Staff Report of the

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REGIONAL WATER QUALITY CONTROL BOARD

CENTRAL VALLEY REGION

AGRICULTURAL DRAINAGE CONTRIBUTION TO WATER QUALITY IN THE GRASSLAND WATERSHED OF WESTERN MERCED COUNTY, CALIFORNIA: OCTOBER 1995 - SEPTEMBER 1997

(WATER YEARS 1996 AND 1997)

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REPORT PREPARED BY:
Jeanne Chilcott, Associate Land and Water Use Analyst
Les Grober, Associate Engineering Geologist
Jan Eppinger, Student Intern
Armando Ramirez, Student Intern

Many thanks to the staff and students of the Agricultural Unit without whose efforts during field sampling, quality control, and data processing, this report would not have been possible.

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EXECUTIVE SUMMARY

Since May 1985, the Central Valley Regional Water Quality Control Board has conducted a water quality monitoring program in the San Joaquin Valley of California to assess the impacts of agricultural subsurface drainage on wetland water supply channels in the Grassland Watershed. The Grassland Watershed is a 370,000-acre area, west of the San Joaquin River covering portions of Merced and Fresno counties between the Tulare Lake Basin and the Orestimba Creek alluvial fan. The watershed contains both farmed land, including a 90,000 acre area known as the Drainage Project Area (DPA), and approximately 100,000 acres of wetland habitat, including State and Federal wildlife refuges and private gun clubs. The watershed is tributary to the San Joaquin River, with Mud Slough (north) and Salt Slough serving as the main drainage arteries. During the period covered by this report, 1 October 1995 through 30 September 1997 (Water Years 1996 and 1997[1]), a major change occurred in the agricultural drainage water management in the Grassland Watershed: the advent of the Grassland Bypass Project (GBP). The project began operation on 23 September 1996 and consolidated subsurface agricultural drainage, which historically flowed through wetland water supply channels, into a single channel, allowing the drainage to bypass approximately 90 miles of wetland water supply channels and Salt Slough. The drainage was redirected into the final 28 miles of the San Luis Drain for discharge into the lower nine miles of Mud Slough (north) and eventually into the San Joaquin River. Data presented in this report represents the water quality in selected water bodies within the Grassland Watershed one year prior to and one year after the advent of the Bypass project.

During Water Year 1996, water quality sampling was conducted at 17 sites within the Grassland Watershed and represented drainage from the DPA, internal wetland supply canals and overall discharge from the watershed. During Water Year 1997, the program was altered to reflect the changes in drainage water management resulting from the use of the Grassland Bypass. The remaining nine monitoring sites focused the program on providing data which could be used to evaluate the impact of the bypass. The primary constituents evaluated included electrical conductivity, boron and selenium, with more limited analyses of molybdenum, copper, chromium, lead, nickel, zinc, chloride and sulfate. Grab samples were collected on a weekly, monthly or quarterly schedule depending on the location and automated, composite samples were collected at selected sites to provide information on fluctuating concentrations and to provide a more complete data set for load calculations for salt, boron, and selenium.

The San Joaquin River Index is used to classify water year type in the river basin based on total runoff (SWRCB, 1995). Both Water Year 1996 and 1997 were classified as wet water years with periods of localized flooding occurring during February and March of 1996 and during the end of January and early February 1997. During the flooding in 1997, the Grassland Bypass could not handle the volume of drainage from the DPA and a portion of subsurface agricultural drainage was diverted through the wetland water supply channels and into Salt Slough between 27 January and 5 February.

During Water Year 1996, constituent concentrations followed trends observed during the previous years of study. The highest concentrations occurred in drains from the DPA, with elevated concentrations also apparent in Salt Slough. Internal channels had varying concentrations, depending on the routing of the subsurface agricultural drainage. Concentrations peaked in April 1996, as flood water receded and pre-irrigation began.

During Water Year 1997, all subsurface agricultural drainage from the DPA was removed from the internal wetland supply canals and Salt Slough and rerouted to the final nine miles of Mud Slough (north) through the San Luis Drain. Electrical conductivity, boron and selenium concentrations in the internal canals and Salt Slough dropped significantly over previous water years with the lowest mean monthly and annual concentrations recorded since 1985. A corresponding increase in constituent concentrations was noted in Mud Slough (north), reflecting discharge from the San Luis Drain which reached concentrations of 5460 µmhos/cm, 8.4 mg/L, and 107 µg/L for electrical conductivity, boron, and selenium, respectively.

[1] A Water Year covers the time period from 1 October through 30 September of the following year.

In October 1988, Central Valley Regional Board adopted water quality objectives for boron, molybdenum and selenium for Mud Slough (north) and Salt Slough and a selenium objective for water used to maintain wetland habitat (Resolution #88-195). The mean monthly boron objective (2.0 mg/L) depends on season and only applies from 15 March through 15 September, while the maximum objective applies year round.. In May 1996, the Regional Board adopted revised selenium water quality objectives for the two sloughs and for wetland water supply channels, as well as a compliance time schedule for Mud Slough (north). The selenium compliance time schedule does not require full compliance with the selenium objective until 1 October 2010. No water quality objectives have been adopted for the San Luis Drain.

During Water Year 1996, based on composite sampling data, the boron objective (2.0 mg/L) was not exceeded in Mud Slough (north), but was exceeded almost continuously from March through July in Salt Slough, with concentrations just below 2.0 mg/L in April. During Water Year 1997, the objective was exceeded in Mud Slough (north) both upstream and downstream of the San Luis Drain discharge. Upstream of the discharge, the exceedances were limited to March and April and may be due to a number of factors including localized elevated levels in groundwater seepage, releases from wetlands, and other surface drainage. Downstream of the discharge, the objective was exceeded continuously from March through September. No boron objective exceedances were observed in Salt Slough, during Water Year 1997. The improved water quality is most likely the result of the diversion of DPA subsurface agricultural drainage out of that water body.

During Water Year 1996, the applicable selenium water quality objective was only exceeded in Salt Slough, with monthly mean concentrations remaining above 10 µg/L from December through September. The selenium objectives changed during Water Year 1997, to a 2 µg/L monthly mean objective for Salt Slough and wetland water supply channels and a 5 µg/L 4-day average objective for Mud Slough (north) that is subject to a compliance time schedule. The revised objectives were not exceeded in Salt Slough, during Water Year 1997, but were exceeded sporadically in the wetland water supply channels. Exceedances in the supply channels may be due to a number of factors including elevated selenium levels in supply water, releases from the DPA (both in response to flood events and seepage from gates and canals), inflows from other agricultural subsurface drainage sources, and local sources such as groundwater seepage and surface return flows. Selenium concentrations in Mud Slough (north) above the drainage discharge remained below 5 µg/L, while monthly mean concentrations in the slough downstream of the drainage discharge remained above 5 µg/L, however, the slough is subject to a compliance time schedule.

Molybdenum concentrations remained consistent between the two water years for all sites except Mud Slough (north) downstream of the San Luis Drain discharge. Prior to Water Year 1997, the 19 µg/L monthly mean molybdenum objective was not exceeded in either Mud Slough (north) or Salt Slough. During Water Year 1997, the molybdenum objective was exceeded downstream of the drainage discharge five times; in February, April, June, August and September. Molybdenum concentrations in the drainage discharge ranged from 22 µg/L to 35 µg/L.

Salt, boron, and selenium loads for the DPA and the Grassland Watershed were calculated using the flow weighted monthly average of the available water quality data. In Water Year 1997, loads that previously had to be summed for individual sites in the DPA were consolidated into the San Luis Drain as part of the GBP. Discharge and loads from the DPA for Water Year 1997 are therefore based on discharge and loads from the GBP. Monthly discharge and monthly flow weighted average concentrations and loads for 1996 and 1997 for the Grassland Watershed are based on the combined discharge and loads for Mud Slough (north) and Salt Slough.

Annual discharge from the DPA dropped 30 percent between Water Years 1996 and 1997, from approximately 53,000 acre-feet to approximately 37,500 acre-feet. Annual salt load for the DPA also dropped 30 percent from just under 200,000 tons in 1996 to 140,000 tons in 1997. Boron loads were practically identical for both years at just over 700,000 pounds. Selenium loads from the DPA dropped 30 percent from approximately 10,000 pounds to under 7,000 pounds between 1996 and 1997.

Annual discharge from the Grassland Watershed to the San Joaquin River was similar in both years, increasing slightly from approximately 270,000 acre-feet in 1996 to approximately 290,000 acre-feet in 1997. Annual salt load for the watershed was similar for both years, dropping from just over 475,000 tons to just under 450,000 tons, while boron loads increased from approximately 1.3 million pounds to 1.4 million pounds. Selenium loads dropped almost 20 percent, from 9,500 pounds in 1996 to 7,700 pounds in 1997.

Although the DPA contributes large quantities of salt and boron, it is not the only source of these constituents in the basin. The DPA is, however, the primary source of selenium in the Grassland Watershed. In 1996, a higher selenium load was actually calculated in the DPA than in the watershed, which may be due to losses in the system or errors in the estimates used for calculating the loads. In 1997, the DPA accounted for 90 percent of the selenium load from the Grassland Watershed.

Monthly loading of constituents depended on the season and on the weather pattern. In the DPA, constituent loads tended to increase in January and stay at elevated levels throughout the irrigation season, dropping off by September. The Grassland Watershed followed a similar pattern, but was greatly influenced by storm events during both Water Years 1996 and 1997. During 1996, the highest monthly loads of all constituents leaving the watershed were recorded during February and March. During 1997, the highest loading leaving the watershed occurred during January, February and March and corresponded to major storms and flooding.

When compared to annual records since Water Year 1986, loads during wet Water Years 1996 and 1997 were comparable to loads for another wet water year (1986) but lower than loads during wet Water Year 1995. Water Year 1995 followed several years of dry and critically dry years. High loads of all constituents in 1995 likely resulted from the leaching of salts that had accumulated in the basin during previous years. Generally lower loads of all constituents in 1996 and 1997 were likely due to lower residual salt loads in the Grassland Watershed following a series of wet years and ongoing drainage management activities in the DPA.

Water quality monitoring in the Grassland Watershed will continue to allow evaluation of management practices on instream water quality and on constituent loads.

INTRODUCTION

The Agricultural Unit of the Central Valley Regional Water Quality Control Board (Regional Board) initiated a water quality monitoring program in May 1985 to evaluate the effects of subsurface agricultural drainage on the water quality of canals, drains, and sloughs in the Grassland Watershed in western Merced County. The Grassland Watershed is located west of the San Joaquin River between the Tulare Lake Basin and the Orestimba Creek alluvial fan. The purpose of this monitoring program was to compile an on-going database of selected inorganic constituents found in agricultural drains that discharge to and flow through wildlife areas before entering the San Joaquin River. This database has been and continues to be used to develop and evaluate agricultural drainage reduction programs in the San Joaquin River Basin.

This report contains laboratory results and a summary of water quality analyses for all constituents measured as part of the program during Water Years 1996 and 1997 (October 1995 through September 1997).[2] These two years represent conditions one year prior to and one year after a major change in the agricultural drainage water management in the Grassland Watershed: the advent of the Grassland Bypass Project. The Grassland Bypass began operation on 23 September 1996. The project consolidated subsurface agricultural drainage, which historically flowed through wetland water supply channels, into a single channel, allowing the drainage to bypass approximately 90 miles of wetland water supply channels. This report presents the data collected during both years, and compares salinity (measured as electrical conductivity), boron and selenium water quality at selected sites with respect to hydrology, change in water management, and applicable water quality objectives.

Water quality data collected during the previous years of study can be found in both a summary report presenting salinity, boron, and selenium information from May 1985 through September 1996 (Steensen et al., 1998) and in a series of annual reports presenting all water quality information collected (James et al., 1988; Chilcott et al., 1989; Westcot et al., 1990, 1991, and 1992; Karkoski and Tucker, 1993; Vargas et al., 1995; Chilcott et al., 1995; and Steensen et al., 1996).

STUDY AREA

The study area consists of the Grassland Watershed located west of the San Joaquin River between the towns of Newman and Mendota, in the San Joaquin River Basin in California. The watershed encompasses approximately 370,000 acres and includes the northern and southern divisions of Grassland Water District (GWD), and farmlands adjacent to the district. The watershed also contains a 90,000 acre area known as the Drainage Project Area (DPA), and approximately 100,000 acres of wetland habitat, including State and Federal wildlife refuges and private gun clubs (Figure 1).

Prior to October 1996, agricultural lands east, west, and south of the GWD discharged subsurface agricultural drainage water (tile drainage) and surface runoff (irrigation tailwater) through the GWD. Subsurface drainage from this area often contains high concentrations of salt, selenium and other trace elements. This regional drainage flowed north through the GWD, carried by a network of canals that could divert water in several possible ways before discharging into Mud Slough (north) or Salt Slough. These two sloughs are tributary to the San Joaquin River and serve as the primary drainage outlets for the Grassland Watershed.

After October 1996, all subsurface agricultural drainage from the DPA was rerouted into the Grassland Bypass which discharges into the final 28 miles of the San Luis Drain. The consolidated subsurface drainage is then released into the final nine miles of Mud Slough (north) for eventual discharge into the San Joaquin River. Consolidating the subsurface drainage removes the primary source of selenium in approximately 90 miles of canals which can supply water to wetland habitat. Reducing selenium in these water bodies is a primary goal of the project, since elevated concentrations of selenium have been documented to be hazardous to waterfowl (Skorupa, 1998).

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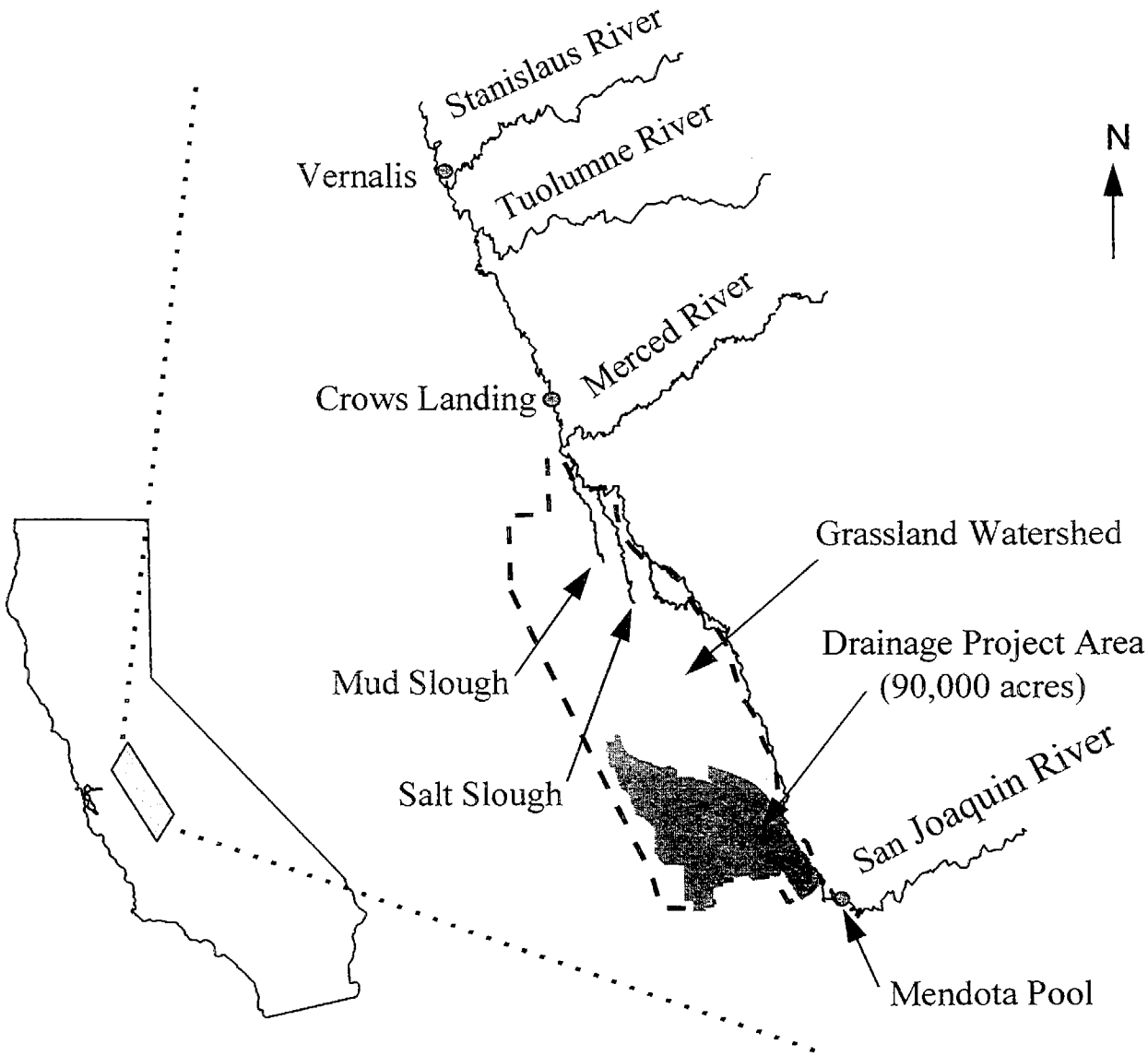
[2] A water year lasts from October 1st of one year through September 30th of the next year.

Figure 1. The Grassland Watershed Within the Lower San Joaquin River Basin.



SAMPLING PROGRAM

During Water Year 1996, water quality sampling was conducted at 17 sites within the Grassland Watershed: nine inflow sites to and four internal flow sites within the GWD and four outflow sites from the Grassland Watershed (Table 1). Inflow monitoring stations were located on drains that discharge into the GWD and are mainly situated at the southern end of the study area. Internal sites were located on canals within the GWD that carry or could carry subsurface tile drainage as it passes through, before discharging to the San Joaquin River. Outflow monitoring stations were located on water bodies which flow out of the Grassland Watershed.

Mud Slough (north) and Salt Slough are the primary tributaries to the San Joaquin River that drain the Grassland Watershed and are described in detail in previous reports (Pierson et al., 1989a and 1989b). Mud Slough (north) at the San Luis Drain (MER542) and Salt Slough at Lander Avenue (MER531) are located near flow monitoring stations operated by the U.S. Geologic Survey and are two principal stations in this monitoring program. These two sites best represent the water quality of the drainage leaving the Grassland Watershed. Los Banos Creek at Highway 140 (MER554) drains into Mud Slough (north) upstream of the San Joaquin River but downstream of the site near the San Luis Drain. Mud Slough (north) at Newman Gun Club (MER551) represents the combined quality of Mud Slough (north) and Los Banos Creek.

During Water Year 1997, the water quality monitoring program was altered to reflect the changes in drainage water management resulting from the use of the Grassland Bypass. With the consolidation of agricultural subsurface drainage, a majority of the inflow sites which historically contained the drainage, were eliminated from the sampling program. The remaining sites focused the monitoring program on providing data which could be used to evaluate the impact of the new bypass. Key sites which were maintained and provide comparison to pre-bypass conditions include: Camp 13 Slough and Agatha Canal (inflow); Santa Fe and San Luis Canals at Henry Miller Road (internal); and Mud Slough (north) at the San Luis Drain terminus and Salt Slough (outflow). In addition, three new sites were added to evaluate the discharge from the bypass itself: Mud Slough (north) upstream of the bypass discharge (MER536), discharge from the San Luis Drain (MER535), and inflow from the Grassland Bypass to the San Luis Drain at Check 17 (MER562). In total, water samples were collected at nine sites during Water Year 1997 (Table 2).

SAMPLE COLLECTION METHODS

Two distinct types of water samples were collected for this program: grab samples and automated composite samples. Although Regional Board staff collected all the water samples during Water Year 1996, staff from the Panoche Water District collected grab samples from five of the sites during Water Year 1997: Camp 13, Agatha Canal, Santa Fe Canal, San Luis Canal, and the Grassland Bypass inflow to the San Luis Drain. Field measurements for water temperature, electrical conductivity (EC), and pH were conducted at all sites monitored by Regional Board staff. Follow up EC measurements were made on all samples at the Regional Board office laboratory: within 24 hours for samples collected by Regional Board staff and within 24 hours of receipt of samples from Panoche Water District staff. The types of samples, methods for collection and quality control and assurance are discussed below.

Grab Samples

During both Water Year 1996 and 1997, grab samples were collected on either a weekly, monthly or quarterly basis depending on site and the constituent to be analyzed (Tables 3 and 4). Analyses for EC, total boron, and total selenium were conducted on all samples. Selected sites were also monitored for molybdenum, copper, chromium, nickel, lead, and zinc on a monthly or quarterly basis. During Water Year 1997, samples were also analyzed for dissolved selenium and total suspended solids at both the inflow to and outflow from the San Luis Drain.

Grab samples were collected in polyethylene bottles, usually within six feet of the bank. All sample bottles were rinsed with deionized water before use. All bottles were also rinsed three times with the water to be sampled prior to sample collection. All samples were kept on ice after collection and until

Table 1. Water Quality Monitoring Sites in the Grassland Watershed for Water Year 1996

Map Index*	RWQCB Site I.D.	Site Name	Site Type
I-1	MER556	Main (Firebaugh) Drain @ Russell Ave.	Inflow
I-2	MER501	Panoche Drain	Inflow
I-4	MER506	Agatha Canal @ Mallard Road	Inflow
I-6	MER504	Hamburg Drain	Inflow
I-7	MER505	Camp 13 Slough	Inflow
I-8	MER502	Charleston Drain	Inflow
I-9	MER555	Almond Drive Drain	Inflow
I-10	MER509	Rice Drain	Inflow
I-12	MER528	Salt Slough Ditch @ Hereford Road	Inflow
T-1	MER510	CCID Main @ Russell Avenue	Internal Flow
T-5	MER519	Sante Fe Canal @ Henry Miller Road	Internal Flow
T-7A	MER532	San Luis Canal @ Henry Miller Road	Internal Flow
T-13	MER548	Porter-Blake Bypass	Internal Flow
O-1	MER551	Mud Slough (N) @ Newman Gun Club	Outflow
O-2	MER542	Mud Slough (N) downstream of the San Luis Drain	Outflow
O-3	MER554	Los Banos Creek @ Highway 140	Outflow
O-4	MER531	Salt Slough @ Lander Avenue	Outflow

* Location Map in Appendix A

Table 2. Water Quality Monitoring Sites in the Grassland Watershed for Water Year 1997

Map Index*	RWQCB Site I.D.	Site Name	Site Type
I-4	MER506	Agatha Canal @ Mallard Road	Inflow
I-7	MER505	Camp 13 Slough	Inflow
T-5	MER519	Sante Fe Canal @ Henry Miller Road	Internal Flow
T-7A	MER532	San Luis Canal @ Henry Miller Road	Internal Flow
O-2	MER542	Mud Slough (N) downstream of the San Luis Drain	Outflow
O-4	MER531	Salt Slough @ Lander Avenue	Outflow
SLD-1	MER562	Inflow to San Luis Drain @ Check 17	Internal Flow
SLD-2	MER535	San Luis Drain @ Terminus	Outflow
O-8	MER536	Mud Slough (N) Upstream of SLD	Internal Flow

* Location Map in Appendix B

Table 3. Water Year 1996 Grassland Watershed Monitoring Sites, Sampling Frequencies, and Parameters Measured

Site ID	Site Description	Constituent									Dissolved	Auto-
		Temp	pH	EC	Se	Mo	TE's	B	Part Min	TSS	Se	Samplers
MER501	Panoche Drain @ O'Banion Gauge Station	W	W	W	W	Q		W	M			b
MER502	Charleston Drain @ CCID Main Canal	W	W	W	W	Q		W	M			
MER504	Hamburg Drain near Camp 13 Slough	W	W	W	W	Q		W	M			
MER505	Camp 13 Slough @ Gauge Station	M	M	M	M			M	M			
MER506	Agatha Canal @ Mallard Road	M	M	M	M			M	M			
MER509	Rice Drain @ Mallard Road	M	M	M	Q			Q	Q			
MER528	Salt Slough Ditch @ Hereford Road	M	M	M	Q			Q	Q			
MER555	Almond Drive Drain	M	M	M	Q			Q	Q			
MER556	Main (Firebaugh) Drain @ Russell Ave.	W	W	W	W	Q		W	M			b
MER510	CCID Main @ Russell Ave.	M	M	M	Q			Q	Q			
MER519	Santa Fe Canal @ Henry Miller Road	M	M	M	M			M	M			
MER532	San Luis Canal @ Henry Miller Road	M	M	M	M			M	M			
MER548	Porter-Blake Bypass	M	M	M	M			M	M			
MER531	Salt Slough @ Lander Ave.	W	W	W	W	Q	Q	W	M			b
MER542	Mud Slough (N) Downstream of San Luis Drain	W	W	W	W	Q	Q	W	M			b
MER551	Mud Slough @ Newman Gun Club	M	M	M	M			M	M			
MER554	Los Banos Creek @ Hwy 140	M	M	M	Q			Q	Q			

W = weekly
M = monthly
Q = quarterly (October, January, April, and July)
b = Four day composite samples for Se and B

I= Inflow
T=Internal flow
O=Outflow

TE's: Trace Elements (Chromium, copper, lead, nickel, zinc)
Part Min = B, Cl, SO4, and Hardness
TSS=total suspended solids

Table 4. Water Year 1997 Monitoring Sites, Sampling Frequencies, and Parameters Measured: Grasslands Bypass Project

Site ID	Site Description	Constituents									Dissolved	Auto-
		Temp	pH	EC	Se	Mo	TE's	B	Part Min	TSS	Se	Samplers
MER505	Camp 13 Slough @ Gauge Station			W	W			W				c
MER506	Agatha Canal @ Mallard Road			W	W			W				c
MER519	Santa Fe Canal @ Henry Miller Road			W	W			W				
MER532	San Luis Canal @ Henry Miller Road			W	W			W				
MER536	Mud Slough (N) Upstream of San Luis Drain	W	W	W	W	M	Q	W	Q			
MER562	Inflow at San Luis Drain: Check 17			W	W			W		W	W	
MER535	San Luis Drain @ Terminus	W	W	W	W	M	Q	W	Q	W	W	a
MER542	Mud Slough (N) Downstream of San Luis Drain	W	W	W	W	M	Q	W	Q			b*
MER531	Salt Slough @ Lander Ave.	W	W	W	W	M	Q	W	Q			b*

*discontinued 3/25/97 (See appendices for miscellaneous discontinued site data)
W = weekly
M = monthly
Q = quarterly (October, January, April, and July)
a = daily composite sample for Se and B
b = Four day composite samples for Se and B
c = used intermittently between January and April 1997

I= Inflow
T=Internal flow
O=Outflow

TE's: Trace Elements (Chromium, copper, lead, nickel, zinc)
Part Min = B, Cl, SO4, and Hardness
TSS=total suspended solids

processing. Selenium, boron, and trace element samples were preserved by lowering the pH to less than 2 within 24 hours of collection, using reagent grade nitric acid. Mineral samples were kept on ice until submittal to the laboratory for analysis.

Composite Automated Samples

In addition to grab samples, four-day composite and daily sampling was conducted at selected sites through the use of automated Sigma sampling devices. During Water Year 1996, Sigma samplers were located at Panoche Drain, Firebaugh (Main) Drain, Mud Slough (north) downstream of the terminus of the San Luis Drain, and Salt Slough at Lander Avenue. Samplers were also intermittently installed at Camp 13 and Agatha Canal to allow continuous data collection when access roads were inaccessible. These samplers were phased out during Water Year 1997, as more focus was placed on the impacts from the discharge from the Grassland Bypass Project. The Panoche Drain and Firebaugh (Main) Drain autosamplers were discontinued in January 1997, and the Salt Slough, Mud Slough (north), Camp 13 and Agatha Canal autosamplers were removed after 25 March 1997. In exchange, two autosamplers (one strictly backup) were installed on the San Luis Drain to collect daily composite samples. Each daily composite is made up of six 85 ml collections pulled at four hour intervals for a total sample volume of 510 ml. During both water years, autosamplers were serviced every two weeks. Both 4-day composite and daily samples were analyzed for EC, boron and selenium. Quality control and assurance methods for the autosamplers are discussed below.

QUALITY CONTROL AND QUALITY ASSURANCE

Standard

Potential contamination from the reagent grade nitric acid used to control pH was evaluated by submitting a deionized water matrix preserved with the normal amount of acid used (1 ml nitric acid per 500 ml of sample), to the analyzing laboratories at monthly intervals to be analyzed for the trace elements of concern. All reported recoveries for these acid check samples were below the analytical detection limit.

Field and handling contamination was evaluated by submitting a travel blank on a monthly basis. The travel blank consisted of a sample of deionized (DI) water which was collected at the Regional Board laboratory, traveled through the sampling run, and was then processed with the sample set. All results for travel blanks fell below the analytical detection limits for the elements of concern.

Additional quality control and quality assurance was conducted using blind split and spiked samples. Blind split samples were collected at a ten percent frequency for each sampling event by collecting the sample in a container double the normal sample volume and splitting that sample into two equal amounts for submittal to the analyzing laboratory. On a monthly basis, half of the blind split samples were spiked with known concentrations of constituents to be analyzed. Comparing the spiked splits to the background splits provided information on analytical accuracy. Comparing data from nonspiked splits provided information on analytical precision.

To evaluate the potential for contamination and evapo-concentration in samples collected using autosampler, a series of special checks were developed. First, whenever the sampler was serviced, a deionized blank sample, without a cap, was left in the collection base to be collected on the next servicing and analyzed for potential contamination. Second, during each servicing, replicate "grab" samples were collected through the autosampler mechanism, one was left in the sampler to be collected at the next servicing and the other was processed for immediate analyses. Final results of the two grabs were evaluated to determine concentration or dilution potentials.

During WY 97, samples for dissolved selenium were collected at two locations (MER535 and MER562). These samples required field filtration through an 0.45 µm cartridge system. To prevent and evaluate potential contamination, the equipment was soaked in a two percent nitric acid solution between usages, and rinsed three times in DI water. The new filters were conditioned at the time of sampling by allowing the first 10 ml of water passed through to be discarded before the remaining

sample was collected. Approximately quarterly, filter blanks were collected using the Regional Board laboratory DI water and processing it through the standard equipment used in the field.

Only data from sample sets whose blind QA/QC met specifications outlined in Table 5 have been included in this report.

Special Studies

With the advent of the Grassland Bypass Project, a number of State and Federal agencies (US Bureau of Reclamation, US Geological Survey, US Fish and Wildlife Service, California Regional Water Quality Control Board, and California Department of Fish and Game) became involved in monitoring potential environmental impacts from the Grassland Bypass Project. A Data Collection and Reporting Team (DCRT) was formed and chaired by the US Bureau of Reclamation to coordinate activities. This team intends to utilize information presented by the Regional Board to evaluate water quality impacts from the project and raised concerns on the following issues:

--complete mixing at Mud Slough (north) downstream of the San Luis Drain discharge;
--field preservation versus laboratory preservation within 24 hours; and
--field versus laboratory filtration for dissolved selenium analyses.

Complete Mixing at Mud Slough (north) Downstream of the San Luis Drain Discharge

Prior to the initiation of the project, there was concern by some members of the DCRT, that the proposed sampling location for Mud Slough (north) downstream of the San Luis Drain (the bridge over Mud Slough [north]) may be too close to the point of discharge to ensure sufficient mixing of the two flows. To assess the extent of mixing, the Regional Board divided the width of the Mud Slough (north) into five intervals. On four separate occasions depth integrated samples were collected from the bridge at each of the intervals and at mid channel; grab samples were also collected from the stream banks. The four sampling events included the range of seasonal flow conditions. Results from the sampling are presented in Table 6.

Visual observation of the data shows almost no variability between samples within a sampling event. Coefficient of variations varied from 1.2 to 5.6 percent. This variation is well within analytical error. Also, there are no apparent trends in the distribution of selenium concentrations within a stream cross section. Statistical analysis of the data was not attempted because of the small sample size. From these results, it is concluded that the flow is sufficiently mixed at this location.

Field versus Laboratory Preservation

Samples collected for selenium require preservation with acid to a pH of 2. The Regional Board staff generally acidify samples in the laboratory within 12 hours of sample collection and not more that 24 hours after collection. Field acidification of samples, immediately after sample collection, is not routinely conducted by Regional Board staff due to safety concerns.

A special study was conducted to assess the impacts of delaying sample preservation on sample integrity. Two paired samplings were conducted in which samples were collected and immediately split into two containers by incremental pouring of small volumes and agitating between pourings. One of the splits was immediately acidified in the field and the other was acidified at a later time as per standard sample handling protocol. A set of samples was collected along the San Luis Drain (Table 7) to represent a high selenium environment. Another set of samples was collected from the San Joaquin River at Crows Landing (Table 8) to represent a low selenium environment.

Statistical analysis of the differences of the paired data was conducted. A test for normality according to the method of Shapiro and Wik (W test) (Gilber, 1987) demonstrated that the data were not normally distributed. Thus, a non-parametric technique, the sign test (Helseland Hirsch, 1997) was used to test the null hypothesis that the probability of $x>y$ is equal to 0.5, where x and y are paired results. The

Table 5. Quality Assurance Tolerance Guidelines Used in the Regional Water Quality Control Board Agricultural Drainage Monitoring Program.

Constituent	Recovery Range at Low Levels (µg/L)*	Acceptable Split/Spike Recovery Range
Copper	1-20 ± 5	>20 70-130%
Chromium	1-20 ± 5	>20 70-130%
Lead	5-25 ± 8	>25 60-140%
Molybdenum	1-10 ± 2	>10 90-110%
Nickel	5-25 ± 6	>25 65-135%
Selenium	0.4-10 ± 0.8	>10 90-110%
Zinc	1-20 ± 6	>20 70-130%
Boron	50	85-115%
Chloride	5000	85-115%

* For certain constituents, recovery is expressed as an absolute value rather than a percentage at low levels. For example, if the result of copper analysis for a particular sample is 10 µg/L, a split analysis must fall between 5 µg/L and 15 µg/L. If the sample is greater than 20 µg/L, recovery is expressed as a percent and must be between 70 and 130%. If a recovery range is not shown at low levels, the detection limit is given.

Table 6. Assessment of Cross-Channel Mixing at Mud Slough (north) Downstream of the San Luis Drain

Date	Selenium Concentration (ug/L)							coefficient of variation
	west bank grab	7-8'	14-15'	mid-channel	23-28'	30-35'	east bank grab	
10/1/96	49.2	49.2	49.5	48.9	49.1	48.9	–	1.2
3/20/97	–	32.8	32.2	32.7	32.4	32.4	–	1.2
6/27/97	54.6	54.6	54.2	55.8	55.8	56.1	54.6	3.4
9/12/97	20.1	20.0	19.3	20.4	19.6	19.3	–	5.6

Table 7. Study: Lab vs Field Preservation
Paired Sampling at San Luis Drain Terminus

Miles below Check 19	Selenium (ug/L)		
	Preserved in Lab	Preserved in Field	Diff.
0.50	62.9	63.0	0.1
1.00	69.1	69.4	0.3
1.65	63.6	62.7	-0.9
3.33	62.5	61.7	-0.8
5.63	63.6	64.3	0.7
7.00	61.1	60.2	-0.9
9.50	54.1	54.2	0.1
10.96	65.1	65.2	0.1
14.16	55.4	55.1	-0.3
14.70	55.2	55.4	0.2
15.20	55.0	55.5	0.5
15.90	57.6	57.2	-0.4
18.00	53.1	52.8	-0.3
19.77	64.5	67.4	2.9
22.47	116	108	-8.0
22.62	112	112	0.0
24.44	91.7	82	-9.7
27.07	83.5	82.2	-1.3
		Mean:	-1.0
		Standard deviation:	3.0

Table 8. Study: Lab vs Field Preservation
Paired Sampling at San Joaquin River, Crows Landing

Feet from East Bank	Time Collected	Selenium (ug/L)		
		Preserved in Lab	Preserved in Field	Diff.
east bank	930	2.41	2.40	-0.01
10	1110	2.48	2.42	-0.06
20	1120	2.42	2.44	0.02
30	1126	2.51	2.62	0.11
40	1131	2.53	2.66	0.13
50	1135	2.58	2.60	0.02
60	1141	2.58	2.61	0.03
70	1146	2.58	2.54	-0.04
80	1151	2.64	2.62	-0.02
90	1157	2.67	2.63	-0.04
100	1201	2.64	2.56	-0.08
110	1207	2.48	2.58	0.10
west pier	1246	2.66	2.63	-0.03
center pier	1247	2.63	2.58	-0.05
east pier	1248	2.58	2.64	0.06
Sigma*	1305	2.65	2.62	-0.03
west bank	1415	2.60	2.86	0.26
			Mean:	0.0
			Standard deviation:	0.1

* = composite sampler

Table 9. Study: Field vs Lab Filtering

Date	Dissolved Selenium (µg/L)			
	Inflow to SLD		Discharge from SLD	
	Field filt.	Lab filt.	Field filt.	Lab filt.
11/8/96	61.1	61.8	42.1	43.4
11/19/96	57.0	58.8	75.2	77.3
11/26/96	39.6	42.8	56.4	58.2
12/5/96	–	–	31.0	28.8
12/10/96	56.3	54.3	39.0	36.2
12/20/96	80.2	81.0	49.0	51.1
12/27/96	91.9	92.0	61.6	63.5
1/9/97	76.6	72.4	34.2	32.4
2/4/97	70.5	70.2	61.8	61.8
2/11/97	96.6	94.2	78.4	78.4
2/18/97	78.6	89.4	83.2	76.5

SLD = San Luis Drain

analysis failed to reject the null hypothesis at α equal to 0.01. The conclusion is that there is no difference in selenium concentrations between field and laboratory preserved samples.

Field versus Laboratory Filtration

The DCRT developed a coordinated monitoring plan which called for assessing dissolved selenium at the inflow and outflow of the San Luis Drain. This assessment requires filtering of samples through a 0.45 µm filter and analyzing the filtrate. Generally, this procedure is conducted in the field using a vacuum system or a peristaltic pump which draws sample through inert tubing into a filter apparatus. Due to resource limitations and logistical difficulties, the Regional Board did not immediately implement the collection of this sample. The Regional Board instead submitted the sample to a contract laboratory for filtration within 24 hours of collection.

A revised filtration method was later suggested. In this revised procedure, a syringe and filter cartridge apparatus is used to quickly and inexpensively filter samples in the field. This procedure overcame the resource and logistical limitations and was subsequently implemented by Regional Board staff. The revised filtration method was evaluated as follows.

To test the hypothesis of no difference in dissolved selenium concentration between samples filtered in the field and those filtered in the laboratory within 24-hours of sample collection, results for dissolved selenium were compared for paired samples filtered in the field and in the laboratory. Results of the paired results are presented on Table 9.

The difference between the paired samples was tested for normality by the W test. The null hypothesis that the difference of the paired samples are normally distributed could not be rejected. Thus, the t-test was used to test the hypothesis that there is no difference between the means. The null hypothesis could not be rejected and thus, it is concluded that there is no difference between field versus laboratory (delayed) filtration.

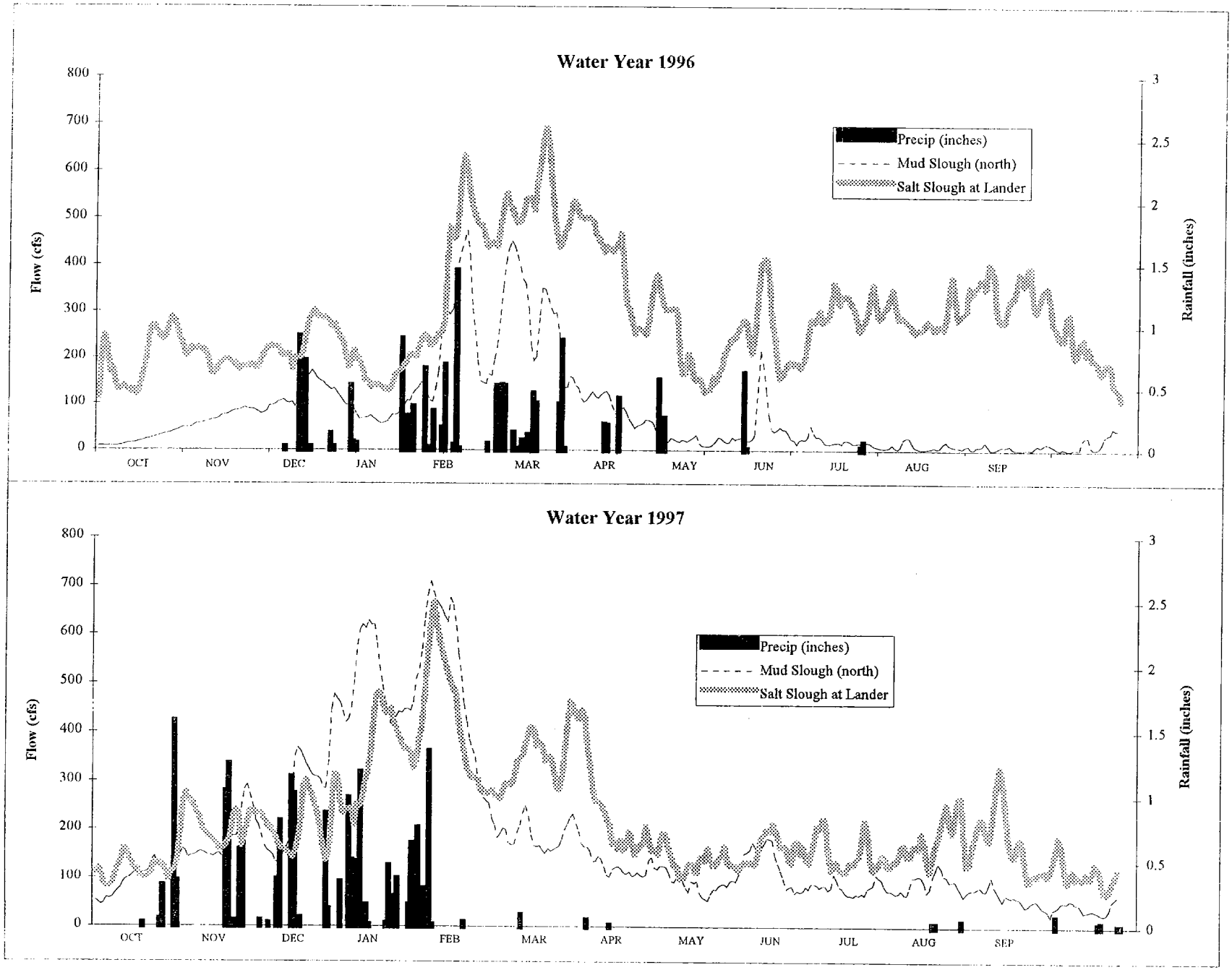
RAINFALL AND DISCHARGE PATTERNS

The San Joaquin River Index, as described in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB, 1995) is used to classify water year type in the river basin based on runoff. The 60-20-20 Index includes one "wet" classification, two "normal" classifications (above and below normal), and two "dry" classifications (dry and critical), for a total of five water year types. Water years 1996 and 1997 were both classified as "wet" based on runoff exceeding 3.8 million acre feet.

