4 Water Quality Monitoring

October 1, 2001 – December 31, 2002

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Introduction

The monitoring program for the Grassland Bypass Project (GBP), including water quality monitoring, is described in detail in Compliance Monitoring Program for the Use and Operation of the Grassland Bypass Project, Phase II (USBR et al., 2002). This chapter provides a summary of the water quality monitoring program, modifications to the plan for the first 15 months of operation of Phase II of the GBP (October 1, 2001 to December 31, 2002), and water quality trends observed during the 15-month period. Detailed water quality data of individual monitoring stations will not be provided in this summary, as the San Francisco Estuary Institute (SFEI) has presented this information in another report (SFEI, 2003).

Monitoring Program

The Central Valley Regional Water Quality Control Board (CVRWQCB) has an on-going water quality monitoring program related to regulatory activities for agricultural subsurface drainage from the Grassland watershed. The water quality monitoring program for the GBP is an adaptation of the CVRWQCB monitoring program. The CVRWQCB conducts most of the water quality sampling, with assistance from the Panoche Water District (under contract with the San Luis & Delta-Mendota Water Authority; SL&D-MWA). The Panoche Water District collects samples at Stations A, J, K, L2, and M2. Samples are transferred to and processed by the CVRWQCB and analyzed by its contract laboratories. The CVRWQCB conducts quality assurance (QA) reviews of the data before submitting them to the SFEI for reporting. However, all CVRWQCB data are provisional and subject to change until the CVRWQCB approves its annual agency report on monitoring results for the 15-month period.

Monitoring Objectives

The water quality monitoring program was designed to provide data for evaluating compliance with commitments in the Project Waste Discharge Requirements, the Use Agreement, and associated documents. The commitments include:

- Monthly and annual selenium load limits on discharges
- No degradation of the San Joaquin River water quality relative to the pre-Project-condition
- Cessation of discharge of agricultural subsurface drainage to the wetland channels
- Management of flows in the San Luis Drain (SLD) so as to not mobilize channel sediments

The Monitoring Program was also designed to verify the validity of assumptions expressed in documents associated with the GBP. The assumptions include:

- The GBP is expected to result in selenium concentrations less than 2 µg/L in approximately 93 miles of wetland water supply channels.
- The increased frequency of exceeding selenium water quality objectives in Mud Slough (north) will be offset by a reduction of exceedances in Salt Slough.

In addition, the Monitoring Program was intended to provide data to be used to assess spatial and temporal trends in water quality parameters of concern and to characterize habitats in which biological samples were collected.

Sampling Locations

Monitoring was conducted in four areas; the SLD, Mud Slough (north), the San Joaquin River, and the Grassland wetland water supply channels, including Salt Slough. Table 1 summarizes the Monitoring Program, and sampling locations are depicted in Figure 2 in Chapter 1.

Frequency of Sampling

The frequency of sampling is outlined in Table 1. Weekly composite samples were collected at Station A (inflow to the SLD). Daily composite samples were collected at Station B (discharge from the SLD), and at Station N (San Joaquin River at Crows Landing). At Station A, daily samples were composited into a weekly sample to be used along with continuous flow data to calculate weekly selenium load inflow to the SLD. At Station B, daily composite samples along with continuous flow data were used to calculate daily selenium load discharge to Mud Slough (north). At Station N, daily composite samples were collected to allow the CVRWQCB to calculate loads and evaluate progress toward compliance with Basin Plan water quality objectives. The compliance date at Station N for the selenium water quality objective (5 µg/L 4-day average) during normal and wet years is October 1, 2005, and during critical years is October 1, 2010 (CVRWQCB, 1998a) (Table 2). Since the objective is based on a 4-day average concentration, consecutive daily samples are required at this station. The remaining stations were sampled on a weekly basis.

Sampling Methodology

Three types of sampling techniques were utilized, depending on the frequency of sampling and data needs: auto-sampler, mid-channel depth-integrated, and grab sample from channel bank. Auto-samplers were used to collect daily and weekly composite samples because of the remoteness of the station and frequency of sampling. At Stations A, B, and D, structures such as a bridge or platform over the channel permitted the collection of mid-channel, depth-integrated samples. At other stations, a grab sample was collected from the stream bank. With respect to stream hydrology, lateral and vertical homogeneity was assumed for dissolved constituents at all sampling stations.

Modifications to the Water Quality Monitoring Program

During the Phase I of the GBP a number of issues were resolved with respect to the water quality monitoring program. These modifications and clarifications to the monitoring program are discussed in the first five Annual Reports (USBR, 1998 and SFEI, 1999, 2000, 2001, and 2002).

Water Quality Trends

Detailed water quality data for each monitoring station are presented in the Grassland Bypass Project Annual Narrative and Graphical Summary, October 2001 to December 2002 (SFEI, 2003). Thus, this presentation will be limited to major water quality trends and findings for the first 15-month period of operation of Phase II of the GBP. Of primary interest are selenium concentrations in the San Joaquin River and water quality trends in Mud Slough (north). Also of interest are sporadic exceedances in the wetland channels of selenium water quality objectives established in the Water Quality Control Plan for the Sacramento/San Joaquin River Basins.

