



Water Quality Progress Report

Grassland Marshes – Selenium

(Approved 2000)

WATER QUALITY STATUS

- TMDL targets achieved
- Conditions improving
- Improvement needed
- Data inconclusive

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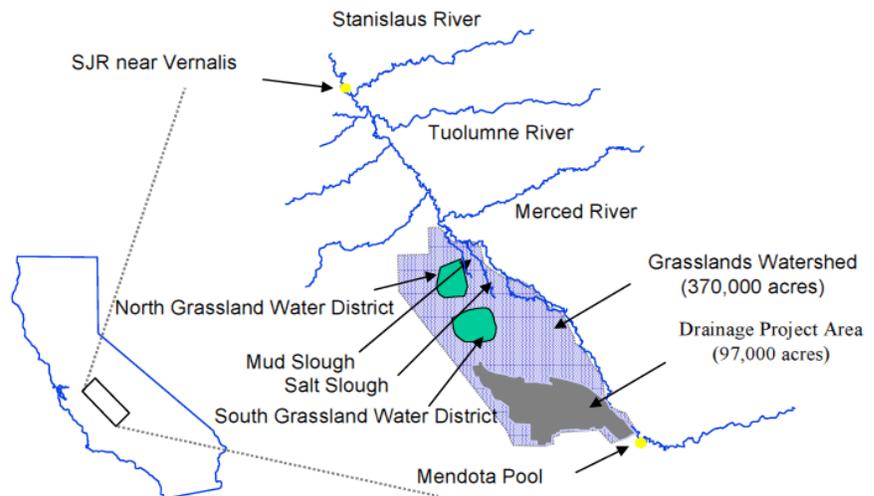
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Total Maximum Daily Load (TMDL) Summary

Waterbody – The Grassland Marshes are part of the Grassland Watershed. This watershed drains 370,000 acres in the Western portion of the San Joaquin River (SJR) Basin in Merced County, California. A portion of the Grassland Watershed that generates subsurface drainage via tile drains is referred to as the Drainage Project Area (DPA) (97,000 acres). Prior to 1996, subsurface tile drainage from the DPA flowed through the Grassland Marshes to the SJR, affecting water quality. The area of the Grassland Marshes that was impaired for selenium was 61,810 acres of wetland marshes and 75 miles of wetland supply channels (see map below).



Grassland Marshes and surrounding area

Water Quality Goals

According to the water quality objectives, **Selenium** is not to exceed a monthly mean concentration of 2 parts per billion (ppb or micrograms per liter [$\mu\text{g/L}$]) nor an instantaneous maximum concentration of 20 ppb in wetland supply channels in order to protect waterfowl using wetlands (Resolution No. [96-147](#)).

Targeted Attainment Date – None specified in TMDL. However, this TMDL is implemented through a prohibition of discharge of agricultural subsurface drainage to wetland supply channels in the Grassland Watershed. Compliance with the 2 ppb monthly mean water quality objective must occur by October 1, 1996, which is before U.S. Environmental Protection Agency (EPA) approval in May 2000.

Water Quality Impairment – Selenium is a bioaccumulative trace element that is an essential nutrient for animals; however, ingestion of too much selenium can be toxic to sensitive species. Selenium can be mobilized and accumulated through the food chain, causing adverse growth and reproductive effects in both fish and birds. Elevated concentrations of selenium have been linked to deformities and deaths of aquatic birds.

The Central Valley Regional Water Quality Control Board (Central Valley Water Board) has monitored selenium levels in the Grassland Watershed since 1985. These monitoring data confirmed high selenium concentrations in the Grassland Marshes and other water bodies within the watershed and downstream. The source of the elevated concentrations was traced to subsurface drainage discharges from the DPA. The subsurface drainage was being utilized to augment limited water supplies for the Grassland marshes. The elevated selenium concentrations were above the selenium criteria being proposed by the U.S. Fish and Wildlife Service to protect waterfowl; therefore, in 1988, 8,224 acres of the Grassland Marshes were added to the California List of Impaired Waterbodies. This listing was reevaluated in 1996 and the areal extent of the impaired waterbody was increased to 61,810 acres.