Mud Slough (north) and Salt Slough are the main water bodies that drain the Grassland Watershed. Daily flows in both sloughs are compared to the monthly rainfall at Friant Dam for Water Years 1996 and 1997 (Figure 2). Water Year 1996 saw flows peak in February and March, while Water Year 1997 saw the flows peak in late January due to an unusual 4.60 inches of rain for the month. The peaks and sustained highs which do not correspond to rainfall events are generally a result of groundwater, wetland discharges, and surface return flows. In addition, between 3 and 17 April 1996, groundwater which had accumulated in the San Luis Drain during years of disuse, was released into Mud Slough (north) under the provisions of the National Pollutant Discharge Elimination System (NPDES), Permit No. CA0083917. The permitted discharge of the groundwater was a regulatory necessity prior to the use of the drain to transport agricultural subsurface drainage. A total of 461 acre-feet of water was discharged over the 15-day period.

The effects of the opening of the Bypass channel in September 1996, can be clearly seen in the comparison of flows from May through August in Water Years 1996 and 1997. The bulk of the subsurface drainage discharges went through Salt Slough in WY 96, whereas in WY 97, much of the discharge was rerouted through Mud Slough (north) via the San Luis Drain. High rainfall during WY 97 resulted in localized flooding which in turn resulted in the diversion of commingled agricultural subsurface and storm drainage flows from the DPA into water bodies flowing through the Grassland

Figure 2. Flows in Mud Slough (north) and Salt Slough as Compared to Rainfall at Friant Dam: Water Years 1996 and 1997



Watershed between 27 January and 5 February 1997. An extensive summary of the hydrology of the Grassland Watershed can be found in Steensen, *et al.*, (1998).

RESULTS

Grab sample water quality results for minerals and trace elements, as well as EC, pH, and temperature at time of sampling, are listed by site in Appendices A through C. Appendix A includes sites sampled in Water Year 1996 and Appendix B contains data for the sites sampled throughout Water Year 1997. All information collected using automated Sigma samplers is presented in Appendix C. The number of sampling events and the ranges, mean and median values for each measured constituent at each site are shown in these appendices. Results are presented below by water year. Water Year 1996 has been divided into results for the inflow, internal flow and outflow sites. Data for Water Year 1997 has been divided into results for the San Luis Drain and Mud Slough (north), and wetland water supply channels and Salt Slough. Also presented is data from the autosamplers which collected either four day or daily composites depending on the location (refer to Tables 3 and 4). Tables 10 and 11 list the median constituent concentrations for all water bodies monitored in the Grassland Watershed for Water Years 1996 and 1997, respectively. Table 12 summarizes annual minimum, mean and maximum EC, boron and selenium concentrations at locations sampled in the watershed during Water Years 1996 and 1997 and compares those values to the average range in concentration during the previous ten water years of record. The previous ten years of record contained seven critically dry years and three wet years as determined using the San Joaquin River Index (SWRCB, 1995). Since both Water Years 1996 and 1997 were classified as wet water years, the previous data record's summary information, although presented in full, has also been separated into critically dry years and wet years.

Water Year 1996

Inflow Monitoring Stations

The inflow monitoring stations represent the quality of water entering the grasslands area and include the following stations: Charleston Drain, Hamburg Drain, Firebaugh (Main) Drain, Panoche Drain, Almond Drive Drain, Rice Drain, Camp 13 Slough, Agatha Canal, and Salt Slough Ditch. Salt Slough Ditch at Hereford Road flows into the North Grassland area; the others flow into the South Grassland area.

The highest combined levels of salinity (based on EC), boron, and selenium were found at the Panoche, Hamburg, Firebaugh and Charleston Drains (Table 10). These drains primarily carry subsurface agriculture drainage from the DPA. Lower concentrations were recorded for the remaining inflow sites which are not as strongly dominated by subsurface agriculture drainage. The highest EC was recorded in the Hamburg Drain on 1 March 1996 (6890 µmhos/cm) and the highest selenium concentration in the Firebaugh Drain (162 µg/L), also on 1 March 1996. The highest boron concentrations were found in the Rice Drain. The Rice Drain, sampled on a quarterly basis in WY 96, had levels of boron ranging from 5.5 mg/L to 15 mg/L, with the maximum occurring on 25 January 1996, and variable levels of selenium (3.4 to 28.4 µg/L). Data is too limited to determine if the concentrations at this site followed seasonal trends.

Camp 13 and the Agatha Canal (sampled on a monthly basis) may carry a combination of supply water and/or agricultural drainage, therefore water quality fluctuated greatly during Water Year 1996. Concentrations at the Agatha Canal at Mallard were high in December, January, February and August (peaking in December with the EC at 4490 µmhos/cm, selenium at 100 µg/L, and boron at 6.3 mg/L). Low concentrations in the Agatha Canal were observed in September and October with the EC at 324 µmhos/cm, selenium at 0.9 µg/L, and boron at 0.12 mg/L. During this time period the Agatha Canal is used exclusively for wetland water deliveries. At Camp 13 Slough, EC, boron and selenium levels were elevated from November through July; particularly in November, January and April. The peak EC occurred in January at 4660 µmhos/cm, while boron peaked in November and January at 6.9 mg/L. The maximum selenium concentration occurred in April at 88.8 µg/L. The lowest concentrations in Camp 13 occurred in September with the EC dropping to 338 µmhos/cm, boron to 0.13 mg/L, and selenium to 0.8 µg/L.

Table 10. Median Constituent Concentrations for Waterways within the Grassland Watershed: Water Year 1996.

Type	Station	EC (umhos/cm)	B	Cl	SO4	Se	Mo	Cr	Cu	Ni	Pb	Zn	Hardness mg/L
			mg/L			ug/L							
I	*Main (Firebaugh) Drain	2870	3.4	285	1100	48.8	26	—	—	—	—	—	720
I	*Panoche Drain	4555	7.0	605	1450	76.5	13	—	—	—	—	—	1100
I	Agatha Canal	588	2.3	66	97	3.6	—	—	—	—	—	—	120
I	Hamburg Drain	4435	4.7	630	1550	57.8	6	—	—	—	—	—	1600
I	Camp 13	3760	5.7	435	1100	57.4	—	—	—	—	—	—	915
I	Charleston Drain	3940	3.5	470	1300	59.8	5	—	—	—	—	—	1000
I	Almond Drain	925	0.47	63	98	1.5	—	—	—	—	—	—	155
I	Rice Drain	2590	6.0	290	960	10.1	—	—	—	—	—	—	600
I	Salt Slough @ Hereford	744	0.27	114	103	0.8	—	—	—	—	—	—	200
T	CCID Main Canal	558	0.42	23	23	0.9	—	—	—	—	—	—	86
T	Santa Fe Canal @ Henry Miller Rd.	608	0.42	67	96	1.8	—	—	—	—	—	—	120
T	San Luis Canal @ Henry Miller Rd.	653	0.52	74	100	1.8	—	—	—	—	—	—	140
T	Porter-Blake Bypass	3155	4.4	330	920	37.8	—	—	—	—	—	—	730
O	Salt Slough @ Lander*	2060	2.0	290	520	16.0	9	12	8	14	<5	26	450
O	Mud Slough @ Newman Gun Club	1787	1.4	270	330	1.2	—	—	—	—	—	—	360
O	Los Banos Creek	1297	1.2	205	220	0.6	—	—	—	—	—	—	305
O	Mud Slough @ San Luis Drain*	1660	1.2	235	305	1.0	9	7	5	10	<5	14	370

—: Not analyzed
I = Inflow O = Outflow
*Autosampler 4-day Composite Data for EC, B, and Se only. T = Internal flow

Table 11. Median Constituent Concentrations for Waterways within the Grassland Watershed: Water Year 1997.

Type	Station	EC (umhos/cm)	B	Cl	SO4	Se	Mo	Cr	Cu	Ni	Pb	Zn	Hardness mg/L
			mg/L			ug/L							
I	Agatha Canal	432	0.2	55	43	1.2	—	—	—	—	—	—	87
I	Camp 13	520	0.4	64	49	1.6	—	—	—	—	—	—	30
T	Santa Fe Canal @ Henry Miller Rd.	833	0.83	59	54	2.1	—	—	—	—	—	—	110
T	San Luis Canal @ Henry Miller Rd.	886	0.87	—	—	2.0	—	—	—	—	—	—	—
O	Salt Slough @ Lander	1320	0.7	190	200	1.0	7	—	—	—	—	—	290
D	Inflow to San Luis Drain @ Ck 17	4390	7.5	—	—	66.4	22	—	—	—	—	—	—
D	San Luis Drain @ Terminus	4330	7.1	460	1300	60.4	26	—	—	—	—	—	1000
B	Mud Slough (N) Upstream of SLD	1160	1.0	130	130	0.8	6	—	—	—	—	—	200
O	Mud Slough dwnstrm of SLD	3100	4.4	195	330	32.4	17	—	—	—	—	—	340
D	San Luis Drain @ Terminus*	4420	7.2	—	—	61.5	—	—	—	—	—	—	—

—: Not analyzed
I = Inflow O = Outflow D = agricultural drainage
*Autosampler Daily Composite Data for EC, B, and Se only. T = Internal flow B = background

Table 12. Annual Minimum, Mean, and Maximum Electrical Conductivity, Boron, and Selenium at Monitoring Sites Within the Grassland Watershed: Water Years 86-95, 96 and 97.

Site	Count	EC (umhos/cm)			Boron (mg/L)			Selenium (ug/L)		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Firebaugh (Main) Drain @ Russell Ave.										
WYs 86-95	334	255	3770	9090	0.12	5.3	23	1.0	65.0	286
WYs 86-95 (critical)	212	2050	3770	9090	1.2	5.3	23	4.0	62.3	286
WYs 86-95 (wet)	115	255	3940	8740	0.12	5.3	18	1.0	71.0	224
WY 96	50	1910	3310	6590	2.4	4.0	9.4	23.0	64.0	162
Panoche Drain										
WYs 86-95	296	2600	4560	5990	3.9	7.5	10	14.0	75.0	156
WYs 86-95 (critical)	197	2700	4580	5860	3.9	7.5	10	14.0	73.6	156
WYs 86-95 (wet)	92	3000	4640	5990	4.5	7.5	10	22.6	79.9	146
WY 96	48	3440	4520	5380	3.8	7.1	9.4	19.7	79.1	137
Hamburg Drain										
WYs 86-95	318	366	7880	7480	0.19	5.5	9.4	3.8	82.0	201
WYs 86-95 (critical)	205	2900	5070	7100	2.1	5.5	9.0	17.1	88.9	201
WYs 86-95 (wet)	107	366	4610	7480	0.6	5.5	9.4	3.8	72.6	200
WY 96	49	383	4250	6890	0.24	4.7	9.7	1.5	59.5	129
Agatha Canal										
WYs 86-95	234	162	3120	8100	0.07	5.0	20	0.8	36.0	116
WYs 86-95 (critical)	153	430	3310	8100	0.10	5.4	20	0.8	37.6	114
WYs 86-95 (wet)	74	162	2770	6600	0.12	4.3	15	1.0	34.0	120
WY 96	12	200	1940	4730	0.12	3.0	6.6	0.9	28.2	100
WY 97	43	187	518	4240	0.11	0.25	0.46	0.5	1.3	3.4
Camp 13 Slough										
WYs 86-95	264	266	3550	6700	0.18	5.0	10	0.9	52.0	144
WYs 86-95 (critical)	185	390	3690	6700	0.22	5.1	10	1.0	53.1	123
WYs 86-95 (wet)	72	266	3320	6510	0.18	4.7	9.3	0.9	50.8	144
WY 96	11	338	3410	4660	0.13	4.9	6.9	0.8	55.9	88.8
WY 97	42	172	822	3760	0.15	1.1	7.1	0.6	2.6	23.4
Charleston Drain										
WYs 86-95	246	304	4140	10200	0.15	4.0	24	1.3	65.0	129
WYs 86-95 (critical)	166	590	4170	10220	0.74	4.0	24	1.9	64.6	125
WYs 86-95 (wet)	75	304	4110	6010	0.15	3.9	7.7	1.3	66.8	129
WY 96	46	553	3600	6370	0.48	3.2	5.4	4.2	53.8	103
Almond Drive Drain										
WYs 86-95	149	70	1560	3530	<0.05	1.4	4.4	0.4	3.4	17
WYs 86-95 (critical)	128	448	1670	3530	0.16	1.5	3.9	0.4	3.5	17
WYs 86-95 (wet)	20	70	1050	3230	0.04	1.0	4.4	0.6	2.4	6.1
WY 96	4	220	1110	2700	0.10	0.68	1.7	0.7	3.0	8.4
Rice Drain										
WYs 86-95	216	1070	2980	7700	0.85	5.9	19	1.0	3.2	36.0
WYs 86-95 (critical)	172	1090	3000	7700	1.6	5.9	18	1.1	3.3	36.0
WYs 86-95 (wet)	36	1070	2950	6900	0.85	5.8	19	1.0	3.0	10.0
WY 96	4	2050	3100	6300	5.5	8.1	15	3.4	13.0	28.4
Salt Slough Ditch @ Hereford Rd.										
WYs 86-95	222	430	1040	1950	0.10	0.35	1.1	<0.4	1.1	22.0
WYs 86-95 (critical)	177	680	1090	1950	0.15	0.35	0.99	0.4	1.1	22.3
WYs 86-95 (wet)	42	430	907	1600	0.10	0.34	1.1	<0.4	1.0	4.0
WY 96	4	515	836	1260	0.20	0.3	0.34	0.6	1.0	1.7

Table 12 continued:

Site	Count	EC (umhos/cm)			Boron (mg/L)			Selenium (ug/L)		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
CCID Main Canal										
WYs 86-95	213	50	719	4280	<0.05	0.45	5.8	<0.4	2.2	76.0
WYs 86-95 (critical)	180	55	734	4280	0.10	0.42	5.2	0.4	2.3	76.0
WYs 86-95 (wet)	33	50	584	2100	<0.05	0.41	2.7	0.6	1.9	16.0
WY 96	3	56	526	1300	<0.05	0.61	1.3	<0.4	2.3	5.2
Santa Fe Canal										
WYs 86-95	105	318	1440	4090	0.19	1.7	5.5	<0.4	10.0	60.0
WYs 86-95 (critical)	41	410	1210	4090	0.22	1.2	5.3	0.3	7.4	59.8
WYs 86-95 (wet)	58	318	1580	3930	0.19	2.0	5.5	1.0	11.0	44.0
WY 96	12	188	675	1450	0.10	0.5	1.3	0.6	2.1	4.7
WY 97	42	339	941	1870	0.24	1.0	2.9	0.8	2.1	3.9
San Luis Canal										
WYs 86-95	114	330	1690	4850	0.19	2.1	7.4	0.7	15.0	74.0
WYs 86-95 (critical)	50	486	1220	4010	0.30	1.2	4.9	0.7	7.0	56.6
WYs 86-95 (wet)	64	330	2050	4850	0.19	2.7	7.4	0.8	20.8	74.0
WY 96	12	196	918	3560	0.10	0.82	4.4	0.8	6.5	40.8
WY 97	41	501	973	1840	0.36	1.1	3.3	1.0	2.1	6.2
Porter-Blake Bypass										
WYs 86-95	110	348	3110	4820	0.30	4.4	7.1	1.7	40.6	88.0
WYs 86-95 (critical)	66	348	3100	4630	1.06	4.4	7.1	3.4	39.4	77.8
WYs 86-95 (wet)	43	786	3120	4820	0.30	4.5	6.9	1.7	42.4	88.0
WY 96	12	532	2830	3800	0.32	3.8	5.3	2.1	36.7	66.3
Mud Slough (N) @ Newman Gun Club										
WYs 86-95	241	230	3120	7570	0.10	2.8	7.0	0.5	8.4	48.0
WYs 86-95 (critical)	206	909	3300	7570	0.30	2.9	7.0	0.5	9.0	48.0
WYs 86-95 (wet)	35	230	2040	4850	0.10	1.7	4.7	1.0	5.0	34.0
WY 96	12	758	2260	5280	0.50	1.9	8.4	0.6	2.3	15.6
Mud Slough (N) @ San Luis Drain										
WYs 86-95	288	616	3320	10900	0.06	2.8	7.9	<0.4	7.8	59.0
WYs 86-95 (critical)	340	660	3510	10860	0.20	3.1	7.9	0.4	9.4	50.0
WYs 86-95 (wet)	114	616	2250	7250	0.27	2.0	6.4	0.4	4.1	59.0
WY 96	50	588	1900	5530	0.45	1.5	8.7	<0.4	1.4	11.8
WY 97	46	1150	2870	4930	1.1	4.1	6.8	5.0	30.7	79.6
Los Banos Creek @ Highway 140										
WYs 86-95	124	641	2030	7450	0.30	1.6	6.6	<0.4	2.1	30.0
WYs 86-95 (critical)	98	669	2140	7450	0.30	1.6	6.6	0.3	2.3	30.0
WYs 86-95 (wet)	25	641	1000	3600	0.33	1.3	2.9	<0.4	1.0	2.0
WY 96	3	509	1260	3350	0.60	1.5	3.0	<0.4	0.6	1.2
Salt Slough @ Lander Ave.										
WYs 86-95	472	780	2220	4050	0.30	2.1	5.0	1.0	15.0	44.0
WYs 86-95 (critical)	351	1020	2230	4050	0.30	2.0	4.7	0.6	14.6	44.0
WYs 86-95 (wet)	115	780	2240	3970	0.43	2.2	5.0	1.0	16.0	42.0
WY 96	49	1010	2010	3000	0.47	2.0	3.5	1.0	16.0	33.5
WY 97	48	922	1370	2000	0.40	0.77	1.8	0.5	1.0	3.4
Inflow to San Luis Drain @ Check 17										
WY 97	48	2620	4460	5600	4.2	7.3	9.0	17.9	65.9	108.0
San Luis Drain @ Terminus										
WY 97	48	2720	4270	5460	4.4	6.8	8.4	17.0	59.3	107.0
Mud Slough (N) upstream of SLD										
WY 97	48	744	1390	2960	0.56	1.2	2.9	<0.4	0.8	1.7

Table 12 continued:

Site	Count	EC (umhos/cm)			Boron (mg/L)			Selenium (ug/L)		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Autosampler Data (1)										
Camp 13 Slough										
WY 97	*	122	1030	4630	0.34	3.8	7.7	<0.4	12.4	33.0
Agatha Canal										
WY 97	†	116	225	809	0.37	0.62	1.0	0.5	1.7	6.8
Panoche Drain										
WY 96	85	3050	4530	5580	3.4	7.0	9.2	23.4	79.9	149
WY 97	29	3830	4750	5320	–	–	–	35.0	72.8	116
Firebaugh (Main) Drain										
WY 96	82	1830	3190	5520	2.1	3.8	7.6	25.2	59.7	136
WY 97	25	2290	4110	5550	–	–	–	28.8	72.7	125
Mud Slough (N) @ SLD										
WY 96	79	610	1880	5150	0.45	1.4	5.6	0.5	1.7	19.4
WY 97	42	1170	2130	3760	1.3	2.5	6.2	4.5	17.1	50.6
Salt Slough at Lander Avenue										
WY 96	95	886	2020	3170	0.47	2.0	3.0	1.2	16.0	37.8
WY 97	43	960	1440	2070	0.47	1.0	1.9	0.5	1.3	6.3
San Luis Drain @ Terminus										
WY 97	344	2620	4390	5880	4.1	7.0	9.3	15.2	62.4	116

Count = the minimum number of analyses out of the three constituents

(1) = All autosamplers except at the San Luis Drain site were removed by April 1997. The San Luis Drain sampler was installed in September 1996. The Camp 13 and Agatha samplers were operated intermittently between January and March 1997.

* = 75 EC, 20 selenium and 8 boron analyses were conducted

† = 67 EC, 9 selenium and 4 boron analyses were conducted

Water year type is based on the San Joaquin 60-20-20 River Index as follows:

Critical Water Year: Runoff < 2.1 million ac-ft (WYS 87-92 and 94)

Wet Water Year: Runoff > 3.81 million ac-ft (WYs 86, 93, 95, 96, and 97)

The Almond Drive Drain, as in previous years, contained low levels of the constituents of concern, as did Salt Slough Ditch at Hereford Road. These sites were sampled on a quarterly schedule and normally carry either surface tailwater or supply water.

Internal Flow Monitoring Sites

Four internal flow sites were monitored in WY 96: Santa Fe Canal at Henry Miller Road, San Luis Canal at Henry Miller Road, and Porter-Blake Bypass on a monthly basis; and CCID Main at Russell on a quarterly basis. These channels can carry supply water for both agriculture lands and wetland habitat, as well as transport agricultural tailwater and subsurface drainage. During Water Year 1996, EC in these water bodies ranged from 56 µmhos/cm to 3800 µmhos/cm, while boron ranged from <0.05 mg/L to 5.3 mg/L (Table 12). Selenium concentration ranged from <0.4 µg/L to 66.3 µg/L. The lowest concentrations occurred in the CCID Main at Russell which primarily carries supply water, while the highest concentrations occurred in the Porter-Blake Bypass, which served as a conduit when subsurface agricultural drainage was discharged into Salt Slough.

When compared to the previous ten years of available data, the Santa Fe and San Luis sites showed significant decreases for the constituents of concern, CCID Main remained at approximately the same level, and Porter-Blake concentrations increased.

Outflow Monitoring Stations

Four outflow stations were sampled during Water Year 1996. Salt Slough at Lander Avenue and Mud Slough (north) downstream of the San Luis Drain were monitored on a weekly basis. Mud Slough (north) at Newman Gun Club was sampled on a monthly basis, and Los Banos Creek at Highway 140 was sampled on a monthly basis, with boron and selenium analyses only conducted on a quarterly basis.

During Water Year 1996, the majority of subsurface drainage flowed through Salt Slough prior to discharge into the San Joaquin River. EC, boron, and selenium concentrations ranged from 1010 to 3000 µmhos/cm, 0.47 to 9.3 mg/L, and 1.0 to 33.5 µg/L, respectively (Table 12). The highest concentrations occurred on 5 May 1996, while lowest occurred the first two weeks in November. Mud Slough (north) at the San Luis Drain and Mud Slough (north) at Newman Gun Club had lower concentrations of boron and selenium than Salt Slough, but higher overall ECs. A short term spike in selenium concentrations occurred in Mud Slough (north) downstream of the San Luis Drain between 14 and 17 April 1996, during the dewatering of groundwater from the drain in preparation for the Grassland Bypass Project. During those four days, selenium concentrations in Mud Slough (north) ranged from 10 µg/L to 21 µg/L. Once the discharge ceased, selenium concentration in Mud Slough (north) dropped back below 2 ug/L.

Los Banos Creek contained consistently low concentrations of EC, boron and selenium, ranging from 509 to 3350 µmhos/cm, 0.60 to 3.0 mg/L, and <0.4 to 1.2 µg/L, respectively.

Composite Samples

Four autosamplers were in place during Water Year 1996, collecting 4-day composite samples at Panoche Drain, Firebaugh (Main) Drain, Mud Slough (north) and Salt Slough (Figures 3 and 4). Autosamplers were also installed intermittently on Camp 13 Slough and the Agatha Canal when flooding made the site inaccessible (Data presented in Appendix C).

The 4-day composite information collected at the Panoche and Firebaugh (Main) Drain, demonstrates not only the overall elevated constituent concentrations at these sites (minimum EC, boron, and selenium concentrations above 2,000 µmhos/cm, 2.5 mg/L, and 25 µg/L, respectively), but also the variability of the concentrations over the season and even within a 4-day period. Even with the few data gaps that occurred during flood events when the sites could not be accessed for maintenance, the composite record provides a more continuous data base than the weekly grab samples for water year 1996.

Figure 3. Electrical Conductivity, Boron and Selenium Concentrations in Panoche and Firebaugh Drains (Sigma Data): Water Year 1996

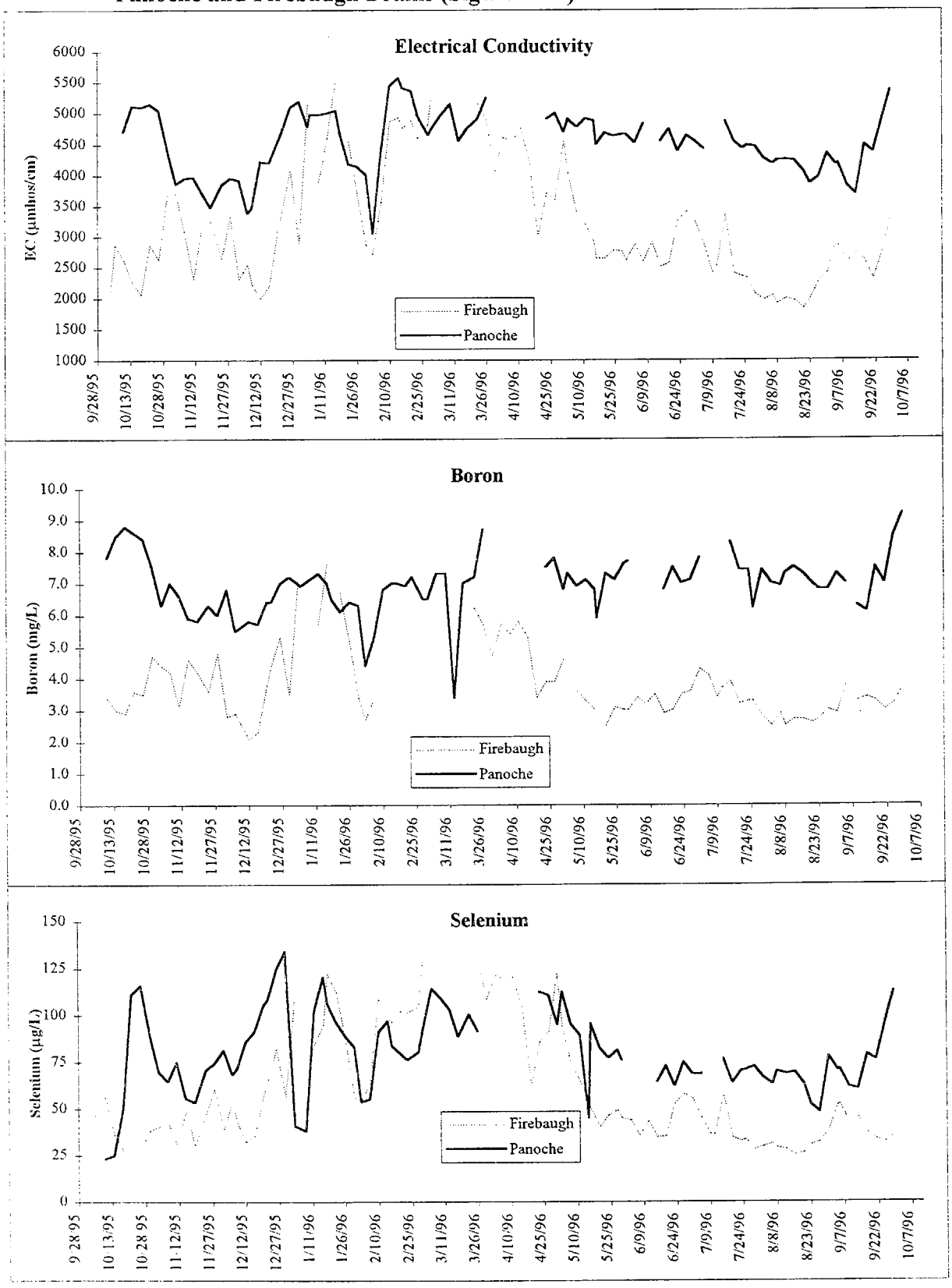


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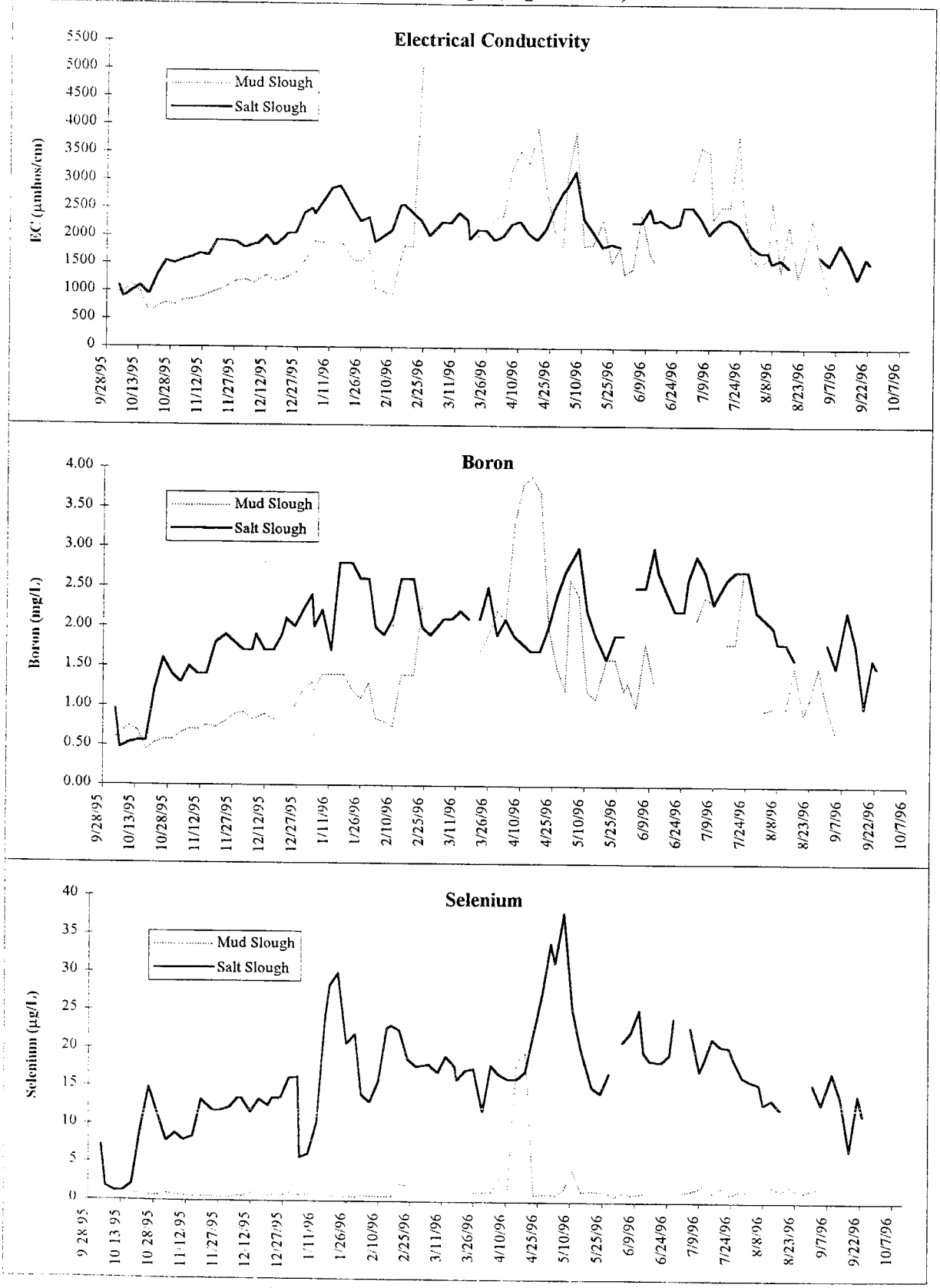
Figure 4. Electrical Conductivity, Boron and Selenium Concentrations Mud Slough (north) and Salt Slough (Sigma Data): Water Year 1996



The composite samplers installed at both Mud Slough (north) and Salt Slough, also provide an almost continuous record of EC, boron and selenium concentrations at the two sites. The Mud Slough (north) sampler was removed for a short period between the end of February and early March, when high flows in the slough threatened to submerge the device which was attached to the bridge. EC and boron concentrations in the two sloughs are comparable with rapid concentration shifts over 4-day periods. Selenium concentrations in Salt Slough remain quite elevated over Mud Slough (north) concentrations during the entire water year except for a peak evident in Mud Slough (north) during mid-April which corresponds to the dewatering of groundwater from the San Luis Drain.

Water Year 1997

With the advent of the Grassland Bypass on 26 September 1996, the focus of the monitoring program shifted from general evaluation of impacts of agricultural drainage on inflow, internal flow and outflow water bodies within the Grassland Watershed, to impacts from consolidating discharge of subsurface drainage into Mud Slough (north) and resulting water quality in wetland water supply channels.

Three new monitoring sites were added in Water Year 1997, due to the opening of the Grassland Bypass Project. One was the inflow to the San Luis Drain which represents the water quality in the Grasslands Bypass. The samples at this site were collected by Panoche Water District on a weekly schedule at a point on the San Luis Drain downstream of the Grassland Bypass inflow. The second addition was the San Luis Drain at its terminus prior to discharge into Mud Slough (north). The final addition, Mud Slough (north) upstream of the San Luis Drain, was added to furnish background data for the Mud Slough (north) site prior to the inflow from the San Luis Drain.

Several of the inflow sites monitored during Water Year 1996, were discontinued in Water Year 1997. The exceptions were Camp 13 Slough and Agatha Canal. Grab samples at these sites were collected by Panoche Water District. The frequency of sampling was increased from monthly to weekly on 3 November 1996, and automated composite samples were collected from 10 January 1997 to 25 March 1997 due to limited direct access.

Two internal sites were continued in WY 97: Santa Fe and San Luis Canals at Henry Miller Road. Weekly sampling by Panoche Water District staff began in November 1996. No data is available for January 1997.

Both the Salt Slough at Lander Avenue and the Mud Slough (north) at the San Luis Drain sites were continued during Water Year 1997. The outflow sites on Los Banos Creek and Mud Slough (north) at Newman Gun Club were discontinued.

Electrical conductivity, boron, and selenium data have been summarized in Tables 11 and 12. Remaining water quality information collected during Water Year 1997, is listed in Appendix B.

San Luis Drain and Mud Slough (north)

Grab samples were collected both from the inflow to and discharge from the San Luis Drain and also from Mud Slough (north) upstream and downstream of the discharge from the San Luis Drain. In addition to EC, boron, and total selenium, dissolved selenium and total suspended solids were analyzed at both San Luis Drain sites.

Concentrations at the inflow to and discharge from the San Luis Drain were similar (Figure 5). The discharge's impact on Mud Slough (north) was pronounced (Figure 6), particularly after February 1997. Elevated background concentrations of EC and boron in Mud Slough (north) upstream of the San Luis Drain discharge (reaching 2960 µmhos/cm and 2.9 mg/L, respectively) are further exacerbated by the drainage discharge, with EC and boron concentrations reaching 4930 µmhos/cm and 6.8 mg/L, respectively. The greatest impact on Mud Slough from the San Luis Drain discharge was on selenium concentrations. Selenium concentrations in Mud Slough (north) upstream of the discharge were below

Figure 5. Electrical Conductivity, Boron and Selenium Concentrations in the Inflow to and Discharge from the San Luis Drain (Grab Data): Water Year 1997.

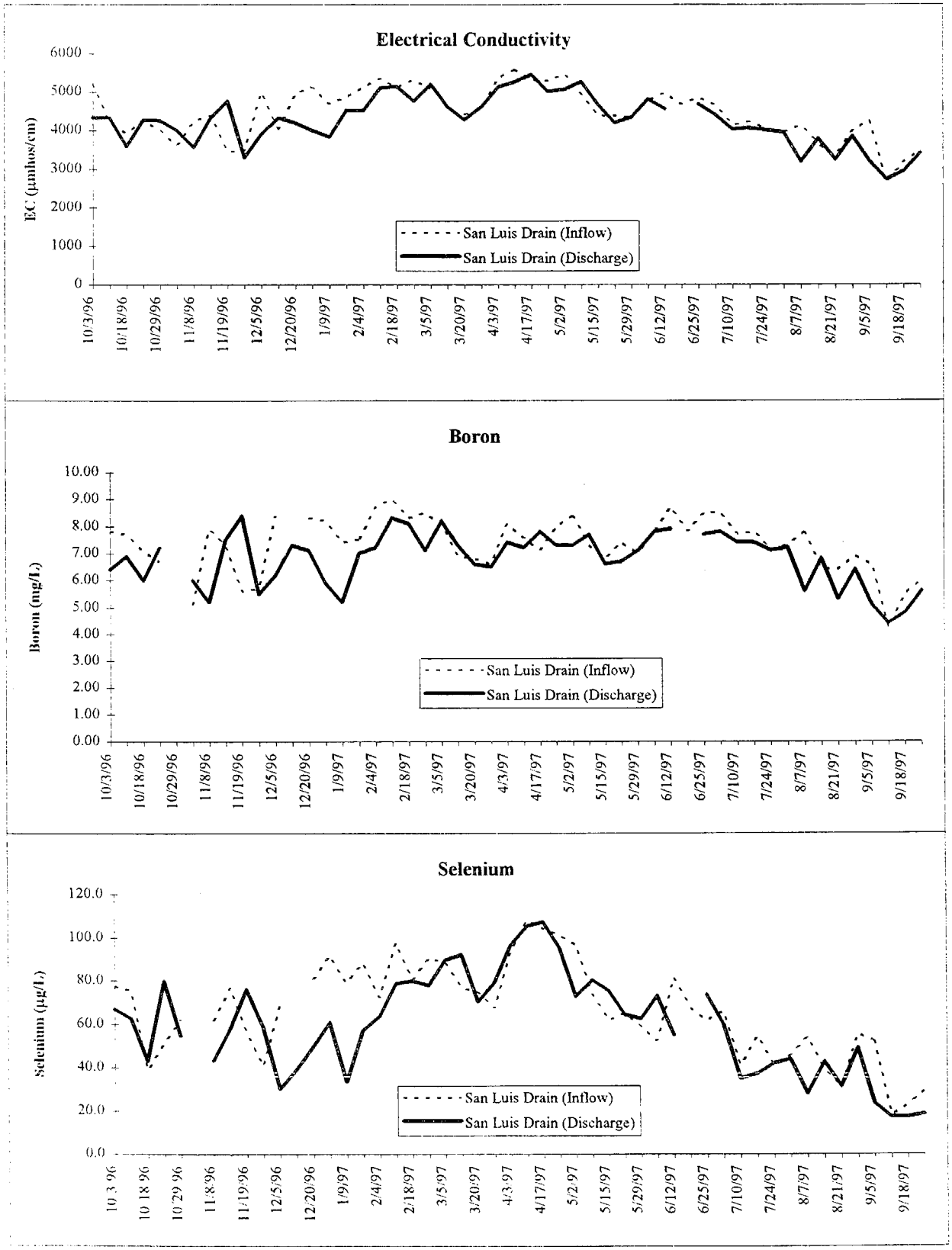
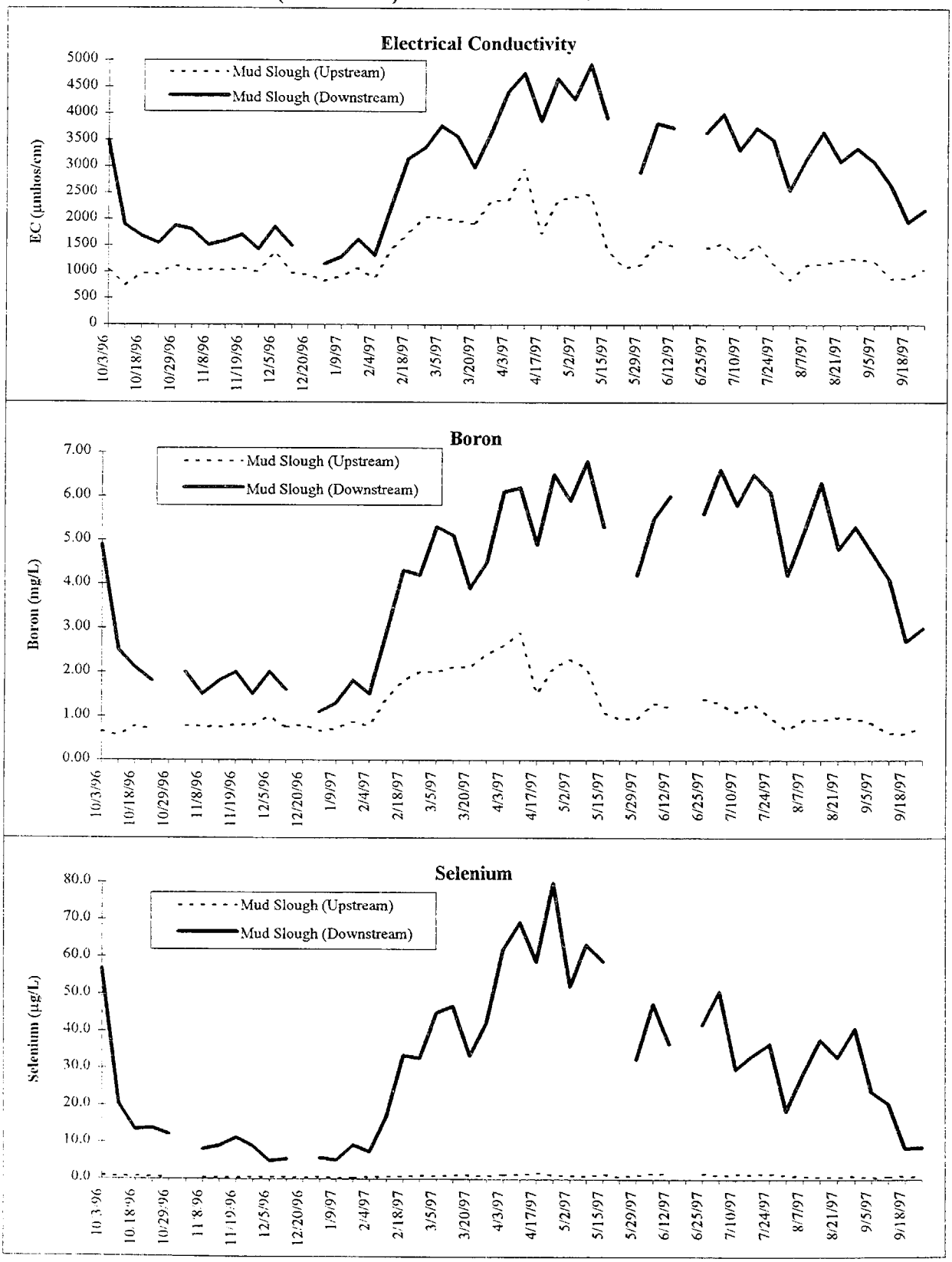


Figure 6. Electrical Conductivity, Boron and Selenium Concentrations in Mud Slough (north) Upstream and Downstream of the Discharge from the San Luis Drain (Grab Data): Water Year 1997.



