GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

April - June 1997

November 3, 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) and in USBR (1997).

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,h,i,j,k). 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 second Quarterly Narrative and Graphical Data Summary covers the third quarter of the project, April-June 1997. The first Quarterly Narrative and Graphical Data Summary covered the first two quarters of the project, October-December 1996 and January-March 1997 (SFEI 1997l).

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 flow into Mud Slough from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Flow near the inlet of agricultural drainage into the San Luis Drain (station A) was very similar to flow at the point of discharge of the San Luis Drain into Mud Slough

(station B) (Figure 3). Average flow was 67 cfs at both station A and station B for the April-June period. April-June flow at station B was similar to the average flow for January-March (71 cfs). 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 (Figure 3). The discharge from the SLD (station B) accounted for an average of 66% of the total flow in Mud Slough (station D) in April-June. Average April-June flow at station D was 102 cfs, lower than the averages for October-December (198 cfs) and January-March (363 cfs). Flow in Salt Slough (station F) was of a similar magnitude as in Mud Slough, averaging 151 cfs (Figure 3). Flow in both Mud Slough and Salt Slough was relatively constant in the quarter. April-June flow in the San Joaquin River at Crow's Landing (station N) averaged 1062 cfs, lower than observed in October-December (2148 cfs) and January-March (17114 cfs). Flow fluctuated between 1000 and 2000 cfs in late April and early May, then declined and remained relatively constant at approximately 600 cfs in June.

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 30 lbs/day in April-June. This load discharge was similar to the average measured in January-March (29 lbs/day), and higher than that measured in October-December (8 lbs/day). Load discharge was highest in April, averaging 43 lbs/day, then declined to 27 lbs/day in May and 20 lbs/day in June. These declines were primarily due to declines in selenium concentration in the Drain, although average flow also declined from an average of 75 cfs in April to 58 cfs in June (Figures 4c-4e). The cumulative load discharge for the quarter was 2740 lbs. The cumulative load discharge for the period October 1996 to April 1997 was 6075 lbs (Figure 4b).

Selenium concentrations at station N (San Joaquin River at Crow's Landing) were quite variable, ranging between a minimum of 2.4 ug/L and a maximum of 10.0 ug/L

(Figure 5b). Some of this variability was driven by variation in River flow, with declining concentrations associated with higher flows (Figures 5a and b).

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab samples collected at 12 stations (Figures 6-8). It should be noted that data from weekly grab samples provide an imprecise basis for comparison of differences between stations.

Based on grab sample results, average selenium concentrations at the inlet to the San Luis Drain (station A), which averaged 79 ug/L in the quarter, were approximately equal to those near the point of discharge into Mud Slough (station B), which averaged 80 ug/L (Figure 6). This similarity was in contrast to results in earlier quarters, in which concentrations declined by more than 10% between station A and station B.

Selenium concentrations in Mud Slough upstream of the GBP discharge (station C) averaged 1.3 ug/l, with a maximum concentration of 1.7 ug/l (Figure 6). Concentrations were higher in Mud Slough downstream of the GBP discharge (station D) than upstream at station C (Figure 6, note differences in scales). Concentrations at station D averaged 53 ug/l for the quarter, with a maximum of 79.6 ug/l on April 24. Selenium concentrations were higher from April through mid-May than from mid-May through June.

Selenium concentrations in Salt Slough (station F) averaged 1.1 ug/l, the same average concentration obtained for January-March. Selenium concentrations in the wetland water supply channels (stations J, K, L, and M) were generally near 2 ug/l (Figure 7). One relatively high concentration was observed at station J on May 7 (13.5 ug/l). The flow at station J on this date was zero, and the elevated concentration was due to minor leakage from gate valves (Al Vargas, Central Valley Regional Water Quality Board, personal communication). Average concentrations for the quarter were 3.0 ug/l at station J, 1.6 ug/l at station K, 2.5 ug/l at station L, and 2.4 ug/l at station M.

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 averaged 0.9 ug/l for the quarter. Concentrations were higher at station H, averaging 14 ug/l and fluctuating between a minimum of 9.7 ug/l and a maximum of 18 ug/l. The average selenium concentration in weekly grab samples at station N was 5.5 ug/l, similar to the average of 6.0 ug/l obtained from daily composites at station N.

