United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
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Sacramento, California 95825-1846

IN REPLY REFER TO:
CRC-Grassland Bypass Project

MAR 23 2009

To: Ms. Judi Tapia, Resources Management Division, Bureau of Reclamation, South-Central California Area Office, Fresno, California

To: Mr. Joseph McGahan, Regional Drainage Coordinator, the San Luis Delta Mendota Water Authority, Los Banos, California

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Comments on the Draft Environmental Impact Statement/Environmental Impact Report for the Continuation of the Grassland Bypass Project from 2010 Through 2019

This memorandum transmits U.S. Fish and Wildlife Service (Service) review comments and recommendations on the U.S. Bureau of Reclamation's (Reclamation) Draft Environmental Impact Statement/Environmental Impact Report (DEIS/DEIR) for the Continuation of the Grassland Bypass Project From 2010 Through 2019 (GBP Extension), dated December 2008. The Service provides these comments and recommendations under authority of, and in accordance with, provisions of the National Environmental Policy Act (NEPA) (40 CFR Part 1500).

One of the purposes of the Grassland Bypass Project is to route subsurface drainage discharges away from approximately 93 miles of Grassland wetland supply channels and to promote continuous improvement to water quality in the San Joaquin River. The Service strongly supports efforts to reduce drainwater contamination and improve water quality in the Grasslands wetland supply channels and the San Joaquin River.

In order to protect fish and wildlife resources in the Grassland watershed, and to protect existing and future runs of anadromous fish associated with the San Joaquin River, the Service recommends that the final EIS/EIR for the GBP Extension be revised to incorporate the following:

1. Inclusion of lands north of the Grassland Drainage Area into the GBP Extension that still discharge directly into the south Grasslands wetland supply channels;
2. Elimination of discharges into the Delta Mendota Canal from the drainage sumps in the Firebaugh Canal Water District owned by the U.S. Bureau of Reclamation (DMC sumps);

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3. An evaluation of alternative routes of disposal and/or storage of excess drainage flows that occur during heavy rainfall events and that have historically been discharged into the Grasslands wetland water supply channels;
4. Revision of load limits for selenium and salinity in above normal and wet water year types to show reductions in loads from the beginning of the project;
5. Revision of Sediment Management Plan (Appendix B of the DEIS/DEIR) for the disposal of dredged material from the San Luis Drain to adequately protect fish and wildlife resources. As written, the proposed acceptable concentrations for selenium in San Luis Drain dredged material for disposal on open upland areas of 2-390 μg/g, dry weight could pose a significant risk to fish and wildlife resources;
6. An evaluation of the environmental effects of the use of subsurface drainage for dust control on roadways;
7. An evaluation of the environmental effects of continued acute spikes of selenium to the biota in the vicinity of the Grasslands wetland supply channels;
8. Identification of the actions that will be implemented to meet selenium and salinity load limits through the life of the GBP Extension, should a proposed, treatment and disposal methodology not prove to be feasible; and
9. Monitoring and reporting for total mercury and methyl-mercury concentrations in water and biotic tissue at all sampling locations of the GBP to establish a mass-balance of sources of mercury in this watershed;

The final EIS should also discuss the relationship between the GBP Extension and past, present and future reasonably foreseeable projects in the Cumulative Effects Section of the DEIS. Specifically, the final EIS should provide additional information on cumulative impacts of: 1) water transfer programs such as the San Joaquin River Exchange Contract 10-year Transfer Program and the San Joaquin River Exchange Contract 25-year Transfer Program; 2) the San Joaquin River Restoration Program and effects of GBP discharges on San Joaquin River salmonids; 3) water quality impacts in the San Joaquin River under two future scenarios, with and without a continuation of the Vernalis Adaptive Management Program (after 2010); and 4) effects of south Delta temporary barriers on the transport and fate of selenium and sulfate from discharges of the GBP into the Delta.

We appreciate the opportunity to review this DEIS/DEIR. Our detailed comments are enclosed. If you have any questions or comments about this letter, please contact Mr. Mark Littlefield or Ms. Joy Winckel of my staff at (916) 414-6600.

Attachment
cc:
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Background

Grasslands Ecological Area

The Grasslands Ecological Area includes over 160,000 acres of Federal, State, and privately-managed marsh, native pasture and riparian zones, including the largest contiguous block of wetlands remaining within the Central Valley. Prior to the early 1900's, this area was part of a vast network of some 4,000,000 acres of wetlands spread throughout the Central Valley. Today that valley-wide network is down to 300,000 acres, of which the Grasslands area is a critical component. As much as thirty percent of the migratory birds that utilize the Central Valley frequent the watershed each winter. The area annually hosts hundreds of thousands of ducks, geese and waterbirds, and is recognized by the Western Hemisphere Shorebird Reserve Network as a place of international importance to wintering and migrant shorebirds. The Grasslands Ecological Area has also been designated a Wetlands of International Importance under the Ramsar Convention, the only international agreement dedicated to the worldwide protection of wetlands.

History of the Grassland Bypass Project

During the 1950's and 1960's, farmers on the west side of the San Joaquin Basin (north of Westlands Water District) began installation of subsurface drainage systems to maintain arability of drainage-impaired agricultural lands. Drainage water collected by those systems was commingled with agricultural tailwater and other waters and discharged into sloughs and creeks of the western Grasslands area enroute to the San Joaquin River. That commingled water was also used for management of tens of thousands of acres of wetlands in the area. In light of the findings of Kesterson Reservoir environmental studies, contamination surveys were conducted in the San Joaquin River beginning in the fall of 1984. The contamination surveys revealed elevated concentrations of salts, arsenic, boron, and/or selenium in waters, sediments, food-chain organisms, fish and wildlife collected from the area (Moore *et al.* 1990).

In 1985, drainwater stopped being used as a water supply for the Grasslands' public and private wetlands. The discovery of avian developmental abnormalities at Kesterson National Wildlife Refuge, caused by selenium contamination from drainwater disposal in surface water and disposal impoundments, resulted in changes in management by wetlands managers in the Grasslands area. Between 1985 and 1996, channels in the Grassland Water District (GWD) were used to convey both drainwater and fresh water. Through an agreement between the GWD and the surrounding agricultural districts, drainage entered the southern portion of the GWD through the Agatha Canal or the Camp 13 Ditch. When one channel was carrying drainwater, the other was used to convey fresh water to the wetlands. Then the system was switched so that the wetlands along the other channel could receive fresh water deliveries. This “flip-flop” system required flushing of the channel for 24 hours, and the flushing was an inefficient use of fresh water. Use of the “flip-flop” system was halted in 1996 with the implementation of the first Grassland Bypass Project (GBP). The original agreement for use of the San Luis Drain (Use Agreement) dated November 3, 1995, allowed the San Luis and Delta-Mendota Water Authority (Authority) to use a portion of the San Luis Drain (SLD) to convey agricultural drainwater through adjacent wildlife management areas to Mud Slough (North), a tributary to the San

Joaquin River. The 1995 Use Agreement allowed for use of the Drain until September 30, 2001. The 2001 Use Agreement allowed continuation of the use of the Drain through December 31, 2009. With implementation of the GBP from 1996 through the present, most of the drainage from farmlands in and adjacent to the Grassland Drainage Area (the agricultural lands that participate in the Grasslands Bypass Project) was no longer conveyed in about 93 miles of Grasslands wetland supply channels. The continued use of the SLD beyond December 31, 2009, requires a revised Use Agreement, an amendment of the Basin Plan Amendment implementation schedule to comply with water quality objectives in impacted waters (particularly Mud Slough [North]) and portions of the San Joaquin River, and additional environmental review and compliance.

Water Quality Objectives for the Grasslands Wetlands

In 1988 the Central Valley Regional Water Quality Control Board (Regional Board) adopted an amendment to the Basin Plan for regulation of agricultural subsurface drainage discharges from the Grassland Watershed of Merced and Fresno Counties. That amendment included a site-specific selenium objective for wetland water supplies in the Grasslands of 2 µg/L on a monthly mean basis. In 1990, the U.S. Environmental Protection Agency approved the 2 µg/L monthly mean selenium objective for the water delivered to wetland areas within the Grassland watershed. A revised Basin Plan amendment was adopted by the Regional Board in 1996, as part of a set of amendments that focused on the control of selenium-laden agriculture subsurface drainage discharges in and from the Grassland watershed. The need to reduce selenium loadings to, and concentrations in, the Grasslands wetland water supplies and downstream waters in order to protect wildlife, including threatened and endangered species, was one of the driving forces behind the Regional Board's adoption of the Control of Agricultural Subsurface Drainage Discharges (Grassland Amendments). The Service has previously reviewed and commented on drafts of these amendments. The Grassland Amendments were adopted May 3, 1996, by the Regional Board via Regional Board Resolution 96-147, and approved by the State Water Resources Control Board in State Board Resolution 96-078 and by the State Office of Administrative Law on January 10, 1997 (CVRWQCB 1998).

In 2000, the Service and the National Marine Fisheries Service (NMFS) issued a final biological opinion to the Environmental Protection Agency (EPA) on the California Toxics Rule (CTR) (USFWS and NMFS 2000). The CTR biological opinion found with respect to selenium that, "*…the chronic aquatic life criterion for selenium proposed in the CTR [5 µg/L] does not protect listed fish and wildlife dependent on the aquatic ecosystem for development and/or foraging*." The Service and NMFS concluded, "*In aggregate, the weight of scientific evidence supporting a chronic criterion for selenium of < 2 µg/L is now overwhelming*." The Service and NMFS further found that, "*Based on data collected by the U.S. Department of Interior's National Irrigation Water Quality Program (NIWQP) from 26 study areas in 14 western states (including 5 California study areas), a 5 µg/L chronic criterion for selenium is only 50-70 percent protective (Adams et al. 1998; Seiler et al. 2003), as opposed to the 95 percent level of protection that EPA's national water quality criteria are intended to achieve (Stephan et al. 1985). The Service believes the NIWQP data suggest that on a dissolved basis a criterion of*

1 µg/L would be required to achieve 95 percent protection, which is approximately equivalent to a 2 µg/L criterion on a total recoverable basis (Peterson and Nebeker 1992)."

The available body of scientific evidence (the majority of which has been produced subsequent to the EPA's 1987 aquatic life criterion derivation for selenium) supports a chronic criterion of 2 µg/L for the protection of sensitive taxa of fish and wildlife (USFWS and NMFS 2000). In the absence of site-specific and species-specific data regarding the sensitivity of particular species and/or populations, a criterion of at most 2 µg/L is required to assure adequate protection of threatened and endangered species of fish and wildlife. This is especially warranted considering the steep response curves for selenium (Hoffman *et al*. 1996; Lemly 1998; Skorupa 1998) and the well-demonstrated potential for selenium-facilitated pathogen susceptibility in controlled laboratory studies (Tully and Franke 1935; Whiteley and Yuill 1989; Larsen *et al.* 1997; Wang *et al.* 1997). The Service and NMFS concluded in the CTR biological opinion that selenium-induced immune dysfunctions have the potential to rapidly extirpate entire populations of fish and wildlife via epizootic events (USFWS and NMFS 2000).

Congressional Mandates for Refuge Water Supplies

Two Federal laws have been enacted that include requirements for provisions of adequate water quality to refuges. Section 3406(d) of the Central Valley Project Improvement Act (Public Law 102-575) requires firm water supplies be provided of "*suitable quality*" to maintain and improve wetland habitat on units of the National Wildlife Refuge System in the Central Valley of California, Los Banos and North Grasslands Wildlife Areas; and on the Grasslands Resource Conservation District. The National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) Section 5(F) states that the Secretary of Interior shall, "*assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the System and the purposes of each refuge*."

In 2001, the Bureau of Reclamation (Reclamation) and the Service entered into a Memorandum of Understanding (MOU) providing for Central Valley Project and acquired water supplies to units in the National Wildlife Refuge System in the San Joaquin Valley (USBR and Service 2001). With respect to water quality, that MOU stipulated, "*the water delivered by Reclamation to the Service pursuant to this MOU shall be of suitable quality to maintain and improve wetland habitat areas…*"

Description of Project

The proposed action would permit the Authority to continue use of the Federally-owned San Luis Drain and implement the GBP Extension from January 1, 2010 through December 31, 2019 under the terms and conditions of the proposed "2010 Use Agreement for Use of the San Luis Drain" (included as Appendix A of the DEIS/DEIR). The GBP Extension proposes to continue to consolidate subsurface drainflows on a regional basis and utilize a portion of the Federally owned San Luis Drain (SLD) to convey drainflows around wetland habitat areas after the existing use agreement expires in 2009. Under the GBP Extension, drainwater would continue to be collected from the 97,400-acre Grassland Drainage Area and place it into the SLD near Dos

Palos, California (Site A). The drainage is then conveyed to the SLD's terminus where it discharges into Mud Slough (North) (Site B).

The purposes and objectives of the proposed continuation of the Grassland Bypass Project, 2010–2019 (Proposed Action) are to:

- Extend the SLD Use Agreement to allow the Grassland Basin Drainers time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives (amendment underway) and Waste Discharge Requirements by December 31, 2019;
- Continue the separation of unusable agricultural drainage water discharged from the GDA from wetland water supply conveyance channels for the period 2010–2019;
- Facilitate drainage management that maintains the viability of agriculture in the Project Area and promotes improvement in water quality in the San Joaquin River.

