GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

October-December 1996 and January-March 1997

August 26, 1997

A cooperative effort of:
U.S. Bureau of Reclamation
Central Valley Regional Water Quality Control Board
U.S. Fish and Wildlife Service
California Department of Fish and Game
San Luis & Delta-Mendota Water Authority
U.S. Environmental Protection Agency
U.S. Geological Survey

Report prepared by San Francisco Estuary Institute

I. INTRODUCTION

The Grassland Bypass Project (GBP) intercepts agricultural irrigation return flows south of the Grassland Water District and conveys them through the northernmost 28 miles of the San Luis Drain to a discharge point in Mud Slough, a tributary of the San Joaquin River. The location of the project and the Grassland Drainage Service Area are shown in Figure 1. A schematic of the GBP showing the hydrology of the project and sampling locations is provided in Figure 2. The GBP has removed agricultural drainage from wetland water supply channels in the Grassland Water District and from Salt Slough, but has increased quantities of agricultural drainage in the six miles of Mud Slough that receives the re-routed drainage water. A detailed monitoring program, the Grassland Bypass Project Compliance Monitoring Program (GBPCMP) has been established to evaluate whether the terms and conditions of the project are being met. Specific conditions for the project include monthly and annual selenium load values from the San Luis Drain into Mud Slough, selenium load reductions over the long term, removal of subsurface agricultural drainage from the wetland water supply channels, the prevention of significant adverse environmental impacts, and the prevention of significant adverse effects on human health. Detailed background information on the GBP is documented in the "Finding of No Significant Impact and Supplemental Environmental Assessment (FONSI)" and the Interim Use Permit (USBR 1995). The comprehensive monitoring plan (USBR 1996) and the Quality Assurance Project Plan (Entrix 1997) contain detailed descriptions of the sampling and analytical methods employed in the GBPCMP. The effect of major storm events in January 1997 on the GBP has been discussed in Grassland Area Farmers (1997). A second report is being prepared by USBR for the Oversight Committee of the GBP and will be available this fall.

The purpose of the Quarterly Narrative and Graphical Data Summary series is to provide an overview of the data collected in the most recent quarter of the GBP. Complete listings of the data are provided in Monthly Data Reports and Quarterly Data Reports (SFEI 1996, 1997a,b,c,d,e,f,g). The data and detailed background information on the GBP are also available on the Internet at the following address: www.mp.usbr.gov/mp400/irrdrn/grasslnd/grasslnd.html. This first Quarterly Narrative and Graphical Data Summary covers the first two quarters of the project, October-December 1996 and January-March 1997.

II. FLOW MONITORING

Flow data in the GBPCMP are measured to allow computation of selenium load discharge, to establish seasonal flow patterns, and to determine the influence of the discharge from the San Luis Drain on the hydrology of Mud Slough. According to the Interim Use Permit, discharge flows into Mud Slough from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Flows near the inlet of agricultural drainage into the San Luis Drain (station A) were very similar to flows at the point of discharge of the San Luis Drain into Mud

Slough (station B) (Figure 3). Flows in the drain were approximately three times higher in January-March (averaging 71.4 cfs at station B) than in October-December (averaging 26.3 cfs at station B). Of the two monitoring stations in Mud Slough above and below the GBP discharge (stations C and D, respectively) flow is measured only at station D. The discharge from the SLD (station B) accounted for an average of 13% of the total flow in Mud Slough (station D) in October-December and 20% in January-March. Two periods of high flows were observed in Mud Slough (station D) in early January (peaking at 619 cfs on January 6) and in late January (peaking at 726 cfs on January 28). Average flows in Mud Slough (station D) were higher in January-March (363 cfs) than in October-December (198 cfs). Flows in Salt Slough (station F) were of a similar magnitude as those in Mud Slough, averaging 366 cfs in January-March and 191 cfs in October-December. The highest flow in Salt Slough (657 cfs) occurred on January 28.

High flows on the San Joaquin River in January and February resulted in flow recorder malfunction at station N (the San Joaquin River at Crow's Landing downstream of its confluence with the Merced River). Data for January and February consequently were estimated from flows at USGS stations at Orestimba Creek and the San Joaquin River at Newman. Flows from October-December averaged 2,148 cfs and were relatively constant for the entire quarter. Flow increased sharply during the first week of January and remained high throughout January and February. The maximum flow measured was 37,100 cfs on January 28.

III. WATER QUALITY MONITORING

Water quality data in the GBP are collected to evaluate compliance with selenium load values given in the FONSI and the Interim Use Permit (USBR 1995), to evaluate compliance with the commitment to not discharge drainage to the wetland channels, and to evaluate potential adverse effects of the GBP discharge and of waters in Mud Slough below the discharge on test organisms.