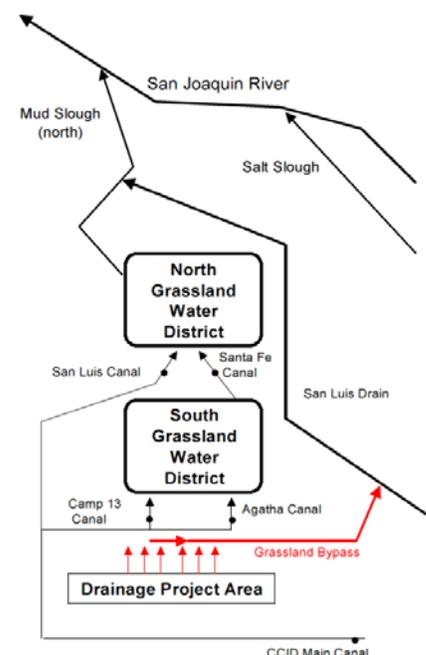
Pollutant Sources – Some soils in the Coast Range are derived from marine sediments, which are naturally high in salts and selenium. The soluble salts and selenium have historically migrated with groundwater to the valley floor where it resides in an unconfined, shallow groundwater layer above the Corcoran Clay Layer. Irrigation is necessary for nearly all crops grown commercially in the watershed and causes the groundwater to rise. Subsurface drainage, specifically from tile drains in the DPA, is produced when farmers drain the salty groundwater from the root zone to protect their crops. Prior to the Grassland Bypass Project, the same wetland channels that carried supply water to the Grassland Marshes also carried agricultural drainage, which was used to augment the limited supplies. Periodically elevated selenium concentrations were subsequently measured in the channels and marshes. The DPA subsurface tile drainage is the primary source of selenium to the Grassland Marshes. Other sources include surface agricultural drainage, wetlands discharges, and surface runoff; however, these were not identified as significant contributors of selenium in the TMDL. The TMDL identified only nonpoint sources of selenium that discharge to the Grassland Marshes.

Loading Capacity and Allocations – The loading capacity is the maximum amount of a contaminant or stressor that can be assimilated in a water body without exceeding the TMDL numeric targets (equal to the water quality objectives for this TMDL). The selenium loading capacity and source allocations in this TMDL are concentration-based limits. A load limit for selenium was considered, but water quality data collected in the late 1980s through early 1990s showed little change in concentrations, even after significant selenium load reductions. It was concluded that removal of untreated subsurface agricultural drainage from wetland supply channels was required to meet water quality objectives and a concentration-based objective was the best measure of success at protecting beneficial uses and achieving water quality improvements. Therefore, the loading capacity and subsurface drainage load allocation are set equal to the water quality objective of 2 ppb, as a monthly mean, with a 20 ppb instantaneous maximum concentration. Other selenium sources (surface agricultural drainage and wetlands discharges) were not identified as significant sources and their selenium concentrations consistently found to be less than the water quality objective. Background sources such as groundwater and surface runoff are assigned a load allocation equal to the water quality objective (a monthly mean concentration of 2 ppb).

Is Water Quality Improving?

Water quality associated with the Grassland Marshes is monitored in four wetland supply channels: San Luis Canal, Santa Fe Canal, Camp 13 Canal, and Agatha Canal (see schematic on the right). The CCID Main Canal is also a wetland water supply channel, but this channel does not receive tile drainage discharge from the DPA. All subsurface discharge from the DPA was rerouted to the Grassland Bypass Channel where it could be controlled and regulated for progressive reductions in selenium loads.