New features include a revised Use Agreement for the SLD, updated compliance monitoring plan, revised selenium and salinity load limits, a new Waste Discharge Requirement from the Regional Board, and mitigation for continued discharge to Mud Slough. In-Valley treatment/drainage reuse at the San Joaquin River Improvement Project (SJRIP) facility would be expanded to 6,900 acres. Also, it is anticipated that at some point during the life of the project, Reclamation and the Authority will need to remove existing and future sediments from the affected portion of the San Luis Drain.

In order to continue to discharge into Mud Slough (North) in the State's China Island Wildlife Area, the Authority would need to extend or amend a Memorandum of Understanding with the California Department of Fish and Game. In addition, the Regional Board will need to amend the 1998 Basin Plan to delay the date for compliance with selenium objectives in Mud Slough (North) and a portion of the San Joaquin River in all water year types.

Service Comments on GBP Extension DEIS/DEIR

Purpose and Need

The DEIS/DEIR identified several purposes and objectives for the proposed continuation of the Grassland Bypass Project, 2010–2019 (Proposed Action) These include:

> *"To continue the separation of unusable agricultural drainage water discharged from the GDA from wetland water supply conveyance channels for the period 2010–2019*."

Because this project objective includes the separation of agricultural drainage water produced in the Grassland Drainage Area from the wetland water supply conveyance channels, the proposed action in the DEIS/DEIR should include the following additional sources of drainage

contamination in the Grasslands wetland channels: 1) Lands to the north of the existing GBP Area that still discharge directly to the wetland supply channels; 2) drainage discharged from Delta Mendota Canal (DMC) sumps; and, 3) discharges during heavy rainfall events.

1. **Sources of selenium in the Grasslands wetland supply channels: lands outside the GBP's Drainage Project Area**

The prohibition of agricultural subsurface drainage to Salt Slough and the Grasslands wetland supply channels resulted in the diversion of most of the drainage to Mud Slough (North) via a portion of the San Luis Drain. However, as was noted in a Regional Board Report reviewing selenium concentrations in wetland water supply channels in the Grassland Watershed (Chilcott 2000), "*Two areas have been identified where agricultural subsurface drainage can enter wetland water supply canals from farmland not contained in the DPA* [Drainage Project Area]. *One area is west of the wetland water supply channels and historically drained into the Almond Drive Drain which entered South Grassland Water District at Almond Drive. A second area is a triangle-shaped area of approximately 7,000 acres south of the Poso Drain (also known as the Rice Drain) and north of the DPA which historically drained into the Poso Drain which enters South GWD from the east..."* Figure 1 below is a copy of the map from Chilcott (2000) that identifies areas where agricultural drainage still enters the wetland water supply canals.

The GBP EIS/EIR in 2001 (USBR and San Luis and Delta Mendota Water Authority, 2001) noted that the proposed action may include the addition of approximately 1,100 acres of farmland to the GBP's Drainage Project Area (DPA), found immediately adjacent to the DPA, south of the San Luis Drain and east of the Grassland Bypass Channel, that currently drain to wetland channels, in the area identified Chilcott (2000) as the Poso Rice Drain Area. The 1,100 acres proposed for inclusion in the GBP EIS/EIR of 2001 is shown in Figure 2. To date, however, these additional acres have not been incorporated into the GBP. The DEIS/DEIR for the GBP Extension notes that these 1,100 acres "*could be annexed to the GDA*."

Figure 3 is a subset of a map of the San Joaquin Valley Drainage Authority, Westside San Joaquin River Watershed Coalition that focuses on the Grasslands Area. From that map, it appears that the lands identified in Chilcott 2000 that still discharge directly to the south Grasslands wetland channels fall within Central California Irrigation District (See Figure 3 below).

Recommendation: Because these discharges contribute to exceedences of the adopted selenium objective of 2 µg/L in the Grasslands wetland supply channels, agricultural lands that still discharge drainage directly to the wetland supply channels should be added to lands participating in the GBP Extension.

Figure 1. From Chilcott 2000

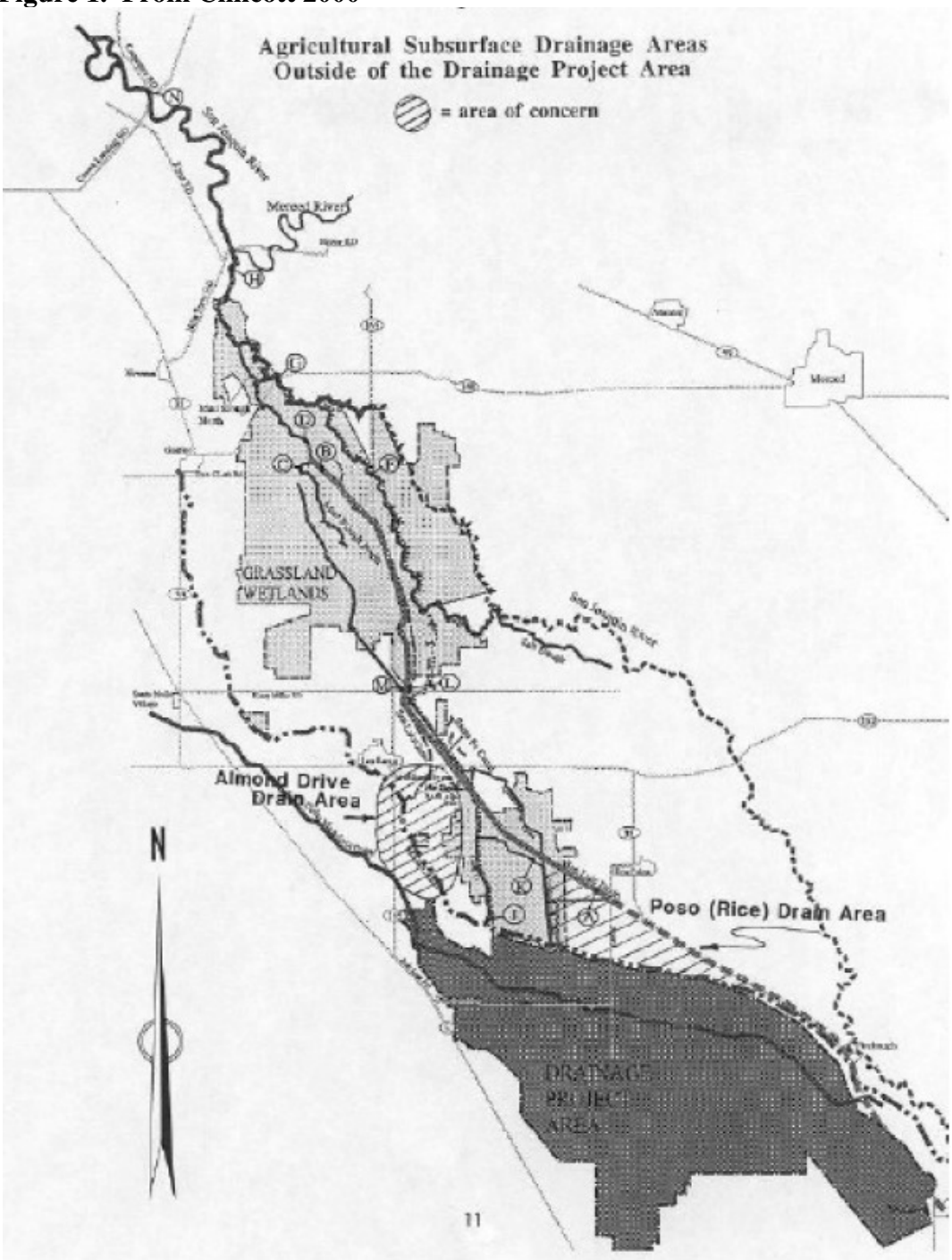


Figure 2. GBP Project Area Map including Proposed 1,100 Acres Additional Lands to be added to the DPA (from Reclamation and San Luis and Delta Mendota Water Authority, 2001)

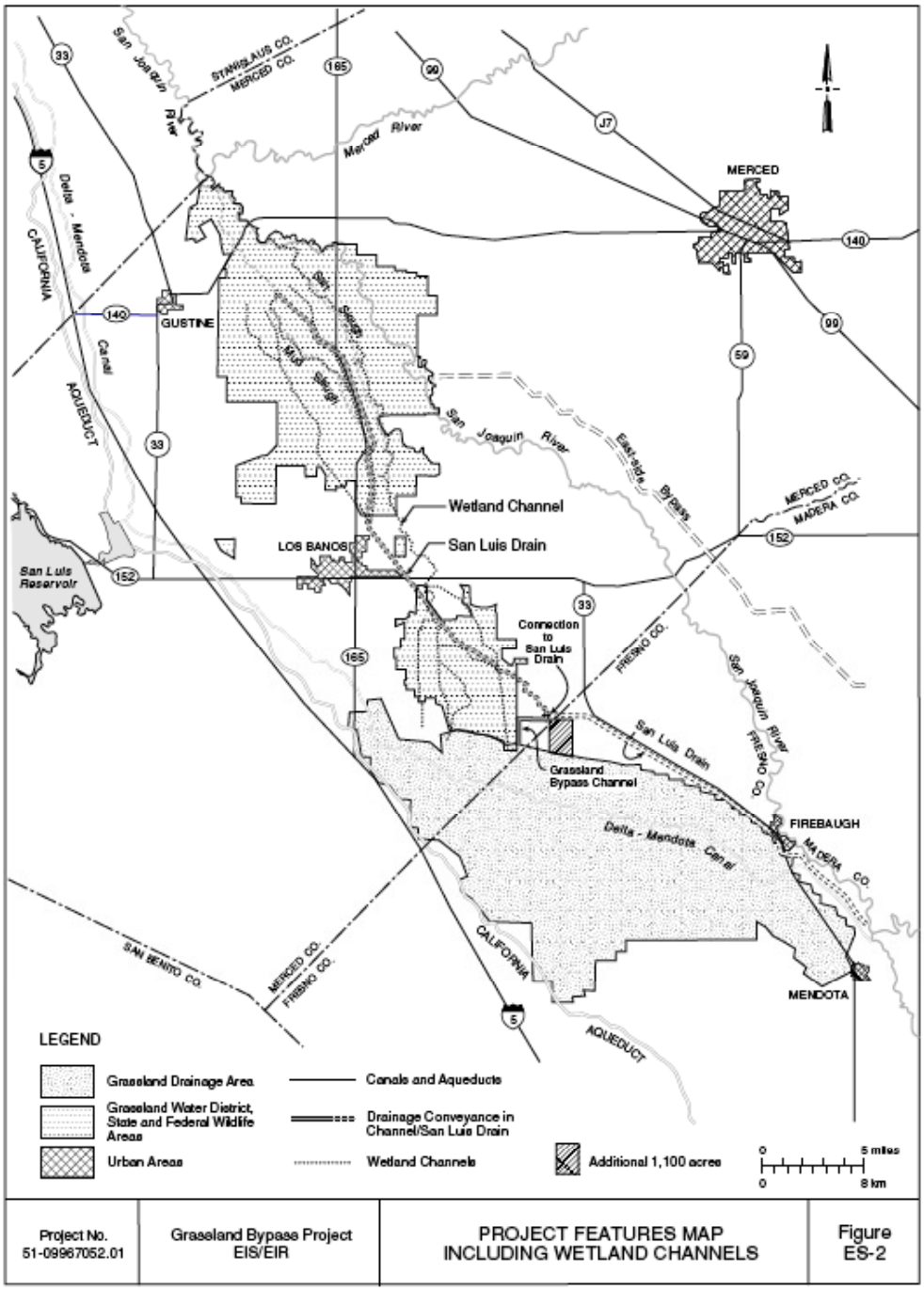
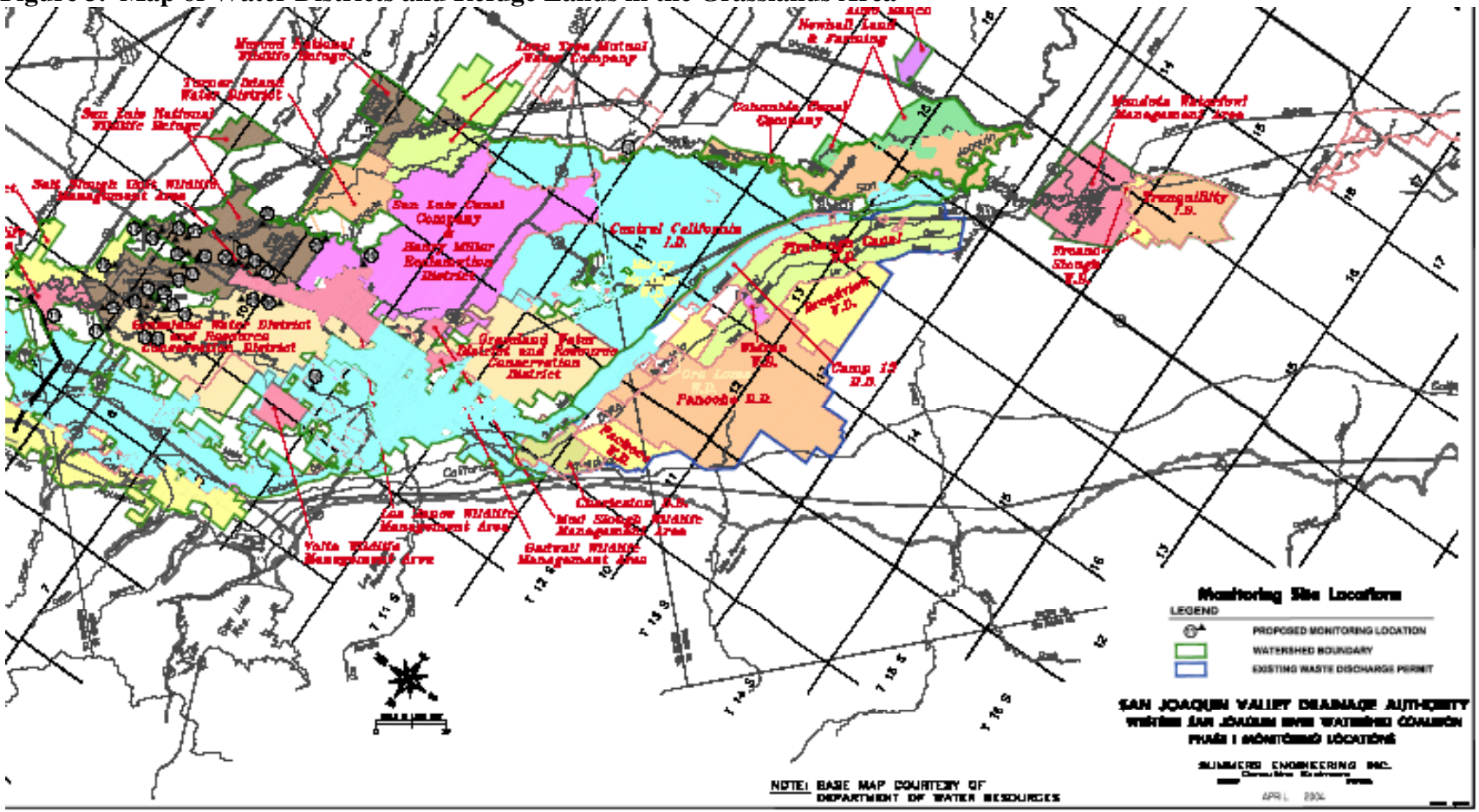