Chemical Monitoring

Selenium

Daily Selenium Measurements

Daily selenium concentrations are measured at stations B and N using autosamplers (USBR 1996). Monthly total selenium load discharge is computed at Station B. Monthly totals are shown in the Table 1 and illustrated in Figure 4a.

Selenium load discharge from the GBP (discharge from the terminus of the Drain) averaged 8.0 lbs/day in October-December, and increased to 28.8 lbs/day in January-March. Load discharge was particularly high in February and March, with a maximum of 43.8 lbs/day on February 9. The increase in January-March load discharge resulted from a combination of distinctly increased flows combined with slightly increased selenium

concentrations (Figures 4b-4d). The cumulative load discharge for the six months from October to March was 3,335 lbs.

Selenium concentrations at station N (San Joaquin River at Crow's Landing) were inversely proportional to flow, with low concentrations (approximately 0.3 ug/l) during the high flow period in January and February, and concentrations of 2 ug/l and higher (up to 3.9 ug/l) during periods with lower flows in October, November, and late March (Figure 5b).

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab samples collected at 12 stations (Figures 6-8). Average selenium concentrations were higher near the inlet to the San Luis Drain (station A) than near the point of discharge into Mud Slough (station B) (Figure 6). Average concentrations at station A were 65 ug/l and 81 ug/l in October-December and January-March, respectively, compared to 56 ug/l and 72 ug/l at station B.

Selenium concentrations in Mud Slough upstream of the GBP discharge (station C) from October-March averaged 0.6 ug/l, with a maximum concentration of 1.0 ug/l (Figure 6). Concentrations were higher in Mud Slough downstream of the GBP discharge (station D) than upstream at station C (note differences in scales). Concentrations at station D were below 20 ug/l from October 8 to February 11. Concentrations rose in late February and March, averaging 38.8 ug/l from February 18 to March 27. This increase corresponded with increased selenium loads in February and March measured at station B (Figure 4).

Selenium concentrations in Salt Slough (station F) and the wetland water supply channels (stations J, K, L, and M) were generally below 2 ug/l (Figure 7). Concentrations at stations F, J, K, and L were sharply elevated in samples collected during the first week of February. Only one sample was collected in the wetland channels in January. This sample, collected from station J on January 27, had a selenium concentration (19 ug/l) comparable to that observed at this station in early February (23 ug/l). March selenium concentrations for stations J, L, and M were high relative to earlier measurements at these stations.

In the San Joaquin River, weekly selenium samples were collected at stations upstream of the GBP discharge (station G), downstream of the discharge and above the Merced River (station H), and downstream of the Merced River (station N) (Figure 8). Selenium concentrations at station G were low, averaging 0.5 ug/l from October-March. Concentrations were higher at station H, averaging 3.0 ug/l from October-March. Concentrations at station H declined gradually from October-December, were low from mid-December to mid-February, then increased abruptly in March.

Specific conductance

Specific conductance is measured at 15 min intervals at stations B, D, F, and N, and in weekly grab samples at stations A, B, C, D, F, G, H, J, K, L, M, and N. These data are presented in Figures 9 and 10.

Toxicity Testing

The purpose of the GBP toxicity testing program is to evaluate the potential adverse effects to test organisms of the GBP discharge and of waters in Mud Slough below the discharge. Monthly toxicity tests are conducted in the laboratory using water collected from stations B, C, D, and F. Test results from these stations are compared to results obtained using water from the Delta-Mendota Canal. Monthly toxicity tests include: the 7-day chronic fathead minnow (*Pimephales promelas*) larvae survival and growth test; the 7-day chronic water flea (*Daphnia magna*) survival and reproduction test; and the 4-day chronic algal (*Selenastrum capricornutum*) growth test. A 7-day *in situ* survival test using 4-day-old fathead minnow larvae is conducted at stations B, D, F, and a reference site (Windmill) on a quarterly basis. Toxicity test results are summarized below; complete datasets are presented in the GBP Monthly Data Reports and GBP Quarterly Data Reports (SFEI 1997a-g).

In the fathead minnow tests, only a few samples exhibited significantly reduced survival (3 samples) or growth (2 samples) from October-March. There was a 50% reduction in survival of fathead minnows in Mud Slough at station C upstream of the GBP discharge. No clear pattern of adverse effects was observed at the sites under the influence of the GBP discharge. In the *Daphnia* tests, no samples caused a reduction in either survival or reproduction. Inhibition of growth was observed in the *Selenastrum* tests, in two samples from station B (discharge from the GBP), three from station D (Mud Slough downstream of the GBP discharge), and one each from stations C (Mud Slough upstream of the GBP discharge) and F (Salt Slough). In December and March similar reductions in algal growth were observed at stations B and D.