1.7 µg/L; downstream of the discharge, the mean selenium concentration was 30.7 µg/L with a maximum of 79.6 µg/L.

A comparison of total versus dissolved selenium concentrations at the two San Luis Drain sites is presented in Table 13. Concentrations of each sample pair fall within the analytical criteria of acceptable split samples, indicating that selenium in the drain is in the dissolved (aqueous) form.

Total suspended sediment was analysed on a weekly basis in the inflow to and discharge from the San Luis Drain. Summary results from the analyses are presented in Table 14 and Figure 7. Complete analytical results are listed in Appendix B. Total suspended sediment concentrations were consistently higher in the inflow to the drain than in the discharge from the drain, although actual weekly concentrations varied widely. Median concentrations in the inflow and discharge were 96 mg/L and 25 mg/L, respectively.

Wetland Water Supply Channels and Salt Slough

Weekly grab samples were collected at: Camp 13 Ditch and the Agatha Canal, major supply canals for wetlands within Grassland Water District; the San Luis Canal and Santa Fe Canal at Henry Miller Road, two internal distribution canals for wetland habitat; and at Salt Slough, a tributary of the San Joaquin River. During a brief period, between 27 January and 5 February 1997, subsurface agricultural drainage was diverted into these channels in response to a flood event. Data for this time period have been presented and discussed in a previous report (USBR, 1997) and are not included in the discussion below.

EC, boron and selenium data for Camp 13 Slough and Agatha Canal are presented in Figure 8. Concentrations were consistently higher at Camp 13 than at the Agatha, except for an EC spike recorded on 4 February 1997, during the tail end of the flood event. EC and boron levels reached their maximum in early April, reaching 3760 µmhos/cm and 7.1 mg/L, respectively, at Camp 13. Selenium showed a peak of 13.5 µg/L on 7 May 1997, at Camp 13, while the median selenium level was 1.6 µg/L. On a number of occasions, Camp 13 Slough exceeded 2.0 µg/L selenium, while the Agatha Canal reached a maximum of 3.4 µg/L and only exceeded 2.0 µg/L on five separate occasions.

Concentrations in the internal supply channels, the San Luis and Santa Fe Canals, fluctuated during Water Year 1997, as depicted in Figure 9. Aside from the storm event, the highest EC and boron concentrations occurred between the end of February and April, a primary period of wetland releases and pre-irrigation. Selenium levels did not demonstrate the same spike; however, concentrations remained above 2.0 µg/L for the majority of samples collected from February through September 1997.

The cause of the elevated selenium levels for that time period is not readily apparent but may be due to a number of different factors. Some potential sources include elevated selenium levels in supply water, releases from the DPA (both in response to flood events and seepage from gates and canals), inflows from other sources such as the Rice Drain and Almond Drive Drain, and local sources such as groundwater seepage and surface return flows.

To evaluate the potential for elevated selenium concentrations in irrigation supply water, all available selenium data since October 1996, for the Delta Mendota Canal, Mendota Pool, and the Central California Irrigation District (CCID) Main Canal, major water supplies for the Grassland Watershed, were compiled and listed in Table 15. Although the data set is extremely limited, on a number of occasions, these sources of supply water have exceeded 2.0 µg/L selenium.

During March and early April, 1997, elevated constituent concentrations were noted at Camp 13 Slough. Regional Board staff observation and discussion with Grassland Water District staff confirmed that water from the Main Drain, which contained drainage from adjacent flooded farm land, was being diverted into Camp 13 ditch during this time period. This water was not from farmland participating in the Grassland Bypass Project and staff from the water district assumed that the flood water was of good quality. Review of data collected using an automated sampler which was in place at Camp 13 Slough, until 25 March 1997, indicated that the diverted water contained elevated levels of all three constituents

Table 13. Total vs Dissolved Selenium Concentrations at the Inflow to and Discharge from the San Luis Drain.

Date	Selenium Concentration (µg/L)			
	Inflow		Outflow	
	Total	Dissolved	Total	Dissolved
9/26/96	44.8	46.0L	20.2	19.5L
10/3/96	77.4	79.1L	66.8	65.8L
10/18/96	38.6	37.5L	43.0	41.8L
10/25/96	51.4	49.5	79.8	77.2
10/29/96	62.0	61.6	54.6	54.8
11/8/96	61.3	61.1	43.2	42.1
11/19/96	56.2	57.0	75.8	75.2
11/26/96	40.6	39.6	58.9	56.4
12/5/96	68.4	69.9L	30.1	31.0
12/10/96			38.9	39.0
12/20/96	80.4	80.2	49.8	49.0
12/27/96	91.7	91.9	60.8	61.6
1/9/97	78.7	76.6	33.3	34.2
1/21/97	88.2	84.8	57.0	56.4
2/4/97	72.0	70.5	63.6	61.8
2/11/97	97.5	96.6	78.4	78.4
2/18/97	80.3	78.6	79.7	83.2
2/28/97	90.3	86.4	77.6	73.4
3/5/97	88.4	91.1	89.3	87.1
3/12/97	76.6	77.2		
3/13/97			91.8	84.4
3/19/97	74.5	71.1		
3/20/97			70.2	70.4
3/26/97	67.0	61.0		
3/27/97			78.9	78.1
4/2/97	93.0	95.8		
4/3/97			96.2	93.7
4/9/97	108	117		
4/10/97			105	102
4/16/97	104	104		
4/17/97			107	110
4/23/97	101	97.6		
4/24/97			95.2	93.6
5/1/97	96.8	96.6		
5/2/97			72.6	73.7
5/7/97	73.6	73.0		
5/8/97			80.3	78.3

Date	Selenium Concentration (µg/L)			
	Inflow		Outflow	
	Total	Dissolved	Total	Dissolved
5/14/97	61.6	57.6		
5/15/97			75.2	75.7
5/21/97	65.0	63.6		
5/23/97			64.2	64.6
5/28/97	58.5	60.6		
5/29/97			62.3	60.9
6/4/97	52.1	50.6		
6/5/97			72.8	70.4
6/11/97	81.0	78.9		
6/12/97			54.6	55.0
6/18/97	67.5	63.1		
6/25/97	61.5	60.5	73.3	73.6
7/2/97	65.8	64.1	59.9	59.8
7/9/97	40.6	40.5		
7/10/97			34.9	35.0
7/16/97	54.5	53.0		
7/17/97			37.0	37.0
7/23/97	40.5	43.5		
7/24/97			41.8	39.5
7/30/97	45.5	44.6		
7/31/97			43.7	42.4
8/6/97	53.8	50.4		
8/7/97			27.9	27.7
8/13/97	38.4	39		
8/14/97			42.3	41.7
8/20/97	30.8	30.4		
8/21/97			31.2	31.0
8/27/97	55.4	53.7	48.9	47.2
9/3/97	52.1	49.4		
9/5/97			23.4	23.3
9/10/97	17.9	16.6		
9/12/97			17.0	16.4
9/17/97	22.8	21.8		
9/18/97			17.1	17.0
9/24/97	29.0	28.0		
9/25/97			18.3	18.4

L = Lab filtered

Table 14. Summarized Total Suspended Sediment Data for the Inflow to and Discharge from the San Luis Drain: Water Year 1997

Location	Total Suspended Sediment (mg/L)					
	Count	Min	Max	Mean	Geo Mean	Median
Inflow to San Luis Drain	43	38	190	100	92	96
Discharge from San Luis Drain	44	8	140	28	23	25

Figure 7. Total Suspended Sediment Concentration in the Inflow to and Discharge from the San Luis Drain: Water Year 1997.

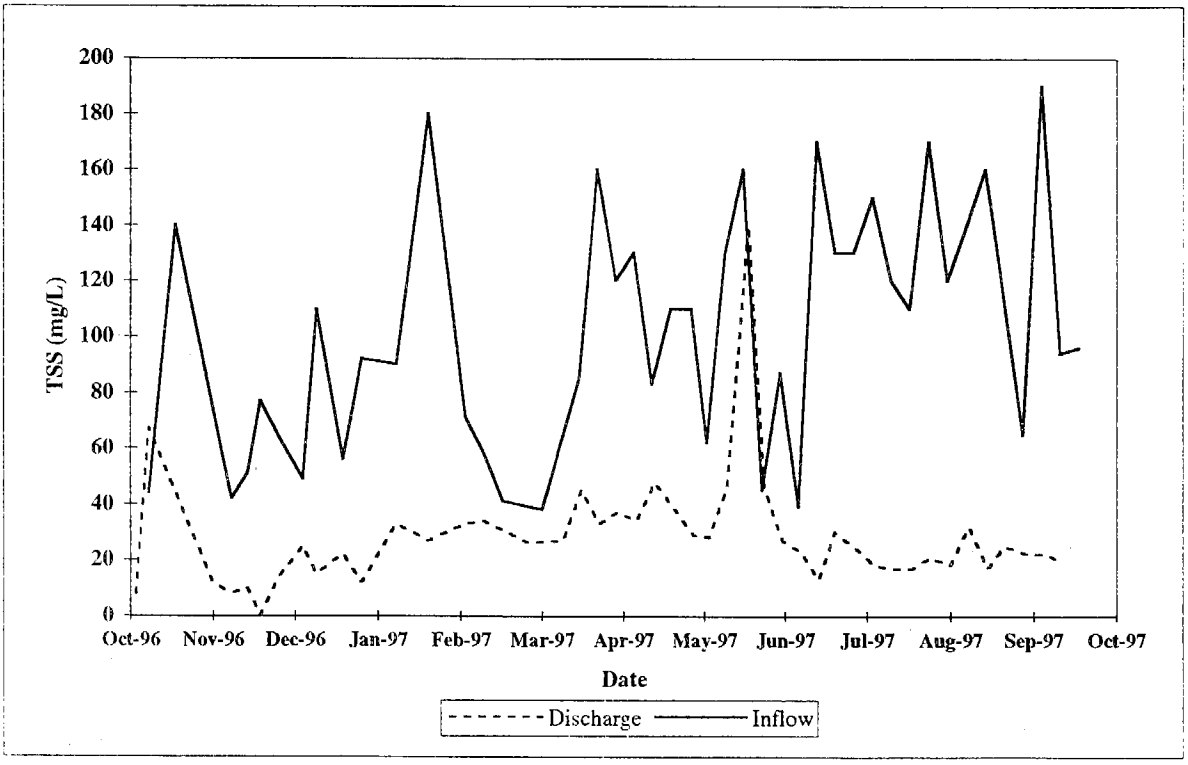


Figure 8. Electrical Conductivity, Boron and Selenium Concentrations in Camp 13 Slough and Agatha Canal (Grab Data): Water Year 1997.

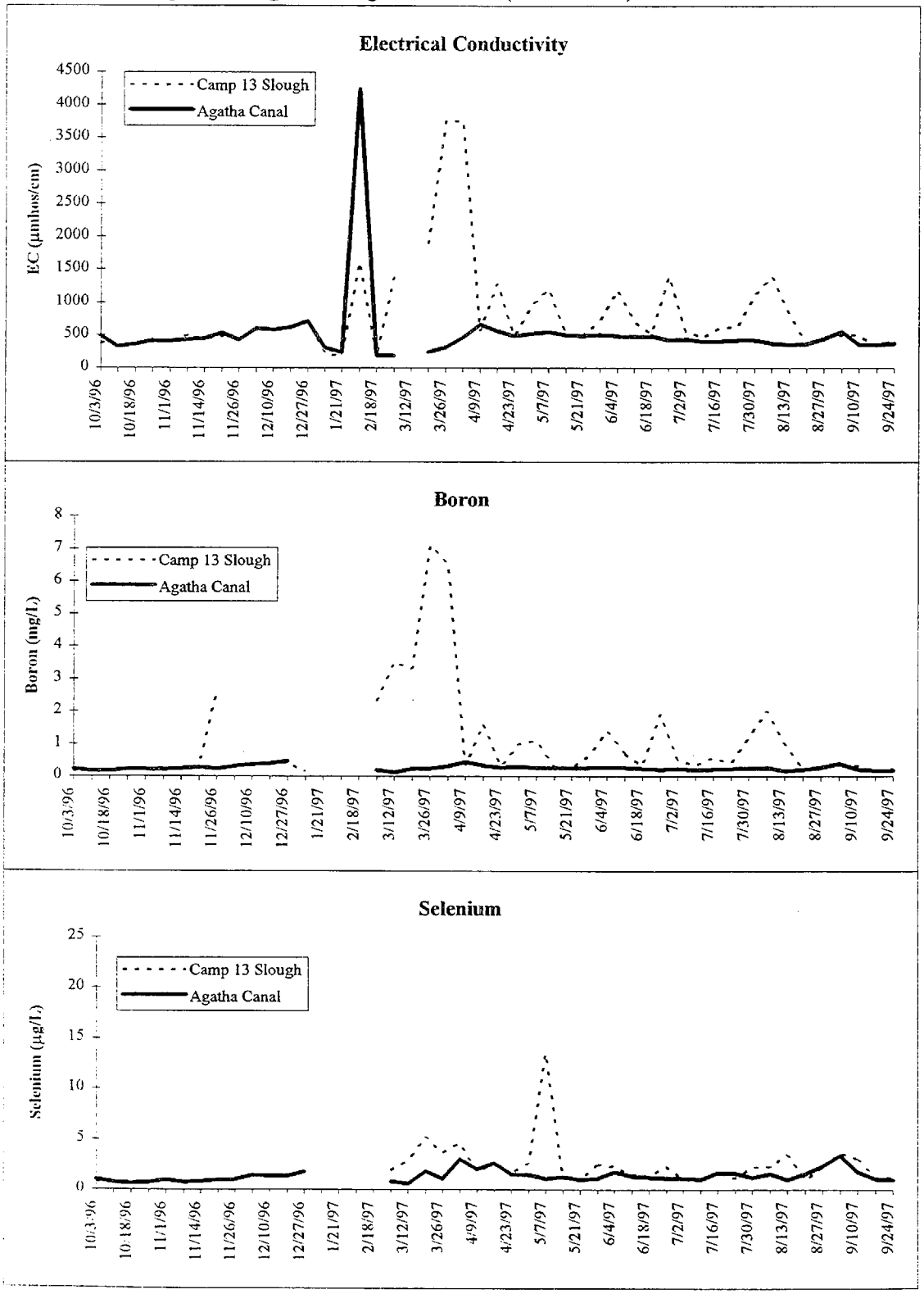


Figure 9. Electrical Conductivity, Boron and Selenium Concentrations in the San Luis Canal and Santa Fe Canal (Grab Data): Water Year 1997.

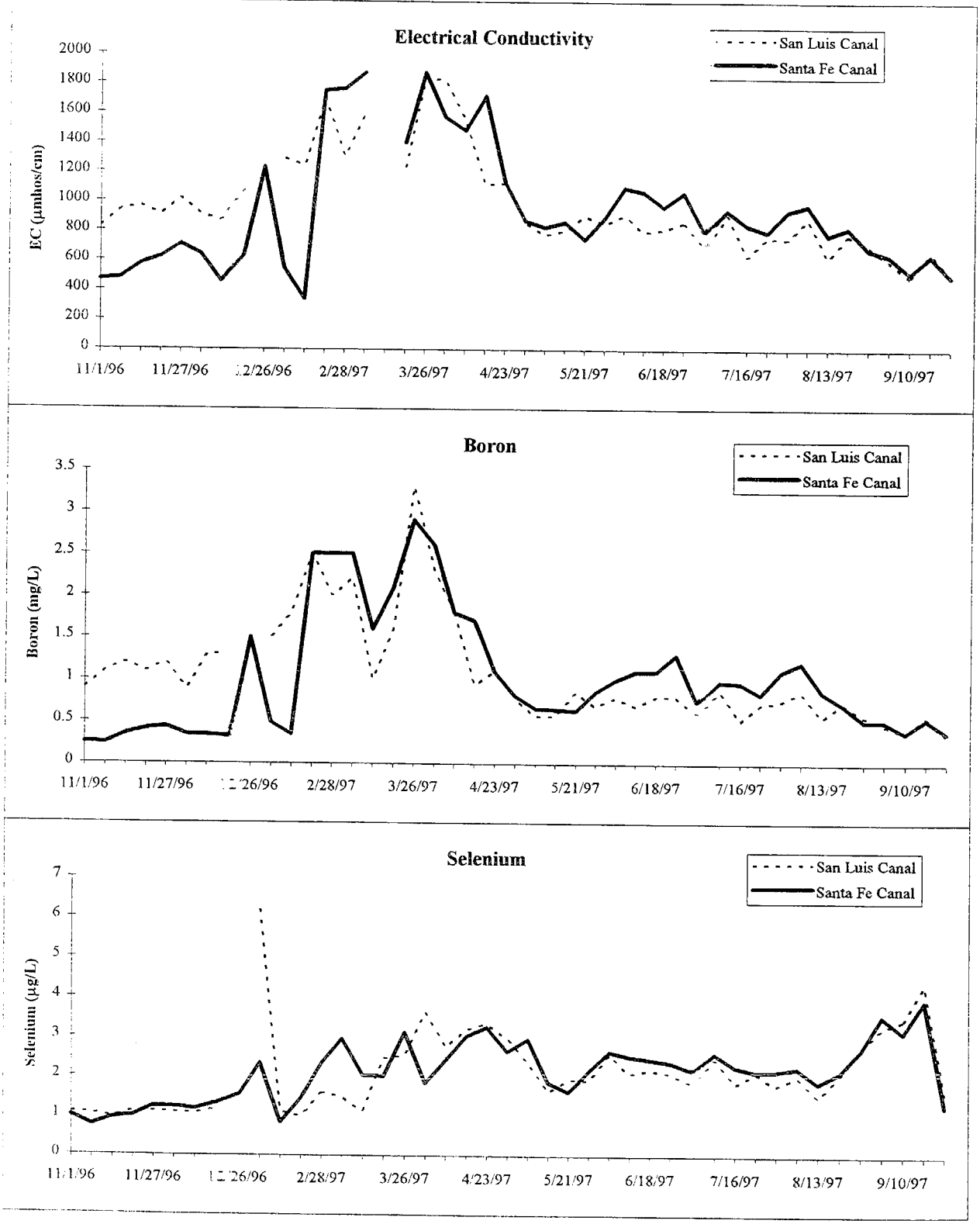


Table 15. Selenium Concentrations in Supply Water to the Grassland Watershed: October 1996 through September 1997.*

Date	Selenium Concentration (µg/L)		
	Delta Mendota Canal MP 110.12	Mendota Pool at Mowry Bridge	CCID Main Canal @ Head of San Luis Canal
10/2/96	<1	—	—
10/14/96		<2	—
11/13/96	<1	—	—
11/15/96	—	2.9	—
12/18/96	—	2.4	—
1/8/97	3	—	—
1/15/97	—	<2	<2
2/11/97	18	—	—
2/18/97	—	<2	—
3/12/97	13	—	—
3/13/97	—	<2	—
4/2/97	2	—	—
4/16/97	—	4	—
5/9/97	<2	—	—
5/15/97	—	4.8	—
6/13/97	<2	—	—
7/9/97	<2	—	—
7/11/97	—	2.2	4
8/14/97	<2	—	—
9/16/97	4	—	—

* = Data provided by Summers Engineering and the Central California Irrigation District based on internal monitoring and sampling conducted by the U.S. Bureau of Reclamation.

of concern. Electrical conductivities reached 4600 µmhos/cm while selenium concentrations peaked at 21.2 µg/L. The automated data confirms the peaks seen during the program's weekly grab samples (Figure 10). The diversion of the ponded water ceased on 28 March 1997. Additional periods of elevated concentrations also occurred between April and September 1997. These elevated concentrations corresponded to a period of very low flow in Camp 13 Slough. Little, if any supply water was being delivered and the majority of flow was from leaks in the gates separating the slough from the main supply canal and from major drains. Reports from the San Luis Delta Mendota Water Authority (SLDMWA, 1997) indicate that between 5 and 10 gpm will leak from the Main Drain into Camp 13 Slough through the closed gates.

Another potential selenium source to the internal wetland supply canals includes elevated concentrations in the Rice Drain, which receives drainage from lands in the eastern portion of the watershed, and the Almond Drive Drain, which receives drainage from lands in the western portion of the watershed. Although these drains were not monitored during Water Year 1997, historical data indicates that both drains have contained selenium concentrations in excess of 2.0 µg/L on many occasions (Figure 11). Sources of drainage into these water bodies needs to be determined.

Other factors such as elevated concentrations in groundwater seepage and in surface drainage may also impact the quality of water in the internal canals. Further review of all factors related to the elevated selenium levels in the internal canals within the Grassland Watershed and possible source flows, is necessary.

Concentrations of electrical conductivity, boron and selenium have all decreased dramatically in Salt Slough as compared to values recorded prior to the operation of the Grassland Bypass Project (Steensen et al., 1998). Concentrations of these three constituents in Salt Slough during Water Year 1997, are depicted in Figure 12. Electrical conductivity and boron remained below 2,000 µmhos/cm and 1.8 mg/L, respectively, throughout the water year. Selenium concentration remained below 2.0 µg/L except for one spike recorded in the first part of February 1997, during the flood event, when concentrations reached 3.4 µg/L.

Daily Composite Samples

Daily composite samples were collected at the discharge from the San Luis Drain. Some inconsistencies in the quality control samples for the discharge were noted for the time period of 10 through 21 January 1997. Although the information collected was graphed, the data were not used in the summary calculations presented in Tables 11 and 12. Daily electrical conductivity (EC), boron and selenium results are presented in Figure 13 along with grab sample data.

At the San Luis Drain discharge, EC and boron concentrations can vary widely on a daily basis. Daily EC values vary up to 1,000 µmhos/cm in a day, while boron concentrations vary up to 2 mg/L per day. Some seasonality is evident with concentrations peaking between February and April and tapering off from June through September. The results obtained from the grab and autosampler show similar means and medians of 4390 µmhos/cm and 4420 µmhos/cm, respectively for EC and 7.0 and 7.2 mg/l, respectively for boron (Tables 11 and 12).

Selenium showed greater seasonal fluctuations than EC or boron, with concentrations peaking in April at 116 µg/L and dropping off to 15.2 µg/L in September. Daily concentration fluctuations could also be high, with a 40 µg/L shift occurring between 2 and 3 October 1996. Although weekly grab samples appear to document the seasonal trends and shifting concentrations, they are unable to detect the potentially large changes in daily concentrations.

DISCUSSION

Comparison of Water Year 1996 with Water Year 1997

When the Grassland Bypass became operational at the end of September 1997, it effectively consolidated agricultural subsurface drainage from the DPA into a single channel for discharge into the

Figure 10. Corroboration of Grab Sample Data by Use of Automated Collection (Sigma) Sampler at Camp 13 Slough: Water Year 1997.

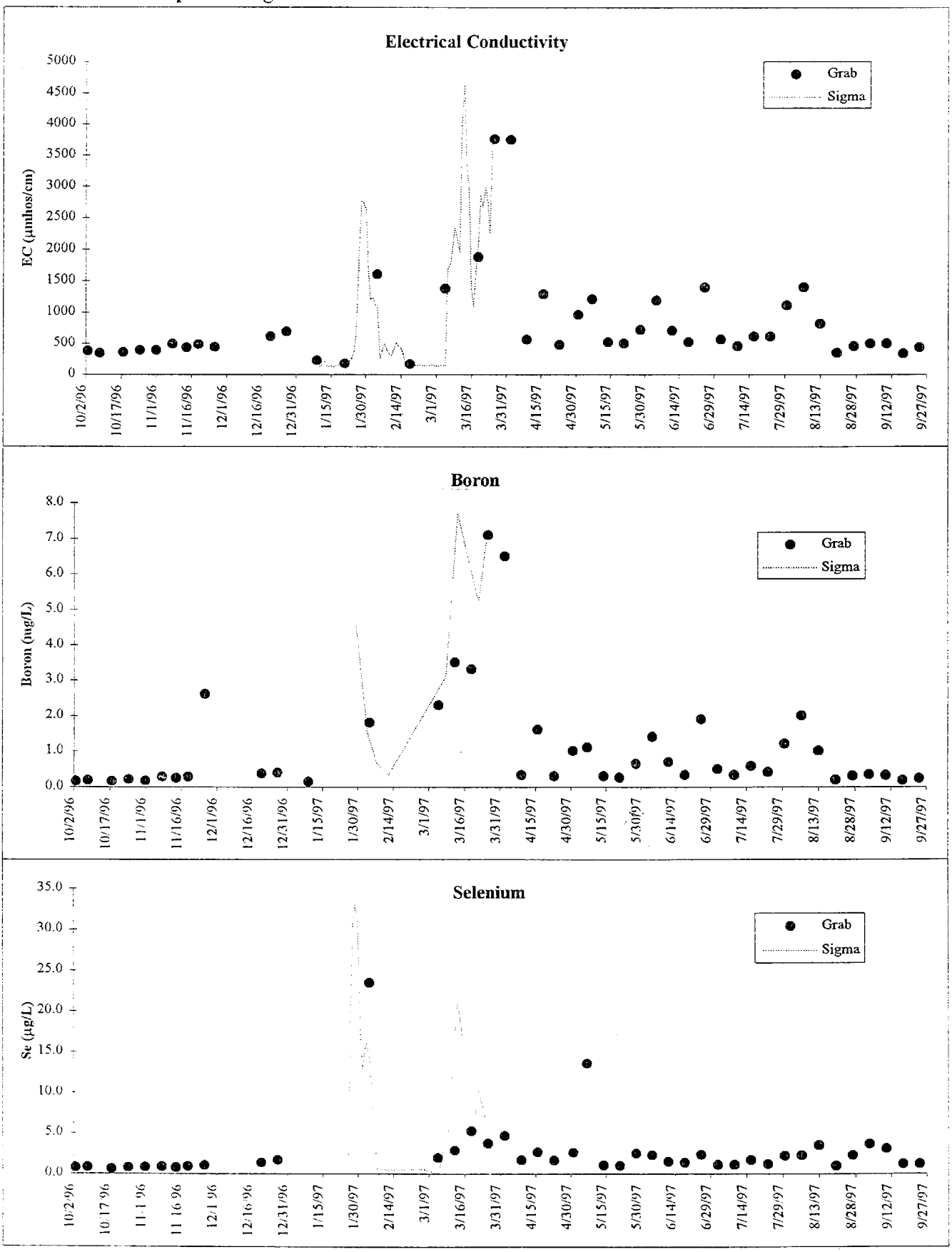
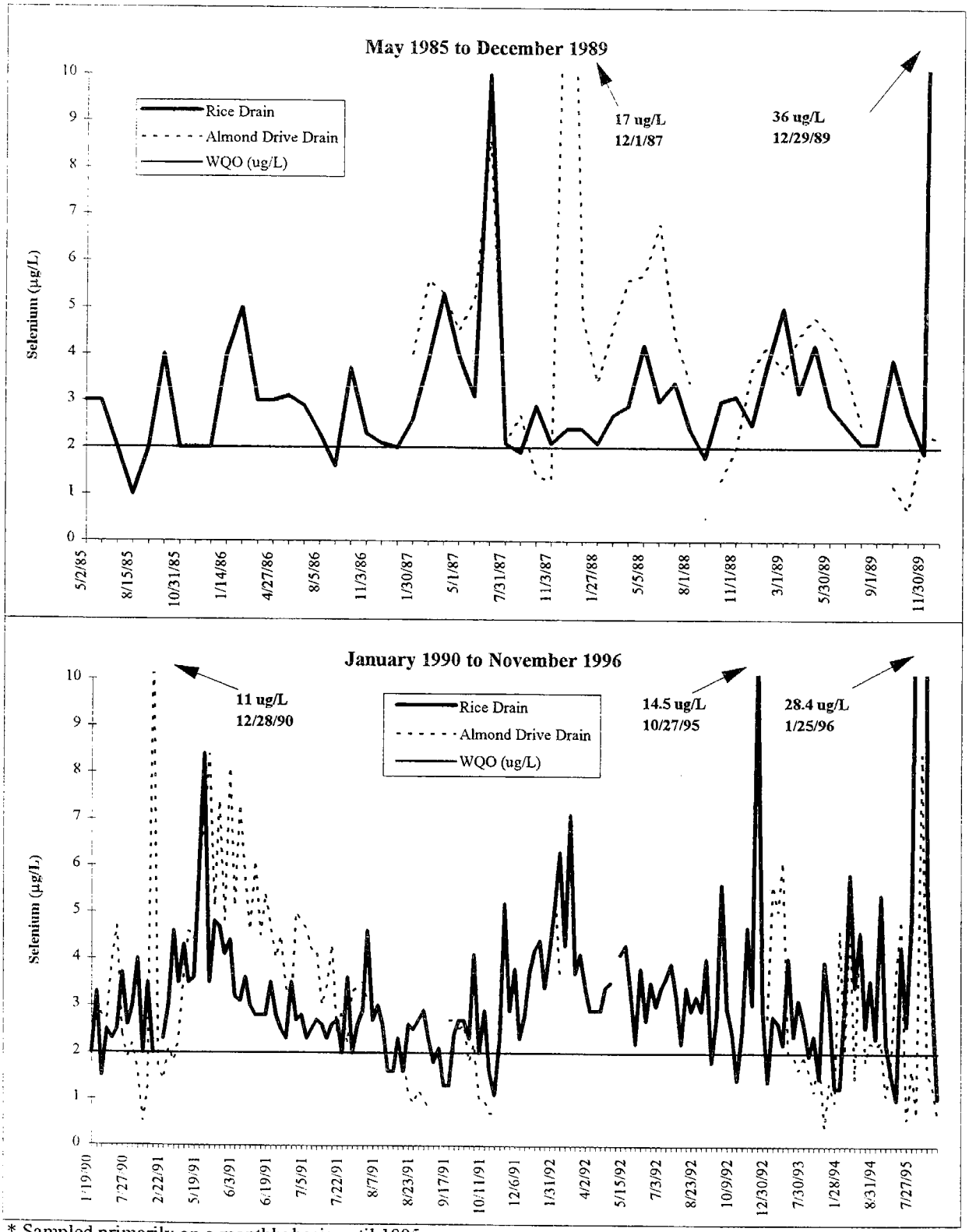


Figure 11. Selenium Concentrations in Almond Drive and Rice Drain: May 1985 to November 1996*



* Sampled primarily on a monthly basis until 1995
1991: special study (frequent sampling)
1995 and 1996: sampled quarterly

Figure 12. Electrical Conductivity, Boron and Selenium Concentrations in Salt Slough (Grab Data): Water Year 1997

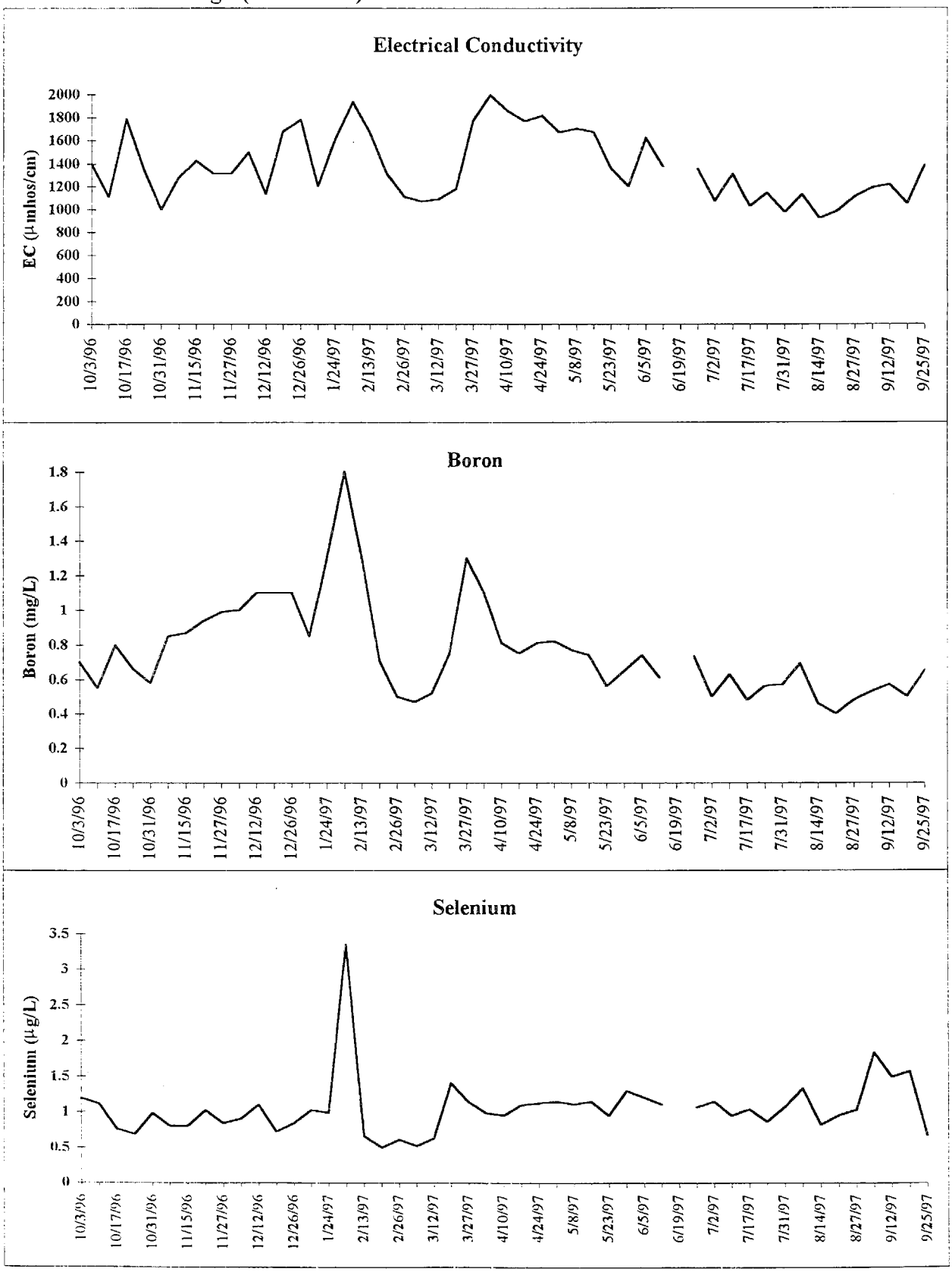
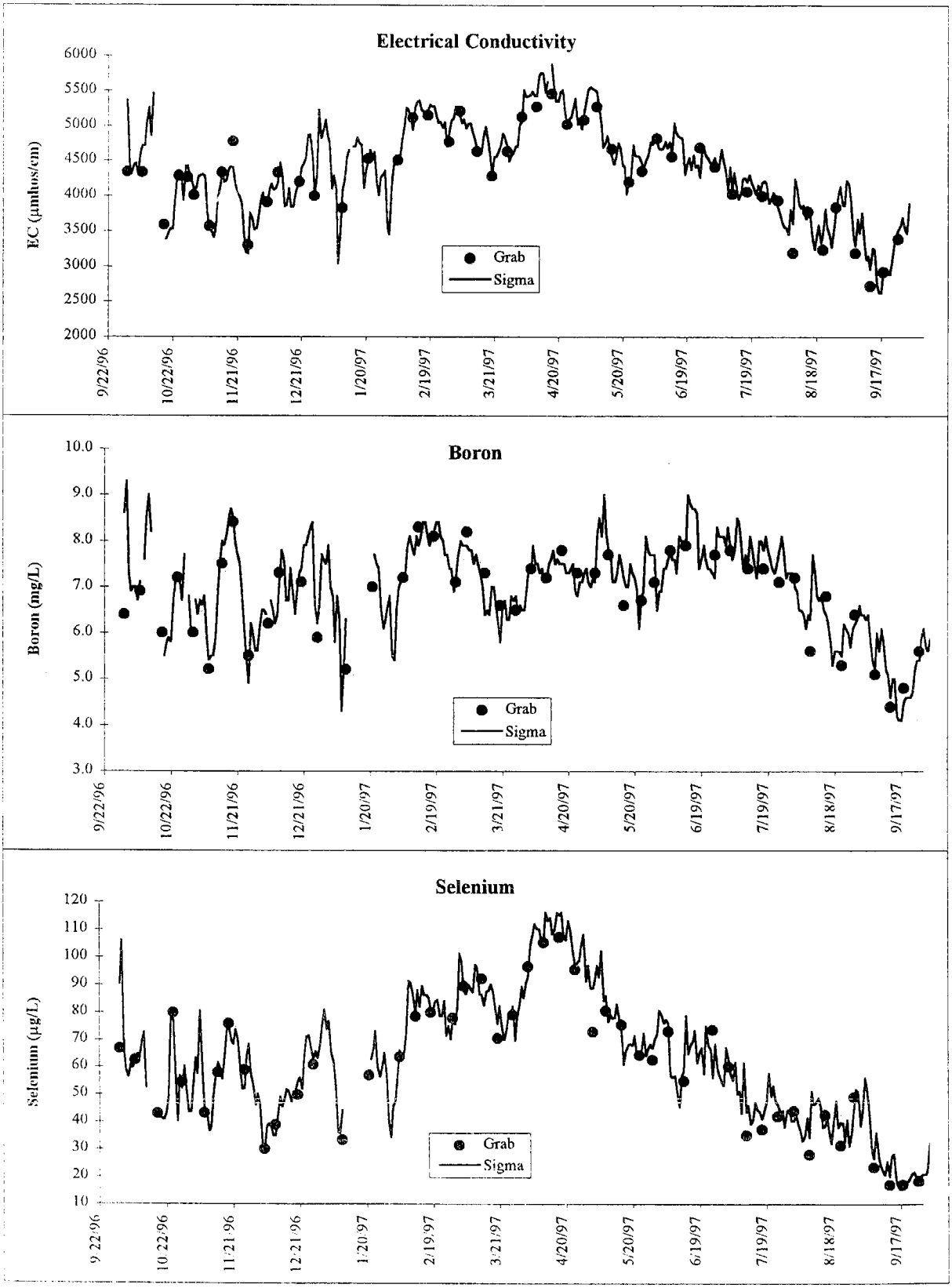


Figure 13. Comparison of Selenium, Boron and Electrical Conductivity at the San Luis Drain Using Grab Sample Data and Autosampler (Sigma) Data: Water Year 1997.



final nine miles of Mud Slough (north). This consolidation removed the subsurface drainage from approximately 90 miles of internal wetland water supply channels and from Salt Slough.

