.00 - 473)	17 (<10 - 700)	16.6	20
Mercury	0.03 (<0.05 - 0.50)	0.046 (<.01 - 4.6)		
Molybdenum	11.6 (1.30 - 283)	0.85 (<3 - 7)		<2
Nickel	25.7 (3.75 - 114)	15 (<5 - 700)	14.1	32
Selenium	0.52 (0.05 - 15)	0.23 (<.10 - 4.3)		5.2
Strontium	252 (51.1 - 2070)	200 (10 - 3000)		330
Uranium	9.33 (1.00 - 290)	2.5 (.68 - 7.9)		<100
Vanadium	55.7 (11.0 - 181)	70 (7 - 500)		55
Zinc	48.1 (7.05 - 176)	55 (10 - 2100)	60.4	39
% Total Organic Carbon	0.67 (0.07 - 4.80)			

Baseline: concentration ranges, Western U.S. (Shacklette, et al., 1984)
CA Mean: California Background Mean (University of California, Davis, 1984)
KR2: Kesterson Reservoir, Pond 2, May 1985 (Fujii, 1988)

Arsenic concentrations ranged from 1.38 to 188 mg/Kg in the pond sediment. The geometric mean of 8.74 mg/Kg does not greatly exceed the baseline mean for soils of the western states (5.5 mg/Kg) or the concentration found at Kesterson Reservoir (<10 mg/Kg). The highest baseline arsenic concentration was reported at 97 mg/Kg. Figure 2 presents the percent of basin acreage which fell into selected concentration ranges during the various surveys. The percentages remained fairly constant over time. Approximately 60% of the basin acreage had concentrations less than the Kesterson background of <10 mg/Kg. Another 25% of the acreage fell within the range of 10 to 25 mg/Kg which falls within the high end of the baseline range. The remaining 15% of acreage had arsenic concentrations exceeding 25 mg/Kg. Four basins represented the elevated concentrations, two near the Alpaugh group and two in the Goose Lake Bed Area. The Alpaugh group ponds averaged near 50 mg/Kg arsenic. The Goose Lake area ponds contained the highest concentrations with averages near 100 mg/Kg.

Molybdenum concentrations in the basin sediments consistently exceeded the baseline values for soils of the western states. The lowest value for the pond sediment (1.30 mg/Kg) is higher than the mean of the western states (0.85 mg/Kg). The highest detected pond sediment molybdenum, 283 mg/Kg, greatly exceeds the highest baseline value reported of 7.0 mg/Kg. Figure 3 compares the molybdenum data to the percentage of acreage falling within selected concentration ranges. Figure 3 indicates that molybdenum may have increased in the sediment over time. Between 1986 and 1989, acreage with concentrations less than 7 mg/Kg (the maximum baseline value) dropped from 54% to roughly 20%. Increases in percentages of acreages occurred in both the 5 - 25 mg/Kg range as well as the 25 - 50 mg/Kg range. The percent of basin acreages with the highest molybdenum concentration (>50 mg/Kg) has remained fairly constant over the surveys at approximately 15%. The highest values were found consistently at TLDD Hacienda in the Tulare Lake Bed and Carmel Ranch in the Goose Lake Bed, although not always in the same cells. Other high values have been detected in basins from all parts of the survey areas. The one consistency in sites with elevated concentrations was that the cells were approaching dryness.

Basin sediment selenium concentrations ranged from <0.05 mg/Kg to 15 mg/Kg. The basin geometric mean was 0.52 mg/Kg, slightly higher than the western states' mean (0.23 mg/Kg) but considerably lower than the concentration found at Kesterson Pond 2 (5.2 mg/Kg). During the 1988 and 1989 surveys, only nine of 183 analyses exceeded the maximum baseline range of 4.3 mg/Kg. Seven of these samples exceeded the Kesterson value. These samples occurred consistently at Sumner Peck (Basin 4) and, in 1989, at Sam Andrews Basin (Basin 26). Percentage of acreage containing selected ranges of sediment selenium are presented in Figure 4 by survey year. Little change was seen in the overall acreages represented by the different concentration ranges between 1986 and 1989. Roughly 80% of the acreage represented values within a baseline range of <0.1 to 4.3 mg/Kg. In 1988, only 2% of the acreage exceeded the maximum range, while in 1989, 17% exceeded 4 mg/Kg. The increase was primarily due to increasing concentrations being found at Sam Andrews Basin.

Soil sediment uranium concentrations were only analyzed during the 1989 survey. Values ranged from 1 mg/Kg to 290 mg/Kg. The basin geometric mean concentration of 9.33 mg/Kg uranium exceeds the highest baseline value for soils of the western states (7.9 mg/Kg). Samples collected from agricultural lands within the Sacramento-San Joaquin Delta of California indicated sediment uranium concentrations ranging from 40 to 120 mg/Kg (Lindeken et al, date unknown).

Figure 2. Percent of Ponded Acreage Containing Selected Concentrations of Sediment Arsenic, 1986 through 1989

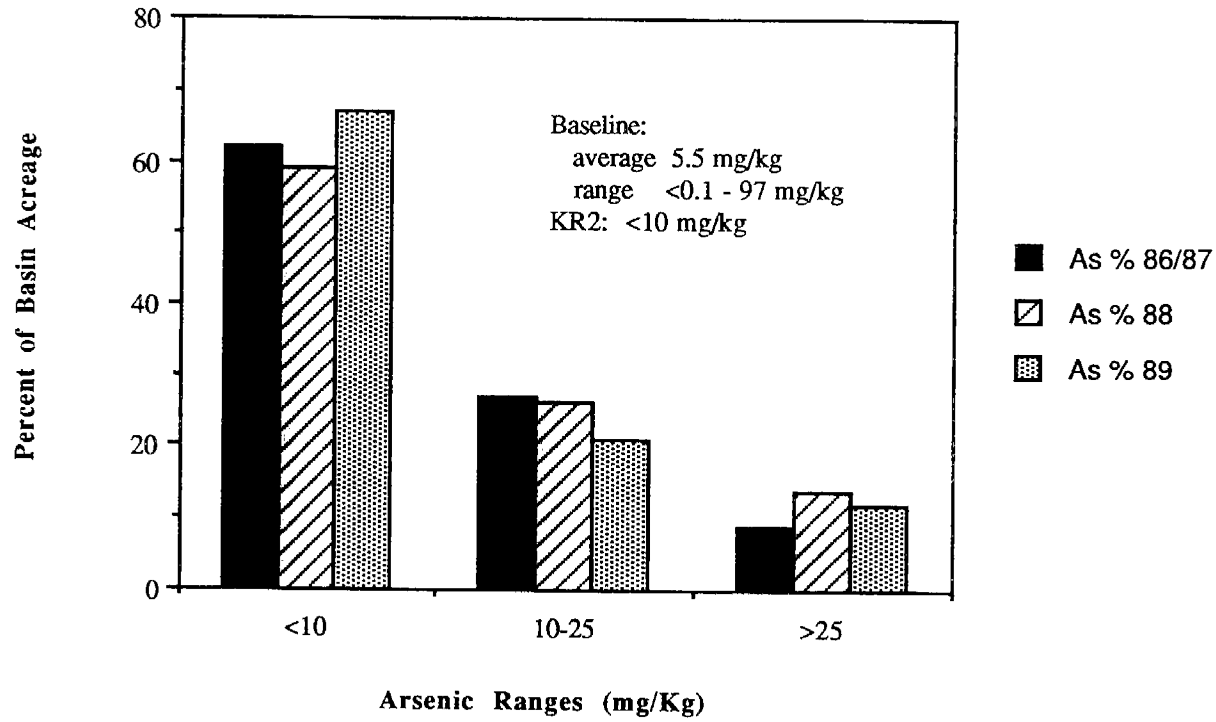


Figure 3. Percent of Ponded Acreage Containing Selected Concentrations of Sediment Molybdenum, 1986 through 1989

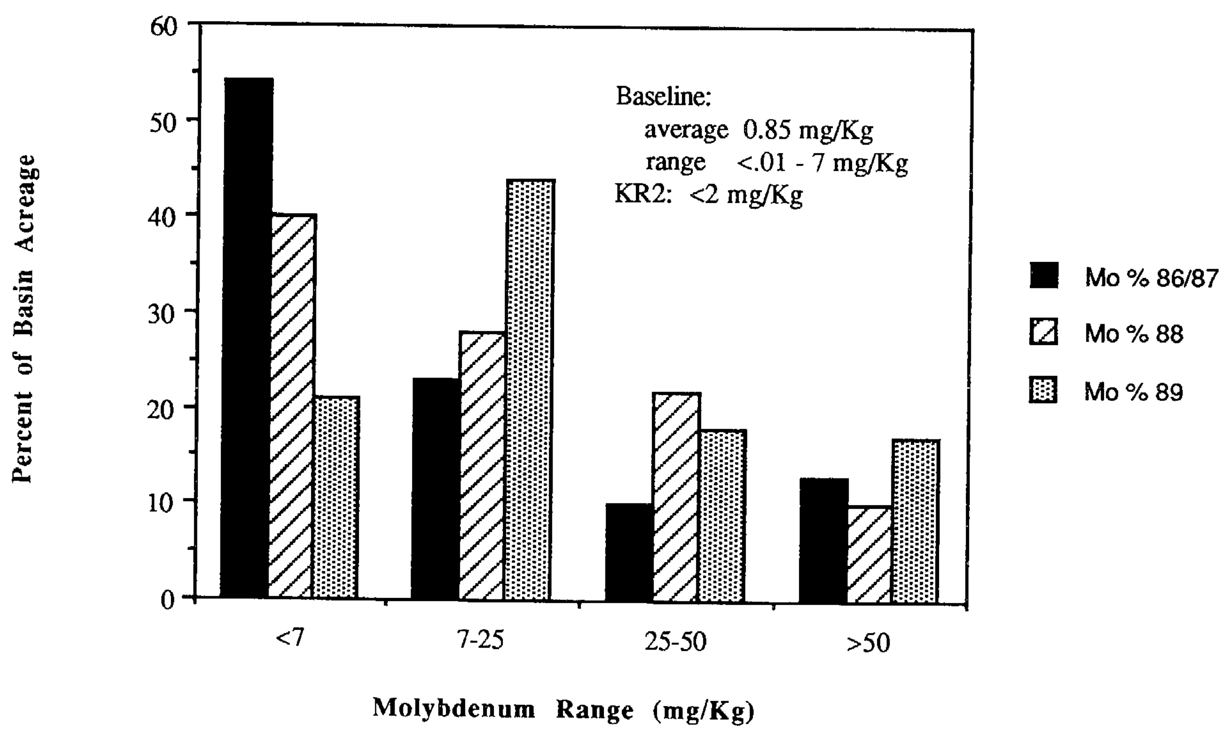
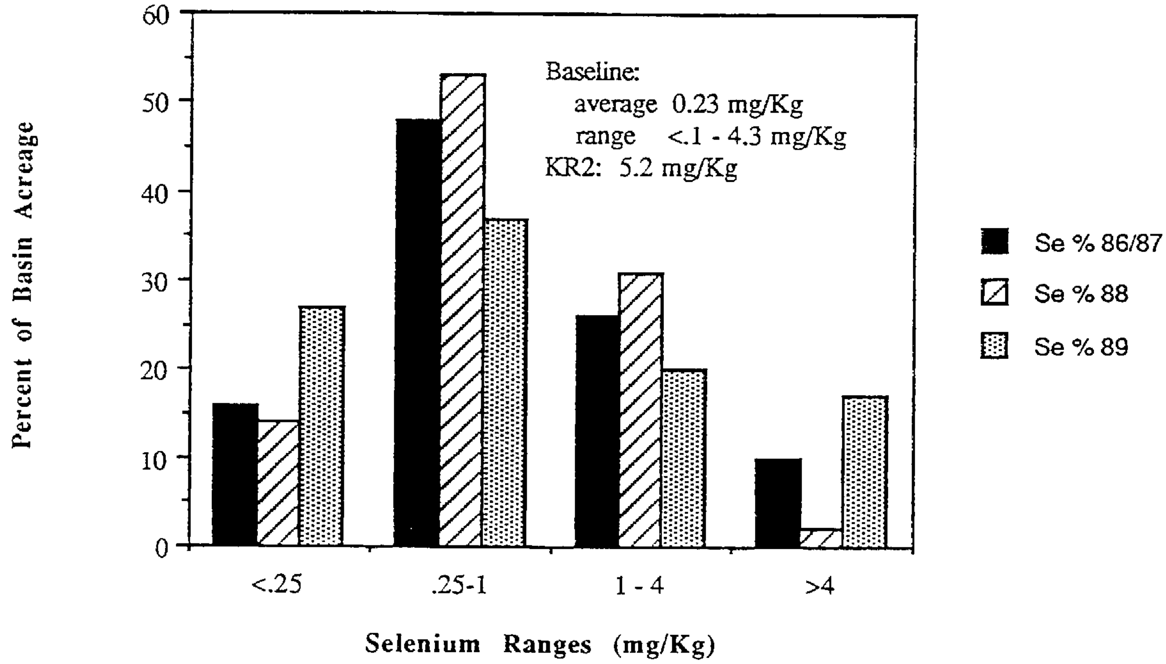


Figure 4. Percent of Ponded Acreage Containing Selected Concentrations of Sediment Selenium, 1986 through 1989



However, these values were converted from activities and may not be entirely accurate (discussed in a later section on radiological data). Phosphate rock, the raw material for production of superphosphate fertilizers, often contains uranium concentrations in the range of 120 to 300 mg/Kg. Percentages of evaporation basin acreage within selected sediment uranium concentrations are shown in Figure 5. Approximately half (52%) of the basin acreage contained less than 10 mg/Kg uranium. Almost 40% of the acreage fell within 10 to 50 mg/Kg uranium. The remaining 8% of ponded land contained greater than 50 mg/Kg uranium in the sediment, with only two basins with exceptionally high values. Those basins were #17, Martin Farms (290 mg/Kg) and #24, Carmel Ranch (61 to 180 mg/Kg).

Both boron and vanadium concentrations were found to be elevated in the water column of the basins (Chilcott et al, 1990) but the levels in the sediment were more difficult to evaluate. During the 1988 and 1989 surveys, sediment boron ranged from 18.9 to 472 mg/Kg with a geometric mean of 112 mg/Kg. The baseline mean for boron in soils of the western United States was reported at 23 mg/Kg with a high value of 300 mg/Kg (Shacklette et al., 1984). Only two evaporation basins contained sediment boron levels exceeding 300 mg/Kg. In contrast, only one sample contained less boron than the baseline mean of 23 mg/Kg. Figure 6 shows the percentage of acreage falling in respective boron concentration ranges.

Basin sediment vanadium concentrations ranged from 11 to 180 mg/Kg with a geometric mean of 56 mg/Kg. The range and mean are below the baseline vanadium range of 7 to 500 mg/Kg and mean of 70 mg/Kg found for soils in the western United States (Shacklette et al, 1984).

Figure 5. Percent of Ponded Acreage Containing Selected Concentrations of Sediment Uranium, 1989

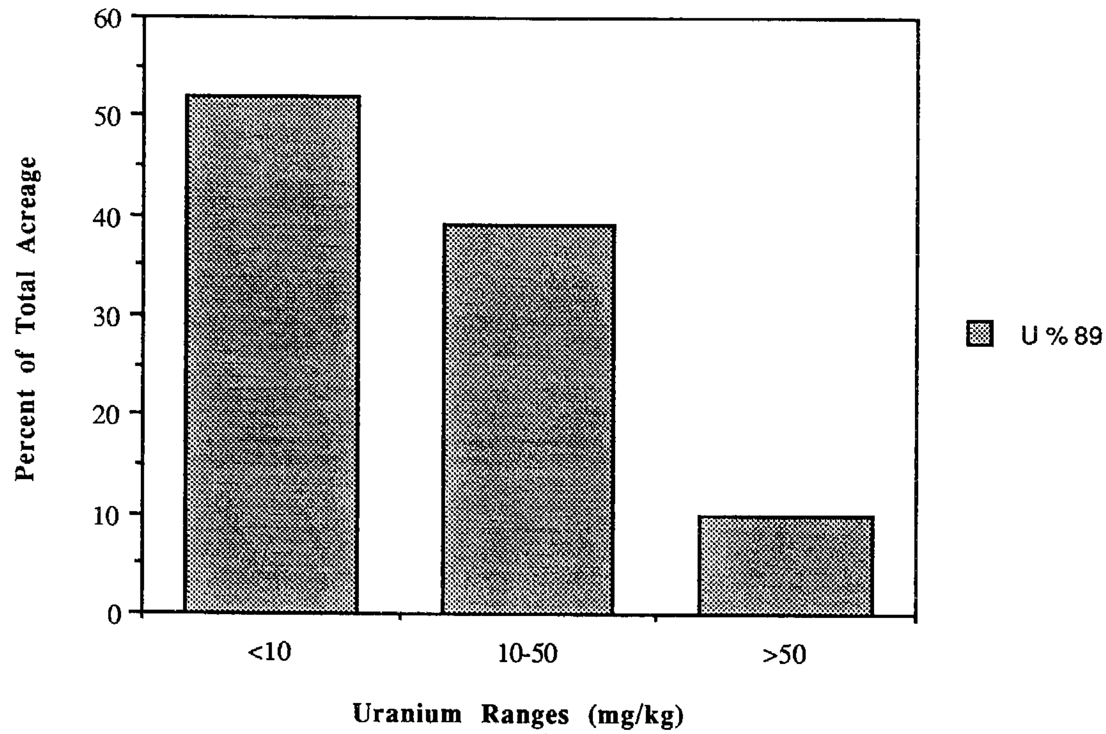
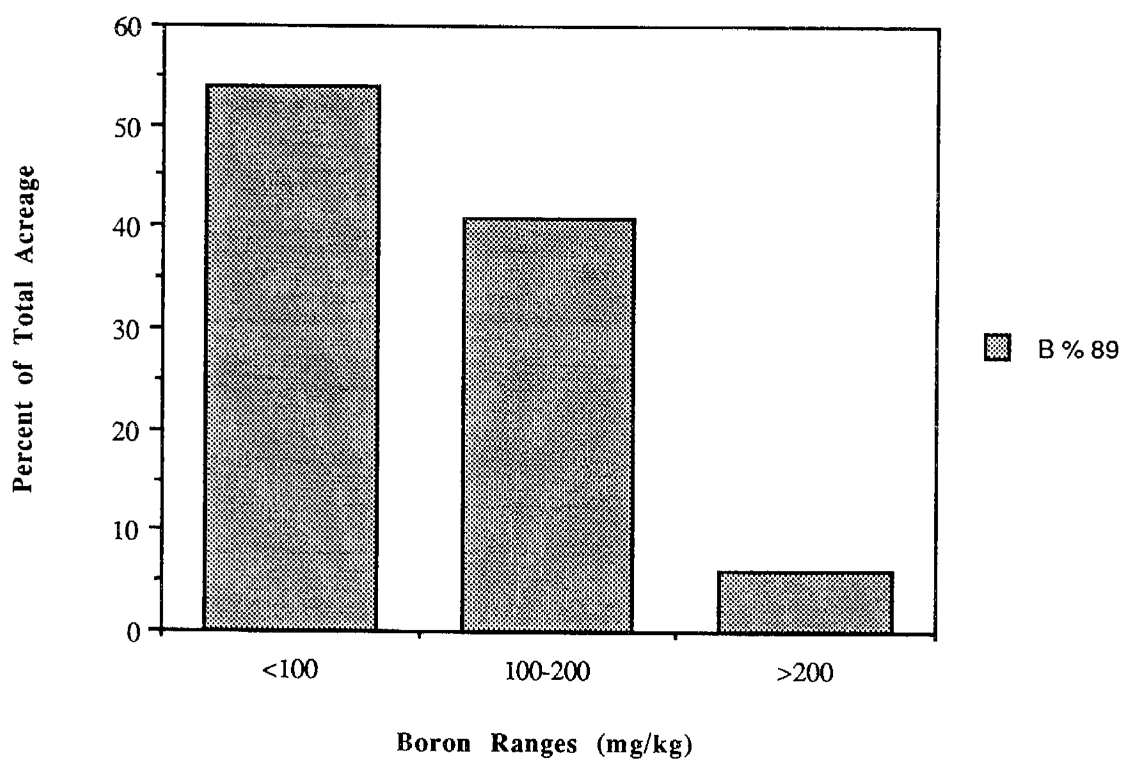


Figure 6. Percent of Ponded Acreage Containing Selected Concentrations of Sediment Boron, 1989



The percent of total organic carbon (TOC) was also calculated for the basin sediments and ranged from 0.07% to 4.8%. It was hypothesized that selected elements found in elevated concentrations would correspond to elevated TOC concentrations. Sediment arsenic, selenium, molybdenum, and uranium concentrations were plotted against the corresponding TOC concentrations in the samples (Figure 7). Poor correlation was observed with R^2 values of 0.202, 0.011, 0.240, and 0.287 for arsenic, selenium, molybdenum, and uranium, respectively. Therefore, the TOC content does not appear at this time to be the determining factor in selected trace element concentrations in basin sediment samples. However, further investigations should be conducted on the importance of the surface layer of organic material evident in a number of the basins.