IV. SEDIMENT MONITORING

Sediment Quality Monitoring

Sediment quality is measured in the San Luis Drain and in Mud and Salt Sloughs. The purpose of monitoring sediment chemistry in the San Luis Drain is to assess whether selenium concentrations in drain sediments are approaching the California Department of Health Services hazardous waste criterion (100 ug/g wet weight) and to provide information on the fate and transport of selenium within the Drain. Stations in Mud and Salt Sloughs are monitored to determine whether changes in sediment chemistry in these locations occur as a result of the GBP and to provide data that can be used in conjunction with biological data to assess accumulation or depletion of selenium in the aquatic food web.

Selenium concentrations in San Luis Drain sediments were higher in November 1996 and March 1997 than they were prior to the initiation of the GBP in late September 1996 (Table 2). This apparent increase was observed both for the top 3 cm of sediment and for sediment from 3 to 8 cm in depth. Subsequent sampling will be required to determine whether the November 1996 and March 1997 results are indicative of a trend. Selenium concentrations in San Luis Drain sediments (stations A and B) were much higher than concentrations at the slough stations (C, D, E, F, and I).

Sediment Quantity Monitoring

A survey to estimate the quantity of sediment in the San Luis Drain is planned for this summer. Results will be summarized and reported as they become available.

V. BIOLOGICAL MONITORING

Organisms are collected throughout the GBP area on a quarterly basis (USBR 1996). Tissue sampling in the GBPCMP is being performed to assess the potential for adverse impacts to fish and wildlife and to assess public health risks. Food web organisms (aquatic plants, invertebrates, and fish) are being analyzed for selenium residues to assess impacts to fish and wildlife. Muscle fillets from gamefish are being analyzed for selenium to assess human health risks. Sample collection has begun for this component. Results will be summarized and reported as they become available.

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SFEI. 1997g. Grassland Bypass Project: Quarterly Data Report, January, February and March 1997. San Francisco Estuary Institute, Richmond, CA.

USBR. 1995. Finding of No Significant Impact and Supplemental Environmental Assessment, Grassland Bypass Channel Project, Interim Use of a Portion of the San Luis Drain for Conveyance of Drainage Water through the Grassland Water District and Adjacent Grassland Areas. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

USBR. 1996. Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

Table 1. Comparison of monthly selenium load discharge from the terminus of the San Luis Drain (station B) with the monthly load values in the Interim Use Permit (USBR 1995).

	Selenium load discharge (lbs)	Monthly load value (lbs)	Amount over monthly load value (%)
Oct 1996	202	348	na
Nov 1996	252	348	na
Dec 1996	285	389	na
Jan 1997	599	533	12
Feb 1997	878	866	1
Mar 1997	1119	1066	5

na: not applicable (load discharge was less than load value)

Table 2. Summary of sediment monitoring results from June 1996 to March 1997. Dry weight concentrations. USBR=U.S. Bureau of Reclamation.

	PARAMETER	**Selenium**			**Organic Carbon**		
	DEPTH	0-3 cm	3-8 cm	Whole Core	(0-3 cm)	(3-8 cm)	Whole Core
Station Code	**SOURCE**	USBR	USBR	USBR	USBR	USBR	USBR
Station Name	**UNITS**	ppm	ppm	ppm	%	%	%
Station A:	Jun-27-1996	8.0	20.0	29.0	4.3	5.0	3.0
Inflow to San Luis	Sep-04-1996	3.4	24.0	7.7	4.4	2.7	4.1
Drain	Nov-12-1996	22.0	62.0	55.0	2.9	3.1	3.7
Station B:	Jun-27-1996	19.0	12.0	30.0	2.7	2.8	2.2
Discharge from	Sep-04-1996	11.0	18.0	20.0	3.9	3.8	2.1
San Luis Drain	Nov-12-1996	24.0	41.0	40.0	2.0	1.9	3.5
	Mar-13-1997	26.0	48.0	42.0	2.9	3.1	3.7
Station C:	Jun-27-1996	0.1	<0.1	0.1	0.5	0.4	0.1
Mud Slough North	Sep-04-1996	0.3	0.3	<0.1	0.4	0.5	0.5
upstream of	Nov-12-1996	0.2	0.2	0.3	0.3	0.3	1.0
drainage discharges	Mar-12-1997	0.2	<0.1	0.1	0.4	0.3	0.7
Station D:	Jun-27-1996	0.4	0.4	0.2	0.3	0.4	0.2
Mud Slough North	Sep-04-1996	0.2	0.2	0.2	0.2	0.2	0.2
downstream of	Nov-13-1996	0.1	0.3	0.2	0.1	0.1	0.1
drainage discharges	Mar-12-1997	0.5	0.3	0.8	0.3	0.2	0.3
Station E:	Jun-27-1996	0.1	0.1	<0.1	1.1	0.5	0.4
Mud Slough at	Nov-13-1996	0.7	0.7	0.7	0.4	0.3	0.3
Highway 140	Mar-13-1997	0.8	1.0	1.0	0.1	0.2	0.1
Station F:	Jun-27-1996	0.6	0.5	0.2	0.7	0.6	0.2
Salt Slough at	Sep-05-1996	0.4	0.8	0.4	0.4	0.8	0.3
Highway 165	Nov-13-1996	0.2	0.4	0.3	0.1	0.2	0.1
	Mar-13-1997	0.9	0.4	0.6	0.6	0.4	0.3
Station I:	Jun-13-1996	0.4	0.4	0.3	1.6	1.3	1.2
Mud Slough:	Mar-13-1997	1.5	0.8	0.4	1.8	0.8	0.6
Seasonal backwater tributary							