Figure 14 depicts the changes in EC, boron, and selenium concentrations in Mud Slough (north) and Salt Slough for the period prior to the Bypass (Water Year 1996) and the first year following the Bypass operation (Water Year 1997). Both EC and boron concentration declined in Salt Slough and increased in Mud Slough (north) once the Bypass began operation. The most dramatic change, however, occurred with selenium concentrations. Removing the agricultural subsurface drainage from Salt Slough, reduced the selenium concentration to below 2.0 µg/L during Water Year 1997 as opposed to a range of 1.0 to 33.5 µg/L during Water Year 1996. A corresponding increase was seen in Mud Slough (north) with selenium concentrations ranging from 5.0 to 79.6 µg/L during Water Year 1997. When subsurface agricultural drainage is present, the higher overall selenium concentrations observed in Mud Slough (north), as compared to Salt Slough, is due to limited dilution potential. Mud Slough (north) has a lower baseline flow and therefore provides less dilution for agricultural subsurface drainage than Salt Slough.

Concentrations in the wetland water supply channels was more variable. Overall concentrations in Camp 13 Slough and the Agatha Canal decreased dramatically after the Bypass began operation, however, a number of concentration spikes were apparent throughout Water Year 1997 (Figure 15). Potential reasons for the concentration spikes include elevated selenium levels in supply water, releases from the DPA (seepage and flood flows), inflows from other sources such as the Rice Drain and Almond Drive Drain, and other internal sources such as groundwater seepage and surface return flows. These potential sources were discussed in more detail in the section on wetland water supply channels and Salt Slough under the results for Water Year 1997.

Concentrations in the San Luis Canal and Santa Fe Canal do not appear to have changed, with similar values recorded both prior to and after Bypass operation (Figure 16). Most subsurface agricultural drainage was diverted out of these canals and into Salt Slough through the Porter-Blake Bypass, upstream of the sampling locations, during water year 1996. Only when subsurface agricultural drainage was diverted to Mud Slough (north) or continued downstream in the San Luis Canal to the City Ditch diversion to Salt Slough, would the drainage be measured in these canals at these sampling locations. By water year 1997, the majority of subsurface drainage had been consolidated into the Grassland Bypass and lower portion of the San Luis Drain, and did not reach the two canals except during flood flows.

Comparison to Applicable Water Quality Objectives

In October 1988, the Regional Board adopted water quality objectives for boron, molybdenum and selenium for Mud Slough (north), Salt Slough and water used to maintain wetland habitat. In May 1996, the Regional Board adopted revised selenium water quality objectives for the two sloughs and for wetland water supply channels, as well as a compliance time schedule for Mud Slough (north). Water quality objectives which applied during each water year are listed in Table 16. The selenium compliance time schedule which applies to Mud Slough (north), does not require full compliance with the selenium objective until 1 October 2010. No water quality objectives have been adopted for the San Luis Drain.

Tables 17 and 18 list the exceedances of boron and selenium water quality objectives, respectively, for both Water Year 1996 and 1997. All potential selenium exceedances have been shown, whether or not they may be subject to the compliance time schedule.

Boron

The boron water quality objective remained unchanged for both water years and only applied to two water bodies, Mud Slough (north) and Salt Slough. In addition, the objective (2.0 mg/L) is applied as a monthly mean for a set time period: 15 March through 15 September. A maximum objective of 5.8 mg/L boron applies year round.

Figure 14. **Comparison of Selenium, Boron and Electrical Conductivity at Salt Slough and Mud Slough (North) Downstream of the San Luis Drain: Water Years 1996 and 1997.**

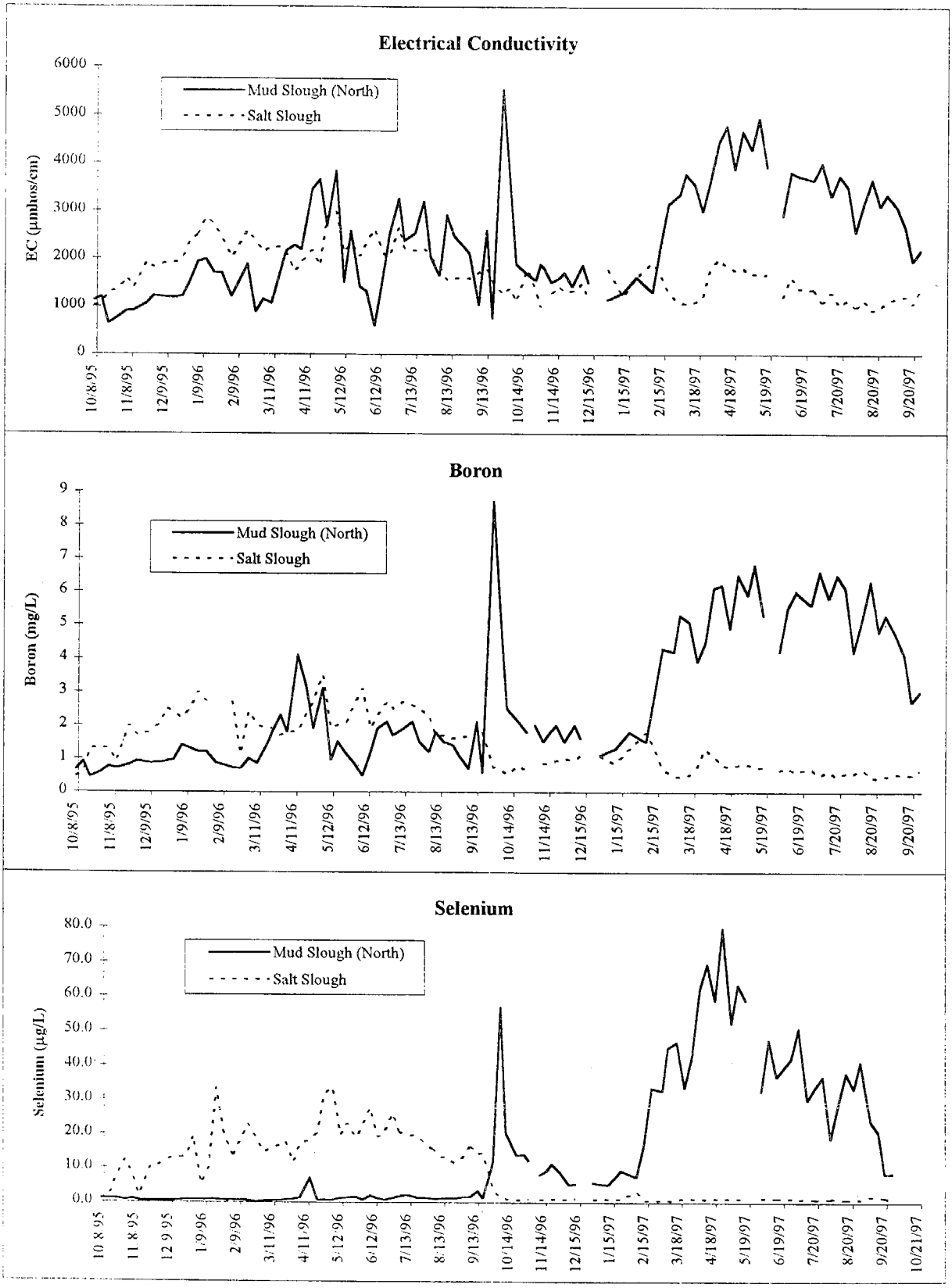


Figure 15. Comparison of Selenium, Boron and Electrical Conductivity at Agatha Canal and Camp 13 Slough: Water Years 1996 and 1997.

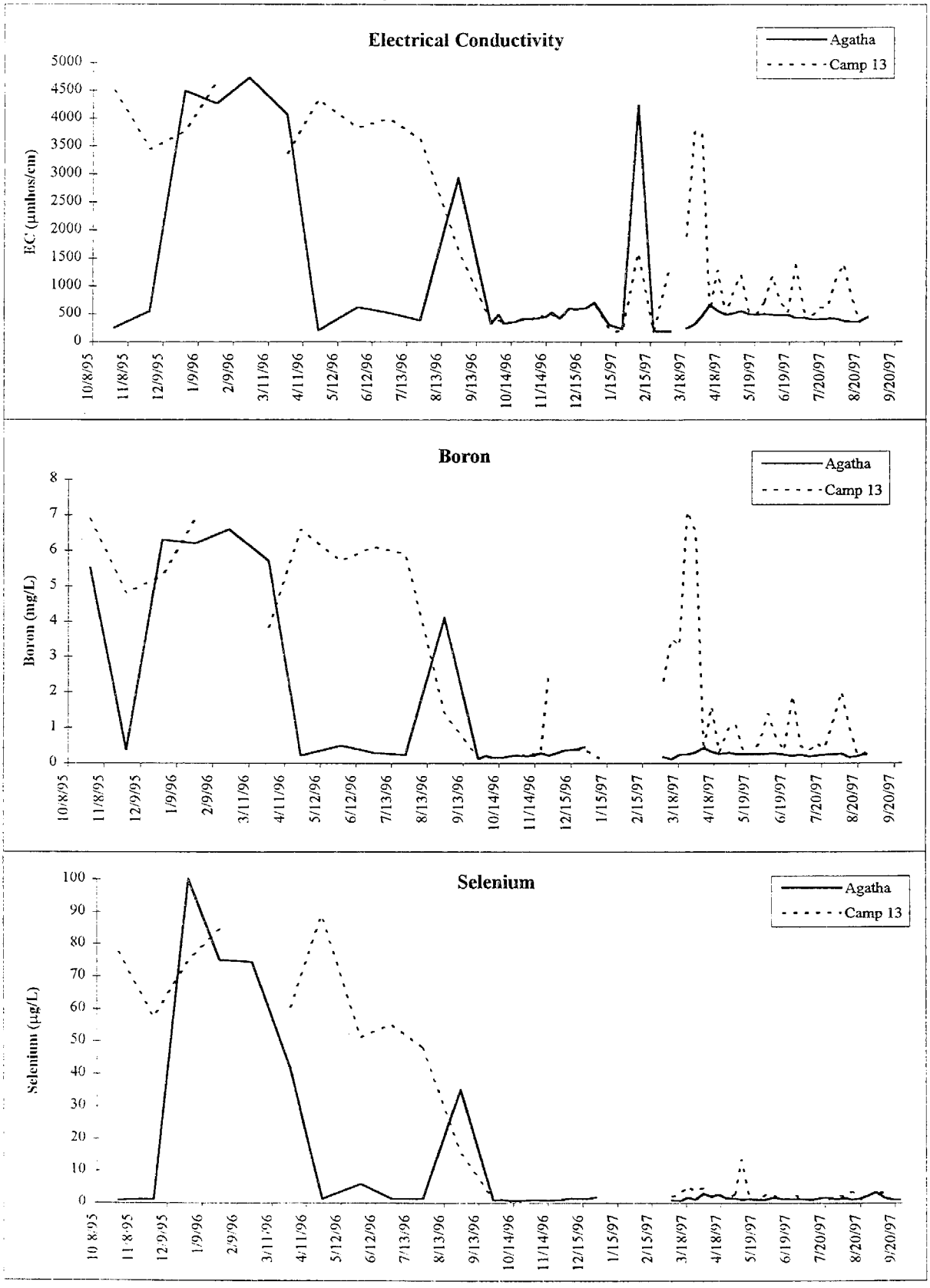


Figure 16. Comparison of Selenium, Boron and Electrical Conductivity at San Luis Canal and Santa Fe Canal at Henry Miller Road: Water Years 1996 and 1997.

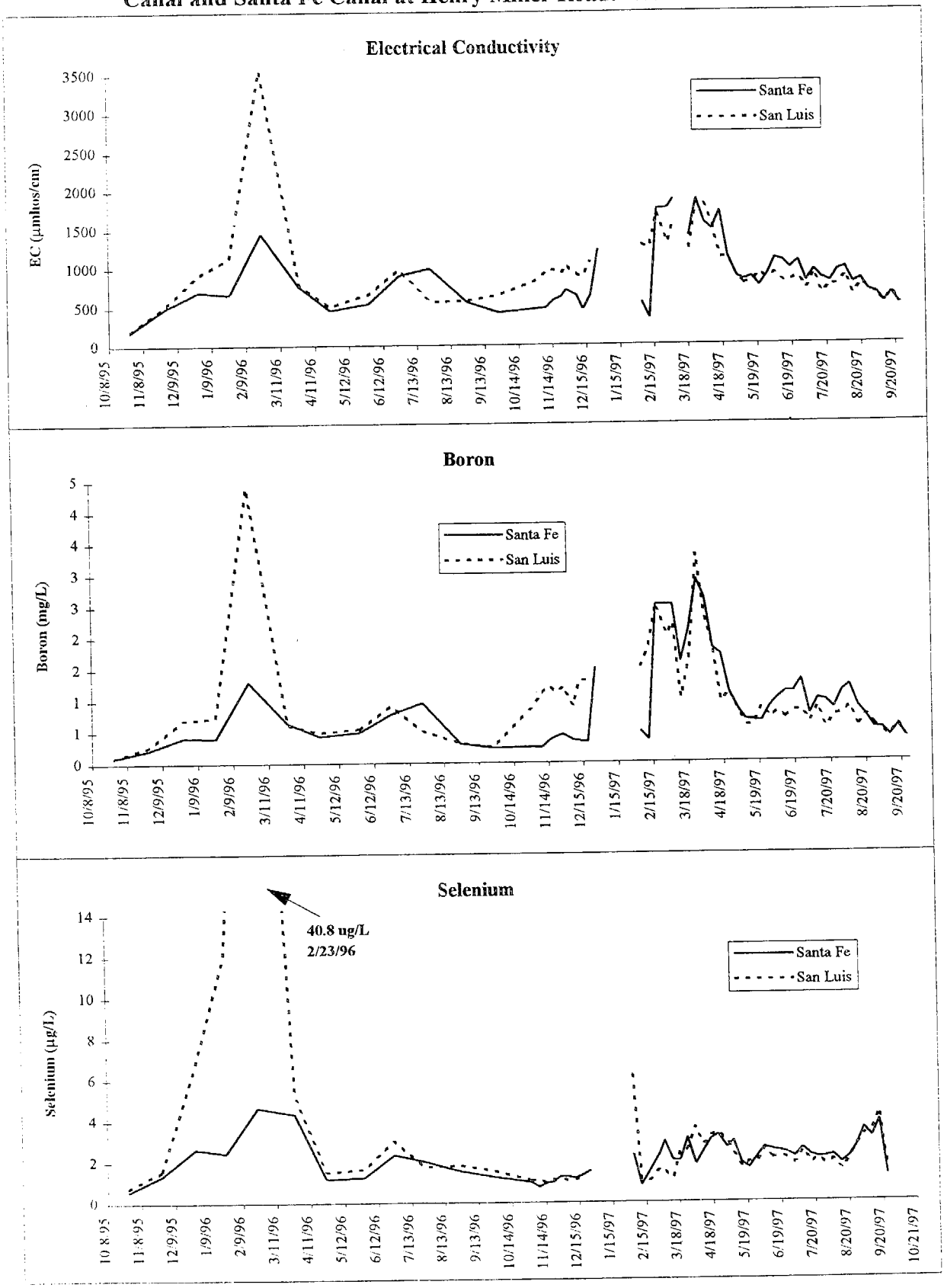


Table 16. Boron, Selenium and Molybdenum Water Quality Objectives for Water Bodies Within the Grassland Watershed. Water Years 1996 and 1997.

Water Body	Boron (mg/L)		Selenium (µg/L)		Molybdenum (µg/L)	
	Continuous	Maximum	Continuous	Maximum	Continuous	Maximum
Mud Slough (north)						
WY 1996	2.0 (monthly mean)†	5.8	10 (monthly mean)	26	19 (monthly mean)	50
WY 1997	2.0 (monthly mean)†	5.8	5 (4-day average)*	20	19 (monthly mean)	50
Salt Slough						
WY 1996	2.0 (monthly mean)†	5.8	10 (monthly mean)	26	19 (monthly mean)	50
WY 1997	2.0 (monthly mean)†	5.8	2 (monthly mean)	20	19 (monthly mean)	50
Wetland Water Supply Channels						
WY 1996	—	—	2 (monthly mean)††	—	—	—
WY 1997	—	—	2 (monthly mean)	20	—	—

† = The water quality objective only applies from 15 March through 15 September

* = Compliance time schedule adopted and in effect until October 2010

†† = as measured in water used for wetland habitat maintenance

Table 17. Boron Water Quality Objective Exceedances in the Grassland Watershed: Water Years 1996 and 1997.

Station ID	Description	Month												Monthly WQO
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Water Year 1996														
MER542	Mud Slough (N) downstream of the SLD	a	a	a	a	a								2.0
MER531	Salt Slough at Lander Ave.	a	a	a	a	a								2.0
MER542	Mud Slough (N) at SLD autosampler	a	a	a	a	a								2.0
MER531	Salt Slough at Lander Avenue autosampler	a	a	a	a	a								2.0
Water Year 1997														
MER536	Mud Slough (N) upstrm of the Drainage Discharge	a	a	a	a	a								2.0
MER542	Mud Slough (N) dwnstrm of the Drainage Discharge	a	a	a	a	a								2.0
MER531	Salt Slough at Lander Avenue	a	a	a	a	a								2.0

= water quality objective exceedance

a = objective only applies 15 March through 15 September
WQO = water quality objective in mg/L

Table 18. Selenium Water Quality Objective Exceedances in the Grassland Watershed: Water Years 1996 and 1997.

Station ID	Description	Month												Monthly WQO
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Water Year 1996														
MER505	Camp 13 Slough			b	b	b	b	b	b	b	b	b		2
MER506	Agatha Canal			b	b	b	b	b	b	b	b	b		2
MER543	San Luis Canal at Henry Miller Road			b	b	b	b	b	b	b	b	b		2
MER519	Santa Fe Canal at Henry Miller Road			b	b	b	b	b	b	b	b	b		2
MER551	Mud Slough (N) at Newman Gun Club													10
MER542	Mud Slough (N) at San Luis Drain													10
MER531	Salt Slough at Lander Avenue													10
MER542	Mud Slough (N) at SLD autosampler													10
MER531	Salt Slough at Lander Avenue autosampler													10
Water Year 1997														
MER505	Camp 13 Ditch				ND									2
MER506	Agatha Canal				ND	ND								2
MER543	San Luis Canal at Henry Miller Road	ND			ND									2
MER519	Santa Fe Canal at Henry Miller Road	ND			ND									2
MER551	Mud Slough (N) upstrm of the Drainage Discharge													5
MER542	Mud Slough (N) dwnstrm of the Drainage Discharge													5
MER531	Salt Slough at Lander Avenue													2

= water quality objective exceedance ND = no data available WQO = water quality objective in µg/L

b = the 2 ug/L objective only applied to wetland water supply so applied to wetland floodup (Sept. through Nov.)

Note that Table 17 is for discussion only as a compliance time schedule applies to the 5 µg/L 4-day average Se water quality objective Beginning WY97, the 2 ug/L objective applied to stations MER531, MER505, MER506, MER543, and MER519

Table 19. Monthly Molybdenum Concentrations and Water Quality Objective Exceedances in the Grassland Watershed: Water Years 1996 and 1997

Station ID	Description	Molybdenum Concentration (ug/L)												Monthly WQO
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Water Year 1996														
MER556	Main (Firebaugh) Drain at Russell Ave.	45	—	—	31	—	—	20	—	—	7	—	—	na
MER501	Panoche Drain at O'Banion Gauge Station	13	—	—	8	—	—	12	—	—	15	—	—	na
MER504	Hamburg Drain near Camp 13 Slough	7	—	—	7	—	—	5	—	—	4	—	—	na
MER502	Charleston Drain at CCID Main Canal	2	—	—	5	—	—	6	—	—	5	—	—	na
MER542	Mud Slough (N) downstream of the SLD	7	—	—	6	—	—	10	—	—	11	—	—	19
MER531	Salt Slough at Lander Ave.	6	—	—	9	—	—	9	—	—	10	—	—	19
Water Year 1997														
MER536	Mud Slough (N) upstrm of the Drainage Discharge	7	—	3	3	—	7	11	5	7	3	5	10	19
MER535	San Luis Drain at the Terminus	35	30	23	22	27	29	26	23	26	25	25	35	na
MER542	Mud Slough (N) dwnstrm of the Drainage Discharge	11	8	3	6	***19***	17	***24***	17	***21***	16	***23***	***20***	19
MER531	Salt Slough at Lander Avenue	4	4	7	7	7	7	10	6	9	5	5	9	19

= water quality objective exceedance — = no data available na = no water quality objective (WQO) for this site

During Water Year 1996, the mean monthly boron water quality objective was exceeded during April and September in Mud Slough (north) based on weekly grab samples. However, when evaluated using 4-day composite data for the same site, monthly mean boron concentrations remained below the 2.0 mg/L objective. In contrast, the boron objective was exceeded continuously from April through July in Salt Slough, based on the weekly grab samples. Review of the 4-day composite information indicates that the objective was also exceeded in March 1996, but concentrations fell just below 2.0 mg/L in April. Maximum boron concentrations remained below 5.8 mg/L in both sloughs.

During Water Year 1997, the mean monthly boron objective was exceeded in Mud Slough (north) both upstream and downstream of the San Luis Drain discharge. The exceedances upstream of the discharge may be due to a number of factors including localized elevated levels in groundwater seepage, releases from wetlands, and other surface drainage. Exceedances in the slough downstream of the discharge increased substantially over both background and previous year concentrations, with exceedances during each month that the water quality objective applied. Maximum boron concentrations in Mud Slough (north) downstream of the San Luis Drain discharge exceeded 5.8 mg/L on nine separate occasions between April and August 1997. Only one mean monthly boron exceedance was recorded in Salt Slough which may reflect the diversion of subsurface agricultural drainage out of that water body. This exceedance was related to the storm event previously discussed. All measured concentrations in Salt Slough remained below 5.8 mg/L during Water Year 1997.

Selenium

Selenium water quality objectives for water bodies within the Grassland Watershed changed between water years 1996 and 1997 with the adoption of the 1996 Basin Plan Amendment. During Water Year 1996, a 10 µg/L monthly mean selenium objective applied to both Mud Slough (north) and Salt Slough, while a 2 µg/L objective applied to water which was used to maintain wetland habitat. The new objectives, which were adopted in May 1996 and went into effect during Water Year 1997, included a 2 µg/L monthly mean selenium objective for all wetland water supply channels (not just the supply water) and Salt Slough. A 5 µg/L, 4-day average objective was adopted for Mud Slough (north) along with a compliance time schedule which requires that the objective be met by 1 October 2010.

During Water Year 1996, the 2 µg/L selenium objective applied primarily from September through November, the normal period of wetland floodup. Of the supply waters sampled, only Camp 13 exceeded the 2 µg/L objective. The exceedances occurred during October and November and were likely due to the use of the channel to convey subsurface agricultural drainage through the Grassland Watershed. Most of the subsurface drainage was routed to Salt Slough during Water Year 1996, which resulted in continuous exceedances of the 10 µg/L selenium objective in that water body from December through September. Available 4-day composite data for Salt Slough confirmed the exceedances. In contrast, Mud Slough (north) remained below the 10 µg/L selenium objective throughout Water Year 1996.

During Water Year 1997, the 2.0 µg/L monthly mean selenium water quality objective was exceeded repeatedly in the supply channels (Camp 13, Agatha, San Luis Canal and Santa Fe Canal), but not in Salt Slough. As discussed earlier, a number of factors may have led to these exceedances and each must be further evaluated to determine a means of meeting the water quality objective.

Although subject to the adopted compliance time schedule, Mud Slough (north) was evaluated against the 5 µg/L, 4-day average selenium water quality objective. Mud Slough (north) downstream of the San Luis Drain Discharge continuously exceeded the objective in Water Year 1997, while there were no exceedances upstream of the discharge.

Molybdenum

Molybdenum analyses in water bodies within the Grassland Watershed were restricted to quarterly analyses in selected drains, Mud Slough (north) and Salt Slough during Water Year 1996. During Water Year 1997, molybdenum monitoring was focused on sites which would likely be influenced by the Grassland Bypass Project and included monthly analyses in Mud Slough (north) upstream and

downstream of the San Luis Drain discharge, the San Luis Drain itself, and Salt Slough. Available data is presented in Table 19.

During Water Year 1996, the monthly mean molybdenum objective (19 µg/L) only applied to Mud Slough (north) and Salt Slough, and was not exceeded based on limited, quarterly grab samples. Although the objective did not apply to upstream water bodies, information collected from the four major discharge points for the Drainage Project Area indicated elevated molybdenum concentrations in the Main (Firebaugh) Drain.

During Water Year 1997, molybdenum concentrations in Mud Slough (north) upstream of the San Luis Drain discharge and in Salt Slough resembled those recorded in Water Year 1996 and did not exceed the 19 µg/L objective. While no objective applied to the drain itself, molybdenum concentrations in the discharge were elevated, ranging from 22 µg/L to 35 µg/L. This discharge did impact the water quality in the downstream segment of Mud Slough (north), elevating molybdenum concentrations over background (upstream) concentrations. The 19 µg/L molybdenum objective was exceeded on five separate occasions at the downstream location: in February, April, June, August and September.

LOADS OF SALT, BORON AND SELENIUM

Salt, boron, and selenium loads for the Drainage Project Area (DPA), Grassland Bypass Project (GBP), and the Grassland Watershed were estimated based upon the flow weighted monthly average of the available water quality data. In Water Year 1997, loads that previously had to be summed for individual sites in the DPA were consolidated into the San Luis Drain as part of the GBP. Discharge and loads from the DPA for Water Year 1997 are therefore based on discharge and loads from the GBP. Discharge data for the DPA obtained for the individual water districts was provided by Joe McGahan (personal communication). Discharge and electrical conductivity data for the Grassland Bypass Project was obtained from the USBR (Nigel Quinn, personal communication). Preliminary daily discharge data and daily electrical conductivity for the two Grassland Watershed outflow sites, Mud Slough (north) and Salt Slough, were obtained from the USGS (Pat Shiffer, personal communication). Salt loads for the GBP and the Grassland Watershed sites are based upon daily electrical conductivity and flow measurements. Salt loads for the DPA are based upon laboratory measurement of electrical conductivity for grab samples and automatic Sigma^{tm} samples collected by Regional Board staff. Boron and selenium loads are also based upon combined grab and automatic Sigma^{tm} automatic sample data for the DPA and GBP sites. Only grab samples were collected and used for the Grassland Watershed sites, during Water Year 1997. The methodology used to calculate loads can be found in Grober et al., 1998. Raw data used to present loads have been tabulated and are available in hard copy from the Regional Board's Sacramento office. This information can also be found at the Regional Board web site. Follow the links to view or download files from:

http://www.swrcb.ca.gov/ ~rwqcb5/home.html

The tabulated flow and water quality data used to compute loads for Water Years 1986 through 1997 are presented chronologically. Each year of data is comprised of four data tables; the first table contains mean daily flow data; the second, third and fourth contain electrical conductivity (EC), boron and selenium data, respectively. Additionally, EC, boron, and selenium data are presented for five Sigma^{TM} automatic sampler sites for Water Years 1995, 1996 and 1997. Matrices are sparsely filled for some water quality data.

For Water Year 1996, mean daily flow data is available for Panoche Drain and Firebaugh Main Drain. Only mean monthly flow data is available for Pacheco Drain, Charleston Drain, and CCID diversions. Full matrices of mean daily flows for these sites are based on mean monthly flow estimates (Summers Engineering, Inc., 1996). Flow data for the Grassland Bypass Project for Water Year 1997 was obtained from the USBR (Nigel Quinn, personal communication). Mean daily flow for Mud Slough (north), and Salt Slough for Water Years 1996 and 1997 were obtained from the United States Geological Survey (Pat Shiffer, personal communication, 1997).

EC data for drains in the DPA are based on water quality samples collected by the Regional Board and by districts in the DPA. Mean daily EC data for the GBP was obtained from continuous EC recorders maintained by the USBR (Nigel Quinn, personal communication). EC data for Mud Slough (north), and Salt Slough are mean daily values obtained from continuous EC recorders maintained by the USGS (Pat Shiffer, personal communication, 1997). Consolidated boron and selenium concentration data presented here are from samples collected and analyzed by the Regional Board.

Monthly discharge and monthly flow weighted average concentrations and loads for the DPA were calculated for Water Year 1996 and 1997 (Table 20). High rainfall in January and early February 1997 (see Figure 2), led to rates of surface runoff in the DPA that exceeded the capacity of the GBP channels. Excess flows from the DPA were discharged to wetland channels in the Grassland Watershed during these flood events. Table 20 does not include flows and loads discharged to wetland channels. Daily flows, electrical conductivities, and selenium concentrations in two major wetland water supply channels from 21 January to 10 February 1997 (the period associated with the flood flows), are listed in Appendix D. Total selenium load to these channels during this time period was 137 pounds (USBR et al., 1997).

Monthly discharge and monthly flow weighted average concentrations and loads for 1996 and 1997 for the Grassland Watershed are based on the combined discharge and loads for Mud Slough (north) and Salt Slough (Table 21). Annual discharge from the DPA dropped 30 percent from approximately 53,000 acre-feet in 1996 to approximately 37,500 acre-feet in 1997. Annual salt load for the DPA also dropped 30 percent from just under 200,000 tons in 1996 to 140,000 tons in 1997. Boron loads were practically identical for both years at just over 700,000 pounds. Selenium loads from the DPA dropped 30 percent from approximately 10,000 pounds in Water Year 1996, to under 7,000 pounds in Water Year 1997.

Annual discharge in the Grassland Watershed was similar in both years, increasing slightly from approximately 270,000 acre-feet in 1996 to approximately 290,000 acre-feet in 1997. Annual salt load for the Grassland Watershed was similar for both years, dropping from just over 475,000 tons to just under 450,000 tons, while boron loads increased from approximately 1.3 million pounds to 1.4 million pounds between 1996 and 1997. Selenium loads dropped almost 20 percent, from 9,500 pounds in 1996 to 7,700 pounds in 1997. Although the DPA contributes large quantities of salt and boron, it is not the only source of these constituents in the basin. The DPA is, however, the primary source of selenium in the Grassland Watershed. A higher selenium load was in fact calculated for the DPA than the Grassland Watershed in Water Year 1996. This discrepancy may be due to losses in the system or an overestimate of loads from the DPA or underestimates for the Grassland Watershed. For a full discussion of possible calculation errors or system losses see Grober et al, 1998. In 1997, the DPA accounted for 90 percent of the selenium load in the Grassland Watershed.

Monthly loads of salt for the DPA and Grassland Watershed are shown in Figure 17. Figures 18 and 19 show the monthly loads of boron and selenium, respectively. The overall pattern of loading for each area was similar in Water Years 1996 to 1997. Monthly salt loads from the DPA were higher in 1996 than 1997 for all months except January. Similarly, salt loads were also higher for the February through September period of 1996 than 1997 in the Grassland Watershed. Salt loads in the Grassland Watershed were higher during the October through January period of 1997 than 1996, particularly in January. This January peak in salt loads in the Grassland Watershed is attributable to extremely high flood flows. January to May boron loads from the GBP were slightly higher in 1997 than 1996. From June through September, boron loads were slightly lower in 1997. A similar trend is evident downstream for the Grassland Watershed, although boron loads were slightly higher in the October to December period of 1997. Once again there was markedly higher boron loading during the extremely wet January of 1997 when compared to 1996. Selenium loads from the DPA were higher for all months of 1996 than 1997 except for April. Selenium loads in the Grassland Watershed were also higher for all months of 1996 than 1997 except for October, January, April, and May.

Figure 20 shows the annual discharge for the combined Grassland Watershed outflow sites, Mud Slough (north) and Salt Slough, and for the DPA, for Water Years 1985 through 1997. Figures 21 through 23 depict the annual salt, boron, and selenium loads from the two areas for the same time

Table 20. **Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for the Drainage Project Area: Water Years 1996 and 1997.**

Water Year 1996 Month	Flow (af)	Loads			Flow Weighted Conc.		
		Se (lbs)	B (1000 lbs)	TDS (tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-95	1,911	313	27	6,346	60.2	5.12	2,442
Nov-95	2,192	324	29	7,017	54.3	4.87	2,354
Dec-95	2,586	578	35	9,053	82.2	4.98	2,575
Jan-96	2,647	687	44	11,148	95.4	6.10	3,097
Feb-96	5,664	1,247	78	25,872	80.9	5.09	3,359
Mar-96	4,620	1,324	67	21,107	105.4	5.32	3,359
Apr-96	4,641	1,243	73	19,431	98.5	5.81	3,079
May-96	5,626	1,145	76	22,050	74.8	4.98	2,882
Jun-96	6,825	977	89	23,387	52.6	4.78	2,520
Jul-96	6,671	992	90	23,147	54.7	4.96	2,551
Aug-96	6,339	747	74	18,758	43.3	4.32	2,176
Sep-96	3,255	459	41	10,210	51.8	4.63	2,307
WY 96 Total	52,978	10,034	723	197,526	69.6	5.02	2,742

Water Year 1997 Month	Flow (af)	Loads			Flow Weighted Conc.		
		Se (lbs)	B (1000 lbs)	TDS (tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-96	1,276	202	25	4,247	58.3	7.10	2,448
Nov-96	1,569	252	29	5,066	59.0	6.73	2,375
Dec-96	1,946	285	38	6,718	53.9	7.18	2,539
Jan-97 *	3,702	599	65	12,926	59.5	6.47	2,568
Feb-97 *	4,172	878	89	17,139	77.3	7.80	3,021
Mar-97	4,875	1,119	93	19,191	84.4	6.98	2,895
Apr-97	4,452	1,280	89	18,886	105.7	7.35	3,120
May-97	4,214	849	85	16,804	74.1	7.39	2,932
Jun-97	3,457	611	74	13,529	65.0	7.85	2,878
Jul-97	3,276	428	69	11,619	48.0	7.71	2,608
Aug-97	3,158	348	54	9,807	40.5	6.30	2,283
Sep-97	1,444	109	21	4,132	27.7	5.33	2,103
WY 97 Total	37,541	6,959	729	140,063	68.2	7.14	2,744

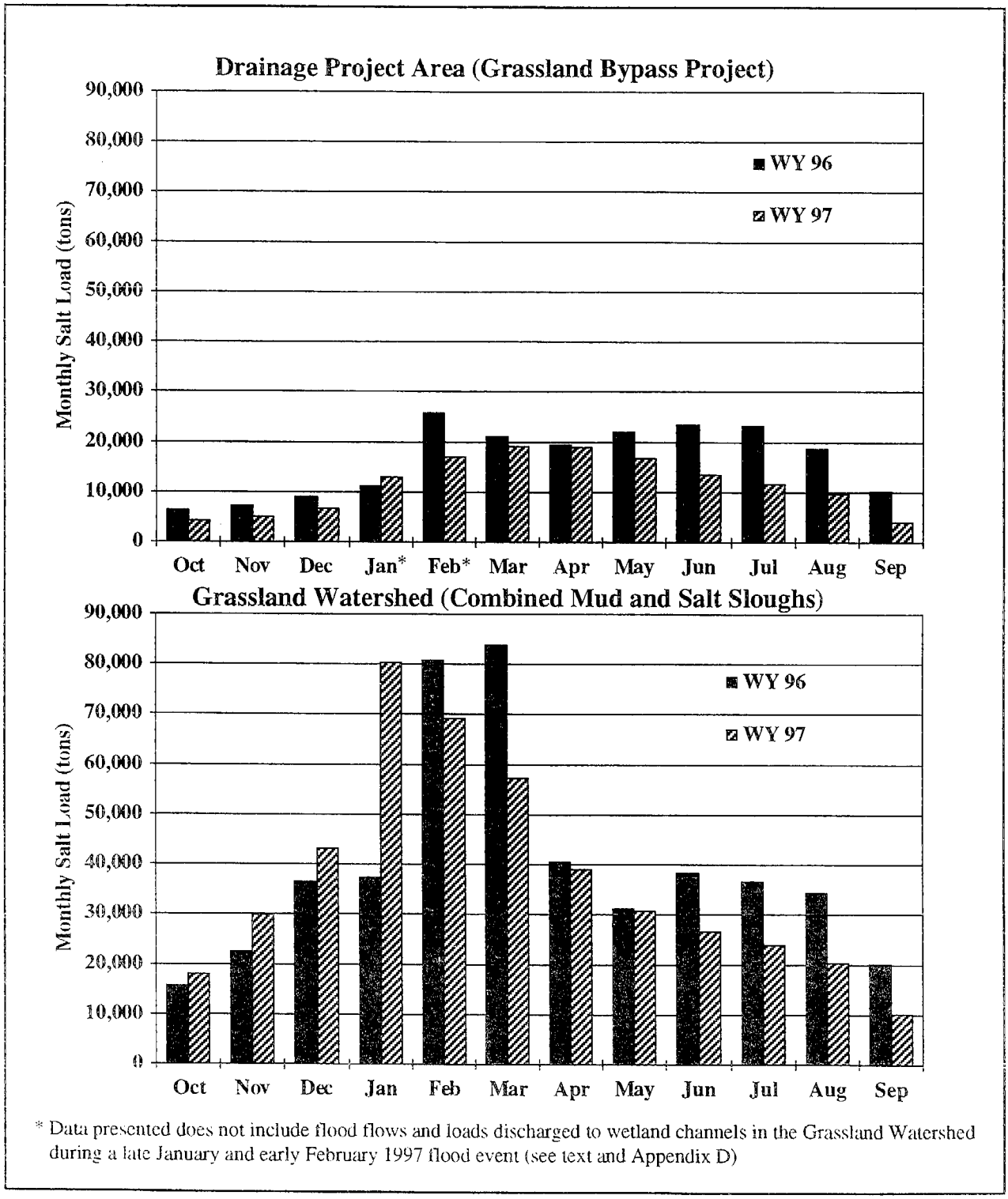
* Data presented does not include flood flows and loads discharged to wetland channels in the Grassland Watershed during a late January and early February 1997 flood event (see text and Appendix D)

Table 21. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for the Grassland Watershed: Water Years 1996 and 1997.