Influence of Geologic Setting

The evaporation basins in the lower San Joaquin Valley are located on soils derived primarily from three different geologic units (Figure 8). As described by Page (1986) and Croft (1972), these units are:

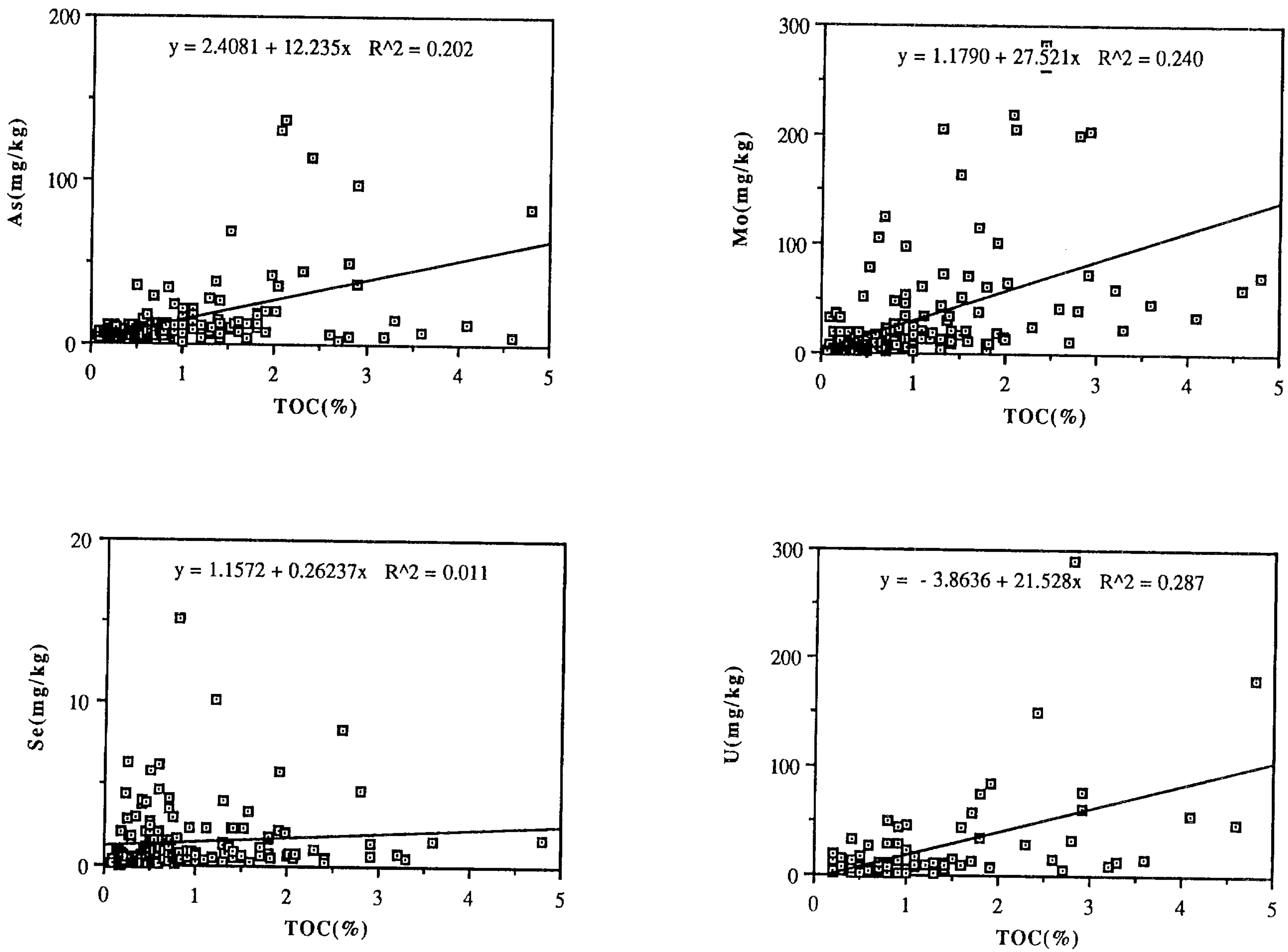
a) Lacustrine and marsh deposits of Tertiary to Holocene age which under-lie the ancient lake bed areas (now farmland) of the lower San Joaquin Valley. The Lacustrine and marsh deposits consist chiefly of clay and silt and underlie the Tulare, Goose, Buena Vista and Kern Lake Beds. These deposits are of mixed Coast Range and Sierra Nevada origin;

b) Continental alluvial deposits of Tertiary to Holocene age which include a heterogeneous mix of generally poorly sorted clay, silt, sand, and gravel commonly deposited in alluvial fans. In the present study area, these alluvial fans are located along the western flank and southern end of the San Joaquin Valley and originated in the Coast Range;

c) Flood-basin deposits of Holocene age which crop out in low-lying areas in the basin (valley) trough. They result from flood waters entering low-lying basins and depositing mostly fine silt and clay and some fine sand derived from both the Coast Range and the Sierra Nevada. These deposits interfinger with and/or grade into the lacustrine and marsh deposits and the alluvial fan deposits.

Table 4 presents a summary of the trace element content of the sediment samples based on geologic setting. Some of the trace elements such as boron, uranium and selenium appear to have a fairly close relationship between sediment concentration and geologic setting, while others have a less defined association. For all the elements evaluated, the highest sediment geometric mean concentrations were found in the same geologic settings as the highest geometric means for water (Chilcott et al, 1990). However, only selenium sediment geometric means followed the trend in water geometric means for all the geologic settings. The remaining elements contained the lowest sediment geometric means in the settings which contained intermediate water geometric means. Some of the differences may be due to water management of individual cells and sample location rather than the geologic setting as is discussed in the section on sediment transects.

Figure 7. Comparison of Sediment Arsenic, Selenium, Molybdenum, and Uranium Concentrations with Percent Total Organic Carbon (TOC), 1988 and 1989 Data



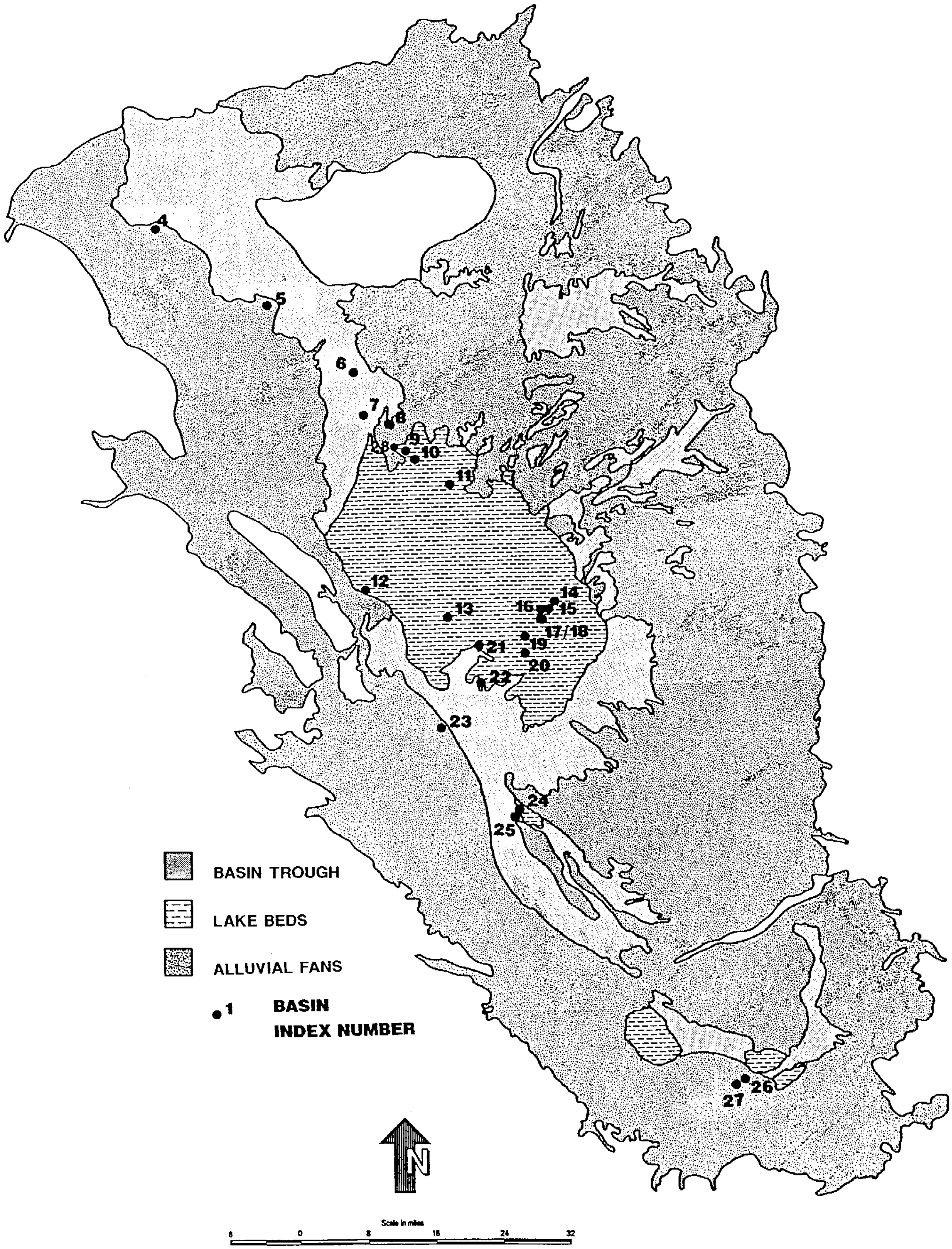


Figure 8. Location of Agricultural Evaporation Basins in Geologic Settings of the Tulare Basin (Taken from Westcot et al., 1988a)

Table 4. Selected Trace Element and Total Organic carbon Concentrations for Evaporation Basin Sediments as Influenced by Geological Setting in the San Joaquin Valley of California, 1988 - 1989.

CONSTITUENT	GEOLOGIC SETTING geometric mean (range)			
	Alluvial Fan	Basin Trough	Lake Bed	Baseline
Total Organic Carbon %	0.55 (0.16 - 2.6)	0.61 (0.07 - 4.6)	0.75 (0.09 - 4.8)	ND ND
B mg/Kg	155 (84 - 360)	140 (77 - 245)	91 (19 - 470)	23 (<20 - 300)
As mg/Kg	7.0 (1.4 - 180)	4.6 (2.0 - 13)	12 (2.5 - 140)	5.5 (<.01 - 97)
Se mg/Kg	1.9 (0.23 - 15)	0.12 (0.05 - 0.95)	0.44 (0.1 - 4.6)	0.23 (<.10 - 4.3)
Mo mg/Kg	5.6 (1.6 - 280)	7.9 (1.3 - 72)	19 (2.0 - 260)	0.85 (<3 - 7)
U mg/Kg	3.3 (1 - 15)	8.3 (1 - 55)	16 (2 - 290)	2.5 (.68 - 7.9)
V mg/Kg	58 (11 - 102)	57 (25 - 105)	54 (14 - 181)	70 (7 - 500)

Baseline values represent those reported for soils in the western United States (Shacklette et al., 1984)

For boron, the lowest values and the lowest geometric mean (91 mg/Kg) was found in the lake bed setting. However, this setting had the highest variability with a range of 19 to 472 mg/Kg. The highest geometric mean (155 mg/Kg) was found in the alluvial fan area, while the intermediate geometric mean (140 mg/Kg) was in the basin trough area. The highest values in the alluvial fan area are consistent with known boron enrichment of the area.

Uranium had the opposite relationship to boron. The lowest geometric mean (3.3 mg/Kg) was found in the alluvial fan, while the highest concentration (290 mg/Kg) and the highest geometric mean (16 mg/Kg) was in the lake bed area. As with boron, the intermediate geometric mean (8.3 mg/Kg) was in the basin trough area.

The highest selenium concentration (15 mg/Kg) and geometric mean (1.9 mg/Kg) was found in the alluvial fan deposits. The highest variability (0.23 to 15 mg/Kg) was also found in the alluvial fan setting. The lowest concentrations and geometric mean (0.12 mg/Kg) were found in the basin trough setting. This setting also had the lowest variability (0.05 to 0.95 mg/Kg). Samples from the basin trough setting generally had selenium concentrations intermediate to the two other settings.

Arsenic had the lowest geometric mean (4.6 mg/Kg) in the basin trough setting. The highest geometric mean (12 mg/Kg) was in the lake bed setting. However, the highest concentration (180 mg/Kg) was found in Basin 23 in the alluvial fan area. The highest concentration found in the lake bed setting (137 mg/Kg) was found in

Basin 25. Both Basins 23 and 25 occur in borderline areas between alluvial fans and basin troughs with Basin 25 additionally influenced by the Goose Lake Bed, a known arsenic enriched area.

Molybdenum appears to have a relationship between sediment concentration and geologic setting with the exception of one site, (Basin 25). Basin 25 is located in the alluvial fan area, and one cell has a value of 280 mg/Kg, the highest molybdenum concentration. The next highest value in the alluvial fan area is 42 mg/Kg in Basin 26. Excluding the one high concentration results in a range of 1.6 to 42 mg/Kg, the smallest range of the geologic settings. This limited range of concentration leaves the alluvial fan setting with the lowest geometric mean (5.6 mg/Kg). The next highest geometric means are the basin trough and lake bed settings with values of 7.9 mg/Kg and 19 mg/Kg, respectively.

Geometric means for vanadium were similar for all three geologic settings, with concentrations of 58 mg/Kg, 57 mg/Kg and 54 mg/Kg for the alluvial fan, basin trough, and lake bed areas, respectively. The three highest concentrations (161 mg/Kg, 178 mg/Kg, and 181 mg/Kg) were found in basins situated on lake bed deposits, but overall concentrations were relatively uniform over all geologic areas.

SPECIAL STUDIES

Trends for In-Series Basins

Three basins, TLDD North, TLDD Hacienda Ranch, and TLDD South, all operated as in-series basins during the 1989 survey. Inflow water circulated through the cell system until reaching a final evaporation cell. The sediment concentrations for selected elements, as they passed through the system, are presented in Table 5.

The series of cells presented for each basin is assuming the water travels as originally designed. In some instances, water may be diverted for a time. At TLDD South, water may travel from Cell 2 directly to Cell 6, bypassing a loop which includes Cells 3, 4, and 5. At the time of the 1989 survey, the three basins appeared to be operating as constructed.

Some general trends appear noticeable for boron, molybdenum, nickel, strontium, and uranium. However, these trends are not consistent. A measure of inconsistency is inherent in the grab sample sampling technique as discussed in the following section on transects. Other inconsistencies may include any number of potential environmental effects such as fluctuating water levels and flows, as well as temperature and redox conditions.

From the data collected in 1989, boron appears to become more concentrated in the sediment as the pond cells progress to final evaporation. A substantial increase was noted for each basin in the final cell's sediment boron level over the level in the inflow cell. The increase between each cell in a series was inconsistent. The data was insufficient, however, to conduct a statistical analysis.

Molybdenum, nickel, and uranium concentrations also followed a similar increase by progressive cells in series; however, more variability was noticed between

Table 5. 1989 Sediment Concentrations for Selected Elements in Basins in Series

Basin	Elements (mg/Kg)							
	B	As	Se	Mo	Ni	Sr	U	V
11 TLDD North								
inflow Cell 1	51	11.0	<0.25	7	15	541	6	58
Cell 2B	66	14.8	0.30	12	21	500	9	65
Cell 2A	90	15.9	0.45	23	29	390	14	85
Cell 3B	79	8.82	0.57	17	32	624	16	57
Cell 3A	49	6.34	<0.25	13	17	196	4	42
Cell 4	70	8.16	<0.25	53	24	228	14	42
Cell 5A	118	9.92	0.26	14	42	238	11	67
Cell 5B	77	9.09	<0.25	20	36	196	12	40
Cell 6	118	12.5	<0.25	13	47	152	10	63
Cell 7 (final)	132	13.4	<0.25	15	45	195	10	61
21 TLDD Hacienda Ranch								
East inflow C1	68	10.3	1.63	27	15	445	50	63
C2(a)	99	13.2	1.72	62	15	725	75	72
C2(b)	77	8.67	0.84	35	12	337	44	51
C3	91	13.2	1.21	115	15	351	57	51
C4 (final)	104	24.3	0.58	99	12	254	29	43
West inflow A1	50	7.65	0.60	17	11	365	27	47
A2(a)	60	7.25	0.67	19	12	349	33	47
A2(b)	92	6.69	0.26	9	18	117	13	49
A3	19	4.40	0.44	9	6	67	16	14
A4 (final)	89	7.80	0.30	20	13	102	19	42
22 TLDD South								
Inflow Cell 1	33	4.58	0.26	8	8	471	8	20
Cell 2	121	5.39	<0.25	10	18	323	2	32
Cell 3	89	8.48	0.33	6	18	309	6	46
Cell 4	80	6.50	0.87	22	16	465	12	38
Cell 5	125	10.1	<0.25	2	26	491	5	49
Cell 6	60	7.24	0.63	49	11	220	28	32
Cell 7	59	4.51	0.46	22	13	220	12	30
Cell 8	54	4.44	<0.25	8	10	385	12	24
Cell 9	77	3.42	<0.25	10	16	135	4	30
Cell 10 (final)	90	2.46	<0.25	3	20	210	7	32

cells within each basin. In a number of instances, the highest, as well as the lowest sediment trace element concentrations, fell within the mid-range cells and not in either the inflow or final cells. A more in-depth sampling program would need to be conducted to determine the statistical variability.

Strontium was an element consistently detected at higher concentrations in the sediment of the inflow cells rather than the sediment of the final cell. Such a trend may be due in part to strontium's rather low solubility relative to the other trace elements selected for comparison.

Vanadium sediment concentrations did not show any distinctive patterns based on water movement between cells. High and low concentrations appeared to be randomly distributed irregardless of waterflow. The irregular pattern was unexpected when compared to concentration patterns in the water column. Chilcott et al (1990), noted substantially higher vanadium concentrations in the inflow water to the basins (geometric mean of 54 μg/L) than in the basin water itself (geometric mean of 27 μg/L). The concentrations seen in the sediment do not indicate that vanadium is dropping out of solution as it enters a basin. A further review of the hydrogeochemistry of vanadium is warranted.

Transects

During surveys conducted in 1987 and 1989, separate sediment samples were collected across the center of selected cells within three basins. In 1987, these transects were conducted across Sumner Peck Cell 3, Sumner Peck Cell 5, and Stone Land Company SW Cell (b). During 1989, the transects were performed at Carmel Ranch Cell 5, Stone Land Company SW(b), and Stone Land Company North (a). The transects were conducted to determine if grab samples collected at the edge of a cell were representative of the sediment concentrations throughout the cell. Each 1987 sample was split 4 times to determine variability in sampling and analytical technique as opposed to location. Results are presented in Appendices C and D. Table 6 presents a summary of selected elements and lists the average concentrations by site and the average of the standard deviations for split samples by cell.

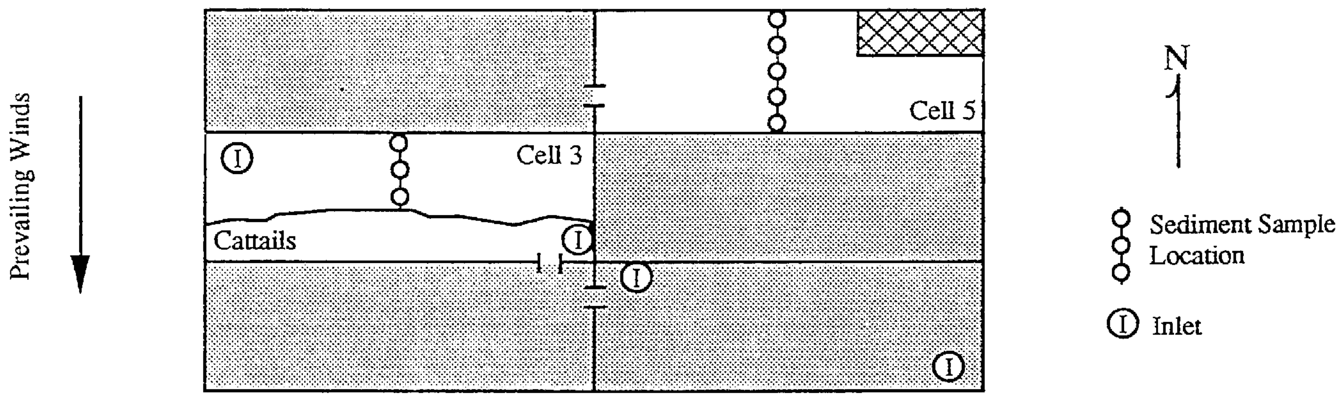
Each basin sampled in transect has different characteristics. Sumner Peck is a basin located on alluvial fan deposits. When sampled, Cell 5 contained 2 to 5 feet of water over the entire surface. Samples were collected from the north to the south, in the same direction as the prevailing wind. Cell 3 was also sampled in a north to south direction. Water levels in Cell 3 varied from 1 to 4 feet with the southern quarter of the cell overgrown with cattails. Samples were collected up to the northern edge of the cattails. An inlet is located in the northwest corner of Cell 3 (Figure 9).