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 for the April-June period are summarized below; complete datasets are presented in the GBP Monthly Data Reports and GBP Quarterly Data Reports (SFEI 1997a-k).

In the fathead minnow tests, no samples caused reduced survival or growth. Similarly, in the *Daphnia* tests no samples caused a reduction in either survival or reproduction. The lowest survival and growth in the fathead minnow tests and survival and reproduction in the *Daphnia* tests were usually observed in either the laboratory control or the Delta-Mendota Canal water. Inhibition of growth was observed in the *Selenastrum* tests, in two samples from station B (discharge from the GBP), two from station C (Mud Slough upstream of the GBP discharge), one from station D (Mud Slough downstream of the GBP discharge), and two from station F (Salt Slough). Inhibition of *Selenastrum* growth was also observed at each of these stations in some samples collected in October-March.

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.

Sediment quality data from November 1996 and March 1997 were described in the last quarterly report (SFEI 1997l). Results from later sampling were not available for inclusion in the April-June Quarterly Data Report. Additional data are expected to be available for the July-September Quarterly Data Report and will be discussed in the GBP Annual Report.

Sediment Quantity Monitoring

A survey to estimate the quantity of sediment in the San Luis Drain was performed this summer. Results are presented in Table 2.

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. Results from these efforts are expected to be available for the July-September Quarterly Data Report and will be discussed in the GBP Annual Report.

REFERENCES

Entrix, Inc. 1997. Final Draft Quality Assurance Plan for the Compliance Monitoring Program for the Use and Operation of the Grassland Bypass Project. Prepared for the U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

Grassland Area Farmers. 1997. Grassland Bypass Channel operations during two major storm events in January 1997. Report to the Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

SFEI. 1996. Grassland Bypass Project: Monthly Data Report, October 1996. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997a. Grassland Bypass Project: Monthly Data Report, November 1996. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997b. Grassland Bypass Project: Monthly Data Report, December 1996. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997c. Grassland Bypass Project: Monthly Data Report, January 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997d. Grassland Bypass Project: Monthly Data Report, February 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997e. Grassland Bypass Project: Monthly Data Report, March 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997f. Grassland Bypass Project: Monthly Data Report, April 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997g. Grassland Bypass Project: Monthly Data Report, May 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997h. Grassland Bypass Project: Monthly Data Report, June 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997i. Grassland Bypass Project: Quarterly Data Report, October, November and December 1996. San Francisco Estuary Institute, Richmond, CA.

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

SFEI. 1997k. Grassland Bypass Project: Quarterly Data Report, April, May and June 1997. San Francisco Estuary Institute, Richmond, CA.

SFEI. 1997l. Grassland Bypass Project: Quarterly Narrative and Graphical Summary, October-December 1996 and January-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.

USBR. 1997. Impact of the January 1997 Flood Event on the Grassland Bypass Channel Project. Prepared for the Grassland Bypass Project Oversight Committee. 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
Apr 1997	1280	799	60
May 1997	849	666	27
Jun 1997	611	599	2

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

Table 2. Results from 1997 survey of sediment quantity in the San Luis Drain and comparison with results of a survey conducted in March 1987.

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.