Figure 1. Map of the Grassland Bypass Project.

Figure 2. Schematic diagram showing locations of GBP monitoring stations relative to major hydrologic features of the study area.

Figure 3. Daily mean flows (cfs) at GBPCMP stations. Flow at station A is recorded as a daily mean. Flows at stations B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axes and break in vertical axis for station N.

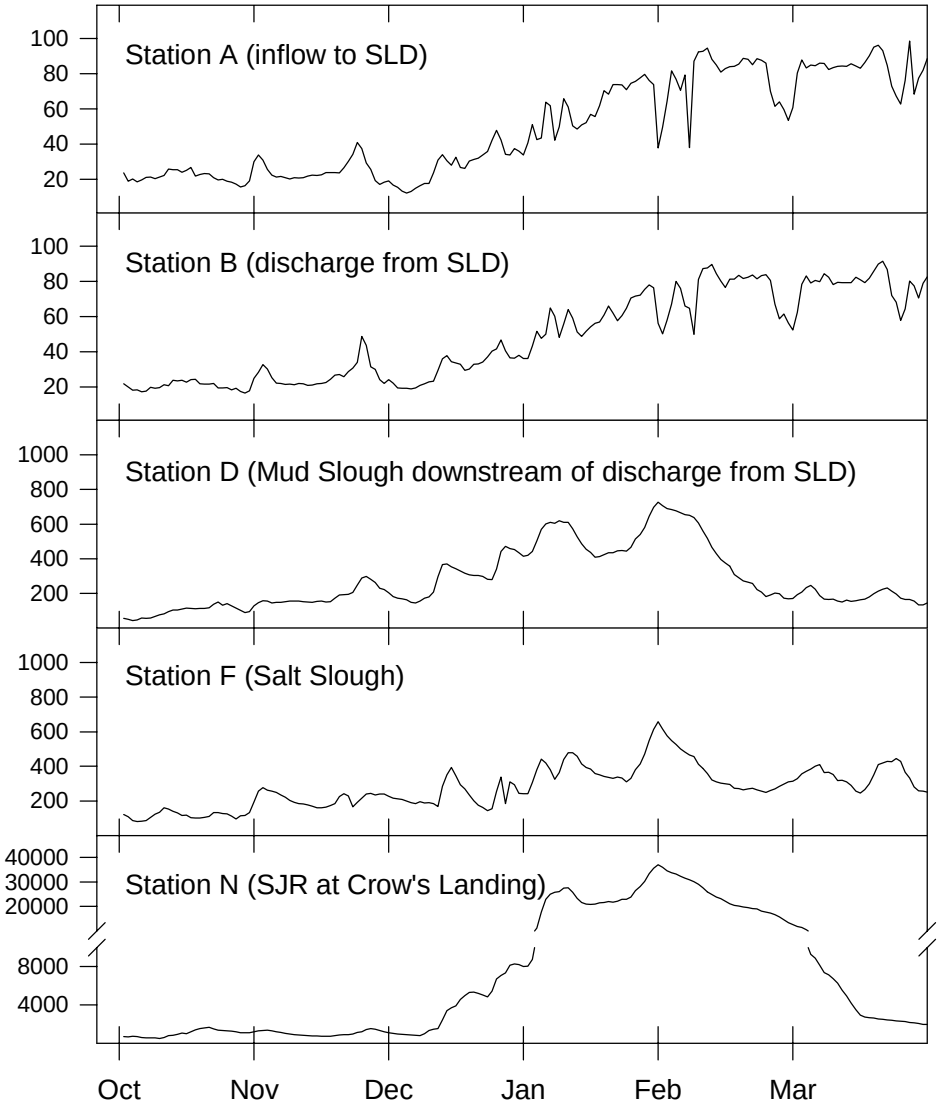

Figure 4. Selenium concentrations and selenium load discharge at station B (discharge from SLD): a) comparison of monthly load discharge and load values; b) comparison of cumulative load discharge and load values; c) daily average flows; d) daily average selenium concentrations; and e) calculated daily average load discharge.