Stone Land Company is located on basin soil deposits. During 1988, the southwest subcell "b" was sampled in transect from east to west. Water depth varied from 1 to 3 feet and distinctive layering was noticeable in the sediment samples. Within the upper two inches of sample was a layer of green decaying algae (approximately 1/4 inch thick) over a layer of black, anaerobic material with a strong sulfur smell (approximately 3/4 inch thick), overlying a gray clay material. Because of the striated pattern, additional separate samples of the green, as well as the black layers, were collected.

Table 6. Selected Mean Trace Element Concentrations for Evaporation Cell Transects, 1987 and 1989

ID	Site	Date	As	Se	Ni	Mo	Sr	Pb	V	U	B
			mg/Kg								
4	Sumner Peck Cell 5	6/9/87									
	North		7.19	17.80	37	6	310	5	54		
	mid North		6.23	19.03	39	9	434	8	48		
	mid Cell		5.60	17.59	33	6	500	6	44		
	mid South		6.09	21.00	39	8	448	7	45		
	South		6.81	22.78	45	8	364	8	50		
	-average		**6.38**	**19.64**	**39**	**7**	**411**	**7**	**48**		
	-ave. standard deviation		**0.23**	**1.88**	**3**	**10**	**39**	**9**	**6**		
4	Sumner Peck Cell 3	6/9/87									
	North		7.56	48.53	39	6	406	8	67		
	North (clay)		7.93	26.63	43	8	287	7	78		
	mid Cell		7.61	28.50	33	5	337	7	66		
	South		7.74	14.38	45	9	195	11	62		
	-average		**7.71**	**29.51**	**40**	**7**	**306**	**8**	**68**		
	-ave. standard deviation		**0.41**	**4.74**	**4**	**9**	**43**	**11**	**6**		
6	Stone Land Company SW(b)	6/10/87									
	East		4.41	1.09	53	37	688	6	41		
	mid East		7.35	1.55	55	59	>800	7	44		
	mid Cell		5.85	0.88	80	26	508	10	51		
	mid West		6.40	1.00	64	48	>800	8	44		
	West		7.74	0.91	80	49	582	10	48		
	-average		**6.35**	**1.09**	**66**	**44**	**593**	**8**	**45**		
	-ave. standard deviation		**0.39**	**0.37**	**4**	**12**	**42**	**10**	**5**		
	Algae		7.80	3.60	52	30	>800	7	50		
	Anaerobic layer		7.34	1.23	74	52	>800	10	51		
6	Stone Land Company SW(b)	6/8/89									
	East		5.52	0.86	52	42	1104	28	46	14	151
	mid East		7.20	1.10	41	63	2063	30	46	27	198
	mid Cell		7.27	1.25	46	76	3108	18	51	30	233
	mid West		8.05	1.53	45	89	2241	12	47	27	274
	West		6.72	1.35	52	89	1543	22	47	24	224
	-average		**6.95**	**1.22**	**47**	**72**	**2012**	**22**	**47**	**24**	**216**
	Composite		**6.80**	**1.15**	**46**	**67**	**2080**	**16**	**47**	**25**	**196**
6	Stone Land Company North(a)	6/8/89									
	East		7.29	0.43	69	45	1760	13	57	13	109
	mid East		4.18	0.35	66	23	1951	17	60	12	122
	mid Cell		4.89	0.32	63	36	2288	18	59	13	120
	mid West		4.68	0.41	60	23	2065	15	59	14	153
	West		2.67	0.26	60	14	1538	10	54	7	128
	-average		**4.74**	**0.35**	**64**	**28**	**1920**	**15**	**58**	**12**	**126**
	Composite		**4.56**	**0.27**	**67**	**29**	**1773**	**33**	**60**	**12**	**120**
24	Carmel Ranch Cell 5	6/7/89									
	SW		97.20	0.60	16	203	1248	22	97	91	472
	mid SW		50.20	0.34	19	40	730	25	68	31	249
	mid Cell		27.50	<0.25	17	21	475	30	63	14	238
	mid NE		16.80	<0.25	16	29	336	22	57	7	164
	NE		65.60	<0.25	28	19	880	36	85	30	237
	-average		**51.46**	**0.47**	**19**	**62**	**734**	**27**	**74**	**35**	**272**
	Composite		**45.00**	**<0.25**	**20**	**40**	**632**	**30**	**72**	**39**	**240**

Figure 9. Location of Sumner Peck Sediment Transect, 1987.



NOT TO SCALE

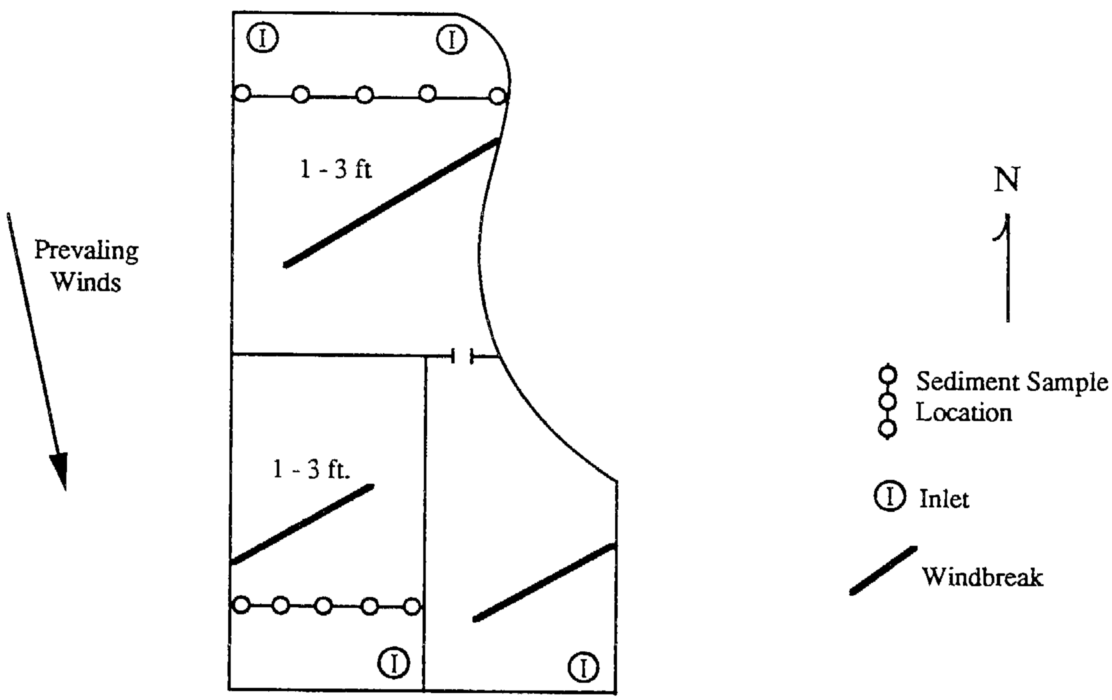
During 1989, subcell "b" of the south west cell was resampled along with subcell "a" of the northern cell. Both cells contained 1 to 3 feet of water with the shallowest depths near the pond edges. Both cells also displayed the same striated patterns in the upper inches of sediment as seen in 1987. The transects were conducted from east to west in both cells. The northern cell has an inlet in each northern corner, and the southwest cell has an inlet in its southeast corner (Figure 10).

The final basin transect was conducted across a semi-dry Cell 5 at Carmel Ranch. This basin is located on Lake Bed deposits. The sediment samples were collected from the southwest corner of the cell to the northeast corner. Two small evaporating pools contained the only visible water and were inaccessible due to unstable footing. The ground was covered with scrub brush and a salt crust (Figure 11).

Results from the transects are variable for the different basins and cells. In some instances (Sumner Peck Cell 3), sampling the sediment in different locations could lead to a 3-fold difference in concentration (14 mg/Kg selenium as compared to 49 mg/Kg selenium). Yet in other locations the differences appear insignificant, such as the variability of selenium concentrations across Stone Land Company SW(b)--0.88 mg/Kg to 1.09 mg/Kg selenium with a standard deviation between split samples of 0.37 mg/Kg.

Enough samples were collected in 1987 to statistically compare sediment concentrations at a specific location within a cell to the overall cell concentration. Significant differences between individual sites were noted for arsenic and selenium in Sumner Peck Cell 5, selenium in Sumner Peck Cell 3, and arsenic, as well as nickel in Stone Land Company SW(b).

Figure 10. Location of Stone Land Co. Sediment Transects, 1987 and 1989.



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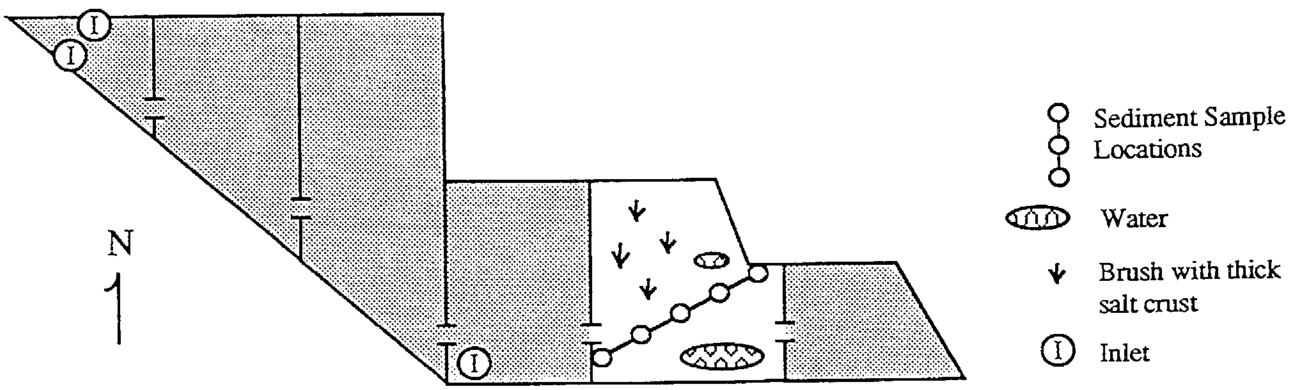
None of the elements analyzed showed consistent patterns of higher concentrations toward the middle or toward the edges of the cells. Although Sumner Peck Cell 5 demonstrated a correlation with the prevailing wind direction, with higher selenium concentrations downwind, the reverse trend was evident for Sumner Peck Cell 3.

All the elements sampled showed deviation based upon sample location. The extent of the deviation depended more upon the basin sampled than the element itself. (The 1987 molybdenum and lead results are difficult to analyze due to the high standard deviation between split samples.)

The two samples collected separately for the algae and the anaerobic layers noticed in Stone Land Company Cell SW(b) showed interesting trends which can not be supported statistically due to the small sample size. Arsenic, strontium, lead and vanadium concentrations appear consistent for both the algae and anaerobic layers. Selenium, however, is three times higher in the algae than the anaerobic layer (3.60 mg/Kg vs. 1.23 mg/Kg). Conversely, molybdenum and nickel concentrations are more elevated in the anaerobic material which follows molybdenum's geochemical nature to attach to sediment in a reducing environment.

Composite samples were obtained by weighing out equal portions of dried sediment from each transect point in an individual cell and submitting the mixed sample

Figure 11. Location of Carmel Ranch Sediment Transect, 1989.



NOT TO SCALE

to the analyzing laboratory for homogenization and analysis. Results from the composited samples appear to compare favorably to expected average site concentrations.

To evaluate the potential differences with collecting a grab sample as opposed to composites, Table 7 lists the means for composite and grab sample sediment concentrations for the various sites. The standard deviation is also noted. Some broad inconsistencies are evident.

For Sumner Peck sites, the major deviations between grab and average samples occurred for selenium and strontium with differences of over 100%. In all cases, the grab sample underestimated the overall cell average.

For the remaining basins, deviations were noted for arsenic, molybdenum, vanadium, uranium, and boron in addition to selenium and strontium. Grab samples which underestimated the cell average included arsenic for Stone Land Company SW(b), as well as selenium, molybdenum, strontium, uranium, and boron at all sites except Carmel Ranch. The grab samples for those elements at Carmel Ranch with the addition of vanadium at Stone Land Company North (a) and at Carmel Ranch all overestimated the average concentration as well as the concentrations of the composites.

Only nickel and lead concentrations appeared relatively unaffected by sample location.

Based on historical records concerning water distribution in the various cells, sediment from areas which have historically contained water through the final stages of drying appear to contain the highest levels of elements known to

Table 7. Comparison of Mean, Composite, and Grab Sediment Concentrations for Evaporation Pond Transect Cells.

ID	Site	Date	As	Se	Ni	Mo	Sr	Pb	V	U	B
							mg/Kg				
4	Sumner Peck Cell 5	6/9/87									
	grab		5.25	7.25	28	<1	223	10	41		
	average		6.38	19.64	39	7	411	7	48		
	standard deviation		0.23	1.88	3	10	39	9	6		
4	Sumner Peck Cell 3	6/9/87									
	grab		6.95	10.85	36	<1	141	13	65		
	average		7.71	29.51	40	7	306	8	68		
	standard deviation		0.41	4.74	4	9	43	11	6		
6	Stone Land Company SW(b)	6/10/87									
	grab		3.30	0.35	66	2	532	<5	36		
	average		6.35	1.09	66	44	593	8	45		
	standard deviation		0.39	0.37	4	12	42	10	5		
	Algae		7.80	3.60	52	30	>800	7	50		
	Anaerobic layer		7.34	1.23	74	52	>800	10	51		
6	Stone Land Company SW(b)	6/8/89									
	grab		3.89	0.59	62	38	815	27	45	13	165
	average		6.95	1.22	47	72	2012	22	47	24	216
	composite		6.80	1.15	46	67	2080	16	47	25	196
6	Stone Land Company North(a)	6/8/89									
	grab		8.58	<0.25	94	3	280	9	105	2	133
	average		4.74	0.35	64	28	1920	15	58	12	126
	composite		4.56	0.27	67	29	1773	33	60	12	120
24	Carmel Ranch Cell 5	6/7/89									
	grab		97.20	0.60	16	203	1248	22	97	91	472
	average		51.46	0.47	19	62	734	27	74	35	272
	composite		45.00	<0.25	20	40	632	30	72	39	240

grab = sediment sample collected at point of water collection
average = average concentration for the cell based on an average of the transect values for that cell
standard deviation = the deviation of results between the transect samples (see Table 6)
composite = a single homogenized sample made up of equal dry weight portions of the transect samples for each cell

concentrate in the water column. These elements are arsenic, selenium, molybdenum, and uranium. A more thorough survey relating historical water patterns and statistical sample collection would need to be conducted to verify this hypothesis.

Radiological Results

During the water quality surveys of the evaporation basins, extremely high levels of total uranium were detected in the water column (Westcot et al, 1988b and Chilcott et al, 1990). The high uranium concentrations indicated the possibility of elevated uranium by-products such as radium 226 (Ra 226). Radium, which has geochemical properties similar to those of barium, is especially hazardous because of its easy incorporation into bone leading to malignancies (Schroeder et al, 1988). Using the Levinson and Coetzee (1978), equation for systems in equilibrium, 0.7 pCi/L of Ra 226 per part per billion uranium can be expected. Based on reported uranium concentrations ranging from 330 to 22,300 ppb, Ra 226 activities should reach over 15,000 pCi/L in the water column of the evaporation basins of the Tulare Lake Bed. Instead, the system was found to be in gross disequilibrium with Ra 226 concentrations ranging from <0.1 to 3.1 pCi/L (Chilcott et al, 1990) which is below the Federal Drinking Water Standard of 5pCi/L.

One factor which may account for the disequilibrium is Ra 226's limited mobility. Factors affecting mobility include co-crystallization by substitution for barium, co-precipitation with iron and manganese, adsorption to organic material and clay, and biological adsorption. In aquatic environments, chlorides of radium are soluble whereas the carbonates and sulfates have very low solubilities (Levinson and Coetzee, 1978). The evaporation ponds are carbonate, sulfate dominant; therefore, radium compounds may have low solubilities and may precipitate out of the water column.

To determine radium levels in the pond sediments, samples collected during the 1989 survey were analyzed for equivalent uranium (eU), equivalent thorium (eTh), and gross gamma uranium [eU(GG)] where:

eU = amount of total natural U that would be present if in equilibrium with measured U daughters that are present (Ra 226);

eTh = amount of total natural Th that would be present if in equilibrium with measured Th daughters that are present (Th 228);

eU(GG) = gross gamma equivalent amount of total natural uranium in equilibrium with all of its daughters that would need to be present to give the total gamma activity as measured in the sample.

The activity of radium may be calculated as follows:

$$\text{Ra 226 (pCi/gm)} = \text{eU (ppm)} \times 0.334$$

Ra 228 (pCi/gm) = eTh (ppm) x 0.110 (assumes Th 228/Ra 228 in equilibrium)

The complete results from the radiological scan is presented in Appendix C. A summary of the various ranges are listed in Table 8.

Table 8. Ranges, Median, and Geometric Mean Concentrations of Radiological Results for Sediment from Agricultural Evaporation Basins, 1989

Element	minimum	median	geometric mean	maximum
uranium (ppm)	1	9.0	9	290
eU(ppm)	<2	2	2	7
eU(GG) (ppm)	1	8	8	39
eTh (ppm)	<4	6	5	19
%K	<0.3	2	2	3.1
calculated Ra 226 (pCi/gm)	0.17	0.67	0.52	4.01
calculated Ra 228 (pCi/gm)	0.11	0.66	0.58	2.75
calculated Ra total (pCi/gm)	0.28	1.44	1.23	6.76

calculations set less than detection values equal to 0.25 times the detection limit

The results show that the sediment uranium and radium concentrations are in gross disequilibrium. These results reflect the findings in the water column (Chilcott et al, 1990). Although the total uranium found in the sediment ranged from 1 to 290 ppm, the total calculated radium values only ranged from 0.42 pCi/gm to 6.76 pCi/gm. The extremely low eU(GG) values support the low findings of radium activities by ranging itself from <2 to 39 ppm. The higher eU(GG) concentrations were due in part to the extremely elevated total uranium concentrations in some samples. For example, the highest eU(GG) value of 39 ppm had corresponding U, eU, eTh, and %K concentrations of 290 ppm, <3 ppm, 6 ppm, and 2.7%, respectively. The eU(GG) can be calculated by adding the activities of all the elements in terms of eU. For the constituents involved, activity in terms of eU can be calculated as follows:

eU of total U = total U(ppm) ÷ 10 = 290 ppm ÷ 10 = 29

eU of eTh = total eTh(ppm) ÷ 3 = 6ppm ÷ 3 = 2

eU of %K = 1 ppm eU per 1%K = 2.7%K = 3

Assuming that the measured eU is 3ppm rather than <3ppm, the total calculated eU(GG) is equal to 37 ppm which compares favorably with the 39 ppm actually measured. Therefore, the primary source of activity is from the high concentration of total uranium rather than from a radioactive by-product (Keil, personal communication).

Based on the results, pond sediments as well as the water column appear to be in gross disequilibrium with respect to uranium and radium. The radium is not noticeably precipitating out of the evaporation pond water column into the sediment, nor is it found in the water column; therefore, the radium does not appear to be moving into the system at an appreciable rate. Levinson and Coetzee (1978), determined that for ground water-transported uranium less than one million years old, such disequilibrium is not unexpected due to radium's limited mobility. The presence of disequilibrium in the ponds does not necessarily indicate a disequilibrium or excessive Ra 226 in another location. Evidence shows that the overall abundance of uranium is such that only a relatively small amount would need to be removed from a geologic deposit to produce the levels reported in the shallow ground water and evaporation basins of the Tulare Lake Bed (Keil, personal communication).

Waste Extraction Tests

Elevated levels of arsenic and selenium were found in selected evaporation basin sediments. The concentrations ranged up to 181 mg/Kg arsenic and 15 mg/Kg selenium. Although these values are less than the criteria for hazardous waste of 500 mg/Kg and 100 mg/Kg for arsenic and selenium, respectively (Sections 66900 and 66699, Title 22, California Code of Regulations), they have potential to exceed the hazardous waste soluble threshold limit concentrations. The soluble threshold limit concentrations are 5 mg/L for arsenic and 1 mg/L for selenium.

To determine if the soluble threshold limit was exceeded, 24 archived sediment samples from 1986 and 1987 were analyzed using the waste extraction technique (WET) defined in Section 66700, Title 22, California Code of Regulations. The selected samples contained the highest levels of arsenic and selenium detected using a total digestion process for the two surveys. Results for the WET test are presented in Table 9.

None of the samples had concentrations which exceeded the hazardous waste soluble threshold limits of 5 mg/L for arsenic or 1 mg/L for selenium. Only two samples approached the limit for arsenic, Lost Hills Ranch Cell 3 and Carmel Ranch Cell 5, with concentrations of 2.75 mg/L and 3.05 mg/L, respectively.