Figure 3. Map of Water Districts and Refuge Lands in the Grasslands Area



2. **Sources of selenium in the Grasslands wetland supply channels: Delta Mendota Canal sumps and check drains**

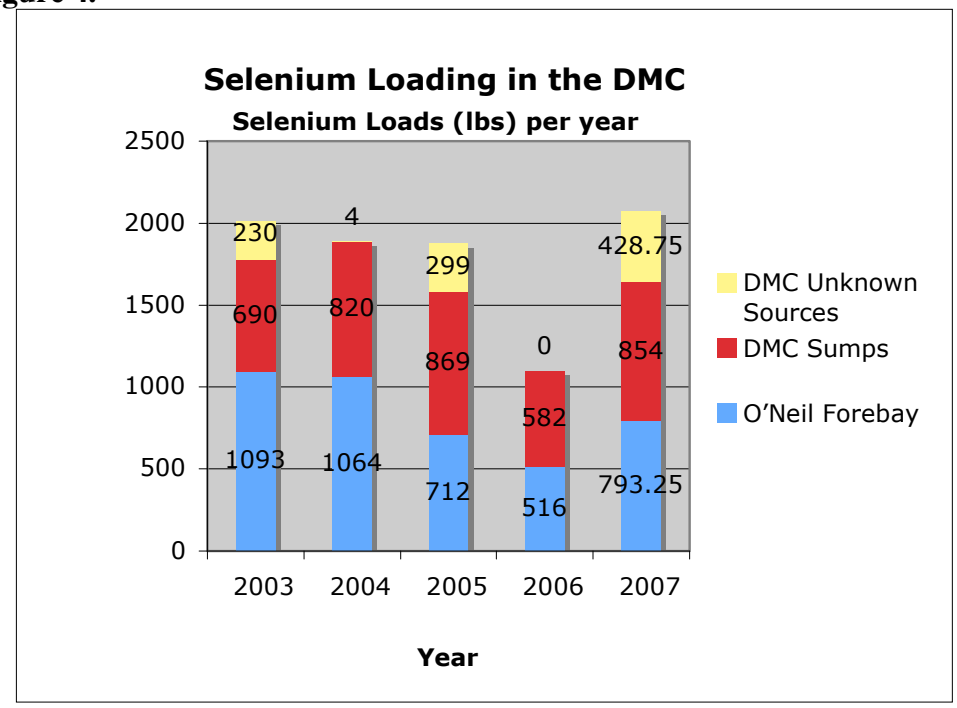
Another source of selenium in the Grasslands wetland supply channels has been identified to be supply water in the DMC (Eppinger and Chilcott, 2002). The major source of supply water to the Grasslands wetland channels and to the agricultural lands of the Grassland Drainage Area is the DMC, via Mendota Pool and the Central California Irrigation District Main Canal. Sources of selenium to the DMC include: groundwater pumping into Mendota Pool, recycling of San Joaquin River drainage into the Federal pumps in the south Delta, flood flow and sediment loading from the Panoche and Silver Creek watersheds, and discharge from DMC subsurface drains and six shallow groundwater sumps (DMC sumps) owned by Reclamation and operated by the San Luis and DMC Water Authority in the Firebaugh Canal Water District (Pierson *et al.* 1987; Chilcott 2000; USBR February 2008).

In the 1950s Reclamation installed check drains and the DMC sumps between Mileposts 99 and 110, parallel to the DMC, to collect small quantities of seepage water or surface runoff to prevent accumulation and possible damage to the canal bank or adjacent lands. Water collected in the subsurface drains is discharged into the DMC by the sumps through six drainage inlet structures. Although flow from Reclamation's DMC sumps is relatively small (the cumulative volume of drainage from the six DMC sumps averages 3.3 acre-feet per day and 110 acre-feet per month from USBR February 2008), selenium concentrations in discharged water have ranged from 57 - 2,100 µg/L between 1985 and 2000 (USBR April 2002). Reclamation monitoring data up to 1994 revealed water discharged from sump "K" exceeded California's hazardous waste threshold for selenium in water (1,000 µg/L) in one or more months sampled annually. Since 2003, selenium in water from DMC sump "K" was at or exceeded this State Hazardous Waste threshold for selenium on two separate dates (May 20, 2003 and April 26, 2006: source USBR February 2008).

Regional Board staff indicated a close correlation between selenium in DMC and Central California Irrigation District's Main Canal source water and selenium in wetland supply channels, during the non-flood water years of 1999 and 2000 (Eppinger and Chilcott 2002). This report noted that when the source water had elevated selenium concentrations (above 2 µg/L) a corresponding increase in selenium concentration was noted in the wetland water supply channels.

Since 2002, Reclamation has monitored the DMC sumps for selenium on a weekly basis. Reclamation water quality monitoring data from various points along the DMC from 2003 to 2007 indicate that between O'Neil Forebay and the Mendota Pool, from 582 to 1,283 pounds of selenium have been added to the DMC supply water annually (see Figure 4 below). Depending on the year, from 67 to 100 percent of that added load downstream of O'Neil Forebay is from the DMC sumps and the remainder of the added load is from unaccounted sources (e.g., DMC check drains) (USBR February 2008).

Figure 4.



1. Selenium loads from Unknown Sources were calculated by subtracting the selenium loads from the DMC sumps and at O'Neil Forebay from the selenium loads at the DMC Terminus (MP-116.48 at Bass Ave). In the case of 2006, the input from Unknown Sources was a negative number, and therefore assumed to be zero.

2. For the month of September 2007 a monthly selenium load was not available for O'Neil Forebay. For the purposes of this analysis, a monthly load was calculated as the average of the monthly selenium loads at this location from September for the years 2003-2006.

As part of the San Luis Drainage Feature Re-evaluation planning effort, Reclamation proposed the building of a DMC Drain to intercept groundwater at the DMC sumps and convey it to the GBP's reuse area for reuse, treatment and disposal of approximately 1,100 AF/year. The DMC Drain was envisioned to consist of two pipelines. The upstream pipeline would convey drainwater 300 feet from Sump A over the DMC and into the adjoining reuse area. The other 39,700 feet of buried pipeline would collect drainwater from the other five sumps and convey it along the southwestern side of the canal to the southeastern corner of the reuse area (USBR May 2006).

Recommendation: Because selenium loading in the DMC supply water can affect water quality in the Grasslands wetland supply channels, the Service recommends that drainage discharges into the DMC be routed to the SJRIP reuse area, and treatment and disposal facilities of the GBP as was proposed in the San Luis Drainage Feature Re-evaluation Final EIS (USBR May 2006).

3. **Sources of selenium in the Grasslands wetland supply channels: heavy rainfall events**

Tile-drained farmlands in the GBP's DPA southwest of the Grasslands wetland supply channels have proven to be susceptible to flooding during winter storm events from the Panoche/Silver Creek watershed in the Coast Range. These flood flows [40,000 acre-feet during 2-week periods associated with these storm events (San Luis and Delta Mendota Water Authority 1997)] have been characterized by high selenium levels and loads. For example, selenium concentrations in flood waters from the Panoche/Silver Creek watershed ranged from 4 to 155µg/L during a February 1998 storm event (Chilcott 2000). Presser and Luoma (2006) estimated the cumulative selenium load from Panoche Creek during the *El Nino* Water Year of 1998 to be 8,045 pounds. Such flood flows have overwhelmed the GBP resulting in the diversion of selenium-contaminated water into the Grasslands wetland supply channels.

Since 1996, there also have been infrequent, short-term instances where agricultural drainage flows within the GBP have been diverted to Grasslands wetland supply channels during winter storm events. Since 1995, such events occurred in water years 1995, 1997, 1998 and 2005 and have resulted in significant spikes in selenium concentrations in the Grasslands wetland supply channels and selenium loading into the San Joaquin River (Presser and Luoma 2006, Grassland Area Farmers 2005). Releases of commingled stormwater and drainwater to the Grasslands wetland supply channels are predicted to occur at similar frequency under the proposed GBP Extension as compared to existing conditions.

The most recent winter storm event in 2005 was described in a report submitted to Reclamation and Regional Board (Grassland Area Farmers 2005). As a result of heavy rainfall, commingled stormwater and drainage flows that normally would have been routed into the San Luis Drain were rerouted into the Agatha Canal in the south Grasslands. During the 2005 storm event, selenium concentrations in water from Agatha Canal were elevated over 2 µg/L for several weeks as denoted in Table 1 below.

Table 1. Flood Flows into Agatha Canal, 2005 (data from Grassland Area Farmers 2005).

Date	Flow (AF)	Selenium (µg/L)	Selenium (pounds)
2/16/2005	7	3.5	0.1
2/17/2005	75	4.5	0.9
2/18/2005	50	3.5	0.5
2/19/2005	44	26.5	3.1
2/20/2005	40	39.9	4.3
2/21/2005	40	43.8	4.7
2/22/2005	14	3.7	0.1
2/23/2005	0	44.4	0
2/24/2005	N/A	24.8	N/A
2/25/2005	N/A	24.2	N/A
2/26/2005	N/A	16.6	N/A
2/27/2005	N/A	14.8	N/A
2/28/2005	N/A	9.27	N/A
3/1/2005	N/A	5.1	N/A
3/2/2005	N/A	2.83	N/A

Selenium bioaccumulates rapidly in aquatic organisms and a single pulse of selenium (>10 µg/L) into aquatic ecosystems could have lasting ramifications, including elevated selenium concentrations in aquatic food webs (Besser *et al.* 1993; Graham *et al.* 1992; Maier *et al*. 1998; Nassos *et al.* 1980; Hamilton 2004). Besser *et al*. (1993) reported that within 24-hours waterborne treatment levels of 100 µg /L selenium in the form of selenite and selenate bioaccumulated to greater than 40 µg/g in algae and 8-15 µg/g in daphnids (both extremely dangerous levels of food web selenium for higher trophic level consumers). Graham *et al.* (1992) also documented rapid bioaccumulation from waterborne spikes of selenium and much slower elimination of that selenium from the food web. Based on standard acute toxicity testing, Nassos *et al.* 1980 concluded that, "… *organisms can concentrate Se* [selenium] *several hundred times the level in the water within a period of 24 h*." Maier *et al*. (1998) documented that a brief pulse of selenium of about 10 µg/L in a Sierra Nevada stream for less than 11 days (selenium was 10.9 µg/L at 3 hrs post-treatment and at < 1 µg/L when next measured 11 days post-treatment) resulted in elevated invertebrate selenium concentrations of > 4 µg/g (composite invertebrate samples collected before fertilization of the treatment area contained 1.67 µg/g selenium (dry weight)). Maier *et al.* found that the invertebrate food web was still contaminated at > 4 µg/g 12 months after selenium treatment when the monitoring ended even though water concentrations were < 1 µg/L.