San Joaquin River

The Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) contains a schedule for compliance with the 5 µg/L (4-day average) selenium water quality objective and performance goals. The compliance date is either October 1, 2005 or October 1, 2010, depending on water year type (wet, dry, etc.) (Table 2). Compliance with selenium water quality objectives and performance goals specified in the Basin Plan is measured at Station N.

Figure 1 depicts selenium concentrations in the San Joaquin River at monitoring Stations G (weekly grab), and N (4-day average) from October 2001 through December 2002. Station G is located at Fremont Ford, upstream of the Mud Slough (north) inflow to the San Joaquin River. Because this station is located upstream of drainage discharges from the GBP service area (except during flood events when drainage has occasionally been routed to Salt Slough), selenium concentrations are relatively low, and remained below 2 µg/L throughout the 15-month period.

Station N is located downstream of the GBP discharges conveyed by Mud Slough (north) and the Merced River inflow to the San Joaquin River. Merced River inflows dilute the upstream selenium contributions (CVRWQCB, 2002). During the 15-month period, selenium concentrations were above 5 µg/L for short periods of time during the months of June and July. The maximum daily concentration observed in the San Joaquin River was 6.8 µg/L at Station N on July 2, 2002.

On October 1, 2002 a performance goal of either 5 µg/L or 8 µg/L monthly mean selenium concentration (depending on water year type) became effective in the San Joaquin River below the confluence with the Merced River. Figure 2 depicts monthly mean selenium concentrations at Station N for the 15-month period. As of October 1, 2002, the applicable performance goal for a dry year, such as WY 2002, is an 8 µg/L monthly mean selenium concentration. Monthly mean selenium concentrations during the 15-month period did not exceed 5 µg/L. Thus, it appears that the GAF have demonstrated the capability of meeting these performance goals

The Basin Plan and the GBP Waste Discharge Requirements (WDRs) prohibit discharge of selenium from agricultural subsurface drainage systems in the Grassland Watershed to the San Joaquin River in amounts exceeding 8,000-pounds per year. Calculations using daily selenium data, preliminary USGS flow data, and the load calculation methods found in CVRWQCB

(1998b) indicate that the annual selenium load measured at Station N during WY 2002 was well below the 8,000-pound annual load limit for the Grassland Watershed.

Wetland Channels

Monthly mean selenium concentrations in the wetland channels for the 15-month period are depicted in Figure 3. The monthly mean 2 µg/L selenium objective was met during all months in Salt Slough. The monthly mean 2 µg/L selenium objective was exceeded in February for Stations J, K, and L2, and in March and April for Station J. The maximum observed monthly mean concentrations of 2.9 µg/L at Stations J and K, and 2.4 µg/L at Station L2, however, are substantially lower than pre-Project concentrations (CVRWQCB, 1998c).

Regional Board staff conducted preliminary investigations on the potential sources of selenium, which are detailed in two separate reports (CVRWQCB, 2000 and CVRWQCB, 2002). In summary, primary sources of selenium to the channels were determined to be diversions from the 94,000-acre Drainage Project Area (DPA) (both stormwater flows and seepage from control gates), supply water, subsurface agricultural drainage from areas outside of the DPA, tailwater and local groundwater. To address the first source, diversions from the DPA, the Grassland Area Farmers (GAF) developed a stormwater management plan, and internal control gates were sealed. These actions appear to have controlled peaks of selenium previously observed during storm events.

Despite the stormwater management plan and control gate modifications made by the GAF, selenium concentrations have continued to sporadically exceed the 2 µg/l monthly mean selenium objective in the wetland channels, particularly from the pre-irrigation season through the early irrigation season (February through April). As a result of the continued elevated selenium concentrations, staff focused the ongoing investigations on potential selenium sources outside of the GBP area: supply water and subsurface agricultural drainage from outside of the GBP service area. Results are currently under review and will be used to direct the ongoing investigation.

Mud Slough (North)

Results of weekly grab sampling for selenium at Station D, Mud Slough (north) downstream of the SLD, are depicted in Figure 4. Selenium concentration distributions as a function of time were similar for all water years. Selenium concentrations tend to be lowest from the fall through early winter (non-irrigation period) and highest during the irrigation period, which commences in mid winter (pre-plant irrigation) and lasts through the summer. During the 15-month period, selenium concentrations in Mud Slough (north) downstream of the SLD ranged from 3.2 µg/L in November 2001, to 54.9 µg/L in April 2002. Water quality in Mud Slough (north) downstream of the SLD is dominated by the GBP drainage discharge. For comparison purposes, the 5 µg/L (4-day average) selenium water quality objective, which applies October 1, 2010 for Mud Slough (north), is noted on Figure 4. Selenium concentrations regularly exceeded 5 µg/L in Mud Slough (north) downstream of the SLD inflow. Upstream of the drainage discharge, the concentration of selenium was usually below 2 µg/L, and the maximum observed selenium concentration of 1.2 µg/L was observed in both April and August 2002 (Figure 5).