Six sediment samples contained soluble selenium at greater than 0.5 mg/L. All the elevated values were in sediments collected from Sumner Peck cells. Although no values exceeded the threshold concentration of 1 mg/L, Cell 3 reported a maximum of 0.7 mg/L.

WET analyses will be conducted on Sumner Peck, Lost Hills Ranch and Carmel Ranch sediments collected during 1988, 1989, and 1990 to observe any changes in composition. Results will be reported in a 1990 summary report.

Table 9. Waste Extraction Technique (WET) Analytical Results for Arsenic and Selenium

ID	Site	Cell	Date	As(WET) mg/L	As(total) mg/Kg	As Ratio WET/total	Se(WET) mg/L	Se(total) mg/Kg	Se Ratio WET/total
4	Sumner Peck	2	12/3/86	0.12	8.75	0.01	0.24	4.4	0.05
4	Sumner Peck	3	6/25/87	0.20	7.45	0.03	0.70	40.6	0.02
4	Sumner Peck	3	6/25/87	0.10	7.60	0.01	0.59	27.9	0.02
4	Sumner Peck	3	9/1/87	0.10	7.80	0.01	0.44	30.6	0.01
4	Sumner Peck	3	9/1/87	0.08	8.40	0.01	0.59	15.3	0.04
4	Sumner Peck	5	6/25/87	0.15	6.25	0.02	0.52	16.9	0.03
4	Sumner Peck	5	6/25/87	0.12	6.35	0.02	0.63	21.8	0.03
4	Sumner Peck	5	6/25/87	0.13	5.75	0.02	0.45	18.2	0.02
4	Sumner Peck	5	6/25/87	0.15	6.10	0.02	0.61	20.3	0.03
4	Sumner Peck	5	6/25/87	0.19	7.40	0.03	0.36	20.9	0.02
4	Sumner Peck		6/9/87	0.19	5.25	0.04	0.16	7.25	0.02
5	Britz-Deav 5pts	North	12/2/86	0.22	6.20	0.04	0.12	12.5	0.01
5	Britz-Deav 5pts	South	12/2/86	0.16	5.90	0.03	0.38	39.8	0.01
5	Britz-Deav 5pts	South	12/2/86	0.29	6.50	0.04	0.12	25.7	<0.01
13	J & W Farms	C	12/3/86	0.69	11.0	0.06	0.38	16.5	0.02
15	Bowman Farms	A	12/3/86	0.42	63.0	0.01	0.18	10.4	0.02
17	Martin Farms	Basin	12/3/86	0.56	61.1	0.01	0.26	11.9	0.02
17	Martin Farms	Basin	6/9/87	0.33	69.5	<0.01	0.20	12.6	0.02
19	4-J Corp	Basin	6/10/87	0.35	80.5	<0.01	0.30	3.45	0.09
24	Carmel	5	6/10/87	3.05	56.0	0.05	0.00	0.15	0.02
25	Lost Hills Ranch	3	6/10/87	2.75	69.0	0.04	0.01	0.4	0.03
26	Sam Andrews' Sons	1	12/18/86	0.18	6.35	0.03	0.12	10.4	0.01
26	Sam Andrews' Sons	2B	12/18/86	0.19	6.90	0.03	0.21	11.8	0.02
26	Sam Andrews' Sons	4A	12/18/86	0.34	6.75	0.05	0.21	12.7	0.02
			Threshold 1/	5.00	500	—	1.00	100	—
			average ratio:			0.03			0.02
			standard deviation:			0.02			0.02

1/ Hazardous Waste Soluble Threshold Limit Concentration, Sections 66900 and 66699, Title 22, California Code of Regulations.

total = concentration based on total sample digestion

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APPENDIX A

Appendix A. Sediment Analyses Conducted by Survey Laboratories and Corresponding Detection limits.

Laboratory	Analyses	Detection Limit (mg/Kg)	Analyses	Detection Limit (%)
Soils Laboratory Colorado State University Fort Collins, Colorado	arsenic	0.1	aluminum	0.01
	barium	1	calcium	0.01
	boron	0.1	iron	0.01
	cadmium	1	manganese	0.01
	chromium	1	magnesium	0.01
	copper	1	phosphorus	0.01
	lead	5	potassium	0.01
	mercury	0.05	sodium	0.01
	molybdenum	2	titanium	0.01
	nickel	1	total organic carbon	0.05
	selenium	0.25		
	strontium	1		
	vanadium	1		
	zin	1		
	WET boron	0.1		
	WET arsenic	0.1		
	WET selenium	0.25		
Natural Resources Laboratory Golden, Colorado	uranium (mg/Kg)	1		
	eU (ppm)	1*		
	eTh (ppm)	3*		
	eU(gg) (ppm)	1*		
	% K	*		

* detection limit varied depending upon amount of available sample and is listed for 500 grams of sample
WET = Waste Extraction Technique as described in Section 66700 of Title 22
eU = The amount of total natural uranium that would be present if in equilibrium with measured uranium daughters that are present (Ra-226)
eTh = The amount of total natural Th that would be present if in equilibrium with measured Th daughters that are present (Th-228).
eU(gg) = The gross gamma equivalient amount of total natural uranium in equilibrium with all of its daughters that would need to be present to give the same total gamma activity measured in the sample

Appendix A. Evaporation Pond Sediment Data, Minerals 1988 and 1989.

ID	Site	Cell	Date	B(WET) 1/	Sat	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti
				mg/L					%					
1	Souza	Basin	7/6/88			0.64	1.115	0.07	0.73	0.035	3.09	3.00	0.043	0.160
1	Souza	Basin	6/15/89	1.1	47.1	0.92	1.56	0.13	0.76	0.038	3.15	2.71	0.047	0.153
3	Britz-S. Dos Palos	South	7/6/88			9.67	0.75	0.19	0.22	0.050	0.92	0.97	0.146	0.115
4	Sumner Peck	1	6/8/88			2.46	1.20	0.44	0.54	0.040	3.79	2.65	0.037	0.150
4	Sumner Peck	2	6/8/88			1.77	1.35	4.93	0.71	0.040	4.64	2.79	0.045	0.127
4	Sumner Peck	2	6/6/89	18.3	81.0	4.49	1.20	2.97	0.50	0.260	2.87	0.56	0.022	0.044
4	Sumner Peck	3	6/8/88			2.32	1.35	0.74	0.69	0.040	4.62	2.65	0.049	0.128
4	Sumner Peck	3	6/6/89	378.0	39.5	0.96	1.20	7.94	0.10	0.046	0.23	0.07	<0.01	0.007
4	Sumner Peck	5	6/8/88			2.04	1.62	1.33	0.80	0.050	4.73	2.69	0.045	0.106
4	Sumner Peck	5	6/6/89	13.4	90.3	2.35	1.56	2.78	0.62	0.057	4.04	1.12	0.035	0.055
4	Sumner Peck	6	6/8/88			2.68	1.49	0.79	0.77	0.040	5.58	2.85	0.050	0.110
4	Sumner Peck	6	6/6/89	9.3	68.1	2.21	1.08	1.30	0.45	0.130	2.66	1.33	0.029	0.066
5	Britz-Deav 5-Pts.	North	6/8/88			1.09	1.74	0.47	0.62	0.050	3.26	3.09	0.047	0.150
5	Britz-Deav 5 Pts	North	6/6/89	9.8	69.9	1.34	2.02	0.57	0.64	0.060	3.51	2.88	0.050	0.112
5	Britz-Deav 5-Pts.	South	6/8/88			1.06	1.86	0.49	0.66	0.060	3.54	3.32	0.052	0.157
5	Britz-Deav 5 Pts	South	6/6/89	9.4	73.1	2.46	2.09	0.63	0.59	0.041	3.10	1.99	0.046	0.070
6	Stone Land Co.	North (a)	6/7/88			2.93	2.08	0.48	0.50	0.070	3.00	2.80	0.043	0.127
6	Stone Land Co.	North (a)	6/6/89	3.9	69.9	3.20	2.23	0.74	0.67	0.068	3.28	3.07	0.053	0.135
6	Stone Land Co.	North (b)	6/7/88			1.93	1.62	0.58	0.58	0.080	2.95	2.63	0.048	0.149
6	Stone Land Co.	North (b)	6/6/89	14.3	71.3	7.54	1.76	1.54	0.52	0.031	2.27	1.44	0.071	0.088
6	Stone Land Co.	SE (a)	6/7/88			1.65	1.81	2.04	0.63	0.050	2.92	1.60	0.047	0.072
6	Stone Land Co.	SE (a)	6/6/89	65.3	60.3	2.12	2.03	3.70	0.57	0.035	2.38	0.56	0.037	0.045
6	Stone Land Co.	SE (b)	6/7/88			1.49	1.88	1.91	0.74	0.030	3.76	2.01	0.053	0.088
6	Stone Land Co.	SE (b)	6/6/89	49.4	73.0	1.92	2.00	2.97	0.61	0.027	2.83	0.81	0.048	0.051
6	Stone Land Co.	SW (a)	6/7/88			1.55	1.94	1.41	0.92	0.060	3.96	2.70	0.060	0.112
6	Stone Land Co.	SW (a)	6/6/89	27.1	66.5	3.21	1.85	2.10	0.51	0.051	2.30	0.94	0.041	0.071
6	Stone Land Co.	SW (b)	6/7/88			1.41	1.94	1.37	0.94	0.070	3.93	2.82	0.058	0.107
6	Stone Land Co.	SW (b)	6/6/89	37.5	76.3	5.27	2.04	3.28	0.62	0.090	2.36	0.44	0.044	0.044
6	Stone Land Co.	SW (b) (Algae)	6/7/89	13.8	*	9.52	1.85	6.92	0.38	0.039	1.34	0.40	0.036	0.033
7	Carlton Duty	Basin	6/8/88			2.90	1.99	3.47	0.76	0.040	3.16	0.49	0.041	0.039
7	Carlton Duty	Basin	6/6/89	67.1	59.5	4.16	2.14	6.45	0.49	0.068	1.86	0.52	0.047	0.052
8	Westlake North	1 (NE)	6/8/88			1.03	0.78	0.75	0.38	<.001	1.75	1.77	0.029	0.156
8	Westlake North	1 (S)	6/8/88			0.70	0.77	0.72	0.35	<.001	1.63	1.77	0.029	0.174
8	Westlake-North	1-NE	6/6/89	6.5	54.4	2.01	0.88	1.04	0.27	0.053	1.47	1.72	0.035	0.151
8	Westlake North	2-NE	6/8/88			0.99	0.57	0.48	0.22	0.040	1.09	1.16	0.021	0.131
8	Westlake North	2-SE	6/8/88			0.78	0.44	0.42	0.17	0.030	0.93	0.92	0.017	0.110
8	Westlake-North	2-SE	6/6/89	4.2	65.1	3.42	1.79	1.16	0.66	0.096	2.78	2.93	0.053	0.138
8	Westlake North	2-SW	6/8/88			1.58	0.67	0.64	0.25	0.040	1.29	1.41	0.025	0.166
9	Meyers Ranch	A	6/7/88			2.07	0.73	0.26	0.34	0.230	1.45	1.51	0.022	0.146
9	Meyers Ranch	A	6/6/89	2.9	78.0	8.73	1.58	1.01	0.49	0.079	2.06	2.18	0.034	0.150

Appendix A. Evaporation Pond Sediment Data, Minerals 1988 and 1989.

ID	Site	Cell	Date	B(WET) 1/	Sat	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti
				mg/L		%								
9	Meyers Ranch	B	6/7/88			0.77	0.73	0.26	0.35	0.070	1.59	1.72	0.023	0.196
9	Meyers Ranch	B	6/7/88			0.72	0.75	0.26	0.37	0.090	1.67	1.78	0.021	0.188
9	Meyers Ranch	B	6/6/89	8.6	100.5	4.77	1.91	2.68	0.53	0.111	2.00	1.33	0.029	0.075
9	Meyers Ranch	C	6/7/88			2.05	1.04	0.34	0.35	0.060	2.01	1.99	0.025	0.196
10	Barbizon Farms	East	6/7/88			1.01	0.87	0.46	0.43	0.040	2.07	2.02	0.026	0.204
10	Barbizon Farms	East	6/6/89	7.0	101.0	7.55	2.42	2.39	0.59	0.162	2.47	1.98	0.029	0.092
10	Barbizon Farms	Middle	6/7/88			0.92	0.97	0.56	0.48	0.030	2.32	2.14	0.021	0.175
10	Barbizon Farms	West	6/7/88			0.77	0.956	0.60	0.45	0.035	2.38	2.04	0.020	0.164
11	TLDD, North	1	6/7/88			13.20	1.57	0.32	0.28	0.140	1.20	1.36	0.093	0.130
11	TLDD, North	1	6/6/89	1.8	48.1	6.91	1.35	0.22	0.15	0.130	0.83	1.20	0.044	0.111
11	TLDD, North	4	6/7/88			1.68	0.99	0.23	0.29	0.030	1.53	1.59	0.027	0.131
11	TLDD, North	2A	6/7/88			1.83	0.94	0.23	0.32	0.050	1.40	1.52	0.027	0.162
11	TLDD, North	2A	6/6/89	4.2	72.7	3.58	1.70	0.53	0.28	0.084	1.49	1.97	0.036	0.160
11	TLDD, North	2B	6/7/88			8.67	1.63	0.29	0.21	0.130	1.12	1.05	0.037	0.101
11	TLDD, North	2B	6/6/89	2.3	55.0	5.79	1.61	0.31	0.24	0.070	1.30	1.45	0.033	0.115
11	TLDD, North	3A	6/7/88			4.12	1.50	0.37	0.44	0.090	2.08	1.95	0.044	0.186
11	TLDD, North	3A	6/6/89	2.4	47.5	2.40	0.90	0.26	0.19	0.140	0.94	1.17	0.025	0.098
11	TLDD, North	3B	6/7/88			10.50	1.78	0.43	0.40	0.140	1.72	4.62	0.088	0.133
11	TLDD, North	3B	6/6/89	2.2	58.6	7.65	1.41	0.37	0.34	0.106	1.65	1.89	0.131	0.133
11	TLDD, North	4	6/6/89	2.5	49.7	3.59	1.19	0.33	0.27	0.126	1.30	1.59	0.048	0.131
11	TLDD, North	5A	6/7/88			1.90	1.08	0.38	0.32	0.100	1.86	1.59	0.031	0.139
11	TLDD, North	5A	6/6/89	2.3	64.8	2.61	1.74	0.57	0.50	0.081	2.66	2.57	0.041	0.185
11	TLDD, North	5B	6/7/88			2.87	1.32	0.32	0.35	0.130	1.77	1.60	0.029	0.119
11	TLDD, North	5B	6/6/89	23.3	50.5	3.15	1.33	0.40	0.30	0.077	1.56	1.67	0.031	0.106
11	TLDD, North	6	6/7/88			2.05	1.39	0.58	0.66	0.090	3.20	2.64	0.043	0.188
11	TLDD, North	6	6/6/89	3.0	71.0	2.20	1.67	0.71	0.58	0.090	3.11	2.84	0.041	0.194
11	TLDD, North	7	6/7/88			3.20	1.39	0.72	0.63	0.140	2.97	2.52	0.040	0.176
11	TLDD, North	7	6/6/89	5.1	68.0	3.16	1.81	0.98	0.65	0.048	3.17	2.98	0.041	0.188
12	Westlake #3	1	6/8/88			1.19	1.49	0.37	0.61	0.060	3.38	3.20	0.056	0.147
12	Westlake #3	1	6/6/89	4.6	61.3	2.84	1.47	1.51	0.53	0.083	2.42	1.03	0.037	0.074
12	Westlake #3	2	6/8/88			1.58	1.65	0.58	0.70	0.050	3.45	3.14	0.051	0.134
12	Westlake #3	2	6/6/89	2.0	48.8	1.71	0.93	0.51	0.34	0.109	1.64	1.71	0.027	0.127
12	Westlake #3	3	6/8/88			1.68	1.82	0.97	0.57	0.040	3.11	2.86	0.053	0.131
12	Westlake #3	4	6/8/88			1.74	1.60	1.32	0.48	0.030	2.64	2.05	0.037	0.097
12	Westlake #3	4	6/6/89	6.1	64.4	1.40	1.87	1.19	0.53	0.091	2.74	2.94	0.043	0.155
12	Westlake #3	5	6/8/88			1.41	1.38	0.93	0.45	0.050	2.32	2.39	0.039	0.129
12	Westlake #3	5	6/6/89	8.6	64.2	4.08	1.22	1.30	0.40	0.143	1.59	0.84	0.022	0.071
12	Westlake #3	6	6/8/88			1.62	1.57	0.66	0.54	0.040	2.96	2.76	0.053	0.135
12	Westlake #3	6	6/6/89	7.3	71.9	5.34	1.62	2.22	0.51	0.310	2.15	0.77	0.037	0.067
14	Pryse Farms	1	6/8/88			1.46	1.22	1.04	0.78	0.050	3.16	2.94	0.043	0.258

Appendix A. Evaporation Pond Sediment Data, Minerals 1988 and 1989.

ID	Site	Cell	Date	B(WET) 1/	Sat	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti
				mg/L					%					
14	Pryse Farms	1	6/8/88			5.12	0.91	1.02	0.39	0.080	1.57	1.28	0.051	0.148
14	Pryse Farms	2	6/8/88			3.86	1.38	1.78	0.65	0.070	2.43	1.73	0.031	0.118
14	Pryse Farms	East	6/7/89	3.1	53.3	3.32	1.51	1.16	0.59	0.028	2.26	2.03	0.039	0.163
15	Bowman Farms	A	6/8/88			5.71	1.55	1.98	0.71	0.050	2.97	2.19	0.058	0.141
15	Bowman Farms	A	6/7/89	3.1	63.4	3.04	1.70	1.09	0.61	0.059	3.34	3.01	0.049	0.200
15	Bowman Farms	B	6/8/88			3.58	1.62	1.40	0.76	0.090	4.02	3.16	0.039	0.194
16	Morris Farms	Cell	6/8/88			6.58	1.59	1.44	0.67	0.110	3.09	2.38	0.045	0.141
16	Morris Farms	Cell	6/7/89	5.0	69.0	5.21	1.85	1.74	0.65	0.053	3.27	2.73	0.043	0.110
17	Martin Farms	Cell	6/8/88			1.34	1.38	1.84	0.71	0.090	4.63	3.16	0.030	0.188
17	Martin Farms	Cell	6/7/89	9.3	75.0	10.60	1.85	2.69	0.49	0.043	1.98	0.88	0.024	0.067
19	4-J Corp.	Cell	6/8/88			5.27	2.35	1.68	0.38	0.090	1.53	1.30	0.020	0.132
19	4-J Corp	Cell	6/7/89	38.1	64.8	3.81	2.58	2.39	0.50	0.063	1.79	1.62	0.027	0.109
21	TLDD Hacienda	A1	6/7/88			4.48	0.63	0.24	0.14	0.060	0.73	0.66	0.028	0.110
21	TLDD, Hacienda	A1 (SE)	6/7/89	3.2	37.7	3.04	0.74	0.26	0.18	0.043	0.72	0.79	0.019	0.125
21	TLDD, Hacienda	A1 (SW)	6/7/89	1.8	51.1	5.60	0.88	0.34	0.28	0.052	1.39	1.36	0.059	0.149
21	TLDD Hacienda	A2(a)	6/7/88			2.14	0.68	0.22	0.22	0.060	0.97	0.89	0.018	0.127
21	TLDD, Hacienda	A2(a)	6/7/89	2.7	41.7	3.03	0.85	0.32	0.27	0.052	1.17	1.19	0.024	0.147
21	TLDD, Hacienda	A2(b)	6/7/89	1.8	60.2	1.95	1.08	0.47	0.47	0.040	2.49	2.09	0.058	0.238
21	TLDD Hacienda	A2(c)	6/7/88			2.05	0.61	0.26	0.18	0.060	0.88	0.76	0.015	0.120
21	TLDD, Hacienda	A3	6/7/89	2.6	43.7	1.33	0.26	0.16	0.16	0.033	0.45	0.47	0.017	0.066
21	TLDD Hacienda	A3	6/7/88			0.88	0.45	0.40	0.17	0.050	0.86	0.88	0.021	0.157
21	TLDD Hacienda	A4	6/7/88			1.59	0.90	1.57	0.30	0.050	1.28	1.35	0.025	0.138
21	TLDD, Hacienda	A4 (NW)	6/7/89	4.1	44.4	1.80	0.77	0.43	0.27	0.051	1.18	1.25	0.036	0.162
21	TLDD, Hacienda	A4 (NE)	6/7/89	14.1	55.3	1.08	1.18	1.51	0.47	0.054	2.19	2.32	0.045	0.207
21	TLDD Hacienda	C1	6/7/88			1.40	0.35	0.17	0.12	0.040	0.68	0.72	0.020	0.142
21	TLDD Hacienda	C1 (SE)	6/7/89	2.4	54.9	4.42	1.18	0.43	0.38	0.063	1.75	1.95	0.049	0.188
21	TLDD, Hacienda	C1 (NW)	6/7/89	2.8	44.7	2.48	0.71	0.33	0.24	0.039	0.92	1.15	0.026	0.141
21	TLDD, Hacienda	C2(a)	6/7/89	5.5	60.4	5.86	1.26	0.80	0.37	0.047	1.52	1.65	0.034	0.149
21	TLDD Hacienda	C2(b)	6/7/88			3.43	0.97	0.57	0.25	0.070	1.24	1.02	0.042	0.130
21	TLDD, Hacienda	C2(b)	6/7/89	3.9	53.3	4.54	1.05	0.54	0.32	0.050	1.22	1.16	0.093	0.118
21	TLDD Hacienda	C3	6/7/88			1.90	0.81	0.67	0.30	0.050	1.42	1.48	0.027	0.200
21	TLDD, Hacienda	C3	6/7/89	8.0	55.7	2.82	1.05	0.94	0.36	0.075	1.24	1.35	0.030	0.102
21	TLDD Hacienda	C4	6/7/88			2.05	0.888	1.27	0.32	0.045	1.24	1.36	0.026	0.144
21	TLDD, Hacienda	C4	6/7/89	18.9	47.8	2.30	0.99	1.46	0.31	0.082	1.07	1.14	0.029	0.089
21	TLDD, Hacienda	Marsh N. Cell	6/7/89	5.9	67.2	4.12	1.54	0.88	0.51	0.070	2.22	2.17	0.035	0.200
21	TLDD, Hacienda	Marsh S. Cell	6/7/89	3.4	60.2	1.62	1.16	0.57	0.53	0.045	2.16	2.48	0.034	0.220
22	TLDD South	1 (SW)	6/8/88			4.18	0.57	0.25	0.13	<.001	0.55	0.60	0.021	0.115
22	TLDD South	1 (N)	6/8/88			4.84	0.75	0.22	0.11	<.001	0.50	0.51	0.019	0.102
22	TLDD, South	1	6/6/89	2.1	44.9	6.80	1.12	0.20	0.15	0.039	0.54	0.73	0.038	0.090
22	TLDD, South	1 SW Side	6/6/89	4.2	43.3	3.86	0.91	0.49	0.24	0.028	0.79	1.02	0.028	0.151

Appendix A. Evaporation Pond Sediment Data, Minerals 1988 and 1989.