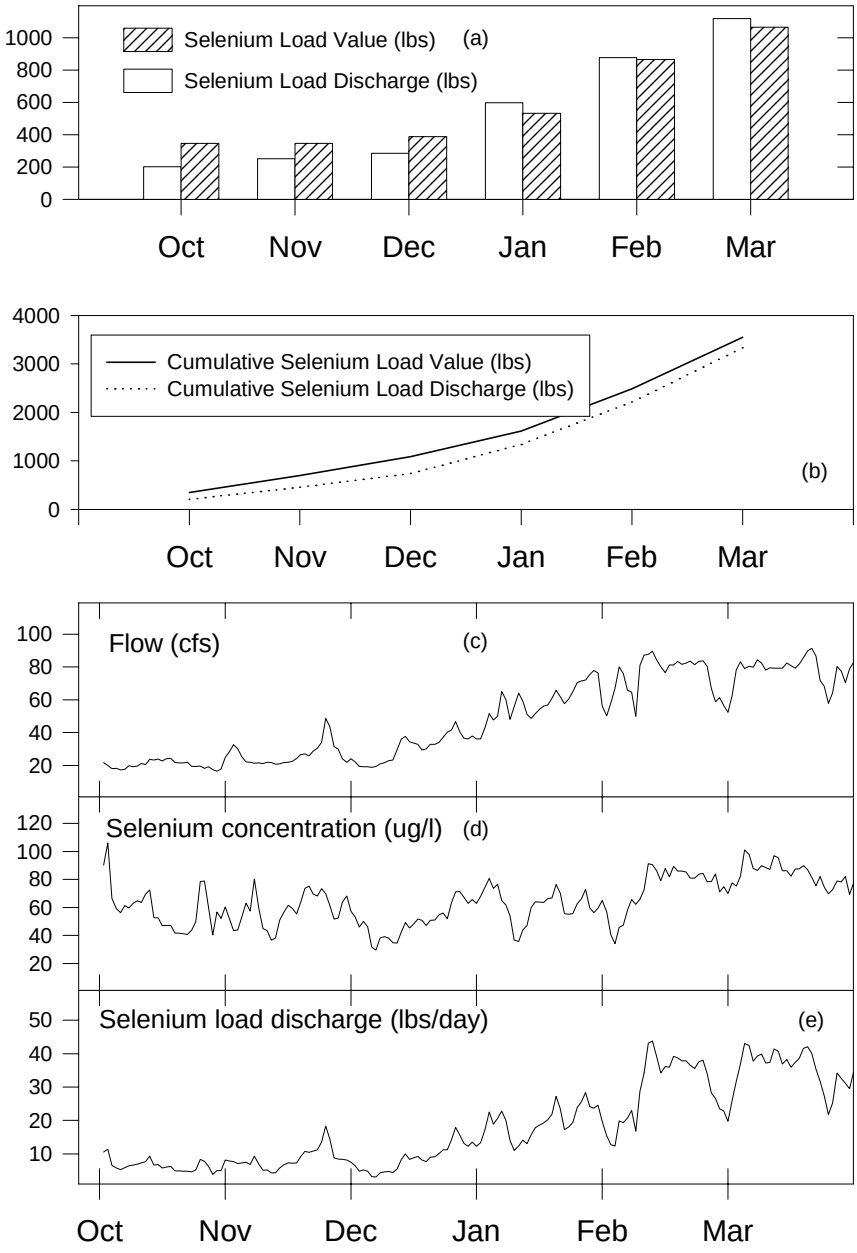

Figure 5. Daily average flows and selenium concentrations at station N (San Joaquin River at Crow's Landing). Flows at station N for January and February were estimated (see text). Note break in vertical axis for flow plot.