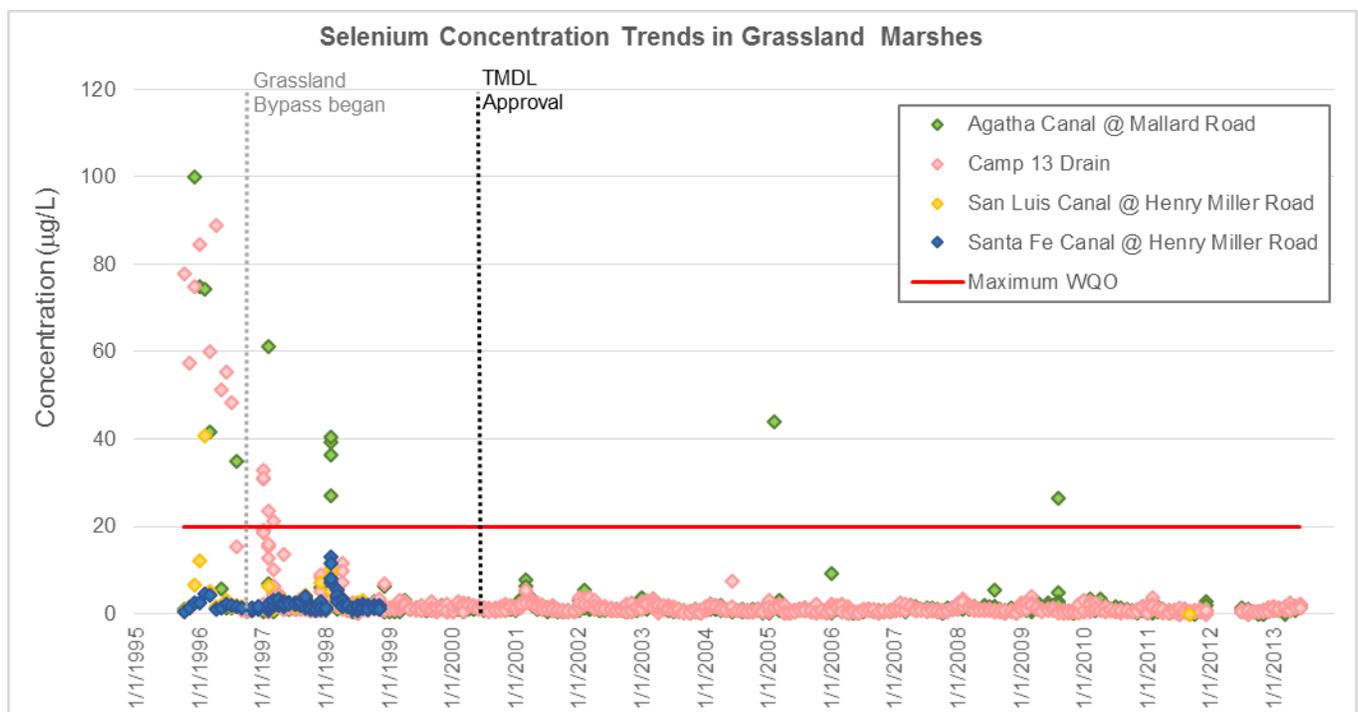
Monitoring has been conducted in the area since 1986. Since the implementation of the Grassland Bypass in October 1996, water quality has improved in the Grassland Marshes through the successful prohibition



of agricultural subsurface drainage. The concentrations of selenium have decreased in the wetland water supply channels. While the monthly mean water quality objective of 2 ppb ($\mu\text{g/L}$) is frequently met it is not consistently achieved. The 20 ppb instantaneous maximum water quality objective has been met in recent years (the most recent exceedance was in 2009).

The graphs below represent the same dataset using slightly different analyses on different scales. The upper graph uses a normal arithmetic scale to show the selenium concentrations associated with all available data (i.e., instantaneous measurements rather than monthly averages) and compares those values to the instantaneous maximum water quality objective of 20 ppb. This illustrates that the concentrations in San Luis Canal, Camp 13 Canal, and Agatha Canal decreased after implementation of the Grassland Bypass in 1996. Concentrations in Santa Fe Canal, which enters the North Grassland Water District area after passing through the South Grassland Water District, remained similar (all measurements were below the instantaneous maximum water quality objective). In 1997 through 1998, exceedances were frequently observed; however, they were at a smaller magnitude than those before 1996. Many of these exceedances occurred during and immediately following major storm events and flooding when the Grassland Bypass' runoff capacity was exceeded and the water flowed again through the wetland supply channels.