ID	Site	Cell	Date	B(WET) 1/	Sat	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti
				mg/L	%									
22	TLDD South	2	6/8/88			4.30	0.97	0.44	0.39	0.080	1.57	1.39	0.018	0.171
22	TLDD, South	2	6/6/89	18.9	49.0	3.65	1.67	1.50	0.35	0.056	1.27	1.33	0.020	0.149
22	TLDD South	3	6/8/88			11.30	1.27	0.51	0.35	0.070	1.42	1.24	0.021	0.110
22	TLDD, South	3	6/6/89	2.8	55.1	4.04	1.43	0.42	0.40	0.072	1.95	2.00	0.024	0.195
22	TLDD South	4	6/8/88			4.13	1.07	1.07	0.29	0.060	1.30	1.13	0.016	0.136
22	TLDD, South	4 (SE)	6/6/89	5.6	60.7	5.80	1.45	0.62	0.39	0.077	1.77	1.68	0.026	0.174
22	TLDD, South	4 (NW)	6/6/89	6.6	60.5	5.84	1.37	0.54	0.29	0.070	1.28	1.30	0.019	0.166
22	TLDD South	5	6/8/88			4.45	1.65	1.34	0.65	0.085	2.35	1.90	0.030	0.160
22	TLDD, South	5	6/6/89	3.9	78.1	6.84	2.03	0.69	0.62	0.171	2.71	2.31	0.028	0.158
22	TLDD South	6	6/8/88			4.41	1.43	0.67	0.26	0.110	1.12	1.05	0.024	0.138
22	TLDD, South	6	6/6/89	3.9	46.0	2.42	1.13	0.44	0.22	0.076	1.01	1.12	0.023	0.164
22	TLDD South	7	6/8/88			3.18	1.26	0.67	20.00	0.050	1.86	1.63	0.027	0.173
22	TLDD, South	7	6/6/89	4.4	50.6	3.17	1.14	0.52	0.23	0.092	1.00	1.11	0.026	0.144
22	TLDD South	8	6/8/88			1.98	0.49	0.37	0.16	0.060	0.62	0.60	0.013	0.149
22	TLDD, South	8	6/6/89	5.8	44.9	6.68	0.95	0.47	0.21	0.025	0.78	0.88	0.052	0.129
22	TLDD South	9	6/8/88			2.07	0.67	0.57	0.16	0.050	0.64	0.70	0.015	0.134
22	TLDD, South	9	6/6/89	8.9	43.7	2.05	0.92	0.71	0.30	0.029	1.08	1.18	0.019	0.139
22	TLDD South	10	6/8/88			3.81	1.002	1.42	0.26	0.055	0.93	0.88	0.020	0.125
22	TLDD, South	10	6/6/89	6.4	43.2	2.52	1.28	0.47	0.49	0.005	1.48	1.47	0.029	0.141
22	TLDD South	Salt Basin	6/8/88			5.24	1.62	0.92	0.40	0.100	1.38	1.33	0.031	0.126
22	TLDD, South	Salt Basin	6/6/89	11.5	40.5	3.38	1.14	0.56	0.30	0.052	0.96	1.00	0.022	0.137
23	Lost Hills WD	1(a)	6/7/88			1.03	1.60	1.09	0.77	0.080	3.41	2.73	0.038	0.125
23	Lost Hills WD	1(a)	6/7/89	29.8	60.2	2.26	1.85	0.68	0.78	0.033	3.15	1.90	0.033	0.095
23	Lost Hills WD	1(c)	6/7/88			1.76	1.36	0.89	0.64	0.070	2.79	2.26	0.037	0.118
23	Lost Hills WD	1(c)	6/7/89	17.6	50.1	1.61	1.44	0.67	0.74	0.099	2.64	2.09	0.035	0.113
23	Lost Hills WD	2-East	6/7/89	22.8	68.9	1.62	2.10	1.84	0.89	0.070	3.81	2.39	0.044	0.100
23	Lost Hills WD	2-West	6/7/89	36.0	75.6	2.18	2.15	1.45	0.89	0.066	3.88	2.00	0.043	0.092
23	Lost Hills WD	3A-North	6/7/88			0.89	1.19	1.49	0.71	0.080	2.75	2.30	0.034	0.121
23	Lost Hills WD	3A-North	6/7/89	27.0	48.0	0.60	1.09	1.08	0.67	0.042	2.44	2.26	0.031	0.136
23	Lost Hills WD	3A-South	6/7/88			0.92	1.84	1.99	0.89	0.090	4.25	3.26	0.046	0.158
23	Lost Hills WD	3A-South	6/7/89	61.1	61.7	11.30	1.04	2.28	0.41	0.041	1.68	0.42	0.023	0.045
23	Lost Hills WD	3B-North	6/7/88			1.69	1.10	1.53	0.52	0.050	2.29	1.56	0.029	0.089
23	Lost Hills WD	3B-North	6/7/89	37.1	58.0	1.16	1.73	1.60	0.74	0.047	3.04	2.16	0.035	0.105
23	Lost Hills WD	3B-South	6/7/88			2.06	1.49	1.99	0.68	0.050	2.96	1.25	0.034	0.078
23	Lost Hills WD	3B-South	6/7/89	26.3	62.3	1.99	2.05	1.79	0.87	0.045	3.60	1.92	0.040	0.086
23	Lost Hills WD	3C	6/7/88			4.78	1.37	1.06	0.63	0.050	3.00	0.61	0.027	0.058
23	Lost Hills WD	3C	6/7/89	51.0	58.5	4.60	1.30	1.84	0.52	0.080	2.18	0.68	0.022	0.066
23	Lost Hills WD	4-NE	6/7/88			0.64	1.29	1.86	0.69	0.080	2.92	2.44	0.037	0.117
23	Lost Hills WD	4-NE	6/7/89	49.8	52.8	0.78	1.62	2.38	0.88	0.075	3.10	2.15	0.038	0.098
23	Lost Hills WD	4-NW	6/7/88			0.97	1.44	1.68	0.72	0.070	3.14	2.30	0.037	0.096

Appendix A. Evaporation Pond Sediment Data, Minerals 1988 and 1989.

ID	Site	Cell	Date	B(WET) 1/	Sat	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti
				mg/L	%									
23	Lost Hills WD	4-NW	6/7/89	105.7	40.9	2.37	0.79	1.94	0.35	0.039	1.32	0.68	0.017	0.061
23	Lost Hills WD	5	6/7/88			6.02	1.805	10.44	0.59	0.060	1.77	0.71	0.032	0.069
23	Lost Hills WD	Borrow Pit	6/7/89	33.8	64.2	6.12	1.24	1.99	0.50	0.168	1.97	0.56	0.049	0.057
24	Carmel Ranch	1	6/7/88			9.88	1.58	2.18	0.42	0.100	1.60	1.34	0.048	0.104
24	Carmel Ranch	1	6/7/89	20.3	51.1	8.73	1.35	1.23	0.38	0.096	1.57	1.49	0.052	0.134
24	Carmel Ranch	2	6/7/88			4.40	1.86	5.60	0.66	0.040	2.93	1.56	0.030	0.105
24	Carmel Ranch	2	6/7/89	156.0	50.7	4.67	1.69	8.64	0.35	0.161	1.19	0.38	0.019	0.042
24	Carmel Ranch	3	6/7/88			4.83	1.87	1.36	0.93	0.090	3.98	3.14	0.039	0.166
24	Carmel Ranch	3	6/7/89	44.9	87.7	12.40	2.76	4.61	0.31	0.040	1.19	0.89	0.022	0.069
24	Carmel Ranch	4	6/7/88			11.60	1.52	1.05	0.65	0.110	2.66	2.08	0.035	0.121
24	Carmel Ranch	4	6/7/89	18.5	72.8	15.70	1.54	1.87	0.31	0.068	1.25	1.08	0.032	0.077
24	Carmel Ranch	5	6/7/88			7.28	1.72	9.08	0.52	0.060	1.61	1.01	0.032	0.093
24	Carmel Ranch	5	6/7/89	159.0	59.0	5.66	1.98	8.49	0.41	0.050	1.42	0.54	0.021	0.053
25	Lost Hills Ranch	1	6/7/88			5.25	1.16	1.08	0.54	0.150	2.05	1.79	0.035	0.132
25	Lost Hills Ranch	1	6/7/89	5.4	58.5	5.91	1.63	0.84	0.74	0.048	3.03	2.64	0.046	0.176
25	Lost Hills Ranch	2	6/7/88			3.36	1.45	2.40	0.86	0.130	3.41	2.71	0.034	0.121
25	Lost Hills Ranch	2	6/7/89	39.7	48.9	3.14	1.06	2.84	0.51	0.048	1.61	1.16	0.032	0.066
25	Lost Hills Ranch	3	6/7/89	11.6	41.5	4.38	1.06	0.73	0.37	0.066	1.27	1.34	0.029	0.138
26	Sam Andrews' Sons	1	6/7/88			4.23	1.08	0.61	0.46	0.070	1.95	1.38	0.027	0.097
26	Sam Andrews' Sons	1	6/7/89	14.7	76.6	4.74	1.63	1.47	0.66	0.070	2.57	1.65	0.036	0.096
26	Sam Andrews' Sons	2A	6/7/88			7.44	1.39	0.89	0.56	0.060	2.24	0.64	0.029	0.067
26	Sam Andrews' Sons	2A	6/7/89	47.2	80.6	5.83	1.88	2.92	0.62	0.071	2.22	0.78	0.029	0.069
26	Sam Andrews' Sons	2B	6/7/88			5.04	1.41	0.83	0.69	0.070	2.63	0.97	0.035	0.064
26	Sam Andrews' Sons	2B	6/7/89	23.6	70.1	2.00	1.50	1.00	0.68	0.066	2.83	2.09	0.038	0.093
26	Sam Andrews' Sons	3A	6/7/88			1.57	1.69	1.01	1.04	0.100	3.68	2.59	0.052	0.104
26	Sam Andrews' Sons	3A	6/7/89	24.8	72.2	10.20	1.15	0.93	0.34	0.041	1.16	0.71	0.021	0.072
26	Sam Andrews' Sons	3B	6/7/88			1.88	1.61	1.07	1.07	0.090	3.84	2.38	0.048	0.081
26	Sam Andrews' Sons	3B	6/7/89	58.3	102.0	11.30	1.08	2.00	0.32	0.063	0.95	0.41	0.015	0.051
26	Sam Andrews' Sons	4A	6/7/88			2.36	1.34	0.93	0.70	0.060	2.64	1.42	0.037	0.080
26	Sam Andrews' Sons	4A	6/7/89	57.6	60.8	2.46	1.52	2.04	0.76	0.071	2.79	0.88	0.036	0.049
26	Sam Andrews' Sons	4B	6/7/88			3.23	1.57	3.20	0.79	0.050	2.78	0.57	0.031	0.052
26	Sam Andrews' Sons	4B	6/7/89	71.5	65.8	4.96	1.23	2.36	0.49	0.046	1.71	0.45	0.024	0.043

1/ (WET) = Waste extraction test as described in Section 66700 of Title 22.

APPENDIX B

Appendix B. Evaporation Pond Sediment Data, Trace Elements, 1988 to 1989.

ID	Site	Cell	Date	TOC	B	Ba	Cd	Cr	Cu	Pb	Ni	Mo	Sr	V	Zn	As	Se	Hg	U
				%	mg/Kg														
1	Souza	Basin	7/6/88	0.22		245	<1	57	25	9	57	2	84	70	58	6.90	0.20	<0.05	
1	Souza	Basin	6/15/89	0.40	109	330	2	70	28	29	67	5	124	84	63	7.66	<0.25		1
3	Britz-S. Dos Palos	South	7/6/88	0.94		80	<1	29	10	9	16	5	565	30	23	3.20	2.35	0.08	
4	Sumner Peck	1	6/8/88	0.25		293	<1	37	25	11	45	2	171	81	80	8.05	6.25	<0.05	
4	Sumner Peck	2	6/8/88	0.25		340	1	27	33	13	49	2	136	87	98	8.55	2.80	0.05	
4	Sumner Peck	2	6/6/89	0.80	91	170	<1	40	22	6	38	4	315	51	67	6.08	15.15	0.08	7
4	Sumner Peck	3	6/8/88	0.22		290	<1	32	35	14	48	2	157	88	96	8.45	4.40	<0.05	
4	Sumner Peck	3	6/6/89	1.00	362	23	<1	20	2	< 5	5	2	467	11	7	1.38	0.82	0.15	5
4	Sumner Peck	5	6/8/88	0.49		326	1	41	31	15	69	3	156	88	103	9.60	5.75	<0.05	
4	Sumner Peck	5	6/6/89	0.60	104	278	<1	22	30	10	52	3	204	69	91	6.67	4.63	0.11	4
4	Sumner Peck	6	6/8/88	0.18		319	<1	26	3	16	52	2	173	90	113	8.55	2.05	<0.05	
4	Sumner Peck	6	6/6/89	0.60	85	266	<1	70	21	5	38	7	159	60	72	6.01	6.18	0.10	5
5	Britz-Deav 5-Pts.	North	6/8/88	0.19		244	<1	67	29	11	86	2	87	82	69	8.25	0.80	<0.05	
5	Britz-Deav 5 Pts	North	6/6/89	0.20	139	292	<1	48	39	6	104	3	104	102	78	8.82	0.47	0.07	1
5	Britz-Deav 5-Pts.	South	6/8/88	0.28		267	1	79	33	11	92	2	93	88	75	9.70	1.85	<0.05	
5	Britz-Deav 5 Pts	South	6/6/89	1.30	114	257	<1	119	34	8	114	4	182	82	176	7.52	1.34	0.12	2
6	Stone Land Co.	North (a)	6/7/88	0.18		254	1	59	31	15	90	2	219	87	64	11.35	0.05	<0.05	
6	Stone Land Co.	North (a)	6/6/89	0.40	133	352	<1	61	36	9	94	3	280	105	72	8.58	<0.25	0.11	2
6	Stone Land Co.	North (b)	6/7/88	0.60		230	1	55	33	14	69	3	195	74	63	4.90	0.10	<0.05	
6	Stone Land Co.	North (b)	6/6/89	2.70	148	227	<1	57	26	8	58	11	734	61	61	2.64	<0.25	0.05	6
6	Stone Land Co.	SE(a)	6/7/88	0.37		188	1	50	39	13	73	2	151	60	63	5.60	0.10	<0.05	
6	Stone Land Co.	SE(a)	6/6/89	0.70	169	158	<1	51	25	10	66	4	197	49	61	2.39	<0.25	0.06	2
6	Stone Land Co.	SE(b)	6/7/88	0.52		205	1	41	42	17	76	3	129	73	77	5.65	0.20	<0.05	
6	Stone Land Co.	SE(b)	6/6/89	1.00	179	204	<1	46	28	10	67	4	183	54	63	4.67	<0.25	0.06	2
6	Stone Land Co.	SW(a)	6/7/88	0.46		269	1	51	40	16	90	3	172	82	82	7.90	0.10	0.05	
6	Stone Land Co.	SW(a)	6/6/89	0.70	129	199	2	64	22	27	56	24	284	50	52	3.63	<0.25	0.09	4
6	Stone Land Co.	SW(b)	6/7/88	0.47		264	1	48	37	18	87	3	140	84	82	7.10	0.15	<0.05	
6	Stone Land Co.	SW(b)	6/6/89	1.70	165	111	2	38	23	27	62	38	815	45	58	3.89	0.59	0.11	13
6	Stone Land Co.	SW(b) (Algae)	6/7/89	3.60	291	54	1	24	28	19	48	46	1573	42	48	7.18	1.57		16
7	Carlton Duty	Basin	6/8/88	0.96		75	1	41	28	9	75	14	331	45	65	2.90	0.95	<0.05	
7	Carlton Duty	Basin	6/6/89	3.20	245	57	1	88	22	13	52	60	521	40	47	5.56	0.83	0.05	10
8	Westlake North	1 (NE)	6/8/88	0.35		96	<1	23	12	6	20	9	111	46	42	5.00	0.20	0.06	
8	Westlake North	1 (S)	6/8/88	0.25		94	<1	28	16	6	19	4	62	46	41	3.40	0.10	0.07	
8	Westlake-North	1-NE	6/6/89	0.70	77	132	<1	228	15	6	27	24	240	67	46	2.89	<0.25	<0.05	9
8	Westlake North	2-NE	6/8/88	0.20		55	<1	19	7	5	12	9	103	32	27	3.80	0.10	<0.05	
8	Westlake North	2-SE	6/8/88	0.17		43	<1	15	5	<5	9	2	65	25	20	2.00	0.05	<0.05	
8	Westlake-North	2-SE	6/6/89	1.60	120	251	1	69	25	11	49	72	400	67	82	7.78	<0.25	<0.05	45
8	Westlake North	2-SW	6/8/88	0.37		68	<1	25	9	5	14	13	167	40	31	3.45	0.15	<0.05	
9	Meyers Ranch	A	6/7/88	0.38		114	<1	25	11	5	17	7	151	43	38	2.90	0.25	<0.05	
9	Meyers Ranch	A	6/6/89	2.80	120	214	1	100	24	11	39	40	747	64	51	5.65	<0.25	<0.05	32

Appendix B. Evaporation Pond Sediment Data, Trace Elements, 1988 to 1989.