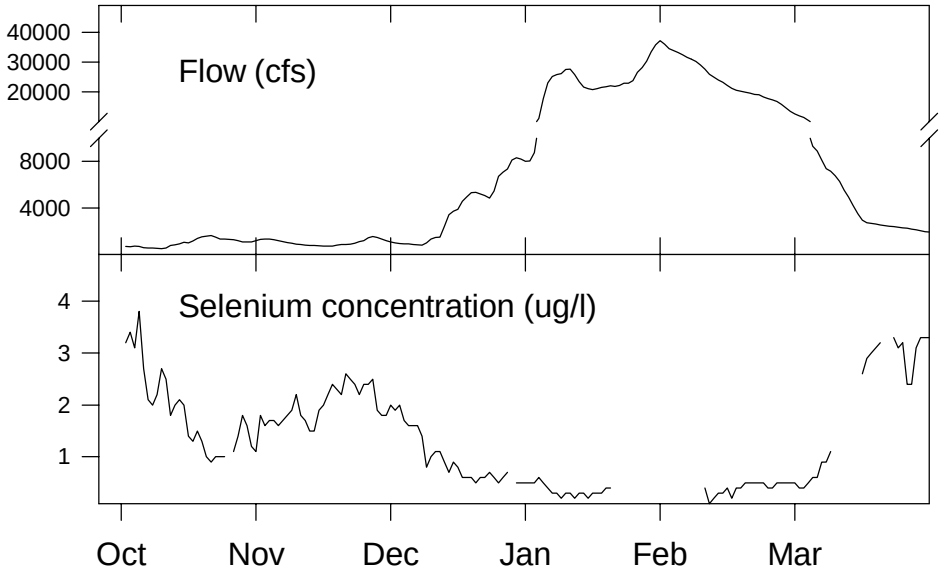

Figure 6. Selenium concentrations (ug/l) at station A (near the inlet to the San Luis Drain), station B (discharge from the San Luis Drain), station C (Mud Slough upstream of the GBP discharge), and station D (downstream of the GBP discharge). Data from weekly grab samples.

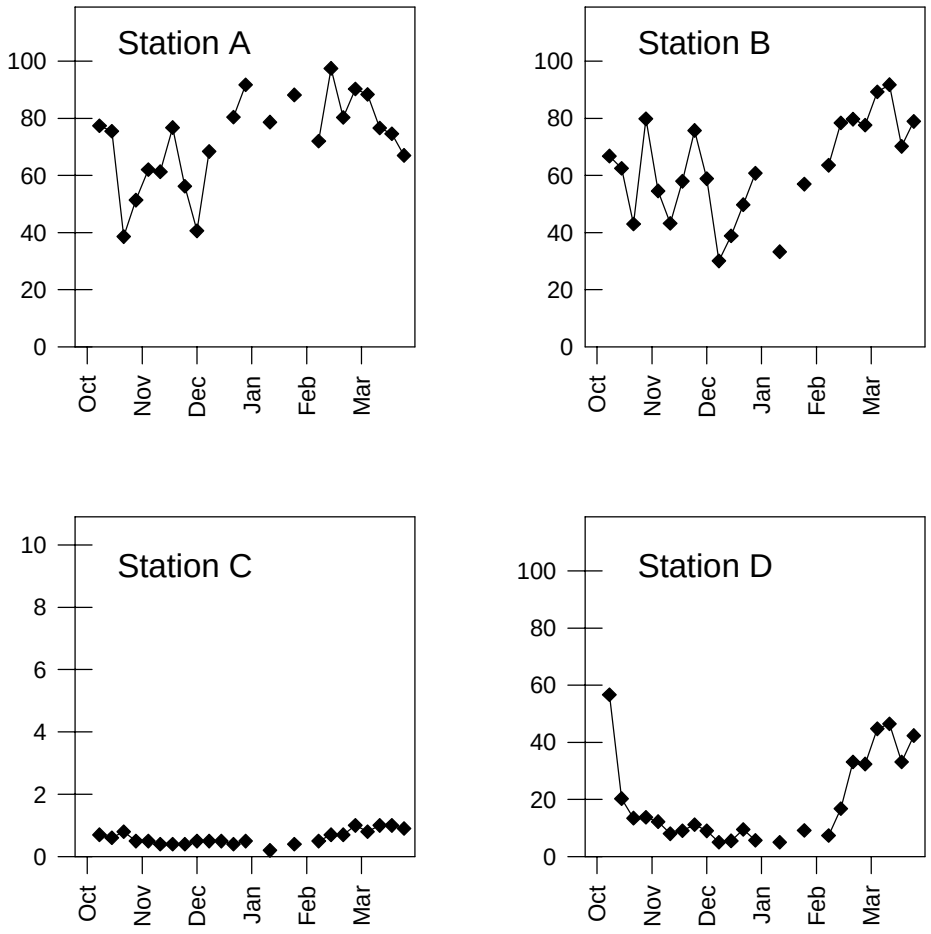

Figure 7. Selenium concentrations (ug/l) at station F (Salt Slough) and in the wetland water supply channels at station J, station K, station L, and station M. Data from weekly grab samples.