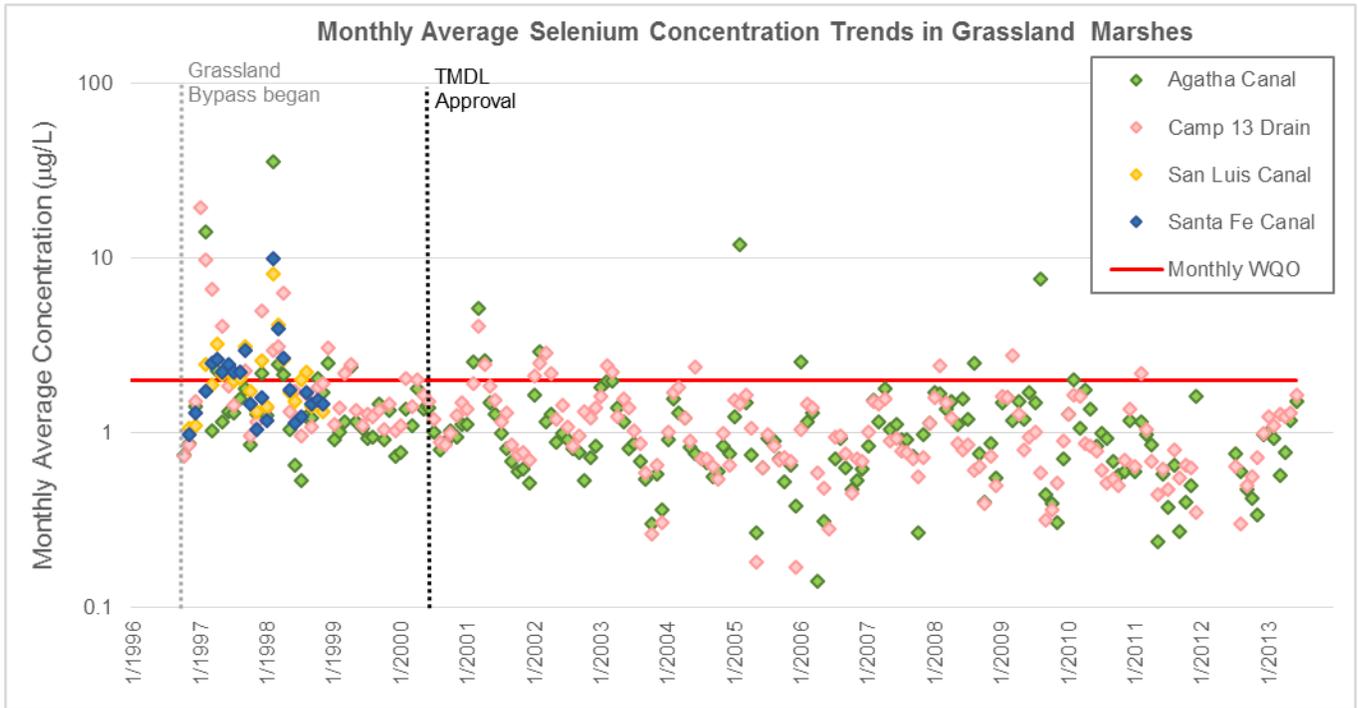
After the 1998 El Nino year, the San Luis Delta-Mendota Water Authority developed a stormwater management plan, which addressed the violations that occurred when high flows caused subsurface drainage to be discharged to the Grassland Marshes. Beginning in 1999, exceedances became less frequent. Selenium concentrations above the instantaneous maximum water quality objective have not been observed since 2009 in the Agatha Canal.



Because there are so many measurements shown in the time series plot above, the data were summarized to highlight temporal trends. The average monthly concentrations in San Luis Canal, Santa Fe Canal, Camp 13 Canal, and Agatha Canal were calculated. This is also consistent with the application of the monthly mean water quality objective. These data are plotted on a logarithmic scale of selenium concentrations. This scale separates the data so the values close to the water quality objective are visible. After TMDL approval, most monthly average concentrations were below the monthly mean water quality objective (note: no data were available from

the California Environmental Data Exchange Network [www.ceden.org] for the San Luis and Santa Fe canals during this period).

The most recent two years of data do not show any exceedances. Monitoring will continue to ensure this trend continues. If future monitoring shows concentrations that exceed the water quality objectives, further review will be needed to determine if the exceedances are due to controllable factors or seepage of groundwater with locally elevated levels of selenium.