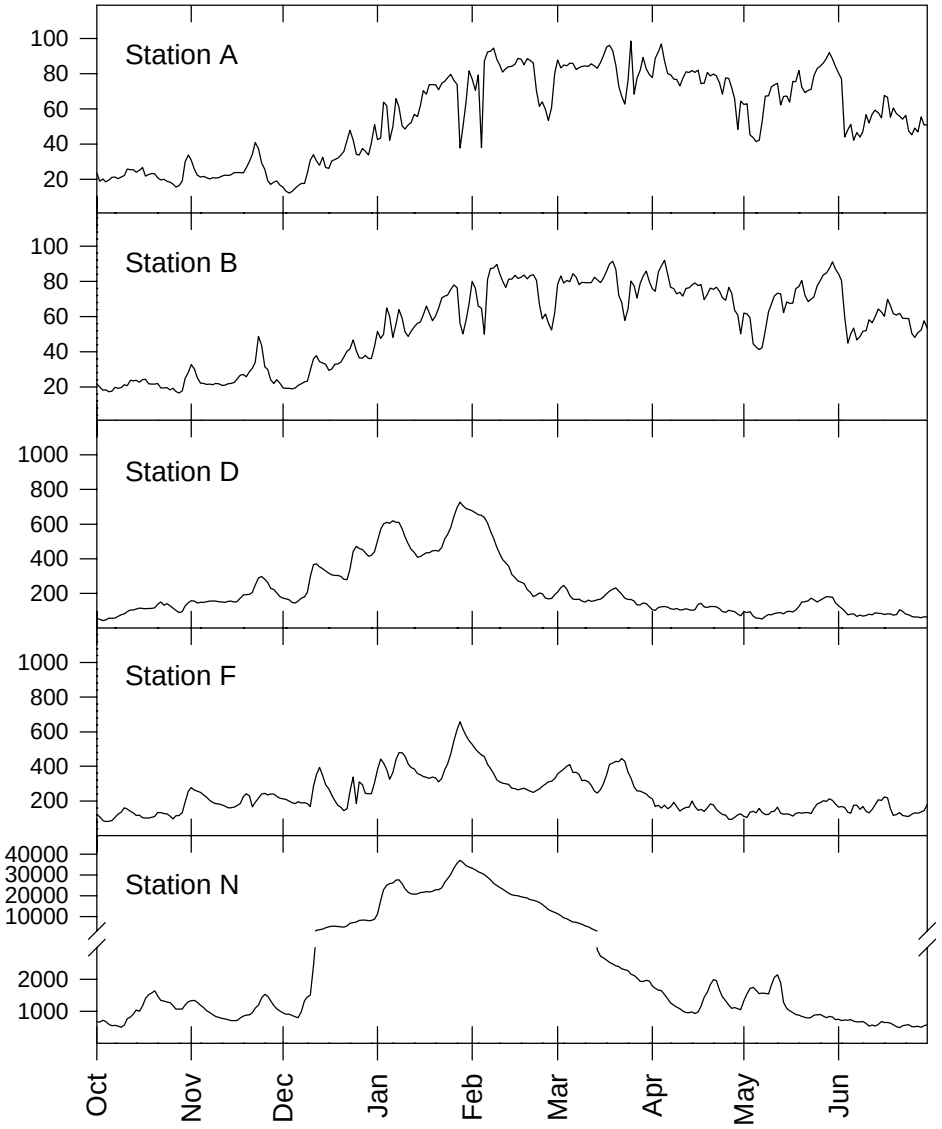

Figure 4. Selenium concentrations and selenium load discharge at station B (discharge from SLD): a) comparison of monthly load discharge and load values; b) comparison of cumulative load discharge and annual load value; c) daily average flows; d) daily average selenium concentrations; and e) calculated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