Boron Water Quality Objectives

Boron water quality objectives and monthly mean boron concentrations for Mud Slough, Salt Slough, and the San Joaquin River during the 15-month period are presented in Table 3. Exceedances of the 2.0 mg/L objective occurred at Station C in March and April 2002, and at Station D from March through September 2002. The 1.0 mg/L objective was exceeded at Station N during February and March, and the 0.8 mg/L objective was exceeded at Station N during March and April and from June through September 15, 2002. Sources of boron occur throughout the San Joaquin Basin and are not restricted to the GBP (CVRWQCB, 2002). The CVRWQCB is concurrently conducting a separate effort to control salt and boron loading to the lower San Joaquin Basin.

Molybdenum Water Quality Objectives

Molybdenum water quality objectives and monthly mean molybdenum concentrations for Mud Slough, Salt Slough, and the San Joaquin River during the 15-month period are presented in Table 4. The data indicates that molybdenum concentrations were below the water quality objectives in Mud Slough, Salt Slough, and the San Joaquin River throughout the 15-month period.

Nutrient Data

CVRWQCB staff collected nutrient samples at Stations C, G, and N. Laboratory results for many of the nutrient samples did not meet the recovery criteria specified in the WDRs. Due to lab turnaround-time and holding-time issues, these samples could not be reanalyzed. As a result, these data were not reported. As discussed in Chapter 11, the University of California at Davis, under contract with the USFWS, collected and analyzed samples from Stations B and D. A data audit by the GBP Quality Assurance Officer revealed that external quality assurance data were not available for the water samples collected at Sites B and D. As the quality of these data could not be confirmed, these data were not reported and are not included in this report. The DCRT has taken measures to correct the collection and analysis problems with the nutrient data.

Available nutrient data for Mud Slough (north), and the San Joaquin River are presented in Tables 5, 6, and 7. For comparison purposes, the Primary Maximum Contaminant Level (MCL) for nitrate in drinking water (expressed as nitrogen) is 10 mg/L (CVRWQCB, 2003). Nitrate levels were below the MCL at Stations C, G, and N in all samples. Freshwater aquatic life criteria for ammonia are found in CVRWQCB (2003). Ammonia levels were below the toxicity threshold at Stations C, G, and N in all samples. Although there are currently no water quality objectives with which to evaluate the remaining constituents, they continue to be collected to aid in the development of a TMDL for oxygen demanding substances in the San Joaquin River and future nutrient criteria.

Conclusions

Monitoring has shown that selenium concentrations in the San Joaquin River are a function of location in the River with respect to discharge points and tributary inflows, and of the assimilative capacity of the River. The lowest selenium concentrations in the San Joaquin River are upstream of Mud Slough (north) inflows. Mud Slough (north) inflow contains relatively high

concentrations of selenium. The Merced River dilutes the San Joaquin River with respect to selenium. Selenium concentrations in the San Joaquin River at Station N, however, remain elevated relative to the background condition in the San Joaquin River at Station G.

The 2 µg/L monthly mean selenium water quality objective was exceeded in three of the wetland supply channels during the 15-month period. The maximum monthly mean observed was 2.9 µg/L at Station K (Agatha Canal) in February and 2.9 µg/L Station J in March. A number of sources may contribute to the exceedances of selenium water quality objectives in the wetland channels, including agricultural subsurface drainage from areas outside the GBP being discharged to the channels upstream of the wetlands. Regional Board staff is conducting ongoing investigations focusing on identifying sources of selenium that contribute to exceedances of the selenium water quality objective in the wetland supply channels. The results of these investigations are detailed in separate reports that are available from the Regional Board. The CVRWQCB is evaluating control actions to reduce selenium concentrations in the wetland channels.

The water quality of Mud Slough (north) downstream of the SLD inflow is governed by the GBP drainage discharge and fluctuates widely. Selenium concentrations tend to be lowest from the fall through early winter (non-irrigation period) and highest during the irrigation period, which commences in mid winter (pre-plant irrigation) and lasts through the summer. Selenium concentrations regularly exceeded 5 µg/L in Mud Slough (north) downstream of the SLD inflow. Upstream of the drainage discharge, the concentration of selenium was usually below 2 µg/L.

Boron and molybdenum water quality data from Mud Slough (north), Salt Slough, and the San Joaquin River were compared to applicable water quality objectives. Boron water quality objectives were exceeded at Mud Slough and in the San Joaquin River (Table 3). The exceedances occurred during the irrigation season. Sources of boron occur throughout the San Joaquin Basin and are not restricted to the GBP. The CVRWQCB is concurrently conducting a separate effort to control salt and boron loading to the lower San Joaquin Basin. Molybdenum water quality objectives were met in Mud Slough (north), Salt Slough, and the San Joaquin River throughout the 15-month period (Table 4).