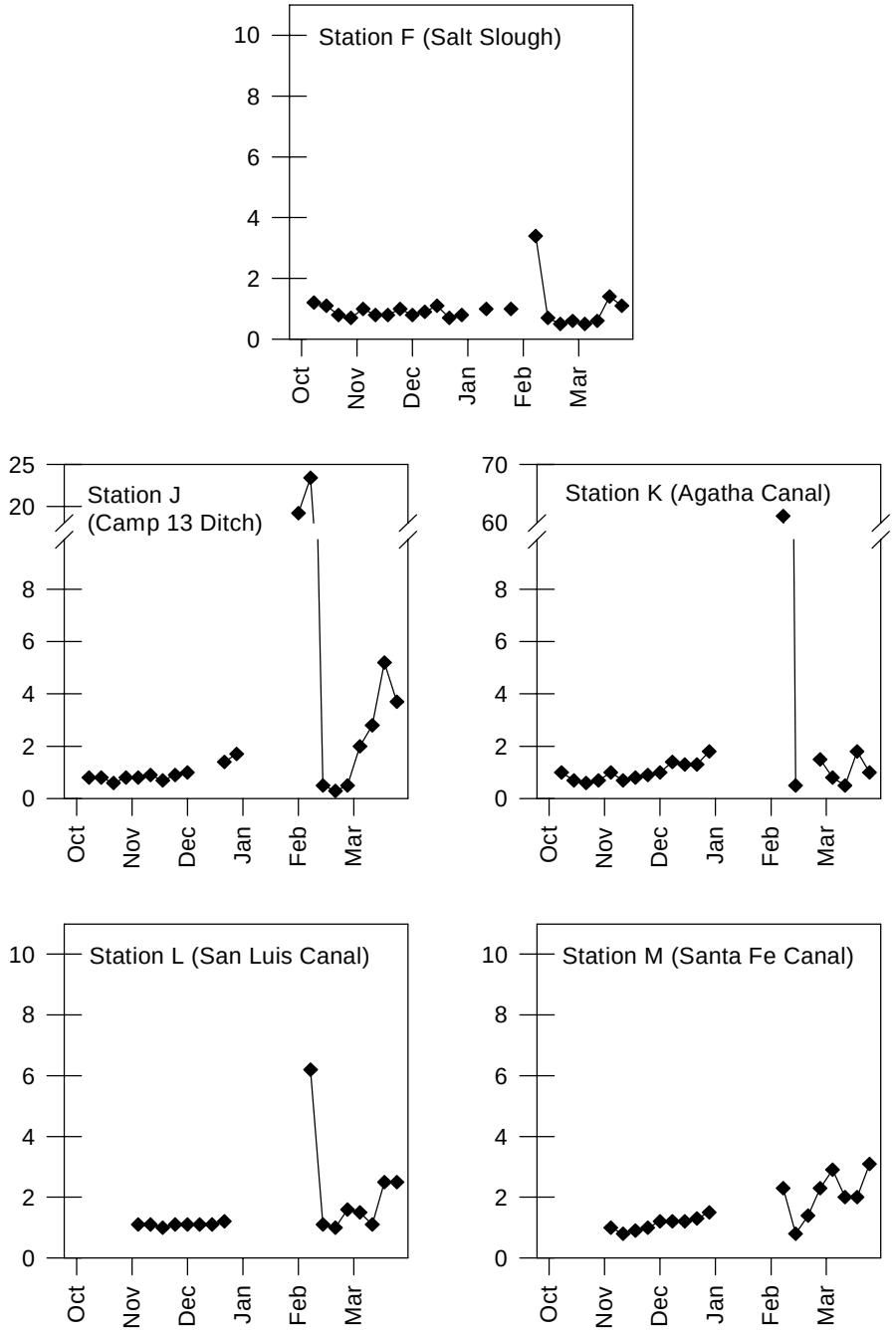

Figure 8. Selenium concentrations (ug/l) at San Joaquin River stations G (San Joaquin River upstream of Mud Slough confluence), H (San Joaquin River downstream of Mud Slough confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