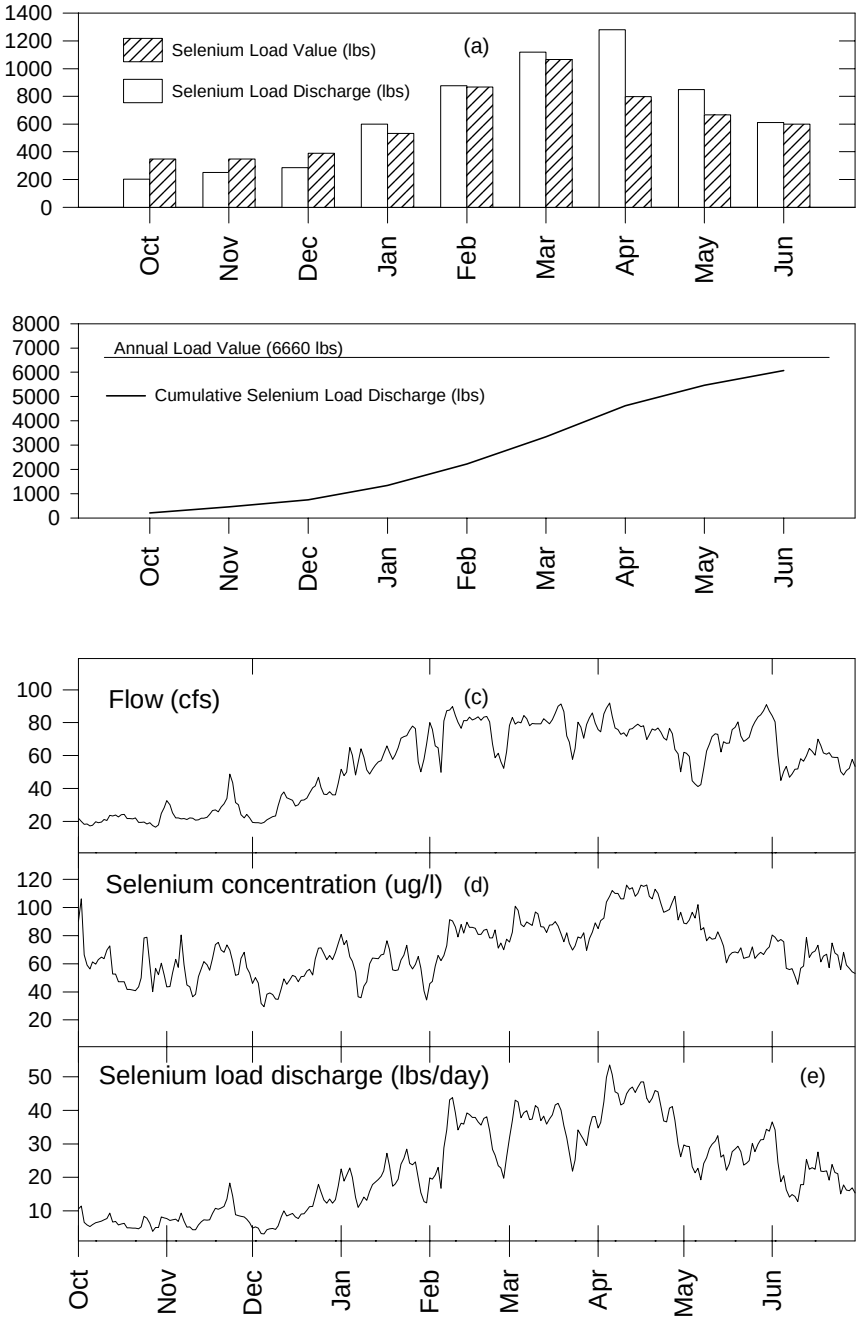

Figure 5. Daily average flows and selenium concentrations at station N (San Joaquin River at Crow's Landing). Flows at station N for January and February were estimated (see text). Note break in vertical axis for flow plot.