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Table 1. Summary of Water Quality Monitoring Plan

Location	Site	Description	Purpose	Analytical Parameter	Frequency	Sampling Methodology
San Luis Drain	A	inflow to SLD	water quality of inflow (Se and TSS)	Se, B, EC	weekly composite	auto-sampler
				EC, TSS	weekly	mid-channel, depth integrated
	B	discharge from SLD	water quality of discharge (Se and TSS) (for Se load calculation)	Se, B, EC	daily composite	auto-sampler
				pH, EC, Temp, Se, B, TSS[1], Mo[2], Nutrients[3]	weekly	mid-channel, depth integrated
Mud Slough (north)	C	upstream of SLD discharge	Mud Slough (north) base water quality prior to receiving drainage discharges	pH, EC, Temp, Se, B, Mo[2], Nutrients[3]	weekly	grab
	D	downstream of discharge	Mud Slough (north) water quality as impacted by drainage discharge	pH, EC, Temp, Se, B, Mo[2], Nutrients[3]	weekly	mid-channel, depth integrated
	I/I2	back water	water quality impact of Mud Slough (north) flooding in Kesterson Refuge	Se, B, EC	annually	N/A
Wetland Channels	F	Salt Slough	water quality of habitat and to track	Se, B, EC	weekly	grab
	J	Camp 13	verify no discharge of drainage provision	Se, B, EC	weekly	grab
	K	Agatha Canal	verify no discharge of drainage provision	Se, B, EC	weekly	grab
	L2	San Luis Canal	water quality of wetland water supply channel	Se, B, EC	weekly	grab
	M2	Santa Fe Canal	water quality of wetland water supply channel	Se, B, EC	weekly	grab
San Joaquin River	G	at Fremont Ford (upstream of drainage inflow)	track improvements in former drainage conveyance channel and characterize water quality of habitat	pH, EC, Temp, Se, B, Mo[2], Nutrients[3]	weekly	grab
	H	at Hill's Ferry (downstream of drainage inflow)	intended to represent water quality of river most impacted by drainage discharge	Se, B, EC	discontinued; determined to be downstream of seasonal Merced River inflows	grab
	N	at Crows Landing (downstream of Merced River confluence)	characterize water quality of habitat	Se, B, EC	daily composite	auto-sampler
				pH, EC, Temp, Se, B, Mo[2], Nutrients[3]	weekly	grab

Notes:

1 TSS required daily during storm events

2 Molybdenum required monthly

3 Nutrients required monthly September through February and every other week March through August

Table 2. Summary of Selenium Water Quality Objectives and Compliance Time Schedule

Water Body/Water Year Type (1)	1 October, 1996	1 October, 2002	1 October, 2005	1 October, 2010
Salt Slough and Wetland Water Supply Channels listed in Appendix 40 (4)	**2 µg/L monthly mean (2)**			
San Joaquin River below the Merced River; Above Normal, and Wet Water Year Types		*5 µg/L monthly mean (3)*	**5 µg/L 4-day average (2)**	
San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year Types		*8 µg/L monthly mean (3)*	*5 µg/L monthly mean (3)*	**5 µg/L 4-day average (2)**
Mud Slough (north) and the San Joaquin River from Sack Dam to the Merced River				**5 µg/L 4-day average (2)**

(1) The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification (as defined in Footnote 17 for Table 3 in the State Water Resources Control Board's Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, May 1995) at the 75% exceedance level using data from the Department of Water Resources Bulletin 120 series. The previous water year's classification will apply until an estimate is made of the current water year.

(2) Water Quality Objective (in bold)

(3) Performance Goal (in italics)

(4) CVRWQCB. 1998a. Appendix 40, The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region, Fourth Edition: The Sacramento River Basin and the San Joaquin River Basin. California Regional Water Quality Control Board, Central Valley Region. Sacramento, CA

Table 3. Boron Concentrations in the Grassland Watershed and San Joaquin River: October 2001 - December 2002

Station ID	Description	Mean Monthly Concentration (mg/L)															
		Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02		
C	Mud Slu (N) upstrm of SLD Discharge	a	a	a	a	a	na	2.8	2.3	1.9	1.6	1.5	1.1	0.8	na	a	a
D	Mud Slu (N) dwnstrm of SLD Discharge	a	a	a	a	a	na	3.8	5.9	5.5	6.1	5.9	5.1	4.6	na	a	a
F	Salt Slough at Lander Avenue	a	a	a	a	a	1.5	na	0.7	0.6	0.5	0.6	0.5	0.5	na	a	a
G	SJR at Fremont Ford	a	a	a	a	a	1.1	na	0.8	0.7	0.6	0.6	0.5	0.6	na	a	a
N	JR at Crows Landing Weekly Grab Sampl	0.5	0.5	0.7	0.8	1.1	1.4	1.3	1.0	0.8	1.2	1.2	1.2	1.0	0.9	0.6	0.8
N	SJR at Crows Landing Daily Autosamples	0.7	na	na	na	1.2	1.3	1.4	1.0	0.7	1.2	1.3	1.2	1.1	0.9	0.6	0.7

Notes:

= water quality objective exceedance

WQO = water quality objective in mg/L

na = no data available

a = objective only applies 15 March through 15 September

[1] = 1.0 mg/L applies 16 September through 14 March
0.8 mg/L applies 15 March through 15 September

Table 4. Molybdenum Concentrations in the Grassland Watershed and San Joaquin River: October 2001 - December 2002