Another field example of an effect of a selenium pulse in water was noted at the Tulare Lake Drainage District's flow-thru compensation wetland in the southern San Joaquin Valley. Although the water supplied to the wetland was generally managed to keep its selenium content at or below about 2- 3 µg/L, a pulse of 23 µg/L was documented on March 29, 1995, (Tulare Lake Drainage District 1996). Three months later (June 20, 1995), and without any additional selenium pulses, 16 avian eggs sampled at the site contained from 3.4 to 6.2 µg/g selenium and

averaged 4.75 µg/g selenium (Tulare Lake Drainage District 1996) which exceeds the embryotoxic risk threshold reported in Skorupa (1998). In June 1995, 12 percent of sampled eggs exceeded 6 µg/g selenium which very plausibly may have been linked to the late March pulse of 23 µg/L selenium that passed through the system. In 1996, a year without any selenium pulses 16 avian eggs sampled in June at the same site contained from 2.2 to 4.1 µg/g and averaged 3.00 µg/g selenium (Tulare Lake Drainage District 1997). Twelve of the 16 eggs collected in 1995 contained more selenium than the maximum egg selenium from 1996. The average selenium value in 1995 was statistically significantly higher than in 1996 based on a two-sample nonparametric medians test (Skorupa pers. comm. January 7, 2009).

Recommendation: The final EIS for the GBP Extension should include an evaluation of alternative routes of disposal and/or storage of excess drainage flows that occur during heavy rainfall events and that have historically been discharged into the Grasslands wetland supply channels.

4. **Selenium and salinity load limits**

The purposes and objectives of the GBP Extension also include the following:

> *"To facilitate drainage management that maintains the viability of agriculture in the Project Area and promotes continuous improvement in water quality in the San Joaquin River."*

As is discussed below, the selenium and salinity load limits for wet and above normal year types are the same as load limits established for the GBP in 2005 (as shown in Tables 2 and 4 below). There is no reduction in salinity or selenium loads for wet and above normal years until 5 years into the GBP Extension (i.e. 2015). This appears inconsistent with the purpose and need, to facilitate drainage management that "*promotes continuous improvement in water quality in the San Joaquin River*."

Actual GBP selenium loads for calendar years 2002-2007 are presented in Table 3. Average annual selenium load from GBP for years 2002-2007 was: 3,684 pounds. Yet, the selenium load limits established for wet and above normal water year types in the GBP Extension are well above this average (4,480 and 4,162 pounds, respectively). Thus the new use agreement sets selenium load limits that do not show any improvement over what was required in 2005 for the first five years of the GBP Extension in wet or above normal years.

The salinity load limit is applied to the influent in the Drain at Station A. The salinity load that is actually discharged into Mud Slough (Station B) is lower due to deposition of solids in the sediment of the Drain. Actual GBP salinity loads for calendar years 2002-2007 are presented in Table 5. Average annual salinity load from GBP for years 2002-2007 was: 108,432 tons discharged from Station A into the San Luis Drain. Yet, the load limits established for wet and above normal water year types in the GBP Extension are well above this average (167,846 and 164,400 tons, respectively) and in fact are well above the highest annual salinity loads measured from the project since 2002. Thus, the new use agreement sets salinity load limits that are too

high and do not show any improvement over what was required in 2005 for the first five years of the GBP Extension for wet or above normal years.

Table 2. Grassland Bypass Project Annual Selenium Load Limit in Pounds (Applied to Loads of Selenium Discharged From the San Luis Drain Terminus at Station B).

Year	Critical	Dry/Below Normal	Above Normal	Wet
2002	5328/	5328	5328	5328
2003	4995	4995	4995	4995
2004	4662	4662	4662	4662
2005	4162	4162	4162	4480
2006	3853	3995	4162	4480
2007	3545	3829	4162	4480
2008	3236	3662	4162	4480
2009	2557	3296	4162	4480
2010	1658	2864	4162	4480
2011	1075	2496	4162	4480
2012	1075	2496	4162	4480
2013	1075	2496	4162	4480
2014	1075	2496	4162	4480
2015	844	1947	3234	3510
2016	613	1398	2306	2540
2017	381	849	1378	1570
2018	150	300	450	600
2019	150	300	450	600

Table 3. Actual Selenium Loading in Pounds from the GBP measured at San Luis Drain Terminus at Station B.

Calendar Year	Water Year Type for the San Joaquin Valley (from http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST)	Selenium Load Limit Based on Water Year Type	Actual Load from Station B (data from Chris Eacock pers. comm., 2.26.09)
2002	Dry	5328	4,176
2003	Below Normal	4995	4,007
2004	Dry	4662	3,672
2005	Wet	4480	4,286
2006	Wet	4480	3,690
2007	Critical	3545	2,274

Table 4. Salinity Load Values (in tons) GBP from 2001 through the Extension (2019) based on salt loading in influent into the San Luis Drain at Station A.

Year	Critical	Dry/Below Normal	Above Normal	Wet
2002	190,301	190,301	190,301	190,301
2003	180,786	180,786	180,786	180,786
2004	171,271	171,271	171,271	171,271
2005	167,845	167,845	167,845	167,845
2010	77,700	113,100	164,400	167,846
2011	58,000	98,600	164,400	167,846
2012	58,000	98,600	164,400	167,846
2013	58,000	98,600	164,400	167,846
2014	58,000	98,600	164,400	167,846
2015	49,100	79,900	132,200	144,600
2016	39,100	61,100	100,000	112,200
2017	27,500	42,400	67,800	79,800
2018	13,000	23,700	35,600	47,400
2019	13,000	23,700	35,600	47,400

Table 5. Actual Salinity Load in Tons from the GBP by Calendar Year measured at San Luis Drain inflow at Station A.

Calendar Year	Water Year Type for the San Joaquin Valley (from http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST)	Salinity Load Limit Based on Water Year Type	Actual Load Discharged at Station A (data from Chris Eacock pers. comm., 2.26.09)
2002	Dry	190,301	116,200
2003	Below Normal	180,786	114,240
2004	Dry	171,271	111,860
2005	Wet	167,845	123,670
2006	Wet	None Established	113,020
2007	Critical	None Established	71,600

***Recommendation*:** Load limits for selenium and salinity in above normal and wet water year types should be revised to require reductions in loads from the beginning of the project (2010).

Environmental Effects of the Project Not Adequately Addressed

As is noted on Reclamation's website regarding the National Environmental Policy Act (NEPA) (from http://www.usbr.gov/mp/nepa/nepa_overview.cfm),

> "*NEPA requires full disclosure about major actions taken by Federal agencies, including alternatives to the actions, impacts, and possible mitigation. NEPA also requires that environmental concerns and impacts be evaluated during planning and decision making. For any proposed Federal action, Federal agencies such as the Bureau of Reclamation prepare a NEPA compliance document to provide this full disclosure to the public*."

However, the Service believes that there are several aspects of the proposed action that are not adequately described and/or analyzed in the DEIS/DEIR. These include the following: 1) San Luis Drain sediment disposal on upland open areas; 2) use of subsurface drainage for dust control on roadways; 3) effects of current selenium levels in the Grasslands wetlands supply channels to biota; and, 4) identification of what measures will be implemented should the drainage treatment and disposal technologies (that have not yet been fully tested) prove technologically or economically infeasible.

1. **<u>San Luis Drain sediment disposal on upland open areas</u>**

Section 404 of the Clean Water Act requires authorization from the Corps of Engineers, for the discharge of dredged or fill material into all waters of the United States, including wetlands. Discharges of fill material generally include: placement of fill that is necessary for the construction of any structure, or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fills for recreational, industrial, commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for intake and outfall pipes and subaqueous utility lines; fill associated with the creation of ponds; and any other work involving the discharge of fill or dredged material.

Waters of the United States includes essentially all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. Section 404 permits are required for discharges of dredged or fill material placed in these waters.

The Service recommends that Reclamation consult with the Corps of Engineers regarding the need for any section 404 permits, since the Grassland Bypass has a direct connection with Mud Slough (North) and the San Joaquin River. This direct connection would make the Grassland Bypass a tributary to the San Joaquin River and any discharges of dredged or fill material into the Bypass or adjacent wetlands would likely be subject to the Clean Water Act.

As of 2007, an estimated 222,025 cubic yards of sediment has accumulated over the entire reach of the SLD. The majority of this sediment is located in the upstream portion of the SLD near Site B. The DEIS/DEIR notes that when sediment depths exceed 4.4 feet, the 1 foot per second flow rate (corresponding to a flow of 150 cubic feet per second (cfs), to prevent the mobilization of the deposited sediment and discharge to Mud Slough) can not be met. The most recent sampling indicates that the area between SLD check 14 and SLD check 17 exceeds 4.4 feet. Most recently, between October 2006 and 2007, the volume of sediment in the SLD increased by 3,017 cubic yards. The primary concern with sediment accumulation is that sediment will restrict the capacity of the SLD to carry the maximum allowed flow (150 cfs). The sediment rate of accumulation is estimated to be about 1 to 2 inches per year spread through the entire SLD. This rate corresponds to a total average accumulation of between 8 and 16 inches of sediment over the life of the Project.

The State Water Resource Control Board found in Order No. WQ 85-1 the soils and wastewater associated with Kesterson Reservoir to be a "designated waste" that posed a hazard to the environment, and as such, should be handled, stored, or disposed of in a manner consistent with hazardous waste management provisions. This concern, prompted a recommendation for complete sediment removal from the portion of the SLD to be reopened as part of the GBP as the project was originally conceived by the San Joaquin Valley Drainage Program (1990). However, the recommendation was never carried out (Presser and Piper 1998). Rather, dredging and disposal of the sediment in the SLD is proposed in the DEIS/DEIR Sediment Management Plan (SMP) in Appendix B, even though levels of concern and hazard have been exceeded. California's criterion for solid hazardous selenium waste is defined as 100 µg/g wet weight (California Code of Regulation 1979).

The DEIS/DEIR proposes to dredge and dispose of SLD sediment in accordance with the new Use Agreement, applicable laws and regulations, and the SMP provided in Appendix B of the DEIS/DEIR. The SMP states, "*Sediments which contain selenium concentrations below hazardous waste criteria but exceed ecological risk criteria may be applied for reuse to lands zoned for agricultural, residential or industrial development, and upland open areas outside of the rainy season…*" The SMP establishes Ecological Risk Criteria for sediment as follows: Level of Concern - 2 – 4 µg/g selenium dry weight, and Toxic - greater than 4 µg/g of selenium on a dry weight basis (Van Derveer and Canton 1997). However, the Van Derveer and Canton (1997) paper does not provide a valid basis for setting ecological risk criteria for sediment selenium. The 4 µg/g value was derived by taking the 10th percentile of a 7-point dataset representing seven case studies where severe selenium toxicity was observed in each case study (i.e., Kesterson, Belews Lake, etc.). Thus, what 4 µg/g really represents is the estimated EC10 for catastrophic selenium contamination, not a "toxicity threshold" in the more common meaning of the term, i.e., the threshold between no toxicity and the onset of toxicity.

The correct Ecological Risk Criteria for selenium in sediment is found in the Environmental Protection Agency's (EPA) (2007) Selenium Ecological Soil Screening Levels document. EPA (2007) defined Ecological Soil Screening Levels (Eco-SSLs) as "concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or

consume biota that live in or on soil. Eco-SSL's are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening state of an ecological risk assessment."

Based on EPA (2007), for full protection of all life forms, an ecological risk criterion for SLD sediment of 0.5 µg/g, dry weight, should be used instead of the 4 µg/g cited in the SMP (see Table 2.1 from EPA 2007 below). The DEIS/DEIR and SMP should be revised to incorporate this information.

Table 2.1 Selenium Eco-SSLs (mg/kg dry weight in soil)			
Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
0.52	4.1	1.2	0.63

With respect to disposal of Drain sediment on open upland areas, the Service believes there is sufficient evidence to conclude that such a practice would pose a significant risk to fish and wildlife resources. The Service strongly objects to the "Acceptable Concentrations of Selenium in Sediment" presented in Table 3 of the SMP for the disposal of dredged material on Open Space (Upland Areas – outside of wet season) of 2 – 390 µg/g selenium, dry weight. This range of concentrations in sediment would likely pose a risk to wildlife foraging in the upland areas where dredged material is disposed of. We base this conclusion on the EPA document cited above and on data from two separate field studies that spread sediment from the San Luis Drain on agricultural and open space lands (Zawislanski *et al*. 2002; Banuelos *et al*. 2005).

In the first study, Zawislanski *et al*. (2002) applied SLD sediments to land at five sites at two locations near Dos Palos (an area with a history of selenium contamination in subsurface drainwater). Three sites were embankment plots adjacent to the San Luis Drain, and two sites were within a cultivated field. SLD sediment was applied to a 15 cm thickness. In the embankment plots applied sediment selenium concentrations averaged 2.56, 37.10, and 19.53 mg/kg, in Embankment Plot (EP)-1, EP-2, and EP-3, respectively. Alkali mallow (*Malvella leprosa*) and Russian knapweed (*Acroptilon repens*) were the dominant plant species on the embankment plots. Selenium concentrations in the aboveground parts of plants from the embankment plots ranged from 0.87 to 1.63 µg/g on a dry weight basis.