ID	Site	Cell	Date	TOC	B	Ba	Cd	Cr	Cu	Pb	Ni	Mo	Sr	V	Zn	As	Se	Hg	U
				%	mg/Kg														
9	Meyers Ranch	B	6/7/88	0.41		104	1	34	15	7	18	7	52	49	39	2.30	0.15	0.05	
9	Meyers Ranch	B	6/7/88	0.33		111	<1	26	12	6	19	7	51	50	40	2.35	0.20	0.05	
9	Meyers Ranch	B	6/6/89	4.60	148	175	1	151	21	11	37	59	527	51	56	5.46	<0.25	<0.05	48
9	Meyers Ranch	C	6/7/88	0.07		141	1	27	13	6	29	1	120	75	44	4.70	0.15	<0.05	
10	Barbizon Farms	East	6/7/88	0.55		123	1	27	16	8	24	7	60	55	50	4.15	0.10	<0.05	
10	Barbizon Farms	East	6/6/89	4.10	153	205	1	32	30	14	37	35	747	90	59	13.40	<0.25	<0.05	55
10	Barbizon Farms	Middle	6/7/88	0.48		135	1	28	18	9	28	8	63	59	52	4.25	0.15	<0.05	
10	Barbizon Farms	West	6/7/88	0.57		141	1	26	20	8	29	11	67	57	50	5.25	0.18	<0.05	
11	TLDD, North	1	6/7/88	1.80		115	1	18	15	13	22	5	1291	90	36	18.85	0.75	<0.05	
11	TLDD, North	1	6/6/89	1.00	51	88	<1	103	10	7	15	7	541	58	29	10.99	<0.25	<0.05	6
11	TLDD, North	2A	6/7/88	0.79		80	<1	17	11	6	18	11	160	46	38	6.20	0.35	<0.05	
11	TLDD, North	2A	6/6/89	3.30	90	133	<1	246	17	7	29	23	390	85	39	15.93	0.45	<0.05	14
11	TLDD, North	2B	6/7/88	1.82		87	1	17	13	11	17	9	755	105	27	18.22	0.50	<0.05	
11	TLDD, North	2B	6/6/89	1.60	66	133	<1	107	13	7	21	12	500	65	41	14.08	0.30	<0.05	9
11	TLDD, North	3A	6/7/88	1.19		130	<1	25	18	9	25	13	345	82	49	11.35	0.45	<0.05	
11	TLDD, North	3A	6/6/89	0.70	49	106	<1	191	9	< 5	17	13	196	42	30	6.34	<0.25	<0.05	4
11	TLDD, North	3B	6/7/88	2.01		128	<1	23	21	<5	20	14	1136	101	43	20.25	0.70	0.11	
11	TLDD, North	3B	6/6/89	1.50	79	150	<1	145	21	9	32	17	624	57	49	8.82	0.57	0.05	16
11	TLDD, North	4	6/7/88	0.56		86	<1	24	13	6	27	10	110	46	36	6.30	0.35	<0.05	
11	TLDD, North	4	6/6/89	0.90	70	116	<1	114	14	52	24	53	228	42	36	8.16	<0.25	<0.05	14
11	TLDD, North	5A	6/7/88	0.65		108	<1	22	40	7	24	7	150	48	40	9.20	0.40	<0.05	
11	TLDD, North	5A	6/6/89	1.30	118	223	1	87	26	12	42	14	238	67	63	9.92	0.26		11
11	TLDD, North	5B	6/7/88	0.71		100	1	24	15	8	27	12	186	51	43	10.00	0.25	<0.05	
11	TLDD, North	5B	6/6/89	0.70	77	141	<1	91	15	6	36	20	196	40	52	9.09	<0.25	0.06	12
11	TLDD, North	6	6/7/88	0.78		194	1	27	27	9	41	8	120	66	66	11.35	0.25	<0.05	
11	TLDD, North	6	6/6/89	1.10	118	245	1	46	31	14	47	13	152	63	73	12.50	<0.25	0.05	10
11	TLDD, North	7	6/7/88	0.81		185	1	29	24	10	36	8	181	62	62	11.15	0.20	<0.05	
11	TLDD, North	7	6/6/89	1.10	132	274	1	49	31	14	45	15	195	61	77	13.39	<0.25	0.12	10
12	Westlake #3	1	6/8/88	0.21		233	<1	61	39	11	85	3	89	86	76	8.00	0.50	0.13	
12	Westlake #3	1	6/6/89	0.60	61	209	<1	65	25	10	66	6	192	42	55	5.62	0.27	0.11	5
12	Westlake #3	2	6/8/88	0.26		242	<1	62	32	10	83	2	113	85	77	12.00	0.45	0.12	
12	Westlake #3	2	6/6/89	0.20	72	231	<1	222	15	7	39	11	127	47	40	5.91	<0.25	0.15	3
12	Westlake #3	3	6/8/88	0.19		235	<1	59	32	11	86	3	142	81	72	11.30	0.45	0.12	
12	Westlake #3	4	6/8/88	0.36		186	<1	61	24	9	77	2	165	64	57	9.30	0.55	0.15	
12	Westlake #3	4	6/6/89	0.40	140	280	1	93	32	11	89	5	138	71	63	11.02	<0.25	0.22	2
12	Westlake #3	5	6/8/88	0.31		162	<1	71	22	8	67	2	98	67	54	6.15	0.10	0.11	
12	Westlake #3	5	6/6/89	0.80	74	154	<1	170	18	10	50	21	381	40	39	11.29	0.33	0.09	7
12	Westlake #3	6	6/8/88	0.21		408	<1	65	37	10	92	5	102	78	63	9.48	0.60	0.14	
12	Westlake #3	6	6/6/89	1.40	79	163	1	129	25	14	70	22	590	44	50	12.50	0.47	0.12	10
14	Pryse Farms	1	6/8/88	0.78		231	<1	17	20	8	18	6	110	68	71	6.95	0.15	0.05	

Appendix B. Evaporation Pond Sediment Data, Trace Elements, 1988 to 1989.

ID	Site	Cell	Date	TOC	B	Ba	Cd	Cr	Cu	Pb	Ni	Mo	Sr	V	Zn	As	Se	Hg	U
				%	mg/Kg														
14	Pryse Farms	1	6/8/88	0.68		112	<1	22	11	7	15	125	851	61	31	29.40	1.55	<0.05	
14	Pryse Farms	2	6/8/88	0.74		169	<1	22	18	9	24	13	302	54	50	9.35	0.45	<0.05	
14	Pryse Farms	East	6/7/89	1.10	91	218	<1	39	20	5	24	61	236	72	56	17.55	0.42	0.06	18
15	Bowman Farms	A	6/8/88	1.30		188	1	23	30	11	28	206	1054	96	63	27.90	4.00	<0.05	
15	Bowman Farms	A	6/7/89	1.00	125	246	<1	28	29	5	32	17	250	90	71	21.95	0.66	0.08	46
15	Bowman Farms	B	6/8/88	0.72		256	<1	32	35	12	39	12	392	85	76	12.80	1.60	0.06	
16	Morris Farms	Cell	6/8/88	1.57		205	1	29	28	11	33	22	549	72	64	13.00	3.35	0.06	
16	Morris Farms	Cell	6/7/89	1.90	130	330	<1	25	32	5	39	102	432	90	71	20.15	2.12	0.07	84
17	Martin Farms	Cell	6/8/88	0.81		477	1	29	50	13	44	8	190	81	86	12.30	0.80	0.05	
17	Martin Farms	Cell	6/7/89	2.80	133	178	<1	26	22	8	23	200	691	89	45	50.39	4.58	0.15	290
19	4-J Corp.	Cell	6/8/88	1.98		145	<1	26	16	10	22	15	1728	181	35	41.77	2.08	<0.05	
19	4-J Corp	Cell	6/7/89	2.30	180	194	<1	57	20	< 5	25	25	690	161	42	44.77	1.02	<0.05	28
21	TLDD Hacienda	A 1	6/7/88	0.51		49	<1	12	8	5	6	15	504	31	18	7.05	1.45	<0.05	
21	TLDD, Hacienda	A1 (SE)	6/7/89	0.50	41	108	<1	103	8	<5	9	14	365	39	17	9.26	0.64	<0.05	27
21	TLDD, Hacienda	A1 (SW)	6/7/89	0.70	59	134	1	93	18	7	13	19	365	55	45	6.04	0.55	0.05	28
21	TLDD Hacienda	A2(a)	6/7/88	0.19		65	<1	14	8	<5	11	11	154	28	22	3.90	0.65	<0.05	
21	TLDD, Hacienda	A2(a)	6/7/89	0.40	60	131	<1	115	13	< 5	12	19	349	47	31	7.25	0.67	0.08	33
21	TLDD, Hacienda	A2(b)	6/7/89	0.20	92	157	1	45	29	14	18	9	117	49	73	6.69	0.26	0.13	13
21	TLDD Hacienda	A2(c)	6/7/88	0.33		52	<1	13	8	<5	8	6	152	27	19	3.95	0.45	<0.05	
21	TLDD, Hacienda	A3	6/7/89	0.30	19	50	1	43	7	12	6	9	67	14	13	4.40	0.44	<0.05	16
21	TLDD Hacienda	A3	6/7/88	0.16		45	<1	9	8	<5	5	37	59	28	24	6.55	0.40	<0.05	
21	TLDD Hacienda	A4	6/7/88	1.32		72	<1	12	13	7	10	73	201	41	37	10.45	0.80	<0.05	
21	TLDD, Hacienda	A4 (NW)	6/7/89	0.30	58	122	<1	70	13	6	12	31	114	32	38	6.96	0.40	<0.05	19
21	TLDD, Hacienda	A4 (NE)	6/7/89	0.10	120	139	1	37	24	9	14	9	89	51	73	8.63	<0.25	0.06	5
21	TLDD Hacienda	C1	6/7/88	0.14		33	<1	8	6	<5	4	19	114	26	18	6.25	0.85	<0.05	
21	TLDD, Hacienda	C1 (SE)	6/7/89	1.00	83	148	<1	72	23	5	17	31	577	76	53	11.86	2.35	0.07	50
21	TLDD, Hacienda	C1 (NW)	6/7/89	0.50	53	88	<1	240	14	<5	12	22	312	49	30	8.68	0.91	<.05	23
21	TLDD, Hacienda	C2(a)	6/7/89	1.80	99	130	<1	132	19	5	15	62	725	72	55	13.19	1.72	0.05	75
21	TLDD Hacienda	C2(b)	6/7/88	1.38		62	1	12	12	8	8	35	323	43	33	15.45	2.35	<0.05	
21	TLDD, Hacienda	C2(b)	6/7/89	0.90	77	115	1	136	17	7	12	35	337	51	37	8.67	0.84	<0.05	44
21	TLDD Hacienda	C3	6/7/88	0.52		71	<1	12	15	7	8	78	206	43	40	10.30	1.25	<0.05	
21	TLDD, Hacienda	C3	6/7/89	1.70	91	121	<1	155	15	< 5	15	115	351	51	47	13.23	1.21	<0.05	57
21	TLDD Hacienda	C4	6/7/88	0.61		62	<1	12	14	7	8	106	219	39	37	18.45	1.00	0.06	
21	TLDD, Hacienda	C4	6/7/89	0.90	104	102	<1	148	12	< 5	12	99	254	43	31	24.26	0.58	<0.05	29
21	TLDD, Hacienda	Marsh N. Cell	6/7/89	1.80	110	172	<1	47	25	5	17	10	503	76	70	10.63	1.85	<0.05	34
21	TLDD, Hacienda	Marsh S. Cell	6/7/89	0.40	97	183	<1	33	23	< 5	14	2	206	74	77	4.11	0.54	0.07	14
22	TLDD South	1 (SW)	6/8/88	0.29		42	<1	10	6	4	5	18	467	25	14	6.65	1.55	<0.05	
22	TLDD South	1 (N)	6/8/88	0.28		50	<1	10	5	5	5	17	410	21	12	6.15	1.25	<0.05	
22	TLDD, South	1	6/6/89	0.30	33	100	<1	125	8	8	8	8	471	20	16	4.58	0.26	<0.05	8
22	TLDD, South	1 SW Side	6/6/89	0.50	54	178	<1	165	9	5	13	16	469	27	24	4.12	0.54	<0.05	18

Appendix B. Evaporation Pond Sediment Data, Trace Elements, 1988 to 1989.

ID	Site	Cell	Date	TOC	B	Ba	Cd	Cr	Cu	Pb	Ni	Mo	Sr	V	Zn	As	Se	Hg	U
				%	mg/Kg														
22	TLDD South	2	6/8/88	0.66		101	<1	22	12	7	14	9	243	41	33	11.10	0.95	<0.05	
22	TLDD, South	2	6/6/89	0.60	121	163	<1	57	14	6	18	10	323	32	43	5.39	<0.25	0.06	2
22	TLDD South	3	6/8/88	0.54		175	<1	19	13	14	14	4	610	37	31	8.55	0.45	<0.05	
22	TLDD, South	3	6/6/89	0.40	89	170	<1	47	18	8	18	6	309	46	59	8.48	0.33	<0.05	6
22	TLDD South	4	6/8/88	1.29		94	<1	17	11	7	12	44	291	36	31	6.30	1.45	<0.05	
22	TLDD, South	4 (SE)	6/6/89	1.40	85	193	<1	53	16	6	17	12	421	40	44	6.42	0.86	<0.05	12
22	TLDD, South	4 (NW)	6/6/89	1.40	75	164	<1	79	13	9	14	32	508	35	33	6.58	0.87	<0.05	25
22	TLDD South	5	6/8/88	0.91		141	<1	24	17	11	21	46	332	47	52	11.42	0.85	0.05	
22	TLDD, South	5	6/6/89	0.70	125	249	1	22	25	8	26	2	491	49	58	10.05	<0.25	<0.05	5
22	TLDD South	6	6/8/88	1.11		80	<1	19	10	8	12	35	424	41	28	8.80	2.35	<0.05	
22	TLDD, South	6	6/6/89	0.80	60	152	<1	59	9	5	11	49	220	32	33	7.24	0.63	<0.05	28
22	TLDD South	7	6/8/88	0.10		106	1	15	18	10	12	7	239	46	45	4.35	0.15	0.05	
22	TLDD, South	7	6/6/89	0.80	59	191	<1	86	10	6	13	22	220	30	27	4.51	0.46	<0.05	12
22	TLDD South	8	6/8/88	0.09		49	<1	12	4	<5	6	33	111	20	14	7.60	0.35	<0.05	
22	TLDD, South	8	6/6/89	0.30	54	216	1	95	10	10	10	8	385	24	23	4.44	<0.25	<0.05	12
22	TLDD South	9	6/8/88	0.21		38	<1	9	5	5	6	32	140	21	16	5.55	0.30	<0.05	
22	TLDD, South	9	6/6/89	0.40	77	183	<1	120	10	7	16	10	135	30	28	3.42	<0.25	<0.05	4
22	TLDD South	10	6/8/88	0.45		66	<1	15	7	6	11	52	256	26	21	8.38	0.33	<0.05	
22	TLDD, South	10	6/6/89	0.50	90	209	<1	43	12	6	20	3	210	32	39	2.46	<0.25	<0.05	7
22	TLDD South	Salt Basin	6/8/88	1.52		79	<1	20	12	9	17	53	537	54	35	10.70	2.25	<0.05	
22	TLDD, South	Salt Basin	6/6/89	0.90	79	148	<1	19	9	5	12	13	390	29	25	4.28	0.45	<0.05	14
23	Lost Hills WD	1(a)	6/7/88	0.45		209	1	37	33	11	44	7	115	74	76	7.50	1.10	<0.05	
23	Lost Hills WD	1(a)	6/7/89	0.30	174	274	3	37	31	26	47	7	285	68	78	6.46	1.81		4
23	Lost Hills WD	1(c)	6/7/88	0.49		168	1	37	23	8	36	6	157	62	64	5.40	2.65	<0.05	
23	Lost Hills WD	1(c)	6/7/89	0.60	150	245	2	38	23	21	41	6	172	65	66	5.10	0.71		3
23	Lost Hills WD	2-East	6/7/89	0.80	178	287	4	27	38	37	55	8	183	83	92	8.61	0.36		2
23	Lost Hills WD	2-West	6/7/89	0.50	254	276	3	28	40	36	56	8	262	83	92	9.23	0.56		2
23	Lost Hills WD	3A-North	6/7/88	0.55		183	1	38	20	7	37	4	100	63	61	5.10	1.55	0.06	
23	Lost Hills WD	3A-North	6/7/89	0.70	144	236	2	64	18	23	38	8	84	70	67	4.53	0.72		1
23	Lost Hills WD	3A-South	6/7/88	0.55		259	1	36	34	11	52	3	104	93	89	9.15	0.88	0.06	
23	Lost Hills WD	3A-South	6/7/89	0.40	157	68	2	19	16	20	24	3	126	36	36	3.51	3.74		1
23	Lost Hills WD	3B-North	6/7/88	0.42		172	1	39	18	7	30	11	165	53	50	5.00	3.95	<0.05	
23	Lost Hills WD	3B-North	6/7/89	0.50	185	262	3	34	29	26	47	8	156	78	73	6.52	1.81		2
23	Lost Hills WD	3B-South	6/7/88	0.47		184	1	32	25	8	37	4	173	54	62	6.75	1.20	0.06	
23	Lost Hills WD	3B-South	6/7/89	0.70	180	264	4	30	37	35	54	8	265	76	87	7.61	1.11		2
23	Lost Hills WD	3C	6/7/88	0.34		162	<1	26	24	8	35	4	344	44	62	6.80	3.00	<0.05	
23	Lost Hills WD	3C	6/7/89	0.70	156	160	2	38	22	22	31	12	384	47	55	4.44	4.10		5
23	Lost Hills WD	4-NE	6/7/88	1.00		179	1	36	23	9	39	4	91	68	66	5.80	0.75	0.05	
23	Lost Hills WD	4-NE	6/7/89	0.90	203	235	3	29	25	28	46	6	114	74	72	6.15	0.46		1
23	Lost Hills WD	4-NW	6/7/88	0.43		179	<1	35	25	7	41	5	114	68	68	8.90	1.05	<0.05	

Appendix B. Evaporation Pond Sediment Data, Trace Elements, 1988 to 1989.

ID	Site	Cell	Date	TOC	B	Ba	Cd	Cr	Cu	Pb	Ni	Mo	Sr	V	Zn	As	Se	Hg	U
				%	mg/Kg														
23	Lost Hills WD	4-NW	6/7/89	0.60	171	182	1	78	13	14	22	8	274	36	35	4.00	2.01		2
23	Lost Hills WD	5	6/7/88	2.42		101	<1	16	17	11	18	283	980	96	40	181.30	0.23	0.06	
23	Lost Hills WD	Borrow Pit	6/7/89	1.40	124	152	2	48	17	18	26	9	1048	42	48	3.31	2.34		8
24	Carmel Ranch	1	6/7/88	2.03		117	1	20	14	12	15	66	1054	123	35	35.35	0.75	<0.05	
24	Carmel Ranch	1	6/7/89	1.00	127	164	2	17	16	27	16	25	653	85	39	18.55	0.31	<0.05	24
24	Carmel Ranch	2	6/7/88	1.51		150	<1	21	26	13	25	163	529	93	58	68.88	0.70	0.06	
24	Carmel Ranch	2	6/7/89	2.40	398	86	1	38	13	20	15	264	1073	74	32	113.58	0.45	0.10	150
24	Carmel Ranch	3	6/7/88	0.57		205	<1	26	25	14	30	5	305	87	83	15.10	0.40	<0.05	
24	Carmel Ranch	3	6/7/89	4.80	344	103	1	28	15	28	15	71	1682	178	43	83.69	1.63	0.15	180
24	Carmel Ranch	4	6/7/88	1.36		142	1	24	22	14	22	31	935	90	53	38.30	1.10	0.06	
24	Carmel Ranch	4	6/7/89	2.90	122	110	2	36	16	26	15	74	2066	97	40	37.16	1.40	0.05	61
24	Carmel Ranch	5	6/7/88	2.06		96	1	17	18	12	16	220	748	84	37	130.50	0.45	0.06	
24	Carmel Ranch	5	6/7/89	2.90	472	104	1	31	16	22	16	203	1248	97	36	97.24	0.60	0.05	76
25	Lost Hills Ranch	1	6/7/88	0.83		140	<1	22	17	7	19	22	343	67	47	34.95	0.40	<0.05	
25	Lost Hills Ranch	1	6/7/89	1.40	148	278	3	32	28	473	29	12	398	88	74	26.79	<0.25		5
25	Lost Hills Ranch	2	6/7/88	2.10		161	<1	28	30	11	30	207	293	118	75	137.00	0.75	0.05	
25	Lost Hills Ranch	2	6/7/89	1.10	142	240	1	78	16	18	21	22	229	54	49	22.24	<0.25		7
25	Lost Hills Ranch	3	6/7/89	0.50	112	224	1	88	14	17	19	16	240	67	36	35.30	<0.25		7
26	Sam Andrews' Sons	1	6/7/88	0.51		113	<1	21	14	8	16	3	262	40	50	6.45	2.45	0.07	
26	Sam Andrews' Sons	1	6/7/89	1.90	140	184	1	81	24	8	31	20	337	62	71	7.53	5.82	0.15	8
26	Sam Andrews' Sons	2A	6/7/88	0.70		130	1	18	18	10	19	4	448	36	56	6.80	3.40	0.07	
26	Sam Andrews' Sons	2A	6/7/89	2.60	211	162	1	70	23	9	24	42	406	51	61	5.91	8.27	0.16	15
26	Sam Andrews' Sons	2B	6/7/88	0.75		142	1	20	17	10	22	5	311	40	66	7.55	3.00	0.05	
26	Sam Andrews' Sons	2B	6/7/89	0.50	134	194	1	34	21	7	28	5	120	71	80	9.57	1.01	0.06	4
26	Sam Andrews' Sons	3A	6/7/88	0.70		180	1	29	24	14	28	6	95	69	92	11.25	1.25	0.05	
26	Sam Andrews' Sons	3A	6/7/89	0.70	117	96	<1	49	11	9	12	6	607	36	31	5.25	3.51	0.08	6
26	Sam Andrews' Sons	3B	6/7/88	0.46		182	1	26	26	12	29	5	122	65	95	11.80	2.05	0.05	
26	Sam Andrews' Sons	3B	6/7/89	1.20	186	74	<1	87	16	9	12	20	680	31	36	4.29	10.14	0.08	9
26	Sam Andrews' Sons	4A	6/7/88	0.16		135	<1	23	21	9	22	4	124	44	64	7.55	0.90	0.09	
26	Sam Andrews' Sons	4A	6/7/89	0.50	151	158	<1	82	20	8	27	7	165	46	73	7.37	0.78	0.08	4
26	Sam Andrews' Sons	4B	6/7/88	0.45		108	<1	22	20	11	23	8	214	40	67	7.85	3.90	0.06	
26	Sam Andrews' Sons	4B	6/7/89	0.50	164	124	<1	59	14	6	18	7	386	37	45	6.40	2.06	0.10	4

APPENDIX C

Appendix C. Evaporation Pond Sediment Data, Radiological Data.