Station ID	Description	Mean Monthly Concentration (ug/L)															Monthly WQO
		Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02	Dec-02	
C	Mud Slu (N) upstrm of SLD Discharge	5.5	5.6	7.6	6.8	6.9	17.1	10.4	16.9	10.3	0.5	4.6	3.2	na	4.3	4.9	19.0
D	Mud Slu (N) dwnstrm of SLD Discharge	9.9	10.1	11.3	11.5	12.1	12.9	16.8	19.1	19.3	9.7	11.3	11.4	na	7.2	6.7	19.0
F	Salt Slough at Lander Avenue	8.5	7.9	11.0	8.3	8.0	11.2	10.8	8.0	8.0	0.5	1.8	4.4	na	5.0	3.8	19.0
G	SJR at Fremont Ford	na	na	na	na	na	na	na	11.4	8.0	2.2	na	na	na	5.1	1.0	19.0
N	SJR at Crows Landing Grab Samples	2.7	3.9	5.2	6.0	7.3	8.4	5.4	6.9	6.4	1.8	0.5	3.6	na	3.7	3.8	10.0

Notes:

= water quality objective exceedance

WQO = water quality objective in ug/L

na = no data available

Table 5. Nutrient Series Data, Site C, Mud Slough (North) Upstream of SLD (MER536)

Parameter	Nitrate	Dissolved Nitrate-Nitrite	Dissolved Ammonia	Total Kjeldhal Nitrogen	Total Phosphorus	Ortho Phosphate
Units	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L as P
10/1/2001						
11/1/2001		0.27				0.20
12/1/2001		0.17		0.80	0.17	0.12
1/1/2002					0.19	
2/1/2002						0.27
3/14/2002						
3/28/2002						
4/11/2002						
4/25/2002		0.67			0.34	
5/16/2002						
5/30/2002						0.22
6/13/2002						
6/20/2002		0.59		1.02	0.29	0.12
7/18/2002	ND*		<1	<2		<1
7/25/2002	0.9		<1	<2	0.19	<1
8/15/2002	ND*		<1	<2	0.25	<1
8/29/2002		0.03		1.37	0.30	0.07
9/1/2002		0.03		0.79		0.09
10/1/2002		0.08		1.24	0.34	0.30
11/1/2002		0.19		1.23	0.33	0.24
12/1/2002		0.24		1.28	0.28	0.02

Data Source: California Regional Water Quality Control Board, Central Valley Region

Note: * <2 mg/L NO_3 as NO_3

Table 6. Nutrient Series Data, Site G, San Joaquin River at Fremont Ford (MER538)

Parameter	Nitrate	Dissolved Nitrate-Nitrite	Dissolved Ammonia	Total Kjeldhal Nitrogen	Total Phosphorus	Ortho Phosphate
Units	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L as P
10/1/2001						
11/1/2001		0.34				0.07
12/1/2001		0.38			0.14	0.02
1/1/2002					0.16	
2/1/2002		2.28			0.23	0.08
3/14/2002		2.33				0.11
3/28/2002		1.16		1.08	0.21	0.06
4/11/2002		0.94		0.69	0.19	0.04
4/25/2002		0.73			0.27	
5/16/2002		0.64				0.13
5/30/2002		0.60				0.16
6/13/2002	2.7				0.29	0.14
6/20/2002		1.69		1.16		0.14
7/18/2002	1.4		<1	<2		0.17
7/25/2002	1.4		<1	<2	0.33	0.16
8/15/2002	0.9		<1	<2	0.26	0.16
8/29/2002		0.39		1.00		0.15
9/1/2002		0.16		0.60	0.18	0.12
10/1/2002		0.32		0.75	0.21	0.10
11/1/2002		0.26		1.10	0.12	0.04
12/1/2002		0.56		1.76	0.20	0.09

Data Source: California Regional Water Quality Control Board, Central Valley Region

Table 7. Nutrient Series Data, Site N, San Joaquin River at Crows Landing (STC504)

Parameter	Nitrate	Dissolved Nitrate-Nitrite	Dissolved Ammonia	Total Kjeldhal Nitrogen	Total Phosphorus	Ortho Phosphate
Units	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L as P
10/1/2001						
11/1/2001		1.33				0.10
12/1/2001		1.32		0.36	0.13	0.05
1/1/2002					0.15	
2/1/2002						0.09
3/14/2002		3.26				0.11
3/28/2002		2.41		1.12	0.18	0.10
4/11/2002		2.43		0.63	0.16	0.05
4/25/2002		2.66			0.17	
5/16/2002		1.54				0.12
5/30/2002						0.12
6/13/2002	3.8				0.16	<1
6/20/2002		4.35		1.15	0.22	0.06
7/18/2002	5.2		<1	<2		0.11
7/25/2002	2.5		<1	<2	0.29	<1
8/15/2002	2.5		<1	<2	0.15	<1
8/29/2002		3.65		1.14	0.25	0.10
9/1/2002		3.81		0.61		0.14
10/1/2002						
11/1/2002		1.4		1.12	0.11	0.10
12/1/2002		1.35		1.31	0.20	0.02

Data Source: California Regional Water Quality Control Board, Central Valley Region

Figure 1. Selenium Concentration in the San Joaquin River
October 2001 - December 2002