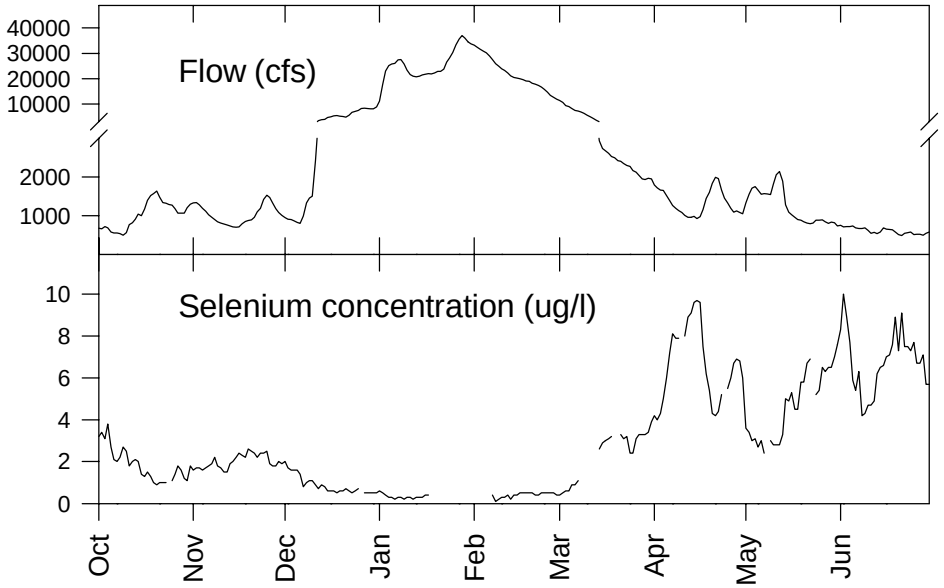

Figure 6. Selenium concentrations (ug/l) at station A (near the inlet to the San Luis Drain), station B (discharge from the San Luis Drain), station C (Mud Slough upstream of the GBP discharge), and station D (downstream of the GBP discharge). Data from weekly grab samples.

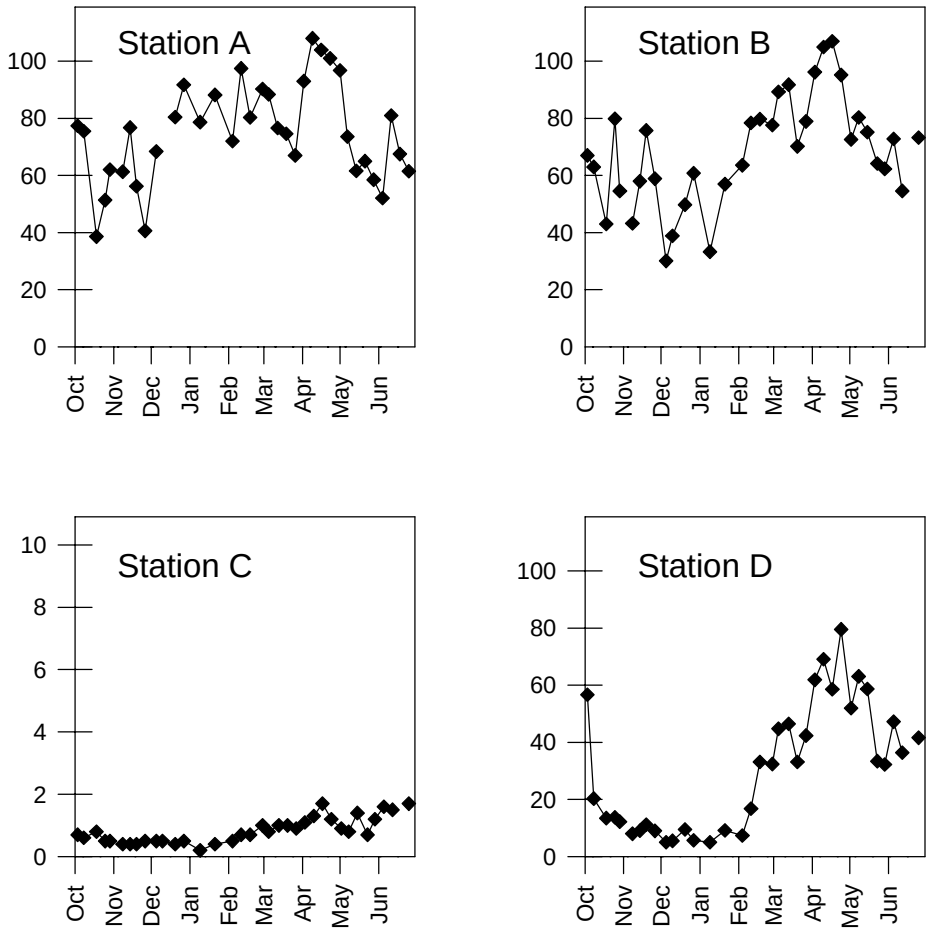

Figure 7. Selenium concentrations (ug/l) at station F (Salt Slough) and in the wetland water supply channels at station J, station K, station L, and station M. Data from weekly grab samples.