In the farm plots, selenium concentrations in SLD sediments applied averaged 111.6 and 66.7 mg/kg, in Farm Plot (FP)-1 and FP-2, respectively. Cotton, wheat and cantaloupes were grown in the cultivated field plots. Selenium uptake by cotton, wheat, and cantaloupe resulted in 5- to 20-fold increases in tissue-Se relative to plants from a control area. In all plants, selenium levels were proportional to soil selenium in the given plot; i.e., FP-1 > FP-2 > FP-C. The highest

cotton tissue selenium was observed in FP-1 at 22.7 µg/g. The authors concluded that cantaloupe and wheat should not be grown in soils amended with very high Se sediment, in the 50- to 100-mg/kg range due to potential human health risks (Zawislanski *et al*., 2002). Average selenium concentrations in tissues from cotton, wheat, and cantaloupes grown on the Farm Plots amended with San Luis Drain Sediment are represented in Figures 5 - 7 below:

Figure 5. Selenium in Above and Below Ground Cotton Tissue from Farm Plots Amended with San Luis Drain Sediment Compared with a Control Site . From Zawislanski *et al*. 2002.

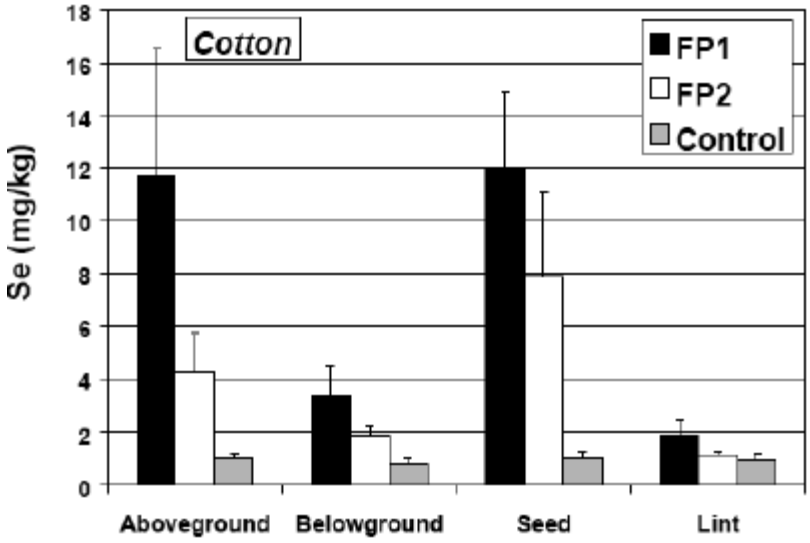


Figure 6. Selenium in Above and Below Ground Wheat Tissue from Farm Plots Amended with San Luis Drain Sediment Compared with a Control Site. From Zawislanski *et al*. 2002.

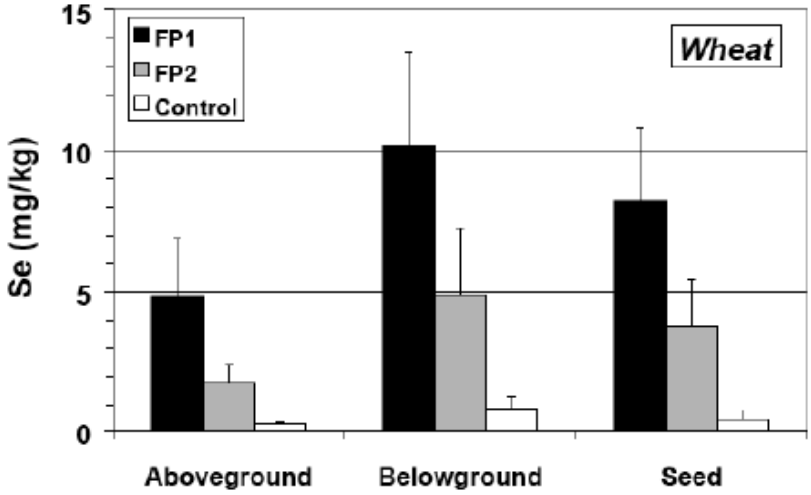
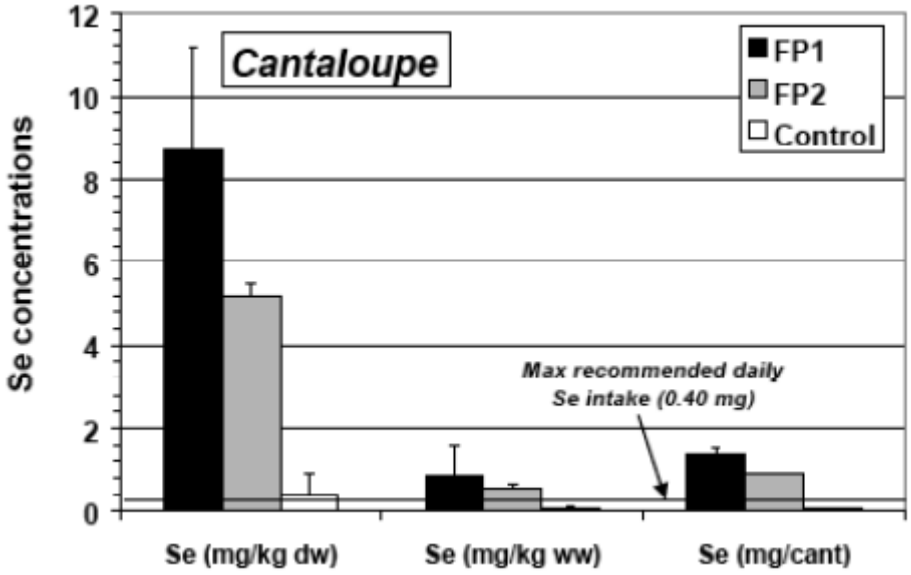


Figure 7. Selenium in Cantaloupes Grown on Farm Plots Amended with San Luis Drain Sediment Compared with a Control Site. From Zawislanski *et al*. 2002.



In the second study Banuelos *et al*. (2005) conducted a two-year field trial to identify the best plant species that are salt and boron tolerant and can volatilize selenium from drainage sediment. In this experiment, sediment was collected at 0–25 cm depth from the SLD, Mendota, CA, and spread to a depth of 40 cm in a previously excavated field plot in 2000 at the USDA Research Facility in Parlier, CA (an area with no history of selenium contamination). The drainage sediment was mixed with clean soil, and vegetated with salado alfalfa (*Medicago sativa salado*), salado grass (*Sporobulus airoides salado*), saltgrass-turf (*Distichlis* spp. NYPA Turf), saltgrass-forage (*Distichlis spicata* (L.) Greene), cordgrass *(Spartina patens* Flageo), Leucaenia (*Leucaena leucocephola*), elephant grass (*Pennistum purpureum*), or wild type-Brassica (*Brassica* spp.). Selenium concentrations in crops grown on SLD-supplemented soil ranged from 7 µg/g selenium, dry weight in elephant grass, to 48 µg/g selenium, dry weight in wild-type Brassica (see Table 6 below). The authors found that overall, rates of selenium volatilization in drainage sediment were relatively low due to high levels of sulfate.

Table 6. From Banuelos *et al*., 2005.

Mean dry weight yield and concentrations of Se, S, B, and Cl in different crops grown in drainage sediment plots for 2002 and 2003 growing seasons; The control treatment was sandy loam soil (without drainage sediment)

Plant species	Dry matter yields* ($g\ m^{-2}$)		Concentration in plant ($mg\ kg^{-1}$ DM)			
	Control	Sediment	Se	S	B	Cl
Elephant grass ($n = 6$)**	5967 (160)a	3206 (81)***a	7 (0.4)d	1825 (57)f	77 (2.2)†c	6211 (139)f
Salado grass ($n = 6$)	2105 (70)b	2306 (80)c	11 (0.7)bc	3750 (84)c	40 (1.5)d	13420 (280)d
Cordgrass ($n = 6$)	1221 (49)c	1642 (59)d	10 (0.7)bcd	7120 (156)b	35 (1.4)de	33600 (685)b
Saltgrass-turf ($n = 4$)	2209 (65)b	2708 (72)b	11 (0.6)bc	3624 (80)c	31 (1.3)e	24920 (553)c
Leucaenia ($n = 4$)	2575 (62)b	2312 (69)c	13 (0.8)b	2675 (76)e	278 (9.8)b	7335 (150)ef
Salado alfalfa ($n = 8$)††	2502 (68)b	1353 (43)d	8 (0.5)cd	2880 (78)de	80 (3.1)c	7200 (154)ef
Saltgrass-forage ($n = 4$)	2602 (73)b	2907 (79)ab	9 (0.5)cd	3153 (80)cd	23 (1.0)f	10110 (243)de
Wild-type *Brassica* ($n = 6$)	2225 (61)b	1800 (55)d	48 (2.8)a	24025 (546)a	248 (9.6)a	41502 (861)a

* Mean annual total dry matter of plants grown in either control or sediment plots, which includes all clippings from perennial crops for all replications for 2002 and 2003 growing seasons. Means followed by the same letter are not significantly different at the $P < 0.05$ level within each column.

** Total number (n) of replications for each species.

*** Values represent the mean and standard error in parenthesis for two years.

† Mean B concentration at first clipping was 920 $mg\ kg^{-1}$, while 77 $mg\ kg^{-1}$ was the mean concentration from clippings two through four.

†† Data are presented for only one year due to crop destruction by gophers.

As was noted in the Biological Assessment for the Grassland Bypass Project in 2001 (USBR 2001), "*Chronic exposure to diets with selenium concentrations as low as 1 mg/kg can cause adverse effects on mammals (intestinal lesions and longevity in rats, Eisler 1985). Reproductive impairment has been reported at a dietary exposure of 3 mg/kg (rats, Olsen 1986). In dogs (in the same family as kit fox) sublethal effects were found at a dietary exposure of about 7 mg/kg (Rhian and Moxon 1943). Based on these data, 3 mg/kg would be a conservative Level of Concern threshold, and 7 mg/kg would be a reasonable Toxicity threshold for dietary exposure to selenium applicable to mammals such as the kit fox.*"

Further, the Biological Assessment established a Level of Concern threshold for dietary effects on mammals for plants in the SJRIP drainage reuse area of the GBP as follows, "*A monitoring program and contingency plan will be designed with recommendations from the Service to address potential kit fox exposure to selenium. Selenium uptake by salt-tolerant crops irrigated with drainwater at the IVT will continue to be monitored. If selenium concentrations in these crops reach the Level of Concern threshold for dietary effects on mammals (3 mg/kg), a contingency plan and monitoring program will be instituted to determine selenium dietary effects on the small mammal prey of kit fox.*"

With the exception of the Embankment Plots[1], all of the crops grown on soils supplemented with SLD sediment contained selenium well in excess of 3 µg/g (mg/kg), the Level of Concern threshold established for protection of mammals foraging in the SJRIP drainage reuse area in the

[1] The plants harvested from the embankment plots likely had lower selenium concentrations because the sediment applied was lower in selenium than sediment applied to farm plots, and sediment was applied to the soil surface but not mixed in at the embankment plots whereas with the farm plots for both Zawislanski *et al.* (2002) and Banuelos *et al.* (2005) studies, the sediment was mixed in with the soil.

GBP 2001 Biological Assessment. Field studies have demonstrated that significant levels of selenium can accumulate in plant tissues where land has been amended with SLD sediment (Zawislanski *et al*. 2002; Banuelos *et al*. 2005). The Service therefore concludes that SLD sediment is not suitable for land disposal in open upland areas, and recommends that the DEIS/DEIR and SMP be revised accordingly.

Recommendation: The Service recommends that Reclamation consult with the Corps of Engineers regarding the need for a section 404 permit to dredge and dispose of sediment from the SLD. Further, in order to protect fish and wildlife resources, disposal of SLD sediment exceeding 0.5 µg/g selenium (dry weight) on upland open areas should be removed as an option for consideration in the SMP.

2. **Use of subsurface drainage for dust control on roadways**

On page 2-20 of the DEIS/DEIR, under the section describing other drainwater actions in the Proposed Action, one sentence is included describing the use of drainage to control dust, "*Implementing drainwater displacement projects such as using subsurface drainage for dust control on roadways*." Aside from the acknowledgement that agricultural drainage is used to control dust, there is no description of the timing, quantity of drainage used, concentrations of drainage contaminants in the drainage water, sources of the drainage water, or locations of these dust control activities (e.g., proximity to wetland areas).