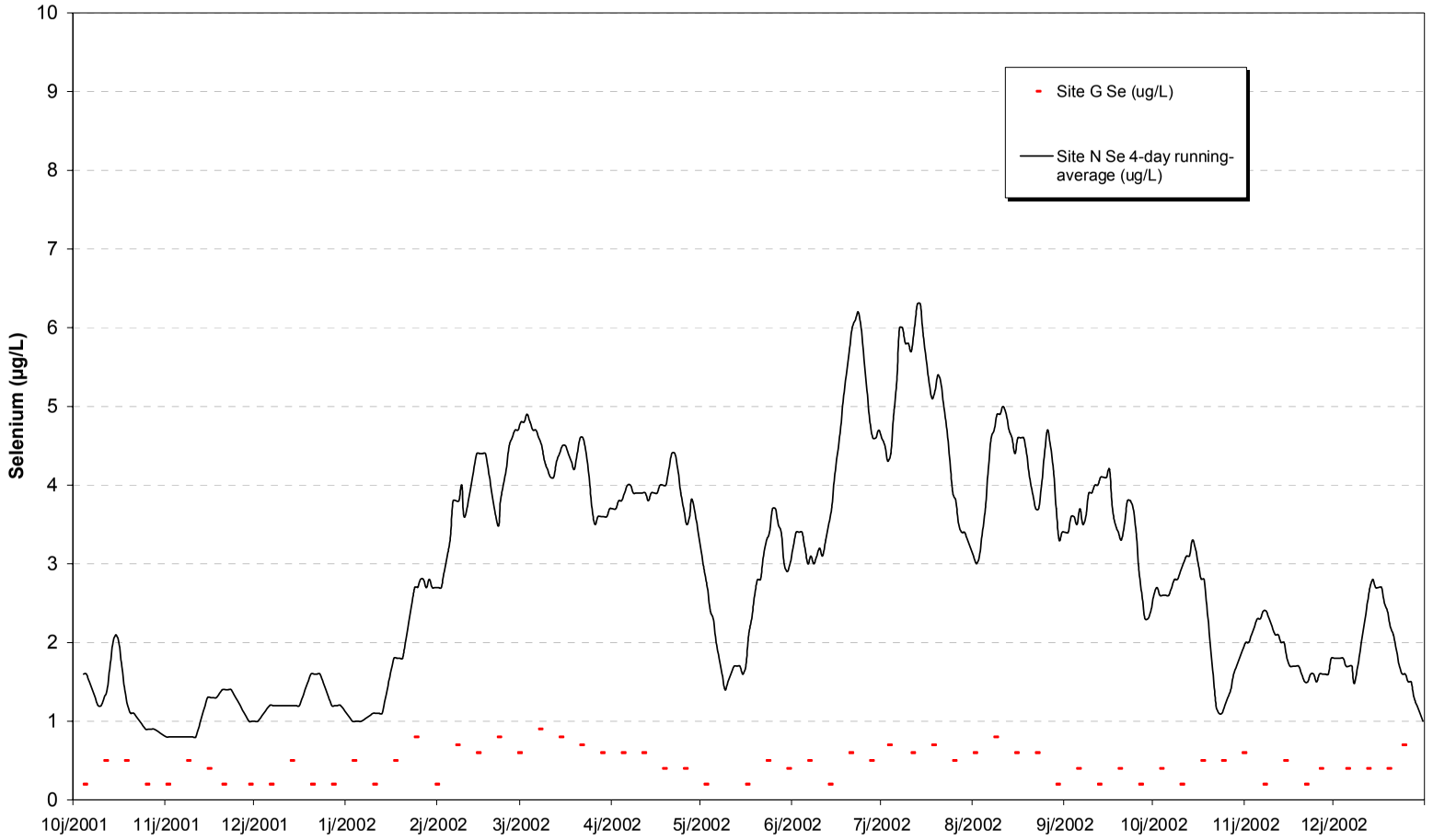

Figure 2. Monthly Mean Selenium Concentration at Site N
October 2001 - December 2002