Water Year 1996 Month	Flow (af)	Loads			Flow Weighted Conc.		
		Se (lbs)	B (1000 lbs)	TDS (tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-95	13821	248	40	15696	6.6	1.05	835
Nov-95	15894	319	56	22450	7.4	1.30	1039
Dec-95	22033	538	94	36391	9.0	1.56	1215
Jan-96	17621	625	97	37333	13.0	2.03	1558
Feb-96	47067	1466	210	80753	11.5	1.64	1262
Mar-96	43499	1451	215	83854	12.3	1.81	1418
Apr-96	19991	911	109	40429	16.7	2.00	1487
May-96	17007	851	88	31194	18.4	1.91	1349
Jun-96	17365	906	109	38354	19.2	2.30	1624
Jul-96	18650	956	123	36708	18.8	2.42	1447
Aug-96	21074	749	94	34444	13.1	1.65	1202
Sep-96	13927	470	66	20120	12.4	1.74	1062
WY 96 Total	267948	9491	1299	477725	13.0	1.78	1311

Water Year 1997 Month	Flow (af)	Loads			Flow Weighted Conc.		
		Se (lbs)	B (1000 lbs)	TDS (tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-96	13566	279	52	18084	7.6	1.42	980
Nov-96	23296	302	82	29742	4.8	1.30	939
Dec-96	31885	355	112	43003	4.1	1.30	992
Jan-97	59661	833	214	80247	5.1	1.32	989
Feb-97	40336	1055	211	69194	9.6	1.92	1261
Mar-97	32632	1169	180	57205	13.2	2.03	1289
Apr-97	15999	1205	126	39133	27.7	2.91	1799
May-97	16225	859	110	30740	19.5	2.49	1393
Jun-97	14030	586	93	26449	15.4	2.44	1386
Jul-97	15410	504	99	23926	12.0	2.37	1142
Aug-97	16021	437	80	20405	10.0	1.83	937
Sep-97	9193	138	35	10219	5.5	1.41	817
WY 97 Total	288253	7722	1396	448347	9.8	1.78	1144

Figure 17. **Monthly Salt Loads Discharged from the Drainage Project Area and the Grassland Watershed, Water Years 1996 and 1997**



* Data presented does not include flood flows and loads discharged to wetland channels in the Grassland Watershed during a late January and early February 1997 flood event (see text and Appendix D)

Figure 18. Monthly Boron Loads Discharged from the Drainage Project Area and the Grassland Watershed, Water Years 1996 and 1997

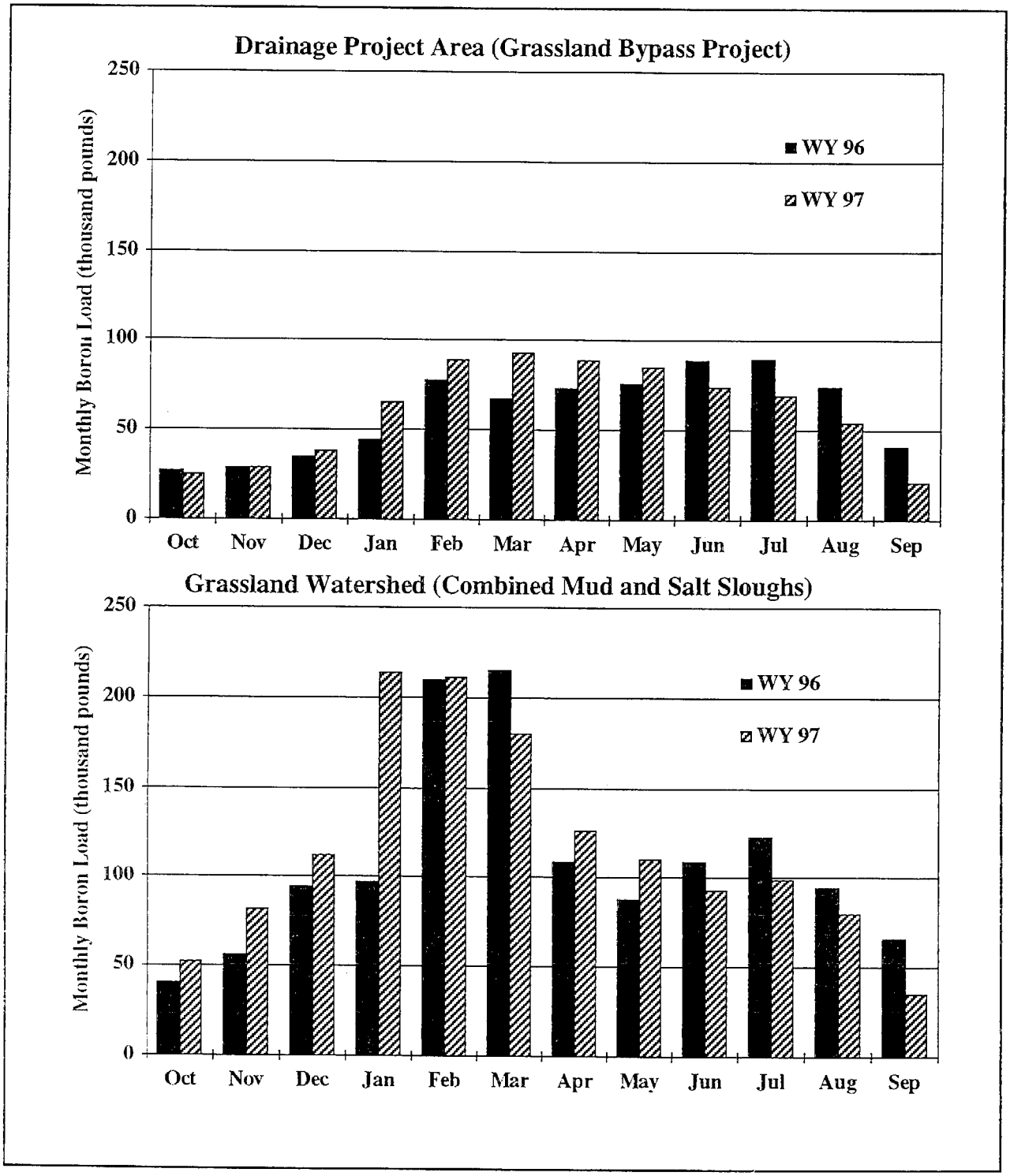


Figure 19. Monthly Selenium Loads Discharged from the Drainage Project Area and the Grassland Watershed, Water Years 1996 and 1997

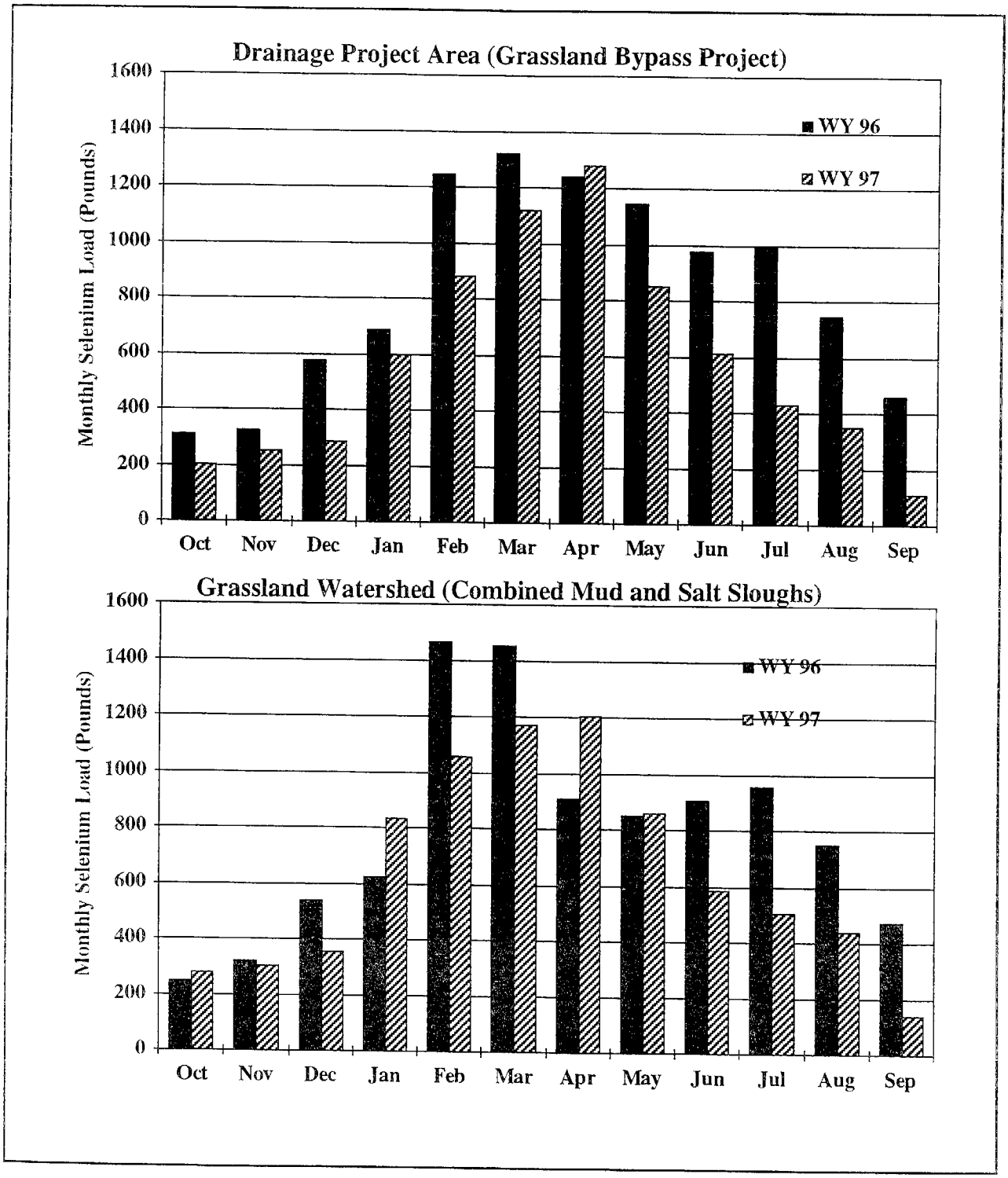


Figure 20. Annual Discharge from the Drainage Project Area and the Grassland Watershed, Water Years 1986 through 1997

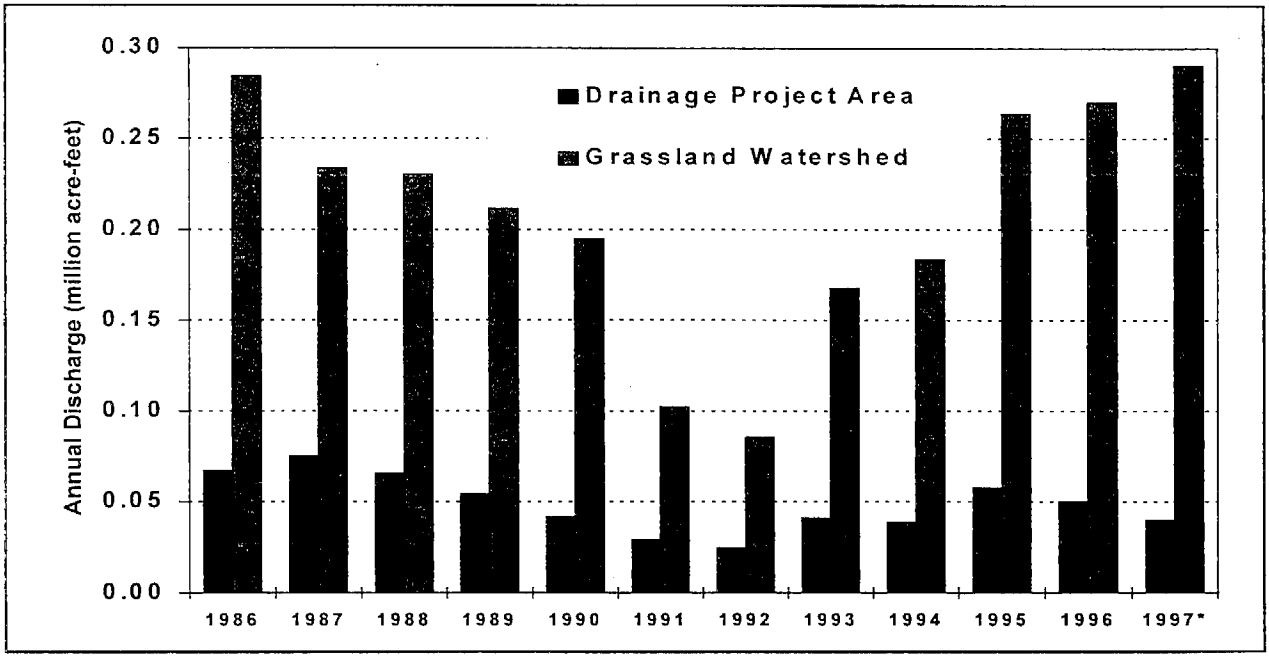


Figure 21. Annual Salt Load from the Drainage Project Area and the Grassland Watershed, Water Years 1986 through 1997

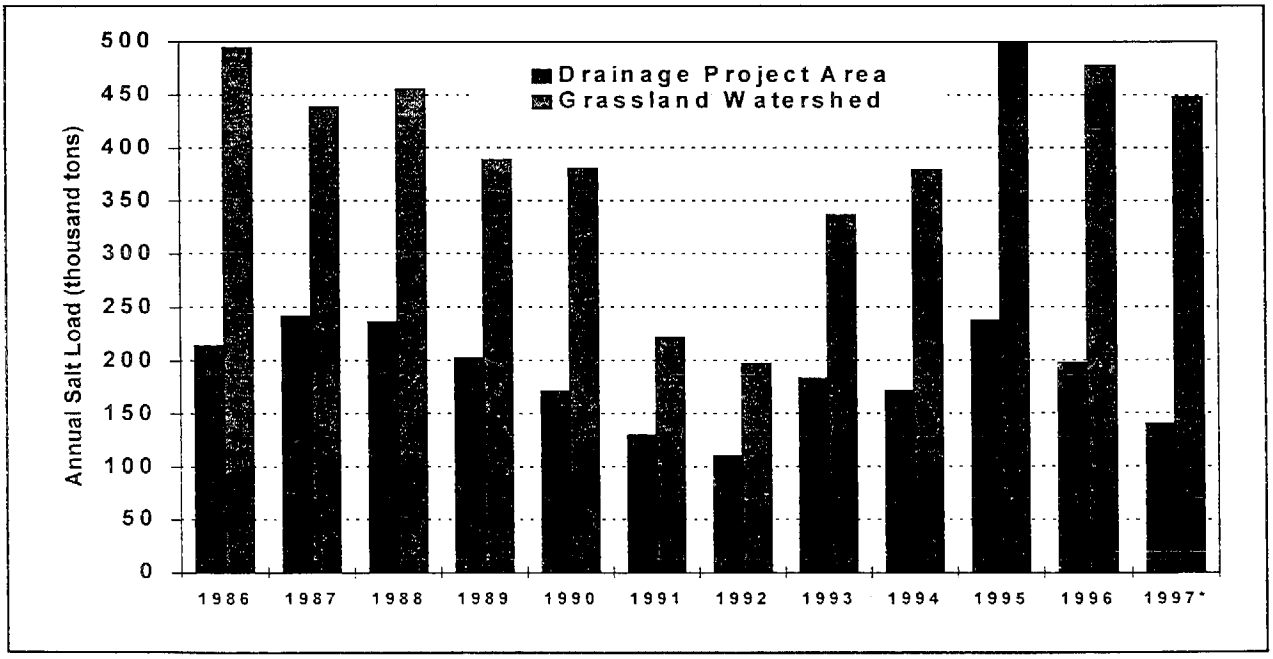


Figure 22. Annual Boron Load from the Drainage Project Area and the Grassland Watershed, Water Years 1986 through 1997

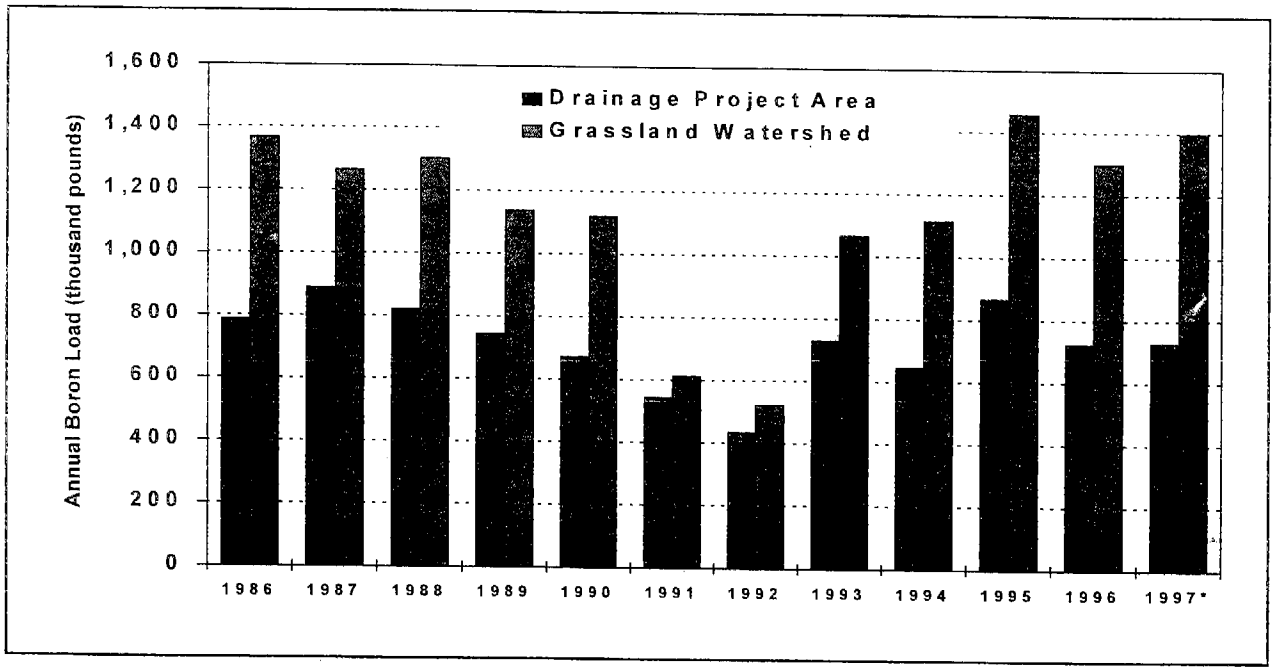
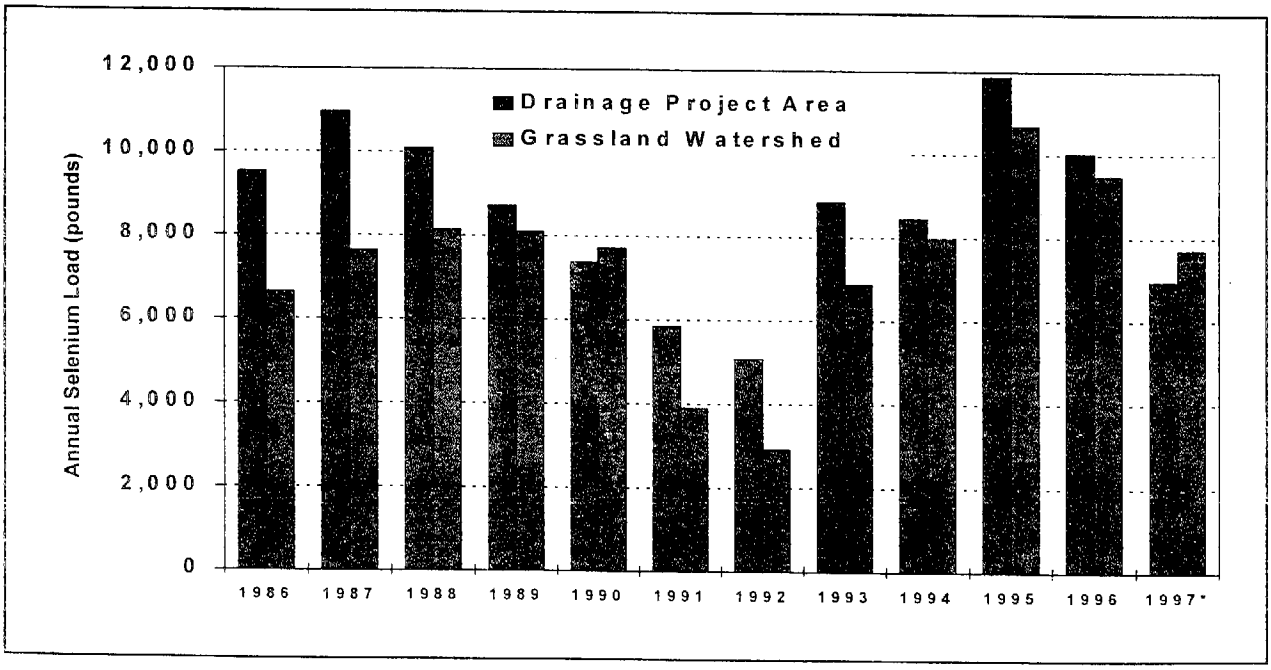


Figure 23. Annual Selenium Load from the Drainage Project Area and the Grassland Watershed, Water Years 1986 through 1997



period. Discharge for the DPA and Grassland Watershed for Water Years 1996 and 1997 was similar to Water Year 1995, another wet year, but significantly higher than 1991 through 1994. Water Year 1995 was the first wet year following several dry and critically dry years. High loads of all constituents in 1995 likely resulted from the leaching of salts that had accumulated in the basin during previous years. Generally lower loads of all constituents in 1996 and 1997 were likely due to lower residual salt loads in the Grassland Watershed following a series of wet years. Markedly lower selenium loads from the DPA are also attributable to district recycling and other water conservation and drainage reduction methods that were initiated in 1997 to reduce selenium loads as part of the Grassland Bypass Project.

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APPENDIX A

Water Quality Data for Grab Samples: Water Year 1996

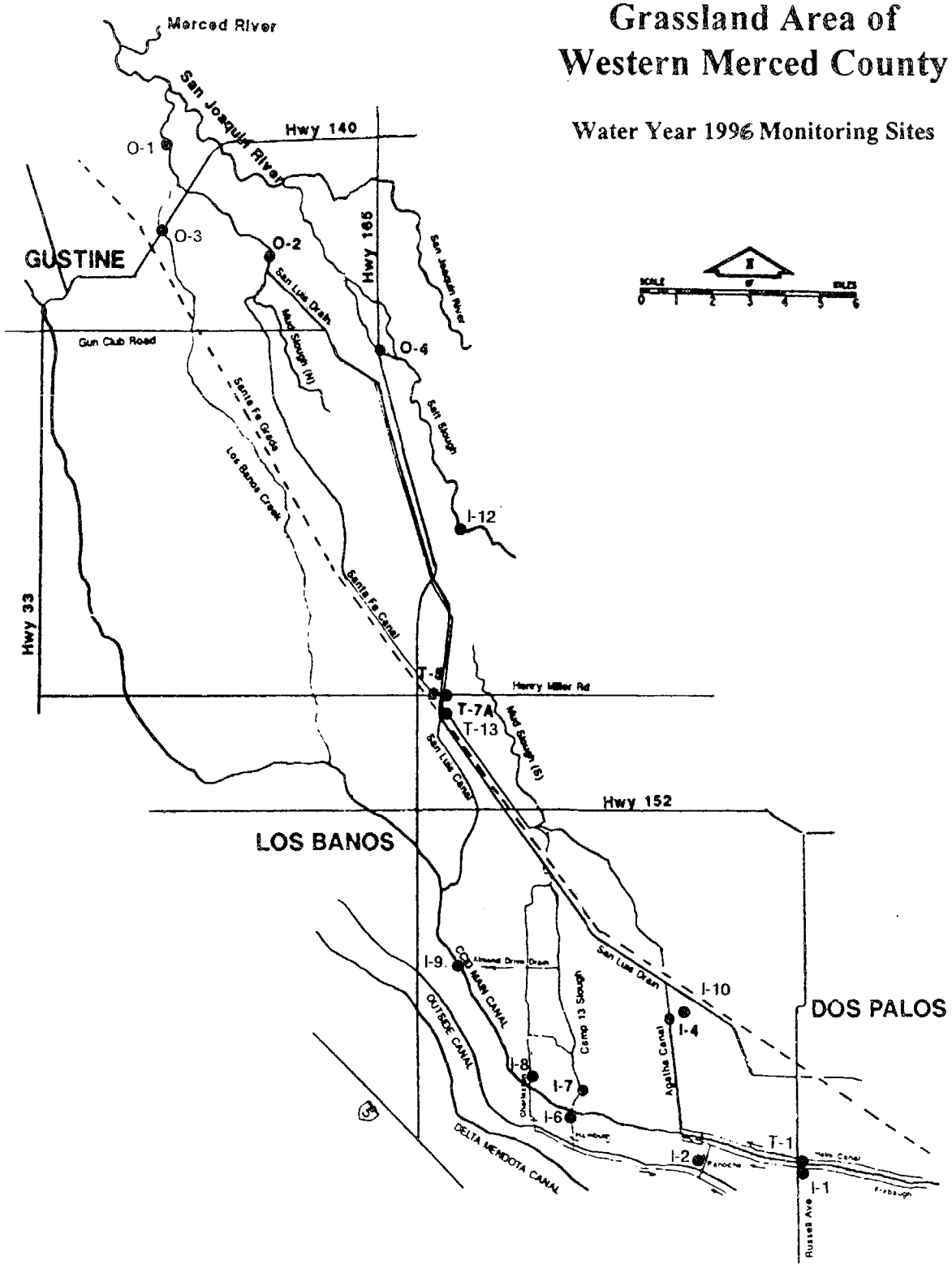
Legend of Abbreviations

EC	Electrical Conductivity
Se	Selenium
Mo	Molybdenum
Cr	Chromium
Cu	Copper
Ni	Nickel
Pb	Lead
Zn	Zinc
B	Boron
Cl	Chlorine
SO4	Sulfate
HDNS	Hardness

Figure A-1

Grassland Area of Western Merced County

Water Year 1996 Monitoring Sites



Main (Firebaugh) Drain at Russel Avenue (MER556)

Location: Latitude: 36°55'27". Longitude 120°39'11". In SW 1/4, SW 1/4, SW 1/4, Sec. 34, T.11S..R.12E.
East side of Russel Avenue, 2.7 miles south of Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/6/95	815	64	7.6	3950	72.9		4.9					
10/12/95	803	64	7.5	1940	30.0		2.7					
10/18/95	812	64	7.8	2580	37.9		3.5					
10/27/95	1045	NA	8.0	4200	41.0	45	5.3	450	1600	1120	280	103
11/3/95	811	59	7.8	3280	40.2		4.2					
11/9/95	851	60	8.3	2220	27.1		2.9					
11/20/95	806	59	8.0	2410	29.4		3.2					
11/27/95	846	52	7.9	3320	57.8		4.7	290	1200	910	220	88
12/8/95	932	58	8.1	2590	52.2		3.1					
12/18/95	930	NA	8.0	3080	62.0		4.1					
12/22/95	850	48	8.1	3680	80.4		5.1					
12/28/95	1105	50	8.0	2720	52.8		3.4	240	980	NA	170	73
1/4/96	1020	50	8.3	6590	161		9.4					
1/11/96	908	52	8.4	3940	78.0		4.5					
1/18/96	1041	50	8.4	4490	114		5.2					
1/25/96	1029	52	7.9	3660	77.0	31	5.0	350	1200	720	180	67
2/2/96	948	56	7.9	3370	58.0		3.0					
2/9/96	NA	NA	NA	NA	NA		NA					
2/16/96	754	61	7.7	4680	89.6		4.5					
2/23/96	1001	56	7.9	4810	101		5.2	490	1700	950	234	88
3/1/96	926	52	8.1	6120	162		6.8					
3/8/96	910	60	8.3	4570	104		4.8					
3/18/96	1600	70	7.9	5380	138		6.1					
3/21/96	845	66	7.8	5610	146		5.8					
3/28/96	930	62	7.9	3960	108		4.6	450	1400	910	219	87
4/3/96	942	61	6.8	4610	120		5.1					
4/12/96	934	62	7.6	4110	96.6		4.5					
4/19/96	840	60	8.1	3220	74.2		3.8					
4/25/96	1000	66	8.1	3480	75.4	20	4.3	320	1200	770	187	74
5/3/96	828	69	7.7	4400	119		5.6					
5/10/96	910	63	7.9	3050	51.5		2.8					
5/16/96	1030	67	7.6	2560	44.0		2.4					
5/24/96	950	60	7.8	2750	42.8		3.3					
5/30/96	940	68	7.9	2820	50.2		3.2	260	870	650	156	62
6/6/96	1020	74	7.6	2640	35.6		3.3					
6/13/96	852	69	7.8	2220	30.4		2.7					
6/19/96	900	72	7.7	2640	37.7		3.5					
6/27/96	1040	68	7.8	3110	50.7		3.5	280	990	690	170	64
7/2/96	920	80	7.7	3320	60.4		3.7					
7/11/96	815	76	7.6	2870	44.1		3.8					
7/19/96	854	69	7.7	1910	23.0		2.6					
7/25/96	950	79	7.7	1990	27.2	7	2.6	160	620	460	110	46
8/2/96	940	76	8.1	2100	29.4		2.7					
8/8/96	950	74	7.4	1930	28.2		2.4					
8/15/96	830	78	7.7	2040	25.7		2.6					
8/23/96	849	72	7.9	1960	29.8		2.6					
8/28/96	1015	74	7.8	2310	30.2		2.5	200	650	460	100	51
9/5/96	931	68	7.8	2690	48.4		3.7					
9/12/96	1101	67	7.7	2650	44.0		3.5					
9/17/96	940	62	8.2	1940	28.1		2.5					
9/26/96	1120	68	7.7	2930	31.7		2.8	280	900	550	130	55
Count		48	50	50	50	4	50	12	12	11	12	12
Min		48	6.8	1910	23.0	7	2.4	160	620	460	100	46
Max		80	8.4	6590	162	45	9.4	490	1700	1120	280	103
Mean		64	7.8	3310	64.0	26	4.0	314	1109	745	180	72
Geo Mean		63	7.8	3130	54.8	21	3.8	299	1060	716	172	70
Median		64	7.8	3060	51.1	26	3.6	285	1095	720	175	70

Panoche Drain at O'Banion Gauge Station (MER501)

Location: Latitude 36°55'14". Longitude 120°41'43". In SW 1/4, SW 1/4, SW 1/4, Sec. 32, T.11S., R.12E. Located 0.5 miles south of CCID Main Canal. 1.9 miles west of Russel Road. 5.5 miles SW of Dos Palos. 3.4 miles SW of South Dos

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/6/95	910	60	7.7	4390	19.7		7.3					
10/12/95	826	61	7.3	5380	25.2		9.3					
10/18/95	902	64	7.5	4920	30.6		8.2					
10/27/95	1110	NA	8.5	4990	104	13	7.8	680	1600	1180	300	105
11/3/95	847	60	7.9	3790	55.8		6.0					
11/9/95	905	60	8.1	4230	80.6		6.4					
11/20/95	853	58	7.9	3440	31.4		5.1					
11/27/95	858	52	8.0	3700	32.4		5.4	490	1100	1100	280	87
12/8/95	1010	58	7.9	3620	71.7		5.2					
12/18/95	NA	NA	NA	NA	NA		NA					
12/22/95	930	49	8.0	4430	103		8.1					
12/28/95	1121	54	8.7	5200	137		7.3	710	1700	NA	380	110
1/4/96	1040	52	7.7	5020	40.4		7.1					
1/11/96	923	52	8.0	5140	124		7.3					
1/18/96	1155	52	8.1	4450	104		6.4					
1/25/96	1059	52	7.7	4270	65.4	8	6.2	550	1200	950	270	70
2/2/96	1030	58	7.8	3940	52.0		5.0					
2/9/96	NA	NA	NA	NA	NA		NA					
2/16/96	NA	NA	NA	NA	NA		NA					
2/23/96	915	57	7.8	4810	75.4		7.0	600	1400	1100	300	77
3/1/96	1015	54	7.9	4810	89.2		7.6					
3/8/96	925	58	7.9	5250	106		3.8					
3/18/96	1635	73	7.9	3990	80.8		5.5					
3/21/96	900	62	NA	5210	117		8.0					
3/28/96	950	65	7.9	4950	92.6		9.0	730	1600	1200	325	93
4/3/96	950	62	7.2	5130	116		8.0					
4/12/96	1008	60	7.7	5330	86.6		8.4					
4/19/96	910	60	7.8	4890	115		8.6					
4/25/96	1025	66	8.0	5270	121	12	8.8	640	1600	1200	320	100
5/3/96	905	68	7.8	4920	102		9.4					
5/10/96	935	63	7.7	5110	85.6		6.6					
5/16/96	1110	66	7.8	4290	79.2		5.7					
5/24/96	1010	59	7.9	4760	83.5		7.8					
5/30/96	1010	68	7.9	5030	96.7		7.8	610	1500	1200	320	91
6/6/96	1120	80	7.8	4460	74.2		7.1					
6/13/96	907	68	7.8	4500	72.4		7.6					
6/19/96	840	68	7.4	4440	77.5		7.9					
6/27/96	1125	70	7.8	3980	75.8		6.5	470	1100	880	240	69
7/2/96	935	76	7.5	4160	73.0		7.0					
7/11/96	910	73	7.5	4620	96.6		8.0					
7/19/96	902	68	7.5	4340	90.2		6.9					
7/25/96	1035	80	7.8	4480	96.0	15	7.8	510	1300	1010	270	80
8/2/96	1000	74	7.8	4170	68.3		7.2					
8/8/96	1040	76	7.3	4060	91.0		6.2					
8/15/96	850	78	7.5	4080	90.4		6.3					
8/23/96	920	74	7.7	3610	46.0		6.2					
8/28/96	1035	78	7.9	4380	96.2		6.4	450	1200	780	190	74
9/5/96	1009	66	7.7	4150	72.7		7.1					
9/12/96	1110	66	7.7	3800	72.3		6.2					
9/17/96	1010	64	7.9	4050	94.9		7.0					
9/26/96	1130	70	7.8	5210	93.2		7.8	660	1500	950	233	89
	Count	47	47	48	48	4	48	12	12	11	12	12
	Min	49	7.2	3440	19.7	8	3.8	450	1100	780	190	69
	Max	80	8.7	5380	137	15	9.4	730	1700	1200	380	110
	Mean	64	7.8	4520	79.1	12	7.1	592	1400	1050	286	87
	Geo Mean	64	7.8	4490	74.7	12	7.0	584	1385	1040	281	86
	Median	64	7.8	4460	76.5	13	7.1	605	1450	1100	290	88

Agatha Canal at Mallard Road (MER506)

Location: Latitude: 36°56'12", Longitude 120°42'07". In NE 1/4, NW 1/4, SW 1/4, Sec. 7, T.11S., R.11E.
South of Sante Fe Grade at Brito, west of Mallard Road. 4.5 miles west of Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B µg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	1135	NA	7.9	254	0.9	5.5	25	29	60	14	6
11/27/95	924	56	8.3	553	1.4	0.38	69	74	120	28	13
12/28/95	1144	54	8.8	4490	100	6.3	610	1400	NA	350	110
1/25/96	1125	56	7.8	4260	74.9	6.2	550	1200	910	250	71
2/23/96	1055	58	7.9	4730	74.3	6.6	540	1500	1100	295	84
3/28/96	1020	64	8.2	4070	41.7	5.7	580	1300	1000	260	85
4/25/96	1100	68	8.5	200	1.3	0.22	16	25	64	15	6.5
5/30/96	1100	68	8.5	622	5.8	0.50	63	120	140	32	15
6/27/96	1150	74	8.5	518	1.3	0.30	56	73	120	28	12
7/25/96	1056	82	8.6	382	1.4	0.23	38	48	100	24	9.9
8/28/96	1100	72	7.9	2930	35.0	4.1	280	800	550	130	55
9/26/96	1205	72	8.5	324	0.9	0.12	29	29	72	15	8.6
Count		11	12	12	12	12	12	12	11	12	12
Min		54	7.8	200	0.9	0.12	16	25	60	14	6
Max		82	8.8	4730	100	6.6	610	1500	1100	350	110
Mean		66	8.3	1944	28.2	3.0	238	550	385	120	40
Geo Mean		65	8.3	1016	7.0	1.2	110	186	207	59	23
Median		68	8.4	588	3.6	2.3	66	97	120	30	14

Hamburg Drain near Camp 13 Slough (MER504)

Location: Latitude: 36°56'20". Longitude 120°45'26". In SE 1/4, SE 1/4, SW 1/4, Sec. 27, T.11S., R.11E. 50 feet south of CCID main canal. 9.2 miles S-SE of Los Banos. 6.7 miles W-SW of South Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/6/95	755	64	8.1	479	2.0		0.32					
10/12/95	744	65	7.9	383	2.1		0.32					
10/18/95	753	62	6.8	5450	80.6		6.2					
10/27/95	910	NA	7.9	5500	79.7	7	6.5	870	1700	1800	540	109
11/3/95	753	58	7.1	5120	79.4		6.1					
11/9/95	833	58	7.6	3860	43.9		4.1					
11/20/95	750	59	7.9	3650	40.2		4.4					
11/27/95	810	52	8.1	3490	52.0		3.5	510	1000	1200	350	74
12/8/95	915	58	8.1	3760	36.8		5.0					
12/18/95	845	NA	7.9	4090	27.8		5.7					
12/22/95	825	48	8.1	3760	26.2		4.4					
12/28/95	1037	52	9.6	3360	22.3		3.3	410	1300	NA	470	62
1/4/96	910	47	8.1	3650	29.8		3.6					
1/11/96	843	48	8.1	3920	40.5		3.4					
1/18/96	1003	50	8.5	3480	27.2		3.3					
1/25/96	950	51	7.7	5790	100	7	6.0	880	1800	1700	520	100
2/2/96	825	62	7.4	5650	107		4.4					
2/9/96	945	59	7.7	5000	67.4		5.1					
2/16/96	NA	NA	NA	NA	NA		NA					
2/23/96	851	60	7.8	5960	93.6		5.9	870	1800	1700	530	102
3/1/96	910	59	7.8	6890	129		9.2					
3/8/96	855	52	8.3	3840	36.1		3.5					
3/18/96	1538	77	8.1	5590	96.4		5.9					
3/21/96	820	60	7.8	5540	106		5.2					
3/28/96	845	62	7.8	5480	110		5.4	780	1900	1900	560	120
4/3/96	919	60	6.9	5720	106		5.9					
4/12/96	914	58	6.9	4820	90.4		4.2					
4/19/96	820	59	8.1	3990	71.5		4.4					
4/25/96	915	63	7.5	5100	98.1	5	5.1	640	1700	1600	470	92
5/3/96	758	61	7.1	4620	85.0		5.4					
5/10/96	850	62	7.7	4790	76.2		4.0					
5/16/96	835	65	7.6	4550	66.2		4.3					
5/24/96	930	58	7.9	6040	116		6.8					
5/30/96	905	64	7.6	4580	57.8		5.7	620	1400	1300	390	90
6/6/96	1000	76	7.8	458	3.2		0.3					
6/13/96	835	68	7.9	3190	47.0		3.0					
6/19/96	845	68	7.3	4290	NA		4.7					
6/27/96	930	68	7.6	5530	63.6		7.7	700	1800	2000	620	100
7/2/96	905	72	6.4	5100	62.6		4.0					
7/11/96	800	69	7.2	4005	49.7		5.1					
7/19/96	840	66	6.8	4590	62.3		5.0					
7/25/96	840	74	7.6	3380	38.4	4	4.0	400	990	990	290	64
8/2/96	915	70	7.8	3960	46.4		4.7					
8/8/96	910	70	6.5	3180	38.6		3.4					
8/15/96	810	70	6.9	3330	38.4		4.1					
8/23/96	832	68	7.4	4390	60.6		4.9					
8/28/96	938	74	7.6	4480	48.2		4.6	590	1200	1000	260	88
9/5/96	915	62	6.9	5090	70.6		6.3					
9/12/96	1040	69	7.4	5340	47.8		9.7					
9/17/96	920	62	7.6	4000	33.3		6.2					
9/26/96	1050	72	8.5	446	1.5		0.24	45	59	93	21	10
Count		48	50	50	49	4	50	12	12	11	12	12
Min		47	6.4	383	1.5	4	0.24	45	59	93	21	10
Max		77	9.6	6890	129	7	9.7	880	1900	2000	620	120
Mean		62	7.7	4250	59.5	6	4.7	610	1387	1389	418	84
Geo Mean		62	7.6	3730	44.6	6	3.9	511	1124	1148	341	74
Median		62	7.7	4440	57.8	6	4.7	630	1550	1600	470	91

Camp 13 Slough at Gauge Station (MER505)

Location: Latitude 36°56'21", Longitude 120°45'22". In SE 1/4, SE 1/4, SW 1/4, Sec. 27, T.11S., R.11E. 150 feet north of CCID Main Canal, 6.4 miles west of Russel Avenue. 9.2 miles SE of Los Banos. 6.7 miles SW of South Dos Palos

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	920	NA	8.3	4510	77.8	6.9	590	1500	1090	280	94
11/27/95	823	51	7.9	3440	57.4	4.8	440	1000	910	240	76
12/28/95	1044	50	8.9	3760	75.0	5.3	430	1300	NA	270	105
1/25/96	957	52	7.9	4660	84.6	6.9	570	1500	1030	270	89
2/23/96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3/28/96	850	64	8.1	3360	60.1	3.8	420	1100	830	210	75
4/25/96	930	66	7.8	4340	88.8	6.6	NA	NA	1000	260	85
5/30/96	912	68	7.8	3830	51.1	5.7	440	1100	920	240	78
6/27/96	937	69	7.9	4000	55.2	6.1	450	1200	950	250	79
7/25/96	855	80	7.7	3630	48.2	5.9	400	1100	850	220	74
8/28/96	950	76	7.9	1650	15.4	1.4	190	350	350	88	32
9/26/96	1055	70	8.4	338	0.8	0.13	31	35	72	15	8.4
Count		10	11	11	11	11	10	10	10	11	11
Min		50	7.7	338	0.8	0.13	31	35	72	15	8
Max		80	8.9	4660	88.8	6.9	590	1500	1090	280	105
Mean		65	8.1	3411	55.9	4.9	396	1019	800	213	72
Geo Mean		64	8.1	2902	38.3	3.6	323	751	661	175	62
Median		67	7.9	3760	57.4	5.7	435	1100	915	240	78

Charleston Drain at CCID Main Canal (MER502)

Location: Latitude 36°56'59" Longitude 120°46'48". In NE 1/4, SE 1/4, NE 1/4, Sec. 29, T.11S., R.11E.