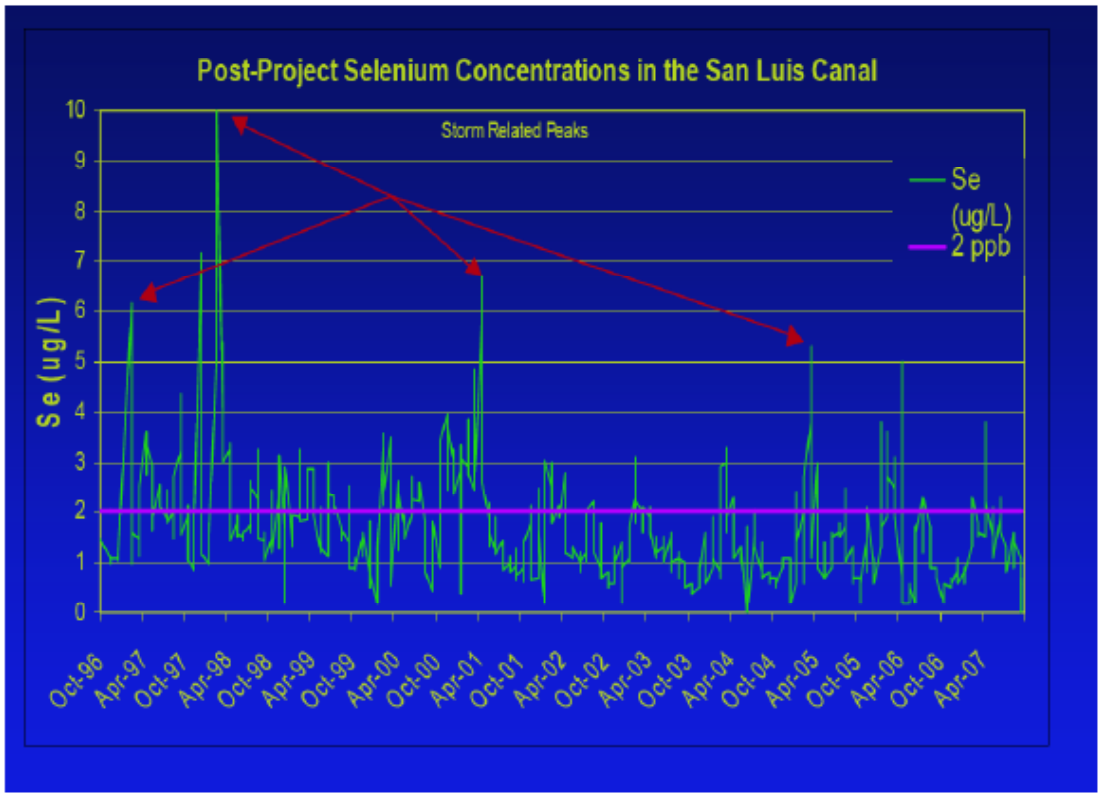
Recommendation: The final EIS should fully analyze the potential environmental effects of the use of drainage for dust control on roadways. The Service also recommends that monitoring of water and biota in the vicinity of these dust control activities be added to the monitoring program for the GBP Extension.

3. **Effects of current selenium levels in the Grasslands wetlands supply channels to biota**

Implementation of the GBP has significantly improved water quality in the Grasslands wetland channels (with the exception of Mud Slough North where drainage is routed to the San Joaquin River), and reduced salt and selenium loading to the San Joaquin River. With respect to the Grasslands wetland channels, the Grassland Amendments, ***Basin Plan Chapter*** *IV,* IMPLEMENTATION, included the following prohibitions (CVRWQCB 1998):
"*Discharge of agricultural subsurface drainage water to Salt Slough and the identified wetland water supply channels after January 10, 1997, unless water quality objectives for selenium are being met. This prohibition is intended to ensure that discharge of agricultural subsurface drainage water does not interfere with achievement of water quality objectives for selenium in Salt Slough and the wetland water supply channels after 1/10/97. If selenium objectives are not met, the prohibition requires the elimination of agricultural subsurface drainage flows to Salt Slough and the wetland channels. This is consistent with one of the Fish and Wildlife Service's priorities regarding agricultural drainage in the Grassland area, as stated in written comments to the Regional Board in 1995, i.e., "[remove agricultural drainage flows from over 90 miles of Grassland channels, including Salt Slough, so as to free them for delivery of freshwater to Refuges made available pursuant to the CVPIA" (Medlin 1995b).*"

However, exceedences of 2 µg/L selenium in water from wetland supply channels still occur, typically associated with heavy rainfall events and in the spring of each year (usually in March and/or April) as depicted in Figure 8 below, Post-Project Weekly Selenium Concentrations in the San Luis Canal (a wetland supply channel in the South Grasslands). As a result, the Grasslands wetland supply channels and Salt Slough were put back on the 2006 303(d) list of impaired water bodies for California due to non-compliance with water quality objectives and existing total maximum daily load (TMDL)s (for selenium) for those channels (SWRCB 2007).

Figure 8. Weekly Selenium Concentrations in the San Luis Canal, 1996 – 2007 from Chilcott and Schnagl, 2008



Two recent studies have documented selenium levels in biota from the Grasslands wetland supply channels (Beckon *et al.* 2007; Paveglio and Kilbride 2007). In the first study, the Service's Sacramento Fish and Wildlife Office, Environmental Contaminants Division, conducted a field investigation of sediment, aquatic invertebrates, bird eggs and fish from wetlands in the Grasslands area and analyzed these constituents for selenium from five areas that receive water from different or mixed water sources (Beckon *et al.* 2007). Sediments are thought to serve as an important reservoir of selenium contributing to long-term cycling of selenium in aquatic ecosystems long after influx of selenium has been stopped. The authors concluded that

selenium concentrations in sediments and invertebrates are likely due to a continuing influx of selenium contamination that has not been fully abated in the area. The study's findings included:

- *"Of the 62 avian eggs sampled, 6.5 percent exceeded the threshold of concern for avian eggs (6 µg/g dw,). Those four eggs ranged from 6.0 to 6.9 µg/g.*
- *Of the 74 whole body fish samples collected 27 (36.5 percent) exceeded the threshold of concern for selenium in warmwater fish (4 µg/g selenium). All 12 samples of striped bass (Morone saxatilis, all of them juveniles: 11 from Gadwall Canal at Santa Cruz Gun Club, and one from Camp 13 Ditch at Checkpoint 4) exceeded the threshold of concern for selenium in warmwater fish.*
- *Thirty-two samples of invertebrates were collected in the South Grasslands. Thirteen of these (40.6 percent, Figure 5) reached or exceeded the threshold of concern for invertebrates as diet for birds (3 µg/g dietary selenium). The most effective invertebrate bioaccumulators of selenium were European freshwater snails (Physa) and Siberian shrimp (Exopalaemon modestus). The latter is a recently introduced species that evidently bioaccumulates selenium more effectively than other aquatic invertebrates in the area, such as red crayfish, that it seems to be replacing."*

In the second study, the Service's Division of Natural Resources, Branch of Refuge Biology, Vancouver, WA, conducted follow-up collections during 2005 to determine selenium concentrations in aquatic birds after long-term use (20 years) of predominately freshwater for wetland management in the Grasslands (Paveglio and Kilbride 2007). The authors found the following, *"Selenium concentrations were higher for birds from the South Grasslands during 2005, which historically received more undiluted drainage water compared with the North Grasslands. Liver selenium concentrations for black-necked stilts from the South Grasslands were within ranges associated with the first incidence of reproductive impairment. Shovelers, coots, and black-necked stilts from the South Grasslands during 2005 were found to be significantly above the background level (at a 95% confidence level)…"* The authors reported selenium concentrations in livers from northern shovelers collected in the south Grasslands (8.5 – 11 µg/g dry weight) that were comparable to levels associated with significantly reduced disease resistance and increased mortality in a controlled field experiment on mallard ducks (Hansen and Whiteley 1990; Whiteley and Yuill 1991). Paveglio and Kilbride concluded that selenium cycling within Grasslands wetlands likely is attributable to three factors: 1) historic use of agricultural drainage resulting in a reservoir of selenium in wetlands and supply channel sediments; 2) storm-water inflows; and, 3) unregulated inflows of subsurface drainage directly into wetlands or indirectly into their supply channels.

Recommendation: The final EIS should be revised to include an analysis of the effects of current selenium levels in the Grasslands wetland supply channels to biota in the vicinity. As noted in our comments under Purpose and Need I of these comments, the final EIS should incorporate actions that address the other sources of drainage contamination in the Grasslands wetland supply channels.

4. **Identification of what measures will be implemented should the drainage treatment and disposal technologies prove technologically or economically infeasible**

The proposed action relies on drainage treatment and disposal technologies that have not yet been fully tested nor proven feasible or cost effective. As is noted on page 1-2 of the DEIS/DEIR, "*It is anticipated that the proposed continuation of the Grassland Bypass Project for an additional 10 years would allow enough time to acquire funds to develop feasible treatment technology in order to meet the 1998 Basin Plan objectives and WDRs…*" And on Page 1-5 the DEIS/DEIR states, "*The proposed continuation of the Grassland Bypass Project is needed in the short term (2010–2019) to allow time for additional research and evaluation of long-term treatment options and to secure funding to implement treatment and disposal of drainage and end products, primarily salt*."

As described on Page 2-14, drainage management to achieve the selenium and salinity load limits established in the draft Use Agreement would involve three phases:

- Phase I: Purchase of land and planting to salt-tolerant crops;
- Phase II: Installation of subsurface drainage and collection systems, and an initial treatment/salt disposal system;
- Phase III: Completion of construction of treatment removal/salt disposal system. This phase would include expansion of the pilot treatment/salt disposal (under Phase II) with construction of full-scale treatment/salt disposal facilities, as well as waste disposal units, with or without production of usable water as a byproduct of the treatment process.

The SJRIP facility would be implemented on up to 6,900 acres of land within the GDA. This component of the GBP already dedicates specific lands for the irrigation of salt-tolerant crops with subsurface drainwater to reduce the volume; would treat the concentrated drainwater to remove salt, selenium, and boron; and would dispose of the removed salts "in valley" to prevent them from discharging to the San Joaquin River. The treatment systems would also potentially produce a product water-sufficient in quality for reuse on agricultural lands within the GDA. At completion, the facility is planned to handle all of the drainwater produced in the GDA (up to 29,500 acre-feet annually.

In Phase I of the SJRIP, 6,900 acres of such land were acquired, of which 4,300 acres were planted with salt-tolerant crops and placed as of November 2008 (incorporating an additional 500 acres on the western side of Russell Avenue).

By late 2007, Phase II was partially implemented with the installation of subsurface drains on approximately 1,700 acres within the 3,800-acre planted area. On-site tile drainage water is returned to the irrigation system or discharged. The Proposed Action would expand the drains and sequential reuse to the full acquired and planned acreage, up to 6,900 acres. The irrigation of salt-tolerant crops on the expanded area was evaluated in an Initial Study, and a Mitigated Negative Declaration was approved by Panoche Drainage District in August 2007. CEQA compliance was included on a programmatic basis in the 2001 GBP EIS/EIR. Site-specific environmental analysis has been/will be performed for each installation, as necessary.

No treatment has been implemented to date, although a pilot treatment project has been approved with its own CEQA review and is expected to remain in effect for 1 year. The treatment process and the specific facility location have not been selected. The implementation date for Phase III is presently unknown, in part because inadequate funds have been available for development of economically viable treatment/salt disposal alternatives. The goal of treatment is to remove the salt from the drainage system, maintain a salt balance for continued agricultural production in the region, and provide appropriate salt disposal. Additional NEPA/CEQA impact analysis would be required to implement the treatment component (beyond drainage reuse on the 6,900 acres at the SJRIP). Given the significant uncertainties associated with drainwater treatment and disposal, Presser and Schwarzbach (2008) concluded in a technical Analysis of In-Valley Drainage Management Strategies for the Western San Joaquin Valley, "*The treatment sequence of reuse, reverse osmosis, selenium bio-treatment, and enhanced solar evaporation is unprecedented and untested at the scale needed to meet plan requirements*." The DEIS/DEIR does note the following should the treatment technology prove infeasible, "*If Phase III is not fully implemented because treatment is not feasible, then the reuse area would operate as long as possible and more drainage would be recirculated on-farm with resulting impacts on production*."

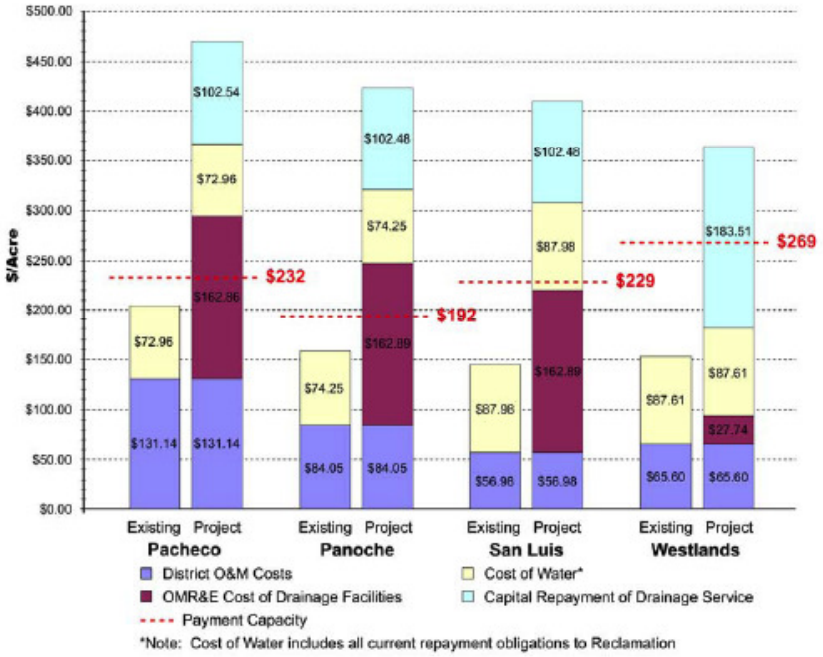
The DEIS/DEIR estimates the cost of drainage treatment to be $1500 per acre-foot of drainwater treated. Presser and Schwarzbach (2008) noted with respect to salt disposal after drainage treatment that, "*Salt produced and stored at the surface in solar evaporators in the 100,000-acre, 200,000-acre and 300,000-acre* [land retirement alternatives] *totals 412,000, 307,000 and 181,000 tons per year. At 50 years, the 100,000-acre land retirement option will require salt storage of 20 million tons in these evaporators or landfills. This salt will be contaminated with a variety of trace elements common in drainage waters including selenium, boron, molybdenum, chromium, and arsenic*." It is unclear whether the cost figure in the DEIS/DEIR for treatment includes the cost of disposal of treatment brine, acquisition and operation of disposal sites (solar evaporators) and of landfill disposal of salts and trace elements.