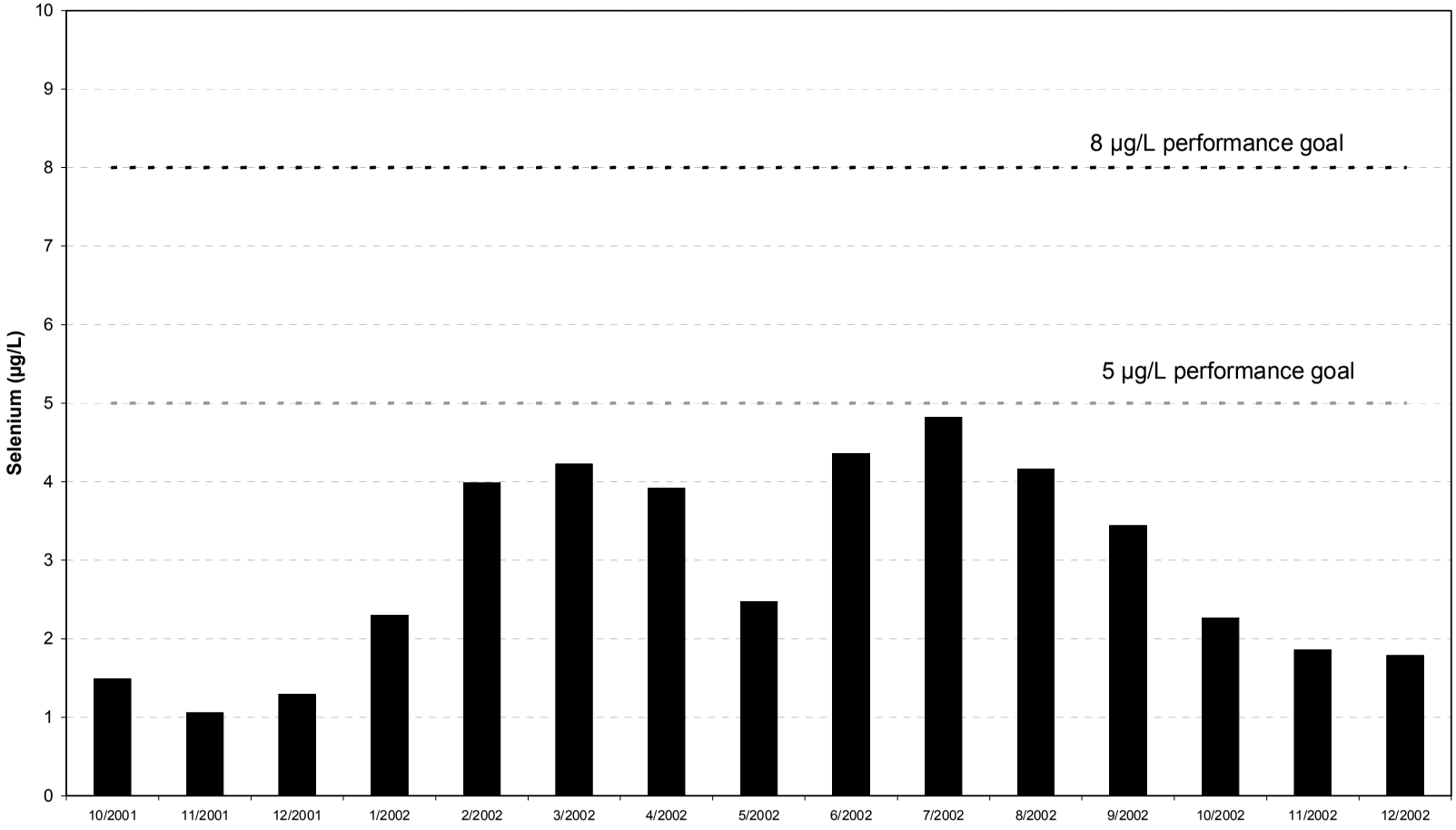

Figure 3. Mean Monthly Selenium Concentration in the Grassland Wetland Supply Channels October 2001 -December 2002