TMDL Progress – Implementation activities and milestones

Implementation Activity	Target Date	Status	Progress Details
Attainment of water quality objectives.	10/1/1996	In Progress	<ul style="list-style-type: none"> Data show that selenium concentrations in wetland water supply channels to Grassland Marshes are improved, but the 2 ppb monthly mean water quality objective is exceeded (most recently in 2011). The 20 ppb instantaneous maximum concentration water quality objective is consistently being met and has not been exceeded since 2009.
The Basin Plan contains a prohibition of discharge of agricultural subsurface drainage water.	01/10/1997	Complete	<ul style="list-style-type: none"> This prohibition was adopted in a Basin Plan Amendment for the Control of Subsurface Drainage Discharges (State Water Board Resolution 96-078). Discharge from subsurface agricultural drainage is prohibited, unless water quality objectives are being met.

Implementation Activity	Target Date	Status	Progress Details
Tile drainage from the DPA rerouted through the Grasslands Bypass Structure (portion of the former San Luis Drain) and away from the Grassland wetlands.	10/01/1996	Complete	<ul style="list-style-type: none"> Beginning in September 1996 Grassland Bypass began operating (link). This consolidated the subsurface drainage from DPA into a single channel that discharges into the Mud Slough (north) via the San Luis Drain. This removed the DPA drainage from approximately 90 miles of canals that supply water to wetland habitat.
Waste discharge requirements for the Grassland Bypass Project, which require progressive load reductions.	None specified	Complete/ Ongoing	<p>WDRs for the Grassland Bypass Project ensure that the prohibition of discharge stays in effect.</p> <ul style="list-style-type: none"> Phase I of the project regulated by Order No. 98-171. Phase II regulated by Order No. 5-01-234 (link) Revised WDRs and a revised monitoring and reporting program are under development by the Central Valley Water Board (link)

What Next?

Water quality goals are currently being achieved. The U.S. Environmental Protection Agency (EPA) is intending to propose new water quality criteria for the protection of aquatic life and wildlife for San Francisco Bay and the Delta by June 2016. These criteria will likely be more stringent than existing criteria for the estuary. When the new criteria are finalized, selenium loads from upstream water bodies, stormwater, and groundwater may need to be reviewed for consistency with downstream water quality standards.

Information Source Documents

- **Selenium Total Maximum Daily Load (TMDL) for Grassland Marshes** ([link](#))
- **Loads of Salt, Boron, and Selenium in the Grassland Watershed and Lower San Joaquin River**, October 1985 to September 1995, California Regional Water Quality Control Board, Central Valley Region (executive summary [link](#); raw data [link](#))
- **Review of Selenium Concentrations in Wetland Water Supply Channels in the Grassland Watershed** (Water Year 1998 [link](#); Water Years 1999 and 2000 [link](#))
- **Basin Plan Amendment for the Control of Subsurface Drainage Discharges** (State Water Board Resolution 96-078), effective January 10, 1997
- **Waste Discharge Requirements for San Luis & Delta Mendota Water Authority and United States Department of the Interior Bureau of Reclamation, Grassland Bypass Project (Phase II)** ([link](#))
- **Revised Monitoring and Reporting Program No. 5-01-234 for San Luis & Delta Mendota Water Authority and United States Department of the Interior Bureau of Reclamation, Grassland Bypass Project (Phase II)** ([link](#))

- **Central Valley RWQCB Resolution** – Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins to Address the Control of Agricultural Subsurface Drainage, Resolution No. 96-147 ([link](#))
- **October 2014 Draft Waste Discharge Requirements and Monitoring and Reporting Program for Growers in the Grassland Drainage Area** ([link](#); full description of the status and documentation is available at: http://www.waterboards.ca.gov/centralvalley/water_issues/grassland_bypass/)
- **Grassland Bypass Project Central Valley RWQCB website** ([link](#))
- **Grassland Bypass Project, Summary Reports** ([link](#))
- **Grassland Bypass Project U.S. Bureau of Reclamation website** ([link](#))
- **A Storm Event Plan for Operating the Grassland Bypass Project**, Grassland Area Farmers and San Luis & Delta-Mendota Water Authority, 1997 ([link](#))