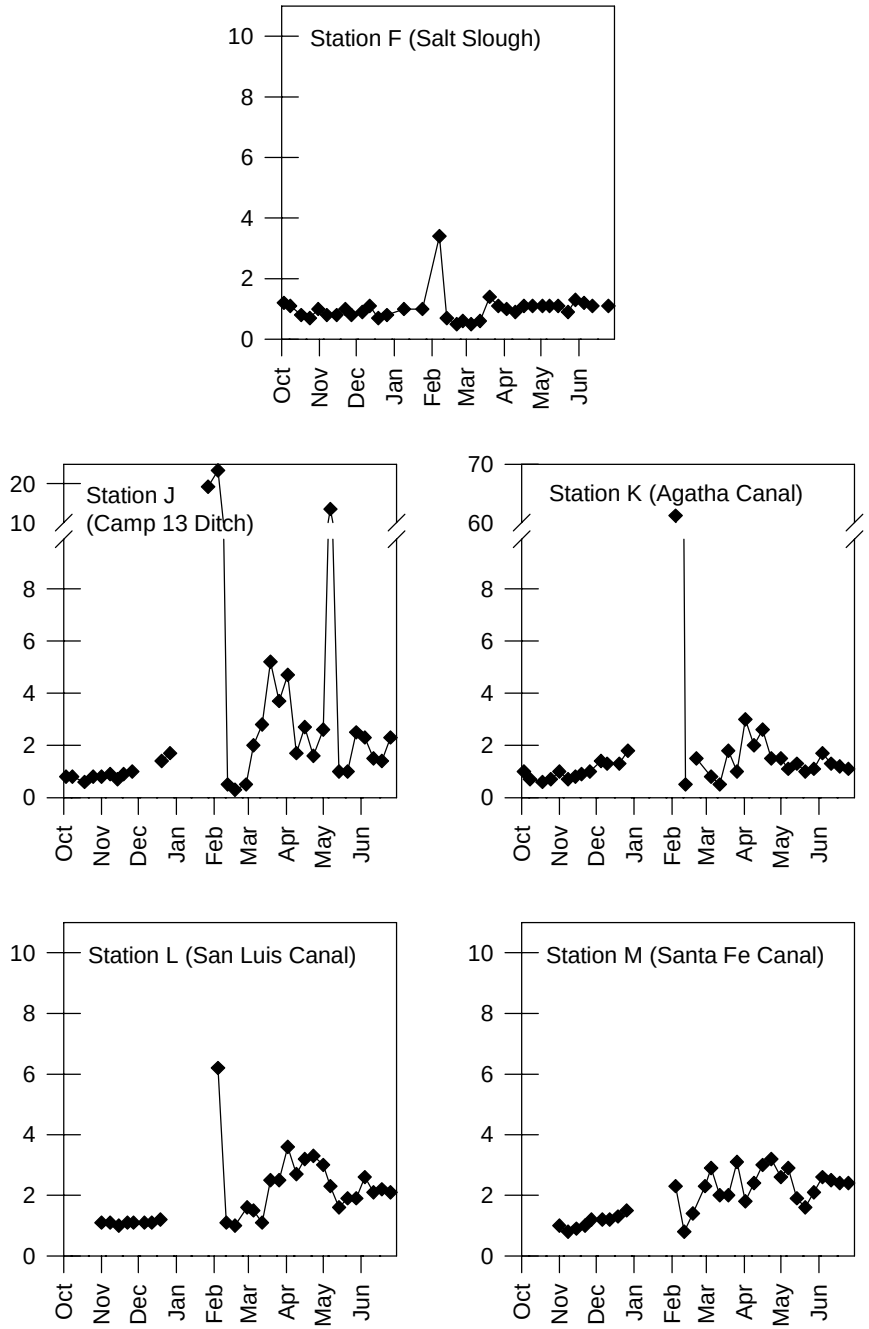

Figure 8. Selenium concentrations (ug/l) at San Joaquin River stations G (San Joaquin River upstream of Mud Slough confluence), H (San Joaquin River downstream of Mud Slough confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