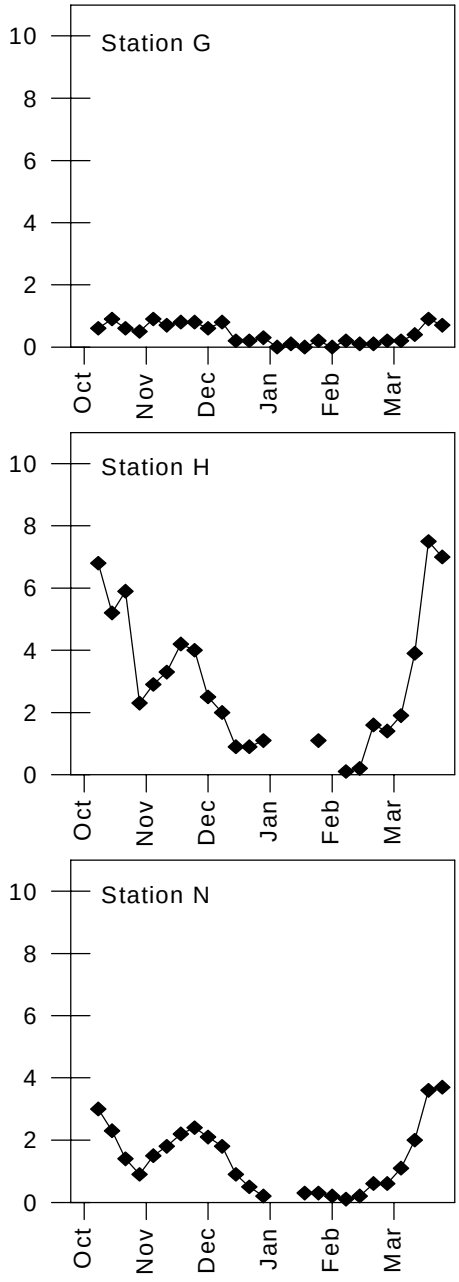

Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at stations B (discharge from the SLD), D (Mud Slough downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

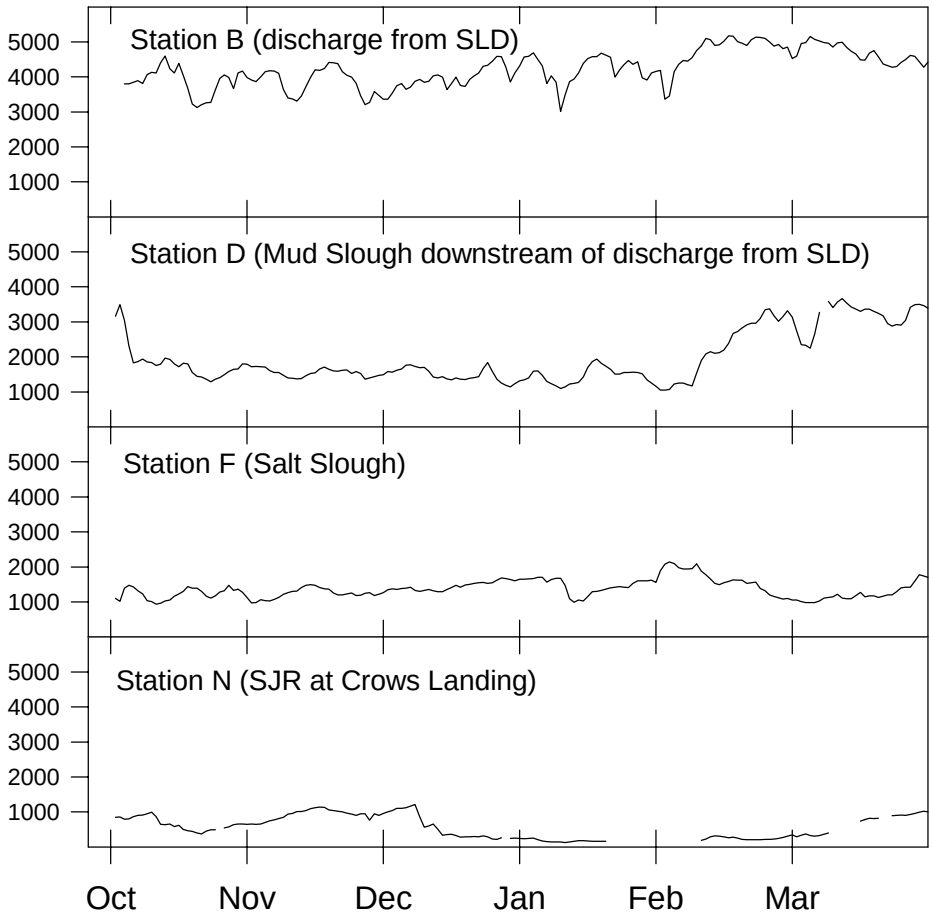

Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate stations.