North Side of CCID Main Canal, 8.7 miles S-SE of Los Banos. 7.9 miles W-SW of South Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	CA mg/L	Mg mg/L
10/6/95	740	62	7.9	949	9.0		0.84					
10/12/95	732	64	7.9	553	4.2		0.48					
10/18/95	740	64	6.6	1160	11.6		1.0					
10/27/95	845	NA	7.6	1250	14.4	2	1.3	160	320	390	97	36
11/3/95	740	58	7.2	2140	26.4		2.2					
11/9/95	821	60	7.6	2180	27.2		2.0					
11/20/95	734	58	7.9	2210	24.8		2.0					
11/27/95	758	52	7.7	2110	25.1		1.9	280	570	680	190	50
12/8/95	850	58	7.4	2330	28.7		2.1					
12/18/95	830	NA	7.8	4800	77.1		4.7					
12/22/95	810	50	7.8	4950	79.2		4.9					
12/28/95	1025	52	8.4	5110	79.4		NA	700	1900	NA	460	99
1/4/96	900	52	7.3	5420	84.7		5.1					
1/11/96	833	52	7.5	5000	69.4		4.3					
1/18/96	951	52	7.7	5160	53.0		5.4					
1/25/96	936	52	7.4	4530	57.2	5	3.9	670	1300	1300	360	83
2/2/96	NA	NA	NA	NA	NA		NA					
2/9/96	935	60	7.4	6370	91.0		4.8					
2/16/96	NA	NA	NA	NA	NA		NA					
2/23/96	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA
3/1/96	NA	NA	NA	NA	NA		NA					
3/8/96	840	58	7.6	4810	72.9		4.0					
3/18/96	1529	71	8.0	5280	92.6		4.4					
3/21/96	805	60	NA	5080	81.6		4.2					
3/28/96	830	62	7.5	4320	69.2		3.6	560	1600	1400	430	90
4/3/96	909	59	6.0	5390	93.7		4.6					
4/12/96	900	58	5.4	5290	84.2		4.2					
4/19/96	755	58	8.1	3340	68.8		3.3					
4/25/96	900	62	6.7	5530	103	6	4.9	730	1800	1700	530	97
5/3/96	750	62	6.1	5300	98.2		5.0					
5/10/96	840	62	7.8	3960	59.8		2.9					
5/16/96	820	64	7.5	4400	60.3		4.4					
5/24/96	915	58	7.5	4890	81.3		4.4					
5/30/96	855	66	7.7	4180	69.2		3.4	470	1400	1200	370	68
6/6/96	945	72	7.2	2230	16.6		2.1					
6/13/96	818	66	7.4	4010	75.2		4.0					
6/19/96	830	70	6.8	3950	63.6		3.7					
6/27/96	920	68	7.5	3940	64.8		3.5	430	1400	1600	520	69
7/2/96	855	76	5.7	3340	46.6		2.6					
7/11/96	750	70	6.5	4300	81.5		4.6					
7/19/96	830	67	6.4	3740	61.3		3.4					
7/25/96	820	74	6.9	2780	43.0	5	2.3	290	890	800	240	48
8/2/96	900	71	7.0	3390	39.0		3.8					
8/8/96	855	70	5.8	2930	43.2		2.6					
8/15/96	800	74	6.0	2670	38.3		2.4					
8/23/96	825	73	7.2	2040	24.8		1.8					
8/28/96	920	71	7.2	2230	22.9		2.1	530	1000	530	130	49
9/5/96	903	64	6.7	2510	31.0		2.8					
9/12/96	1030	64	7.5	3730	47.2		3.8					
9/17/96	905	64	7.0	1860	20.1		1.8					
9/26/96	1040	68	7.9	1597	11.0		1.1	220	350	320	86	26
Count		45	46	47	47	4	46	11	11	10	11	11
Min		50	5.4	553	4.2	2	0.48	160	320	320	86	26
Max		76	8.4	6370	103	6	5.4	730	1900	1700	530	99
Mean		63	7.2	3600	53.8	5	3.2	458	1139	992	310	65
Geo Mean		62	7.2	3220	44.0	4	2.9	412	979	857	259	60
Median		62	7.4	3940	59.8	5	3.5	470	1300	1000	360	68

Almond Drive Drain (MER555)

Location: Latitude 36°59'55", Longitude 120°49'00". In SW 1/4, SW 1/4, SW 1/4, Sec. 6, T.11S., R.11E. North side of Almond Drive. 1.1 miles east of Mercy Springs Drain, 100 feet east of CCID Main Canal. 4.7 miles south of Los Banos

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B µg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	830	NA	8.0	220	0.7	0.10	22	25	55	12	6
11/27/95	740	52	7.6	447							
12/28/95	957	52	8.1	2700							
1/25/96	915	51	7.8	1650	8.4	1.7	210	390	380	74	48
2/23/96	750	52	7.9	1690							
3/28/96	800	64	7.2	1100							
4/25/96	845	63	6.0	885	1.6	0.72	88	150	210	40	26
5/30/96	835	66	7.7	642							
6/27/96	850	68	7.8	965							
7/25/96	800	80	8.0	362	1.3	0.21	37	46	100	22	11
8/28/96	900	70	7.6	2230							
9/26/96	1030	70	8.3	402							
Count		11	12	12	4	4	4	4	4	4	4
Min		51	6.0	220	0.7	0.10	22	25	55	12	6
Max		80	8.3	2700	8.4	1.7	210	390	380	74	48
Mean		63	7.7	1108	3.0	0.68	89	153	186	37	23
Geo Mean		62	7.7	851	1.9	0.40	62	91	145	30	17
Median		64	7.8	925	1.5	0.47	63	98	155	31	19

Rice Drain at Mallard Road (MER509)

Location: Latitude 36°59'22" Longitude 120°42' 14". In NE 1/4, NW 1/4, SW 1/4, Sec. 7, T.11S., R.11E.
South of Sante Fe Grade at Brito, 50 feet west of Mallard Road. 4.5 miles west of Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	1130	NA	7.8	3360	14.5	5.5	340	1100	630	140	68
11/27/95	931	53	7.8	2050							
12/28/95	1151	50	8.4	2540							
1/25/96	1135	52	8.2	6300	28.4	15	650	2300	1100	240	120
2/23/96	1105	57	7.8	4010							
3/28/96	1015	60	7.7	2500							
4/25/96	1050	67	8.4	2500	5.6	5.8	210	820	520	124	51
5/30/96	1105	69	7.7	3450							
6/27/96	1210	70	7.9	3180							
7/25/96	1110	80	7.9	2640	3.4	6.2	240	810	570	140	56
8/28/96	1110	71	7.7	2210							
9/26/96	1200	72	8.3	2430							
Count		11	12	12	4	4	4	4	4	4	4
Min		50	7.7	2050	3.4	5.5	210	810	520	124	51
Max		80	8.4	6300	28.4	15	650	2300	1100	240	120
Mean		64	8.0	3098	13.0	8.1	360	1257.5	705	161	74
Geo Mean		63	8.0	2947	9.4	7.4	325	1139	673	155	69
Median		67	7.9	2590	10.1	6.0	290	960	600	140	62

Salt Slough Ditch at Hereford Road (MER528)

Location: Latitude 37°08'30" Longitude 120°45'17". In NW 1/4, NE 1/4, NW 1/4, Sec. 22, T.9S., R.11E.
3.0 miles north on Hereford Road from Henry Miller Road.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	855	60	7.8	515	0.6	0.20	77	63	130	29	13
11/27/95	1105	54	8.1	735							
12/28/95	1254	54	8.5	1260							
1/25/96	1250	56	7.8	962	1.7	0.34	140	130	210	51	20
2/23/96	1206	58	7.7	898							
3/28/96	1155	66	7.6	741							
4/25/96	1235	70	7.9	1150	0.6	0.27	160	140	290	73	27
5/30/96	1229	70	7.4	642							
6/27/96	1345	74	8.1	951							
7/25/96	1235	84	7.8	708	1.0	0.26	87	76	190	45	18
8/28/96	1220	74	7.8	718							
9/26/96	955	70	8.0	746							
Count		12	12	12	4	4	4	4	4	4	4
Min		54	7.4	515	0.6	0.20	77	63	130	29	13
Max		84	8.5	1260	1.7	0.34	160	140	290	73	27
Mean		66	7.9	836	1.0	0.27	116	102	205	50	20
Geo Mean		65	7.9	811	0.9	0.26	111	97	197	47	19
Median		68	7.8	744	0.8	0.27	114	103	200	48	19

CCID Main at Russel Avenue (MER510)

Location: Latitude 36°55'28". Longitude 120°39'11". In SE 1/4. SE 1/4, SE 1/4, Sec. 33, T.11S., R.12E.
2.7 miles south of Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	1050	NA	8.4	243	1.1	0.12	25	27	62	13	7.2
11/27/95	840	56	8.6	372							
12/28/95	1103	50	7.8	889							
1/25/96	1023	51	8.2	1300	5.2	1.3	110	380	350	96	27
2/23/96	955	59	8.1	558							
3/28/96	930	62	8.4	608							
4/25/96	1000	66	8.8	56	<0.4	<0.05	2	1.8	25	5.1	2.9
5/30/96	930	70	8.1	595							
6/27/96	1005	72	8.5	NA							
7/25/96	920	82	8.3	228	0.7	0.42	21	19	110	26	12
8/28/96	1010	78	8.0	618							
9/26/96	1110	70	8.3	318							
Count		11	12	11	3	3	4	4	4	4	4
Min		50	7.8	56	<0.4	<0.05	2	2	25	5	3
Max		82	8.8	1300	5.2	1.3	110	380	350	96	27
Mean		65	8.3	526	2.3	0.61	40	107	137	35	12
Geo Mean		64	8.3	409	1.6	0.40	18	24	88	20	9
Median		66	8.3	558	1.1	0.42	23	23	86	20	10

Santa Fe Canal at Henry Miller Road (MER519)

Location: Latitude 37°05'59", Longitude 120°49'44". In NE 1/4, NE 1/4, Sec. 1, T.10S., R.10E. 0.3 miles east of Lander Avenue. 3.0 miles north of Gustine.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	755	60	7.6	188	0.6	0.10	20	20	49	10	5.8
11/27/95	1021	56	8.4	487	1.3	0.22	58	64	110	25	12
12/28/95	1220	52	8.9	696	2.7	0.41	86	120	NA	40	16
1/25/96	1200	54	8.4	659	2.4	0.40	75	100	150	36	15
2/23/96	1134	60	8.5	1450	4.7	1.3	180	340	310	73	30
3/28/96	1125	67	8.4	766	4.3	0.64	80	170	130	27	16
4/25/96	1135	70	8.1	456	1.2	0.43	41	73	110	21	14
5/30/96	1155	74	8.8	537	1.2	0.49	54	91	120	25	15
6/27/96	1250	82	8.7	900	2.3	0.77	97	160	220	46	25
7/25/96	1135	84	7.8	988	2.0	0.95	110	160	280	56	33
8/28/96	1138	76	8.0	556	1.5	0.30	58	70	120	24	15
9/26/96	920	69	8.5	421	1.3	0.23	42	50	93	19	11
Count		12	12	12	12	12	12	12	11	12	12
Min		52	7.6	188	0.6	0.10	20	20	49	10	6
Max		84	8.9	1450	4.7	1.3	180	340	310	73	33
Mean		67	8.3	675	2.1	0.52	75	118	154	34	17
Geo Mean		66	8.3	604	1.8	0.42	65	95	136	30	16
Median		68	8.4	608	1.8	0.42	67	96	120	26	15

San Luis Canal at Henry Miller Road (MER532)

Location: Latitude 37 06' 00" Longitude 120 49' 13". In SE 1/4. SW 1/4, SE 1/4, Section 36, T10s, R10E.

The site is 3 miles northeast of Los Banos at the Los Banos Wildlife Refuge.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	815	60	7.5	196	0.8	0.10	20	22	52	11	5.9
11/27/95	1031	56	8.3	507	1.6	0.27	61	69	120	26	13
12/28/95	1227	52	8.4	918	6.6	0.69	140	180	NA	54	19
1/25/96	1220	52	8.0	1120	12.0	0.73	130	230	280	76	22
2/23/96	1142	58	7.9	3560	40.8	4.4	400	1000	750	189	68
3/28/96	1130	66	8.0	790	5.3	0.61	80	190	140	28	17
4/25/96	1150	68	7.9	505	1.5	0.49	NA	NA	110	23	14
5/30/96	1205	70	7.8	660	1.6	0.54	74	100	160	33	18
6/27/96	1305	72	8.4	979	3.0	0.91	100	180	240	48	28
7/25/96	1153	84	7.9	565	1.8	0.50	57	83	160	32	20
8/28/96	1150	74	7.8	568	1.8	0.31	59	72	120	240	150
9/26/96	930	70	8.4	646	1.5	0.25	48	57	100	22	11
Count		12	12	12	12	12	11	11	11	12	12
Min		52	7.5	196	0.8	0.10	20	22	52	11	6
Max		84	8.4	3560	40.8	4.4	400	1000	750	240	150
Mean		65	8.0	918	6.5	0.82	106	198	203	65	32
Geo Mean		65	8.0	720	3.1	0.51	80	120	158	43	21
Median		67	8.0	653	1.8	0.52	74	100	140	33	19

Porter-Blake Bypass (MER548)

Location: Latitude 37°05'58.5", Longitude 120°49'14.5". In NW 1/4, Sec. 1, T.10S., R.10E. 7.5 miles east of the intersection of Henry Milller and Mercy Springs Roads. 2 miles north of Los Banos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	830	60	7.3	1738	26.6	2.3	210	500	370	94	34
11/27/95	1044	58	7.9	2200	23.9	2.8	250	620	600	150	56
12/28/95	1238	52	8.5	2600	33.2	3.6	310	750	NA	150	58
1/25/96	1235	56	7.8	3390	36.2	4.7	420	940	720	180	65
2/23/96	1152	58	7.8	3680	44.8	4.6	410	1100	760	194	68
3/28/96	1140	66	8.1	3300	34.6	4.1	390	970	730	180	71
4/25/96	1205	71	7.5	3800	66.3	5.3	NA	NA	870	228	73
5/30/96	1210	69	8.0	3310	48.5	4.7	390	930	820	220	66
6/27/96	1320	72	7.9	3480	44.9	4.9	370	1000	760	200	64
7/25/96	1215	84	7.8	3010	39.8	5.1	330	920	730	190	62
8/28/96	1200	74	7.9	2890	39.4	3.6	280	770	580	140	56
9/26/96	940	70	8.3	532	2.1	0.32	56	71	110	25	12
Count		12	12	12	12	12	11	11	11	12	12
Min		52	7.3	532	2.1	0.32	56	71	110	25	12
Max		84	8.5	3800	66.3	5.3	420	1100	870	228	73
Mean		66	7.9	2828	36.7	3.8	311	779	641	163	57
Geo Mean		65	7.9	2570	30.2	3.3	280	663	574	145	53
Median		68	7.9	3155	37.8	4.4	330	920	730	180	63

Mud Slough at Newman Gun Club (MER551)

Location: Latitude 37°18"33", Longitude 120°57'18". In NW 1/4. NW 1/4, SW 1/4, Sec. 23, T.7S., R.9E.
1.7 miles north of Santa Fe Grade. 1.2 miles north of Highway 140. 4.2 miles NE of Gustine.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	1430	NA	7.9	758	0.8	0.50	89	110	170	36	20
11/27/95	940	52	8.1	1130	0.7	0.78	150	160	220	41	28
12/28/95	1125	51	8.1	1650	0.8	1.1	230	270	290	52	39
1/25/96	950	46	7.9	1820	0.6	1.2	260	320	340	62	44
2/23/96	1010	47	7.8	1080	0.7	0.70	120	170	230	43	29
3/28/96	1050	62	7.7	1750	1.2	1.7	280	340	380	70	50
4/25/96	1140	66	8.1	3540	1.4	2.2	540	740	570	91	83
5/30/96	1045	72	7.9	1690	2.2	1.0	220	320	290	54	37
6/27/96	1110	70	8.4	3040	1.3	1.5	500	590	530	90	73
7/25/96	1130	85	8.6	2590	1.2	1.7	340	490	530	93	71
8/28/96	1141	78	8.1	2750	1.3	1.7	430	580	560	92	79
9/26/96	1105	70	7.4	5280	15.6	8.4	610	1800	950	200	110
Count		11	12	12	12	12	12	12	12	12	12
Min		46	7.4	758	0.6	0.50	89	110	170	36	20
Max		85	8.6	5280	15.6	8.4	610	1800	950	200	110
Mean		64	8.0	2260	2.3	1.9	314	491	422	77	55
Geo Mean		62	8.0	1970	1.3	1.4	269	369	376	69	49
Median		66	8.0	1780	1.2	1.4	270	330	360	66	47

Mud Slough (north) at San Luis Drain (MER542)

Location: Latitude 37°19'50". Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E. 5.0 miles east of Gustine, 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

Date	Time	Temp F	pH	EC µmhos/cm	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg
					µg/L							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10/6/95	1120	69	8.3	1130	1.2							0.66					
10/12/95	1018	62	7.8	1200	1.1							0.91					
10/18/95	1030	69	7.8	632	1.1							0.45					
10/27/95	1310	NA	7.7	769	0.6	7	2	4	7	<5	<1	0.60	91	100	170	34	20
11/3/95	1045	62	8.1	904	0.9							0.76					
11/9/95	1050	64	7.7	906	0.5							0.69					
11/20/95	1152	64	7.6	1060	0.4							0.81					
11/27/95	1156	54	8.1	1220	0.5							0.92	160	180	380	90	39
12/8/95	1332	60	8.1	1190	0.4							0.85					
12/18/95	1020	NA	8.9	1200	0.6							0.88					
12/22/95	1230	50	7.9	1230	0.8							0.91					
12/28/95	1332	52	8.2	1540	0.7							0.97	220	260	NA	44	33
1/4/96	1230	55	7.9	1930	0.7							1.4					
1/11/96	1114	52	7.9	1980	0.8							1.3					
1/18/96	1320	51	8.1	1710	0.8							1.2					
1/25/96	1345	54	7.8	1690	0.5	6	6	2	10	<5	<1	1.2	240	250	270	52	35
2/2/96	1235	57	8.0	1210	0.7							0.87					
2/9/96	NA	NA	NA	NA	NA							NA					
2/16/96	951	62	7.5	1880	0.5							0.73					
2/23/96	1300	60	7.8	880	<0.4							0.69	91	120	200	37	25
3/1/96	1310	62	8.1	1160	0.5							1.0					
3/8/96	1015	58	8.0	1070	0.6							0.86					
3/18/96	1145	72	8.4	1950	0.7							1.5					
3/21/96	1035	68	8.1	2160	0.7							1.8					
3/28/96	1245	66	8.2	2270	1.0							2.3	330	380	370	62	52
4/3/96	1438	64	7.5	2180	1.4							1.8					
4/12/96	1356	66	7.8	3440	7.1							4.1					
4/19/96	1120	62	8.0	3640	0.8							3.2					
4/25/96	1320	73	8.3	2670	0.9	10	8	7	9	<5	11	1.9	370	490	420	70	60
5/3/96	1216	75	7.7	3820	0.8							3.1					
5/10/96	1100	67	8.1	1510	1.2							0.95					
5/16/96	1250	66	7.9	2560	1.5							1.5					
5/24/96	1145	66	8.1	1420	1.5							1.1					
5/30/96	1335	76	8.1	1310	0.7							0.87	170	250	220	40	28
6/6/96	1300	88	7.8	588	2.0							0.49					
6/13/96	1224	78	8.2	1610	1.1							1.2					
6/19/96	1025	74	7.9	2520	0.7							1.9					
6/27/96	1445	80	8.1	3250	1.2							2.1	440	720	500	81	72
7/2/96	1125	86	7.3	2360	1.8							1.7					
7/11/96	1204	82	7.8	2520	2.1							1.9					
7/19/96	1245	78	8.3	3190	1.3							2.1					
7/25/96	1345	90	8.3	2020	1.4	11	12	6	15	<5	16	1.5	260	390	370	65	51
8/2/96	1200	82	8.2	1650	1.0							1.2					
8/8/96	1235	82	7.9	2900	1.1							1.8					
8/15/96	1045	79	8.0	2460	1.2							1.5					
8/23/96	1200	80	8.1	2250	1.2							1.4					
8/28/96	1320	80	8.3	2110	1.6							1.1	230	350	300	51	43
9/5/96	1306	72	8.1	1040	1.7							0.71					
9/12/96	945	66	7.7	2580	3.4							2.1					
9/17/96	1330	76	8.5	749	1.3							0.58					
9/26/96	830	69	8.2	5530	11.8							8.7	600	1900	890	192	100
Count		48	50	50	49	4	4	4	4	4	4	50	12	12	11	12	12
Min		50	7.3	588	<0.4	6	2	2	7	<5	11	0.45	91	100	170	34	20
Max		90	8.9	5530	11.8	11	12	7	15	<5	16	8.7	600	1900	890	192	100
Mean		68	8.0	1890	1.4	9	7	5	10	<5	7	1.5	267	449	372	68	47
Geo Mean		68	8.0	1680	1.0	8	6	4	10	<5	3	1.2	231	322	335	60	42
Median		67	8.1	1700	1.0	9	7	5	10	<5	6	1.2	235	305	370	57	41

Los Banos Creek at State Highway 140 (MER554)

Location: Latitude 37°16'35", Longitude 120°57'14". In NE 1/4, SW 1/4, SW 1/4, Sec., 35, T.7S., R.9E.
South side of highway 140, 2.9 miles NE of Gustine.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/27/95	1025	58	7.7	1340	0.5	0.60	210	130	250	48	31
11/27/95	903	54	8.0	709							
12/28/95	1045	50	8.0	1460							
1/25/96	756	45	6.7	1450	<0.4	1.0	200	200	260	46	35
2/23/96	914	47	7.6	515							
3/28/96	925	61	6.5	509							
4/25/96	930	62	6.8	3350	0.7	3.0	450	670	600	94	88
5/30/96	1109	73	7.9	850							
6/27/96	1145	71	8.4	1250							
7/25/96	1205	84	8.5	1530	1.2	1.4	180	240	350	64	45
8/28/96	1203	76	8.6	1600							
9/26/96	1020	68	7.5	548							
Count		12	12	12	3	4	4	4	4	4	4
Min		45	6.5	509	<0.4	0.60	180	130	250	46	31
Max		84	8.6	3350	1.2	3.0	450	670	600	94	88
Mean		62	7.7	1259	0.6	1.5	260	310	365	63	50
Geo Mean		61	7.7	1080	0.5	1.3	242	254	342	60	46
Median		61	7.8	1300	0.6	1.2	205	220	305	56	40

Salt Slough at Lander Avenue (State Highway 165) (MER531)

Location: Latitude 37°14'55", Longitude 120°51'04". In NW 1/4, SE 1/4, SE 1/4, Sec. 10, T.8S., R.10E. 13.0 miles north of Los Banos. 5.0 miles south of Highway 140.

Date	Time	Temp °F	pH	EC µmhos/cm	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg
					µg/L							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10/6/95	1210	70	8.2	1010	1.1							0.47					
10/12/95	1040	68	7.8	1070	1.0							0.58					
10/18/95	1125	70	7.1	1300	6.8							1.3					
10/25/96	930	62	7.6	1360	12.4	6	12	6	15	<5	16	1.3	170	310	260	63	26
11/3/95	1241	64	7.9	1590	7.7							1.3					
11/9/95	955	64	8.1	1370	1.9							0.88					
11/20/95	1029	63	7.8	1930	10.6							2.0					
11/27/95	825	54	8.0	1810	10.9							1.7	240	410	380	90	39
12/8/95	1132	60	7.9	1920	12.8							1.8					
12/18/95	1230	NA	7.8	1920	13.1							2.1					
12/22/95	1055	50	7.9	2010	13.4							2.5					
12/28/95	1005	51	7.7	2380	19.3							2.4	330	560	490	115	49
1/4/96	1300	55	7.7	2490	5.2							2.2					
1/11/96	1016	52	7.7	2850	10.0							2.5					
1/18/96	1353	52	7.9	2690	33.3							3.0					
1/25/96	836	46	7.6	2430	19.5	9	NA	NA	NA	NA	NA	2.7	320	590	500	118	49
2/2/96	1320	56	7.8	2010	13.6							NA					
2/9/96	NA	NA	NA	NA	NA							NA					
2/16/96	1030	62	7.6	2580	22.7							2.7					
2/23/96	830	47	6.9	2340	18.6							1.1	300	570	240	59	23
3/1/96	1410	58	7.8	2130	14.5							2.4					
3/8/96	1035	62	7.7	2250	15.8							2.0					
3/18/96	1325	68	7.4	2220	16.9							1.9					
3/21/96	1125	68	NA	2120	17.8							1.9					
3/28/96	950	61	7.4	1720	11.6							1.7	280	430	450	102	45
4/3/96	1455	67	7.6	1920	17.2							1.8					
4/12/96	1146	64	7.8	2170	18.0							1.8					
4/19/96	1140	62	8.0	1840	20.3							2.3					
4/25/96	1030	65	7.7	2850	31.6	9	12	9	11	<5	26	2.7	370	670	580	144	54
5/3/96	1015	72	7.9	3000	33.5							3.5					
5/10/96	1115	66	7.7	2110	19.4							1.9					
5/16/96	1350	70	7.7	2320	23.0							2.0					
5/24/96	1220	64	7.8	2030	18.7							2.1					
5/30/96	1200	70	7.6	2330	22.0							2.6	300	570	520	130	47
6/6/96	1230	80	7.8	2610	27.5							3.1					
6/13/96	1055	75	7.8	2120	18.8							1.9					
6/19/96	1050	75	7.8	2020	20.6							2.3					
6/27/96	1215	68	7.7	2650	25.8							2.7	360	660	510	130	46
7/2/96	1030	83	7.4	2210	20.4							2.5					
7/11/96	1050	77	7.6	2160	19.6							2.7					
7/19/96	1040	74	7.5	2210	19.4							2.6					
7/25/96	1300	84	7.9	2020	17.3	10	15	8	14	<5	26	2.5	220	480	450	110	42
8/2/96	1240	82	7.8	1830	15.6							2.3					
8/8/96	1315	78	8.2	1560	13.4							1.7					
8/15/96	1140	82	8.0	1610	13.0							1.7					
8/23/96	1225	80	7.9	1580	11.4							1.6					
8/28/96	1238	75	8.0	1590	12.5							1.6	190	360	330	75	35
9/5/96	1120	70	7.2	1710	16.4							1.7					
9/12/96	750	68	6.9	1800	14.1							9.3*					
9/17/96	1430	70	8.0	1540	14.4							1.8					
9/26/96	935	68	5.8	1250	3.8							0.75	170	200	230	49	26
Count		49	49	50	50	4	3	3	3	<5	3	48	12	12	12	12	12
Min		46	5.8	1010	1.0	6	12	6	11	<5	16	0.47	170	200	230	49	23
Max		84	8.2	3000	33.5	10	15	9	15	<5	26	3.5	370	670	580	144	54
Mean		66	7.7	2010	16.0	9	13	8	13	<5	23	2.0	271	484	412	99	40
Geo Mean		66	7.7	1960	13.4	8	13	8	13	<5	22	1.9	262	460	393	94	39
Median		68	7.8	2020	16.1	9	12	8	14	<5	26	2.0	290	520	450	106	44

APPENDIX B

Water Quality Data for Grab Samples: Water Year 1997

* Sampling discontinued in December 1996

† Data only available for November 1996

SLD = San Luis Drain

Legend of Abbreviations

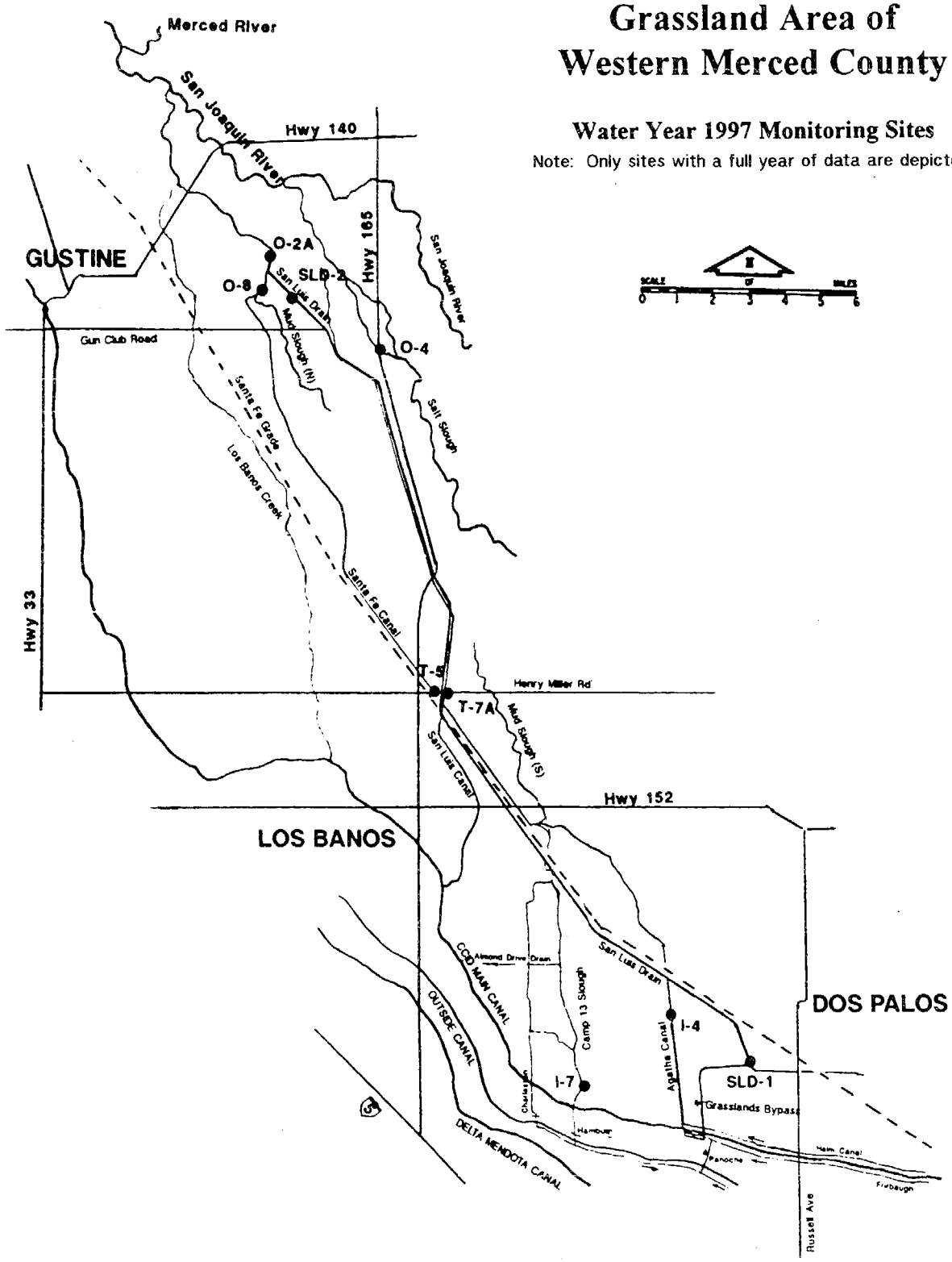
EC	Electrical Conductivity
Se	Selenium
Mo	Molybdenum
Cr	Chromium
Cu	Copper
Ni	Nickel
Pb	Lead
Zn	Zinc
B	Boron
Cl	Chlorine
SO4	Sulfate
HDNS	Hardness

Figure B-1

Grassland Area of Western Merced County

Water Year 1997 Monitoring Sites

Note: Only sites with a full year of data are depicted.



Main (Firebaugh) Drain at Russel Avenue (MER556)

Location: Latitude: 36°55'27", Longitude 120°39'11". In SW 1/4, SW 1/4, SW 1/4, Sec. 34, T.11S.,R.12E. East side of Russel Avenue, 2.7 miles south of Dos Palos.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
10/3/96	1045	68	7.8	4780	95.7	7.7
10/8/96	1150	72	7.4	4150	74.6	7.4
10/18/96	1140	60	7.7	4780	78.8	8.0
10/25/96	1335	61	7.6	3990	45.2	5.8
11/1/96	1400	60	7.9	2430	26.2	3.1
11/8/96	1135	55	7.7	5350	84.4	9.5
11/14/96	1035	58	8.0	3190	47.6	4.7
11/19/96	1110	61	8.0	2190	32.6	2.8
11/26/96	1200	58	7.7	4160	87.8	6.5
12/5/96	1053	NA	7.8	4150	88.2	6.5
12/10/96	1415	58	7.5	3440	73.2	5.2
12/20/96	1035	47	7.8	5130	104	8.3
12/27/96	0830	51	7.6	5870	134	9.5
Count		12	13	13	13	13
Min		47	7.4	2190	26.2	2.8
Max		72	8.0	5870	134	9.5
Mean		59	7.7	4124	74.8	6.5
Geo Mean		59	7.7	3973	68.2	6.1
Median		59	7.7	4150	78.8	6.5

Panoche Drain at O'Banion Gauge Station (MER501)

Location: Latitude 36°55'14", Longitude 120°41'43". In SW 1/4. SW 1/4, SW 1/4, Sec. 32, T.11S., R.12E. Located 0.5 miles south of CCID Main Canal, 1.9 miles west of Russel Road. 5.5 miles SW of Dos Palos. 3.4 miles SW of South Dos

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
10/3/96	1115	68	7.9	5720	120	8.9
10/8/96	1220	74	8.0	4470	66.5	8.5
10/18/96	1155	60	7.9	4900	49.6	8.8
10/25/96	1430	62	8.3	5050	96.6	8.8
11/1/96	1430	68	7.2	4560	62.3	7.6
11/8/96	1230	60	7.8	5150	89.6	8.7
11/14/96	1050	58	7.5	5400	98.0	9.6
11/26/96	1237	60	7.5	4080	27.7	7.0
12/5/96	1131	NA	7.6	4690	32.5	7.8
12/20/96	1155	50	7.9	4870	83.4	7.8
Count		9	10	10	10	10
Min		50	7.2	4080	27.7	7.0
Max		74	8.3	5720	120	9.6
Mean		62	7.7	4890	72.6	8.4
Geo Mean		62	7.7	4870	66.0	8.3
Median		60	7.8	4880	75.0	8.6

Agatha Canal at Mallard Road (MER506)

Location: Latitude: 36°56'12", Longitude 120°42'07". In NE 1/4, NW 1/4, SW 1/4, Sec. 7, T.11S., R.11E.
South of Sante Fe Grade at Brito, west of Mallard Road. 4.5 miles west of Dos Palos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/3/96	1215	70	8.5	481	1.0	0.21					
10/8/96	1315	74	8.7	324	0.7	0.16					
10/18/96	1240	64	7.9	358	0.6	0.16					
10/25/96	1510	59	8.6	412	0.7	0.21					
11/1/96	1238	62	7.7	407	1.0	0.21					
11/8/96	1355	57	6.6	427	0.7	0.20					
11/14/96	1145	59	8.5	445	0.8	0.23					
11/19/96	1030	61	8.5	528	0.9	0.28					
11/26/96	1120	60	8.3	418	1.0	0.21	55*	43*	87	18	10
12/5/96	1243	NA	8.3	601	1.4	0.31					
12/10/96	1430	56	7.8	573	1.3	0.36					
12/20/96	NA	NA	NA	612	1.3	0.39					
12/27/96	1040	54	7.0	704	1.8	0.46					
1/9/97	1103	52	8.0	305	NA	NA					
1/21/97	1400	56	8.1	231	NA	0.39					
2/4/97	0715	56	6.1	4240	NA	NA					
2/18/97	1310	55	8.4	193	NA	NA					
3/5/97	1433	NA	NA	187	0.8	0.18					
3/12/97	1035	NA	NA	NA	0.5	0.11					
3/19/97	1111	NA	NA	235	1.8	0.24					
3/26/97	1140	NA	NA	317	1.0	0.24					
4/2/97	1143	NA	NA	457	3.0	0.31					
4/9/97	1145	NA	NA	661	2.0	0.43					
4/16/97	1240	NA	NA	559	2.6	0.32					
4/23/97	1258	NA	NA	481	1.5	0.26					
5/1/97	1141	NA	NA	520	1.5	0.30					
5/7/97	1240	NA	NA	547	1.1	0.25					
5/14/97	1238	NA	NA	497	1.3	0.25					
5/21/97	1135	NA	NA	486	1.0	0.25					
5/28/97	1240	NA	NA	504	1.1	0.26					
6/4/97	1150	NA	NA	481	1.7	0.27					
6/11/97	1155	NA	NA	476	1.3	0.27					
6/18/97	1151	NA	NA	484	1.2	0.24					
6/25/97	1240	NA	NA	423	1.1	0.20					
7/2/97	1320	NA	NA	436	1.1	0.24					
7/9/97	1240	NA	NA	396	1.0	0.19					
7/16/97	1245	NA	NA	406	1.6	0.22					
7/23/97	1240	NA	NA	419	1.6	0.24					
7/30/97	1245	NA	NA	419	1.2	0.24					
8/6/97	1240	NA	NA	373	1.5	0.27					
8/13/97	1245	NA	NA	354	1.0	0.16					
8/20/97	1240	NA	NA	368	1.5	0.20					
8/27/97	1245	NA	NA	442	2.3	0.26					
9/3/97	1050	NA	NA	553	3.4	0.38					
9/10/97	1240	NA	NA	358	1.8	0.21					
9/17/97	1130	NA	NA	354	1.1	0.17					
9/24/97	956	NA	NA	379	1.0	0.19					
Count		15	16	46	43	44	0	0	1	1	1
Min		52	6.1	187	0.5	0.11			87	18	10
Max		74	8.7	4240	3.4	0.46			87	18	10
Mean		60	7.9	518	1.3	0.25			87	18	10
Geo Mean		59	7.9	441	1.2	0.24			87	18	10
Median		59	8.2	432	1.2	0.24			87	18	10

Hamburg Drain near Camp 13 Slough (MER504)

Location: Latitude: 36°56'20", Longitude 120°45'26". In SE 1/4, SE 1/4, SW 1/4, Sec. 27, T.11S., R.11E. 50 feet south of CCID main canal. 9.2 miles S-SE of Los Banos. 6.7 miles W-SW of South Dos Palos.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
10/3/96	1015	69	8.5	476	1.3	0.24
10/8/96	1125	81	8.7	598	2.3	0.59
10/18/96	1105	62	8.0	3530	19.8	4.2
10/25/96	1130	59	8.4	3430	19.8	4.2
11/1/96	1505	79	8.2	3450	18.8	3.9
11/8/96	1055	62	8.4	3510	19.8	4.4
11/14/96	1010	59	8.3	3350	18.2	4.2
11/19/96	1237	66	8.3	3410	17.2	4.2
11/26/96	1330	68	8.2	3250	17.6	4.2
12/20/96	0955	46	7.5	3580	18.4	4.2
12/27/96	1700	52	8.0	3610	22.6	4.4
Count		11	11	11	11	11
Min		46	7.5	476	1.3	0.2
Max		81	8.7	3610	22.6	4.4
Mean		64	8.2	2930	16.0	3.5
Geo Mean		63	8.2	2460	12.4	2.7
Median		62	8.3	3430	18.4	4.2

Camp 13 Slough at Gauge Station (MER505)

Location: Latitude 36°56'21". Longitude 120°45'22". In SE 1/4, SE 1/4, SW 1/4, Sec. 27, T.11S., R.11E. 150 feet north of CCID Main Canal. 6.4 miles west of Russel Avenue. 9.2 miles SE of Los Banos. 6.7 miles SW of South Dos Palos

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/3/96	1020	69	8.3	382	0.8	0.16					
10/8/96	1135	72	8.7	347	0.8	0.18					
10/18/96	1110	64	8.5	360	0.6	0.16					
10/25/96	1145	59	8.7	394	0.8	0.21					
11/1/96	1500	63	9.0	394	0.8	0.17					
11/8/96	1110	56	7.5	491	0.9	0.28					
11/14/96	1020	59	8.7	434	0.7	0.25					
11/19/96	1230	61	8.4	483	0.9	0.28					
11/26/96	1320	61	8.1	445	1.0	2.6	64*	49*	30	9	1.8
12/5/96	NA	NA	NA	NA	NA	NA					
12/10/96	NA	NA	NA	NA	NA	NA					
12/20/96	1005	46	8.4	612	1.4	0.37					
12/27/96	NA	NA	NA	689	1.7	0.40					
1/9/97	0929	50	8.5	224	NA	0.15					
1/21/97	NA	NA	NA	178	NA	NA					
2/4/97	0838	58	7.6	1600	23.4	1.8					
2/18/97	1409	56	7.9	172	NA	NA					
3/5/97	1400	58	6.6	1380	2.0	2.3					
3/12/97	0800	NA	NA	NA	2.8	3.5					
3/19/97	0837	NA	NA	1880	5.2	3.3					
3/26/97	0840	NA	NA	3760	3.7	7.1					
4/2/97	0840	NA	NA	3750	4.7	6.5					
4/9/97	0842	NA	NA	560	1.7	0.33					
4/16/97	0943	NA	NA	1290	2.7	1.6					
4/23/97	0920	NA	NA	480	1.6	0.30					
5/1/97	0927	NA	NA	955	2.6	1.0					
5/7/97	0925	NA	NA	1210	13.5	1.1					
5/14/97	1000	NA	NA	520	1.0	0.30					
5/21/97	0917	NA	NA	496	1.0	0.26					
5/28/97	0920	NA	NA	715	2.5	0.64					
6/4/97	1005	NA	NA	1190	2.3	1.4					
6/11/97	1051	NA	NA	703	1.5	0.69					
6/18/97	1034	NA	NA	519	1.4	0.33					
6/25/97	0953	NA	NA	1390	2.3	1.9					
7/2/97	1042	NA	NA	563	1.1	0.49					
7/9/97	1023	NA	NA	460	1.1	0.33					
7/16/97	1050	NA	NA	614	1.6	0.58					
7/23/97	1030	NA	NA	614	1.2	0.41					
7/30/97	1054	NA	NA	1110	2.2	1.2					
8/6/97	1050	NA	NA	1400	2.2	2.0					
8/13/97	1048	NA	NA	815	3.5	1.0					
8/20/97	1027	NA	NA	352	1.0	0.20					
8/27/97	1032	NA	NA	459	2.3	0.31					
9/3/97	1000	NA	NA	502	3.6	0.35					
9/10/97	1022	NA	NA	496	3.1	0.32					
9/17/97	1015	NA	NA	341	1.2	0.18					
9/24/97	800	NA	NA	439	1.2	0.23					
Count		14	14	44	42	43	0	0	1	1	1
Min		46	6.6	172	0.6	0.15			30	9	1.8
Max		72	9.0	3760	23.4	7.1			30	9	1.8
Mean		59	8.2	822	2.6	1.1			30	9	1.8
Geo Mean		59	8.2	634	1.8	0.58			30	9	1.8
Median		59	8.4	520	1.6	0.37			30	9	1.8

Charleston Drain at CCID Main Canal (MER502)