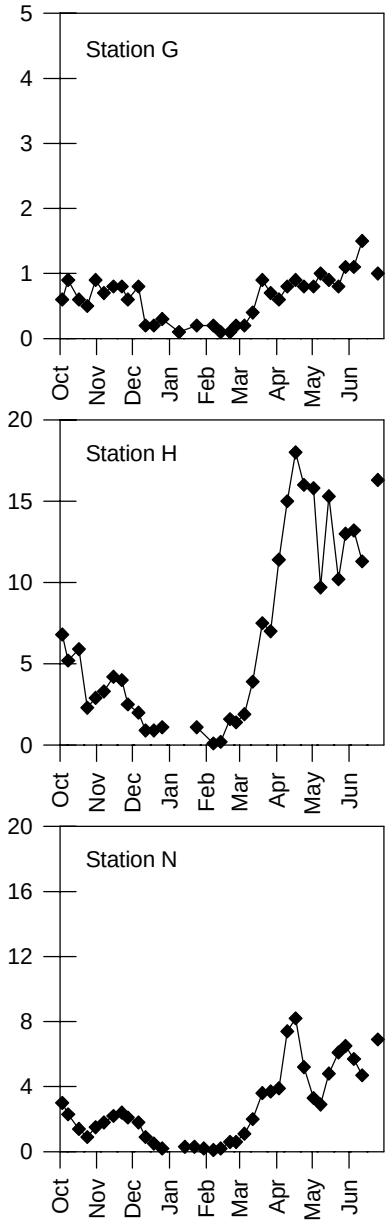

Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at stations B (discharge from the SLD), D (Mud Slough downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

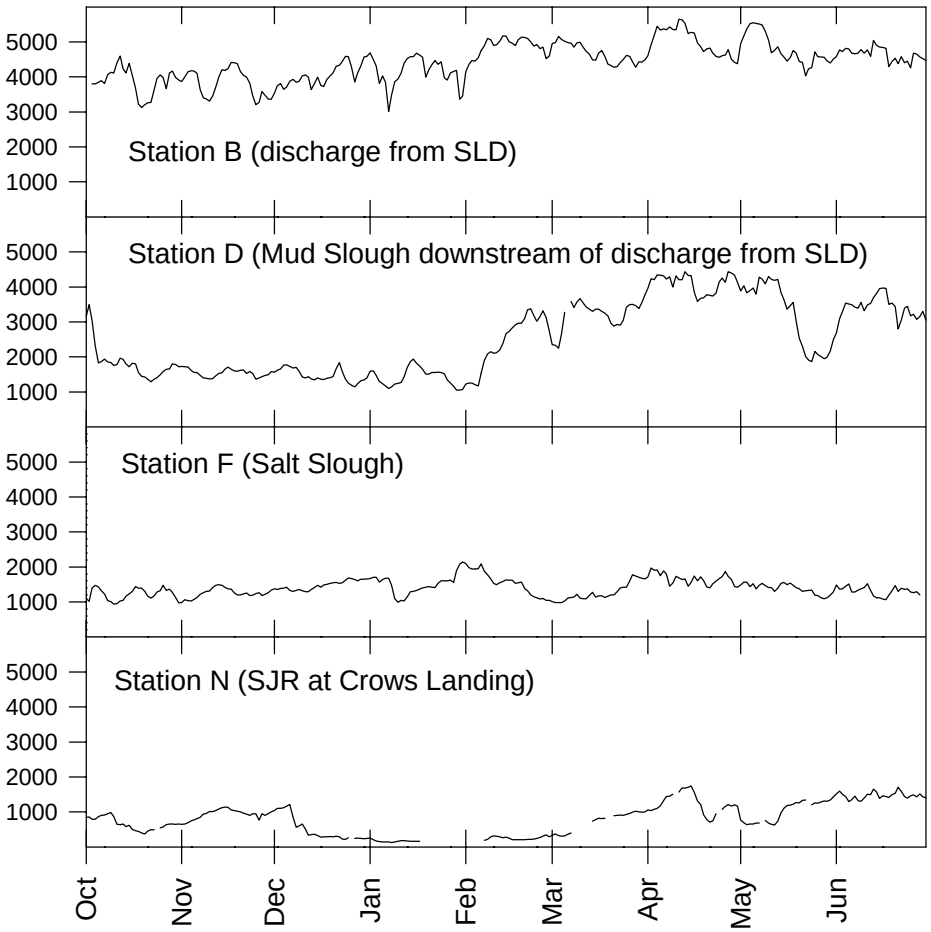

Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate stations.