Numerous planning efforts over the last several decades have looked into developing a feasible drainage solution in the San Joaquin Valley. The most recent of these efforts, the San Luis Drainage Feature Re-evaluation (SLDFR), selected the In-Valley/Water Needs Land Retirement Alternative in their Record of Decision (USBR March 2007). This alternative was considered as the locally preferred alternative because it most closely parallels a locally developed drainage plan—the Westside Regional Drainage Plan. The In-Valley/Water Needs Land Retirement Alternative includes drainage reduction measures, drainage water reuse facilities, treatment systems, and evaporation ponds. It differs slightly from the GBP Extension in the choice of a terminal disposal methodology (e.g., SLDFR: evaporation ponds; GBP Extension: an undefined salt disposal system). The DEIS/DEIR refers to a salt disposal system that would involve additional CEQA/NEPA analysis on the site and design-specific aspects of the facility including disposal of any treatment by-products. No other specific details are provided in the DEIS/DEIR.

In 2008 Reclamation completed feasibility-level designs and cost estimates (SLDFR Feasibility Report) for the SLDFR In-Valley/Water Needs Land Retirement Alternative (USBR March 2008). The SLDFR Feasibility Report concluded that because the In-Valley/Water Needs Land Retirement Alternative would result in net negative NED benefits, this alternative is not economically justified for implementation. The In-Valley/Water Needs Land Retirement Alternative has negative net NED benefits of ($131,146,000). The Feasibility Report concluded that the In-Valley/Water Needs Land Retirement Alternative is financially infeasible for implementation. The Feasibility Report found that, "*Only San Luis and Westlands Water Districts are capable of generating adequate agricultural revenues to pay their existing district O&M and assigned annual OMR&E costs of drainage service. None of the four water districts have the ability to fully repay its assigned capital costs of drainage service facilities. The implementation of either action alternative would far exceed their ability to repay the associated costs of the project when coupled with their existing obligations…*"and that, "*None of the San Luis Unit contractors would be able to pay the Restoration Fund charges if* [the] *action alternative is implemented*."

Figure 9 illustrates the four San Luis Unit water districts' payment capacity relative to their existing obligations and the implementation of the In-Valley/Water Needs Land Retirement Alternative at a cost per acre. While all four districts currently have some remaining payment capacity, implementing this alternative far exceeds their ability to repay the associated costs of the project when coupled with their existing obligations (USBR March 2008).

Figure 9. In-Valley/Water Needs Land Retirement Alternative district payment capacity ($/acre), with and without project (From USBR 2008, SLDFR Feasibility Report).



Recommendation: There remains significant uncertainty that a technically and economically feasible solution to treat and dispose of drainage will be found and implemented by 2015. If Phase III of the GBP is not fully implemented because drainage treatment and/or disposal is not economically or technically feasible, drainage would be routed to the reuse area and would be recirculated on-farm (similar to the No Action Alternative), and could result in adverse effects to fish and wildlife resources. The final EIS should identify how the GBP Extension will meet selenium and salinity load limits after year 5 of the project if the drainage treatment and disposal technologies fail to meet expectations.

Project Effects Not considered

Mercury in the Grassland watershed

In 1987, mercury was identified as a potential substance of concern in agricultural drainage water from the west side San Joaquin Valley and was assigned to the highest priority rank (Hansen and Morehardt 1987). The San Joaquin Valley Drainage Program identified mercury as a substance of concern that warrants further attention (Moore *et al.* 1990). Elevated concentrations of vanadium, chromium, and mercury have also been observed in the shallow groundwater in the San Luis Unit (Deverel *et al.* 1984 cited in USBR September 2005).

Water quality sampling of the DMC sumps (along the Delta Mendota Canal in the Firebaugh Canal Water District) from 2002 through 2007 by Reclamation has documented elevated concentrations of total mercury in the sump water currently being pumped into the Delta Mendota Canal. Total mercury in water from the DMC sumps has ranged from 200 ng/L to 3,000 ng/L and is currently being pumped into the DMC upstream of Mendota Pool (USBR February 2008).

Eighteen miles of Panoche Creek (from Silver Creek to Belmont Avenue) and the San Joaquin River (from Bear Creek to the Delta Boundary) are listed on the 2006 Clean Water Act section 303(d) List of Water Quality Limited Segments for mercury impairment (SWRCB 2007). Mercury levels in fish from the lower San Joaquin River and Mud Slough have been found to be elevated (Davis *et al.* 2000; Slotton *et al.* 2000). The principal finding of a CalFed Mercury Study in the San Joaquin Basin is that Mud Slough contributes about 50 percent of the methylated mercury at Vernalis (legal boundary of the Delta) but only 10 percent of the water volume during the non-irrigation season (September to March) (Stephenson *et. al.*, 2005).

Preliminary methyl mercury water data collected from the vicinity of the San Luis Drain was provided to the Service in a letter from Dr. Chris Foe, staff scientist of the Regional Board in 2005 (Foe 2005). In that letter Dr. Foe noted, "*Regional Board staff has been monitoring methyl mercury concentrations in the San Joaquin watershed for the past two years to identify sources and to characterize concentrations and loads. The highest concentrations in the Basin occur in Mud Slough downstream of the inflow from the San Luis Drain (GBP monitoring site D). Methyl mercury loads in Mud Slough are sufficiently high that they may account for 40-60 percent of the Vernalis load during non-irrigation season. Similar calculations have not been made for the*

irrigation season as the amount of water removed and returned to the River by water agencies and others is not known. However, Mud Slough concentrations and loads remain high suggesting that the Slough is still a significant source of River methyl mercury. The non-irrigation season loads imply that Mud Slough is responsible for about half the methyl mercury accumulating in fish in the main stem San Joaquin River in winter. The source of the methyl mercury in Mud Slough is not known." Table 7 summarizes the preliminary methyl mercury concentrations for the San Joaquin River at Vernalis, and for Mud Slough at site D and the San Luis Drain.

Dr. Foe concluded that, "*The results suggest that methyl mercury concentrations at all three sites are elevated and may constitute a health hazard to wildlife consuming local fish. Methyl mercury mass balance calculations have not yet been made for Mud Slough. Regional Board staff has commenced a mass balance study to better define the primary source(s) of methyl mercury in Mud Slough."*

Table 7. Summary of unfiltered methyl mercury concentrations (ng/L) in the Grassland Bypass portion of the San Luis Drain, Mud Slough at Site D and San Joaquin River at Vernalis (from Foe 2005).

Date	San Luis Drain @ Site B	Mud Slough @ Site D	San Joaquin @ Vernalis
6/14/05	0.302	0.671	0.235
7/13/05	0.648	0.769	0.218
8/9/05	1.150	1.430	0.226
9/12/05	0.846	1.070	0.062

Recommendation: Given the fact that some drainage sump water in the GBP DPA (i.e., DMC sumps) and the San Luis Drain is elevated in total mercury, a more comprehensive reconnaissance survey of the extent of mercury contamination in subsurface drainage in the DPA is warranted. The Service therefore recommends that if the GBP is extended, monitoring and reporting for total mercury and methyl-mercury concentrations in water and biotic tissue be required at all sampling locations of the GBP to establish a mass-balance of sources of mercury in this watershed.

Cumulative Effects Not Considered or Adequately Addressed

The Council on Environmental Quality's (CEQ) regulations (40 CFR §§ 1500 – 1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 §§ 4321 *et seq*.) define cumulative effects as:

> *"The impact of the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless*

> *of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR § 1508.7)."*

The final EIS should discuss the relationship between the GBP Extension and past, present and future reasonably foreseeable projects in the Cumulative Effects Section of the DEIS. Specifically, the final EIS should provide additional information on cumulative impacts of past and present water transfer programs such as the San Joaquin River Exchange Contract 10-year Transfer Program and the San Joaquin River Exchange Contract 25-year Transfer Program and future projects including the San Joaquin River Restoration. In addition, the final EIS should analyze the effects of the GBP Extension on water quality should the Vernalis Adaptive Management Program not be continued past 2010, and should assess the effect of operations of the south Delta temporary barriers on transport and environmental fate of selenium and sulfate in the Delta.

<u>San Joaquin River Restoration Settlement</u>

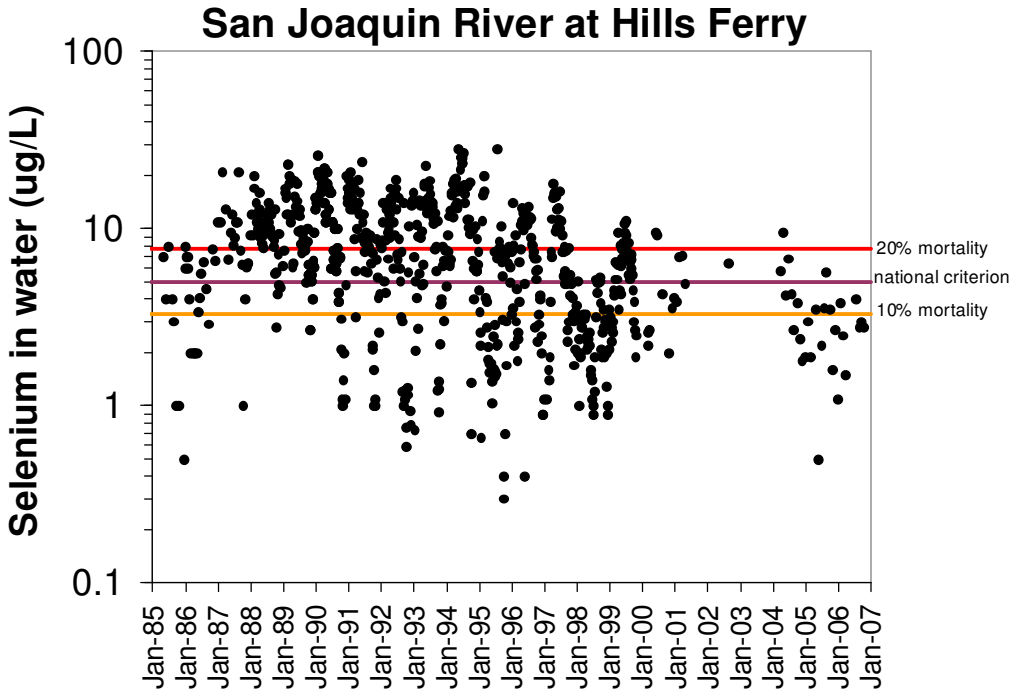
The DEIS/DEIR briefly describes the cumulative effects of the GBP Extension on the San Joaquin River Restoration Settlement (4-67 to 4-68). This section concludes, "*Alternatives would result in slightly reduced flows in the San Joaquin River, as compared to existing conditions, which would be in conflict with the San Joaquin River Restoration Settlement goals for flow; however, the two Action Alternatives will result in less Se* [selenium] *contamination in the lower San Joaquin River*."

The Service believes that further discussion and analysis in the DEIS/DEIR is needed on the effects of the GBP Extension selenium discharges on anadromous fish including the proposed San Joaquin River Restoration runs of Chinook salmon and steelhead. The San Joaquin River Restoration Program (SJRRP) is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River, ensure irrigation supplies to Friant Water users, and restore a self-sustaining Chinook salmon fishery in the river. The SJRRP will implement the San Joaquin River Litigation Settlement (Settlement), filed in Federal Court in September 2006 (SJRRP 2007). The SJRRP includes a Restoration Goal to, "*To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish*." A Draft SJRRP Environmental Impact Statement/Environmental Impact Report (Draft Program EIS/R) is scheduled for release in Spring 2009. The Final Program EIS/R is scheduled for release in July 2009 (SJRRP 2008). The Settlement calls for interim flows to begin in the fall of 2009 and full restoration flows to begin no later than January 2014. Additionally, salmon are to be reintroduced no later than December 31, 2012, in the upper reaches of the San Joaquin River (SJRRP 2007).

In an analysis of the effects of San Luis Unit selenium contamination on federally-listed species, Beckon and Maurer (2008) found that seepage and flood flows carrying agricultural drainwater from the San Luis Unit into the San Joaquin River may impact Chinook salmon and steelhead and could impair efforts to restore them to upstream reaches of this river. Central Valley Chinook salmon and steelhead are among the most sensitive of fish and wildlife to selenium

exposure. They are especially vulnerable during juvenile life stages when they migrate and rear in selenium-contaminated Central Valley rivers and the San Francisco Bay/Delta estuary. Rivers and sloughs that carry agricultural drainwater, concentrations of selenium in invertebrates, small (prey) fish, and larger predatory fish commonly reach levels that could kill a substantial portion of young salmon (Beckon *et al*. 2008) if the salmon, on their downstream migration, are exposed to those selenium-laden food items for long enough for the salmon themselves to bioaccumulate selenium to toxic levels. Based on existing water quality data for selenium in specific reaches of the San Joaquin River, Beckon and Maurer (2008) concluded that there remains a substantial ongoing risk to migrating juvenile Chinook salmon and steelhead in the San Joaquin River, as shown in Figure 10 below.