Location: Latitude 36°56'59" Longitude 120°46'48". In NE 1/4, SE 1/4, NE 1/4, Sec. 29, T.11S., R.11E.
North Side of CCID Main Canal, 8.7 miles S-SE of Los Banos. 7.9 miles W-SW of South Dos Palos.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
10/3/96	1005	68	8.2	979	6.7	0.71
10/8/96	1110	72	7.7	870	7.5	0.83
10/18/96	1050	62	7.1	1650	14.4	1.4
10/25/96	1115	58	7.8	1690	14.2	1.5
11/1/96	1510	63	8.6	1680	14.6	1.4
11/8/96	1045	56	7.5	1790	15.9	1.7
11/14/96	1000	58	8.0	1790	15.8	1.6
11/19/96	1300	62	8.7	1880	16.0	1.7
11/26/96	1345	60	8.4	1900	17.6	1.8
12/20/96	0945	48	7.5	2470	24.1	2.4
Count		10	10	10	10	10
Min		48	7.1	870	6.7	0.7
Max		72	8.7	2470	24.1	2.4
Mean		61	7.9	1670	14.7	1.5
Geo Mean		60	7.9	1600	13.8	1.4
Median		61	7.9	1740	15.2	1.6

Almond Drive Drain (MER555)

Location: Latitude 36°59'55", Longitude 120°49'00". In SW 1/4, SW 1/4, SW 1/4, Sec. 6, T.11S., R.11E.
North side of Almond Drive, 1.1 miles east of Mercy Springs Drain, 100 feet east of CCID Main Canal. 4.7 miles south of Los Banos

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
11/1/96	1530	63	8.7	360	0.6	0.14
11/26/96	1405	62	8.2	436	NA	NA
12/27/96	0758	51	6.8	588	NA	NA

Rice Drain at Mallard Road (MER509)

Location: Latitude 36°59'22" Longitude 120°42' 14". In NE 1/4, NW 1/4, SW 1/4, Sec. 7, T.11S., R.11E.
South of Sante Fe Grade at Brito, 50 feet west of Mallard Road. 4.5 miles west of Dos Palos.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
11/1/96	1230	60	7.3	1550	1.0	3.0
11/26/96	1125	59	7.7	1830	NA	NA
12/27/96	1030	54	7.5	2790	NA	NA

Salt Slough Ditch at Hereford Road (MER528)

Location: Latitude 37°08'30" Longitude 120°45'17". In NW 1/4, NE 1/4, NW 1/4, Sec. 22, T.9S., R.11E.
3.0 miles north on Hereford Road from Henry Miller Road.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
11/1/96	1140	60	7.9	741	0.5	0.20
11/27/96	950	55	7.1	758	NA	NA
12/26/96	1420	48	8.0	1110	NA	NA

CCID Main at Russel Avenue (MER510)

Location: Latitude 36°55'28". Longitude 120°39'11". In SE 1/4, SE 1/4, SE 1/4, Sec. 33, T.11S., R.12E.
2.7 miles south of Dos Palos.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
11/1/96	1405	61	8.4	352	0.7	0.13
11/26/96	1205	60	8.1	431	NA	NA
12/27/96	0835	51	7.8	599	NA	NA

Santa Fe Canal at Henry Miller Road (MER519)

Location: Latitude 37°05'59", Longitude 120°49'44". In NE 1/4, NE 1/4, Sec. 1, T.10S., R.10E. 0.3 miles east of Lander Avenue. 3.0 miles north of Gustine.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
11/1/96	1100	60	8.7	467	1.0	0.25	59	54	110	24	13
11/8/96	0940	54	7.0	482	0.8	0.24					
11/15/96	0937	57	7.3	573	0.9	0.35					
11/22/96	0930	63	6.9	620	1.0	0.41					
11/27/96	845	55	6.5	705	1.2	0.44					
12/6/96	0935	50	6.7	638	1.2	0.35					
12/12/96	1155	58	7.7	455	1.2	0.34					
12/19/96	1305	52	7.6	630	1.3	0.32					
12/26/96	1350	48	7.9	1230	1.5	1.5					
2/4/97	1110	58	8.4	544	2.3	0.49					
2/11/97	1240	58	7.9	339	0.8	0.35					
2/18/97	1200	55	7.5	1750	1.4	2.5					
2/28/97	1030	54	8.4	1760	2.3	2.5					
3/5/97	1530	NA	NA	1870	2.9	2.5					
3/12/97	1115	NA	NA	NA	2.0	1.6					
3/19/97	1145	NA	NA	1400	2.0	2.1					
3/26/97	1255	NA	NA	1870	3.1	2.9					
4/2/97	1326	NA	NA	1570	1.8	2.6					
4/9/97	1256	NA	NA	1480	2.4	1.8					
4/16/97	1320	NA	NA	1720	3.0	1.7					
4/23/97	1336	NA	NA	1130	3.2	1.1					
5/1/97	1310	NA	NA	870	2.6	0.81					
5/7/97	1314	NA	NA	825	2.9	0.66					
5/14/97	1321	NA	NA	861	1.9	0.65					
5/21/97	1335	NA	NA	746	1.6	0.63					
5/28/97	1315	NA	NA	892	2.1	0.86					
6/4/97	1340	NA	NA	1100	2.6	1.0					
6/11/97	1320	NA	NA	1070	2.5	1.1					
6/18/97	1330	NA	NA	968	2.4	1.1					
6/25/97	1325	NA	NA	1060	2.4	1.3					
7/2/97	1410	NA	NA	799	2.2	0.74					
7/9/97	1320	NA	NA	946	2.6	0.98					
7/16/97	1330	NA	NA	841	2.2	0.96					
7/23/97	1340	NA	NA	797	2.1	0.83					
7/30/97	1335	NA	NA	938	2.1	1.1					
8/6/97	1340	NA	NA	976	2.2	1.2					
8/13/97	1330	NA	NA	776	1.9	0.86					
8/20/97	1320	NA	NA	825	2.1	0.71					
8/27/97	1340	NA	NA	682	2.7	0.52					
9/3/97	1330	NA	NA	640	3.5	0.51					
9/10/97	1340	NA	NA	521	3.1	0.38					
9/17/97	1240	NA	NA	642	3.9	0.54					
9/24/97	1025	NA	NA	499	1.3	0.38					
Count		13	13	42	43	43	1	1	1	1	1
Min		48	6.5	339	0.8	0.24	59	54	110	24	13
Max		63	8.7	1870	3.9	2.9	59	54	110	24	13
Mean		56	7.6	941	2.1	1.0	59	54	110	24	13
Geo Mean		55	7.5	859	2.0	0.81	59	54	110	24	13
Median		55	7.6	833	2.1	0.83	59	54	110	24	13

San Luis Canal at Henry Miller Road (MER532)

Location: Latitude 37 06' 00" Longitude 120 49' 13". In SE 1/4, SW 1/4, SE 1/4, Section 36, T10s, R10E. The site is 3 miles northeast of Los Banos at the Los Banos Wildlife Refuge.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L
11/1/96	1105	60	8.2	828	1.1	0.90
11/8/96	0950	55	7.5	943	1.1	1.1
11/15/96	0945	58	7.4	967	1.0	1.2
11/22/96	0940	63	7.1	910	1.1	1.1
11/27/96	925	56	7.1	1020	1.1	1.2
12/6/96	0950	50	7.0	911	1.1	0.88
12/12/96	1200	57	7.5	868	1.1	1.3
12/19/96	1315	52	7.6	1080	1.2	1.3
12/26/96	1410	NA	NA	NA	NA	NA
2/4/97	1120	60	7.9	1290	6.2	1.5
2/11/97	1250	59	7.2	1240	1.1	1.8
2/18/97	1210	55	7.7	1700	1.0	2.5
2/28/97	1040	52	8.2	1300	1.6	2.0
3/5/97	1520	NA	NA	1590	1.5	2.2
3/12/97	1125	NA	NA	NA	1.1	1.0
3/19/97	1150	NA	NA	1230	2.5	1.6
3/26/97	1115	NA	NA	1840	2.5	3.3
4/2/97	1340	NA	NA	1820	3.6	2.3
4/9/97	1315	NA	NA	1550	2.7	1.8
4/16/97	1307	NA	NA	1140	3.2	0.94
4/23/97	1328	NA	NA	1120	3.3	1.1
5/1/97	1320	NA	NA	860	3.0	0.78
5/7/97	1320	NA	NA	775	2.3	0.57
5/14/97	1315	NA	NA	803	1.6	0.57
5/21/97	1345	NA	NA	908	1.9	0.86
5/28/97	1307	NA	NA	848	1.9	0.69
6/4/97	1350	NA	NA	909	2.6	0.79
6/11/97	1315	NA	NA	798	2.1	0.69
6/18/97	1306	NA	NA	813	2.2	0.80
6/25/97	1315	NA	NA	860	2.1	0.80
7/2/97	1400	NA	NA	698	1.9	0.61
7/9/97	1310	NA	NA	917	2.5	0.87
7/16/97	1321	NA	NA	628	1.8	0.52
7/23/97	1320	NA	NA	762	2.1	0.71
7/30/97	1320	NA	NA	750	1.8	0.75
8/6/97	1330	NA	NA	886	2.0	0.86
8/13/97	1310	NA	NA	619	1.5	0.55
8/20/97	1311	NA	NA	781	2.0	0.73
8/27/97	1330	NA	NA	708	2.7	0.57
9/3/97	1300	NA	NA	605	3.2	0.47
9/10/97	1331	NA	NA	501	3.4	0.38
9/17/97	1150	NA	NA	660	4.3	0.57
9/24/97	1020	NA	NA	507	1.6	0.36
Count		12	12	41	42	42
Min		50	7.0	501	1.0	0.36
Max		63	8.2	1840	6.2	3.3
Mean		56	7.5	973	2.1	1.1
Geo Mean		56	7.5	924	1.9	0.94
Median		57	7.5	886	2.0	0.87

Porter-Blake Bypass (MER548)

Location: Latitude 37°05'58.5", Longitude 120°49'14.5". In NW 1/4, Sec. 1, T.10S., R.10E. 7.5 miles east of the intersection of Henry Milller and Mercy Springs Roads. 2 miles north of Los Banos.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	B mg/L
11/1/96	1120	62	8.00	832	1.0	0.92
11/27/96	910	55	6.86	1050	1.1	1.3

Mud Slough (north) at San Luis Drain (MER542)

Location: Latitude 37°19'50", Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E. 5.0 miles east of Gustine. 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/3/96	0840	68	7.0	3490	56.7		4.9					
10/8/96	0950	73	8.0	1890	20.3		2.5					
10/18/96	0835	59	6.0	1680	13.5		2.1					
10/25/96	0930	58	8.0	1540	13.8		1.8					
10/29/96	1135	56	7.4	1880	12.2	11	NA					
11/1/96	0835	59	6.4	1810	NA		2.0	210	390	410	98	39
11/8/96	0830	54	7.6	1510	8.0		1.5					
11/14/96	0815	58	6.5	1590	9.1		1.8					
11/19/96	0915	62	6.5	1710	11.2		2.0					
11/26/96	0830	59	6.5	1430	9.0	8	1.5	180	270	270	59	30
12/5/96	0809	NA	6.5	1860	5.0		2.0					
12/10/96	1145	56	7.3	1500	5.5		1.6					
12/27/96	1158	56	7.4	1150	5.7	3	1.1					
1/9/97	1342	54	7.7	1280	5.0		1.3					
1/21/97	0940	53	7.7	1620	9.2	6	1.8					
2/4/97	1231	62	7.5	1310	7.4		1.5					
2/11/97	0955	55	7.8	2250	16.8		2.9					
2/18/97	0935	52	7.8	3140	33.2		4.3					
2/28/97	0758	51	8.1	3350	32.4	19	4.2					
3/5/97	1710	58	8.5	3770	44.8		5.3					
3/13/97	0810	61	8.2	3560	46.5		5.1					
3/20/97	0800	64	7.9	2980	33.2		3.9					
3/27/97	1425	72	8.3	3640	42.4	17	4.5					
4/3/97	1247	60	8.1	4420	61.9		6.1					
4/10/97	0730	58	7.4	4770	69.1		6.2					
4/17/97	1210	72	8.0	3870	58.6		4.9					
4/24/97	1116	64	8.4	4660	79.6	24	6.5					
5/2/97	0945	64	8.4	4280	52.0		5.9					
5/8/97	0725	67	8.1	4930	63.1		6.8					
5/15/97	1415	83	8.6	3920	58.7		5.3					
5/29/97	0935	76	8.5	2890	32.3	17	4.2					
6/5/97	1113	74	8.3	3810	47.2		5.5					
6/12/97	1110	78	8.5	3730	36.4		6.0					
6/19/97	NA	NA	NA	NA	NA		NA					
6/25/97	1115	76	8.2	3640	41.6	21	5.6					
7/2/97	1300	77	8.4	3990	50.4		6.6					
7/10/97	1144	78	8.3	3310	29.7		5.8					
7/17/97	1140	82	8.4	3730	33.3		6.5					
7/24/97	1148	82	7.9	3510	36.4		6.1					
7/31/97	1245	80	7.2	2550	18.4	16	4.2					
8/7/97	0947	81	8.0	3150	28.6		5.2					
8/14/97	1220	80	7.6	3650	37.5		6.3					
8/21/97	1537	84	7.8	3100	32.9		4.8					
8/27/97	1145	78	6.0	3340	40.6	23	5.3					
9/5/97	0915	80	7.2	3080	23.6		4.7					
9/12/97	0930	73	7.4	2640	20.4		4.1					
9/18/97	1252	78	7.8	1950	8.4		2.7					
9/25/97	1505	84	8.0	2170	8.6	20	3.0					
Count		46	47	47	46	12	46	2	2	2	2	2
Min		51	6.0	1150	5.0	3	1.1	180	270	270	59	30
Max		84	8.6	4930	79.6	24	6.8	210	390	410	98	39
Mean		68	7.7	2870	30.7	15	4.1	195	330	340	79	35
Geo Mean		67	7.6	2660	23.3	13	3.6	194	324	333	76	34
Median		66	7.8	3100	32.4	17	4.4	195	330	340	79	35

Los Banos Creek at State Highway 140 (MER554)

Location: Latitude 37°16'35", Longitude 120°57'14". In NE 1/4, SW 1/4, SW 1/4, Sec., 35, T.7S., R.9E.
South side of highway 140, 2.9 miles NE of Gustine.

Date	Time	Temp F	pH	Lab EC (µmhos/cm)	Se (µg/L)	Boron (mg/L)
10/31/96	1055	58	7.0	725	0.3	0.52
11/27/96	1130	57	7.1	1140	NA	NA
12/26/96	1250	48	7.8	1320	NA	NA

Salt Slough at Lander Avenue (State Highway 165) (MER531)

Location: Latitude 37°14'55". Longitude 120°51'04". In NW 1/4, SE 1/4, SE 1/4, Sec. 10, T.8S., R.10E. 13.0 miles north of Los Banos. 5.0 miles south of Highway 140.

Date	Time	Temp °F	pH	EC µmhos/cm	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg
					µg/L							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10/3/96	0745	67	5.6	1400	1.2							0.70					
10/8/96	1030	72	7.9	1110	1.1							0.55					
10/17/96	1025	65	6.7	1790	0.8							0.80					
10/24/96	0900	59	6.1	1360	0.7							0.66					
10/31/96	0950	57	5.7	1000	1.0	4						0.58	130	130	240	53	25
11/7/96	0740	58	5.3	1280	0.8							0.85					
11/15/96	1005	57	7.5	1420	0.8							0.87					
11/22/96	1010	64	7.4	1320	1.0							0.94					
11/27/96	1040	58	7.1	1320	0.8	4						0.99	190	200	290	65	31
12/6/96	1010	51	7.2	1500	0.9							1.0					
12/12/96	1135	58	6.9	1130	1.1							1.1					
12/19/96	1230	54	7.0	1680	0.7							1.1					
12/26/96	1322	48	7.4	1780	0.8	7						1.1					
1/9/97	1225	52	8.0	1200	1.0							0.85					
1/24/97	1255	52	7.0	1610	1.0	7						1.3	240	290	350	76	39
2/7/97	1420	57	7.4	1930	3.4							1.8					
2/13/97	1310	54	7.8	1670	0.7							1.3					
2/21/97	1010	56	7.3	1310	0.5							0.71					
2/26/97	1250	53	7.4	1110	0.6	7						0.50					
3/5/97	1615	57	7.8	1070	0.5							0.47					
3/12/97	1820	59	7.8	1090	0.6							0.52					
3/20/97	1030	66	8.0	1180	1.4							0.75					
3/27/97	1310	70	7.5	1780	1.1	7						1.3					
4/3/97	1020	60	7.7	2000	1.0							1.1					
4/10/97	0820	58	8.1	1860	1.0							0.81					
4/17/97	1020	70	8.0	1770	1.1							0.75					
4/24/97	1012	62	7.5	1820	1.1	10						0.81	280	250	360	77	41
5/2/97	0800	61	8.2	1670	1.1							0.82					
5/8/97	0821	69	7.9	1700	1.1							0.77					
5/15/97	0905	75	7.9	1670	1.1							0.74					
5/23/97	1200	72	8.2	1360	0.9							0.56					
5/29/97	1050	78	8.4	1200	1.3	6						0.65					
6/5/97	0952	70	6.6	1620	1.2							0.74					
6/12/97	1240	80	8.1	1370	1.1							0.61					
6/19/97	NA	NA	NA	NA	NA							NA					
6/25/97	1010	76	7.8	1350	1.1	9						0.73					
7/2/97	1150	74	7.7	1070	1.1							0.50					
7/10/97	0932	75	7.8	1310	0.9							0.63					
7/17/97	1100	78	8.6	1030	1.0							0.48					
7/24/97	0945	78	8.2	1140	0.9							0.56					
7/31/97	1045	78	8.4	975	1.1	5						0.57	110	120	200		
8/7/97	0834	79	7.3	1130	1.3							0.69					
8/14/97	1135	80	7.8	922	0.8							0.46					
8/21/97	1214	80	7.6	982	0.9							0.40					
8/27/97	1430	80	6.0	1110	1.0	5						0.48					
9/5/97	1050	82	8.1	1190	1.8							0.53					
9/12/97	0815	74	6.7	1200	1.5							0.57					
9/18/97	1039	74	7.0	1050	1.6							0.50					
9/25/97	1600	85	8.0	1380	0.7	9						0.65					
Count		48	48	48	48	12	0	0	0	0	0	48	5	5	5	4	4
Min		48	5.3	922	0.5	4						0.40	110	120	200	53	25
Max		85	8.6	2000	3.4	10						1.8	280	290	360	77	41
Mean		67	7.4	1370	1.0	7						0.77	190	198	288	68	34
Geo Mean		66	7.4	1340	1.0	6						0.73	179	187	281	67	33
Median		67	7.6	1320	1.0	7						0.72	190	200	290	71	35

Mud Slough Upstream of San Luis Drain (MER536)

Location: Latitude 37°19'50", Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E. 5.0 miles east of Gustine. 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L
10/3/96	0830	65	6.3	1050	0.7		0.65					
10/8/96	1010	71	8.0	744	0.6		0.56					
10/18/96	0825	58	5.2	967	0.8		0.77					
10/25/96	0955	57	7.8	953	0.5		0.71					
10/29/96	1135	56	7.8	1120	0.5	7	NA	NA	NA	NA	NA	NA
11/1/96	0820	59	5.4	1020	NA		0.77					
11/8/96	0810	54	7.3	1050	0.4		0.76					
11/14/96	0805	58	6.1	1020	0.4		0.75					
11/19/96	0900	62	6.5	1070	0.4		0.81					
11/26/96	0905	59	7.3	1000	0.5	NA	0.79	140	120	180	34	23
12/5/96	0801	NA	5.9	1380	0.5		1.0					
12/10/96	1215	58	7.4	983	0.5		0.75					
12/20/96	0835	46	7.9	950	0.4		0.80					
12/27/96	1150	56	7.4	828	0.5	3	0.67					
1/9/97	1331	54	7.5	921	<0.4		0.72					
1/21/97	0920	53	7.6	1070	0.4	3	0.87	120	140	210	39	27
2/4/97	1219	62	7.5	875	0.5		0.77					
2/11/97	0930	56	7.2	1430	0.7		1.4					
2/18/97	0925	52	7.6	1730	0.7		1.8					
2/28/97	0741	50	7.6	2040	1.0	NA	2.0					
3/5/97	1725	60	8.3	2030	0.8		2.0					
3/13/97	0750	51	7.1	1970	1.0		2.1					
3/20/97	0739	64	6.8	1910	1.0		2.1					
3/27/97	1415	72	8.1	2350	0.9	7	2.4					
4/3/97	1311	66	8.2	2350	1.1		2.6					
4/10/97	0718	54	6.8	2960	1.3		2.9					
4/17/97	1225	72	8.2	1720	1.7		1.5					
4/24/97	1140	62	8.4	2360	1.2	11	2.1	320	490	430	74	59
5/2/97	1010	63	8.2	2430	0.9		2.3					
5/8/97	0711	63	8.4	2470	0.8		2.1					
5/15/97	1435	84	8.5	1430	1.4		1.1					
5/23/97	1040	70	7.9	1080	0.7		0.95					
5/29/97	0950	76	8.3	1130	1.2	5	0.94					
6/5/97	1128	74	8.3	1610	1.6		1.3					
6/12/97	1125	78	8.3	1500	1.5		1.2					
6/19/97	NA	NA	NA	NA	NA		NA					
6/25/97	1105	76	7.9	1460	1.7	7	1.4					
7/2/97	1245	79	8.4	1540	1.0		1.3					
7/10/97	1205	77	8.1	1200	1.4		1.1					
7/17/97	1200	80	8.3	1550	1.3		1.3					
7/24/97	1204	83	8.1	1160	1.5		1.0					
7/31/97	1300	80	8.0	859	1.1	3	0.70	93	120	190		
8/7/97	1002	81	8.3	1130	0.8		0.92					
8/14/97	1210	82	7.3	1160	0.6		0.91					
8/21/97	1556	89	8.2	1220	0.6		0.98					
8/27/97	1135	78	5.8	1260	1.1	5	0.96					
9/5/97	0900	76	7.4	1190	0.6		0.85					
9/12/97	0920	78	7.3	873	0.7		0.62					
9/18/97	1307	79	8.1	881	1.0		0.60					
9/25/97	1455	84	7.6	1050	0.6	10	0.77					
Count		48	49	49	48	10	48	4	4	4	3	3
Min		46	5.2	744	<0.4	3	0.56	93	120	180	34	23
Max		89	8.5	2960	1.7	11	2.9	320	490	430	74	59
Mean		67	7.5	1390	0.8	6	1.2	168	218	253	49	36
Geo Mean		66	7.5	1300	0.8	6	1.1	150	177	236	46	33
Median		65	7.8	1160	0.8	6	0.96	130	130	200	39	27

Inflow at San Luis Drain: check 17 (MER562)

Location: Latitude: 36°57.980', Longitude 120°40.238'. In Sec. 21, T.11S., R.12E. Just west of South Dos Palos.
Slightly downstream of point where the Grasslands Bypass empties into the San Luis Drain.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Diss Se ug/L	TSS mg/L
10/3/96	1200	70	8.1	5210	77.4		7.8				79.1	
10/8/96	1300	78	8.3	4220	75.5		7.7					44
10/18/96	1230	62	7.1	3940	38.6		7.1				37.5	140
10/25/96	1450	58	8.3	4270	51.4		6.7				49.5	
10/29/96	1400	54	8.1	4020	62.0	27	NA				61.6	
11/1/96	1310	62	7.4	3610	NA		5.1					
11/8/96	1330	58	6.8	4250	61.3		7.9				61.1	42
11/14/96	1130	58	8.1	4390	76.8		7.3					51
11/19/96	1100	64	7.7	3460	56.2		5.6				57.0	77
11/26/96	1140	60	7.4	3470	40.6		5.7				39.6	64
12/5/96	1222	NA	7.7	5000	68.4		8.4				69.9	49
12/10/96	1400	58	7.0	4020	NA		NA				56.3	110
12/20/96	1305	48	8.5	4970	80.4		8.3				80.2	56
12/27/96	0945	55	7.8	5130	91.7		8.2				91.9	92
1/9/97	0854	50	8.0	4710	78.7		7.4				76.6	90
1/21/97	1315	61	8.0	4870	88.2	16	7.5				84.8	180
2/4/97	1006	62	8.0	5140	72.0		8.7				70.5	71
2/11/97	1355	59	7.9	5360	97.5		9.0				96.6	58
2/18/97	1245	55	7.9	5140	80.3		8.3				78.6	41
2/28/97	1124	54	8.0	5330	90.3		8.5				86.4	
3/5/97	1435	58	7.5	5100	88.4		8.1				91.1	38
3/12/97	0950	NA	NA	NA	76.6		6.9				77.2	
3/19/97	1050	NA	NA	4420	74.6		6.8				71.1	85
3/26/97	1100	NA	NA	4580	67.0		6.6				61.0	160
4/2/97	1115	NA	NA	5370	93.0		8.1				95.8	120
4/9/97	1115	NA	NA	5600	108		7.6				117	130
4/16/97	1140	NA	NA	5310	104		7.1				104	83
4/23/97	1125	NA	NA	5290	101		8.0				97.6	110
5/1/97	1113	NA	NA	5480	96.8		8.4				96.6	110
5/7/97	1220	NA	NA	4930	73.6		7.3				73.0	62
5/14/97	1130	NA	NA	4380	61.6		6.8				57.6	130
5/21/97	1100	NA	NA	4380	65.0		7.4				63.6	160
5/28/97	1130	NA	NA	4330	58.5		7.0				60.6	45
6/4/97	1055	NA	NA	4780	52.1		7.8				50.6	87
6/11/97	1120	NA	NA	4980	81.0		8.7				78.9	39
6/18/97	1112	NA	NA	4690	67.5		7.8				63.1	170
6/25/97	1141	NA	NA	4850	61.5		8.5				60.5	130
7/2/97	1123	NA	NA	4660	65.8		8.5				64.1	130
7/9/97	1117	NA	NA	4140	40.6		7.7				40.5	150
7/16/97	1123	NA	NA	4220	54.5		7.8				53.0	120
7/23/97	1119	NA	NA	4050	40.5		7.1				43.5	110
7/30/97	1134	NA	NA	3950	45.5		7.3				44.6	170
8/6/97	1130	NA	NA	4130	53.8		7.8				50.4	120
8/13/97	1122	NA	NA	3650	38.4		6.4				39.0	140
8/20/97	1106	NA	NA	3330	30.8		6.4				30.4	160
8/27/97	1110	NA	NA	3990	55.4		6.9				53.7	
9/3/97	0900	NA	NA	4250	52.1		6.6				49.4	65
9/10/97	1130	NA	NA	2620	17.9		4.2				16.6	190
9/17/97	1050	NA	NA	3160	22.8		5.5				21.8	94
9/24/97	945	NA	NA	3460	29.0		6.0				28.0	96
Count		20	21	49	48	2	48	0	0	0	47	43
Min		48	6.8	2620	17.9	16	4.2				16.6	38
Max		78	8.5	5600	108	27	9.0				117	190
Mean		59	7.8	4460	65.9	22	7.3				64.5	100
Geo Mean		59	7.8	4405	61.7	21	7.3				60.0	92
Median		58	7.9	4390	66.4	22	7.5				61.6	96

San Luis Drain @ Terminus (MER535)

Location: Latitude 37°19'50". Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E. 5.0 miles east of Gustine, 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

Date	Time	Temp °F	pH	EC µmhos/cm	Se µg/L	Mo µg/L	B mg/L	Cl mg/L	SO4 mg/L	HDNS mg/L	Ca mg/L	Mg mg/L	Diss Se µg/L	TSS mg/L
10/3/96	0915	70	7.9	4340	66.8		6.4						65.8	
10/8/96	0930	74	7.3	4330	62.5		6.9							8
10/18/96	0935	62	6.9	3590	43.0		6.0						41.8	67
10/25/96	0859	58	8.0	4280	79.8		7.2						77.2	NA
10/29/96	1045	54	7.6	4260	54.6	35	NA	460	1200	1000	280	79	54.8	
11/1/96	0915	60	7.4	4010	NA		6.0							
11/8/96	0900	55	8.0	3570	43.2		5.2						42.1	12
11/14/96	0850	58	7.6	4330	58.0		7.5						NA	8
11/19/96	0930	62	7.2	4770	75.8		8.4						75.2	10
11/26/96	0950	60	7.4	3300	58.9	30	5.5	390	1100	860	230	69	56.4	<1
12/5/96	840	NA	7.1	3910	30.1		6.2						31.0	14
12/10/96	1110	56	6.5	4330	38.9		7.3						39.0	25
12/20/96	0945	46	8.1	4200	49.8		7.1						49.0	15
12/27/96	1321	57	7.6	4000	60.8	23	5.9						61.6	22
1/9/97	1505	56	7.9	3830	33.3		5.2						34.2	12
1/21/97	1050	54	7.9	4530	57.0	22	7.0	520	1400	1100	280	92	56.4	33
2/4/97	1315	62	7.6	4510	63.6		7.2						61.8	27
2/11/97	1050	58	7.8	5110	78.4		8.3						78.4	33
2/18/97	1020	54	8.1	5150	79.7		8.1						83.2	34
2/28/97	0905	50	8.3	4770	77.6	27	7.1						73.4	
3/5/97	1700	58	8.3	5210	89.3		8.2						87.1	26
3/13/97	0925	58	7.1	4630	91.8		7.3						84.4	
3/20/97	0925	64	8.4	4280	70.2		6.6						70.4	27
3/27/97	1445	72	8.5	4630	78.9	29	6.5						78.1	45
4/3/97	1050	59	8.1	5130	96.2		7.4						93.7	33
4/10/97	0755	58	7.6	5270	105		7.2						102	37
4/17/97	1055	71	8.2	5460	107		7.8						110	34
4/24/97	1048	65	8.0	5020	95.2	26	7.3	600	1700	1200	320	100	93.6	48
5/2/97	0830	63	8.4	5080	72.6		7.3						73.7	39
5/8/97	0750	67	8.3	5270	80.3		7.7						78.3	29
5/15/97	0940	76	8.5	4670	75.2		6.6						75.7	28
5/23/97	1105	74	8.2	4200	64.2		6.7						64.6	46
5/29/97	0915	78	8.2	4350	62.3	23	7.1						60.9	140
6/5/97	1018	74	8.0	4820	72.8		7.8						70.4	46
6/12/97	1015	76	8.5	4560	54.6		7.9						55.0	27
6/19/97	NA	NA	NA	NA	NA		NA						71.3	23
6/25/97	1135	76	8.3	4690	73.3	26	7.7						73.6	13
7/2/97	1230	76	8.4	4410	59.9		7.8						59.8	30
7/10/97	1118	78	8.3	4030	34.9		7.4						35.0	25
7/17/97	1120	80	8.2	4060	37.0		7.4						37.0	18
7/24/97	1011	81	8.0	4000	41.8		7.1						39.5	17
7/31/97	1200	78	6.3	3940	43.7	25	7.2	420	1300	920			42.4	17
8/7/97	0856	81	7.6	3190	27.9		5.6						27.7	21
8/14/97	1235	80	8.0	3780	42.3		6.8						41.7	18
8/21/97	1430	82	7.2	3240	31.2		5.3						31.0	32
8/27/97	1200	78	7.2	3840	48.9	25	6.4						47.2	17
9/5/97	0930	82	8.1	3190	23.4		5.1						23.3	25
9/12/97	1020	78	7.9	2720	17.0		4.4						16.4	22
9/18/97	1225	78	7.3	2920	17.1		4.8						17.0	22
9/25/97	1535	82	8.0	3390	18.3	35	5.6						18.4	19
Count		48	49	49	48	12	48	5	5	5	4	4	47	44
Min		46	6.3	2720	17.0	22	4.4	390	1100	860	230	69	16.4	8
Max		82	8.5	5460	107	35	8.4	600	1700	1200	320	100	110	140
Mean		67	7.8	4270	59.3	27.167	6.8	478	1340	1016	278	85	58.7	28
Geo Mean		66	7.8	4220	54.0	26.867	6.7	472	1325	1009	276	84	53.4	23
Median		66	8.0	4330	60.4	26	7.1	460	1300	1000	280	86	60.9	25

APPENDIX C

Water Quality Data from Sigma Autosamplers: Water Years 1996 and 1997

Legend of Abbreviations

EC	Electrical Conductivity
Se	Selenium
B	Boron

Main (Firebaugh) Drain at Russel Avenue (MER556S)

Location: Latitude: 36°55'27". Longitude 120°39'11". In SW 1/4, SW 1/4, SW 1/4, Sec. 34, T.11S.,R.12E.
East side of Russel Avenue, 2.7 miles south of Dos Palos.

AUTOSAMPLER DATA : 4 day composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se g/L	B mg/L
10/4/95	2120	33.7	2.8	4/7/96	4540	119	5.4
10/6/95	2870	50.7	NA	4/11/96	4770	120	5.8
10/10/95	2630	56.4	3.4	4/15/96	4230	104	5.3
10/14/95	2250	36.4	3.0	4/19/96	2990	61.9	3.4
10/18/95	2060	27.4	2.9	4/23/96	3710	85.6	3.9
10/22/95	2870	34.5	3.6	4/27/96	3590	90.8	3.9
10/26/95	2630	29.4	3.5	5/1/96	4550	122	4.6
10/30/95	3670	38.4	4.7	5/3/96	4030	94.0	NA
11/3/95	3700	40.3	4.4	5/7/96	3390	74.3	3.6
11/7/95	3060	42.8	4.2	5/11/96	3200	64.5	3.3
11/11/95	2320	31.0	3.1	5/15/96	2920	54.6	3.0
11/15/95	3140	48.0	4.6	5/16/96	2640	49.5	NA
11/19/95	3250	30.1	4.2	5/20/96	2640	40.0	2.5
11/24/95	2640	47.2	3.6	5/24/96	2770	46.2	3.1
11/28/95	3330	60.4	4.8	5/28/96	2760	48.8	3.0
12/2/95	2310	38.8	2.8	5/30/96	2610	44.5	3.0
12/6/95	2550	53.3	2.9	6/3/96	2870	43.6	3.4
12/8/95	2220	42.6	2.6	6/7/96	2600	35.4	3.2
12/12/95	2000	31.9	2.1	6/11/96	2910	43.1	3.5
12/16/95	2200	35.4	2.3	6/15/96	2510	34.6	2.9
12/20/95	3070	57.8	3.8	6/19/96	2570	34.9	3.0
12/22/95	3390	65.2	4.4	6/23/96	3250	52.2	3.5
12/26/95	4080	81.8	5.3	6/27/96	3410	57.4	3.6
12/30/95	2890	56.4	3.5	7/1/96	3240	55.0	4.3
1/3/96	5150	108	6.9	7/5/96	2870	44.8	4.1
1/4/96	NA	NA	NA	7/9/96	2400	36.2	3.4
1/8/96	3890	NA	NA	7/11/96	2530	35.8	3.7
1/12/96	4600	83.8	5.7	7/15/96	3350	57.4	3.9
1/16/96	5520	94.4	7.6	7/19/96	2400	34.2	3.2
1/18/96	NA	122	NA	7/23/96	2350	32.2	3.3
1/22/96	4540	112	6.7	7/25/96	2330	33.3	3.3
1/26/96	3680	87.9	5.2	7/29/96	2060	27.8	2.8
1/30/96	2870	55.6	3.4	8/2/96	1970	29.4	2.5
2/2/96	2710	53.4	2.7	8/6/96	2040	31.0	2.9
2/6/96	3560	63.2	3.4	8/8/96	1910	28.6	2.5
2/10/96	4870	108	NA	8/12/96	1990	27.9	2.7
2/14/96	4930	98.2	NA	8/16/96	1960	25.2	2.7
2/16/96	4760	95.9	4.4	8/20/96	1830	26.0	2.6
2/20/96	4890	102	NA	8/23/96	1980	30.2	2.7
2/23/96	4600	101	NA	8/27/96	2270	31.7	3.0
2/28/96	4820	104	NA	8/31/96	2410	38.2	2.9
3/1/96	5460	130	NA	9/4/96	2890	51.4	3.8
3/5/96	NA	NA	NA	9/5/96	2850	52.0	NA
3/9/96	NA	NA	NA	9/9/96	2570	41.2	3.3
3/13/96	NA	NA	NA	9/13/96	2730	44.8	3.4
3/17/96	NA	NA	NA	9/17/96	2610	36.7	3.3
3/22/96	5160	136	6.2	9/21/96	2320	33.4	3.0
3/26/96	4910	130	5.7	9/25/96	2740	31.8	3.2
3/30/96	4070	108	4.7	9/29/96	3280	35.0	3.7
4/3/96	4610	121	5.7				

Count	93	93	82
Min	1830	25.2	2.1
Max	5520	136	7.6
Mean	3185	59.7	3.8
Geo Mean	#NUM!	52.9	3.6
Median	2870	48.8	3.4

Main (Firebaugh) Drain at Russel Avenue (MER556S)

Location: Latitude: 36°55'27", Longitude 120°39'11". In SW 1/4, SW 1/4, SW 1/4, Sec. 34, T.11S.,R.12E.
East side of Russel Avenue, 2.7 miles south of Dos Palos.

AUTOSAMPLER DATA : 4 day composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L
10/3/96	4500	68.0	6.2
10/7/96	4290	71.4	
10/8/96	4490	96.8	
10/12/96	2750	36.3	
10/16/96	3700	56.2	
10/20/96	4530	76.2	
10/24/96	3760	40.9	
10/25/96	4050	40.8	
10/29/96	4490	58.4	
11/2/96	2690	28.8	
11/6/96	4360	64.0	
11/8/96	5210	80.5	
11/12/96	4040	61.0	
11/16/96	3170	51.8	
11/19/96	2290	40.0	
11/23/96	2550	45.4	
11/27/96	3740	70.4	
12/1/96	4740	108.0	
12/5/96	5210	118.0	
12/9/96	3410	72.4	
12/13/96	3670	73.0	
12/17/96	4800	103.0	
12/20/96	5260	109.0	
12/24/96	5420	122.0	
12/26/96	5550	125.0	
Count	25	25	1
Min	2290	28.8	6.2
Max	5550	125.0	6.2
Mean	4107	72.7	6.2
Geo Mean	3996	67.2	6.2
Median	4290	70.4	6.2

Panoche Drain at O'Banion Guage Station (MER501S)

Location: Latitude 36°55'14". Longitude 120°41'43". In SW 1/4, SW 1/4, SW 1/4, Sec. 32, T.11S., R.12E. Located 0.5 miles south of CCID Main Canal, 1.9 miles west of Russel Road. 5.5 miles SW of Dos Palos.

AUTOSAMPLER DATA: 4 DAY COMPOSITE SAMPLES

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
10/2/95	5220	149	7.9	4/7/96	NA	NA	NA
10/6/95	NA	NA	NA	4/11/96	NA	NA	NA
10/10/95	4710	23.4	7.8	4/15/96	NA	NA	NA
10/14/95	5120	25.0	8.5	4/19/96	NA	NA	NA
10/18/95	5100	50.5	8.8	4/23/96	4910	112	7.5
10/22/95	5150	111	8.6	4/27/96	5000	110	7.8
10/26/95	5050	116	8.4	5/1/96	4700	94.6	6.8
10/30/95	4430	89.2	7.5	5/3/96	4910	112	7.3
11/3/95	3860	69.6	6.3	5/7/96	4780	95.0	6.9
11/7/95	3950	64.6	7.0	5/11/96	4920	89.0	7.1
11/11/95	3970	74.7	6.6	5/15/96	4880	44.9	6.8
11/15/95	3720	55.6	5.9	5/16/96	4500	95.0	5.9
11/19/95	3480	53.0	5.8	5/20/96	4680	81.8	7.3
11/24/95	3840	70.6	6.3	5/24/96	4630	76.9	7.1
11/28/95	3950	74.2	6.0	5/28/96	4660	80.8	7.6
12/2/95	3910	81.2	6.8	5/30/96	4660	75.4	7.7
12/6/95	3380	68.1	5.5	6/3/96	4520	NA	NA
12/8/95	3470	71.4	5.6	6/7/96	4830	NA	NA
12/12/95	4220	85.2	5.8	6/11/96	NA	NA	NA
12/16/95	4190	91.2	5.7	6/13/96	NA	NA	NA
12/20/95	4530	105	6.4	6/17/96	4550	64.1	6.8
12/22/95	4690	108	6.4	6/21/96	4750	72.4	7.5
12/26/95	5100	124	7.0	6/25/96	4390	61.8	7.0
12/30/95	5190	134	7.2	6/27/96	4640	74.6	7.1
1/3/96	4780	40.2	7.0	7/1/96	4540	68.1	7.8
1/4/96	4980	40.2	6.9	7/5/96	4420	68.3	NA
1/8/96	4970	37.6	7.1	7/9/96	NA	NA	NA
1/12/96	5000	102	7.3	7/11/96	NA	NA	NA
1/16/96	5040	120	7.0	7/15/96	4870	76.0	8.3
1/18/96	4670	106	6.5	7/19/96	4540	63.6	7.4
1/22/96	4180	95.6	6.1	7/23/96	4430	69.8	7.4
1/26/96	4140	88.6	6.4	7/25/96	4480	70.4	6.2
1/30/96	4010	82.8	6.3	7/29/96	4460	72.2	7.4
2/2/96	3050	53.2	4.4	8/2/96	4260	66.2	7.0
2/6/96	4380	54.8	5.3	8/6/96	4180	62.6	6.9
2/10/96	5440	90.8	6.8	8/8/96	4240	69.5	7.3
2/14/96	5580	96.4	7.0	8/12/96	4250	68.2	7.5
2/18/96	5410	83.1	7.0	8/16/96	4230	69.0	7.3
2/22/96	5360	79.1	6.9	8/20/96	4060	62.8	7.0
2/23/96	4960	75.8	7.2	8/23/96	3860	51.7	6.8
2/27/96	4650	80.0	6.5	8/27/96	3970	47.6	6.8
3/1/96	4780	92.3	6.5	8/31/96	4350	77.2	7.3
3/5/96	4980	114	7.3	9/4/96	4170	70.2	7.0
3/9/96	5150	109	7.3	9/5/96	4190	70.7	NA
3/13/96	4560	103	3.4	9/9/96	3830	61.1	6.3
3/17/96	4760	88.2	7.0	9/13/96	3690	60.0	6.1
3/18/96	3810	86.2	NA	9/17/96	4490	78.4	7.5
3/22/96	4920	100	7.2	9/21/96	4370	75.6	7.0
3/26/96	5250	91.1	8.7	9/25/96	4890	94.9	8.5
3/30/96	NA	NA	NA	9/29/96	5370	112	9.2
4/3/96	NA	NA	NA				
				Count	90	88	85
				Min	3050	23.4	3.4
				Max	5580	149	9.2
				Mean	4530	79.9	7.0
				Geo Mean	4500	76.2	6.9
				Median	4560	76.5	7.0

Panoche Drain at O'Banion Gauge Station (MER501)

Location: Latitude 36°55'14", Longitude 120°41'43". In SW 1/4, SW 1/4, SW 1/4, Sec. 32, T.11S., R.12E. Located 0.5 miles south of CCID Main Canal, 1.9 miles west of Russel Road. 5.5 miles SW of Dos Palos.