ID	SITE	CELL	Date	U	eU	eU (GG)	eTh	K	Calculated Values Ra 226	Ra 228	Ra Total Activity
				ppm				%	pCi/gm		
1	Souza	South	6/15/89	1	2	7	6	1.0	0.67	0.66	1.33
4	Sumner Peck	2	6/6/89	7	<3	7	10	1.8	0.25	1.10	1.35
4	Sumner Peck	3	6/6/89	5	<3	1	<6	1.7	0.25	0.17	0.42
4	Sumner Peck	5	6/6/89	4	3	8	9	2.0	1.00	0.99	1.99
4	Sumner Peck	6	6/6/89	5	<3	7	<6	2.0	0.25	0.17	0.42
5	Britz-Deav 5 Pts	North	6/6/89	1	<2	6	5	1.3	0.17	0.55	0.72
5	Britz-Deav 5 Pts	South	6/6/89	2	<2	5	7	1.7	0.17	0.77	0.94
6	Stone Land Co.	North (a)	6/6/89	2	<3	6	6	1.4	0.25	0.66	0.91
6	Stone Land Co.	North (b)	6/6/89	6	<5	5	10	1.2	0.42	1.10	1.52
6	Stone Land Co.	SE(a)	6/6/89	2	<2	5	6	1.8	0.17	0.66	0.83
6	Stone Land Co.	SE(b)	6/6/89	2	<3	6	8	1.4	0.25	0.88	1.13
6	Stone Land Co.	SW(a)	6/6/89	4	3	6	8	2.2	1.00	0.88	1.88
6	Stone Land Co.	SW(b)	6/6/89	13	<2	7	5	1.6	0.17	0.55	0.72
6	Stone Land Co.	SW(b) (Algae)	6/7/89	16	<50	<5	<100	2.4	4.01	2.75	6.76
7	Carlton Duty	Basin	6/6/89	10	2	6	7	2.3	0.67	0.77	1.44
8	Westlake-North	1-NE	6/6/89	9	<5	7	10	1.7	0.42	1.10	1.52
8	Westlake-North	2-SE	6/6/89	45	<3	14	13	1.9	0.25	1.43	1.68
9	Meyers Ranch	A	6/6/89	32	<5	11	<10	2.2	0.42	0.28	0.69
9	Meyers Ranch	B	6/6/89	48	<5	12	10	2.0	0.42	1.10	1.52
10	Barbizon Farms	East	6/6/89	55	<5	13	10	1.7	0.42	1.10	1.52
11	TLDD, North	1	6/6/89	4	2	6	<4	1.4	0.67	0.11	0.78
11	TLDD, North	2A	6/6/89	14	<5	8	<10	2.4	0.42	0.28	0.69
11	TLDD, North	2B	6/6/89	9	3	7	<6	3.1	1.00	0.17	1.17
11	TLDD, North	3A	6/6/89	4	2	6	6	2.1	0.67	0.66	1.33
11	TLDD, North	3B	6/6/89	16	<3	8	8	2.2	0.25	0.88	1.13
11	TLDD, North	4	6/6/89	14	2	8	5	2.0	0.67	0.55	1.22
11	TLDD, North	5A	6/6/89	11	<3	10	<6	2.2	0.25	0.17	0.42
11	TLDD, North	5B	6/6/89	12	4	7	4	2.4	1.34	0.44	1.78
11	TLDD, North	6	6/6/89	10	<3	10	8	2.3	0.25	0.88	1.13

Appendix C. Evaporation Pond Sediment Data, Radiological Data.

ID	SITE	CELL	Date	U	eU	eU (GG)	eTh	K	Ra 226	Ra 228	Ra Total Activity
				ppm				%	pCi/gm		
11	TLDD, North	7	6/6/89	10	<5	10	<10	2.3	0.42	0.28	0.69
12	Westlake #3	1	6/6/89	5	<3	5	<6	2.5	0.25	0.17	0.42
12	Westlake #3	2	6/6/89	3	<3	4	<6	2.8	0.25	0.17	0.42
12	Westlake #3	4	6/6/89	2	3	5	6	2.6	1.00	0.66	1.66
12	Westlake #3	5	6/6/89	7	<3	4	6	2.9	0.25	0.66	0.91
12	Westlake #3	6	6/6/89	11	<3	5	<6	2.5	0.25	0.17	0.42
14	Pryse Farms	East	6/7/89	18	5	14	11	3.0	1.67	1.21	2.88
15	Bowman Farms	A	6/7/89	46	<5	15	<10	2.6	0.42	0.28	0.69
16	Morris Farms	Cell	6/7/89	84	3	18	9	2.7	1.00	0.99	1.99
17	Martin Farms	Cell	6/7/89	290	<3	39	6	2.7	0.25	0.66	0.91
19	4-J Corp	Cell	6/7/89	28	<3	11	6	2.4	0.25	0.66	0.91
21	TLDD, Hacienda	A1 (SE)	6/7/89	27	2	10	8	2.6	0.67	0.88	1.99
21	TLDD, Hacienda	A1 (SW)	6/7/89	28	3	14	9	2.7	1.00	0.99	1.99
21	TLDD, Hacienda	A2(a)	6/7/89	33	3	12	9	2.4	1.00	0.99	1.99
21	TLDD, Hacienda	A2(b)	6/7/89	13	7	17	<6	2.1	2.34	0.17	2.50
21	TLDD, Hacienda	A3	6/7/89	16	5	12	8	3.0	1.67	0.88	2.55
21	TLDD, Hacienda	A4 (NW)	6/7/89	19	5	11	5	3.0	1.67	0.55	3.10
21	TLDD, Hacienda	A4 (NE)	6/7/89	5	5	16	20	2.8	1.67	2.20	3.10
21	TLDD, Hacienda	C1 (SE)	6/7/89	50	6	17	12	2.3	2.00	1.32	1.66
21	TLDD, Hacienda	C1 (NW)	6/7/89	23	<3	11	<6	3.0	0.25	0.17	1.66
21	TLDD, Hacienda	C2(a)	6/7/89	75	3	18	11	0.7	1.00	1.21	2.21
21	TLDD, Hacienda	C2(b)	6/7/89	37	3	15	10	2.6	1.00	1.10	2.10
21	TLDD, Hacienda	C3	6/7/89	57	4	15	<6	1.5	1.34	0.17	1.50
21	TLDD, Hacienda	C4	6/7/89	29	4	13	7	1.4	1.34	0.77	2.11
21	TLDD, Hacienda	Marsh N. Cell	6/7/89	34	7	18	17	1.3	2.34	1.87	4.21
21	TLDD, Hacienda	Marsh S. Cell	6/7/89	14	4	17	19	1.9	1.34	2.09	3.43
22	TLDD, South	1	6/6/89	6	<2	6	<4	1.9	0.17	0.11	0.28
22	TLDD, South	1 SW Side	6/6/89	18	<3	9	<6	1.3	0.25	0.17	0.42
22	TLDD, South	2	6/6/89	2	2	8	<4	0.9	0.67	0.11	0.78

Appendix C. Evaporation Pond Sediment Data, Radiological Data.

ID	SITE	CELL	Date	U	eU	eU (GG)	eTh	K	Ra 226	Ra 228	Ra Total Activity
				ppm				%	pCi/gm (Calculated Values)		
22	TLDD, South	3	6/6/89	6	4	11	14	1.7	1.34	1.54	2.88
22	TLDD, South	4 (SE)	6/6/89	12	3	12	6	2.3	1.00	0.66	2.22
22	TLDD, South	4 (NW)	6/6/89	25	4	12	9	2.0	1.34	0.99	2.22
22	TLDD, South	5	6/6/89	5	4	11	5	2.0	1.34	0.55	1.89
22	TLDD, South	6	6/6/89	28	2	11	7	1.9	0.67	0.77	1.44
22	TLDD, South	7	6/6/89	12	3	10	8	1.9	1.00	0.88	1.88
22	TLDD, South	8	6/6/89	12	6	10	7	<0.3	2.00	0.77	2.77
22	TLDD, South	9	6/6/89	4	<2	8	4	2.0	0.17	0.44	0.61
22	TLDD, South	10	6/6/89	7	3	8	4	1.4	1.00	0.44	1.44
22	TLDD, South	Salt Basin	6/6/89	14	<3	9	<6	1.7	0.25	0.17	0.42
23	Lost Hills WD	1(a)	6/7/89	4	3	8	9	1.3	1.00	0.99	1.99
23	Lost Hills WD	1(c)	6/7/89	3	<2	7	8	1.8	0.17	0.88	1.05
23	Lost Hills WD	2-East	6/7/89	2	3	8	<6	1.1	1.00	0.17	1.17
23	Lost Hills WD	2-West	6/7/89	2	2	8	7	1.4	0.67	0.77	1.44
23	Lost Hills WD	3A-North	6/7/89	1	<3	7	7	1.4	0.25	0.77	1.02
23	Lost Hills WD	3A-South	6/7/89	1	<3	3	<6	0.9	0.25	0.17	0.42
23	Lost Hills WD	3B-North	6/7/89	2	4	7	4	1.5	1.34	0.44	1.78
23	Lost Hills WD	3B-South	6/7/89	2	<3	8	7	0.5	0.25	0.77	1.02
23	Lost Hills WD	3C	6/7/89	5	2	7	4	0.7	0.67	0.44	1.11
23	Lost Hills WD	4 NE	6/7/89	1	3	7	5	1.3	1.00	0.55	1.55
23	Lost Hills WD	4 NW	6/7/89	2	2	6	<4	2.4	0.67	0.11	0.78
23	Lost Hills WD	Borrow Pit	6/7/89	8	3	7	7	2.3	1.00	0.77	1.77
24	Carmel Ranch	1	6/7/89	24	3	10	8	1.9	1.00	0.88	1.88
24	Carmel Ranch	2	6/7/89	165	3	21	10	2.2	1.00	1.10	2.10
24	Carmel Ranch	3	6/7/89	180	<5	24	<10	1.8	0.42	0.28	0.69
24	Carmel Ranch	4	6/7/89	61	5	10	<10	2.0	1.67	0.28	1.95
24	Carmel Ranch	5	6/7/89	91	<3	16	8	1.7	0.25	0.88	1.13
25	Lost Hills Ranch	1	6/7/89	5	3	11	10	1.4	1.00	1.10	2.10
25	Lost Hills Ranch	2	6/7/89	7	3	8	6	1.7	1.00	0.66	1.66

Appendix C. Evaporation Pond Sediment Data, Radiological Data.

ID	SITE	CELL	Date	U	eU	eU (GG)	eTh	K	Ra 226	Ra 228	Ra Total Activity
				ppm				%	pCi/gm		
25	Lost Hills Ranch	3	6/7/89	7	2	8	5	1.9	0.67	0.55	1.22
26	Sam Andrews' Sons	1	6/7/89	8	3	10	8	2.2	1.00	0.88	1.88
26	Sam Andrews' Sons	2A	6/7/89	17	5	9	<10	2.0	1.67	0.28	1.95
26	Sam Andrews' Sons	2B	6/7/89	4	6	11	7	0.6	2.00	0.77	2.77
26	Sam Andrews' Sons	3A	6/7/89	6	<3	5	8	1.8	0.25	0.88	1.13
26	Sam Andrews' Sons	3B	6/7/89	9	<5	5	<10	1.8	0.42	0.28	0.69
26	Sam Andrews' Sons	4A	6/7/89	4	<3	9	13	<5.0	0.25	1.43	1.68
26	Sam Andrews' Sons	4B	6/7/89	4	3	8	8	2.1	1.00	0.88	1.88
	Minimum			1	<2	1	<4	<0.3	0.17	0.11	0.42
	Median			9	2	8	6	2	0.67	0.66	1.44
	Geometric Mean			9	2	8	5	2	0.52	0.58	1.23
	Maximum			290	<50	39	<100	3	4.01	2.75	6.76

Calculated Values: Ra 226, Ra 228, Ra Total Activity.

eU = The amount of total natural uranium that would be present if in equilibrium with measured uranium daughters that are present (Ra-226).

eU(GG) = The gross gamma equivalent amount of total natural uranium in equilibrium with all of its daughters that would need to be present to give the same total gamma activity as measured in the sample.

eTH = The amount of total natural Th that would be present if in equilibruim with measured Th daughters that are present (Th-228).

APPENDIX D

Appendix D. Sediment Trace Element Transect Data for Selected Evapration Basin Cells, 1987 and 1989.

ID	Site	Date	Hg	As	Se	Cu	Zn	Ni	Mo	Cd	Cr	Sr	Ba	Pb	V	U
			mg/Kg													
4	Sumner Peck Cell 5															
	North-a	6/9/87	0.10	6.25	16.90	23	69	36	<1	<1	27	313	200	<5	44	
	-b	6/9/87	<0.05	7.50	18.10	22	63	33	<1	<1	23	325	121	<5	43	
	-c	6/9/87	0.10	7.55	17.60	26	75	39	11	<1	40	300	182	10	65	
	-d	6/9/87	0.05	7.45	18.60	26	76	39	11	<1	36	303	147	9	64	
	-mean		**0.07**	**7.19**	**17.80**	**24**	**71**	**37**	**6**	**<1**	**32**	**310**	**163**	**5**	**54**	
	-standard deviation		0.03	0.63	0.73	2	6	3	8	0	8	11	35	1	12	
	mid North-a	6/9/87	<.05	6.35	21.80	26	75	37	<1	<1	30	477	89	<5	47	
	-b	6/9/87	<.05	5.85	19.80	27	72	35	<1	<1	26	452	110	<5	43	
	-c	6/9/87	<.05	6.35	17.00	29	86	43	17	<1	32	379	226	15	53	
	-d	6/9/87	<.05	6.35	17.50	28	83	41	17	<1	26	428	176	13	48	
	-mean		**<.05**	**6.23**	**19.03**	**28**	**79**	**39**	**9**	**<1**	**29**	**434**	**150**	**8**	**48**	
	-standard deviation		0.00	0.25	2.22	1	7	4	12	0	3	42	63	10	4	
	mid Cell-a	6/9/87	<.05	5.75	18.15	22	66	34	<1	<1	28	510	86	<5	42	
	-b	6/9/87	<.05	5.55	16.10	23	64	33	<1	<1	19	413	113	<5	37	
	-c	6/9/87	<.05	5.60	17.30	24	64	32	12	<1	32	567	74	12	48	
	-d	6/9/87	<.05	5.50	18.80	24	64	32	12	<1	29	509	80	10	49	
	-mean		**<.05**	**5.60**	**17.59**	**23**	**65**	**33**	**6**	**<1**	**27**	**500**	**88**	**6**	**44**	
	-standard deviation		0.00	0.11	1.17	1	1	1	12	0	6	64	17	8	6	
	mid South-a	6/9/87	0.05	6.10	20.30	28	78	39	<1	<1	28	460	121	<5	42	
	-b	6/9/87	<.05	6.00	24.30	34	76	37	<1	<1	20	453	169	<5	40	
	-c	6/9/87	<.05	6.30	19.00	46	82	41	16	<1	30	425	119	15	49	
	-d	6/9/87	<.05	5.95	20.40	39	81	40	16	<1	29	454	100	10	50	
	-mean		**<.05**	**6.09**	**21.00**	**37**	**79**	**39**	**8**	**<1**	**27**	**448**	**127**	**7**	**45**	
	-standard deviation		0.00	0.15	2.29	8	3	2	11	0	5	16	29	9	5	
	South-a	6/9/87	<.05	7.40	20.90	32	90	47	<1	<1	28	322	261	<5	52	
	-b	6/9/87	<.05	6.75	22.80	34	87	46	<1	<1	22	349	285	<5	43	
	-c	6/9/87	<.05	7.15	27.00	30	89	46	16	<1	35	329	244	18	53	
	-d	6/9/87	<.05	5.95	20.40	39	81	40	16	<1	29	454	100	10	50	
	-mean		**<.05**	**6.81**	**22.78**	**34**	**87**	**45**	**8**	**<1**	**29**	**364**	**223**	**8**	**50**	
	-standard deviation		0.00	0.63	3.00	4	4	3	11	0	5	61	83	10	5	

Appendix D continued:

ID	Site	Date	Hg	As	Se	Cu	Zn	Ni	Mo	Cd	Cr	Sr	Ba	Pb	V	U
			mg/Kg													
4	Sumner Peck Cell 3															
	North-a	6/9/87	<.05	7.45	40.60	28	79	40	<1	<1	31	379	318	<5	61	
	-b	6/9/87	<.05	7.50	41.00	34	78	39	<1	<1	31	336	317	<5	66	
	-c	6/9/87	<.05	7.95	67.10	33	77	38	10	<1	39	492	266	15	71	
	-d	6/9/87	<.05	7.35	45.40	32	77	38	11	<1	34	415	298	13	69	
	-mean		**<.05**	**7.56**	**48.53**	**32**	**78**	**39**	**6**	**<1**	**34**	**406**	**300**	**8**	**67**	
	-standard deviation		0.00	0.27	12.57	3	1	1	8	0	4	66	24	10	4	
	North Clay-a	6/9/87	0.25	7.60	27.90	36	83	41	<1	17	35	352	339	<5	67	
	-b	6/9/87	<.05	7.50	29.70	30	83	41	<1	<1	39	308	329	<5	79	
	-c	6/9/87	0.20	8.30	26.40	31	89	45	10	<1	42	252	333	13	84	
	-d	6/9/87	0.45	8.30	22.50	30	84	43	9	<1	37	235	350	13	82	
	-mean		**0.23**	**7.93**	**26.63**	**32**	**85**	**43**	**8**	**4**	**38**	**287**	**338**	**7**	**78**	
	-standard deviation		0.28	0.43	3.06	3	3	2	7	8	3	54	9	9	8	
	mid Cell-a	6/9/87	<.05	7.80	30.60	27	69	36	<1	<1	34	390	299	<5	62	
	-b	6/9/87	<.05	7.25	29.40	25	74	19	<1	<1	43	337	318	<5	64	
	-c	6/9/87	<.05	7.40	27.70	25	74	39	9	<1	42	324	311	12	67	
	-d	6/9/87	<.05	8.00	26.30	25	74	38	9	<1	34	298	309	12	72	
	-mean		**<.05**	**7.61**	**28.50**	**26**	**73**	**33**	**5**	**<1**	**38**	**337**	**309**	**7**	**66**	
	-standard deviation		0.00	0.35	1.89	1	3	9	6	0	5	39	8	9	4	
	South-a	6/9/87	0.10	8.40	15.30	33	97	47	<1	<1	26	185	316	<5	68	
	-b	6/9/87	<.05	7.50	14.60	41	97	46	<1	<1	19	199	275	<5	57	
	-c	6/9/87	0.05	8.00	15.30	33	95	45	17	<1	32	185	275	19	65	
	-d	6/9/87	<.05	7.05	12.30	49	95	43	19	<1	23	210	248	21	56	
	-mean		**0.05**	**7.74**	**14.38**	**39**	**96**	**45**	**9**	**<1**	**25**	**195**	**279**	**11**	**62**	
	-standard deviation		0.06	0.59	1.42	8	1	2	13	0	5	12	28	14	6	
6	Stone Land Company SW(b)															
	East-a	6/10/87	0.10	4.55	1.35	26	51	59	25	<1	31	683	179	<5	38	
	-b	6/10/87	0.10	3.70	0.40	21	45	51	23	<1	27	715	169	<5	36	
	-c	6/10/87	0.20	5.10	1.15	25	54	55	53	<1	48	655	142	12	46	
	-d	6/10/87	0.10	4.30	1.45	20	43	48	47	<1	40	697	108	9	43	
	-mean		**0.13**	**4.41**	**1.09**	**23**	**48**	**53**	**37**	**<1**	**37**	**688**	**150**	**6**	**41**	
	-standard deviation		0.05	0.58	0.48	3	5	5	15	0	9	25	32	8	5	

Appendix D continued:

ID Site	Date	Hg	As	Se	Cu	Zn	Ni	Mo	Cd	Cr	Sr	Ba	Pb	V	U
		mg/Kg													
Stone Land Company SW(b)															
mid East-a	6/10/87	0.15	7.40	2.00	24	43	50	54	<1	34	>800	131	<5	45	
-b	6/10/87	0.10	7.00	0.75	26	45	53	45	<1	28	>800	159	<5	43	
-c	6/10/87	0.25	7.85	1.70	24	46	54	73	<1	45	>800	129	12	43	
-d	6/10/87	0.10	7.15	1.75	29	46	63	63	<1	38	>800	139	14	44	
-mean		**0.15**	**7.35**	**1.55**	**26**	**45**	**55**	**59**	**<1**	**36**	**>800**	**140**	**7**	**44**	
-standard deviation		0.07	0.37	0.55	2	1	6	12	0	7	0	14	9	1	
mid Cell-a	6/10/87	0.15	6.00	0.55	29	63	75	16	<1	35	607	202	<5	41	
-b	6/10/87	0.20	5.85	1.10	34	70	85	26	<1	67	502	216	13	56	
-c	6/10/87	0.15	5.90	0.85	33	68	81	31	<1	54	503	184	13	57	
-d	6/10/87	0.25	5.65	1.00	32	66	79	30	<1	44	420	179	13	50	
-mean		**0.19**	**5.85**	**0.88**	**32**	**67**	**80**	**26**	**<1**	**50**	**508**	**195**	**10**	**51**	
-standard deviation		0.05	0.15	0.24	2	3	4	7	0	14	77	17	11	7	
mid West-a	6/10/87	<.05	6.40	0.60	23	51	62	30	<1	31	>800	181	<5	38	
-b	6/10/87	0.05	6.90	1.25	25	54	66	60	<1	58	>800	139	11	49	
-c	6/10/87	<.05	6.15	1.05	23	50	61	52	<1	43	>800	164	12	45	
-d	6/10/87	0.10	6.15	1.10	25	54	66	51	<1	39	>800	185	9	45	
-mean		**<.05**	**6.40**	**1.00**	**24**	**52**	**64**	**48**	**<1**	**43**	**>800**	**167**	**8**	**44**	
-standard deviation		0.06	0.35	0.28	1	2	3	13	0	11	0	21	10	5	
West-a	6/10/87	0.15	7.90	1.15	32	63	76	57	<1	44	714	172	13	46	
-b	6/10/87	0.25	8.20	0.45	33	64	77	30	<1	33	554	195	<5	39	
-c	6/10/87	0.30	7.00	1.00	35	67	83	54	<1	67	452	164	13	53	
-d	6/10/87	0.15	7.85	1.05	44	68	83	56	<1	57	609	175	13	52	
-mean		**0.21**	**7.74**	**0.91**	**36**	**66**	**80**	**49**	**<1**	**50**	**582**	**177**	**10**	**48**	
-standard deviation		0.08	0.52	0.31	5	2	4	13	0	15	109	13	11	6	
Algae-a	6/10/87	0.05	7.60	3.65	22	46	50	23	<1	35	>800	135	<5	42	
-b	6/10/87	<.05	8.00	3.55	25	46	53	36	<1	54	>800	129	12	57	
-mean		**0.05**	**7.80**	**3.60**	**24**	**46**	**52**	**30**	**<1**	**45**	**>800**	**132**	**7**	**50**	

Appendix D continued:

ID	Site	Date	Hg	As	Se	Cu	Zn	Ni	Mo	Cd	Cr	Sr	Ba	Pb	V	U
			mg/Kg													
	Stone Land Company SW(b)															
	Anaerobic layer-a	6/10/87	0.10	7.80	1.15	29	59	70	39	<1	36	>800	206	<5	44	
	-b	6/10/87	0.30	6.65	1.30	33	69	80	58	<1	63	574	179	14	56	
	-c	6/10/87	0.35	7.75	1.20	31	62	73	60	<1	56	>800	142	12	52	
	-d	6/10/87	0.20	7.15	1.25	30	65	74	50	<1	46	>800	191	13	50	
	-mean		**0.24**	**7.34**	**1.23**	**31**	**64**	**74**	**52**	**<1**	**50**	**>800**	**180**	**10**	**51**	
	-standard deviation		0.11	0.55	0.06	2	4	4	10	0	12	——	27	11	5	
6	Stone Land Company SW(b)															
	East	6/8/89		5.52	0.86	21	46	52	42	1	34	1104	89	28	46	14
	mid East	6/8/89		7.20	1.10	17	36	41	63	2	39	2063	85	30	46	27
	mid Cell	6/8/89		7.27	1.25	20	39	46	76	1	23	3108	113	18	51	30
	mid West	6/8/89		8.05	1.53	21	39	45	89	<1	22	2241	82	12	47	27
	West	6/8/89		6.72	1.35	24	46	52	89	1	22	1543	82	22	47	24
	Composite	**6/8/89**		**6.80**	**1.15**	**20**	**42**	**46**	**67**	**1**	**25**	**2080**	**83**	**16**	**47**	**25**
6	Stone Land Company North(a)															
	East	6/8/89		7.29	0.43	29	51	69	45	1	22	1760	248	13	57	13
	mid East	6/8/89		4.18	0.35	27	51	66	23	1	26	1951	232	17	60	12
	mid Cell	6/8/89		4.89	0.32	26	50	63	36	1	29	2288	225	18	59	13
	mid West	6/8/89		4.68	0.41	25	50	60	23	1	28	2065	218	15	59	14
	West	6/8/89		2.67	0.26	23	43	60	14	1	31	1538	216	10	54	7
	Composite	**6/8/89**		**4.56**	**0.27**	**26**	**54**	**67**	**29**	**2**	**27**	**1773**	**212**	**33**	**60**	**12**
24	Carmel Ranch Cell 5															
	SW	6/7/89	0.05	97.20	0.60	16	36	16	203	1	31	1248	104	22	97	91
	mid SW	6/7/89		50.20	0.34	15	42	19	40	1	32	730	185	25	68	31
	mid Cell	6/7/89		27.50	<0.25	16	43	17	21	2	56	475	215	30	63	14
	mid NE	6/7/89		16.80	<0.25	12	35	16	29	1	65	336	228	22	57	7
	NE	6/7/89		65.60	<0.25	21	60	28	19	2	26	880	184	36	85	30
	Composite	**6/7/89**		**45.00**	**<0.25**	**16**	**47**	**20**	**40**	**2**	**45**	**632**	**198**	**30**	**72**	**39**

Means and standard deviations were calculated by setting values less than the detection limit to 0.25 the detection limit

Appendix D. Sediment Mineral Transect Data for Selected Evaporation Basin Cells, 1987 and 1989.

ID	Site	Date	TOC	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti	B	Sat.	WET B
							%						mg/Kg	%	mg/L
4	Sumner Peck Cell 5														
	North-a	6/9/87	0.5	>2	1.03	1.18	0.50	.045	3.31	0.87	.030	.058			
	-b	6/9/87	0.5	>2	0.91	1.07	0.46	.043	3.04	0.76	.027	.055			
	-c	6/9/87	0.5	>2	1.12	1.27	0.51	.060	3.67	1.70	.035	.101			
	-d	6/9/87	0.5	>2	1.11	1.10	0.52	.062	3.65	1.71	.034	.103			
	-mean		**0.5**	**>2**	**1.04**	**1.16**	**0.50**	**.053**	**3.42**	**1.26**	**.032**	**.079**			
	-standard deviation		0.0	0	0.10	0.09	0.03	.010	0.30	0.52	.004	.026			
	mid North-a	6/9/87	0.9	>2	1.20	1.91	0.55	.048	3.75	1.01	.034	.061			
	-b	6/9/87	0.7	>2	1.17	1.91	0.57	.044	3.70	0.65	.033	.047			
	-c	6/9/87	0.7	>2	1.22	1.67	0.61	.057	4.27	0.86	.039	.047			
	-d	6/9/87	0.8	>2	1.20	1.58	0.59	.057	4.12	0.64	.037	.036			
	-mean		**0.8**	**>2**	**1.20**	**1.77**	**0.58**	**.052**	**3.96**	**0.79**	**.036**	**.048**			
	-standard deviation		0.1	0	0.02	0.17	0.03	.007	0.28	0.18	.003	.010			
	mid Cell-a	6/9/87	0.8	>2	1.06	1.66	0.51	.041	3.33	0.73	.031	.040			
	-b	6/9/87	0.7	>2	1.00	1.34	0.51	.039	3.28	0.49	.029	.035			
	-c	6/9/87	0.9	>2	1.02	1.46	0.42	.051	3.08	0.84	.031	.045			
	-d	6/9/87	0.8	>2	1.03	1.44	0.43	.051	3.17	0.98	.031	.053			
	-mean		**0.8**	**>2**	**1.03**	**1.48**	**0.47**	**.046**	**3.22**	**0.76**	**.031**	**.043**			
	-standard deviation		0.1	0	0.02	0.13	0.05	.006	0.11	0.21	.001	.008			
	mid South-a	6/9/87	0.9	>2	1.32	2.15	0.60	.047	3.96	0.64	.033	.040			
	-b	6/9/87	0.9	>2	1.24	2.01	0.60	.047	3.83	0.51	.032	.038			
	-c	6/9/87	0.9	>2	1.19	1.62	0.54	.057	3.90	0.71	.034	.040			
	-d	6/9/87	1.0	>2	1.22	1.85	0.57	.058	4.04	0.71	.035	.042			
	-mean		**0.9**	**>2**	**1.24**	**1.91**	**0.58**	**.052**	**3.93**	**0.64**	**.034**	**.040**			
	-standard deviation		0.0	0	0.06	0.23	0.03	.006	0.09	0.09	.001	.002			
	South-a	6/9/87	0.7	>2	1.40	1.55	0.66	.055	4.28	1.07	.039	.061			
	-b	6/9/87	0.7	>2	1.37	1.75	0.68	.052	4.22	0.63	.039	.037			
	-c	6/9/87	0.7	>2	1.23	1.61	0.58	.060	4.04	0.94	.039	.044			
	-d	6/9/87	0.8	>2	1.26	1.99	0.64	.058	4.23	0.75	.039	.039			
	-mean		**0.7**	**>2**	**1.32**	**1.73**	**0.64**	**.056**	**4.19**	**0.85**	**.039**	**.045**			
	-standard deviation		0.1	0	0.08	0.20	0.04	.004	0.11	0.20	.000	.011			

Appendix D continued:

ID	Site	Date	TOC	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti	B	Sat.	WET B
							%						mg/Kg	%	mg/L
4	Sumner Peck Cell 3														
	North-a	6/9/87	0.9	>2	1.23	0.76	0.54	.055	3.74	2.22	.034	.097			
	-b	6/9/87	0.9	>2	1.19	0.89	0.54	.059	3.72	2.32	.035	.109			
	-c	6/9/87	1.3	>2	1.10	0.72	0.42	.073	3.36	2.36	.037	.109			
	-d	6/9/87	1.1	>2	1.12	0.80	0.49	.069	3.62	2.19	.034	.105			
	-mean		**1.1**	**>2**	**1.16**	**0.79**	**0.50**	**.064**	**3.61**	**2.27**	**.035**	**.105**			
	-standard deviation		0.2	0	0.06	0.07	0.06	.008	0.17	0.08	.001	.006			
	North Clay-a	6/9/87	0.7	>2	1.27	0.82	0.55	.060	3.96	2.44	.033	.111			
	-b	6/9/87	0.5	>2	1.22	0.64	0.57	.064	4.00	2.70	.032	.116			
	-c	6/9/87	0.6	>2	1.19	0.65	0.53	.083	4.11	2.93	.033	.143			
	-d	6/9/87	0.6	>2	1.18	0.76	0.56	.077	4.02	2.78	.033	.137			
	-mean		**0.6**	**>2**	**1.22**	**0.72**	**0.55**	**.071**	**4.02**	**2.71**	**.033**	**.127**			
	-standard deviation		0.1	0	0.04	0.09	0.02	.011	0.06	0.21	.000	.016			
	mid Cell-a	6/9/87	1.0	>2	1.10	0.83	0.51	.051	3.39	1.95	.036	.053			
	-b	6/9/87	0.8	>2	1.12	0.98	0.49	.054	3.43	2.23	.037	.110			
	-c	6/9/87	0.7	>2	1.09	0.89	0.48	.063	3.45	2.13	.039	.093			
	-d	6/9/87	0.7	>2	1.08	0.70	0.47	.065	3.46	2.38	.037	.128			
	-mean		**0.8**	**>2**	**1.10**	**0.85**	**0.49**	**.058**	**3.43**	**2.17**	**.037**	**.096**			
	-standard deviation		0.1	0	0.02	0.12	0.02	.007	0.03	0.18	.001	.032			
	South-a	6/9/87	0.3	>2	1.40	0.73	0.65	.056	4.77	2.08	.043	.079			
	-b	6/9/87	0.3	>2	1.35	0.66	0.65	.054	5.03	1.54	.043	.068			
	-c	6/9/87	0.3	>2	1.22	0.70	0.56	.063	4.58	1.72	.042	.060			
	-d	6/9/87	0.4	>2	1.20	0.71	0.60	.059	4.80	1.10	.045	.052			
	-mean		**0.3**	**>2**	**1.29**	**0.70**	**0.62**	**.058**	**4.80**	**1.61**	**.043**	**.065**			
	-standard deviation		0.1	0	0.10	0.03	0.04	.004	0.18	0.41	.001	.012			
6	Stone Land Company SW(b)														
	East-a	6/10/87	0.8	>2	1.67	1.55	0.65	.051	2.69	0.53	.066	.042			
	-b	6/10/87	0.8	>2	1.55	1.58	0.57	.050	2.31	0.50	.061	.041			
	-c	6/10/87	0.8	>2	1.39	1.75	0.49	.066	2.36	1.33	.066	.065			
	-d	6/10/87	1.0	>2	1.36	1.86	0.50	.061	2.24	1.18	.063	.066			
	-mean		**0.9**	**>2**	**1.49**	**1.69**	**0.55**	**.057**	**2.40**	**0.89**	**.064**	**.054**			
	-standard deviation		0.1	0	0.14	0.15	0.07	.008	0.20	0.43	.002	.014			

Appendix D continued:

ID	Site	Date	TOC	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti	B	Sat.	WET B
							%						mg/Kg	%	mg/L
	Stone Land Company SW(b)														
	mid East-a	6/10/87	1.9	>2	1.77	3.40	0.56	.056	2.27	0.97	.092	.061			
	-b	6/10/87	1.9	>2	1.70	3.24	0.60	.052	2.33	0.64	.085	.048			
	-c	6/10/87	1.8	>2	1.45	2.74	0.49	.070	2.29	1.19	.084	.049			
	-d	6/10/87	1.8	>2	1.45	2.85	0.51	.065	2.36	0.87	.083	.050			
	-mean		**1.9**	**>2**	**1.59**	**3.06**	**0.54**	**.061**	**2.31**	**0.92**	**.086**	**.052**			
	-standard deviation		0.1	0	0.17	0.31	0.05	.008	0.04	0.23	.004	.006			
	mid Cell-a	6/10/87	0.9	>2	1.81	2.01	0.84	.061	3.25	0.80	.065	.048			
	-b	6/10/87	0.8	>2	1.52	1.39	0.85	.079	3.55	1.49	.059	.042			
	-c	6/10/87	0.8	>2	1.52	1.95	0.83	.081	3.48	1.49	.062	.075			
	-d	6/10/87	0.9	>2	1.49	2.00	0.80	.072	3.35	1.01	.058	.060			
	-mean		**0.9**	**>2**	**1.59**	**1.84**	**0.83**	**.073**	**3.41**	**1.20**	**.061**	**.056**			
	-standard deviation		0.1	0	0.15	0.30	0.02	.009	0.13	0.35	.003	.015			
	mid West-a	6/10/87	1.0	>2	1.74	1.74	0.70	.057	2.70	0.62	.083	.043			
	-b	6/10/87	1.0	>2	1.49	1.80	0.65	.078	2.84	1.49	.088	.062			
	-c	6/10/87	1.2	>2	1.50	2.23	0.62	.073	2.65	0.98	.087	.047			
	-d	6/10/87	1.2	>2	1.49	1.92	0.65	.080	2.88	0.77	.088	.045			
	-mean		**1.1**	**>2**	**1.56**	**1.92**	**0.66**	**.072**	**2.77**	**0.97**	**.087**	**.049**			
	-standard deviation		0.1	0	0.12	0.22	0.03	.010	0.11	0.38	.002	.009			
	West-a	6/10/87	0.8	>2	1.80	2.03	0.84	.058	3.31	0.52	.062	.040			
	-b	6/10/87	0.8	>2	1.53	2.41	0.82	.060	3.47	1.06	.060	.046			
	-c	6/10/87	0.9	>2	1.53	2.36	0.86	.068	3.54	1.01	.069	.050			
	-d	6/10/87	1.1	>2	1.49	2.29	0.75	.063	3.19	0.75	.058	.046			
	-mean		**0.9**	**>2**	**1.59**	**2.27**	**0.82**	**.062**	**3.38**	**0.84**	**.062**	**.046**			
	-standard deviation		0.1	0	0.14	0.17	0.05	.004	0.16	0.25	.005	.004			
	Algae-a	6/10/87	3.8	>2	1.96	6.61	0.61	.068	2.28	0.56	.070	.040			
	-b	6/10/87	3.6	>2	1.52	4.36	0.53	.102	2.30	1.65	.074	.069			
	-mean		**3.7**	**>2**	**1.74**	**5.49**	**0.57**	**.085**	**2.29**	**1.11**	**.072**	**.055**			

Appendix D continued:

ID	Site	Date	TOC	Ca	Mg	Na	K	P	Al	Fe	Mn	Ti	B	Sat.	WET B
							%						mg/Kg	%	mg/L
	Stone Land Company SW(b)														
	Anaerobic layer-a	6/10/87	1.2	>2	1.81	1.84	0.76	.057	3.07	0.78	.072	.045			
	-b	6/10/87	0.9	>2	1.52	2.22	0.79	.066	3.47	1.41	.061	.060			
	-c	6/10/87	1.1	>2	1.49	2.39	0.67	.071	3.14	1.40	.068	.070			
	-d	6/10/87	1.2	>2	1.48	1.71	0.73	.074	3.27	1.15	.065	.058			
	-mean		**1.1**	**>2**	**1.58**	**2.04**	**0.74**	**.067**	**3.24**	**1.19**	**.067**	**.058**			
	-standard deviation		0.1	0	0.16	0.32	0.05	.007	0.18	0.30	.005	.010			
6	Stone Land Company SW(b)														
	East	6/8/89	1.0	7.46	1.95	3.01	0.54	.042	2.12	0.46	.044	.043	151.	89.9	31.4
	mid East	6/8/89	1.0	11.7	1.93	3.11	0.42	.038	1.63	0.45	.061	.044	198.	72.9	37
	mid Cell	6/8/89	1.5	11	1.98	4.77	0.54	.040	1.99	0.62	.074	.055	233.	74.1	48.4
	mid West	6/8/89	2.0	10.4	2.14	6.75	0.58	.040	2.02	0.49	.075	.040	274.	79.5	59
	West	6/8/89	1.8	8.38	2.22	4.41	0.63	.038	2.24	0.39	.058	.038	224.	76.8	48.7
	Composite	**6/8/89**	**1.4**	**9.81**	**2.02**	**1.76**	**0.57**	**.038**	**2.01**	**0.49**	**.057**	**.044**	**196.**	**72.3**	**40.5**
6	Stone Land Company North(a)														
	East	6/8/89	1.4	9.95	1.95	2.58	0.76	.041	2.87	1.02	.133	.083	109.	82.0	12.6
	mid East	6/8/89	1.3	11.5	1.93	2.29	0.68	.040	2.73	1.17	.142	.090	122.	79.8	13.5
	mid Cell	6/8/89	1.5	12	1.88	2.23	0.68	.037	2.66	1.30	.138	.080	120.	74.3	12.5
	mid West	6/8/89	1.8	11.5	1.93	2.50	0.71	.035	2.67	1.18	.092	.069	153.	88.7	16.6
	West	6/8/89	1.3	8.13	1.83	2.26	0.64	.041	2.32	1.27	.085	.085	128.	64.1	14.7
	Composite	**6/8/89**	**1.6**	**10.2**	**1.96**	**1.82**	**0.57**	**.041**	**2.50**	**1.12**	**.108**	**.082**	**120.**	**82.5**	**14.4**
24	Carmel Ranch Cell 5														
	SW	6/7/89	2.9	5.66	1.98	8.49	0.41	.050	1.42	0.54	.021	.053	472.	59.0	159
	mid SW	6/7/89	0.9	6.87	1.95	4.72	0.57	.073	1.78	0.95	.034	.070	249.	54.4	82
	mid Cell	6/7/89	0.7	5.03	1.47	2.95	0.48	.102	1.85	1.41	.040	.081	238.	48.7	109
	mid NE	6/7/89	0.5	4.19	1.11	2.58	0.42	.114	1.47	1.39	.031	.119	164.	43.0	61.4
	NE	6/7/89	1.6	5.38	2.33	4.01	0.80	.086	2.50	1.43	.035	.052	237.	69.5	91.1
	Composite	**6/7/89**	**1.2**	**5.38**	**1.84**	**4.07**	**0.57**	**.085**	**1.85**	**1.16**	**.032**	**.068**	**240.**	**54.6**	**87.2**

Means and standard deviations were calculated by setting values less than the detection limit equal to 0.25 the detection limit