Figure 10. Selenium concentrations measured in the San Joaquin River at Hills Ferry (data from the Central Valley Regional Water Quality Control Board).



Recommendation
The final EIS should include an evaluation of effects of GBP selenium discharges on anadromous fish including the proposed San Joaquin River Restoration runs of Chinook salmon and steelhead.

San Joaquin Exchange Contractors 10-Year Transfer Program
In 2005, Reclamation finalized an EIS/EIR on the San Joaquin Exchange Contractors' 10-year Transfer Program (SJEC EIS/EIR; USBR December 2004). This program allows for the transfer of up to 130,000 acre-feet of substitute water annually to several potential agricultural, municipal and wetland users for a period of 10 years. The preferred alternative would develop up to 130,000 acre feet of water during non-critical years, with up to 80,000 acre feet of water made available through conservation (including tailwater recovery) and groundwater substitution (up to 20,000 acre feet) and up to 50,000 acre feet of water made available through crop idling/temporary land fallowing. During critical years, up to 50,000 acre feet of water may be made available through crop fallowing, and no water is to be made available from conservation/tailwater recovery and groundwater resources.

Modeling of the effects of the preferred alternative in the SJEC EIS/EIR estimated up to a 47 percent flow reduction in Mud and Salt Sloughs during the late spring and dry and below normal water years. The largest reductions in flow would occur during April (36 percent) and May (47 percent) as shown in Table 6-5 of that document. Reclamation determined that the flow reduction would not have a significant effect on the extent or quality of the aquatic or upland habitats in Mud and Salt Sloughs because the flow reductions were in the range of fluctuation that occurs during normal and dry/below normal years (USBR December 2004). The Final SJEC EIS/EIR did not, however, compare the frequency of such flow reductions between the "with project" and "without project" conditions. The effect of reduced flows in Mud and Salt Slough on selenium concentrations in these channels was likewise not analyzed (S. Leach, pers. comm. March 6, 2006). It is reasonable to expect that a reduction of flow in these channels combined with continued selenium inputs into the Grasslands wetland supply channels could result in higher selenium concentrations and potentially a greater frequency of occurrence of water quality objective exceedences in these channels.

Modeling of the effect of the preferred alternative in the SJEC EIS/EIR also indicated reduction in flows in the San Joaquin River at Vernalis. These reductions were shown to vary from 0 to 11 percent. During the late spring out-migration period for anadromous fish, flows would be reduced by 3 to 8 percent (Table 4-44 of the SJEC EIS/EIR). Summer flow reductions would be as high as 11 percent in July. Smaller (2 percent) reductions were predicted in the fall when salmonids begin to migrate upstream in the San Joaquin River. Reclamation determined these reductions in flow did not have a significant effect on the flow or water quality in the San Joaquin River because flow reductions were still within the range of inter-annual variations in monthly river flow as shown in Table 4-1 of that document (USBR December 2004).

Recommendation: The effects of flow reductions in Mud and Salt Sloughs and the San Joaquin River as a result of the SJEC 10-Year Transfer Program combined with continued drainage discharges from the GBP Extension needs to be evaluated in the final EIS.

San Joaquin River Exchange Contract 25-year Transfer Program

In 2007 Reclamation and the San Joaquin Exchange Contractors finalized an Environmental Assessment/Initial Study (EA/IS) for a 25-Year Groundwater Pumping/Water Transfer Project (GW/Transfer Project) proposed by the San Joaquin River Exchange Contractors Water Authority. The Proposed Action would develop up to 20,000 acre-feet/year (AFY) of substitute water from a combination of groundwater pumping and conservation/rotational land fallowing. The Proposed Action would include a maximum groundwater pumping regime of 15,000 AFY from up to 20 wells located in the drainage impaired area of Firebaugh Canal Water District and Central California Irrigation District (CCID). The groundwater would be pumped from the upper aquifer above a depth of 350 feet (above the Corcoran clay) but below the drainage-impaired shallow groundwater, blended with surface water deliveries into two CCID canals (Outside and Main) to ensure adequate water quality for irrigation needs, and then delivered downstream for agricultural use and refuge water supplies. The pumped groundwater would substitute for CVP surface water delivery primarily from the Delta Mendota Canal. An additional 5,000 AFY of water would be "developed" for transfer from conservation and/or rotational land fallowing. The Proposed Action would free up a commensurate quantity of water of the San Joaquin Exchange Contractors' contract supply equivalent to the quantity developed by this project (up to 20,000 AFY) for transfer to San Luis Unit contractors and Santa Clara Valley Water District (USBR November 2007).

The Service submitted comments on the EA/IS for this project that included the following concerns regarding impacts to water supplies used by the public and private wetlands in the Grasslands Area (USFWS 2007): *"Groundwater substitution (pumping groundwater in the drainage impacted area of Firebaugh and Central California Irrigation District) will likely reduce quality (increase total dissolved solids) of water delivered to Grasslands wetlands and refuges. Effects of groundwater degradation and associated effects to downstream refuge water quality were not adequately addressed in the EA/IS for this project. This transfer program also utilizes land fallowing or tailwater recapture and canal lining for up to 5,000 AFY which could likely have an added effect (beyond what was considered in the 10-year transfer program EIS/EIR for the San Joaquin Exchange Contractors) on reducing dilution flows in the Grassland wetland channels which could result in further water quality degradation (increases in selenium, boron, and salt concentrations) in those waters."*

Recommendation: The effects to flow and water quality of this 25-year transfer program in combination with the 10-year transfer program described above needs to be addressed in the Cumulative Effects Section of the final EIS for the GBP Extension.

Vernalis Adaptive Management Program

As is noted on Page 4-66 of the DEIS/DEIR the Vernalis Adaptive Management Program (VAMP) is, "*designed to provide augmented flows to the San Joaquin River to benefit fish*

migration from 1990–2010. This plan resulted in the planned releases of up to 110,000 acre-feet (or more under some hydrologic conditions) during the April to May period, and an additional 12,500 acre-feet of flow during the month of October. The influence of these flows is included in the receiving water model for the Grassland Bypass Project. Therefore, cumulative affects of these flows have already been included in the analysis." However, the DEIS/DEIR notes, "*At issue is whether the plan will continue after 2010 when the current San Joaquin River Agreement expires*."

Recommendation: The Service recommends that the final EIS include an analysis of the GBP Extension and associated effects to water quality in the San Joaquin River both with a continued VAMP and with no VAMP after 2010.

Operation of South Delta Barriers

The south Delta barriers project consists of four rock barriers across South Delta channels. In various combinations, these barriers improve water levels and San Joaquin River salmon migration in the South Delta. The existing temporary barriers program in the south Delta consists of installation and removal of temporary rock barriers at the following locations: 1) Middle River near Victoria Canal, about 0.5 miles south of the confluence of Middle River, Trapper Slough, and North Canal; 2) Old River near Tracy, about 0.5 miles east of the DMC intake; 3) Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of Tracy Boulevard Bridge; and, 4) the head of Old River at the confluence of Old River and San Joaquin River. Operational effects of the south Delta temporary barriers were assessed in the Service's Biological Opinion on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP), dated December 15, 2008 (Service File No. 81420-2008-F-1481-5).

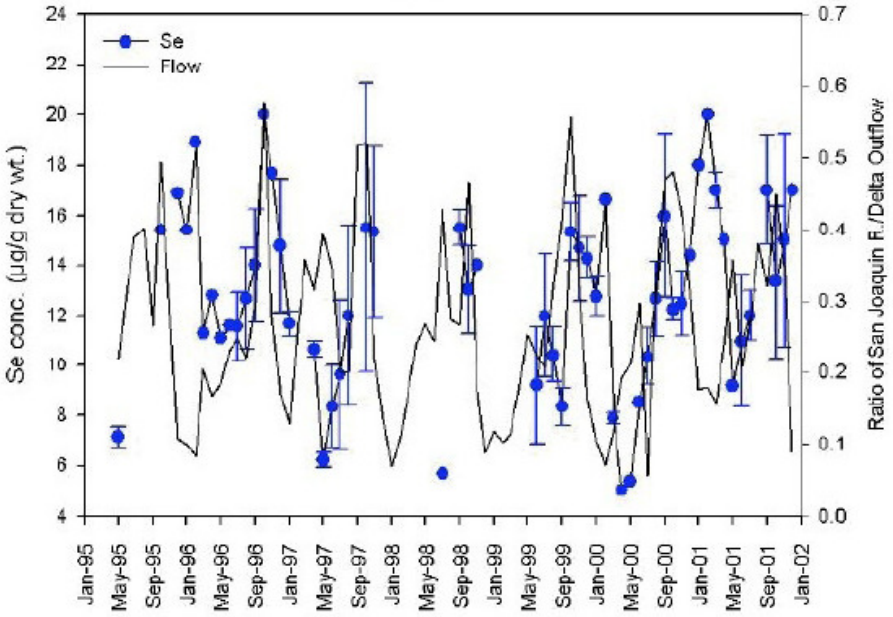
As was noted in Monsen *et al.* (2007) localized diversions such as the south Delta barriers can have regional-scale consequences, some unintended and conflicting with other management objectives. Specifically with respect to the Old River barrier Monsen *et al.* (2007) found, "The head of Old River barrier directs San Joaquin flow to the central Delta mixing zone rather than to the south Delta toward the export pumps." Greater outflow of the San Joaquin River associated with operations of south Delta temporary barriers could result in transport of selenium and sulfate from agricultural drainage discharges of the GBP Extension into the Delta (Lucas and Stewart 2007).

In a report assessing the selenium impairment of San Francisco Bay, Abu-Saba and Ogle (2005) included a graph of selenium concentrations in *Corbula amurensis* plotted against the ratio of San Joaquin River/Delta Outflow (see Figure 11 below). Concentrations of selenium were found to be generally highest when proportionally more San Joaquin River to Sacramento River water contributed to Delta Outflow. Lucas and Stewart (2007) provided some discussion on seasonal trends of bivalve selenium concentrations in the North Delta and its relationship to the San Joaquin River, *"Several explanations for the temporal trends in bivalve Se concentrations (which did not exist in the 1980's) are possible. One possibility is that refinery inputs of selenium have been replaced by San Joaquin River inputs. Models indicate that if SJR inflows to*

the Bay increase, as they may have in recent years with barrier management, particulate Se concentrations in the Bay could double, even with no increase in irrigation drainage inputs to the SJR. The fall increase in Se in C. amurensis also occurs during the time period when the ratio of SJR/Sac River inflow is highest. Further changes in water management could exacerbate these trends…"

Since its introduction in 1986, the clam *C. amurensis* has been found to be a dominant food item in the digestive tracts of benthivorous sturgeon and older splittail (Stewart *et al*., 2004). The highest concentrations of selenium in fish were observed in older Sacramento splittail (length 18 cm; age 1-2 yr) and white sturgeon (length 135-171 cm; age 14-20 yr). Stewart *et al*. (2004) noted that older splittail and white sturgeon accumulated concentrations of selenium that, "… *are beyond the toxicity threshold and have been correlated with adverse reproductive effects*." Linville (2006) concluded that, "*Se concentrations in the benthic food web* [of the North Delta] *should be routinely monitored since relatively small increases of Se in the food web can lead to increased toxicity to this species. Careful management of all processes with potential to increase Se concentrations in the benthic food web is essential to protect sturgeon in San Francisco Bay-Delta and other high-Se systems."* Kaufman *et al*. (2008) reported that green sturgeon were found to be much more sensitive to selenium exposure than white sturgeon at levels currently found in the SF bay-Delta.

Figure 11. Monthly selenium concentrations (µg/g, dry wt) in *Potamocorbula amurensis* at Carquinez Strait. Also plotted is the ratio of monthly flow from the San Joaquin River relative to total Delta outflow. Data from Linville *et al.* (2002) and Luoma (unpublished data). From Abu-Saba and Ogle, 2005.



Sulfate loading in the San Joaquin River from the GBP Extension and in association with operations of south Delta temporary barriers could result in downstream impacts not considered in the DEIS/DEIR. Quinn *et al*. (2006) reported that of the total salt load exported to the San Joaquin River, agricultural subsurface drainage discharged to the San Joaquin River (most from the GBP) accounts for about 34.6 million m^3 per year (28,000 ac-ft per yr), and 110,000 metric tons (121,000 tons) of salt (primarily as sodium sulfate). Wood *et al*. (2006) found that sulfate concentrations are about seven times higher in the San Joaquin River than in the Sacramento River. An indirect consequence of the south Delta barriers is that their operation will affect sulfate concentrations in much of the central and southern Delta. Sulfate reducing bacteria are the primary agents responsible for the methylation of mercury in aquatic ecosystems. Wood *et al.* (2006) noted that addition of sulfate is predicted to stimulate methylmercury production when it is limiting. Two factors influencing sulfate concentrations in the Bay-Delta are the electrical conductivity concentrations (EC) and the ratio of San Joaquin River to Sacramento River water.

Recommendation: The final EIS should assess the effect of operations of south Delta temporary barriers on transport and environmental fate of selenium and sulfate from the GBP into the Delta. Specifically, the final EIS should assess the effects of south Delta barriers on: selenium transport in the San Joaquin River to the impacted benthic foodweb in the Delta, and sulfate loading and its effect on methylation of mercury in the Delta.

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