AUTOSAMPLER DATA : Four day composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L
10/3/96	5320	112.0	9.0
10/7/96	4860	69.0	
10/8/96	4710	66.2	
10/12/96	4940	84.2	
10/16/96	4880	100.6	
10/20/96	4980	70.6	
10/24/96	4870	65.2	
10/25/96	4760	52.6	
10/29/96	5070	88.9	
11/2/96	4560	77.6	
11/6/96	4960	83.1	
11/8/96	5080	89.2	
11/12/96	5160	116.0	
11/16/96	5170	112.0	
11/20/96	4800	100.0	
11/24/96	4340	92.1	
11/26/96	4420	65.5	
11/30/96	4610	37.4	
12/4/96	4910	38.8	
12/5/96	4750	35.0	
12/9/96	4750	35.4	
12/13/96	4390	35.5	
12/17/96	4710	60.4	
12/20/96	5030	91.4	
12/24/96	4330	76.4	
12/28/96	4840	79.0	
1/1/97	4580	79.4	
1/5/97	3830	45.8	
1/9/97	4330	51.0	
Count	29	29	1
Min	3830	35.0	9.0
Max	5320	116.0	9.0
Mean	4757	72.8	9.0
Geo Mean	4746	68.4	9.0
Median	4800	76.4	9.0

Agatha Canal at Mallard Road (MER506S)

Location: Latitude: 36°56'12". Longitude 120°42'07". In NE 1/4, NW 1/4, SW 1/4, Sec. 7, T.11S., R.11E.
South of Sante Fe Grade at Brito, west of Mallard Road. 4.5 miles west of Dos Palos.

AUTOSAMPLER DATA : 12 hour daily composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
1/9/97			0.41	2/22/97	246		
1/10/97	275			2/23/97	225	1.0	
1/11/97	264			2/24/97	208		
1/12/97	286			2/25/97	211		
1/13/97	312			2/26/97	204		
1/14/97	257			2/27/97	205		
1/15/97	258			2/28/97	194		
1/16/97	259			3/1/97	196		
1/17/97	244			3/2/97	199		
1/18/97	243			3/3/97	203	1.3	
1/19/97	236			3/4/97	195		
1/20/97	230			3/5/97	195		
1/21/97	227			35495	187		
1/22/97	244			3/7/97	161		
1/23/97	262			3/8/97	156	0.7	
1/24/97	260			3/9/97	154		
1/25/97	285			3/10/97	148		
1/26/97	308			3/11/97	149		
1/27/97	342			3/12/97	145		
2/5/97	809	6.8	1.0	3/13/97	157	0.7	
2/6/97	235			3/14/97	148		
2/7/97	119			3/15/97	148		
2/8/97	116			3/16/97	138		
2/9/97	125			3/17/97	232		
2/10/97	182			3/18/97	244		
2/11/97	235			3/19/97	235		
2/12/97	255	0.5	0.70	3/20/97	215		
2/13/97	246			3/21/97	178		
2/14/97	229			3/22/97	173	0.8	
2/15/97	221			3/23/97	196		
2/16/97	205			3/24/97	275		
2/17/97	198			3/25/97	308	1.6	
2/18/97	202						
2/19/97	168						
2/20/97	158						
2/21/97	323	1.5	0.37				

Count	67	9	4
Min	116	0.5	0.37
Max	809	6.8	1.0
Mean	225	1.7	0.62
Geo Mean	214	1.2	0.57
Median	215	1.0	0.56

Camp 13 Slough at Gauge Station (MER505S)

Location: Latitude 36°56'21". Longitude 120°45'22". In SE 1/4, SE 1/4, SW 1/4, Sec. 27, T.11S., R.11E. 150 feet north of CCID Main Canal, 6.4 miles west of Russel Avenue. 9.2 miles SE of Los Banos. 6.7 miles SW of S. Dos Palos

AUTOSAMPLER DATA : 12 hour daily composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L
1/10/97	125		
1/11/97	150		
1/12/97	209		
1/13/97	147		
1/14/97	128		
1/15/97	140		
1/16/97	122		
1/17/97	142		
1/18/97	145		
1/19/97	144		
1/20/97	148		
1/21/97	161		
1/22/97	176		
1/23/97	226		
1/24/97	269		
1/25/97	375		
1/26/97	681	2.3	
1/27/97	1980	19.2	
1/28/97	2770	30.8	
1/29/97	2750	33.0	4.6
1/30/97	2640	31.0	
1/31/97	1700	18.6	
2/1/97	1210	12.6	
2/2/97	1230	15.3	
2/3/97	1120	16.0	1.5
2/4/97	1120	14.1	
2/5/97	263		
2/6/97	388		
2/7/97	497	0.6	0.67
2/8/97	395		
2/9/97	335		
2/10/97	307		
2/11/97	407		
2/12/97	513	0.5	0.34
2/13/97	467		
2/14/97	420		
2/15/97	329		
2/16/97	183		
2/17/97	168		
2/18/97	163		
2/19/97	158		
2/20/97	151		
2/21/97	149		
2/22/97	152		
2/23/97	149		
2/24/97	150		
2/25/97	144		
2/26/97	150		
2/27/97	158	0.5	
2/28/97	152		
3/1/97	142		
3/2/97	143		
3/3/97	148		
3/4/97	146		
3/5/97	151	<0.4	
3/6/97	1690		
3/7/97	1770		
3/8/97	2030	4.2	3.1
3/9/97	2350	4.6	
3/10/97	2150		
3/11/97	1960		
3/12/97	3990		
3/13/97	4630	21.2	7.7
3/14/97	3340		
3/15/97	2960		
3/16/97	1370		
3/17/97	1100		
3/18/97	1650		
3/19/97	2140		
3/20/97	2860	6.2	
3/21/97	2670		
3/22/97	2990	10.2	5.2
3/23/97	2750		
3/24/97	2260		
3/25/97	3760	6.3	6.9

	EC µmhos/cm	Se µg/L	B mg/L
Count	75	20	8
Min	122	<0.4	0.34
Max	4630	33.0	7.7
Mean	1030	12.4	3.8
Geo Mean	505	6.1	2.5
Median	375	11.4	3.9

Mud Slough (north) at San Luis Drain (MER542S)

Location: Latitude 37°19'50", Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E.
5.0 miles east of Gustine, 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

AUTOSAMPLER DATA: 4 DAY COMPOSITE SAMPLES

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
10/4/95	987	0.9	0.61	4/7/96	3230	3.0	3.3
10/6/95	978	1.0	0.64	4/11/96	3540	1.7	3.8
10/10/95	1120	1.0	0.75	4/15/96	3320	18.4	3.9
10/14/95	985	0.9	0.69	4/19/96	3940	19.4	3.7
10/18/95	610	1.0	0.45	4/23/96	2870	0.9	2.0
10/22/95	732	0.8	0.53	4/27/96	2130	1.0	1.5
10/26/95	791	0.7	0.58	5/1/96	1820	1.0	1.2
10/30/95	756	0.7	0.58	5/3/96	3070	0.9	2.6
11/3/95	837	1.0	0.66	5/7/96	3880	1.7	2.4
11/7/95	858	0.7	0.71	5/11/96	1840	4.2	1.2
11/11/95	889	0.7	0.70	5/15/96	1860	1.3	1.1
11/15/95	952	0.6	0.76	5/20/96	2300	1.4	1.6
11/19/95	1010	0.6	0.73	5/24/96	1530	1.4	1.6
11/24/95	1100	0.5	0.81	5/28/96	1810	1.1	1.2
11/28/95	1190	0.5	0.90	5/30/96	1340	0.7	1.3
12/2/95	1210	0.5	0.92	6/3/96	1420	1.3	1.0
12/6/95	1150	0.7	0.84	6/7/96	2410	1.0	1.8
12/8/95	1200	0.6	0.85	6/11/96	1700	1.1	1.3
12/12/95	1290	1.1	0.90	6/13/96	1570	1.2	NA
12/16/95	1190	0.7	0.83	6/16/96	NA	NA	NA
12/20/95	1230	0.6	0.89	6/17/96	NA	NA	NA
12/22/95	1260	0.8	0.85	6/21/96	NA	NA	NA
12/26/95	1340	0.7	1.0	6/25/96	NA	NA	NA
12/30/95	1550	1.1	1.2	6/27/96	NA	NA	NA
1/3/96	1760	0.8	1.3	7/1/96	3030	1.3	2.1
1/4/96	1910	0.8	1.2	7/5/96	3600	1.5	2.4
1/8/96	1880	0.9	1.4	7/9/96	3530	1.9	2.3
1/12/96	2000	0.8	1.4	7/11/96	2330	2.4	NA
1/16/96	1870	0.8	1.4	7/15/96	2550	1.3	1.8
1/18/96	1840	0.7	1.4	7/19/96	2550	1.9	1.8
1/22/96	1570	0.7	1.2	7/23/96	3810	1.1	2.7
1/26/96	1550	0.6	1.1	7/25/96	2690	1.2	NA
1/30/96	1750	0.6	1.3	7/29/96	1640	1.7	1.1
2/2/96	1050	0.7	0.85	8/2/96	1500	1.2	0.96
2/6/96	1010	0.7	0.81	8/6/96	1620	1.9	1.0
2/10/96	910	0.6	0.75	8/8/96	2640	1.2	NA
2/14/96	1590	0.6	1.4	8/12/96	1370	2.0	0.99
2/16/96	1830	0.6	1.4	8/16/96	2240	1.5	1.5
2/20/96	1810	2.2	1.4	8/20/96	1290	2.1	0.91
2/24/96	5150	2.1	2.3	8/23/96	1660	1.6	1.1
3/5/96	NA	NA	NA	8/27/96	2360	1.3	1.5
3/9/96	NA	NA	NA	8/31/96	1500	1.9	1.0
3/13/96	NA	NA	NA	9/4/96	967	1.9	0.66
3/17/96	NA	NA	NA	9/9/96	NA	NA	NA
3/18/96	NA	NA	NA	9/13/96	NA	NA	NA
3/22/96	2010	0.8	1.7	9/17/96	NA	NA	NA
3/26/96	2120	1.2	1.9	9/21/96	NA	NA	NA
3/30/96	2330	1.2	2.2	9/23/96	NA	NA	NA
4/3/96	2380	1.3	2.1	9/27/96	3670	7.1	5.6
				Count	83	83	79
				Min	610	0.5	0.45
				Max	5150	19.4	5.6
				Mean	1880	1.7	1.4
				Geo Mean	1680	1.1	1.2
				Median	1660	1.0	1.2

Mud Slough (north) at San Luis Drain (MER542S)

Location: Latitude 37°19'50", Longitude 120°57'03" In NW 1/4, NE 1/4, NW 1/4, Sec.14, T.7S., R.9E
5 miles east of Gustine, 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

AUTOSAMPLER DATA : Four day composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
10/1/96	3760	31.4	6.2	1/4/97	1570	9.9	2.0
10/3/96	3340	50.6	4.9	1/8/97	NA	NA	NA
10/7/96	2380	27.8	3.1	1/9/97	1200	4.6	NA
10/11/96	1950	17.6	2.5	1/13/97	1380	5.7	1.6
10/15/96	1960	15.8	2.6	1/17/97	1900	12.2	2.2
10/18/96	1830	14.0	2.5	1/21/97	1620	9.5	1.8
10/22/96	1480	7.4	1.8	1/25/97	1620	9.6	1.8
10/26/96	1460	7.7	1.7	1/29/97	1280	7.6	1.4
10/29/96	1720	8.4	2.1	2/2/97	1170	4.5	1.3
11/2/96	1860	11.4	2.2	2/4/97	1290	6.7	1.5
11/6/96	1740	10.0	2.0	2/8/97	1680	9.9	2.0
11/10/96	1520	8.8	1.7	2/11/97	2240	17.5	2.7
11/14/96	1520	6.7	1.7	2/15/97	2780	27.8	3.3
11/18/96	1640	9.2	2.2	2/19/97	3150	31.5	4.2
11/22/96	1610	10.4	2.1	2/23/97	3500	36.4	4.8
11/26/96	1460	9.3	1.8	2/27/97	3420	33.0	4.3
11/30/96	1480	7.3	1.5	2/28/97	3300	32.4	NA
12/4/96	1660	6.6	1.8	3/4/97	3620	25.6	3.4
12/8/96	1790	5.0	1.9	3/8/97	3750	44.2	5.1
12/10/96	1650	4.5	1.7	3/12/97	3660	43.4	5.1
12/14/96	1420	4.9	1.6	3/13/97	3500	44.4	
12/18/96	1360	5.5	1.5	3/17/97	3460	42.2	
12/22/96	1510	7.2	1.7	3/21/97	3210	33.5	
12/26/96	1490	7.2	1.7	3/25/97	3140	28.4	
12/31/96	1300	7.1	1.4				
				Count	48	48	42
				Min	1170	4.5	1.3
				Max	3760	50.6	6.2
				Mean	2130	17.1	2.5
				Geo Mean	1980	12.9	2.3
				Median	1700	9.9	2.0

Salt Slough at Lander Avenue (MER531S)

Location: Latitude 37°14'55", Longitude 120°51'04". In NW 1/4, SE 1/4, SE 1/4, Sec. 10, T.8S., R.10E.
13.0 miles north of Los Banos. 5.0 miles south of Highway 140.

AUTOSAMPLER DATA: 4 DAY COMPOSITE SAMPLES

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
10/4/95	1090	7.2	0.95	4/7/96	2230	16.6	1.9
10/6/95	886	1.8	0.47	4/11/96	2280	16.0	1.8
10/10/95	1000	1.2	0.53	4/15/96	2060	16.0	1.7
10/14/95	1090	1.3	0.56	4/19/96	1950	17.0	1.7
10/18/95	938	2.1	0.56	4/23/96	2140	22.1	2.0
10/22/95	1300	9.2	1.2	4/27/96	2520	27.2	2.4
10/26/95	1540	14.8	1.6	5/1/96	2800	33.8	2.7
10/30/95	1500	11.2	1.4	5/3/96	2890	31.2	2.8
11/3/95	1570	7.8	1.3	5/7/96	3170	37.8	3.0
11/7/95	1610	8.9	1.5	5/11/96	2320	25.2	2.2
11/11/95	1680	7.9	1.4	5/15/96	2100	19.9	1.9
11/15/95	1640	8.4	1.4	5/16/96	2310	20.8	NA
11/19/95	1920	13.2	1.8	5/20/96	1810	15.0	1.6
11/24/95	1910	11.9	1.9	5/24/96	1870	14.2	1.9
11/28/95	1890	11.8	1.8	5/28/96	1820	16.8	1.9
12/2/95	1790	12.2	1.7	6/1/96	2260	20.9	2.5
12/6/95	1850	13.4	1.7	6/5/96	2260	22.2	2.5
12/8/95	1860	13.4	1.9	6/9/96	2510	25.1	3.0
12/12/95	2010	11.6	1.7	6/13/96	2270	19.6	2.7
12/16/95	1830	13.3	1.7	6/17/96	2310	18.5	2.5
12/20/95	1960	12.5	1.9	6/21/96	2190	18.3	2.2
12/22/95	2040	13.4	2.1	6/25/96	2250	19.3	2.2
12/26/95	2060	13.4	2.0	6/27/96	2530	24.0	2.6
12/30/95	2410	16.0	2.2	7/1/96	2540	NA	2.9
1/3/96	2500	16.2	2.4	7/5/96	2350	22.8	2.7
1/4/96	2400	5.7	2.0	7/9/96	2060	17.1	2.3
1/8/96	2620	6.1	2.2	7/11/96	2140	18.4	2.4
1/12/96	2850	10.4	1.7	7/15/96	2300	21.4	2.6
1/16/96	2900	24.2	2.8	7/19/96	2330	20.4	2.7
1/18/96	2780	28.2	2.8	7/23/96	2240	20.2	2.7
1/22/96	2510	29.8	2.8	7/25/96	2120	18.8	2.7
1/26/96	2270	20.6	2.6	7/29/96	1860	16.4	2.2
1/30/96	2340	21.8	2.6	8/2/96	1740	15.8	2.1
2/2/96	1900	14.0	2.0	8/6/96	1730	15.4	2.0
2/6/96	2000	12.9	1.9	8/8/96	1530	12.8	1.8
2/10/96	2110	15.7	2.1	8/12/96	1600	13.4	1.8
2/14/96	2550	22.6	2.6	8/15/96	1470	12.1	1.6
2/16/96	2570	23.0	2.6	8/19/96	NA	NA	NA
2/20/96	2420	22.4	2.6	8/23/96	NA	NA	NA
2/24/96	2290	18.6	2.0	8/27/96	NA	NA	NA
2/28/96	2020	17.6	1.9	8/28/96	NA	NA	NA
3/1/96	2070	15.8	2.0	9/1/96	1650	15.4	1.8
3/5/96	2260	17.9	2.1	9/5/96	1510	12.8	1.5
3/9/96	2250	16.9	2.1	9/9/96	1890	16.9	2.2
3/13/96	2430	19.0	2.2	9/12/96	1630	13.6	1.8
3/17/96	2300	17.7	2.1	9/16/96	1260	6.8	1.0
3/18/96	1960	15.9	NA	9/20/96	1630	14.0	1.6
3/22/96	2130	17.1	2.1	9/24/96	1540	11.4	1.5
3/26/96	2110	17.4	2.5	9/26/96	1280	7.4	1.0
3/30/96	1940	11.8	1.9	9/30/96	1160	1.5	0.6
4/3/96	2020	17.8	2.1				
				Count	97	96	95
				Min	886	1.2	0.47
				Max	3170	37.8	3.0
				Mean	2020	16.0	2.0
				Geo Mean	1970	13.9	1.9
				Median	2060	16.0	2.0

Salt Slough at Lander Avenue (State Highway 165) (MER531S)

Location: Latitude 37°14'55", Longitude 120°51'04". In NW 1/4, SE 1/4, SE 1/4, Sec. 10, T.8S., R.10E.
13.0 miles north of Los Banos. 5.0 miles south of Highway 140.

AUTOSAMPLER DATA : Four day composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L
10/4/96	1210	1.5	0.64
10/8/96	1260	1.1	0.66
10/9/96	960	1.4	NA
10/13/96	1020	1.2	0.52
10/17/96	1350	0.9	0.68
10/21/96	1460	0.8	0.71
10/24/96	1190	0.8	0.59
10/28/96	1510	1.5	0.85
11/1/96	1150	0.8	0.65
11/5/96	1090	0.9	0.74
11/7/96	1210	0.9	0.87
11/11/96	1380	1.0	1.0
11/15/96	1490	0.9	1.0
11/19/96	1360	1.2	0.92
11/22/96	1280	1.3	0.92
11/26/96	1540	1.1	1.0
11/30/96	1350	1.0	1.0
12/4/96	1400	1.0	1.0
12/6/96	NA	NA	NA
12/10/96	1500	1.1	1.1
12/14/96	1460	1.1	1.1
12/18/96	1590	1.0	1.1
12/19/96	1620	0.86	NA
12/23/96	1690	1.0	1.1
12/27/96	1810	0.8	1.2
12/31/96	1810	0.9	1.2
1/4/97	1810	1.5	1.7
1/8/97	1840	0.9	1.3
1/9/97	1350	1.1	
1/13/97	1160	1.0	0.93
1/17/97	1460	0.9	1.2
1/21/97	1580	1.0	1.3
1/24/97	1610	1.0	1.3
1/28/97	1650	1.0	1.2
2/1/97	2070	6.3	1.9
2/5/97	1980	4.6	1.7
2/7/97	2060	5.9	1.9
2/11/97	1723	1.4	1.4
2/15/97	1660	0.8	1.2
2/19/97	1650	0.6	1.0
2/21/97	1460	0.5	0.82
2/25/97	1160	0.6	0.57
3/1/97	1070	0.7	0.53
3/5/97	1020	0.6	0.47
3/9/97	1170	0.7	0.51
3/13/97	1180	0.8	0.52
3/17/97	1230	1.2	0.72
3/21/97	1120	1.6	
3/25/97	1360	1.2	
Count	48	48	43
Min	960	0.5	0.47
Max	2070	6.3	1.9
Mean	1440	1.3	1.0
Geo Mean	1410	1.1	0.93
Median	1430	1.0	1.0

San Luis Drain @ Terminus (MER535S)

Location: Latitude 37°19'50". Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E. 5.0 miles east of Gustine. 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

AUTOSAMPLER DATA : 12 hour daily composite samples

Date	EC µmhos/cm	Selenium µg/L	Boron mg/L
9/13/96	7410		
9/14/96	7120		
9/15/96	7340		
9/16/96	8680		
9/17/96	7160		
9/18/96	7330		
9/19/96	7570		
9/20/96	7720		
9/21/96	7730		
9/22/96	7780		
9/23/96	9790		
9/24/96	8510		
9/25/96	9030		
9/26/96	7850		
9/27/96	4660	56.9	
9/28/96	4570	71.6	
9/29/96	5050	77.8	
9/30/96		86.5	
Count	17	4	0
Min	4570	56.9	
Max	9790	86.5	
Mean	7371	73.2	
Geo Mean	7220	72.4	
Median	7570	74.7	

San Luis Drain @ Terminus (MER535S)

Location: Latitude 37°19'50", Longitude 120°57"03". In NW 1/4, NE 1/4, NW 1/4, Sec. 14, T.7S., R.9E.

5.0 miles east of Gustine, 3.5 miles SE of Highway 140. Located within Kesterson N. W. R.

AUTOSAMPLER DATA : 12 hour daily composite samples

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
10/1/96	5360	90.3	8.6	11/24/96	3510	61.4	6.1
10/2/96	4400	106	9.3	11/25/96	3200	51.8	5.5
10/3/96	4340	66.3	7.3	11/26/96	3180	52.4	4.9
10/4/96	4440	59.0	6.9	11/27/96	3750	63.9	6.2
10/5/96	4460	56.4	7.0	11/28/96	3670	68.2	6.0
10/6/96	4290	61.3	7.0	11/29/96	3520	57.3	5.6
10/7/96	4610	59.8	6.7	11/30/96	3540	53.3	5.6
10/8/96	4710	63.0	7.1	12/1/96	3720	46.1	6.1
10/9/96	4710	64.8	NA	12/2/96	3960	50.2	6.5
10/10/96	5030	63.5	7.6	12/3/96	4040	46.2	6.5
10/11/96	5250	69.6	8.5	12/4/96	3850	31.6	6.4
10/12/96	4850	72.6	9.0	12/5/96	3890	29.5	NA
10/13/96	5460	52.6	8.2	12/6/96	4100	38.3	6.7
10/14/96	NA	NA	NA	12/7/96	4170	39.3	6.5
10/15/96	NA	NA	NA	12/8/96	4080	38.2	6.2
10/16/96	NA	NA	NA	12/9/96	4110	34.8	6.4
10/17/96	NA	NA	NA	12/10/96	4190	34.7	7.1
10/18/96	NA	NA	NA	12/11/96	4470	42.4	7.8
10/19/96	3380	41.8	5.5	12/12/96	4320	49.2	7.6
10/20/96	3470	41.4	5.8	12/13/96	3850	45.3	6.7
10/21/96	3530	40.8	5.9	12/14/96	3870	48.3	6.7
10/22/96	3520	43.7	5.8	12/15/96	4100	51.8	7.4
10/23/96	3900	49.8	6.7	12/16/96	3850	50.9	6.9
10/24/96	4260	78.4	7.1	12/17/96	3840	47.2	6.4
10/25/96	4360	78.8	7.3	12/18/96	4020	50.8	6.9
10/26/96	4260	59.8	7.2	12/19/96	4140	51.1	7.3
10/27/96	3940	40.3	6.7	12/20/96	4190	54.8	7.4
10/28/96	4420	56.8	7.7	12/21/96	4400	56.1	7.9
10/29/96	4420	52.3	NA	12/22/96	4470	51.9	7.9
10/30/96	4240	60.3	6.8	12/23/96	4530	63.4	8.1
10/31/96	4200	51.9	6.1	12/24/96	4860	71.0	8.3
11/1/96	4080	43.6	NA	12/25/96	4870	71.3	8.4
11/2/96	4120	43.9	6.7	12/26/96	4580	67.3	6.6
11/3/96	4270	53.4	6.4	12/27/96	4040	62.9	6.2
11/4/96	4290	63.2	6.7	12/28/96	4290	65.7	6.6
11/5/96	4300	57.5	6.6	12/29/96	5220	63.0	7.7
11/6/96	4270	80.3	6.8	12/30/96	4820	67.9	7.6
11/7/96	3790	59.2	5.9	12/31/96	4930	74.6	7.5
11/8/96	3510	45.0	5.4	1/1/97	5080	80.8	7.9
11/9/96	3500	43.6	5.5	1/2/97	4870	73.6	7.0
11/10/96	3410	36.6	5.5	1/3/97	4740	76.6	6.8
11/11/96	3560	38.3	5.9	1/4/97	4100	65.0	5.8
11/12/96	3970	50.9	6.9	1/5/97	4280	61.8	6.8
11/13/96	4130	56.6	7.5	1/6/97	4100	53.9	6.3
11/14/96	4330	61.5	8.0	1/7/97	3040	36.6	4.3
11/15/96	4190	59.4	7.9	1/8/97	3510	35.8	5.3
11/16/96	4220	55.5	8.1	1/9/97	4080	44.1	6.3
11/17/96	4380	63.8	8.5	1/10/97	4250	47.2*	6.6*
11/18/96	4410	73.6	8.7	1/11/97	4550	60.0*	7.5*
11/19/96	4400	75.2	8.5	1/12/97	4650	64.0*	7.3*
11/20/96	4170	69.6	8.0	1/13/97	NA	NA	NA
11/21/96	4050	68.2	7.7	1/14/97	4700	63.6*	7.8*
11/22/96	4000	73.4	7.5	1/15/97	4710	66.3*	7.8*
11/23/96	3900	69.8	6.9	1/16/97	4830	66.8*	8.2*

San Luis Drain @ Terminus (MER535S) continued

Date	EC µmhos/cm	Se µg/L	B mg/L
1/17/97	4740	76.4*	7.3*
1/18/97	4730	70.3*	7.7*
1/19/97	4110	55.7*	5.6*
1/20/97	4360	55.2*	6.9*
1/21/97	4510	55.6*	NA
1/22/97	4650	62.8	7.7
1/23/97	4540	66.2	7.5
1/24/97	4620	73.0	7.4
1/25/97	4170	59.7	6.5
1/26/97	4010	56.4	6.1
1/27/97	4270	59.6	6.3
1/28/97	4300	65.1	6.6
1/29/97	4360	57.0	6.8
1/30/97	3570	40.6	5.5
1/31/97	3450	34.2	5.4
2/1/97	4160	45.8	6.5
2/2/97	4430	47.4	7.0
2/3/97	4550	58.2	7.1
2/4/97	4550	65.8	7.2
2/5/97	4570	62.3	7.3
2/6/97	4810	65.9	7.9
2/7/97	5020	72.8	8.1
2/8/97	5260	91.2	7.9
2/9/97	5230	90.5	7.7
2/10/97	5080	86.2	8.1
2/11/97	4940	79.1	7.9
2/12/97	5270	87.8	8.1
2/13/97	5340	81.8	8.4
2/14/97	5360	89.5	8.4
2/15/97	5230	86.0	8.1
2/16/97	5200	86.0	7.9
2/17/97	5210	85.3	8.1
2/18/97	5220	80.9	8.2
2/19/97	5300	81.0	8.4
2/20/97	5270	83.7	8.4
2/21/97	5280	84.4	8.1
2/22/97	5160	78.3	8.0
2/23/97	5040	78.4	7.7
2/24/97	5050	84.0	7.7
2/25/97	4970	71.1	7.4
2/26/97	5050	74.8	7.4
2/27/97	4700	70.0	6.9
2/28/97	4890	77.4	7.2
3/1/97	5080	75.4	7.7
3/2/97	5090	82.4	8.0
3/3/97	5270	101	7.9
3/4/97	5200	97.9	7.9
3/5/97	5140	87.8	7.9
3/6/97	5030	86.4	7.8
3/7/97	5090	89.8	7.8
3/8/97	4960	88.4	7.5
3/9/97	5030	87.2	7.7
3/10/97	5030	96.9	7.5
3/11/97	4910	95.5	7.3
3/12/97	4800	86.3	7.0
3/13/97	4650	86.2	6.4
3/14/97	4610	82.2	6.5
3/15/97	4600	87.4	6.4
3/16/97	4860	87.6	7.0
3/17/97	4980	89.9	7.0
3/18/97	4780	86.8	6.6
3/19/97	4580	81.4	6.2
3/20/97	4300	75.6	5.8
3/21/97	4550	82.1	6.6
3/22/97	4560	74.5	6.7
3/23/97	4630	69.8	6.3
3/24/97	4710	72.7	6.3
3/25/97	4890	79.0	6.8
3/26/97	4840	78.2	6.7
3/27/97	4710	82.0	6.8
3/28/97	4490	69.4	6.5
3/29/97	4580	78.0	6.6
3/30/97	4610	82.4	6.5
3/31/97	4710	89.0	6.5
4/1/97	4700	85.0	7.0
4/2/97	5020	90.6	7.4
4/3/97	5060	92.6	7.3
4/4/97	5510	104	7.9
4/5/97	5410	108	7.5
4/6/97	5420	112	7.5
4/7/97	5440	110	7.3
4/8/97	5490	110	7.4
4/9/97	5430	106	7.1
4/10/97	5420	106	7.1
4/11/97	5720	116	7.5
4/12/97	5760	113	7.6
4/13/97	5750	114	7.8
4/14/97	5480	108	7.5
4/15/97	5630	110	7.6
4/16/97	NA	116	7.5
4/17/97	5880	115	7.5
4/18/97	5530	116	7.5
4/19/97	5350	108	7.3
4/20/97	5350	106	7.3
4/21/97	5480	113	7.4
4/22/97	5510	110	7.5
4/23/97	5220	103	6.9
4/24/97	5010	96.6	6.8
4/25/97	5090	97.6	7.1
4/26/97	5120	98.6	7.1
4/27/97	5260	104	7.3
4/28/97	5390	108	7.4
4/29/97	5020	91.0	7.1
4/30/97	5090	96.6	7.0
5/1/97	4950	88.8	7.2
5/2/97	5170	88.4	7.1
5/3/97	5370	91.1	8.2
5/4/97	5520	96.6	8.5
5/5/97	5550	92.6	8.1
5/6/97	5530	102	9.0
5/7/97	5510	84.0	8.2
5/8/97	5490	85.7	7.8
5/9/97	5300	76.3	7.8
5/10/97	5050	79.1	7.1
5/11/97	4690	77.4	7.1
5/12/97	4760	77.9	7.3
5/13/97	4860	82.7	7.7

San Luis Drain @ Terminus (MER535S) continued

Date	EC µmhos/cm	Se µg/L	B mg/L	Date	EC µmhos/cm	Se µg/L	B mg/L
5/14/97	4660	77.5	7.5	7/12/97	4120	39.0	7.8
5/15/97	4570	72.4	7.2	7/13/97	3950	41.0	7.5
5/16/97	4450	60.7	7.0	7/14/97	4050	46.9	7.2
5/17/97	4550	65.8	7.0	7/15/97	4240	44.1	8.0
5/18/97	4750	67.8	7.5	7/16/97	4260	43.8	8.0
5/19/97	4690	68.4	7.3	7/17/97	4200	41.0	7.8
5/20/97	4440	67.6	7.2	7/18/97	4300	44.1	8.1
5/21/97	4420	71.4	6.9	7/19/97	4190	47.1	7.8
5/22/97	4030	63.8	6.1	7/20/97	4110	57.4	7.6
5/23/97	4230	64.4	6.8	7/21/97	4030	49.0	7.4
5/24/97	4270	65.0	6.9	7/22/97	4150	52.8	7.3
5/25/97	4720	72.0	8.1	7/23/97	4090	47.0	7.5
5/26/97	4580	63.9	7.8	7/24/97	4190	46.2	7.8
5/27/97	4570	66.6	7.7	7/25/97	4220	43.6	8.1
5/28/97	4560	68.2	7.7	7/26/97	4180	44.0	7.8
5/29/97	4460	66.5	7.7	7/27/97	3900	37.9	7.2
5/30/97	4400	70.0	6.5	7/28/97	3950	44.0	7.3
5/31/97	4520	72.0	6.9	7/29/97	4050	44.3	7.3
6/1/97	4580	80.4	6.9	7/30/97	4000	40.0	7.3
6/2/97	4770	78.8	7.4	7/31/97	3850	40.2	7.0
6/3/97	4730	75.8	7.4	8/1/97	3760	42.6	6.9
6/4/97	4820	77.2	7.6	8/2/97	3620	39.2	6.5
6/5/97	4800	75.7	7.8	8/3/97	3570	36.6	6.5
6/6/97	4680	56.7	7.6	8/4/97	3540	32.9	6.4
6/7/97	4660	55.8	7.6	8/5/97	3460	34.7	6.1
6/8/97	4680	56.5	7.3	8/6/97	3810	41.2	6.4
6/9/97	4780	51.3	8.1	8/7/97	3610	34.0	6.3
6/10/97	4680	45.4	8.0	8/8/97	4250	51.0	7.7
6/11/97	4770	56.8	8.0	8/9/97	4090	46.1	7.3
6/12/97	4590	58.4	7.9	8/10/97	3880	46.9	6.8
6/13/97	5040	78.6	9.0	8/11/97	3830	48.4	6.7
6/14/97	4910	64.4	8.8	8/12/97	3870	46.0	6.8
6/15/97	4850	67.8	8.7	8/13/97	3680	37.8	6.5
6/16/97	4840	69.0	8.7	8/14/97	3730	38.4	6.4
6/17/97	4820	73.0	8.6	8/15/97	3710	41.6	6.2
6/18/97	4300	61.2	7.4	8/16/97	3430	35.6	5.8
6/19/97	4440	65.4	7.6	8/17/97	3240	32.0	5.3
6/20/97	4540	66.7	7.9	8/18/97	3430	40.3	5.6
6/21/97	4380	57.2	7.6	8/19/97	3590	47.4	5.6
6/22/97	4580	74.7	7.4	8/20/97	3330	37.8	5.6
6/23/97	4410	67.7	7.4	8/21/97	3470	39.7	5.5
6/24/97	4450	66.2	7.3	8/22/97	3820	39.5	6.2
6/25/97	4260	55.8	7.2	8/23/97	3550	32.7	6.1
6/26/97	4680	68.1	8.3	8/24/97	3450	40.5	6.0
6/27/97	4650	59.1	8.1	8/25/97	3270	31.0	5.7
6/28/97	4570	56.8	8.1	8/26/97	3540	35.7	6.1
6/29/97	4530	54.2	8.1	8/27/97	3790	45.2	6.2
6/30/97	4470	53.0	7.9	8/28/97	4020	51.6	6.3
7/1/97	4480	66.8	8.3	8/29/97	4140	50.8	6.6
7/2/97	4540	62.8	7.9	8/30/97	3880	38.3	6.4
7/3/97	4400	57.4	7.6	8/31/97	3870	43.2	6.4
7/4/97	4430	54.8	7.8	9/1/97	4230	55.8	6.3
7/5/97	4670	61.4	8.5	9/2/97	4180	52.0	6.4
7/6/97	4510	49.9	8.4	9/3/97	3920	43.0	5.8
7/7/97	4350	51.1	7.9	9/4/97	3440	29.3	5.4
7/8/97	4090	42.9	7.4	9/5/97	3290	26.6	5.2
7/9/97	4410	61.2	7.7	9/6/97	3680	36.0	6.0
7/10/97	4060	43.4	7.5	9/7/97	3480	27.7	5.6
7/11/97	4330	45.8	8.1	9/8/97	3760	24.3	6.1

San Luis Drain @ Terminus (MER535S) continued

Date	EC µmhos/cm	Se µg/L	B mg/L
9/9/97	3410	22.1	5.8
9/10/97	3100	20.6	5.2
9/11/97	3150	25.4	5.1
9/12/97	2960	20.1	4.6
9/13/97	3260	27.4	5.0
9/14/97	3240	28.2	5.0
9/15/97	2740	18.4	4.2
9/16/97	2630	16.5	4.1
9/17/97	2620	15.2	4.1
9/18/97	2950	16.6	4.5
9/19/97	2980	18.4	4.6
9/20/97	2940	18.0	4.6
9/21/97	2890	19.0	4.6
9/22/97	3070	20.9	4.7
9/23/97	3320	21.6	5.2
9/24/97	3440	19.9	5.4
9/25/97	3520	20.0	5.4
9/26/97	3590	20.1	5.9
9/27/97	3700	20.9	6.1
9/28/97	3530	20.7	5.7
9/29/97	3470	22.0	5.6
9/30/97	3900	32.2	5.9
Count	358	348	344
Min	2620	15.2	4.1
Max	5880	116	9.3
Mean	4390	62.4	7.0
Geo Mean	4340	57.7	6.9
Median	4420	61.5	7.2

* Data under review

APPENDIX D

Impact of January 1997 Flood Flows Diverted Around the Grassland Bypass and into Camp 13 Ditch and the Agatha Canal (Data from USBR, 1997)

Key to Data Sources

GWD = Grassland Water District
Board = Central Valley Regional Water Quality Control Board
USBR = US Bureau of Reclamation

APPENDIX D
(Table taken from USBR, 1997)

Table 1. Camp 13 Ditch and Agatha Canal releases, selenium concentrations and selenium loads, with associated inflow to the San Luis Drain (Monitoring Station A), for period of January 21 through February 10, 1997

	Camp 13 Ditch				Agatha Canal				Inflow to Drain (A)
			Selenium				Selenium		
Parameter	Flow	EC	Conc.	Load	Flow	EC	Conc.	Load	Inflow
Data Source	GWD	GWD	Board	Computed	GWD	GWD	Board	Computed	USBR
Units	cfs	umhos	ug/l	lbs	cfs	umhos	ug/l	lbs	cfs
Jan. 21, 1997	91	360	na	na	25	250	na	na	71
Jan. 22, 1997	91	300	na	na	25	300	na	na	75
Jan. 23, 1997	91	300	na	na	25	300	na	na	76
Jan. 24, 1997	80	300	na	na	25	300	na	na	78
Jan. 25, 1997	80	300	na	na	25	300	na	na	80
Jan. 26, 1997	80	300	na	na	25	300	na	na	76
Jan. 27, 1997	220	3300*	19.2	22.8	25	300	na	na	74
Jan. 28, 1997	150	2900*	30.8	24.9	25	300	na	na	34
Jan. 29, 1997	100	2900*	33.0	17.8	25	300	na	na	50
Jan. 30, 1997	100	3100*	31.0	16.7	25	300	na	na	64
Jan. 31, 1997	65	2300*	18.6	6.5	25	300	na	na	82
Feb. 1, 1997	111	1700*	12.6	7.5	20	300	na	na	77
Feb. 2, 1997	111	1600*	15.3	9.2	20	300	na	na	71
Feb. 3, 1997	111	1500*	16.0	9.6	20	200	na	na	79
Feb. 4, 1997	110	1000*	14.1	8.4	70	3900**	33.0	12.5	38
Feb. 5, 1997	83	360	na	na	20	809***	6.8	0.7	87
Feb. 6, 1997	83	360	na	na	20	300	na	na	92
Feb. 7, 1997	20	200	na	na	45	200	na	na	93
Feb. 8, 1997	20	200	na	na	45	200	na	na	95
Feb. 9, 1997	20	200	na	na	45	200	na	na	88
Feb.10, 1997	28	200	na	na	45	200	na	na	85
Total selenium loads				123.4				13.2	

Total Camp 13 Ditch and Agatha Canal loads combined ..... 136.6 pounds

* Indicates commingled drainage waters

** Indicates commingled drainage waters, selenium value estimated

*** Indicates commingled drainage waters, EC source is CVRWQCB