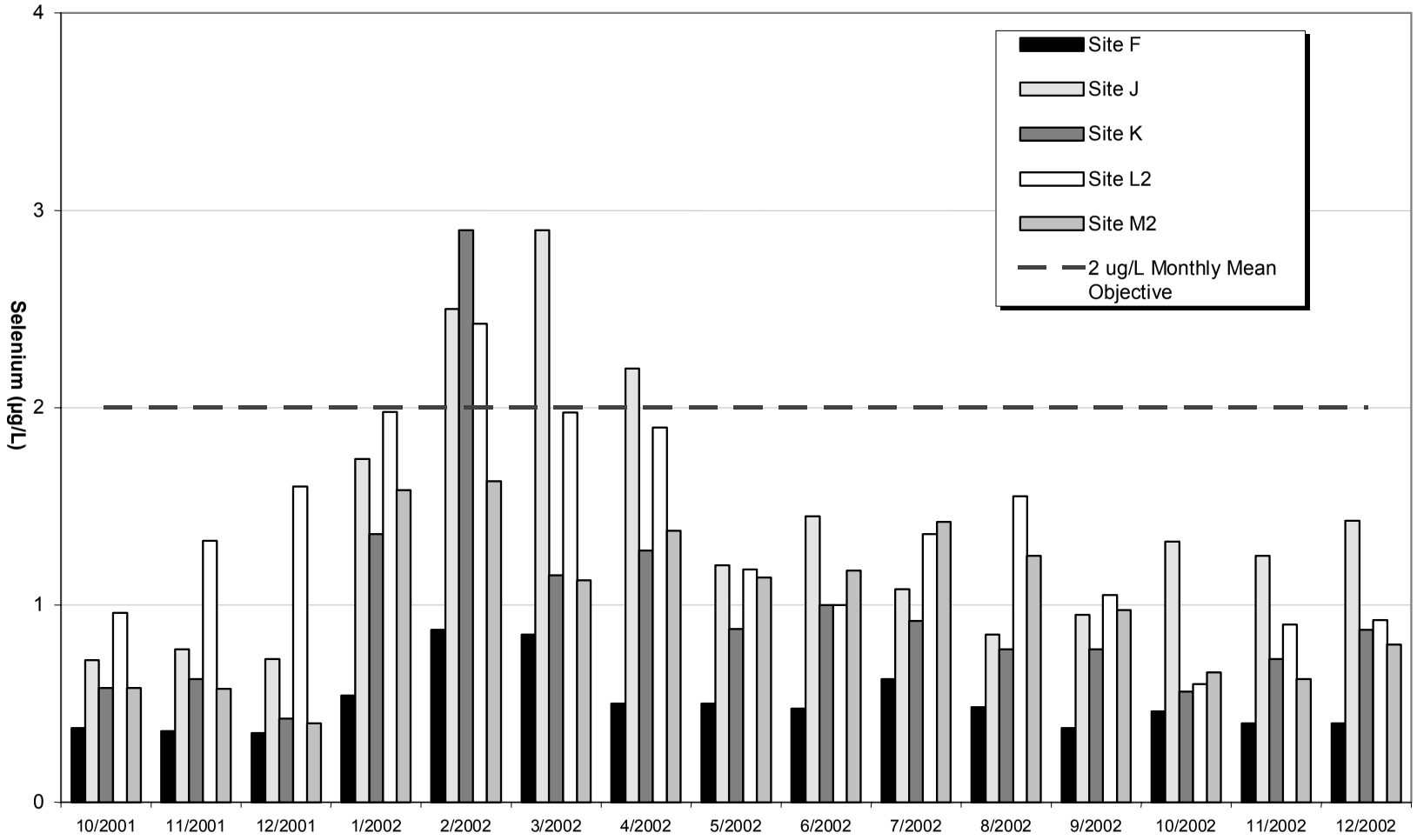

Figure 4. Weekly Grab Selenium Concentration at Site D
October 2001 - December 2002

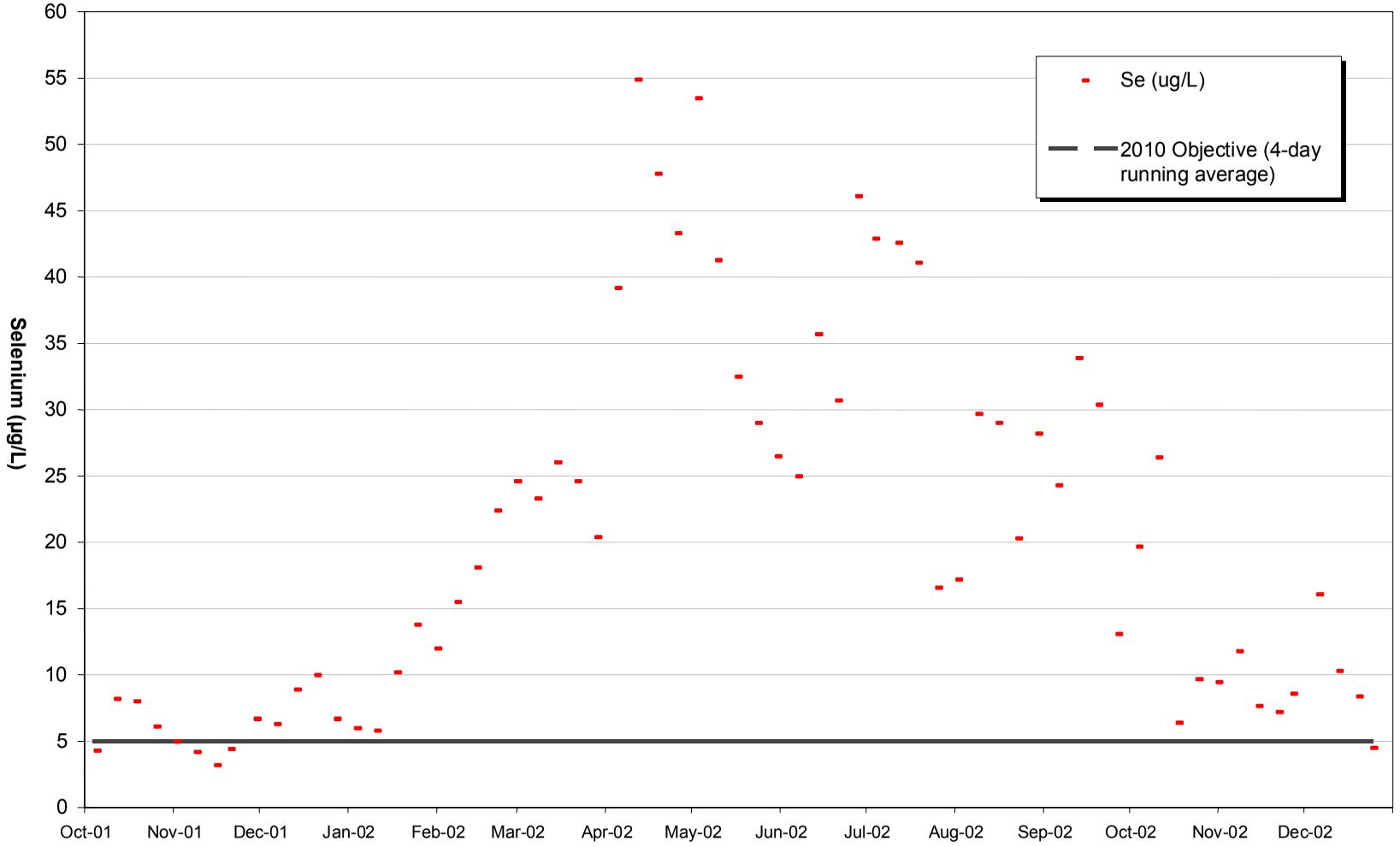

Figure 5. Weekly Grab Selenium Concentration at Site C
October 2001 - December 2002