AGRICULTURAL DRAINAGE THROUGH THE GRASSLAND BYPASS PROJECT

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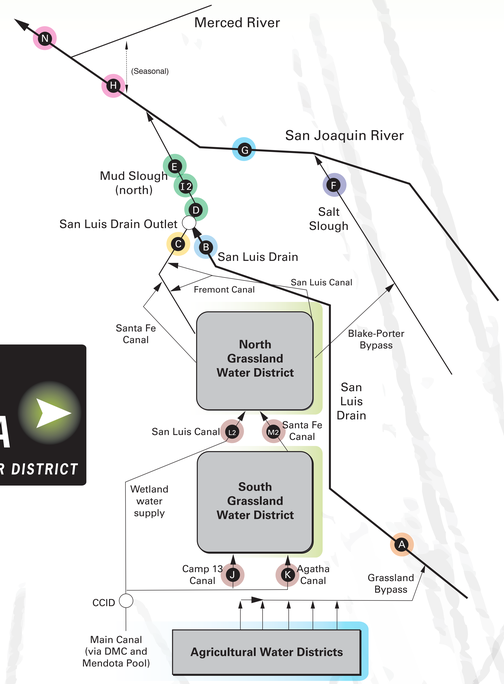
Grassland Bypass Project

INTRODUCTION

The Grassland area in the San Joaquin Valley in California is highly productive and includes approximately 97,000 acres of irrigated farmlands. Soils are primarily derived from rocks that form the California Coastal Range and are elevated in salt and trace elements concentrations. Starting in 1997, the Grassland Bypass Project (GBP) consolidated subsurface drainage water from the agricultural water districts in the San Joaquin Valley utilizing the San Luis Drain. Discharge of the Grassland area prior to the Project was conveyed through channels that delivered water to adjacent wetland areas with high habitat value, resulting in severe impacts on water quality for state and federal wildlife refuges (Ohlendorf et al. 1990). In addition to bypassing vulnerable habitat areas, efforts are made to significantly reduce salt, selenium, and boron loads to the Drain through conservation and improved applications, recycling of irrigation water and reuse on salt tolerant crops, tiered water pricing, etc.

The PROJECT AREA

SCHEMATIC MAP OF THE GRASSLAND WATER DISTRICT



HIGHLY MANAGED HYDROLOGICAL SYSTEM, MANAGING IRRIGATION AND DRAINAGE WATER IN ABSENCE OF PERENNIAL FLOWS WITH ASSIMILATIVE/DILUTION CAPACITY.

MONITORING PROGRAM

The monitoring plan for the GBP includes daily and weekly collection of water quality data, flow, sediment quality, biota, and chronic toxicity data at various sites throughout the Grassland Water District to assess the intended reduction in discharge to the San Luis Drain as well as to evaluate potential project impacts. Sampling sites are located at the inlet (Site A) and the outlet (Site B) of the San Luis Drain, in water supply channels leading to (Sites J, K, L2, and M2) and from the wetland areas (Site C), as well as before the drainage water discharges into the San Joaquin River (Sites D and I2) and after (Site H and N). Reference sites are located along Salt Slough (Site F) and the upper part of the San Joaquin River (Site G).

Station B is the primary sampling location for measuring flow, salt, selenium, and boron loads. Data are collected on a daily basis to evaluate whether the discharge requirements near the terminus of the San Luis Drain are met.

RESULTS

Water Year	Pre-Project Avg. (1986-1996)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Project Avg. (1997-2007)	% Reduction
Drainage Discharge (acre feet)[a]	49,760	37, 800	43,570	30,510	29,330	27,050	25,820	25,250	25,370	27,540	23,080	16,480	28,350	43
Selenium Load (lbs)[b]	8,806	7,418	8,436	5,178	4,685	4,509	3,815	3,865	3,813	3,701	3,612	2,581	4,692	47
Boron Load (1000 lbs)[b]	714	772	868	620	583	538	509	543	513	613	508	309	580	19
Salt Load (tons)[b]	190,150	176,750	211,340	143,910	135,250	125,080	111,220	113,600	110,700	126,990	111,070	77,140	131,190	31

Table 1. Grassland Bypass Project Summary of Annual Volumes and Loads

Within the first 11 years of this Project, the drainage volume from the Grassland Drainage Area has been reduced by 43%, the salt load was reduced by 31%, and the selenium and boron load showed a decline of 47% and 19%, respectively (US Bureau of Reclamation et al. 2008).

BIOLOGICAL MONITORING

At seven different sites selenium concentrations in small and medium fish, invertebrates, vegetation, and bird eggs were measured to study the ecological effects of the Grassland Bypass Project. In general, selenium concentrations in Mud Slough (at Site D) and downstream before the confluent with the San Joaquin River (Site E) exceeded the threshold of toxicity frequently and the overall hazard of selenium to the ecosystem continued to be high according to Lemly's index (Lemly 1995, 1996). This aquatic risk assessment was designed to provide an estimate of ecosystem effects of selenium and is based on maximum contaminant concentrations, rather than means, which makes it a highly sensitive tool.

In Salt Slough, a wetland water supply channel, where drain water has been removed by the GBP, selenium concentrations declined predominantly during the first year of the Project and stayed well below the concern threshold levels since.

	WY 1996		WY 1997		WY 1998		WY 1999		WY 2000		WY 2001		CY 2002		CY 2003		CY 2004		CY 2005	
	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly
Mud Slough																				
Water	19.0	High	80.0	High	104.0	High	5.1	High	66.0	High	51.0	High	55.0	High	48.0	High	48.9	High	36.6	High
Sediment	0.4	None	0.8	None	2.0	Low	4.8	High	4.4	High	3.5	Moderate	8.5	High	7.8	High	7.5	High	6.4	High
Invertebrates	1.6	None	3.3	Low	11.0	High	7.0	High	15.3	High	7.1	High	7.5	High	10.5	High	13.0	High	12.7	High
Fish Eggs	14.2	Moderate	56.1	High	34.2	High	39.6	High	46.5	High	54.8	High	51.5	High	53.2	High	54.6	High	48.8	High
Bird Eggs	3.1	Minimal	4.4	Minimal	6.6	Low	10.0	Low	5.1	Low	7.0	Low	3.2	Minimal	5.6	Low	4.7	Minimal	11.8	Low
	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly	Se	Lemly
Salt Slough																				
Water	38.0	High	3.0	Moderate	5.0	High	1.5	Minimal	1.7	Minimal	2.1	Low	1.1	Minimal	1.3	Minimal	1.1	Minimal	1.0	Minimal
Sediment	0.8	None	0.9	None	2.1	Low	0.9	None	0.7	None	0.8	None	0.7	None	0.8	None	0.6	None	5.0	Minimal
Invertebrates	4.7	Moderate	2.6	Minimal	3.2	Low	2.8	Minimal	2.7	Minimal	0.7	Minimal	2.4	Minimal	2.5	Minimal	3.3	Low	4.2	Moderate
Fish Eggs	28.1	High	17.8	Moderate	12.9	Moderate	11.2	Moderate	14.5	Moderate	12.5	Moderate	13.8	Moderate	11.6	Moderate	10.6	Moderate	11.6	Moderate
Bird Eggs	5.2	Low	3.6	Minimal	3.7	Minimal	2.7	None	4.9	Minimal	4.0	Minimal	2.7	None	1.5	None	5.0	Minimal	5.9	Low

Table 2. Aquatic Hazard Assessment of Selenium in Mud Slough and Slat Slough.

WY – Water Year,
CY – Calendar Year.
Se – maximum selenium concentration (µg/L),
Lemly – Lemly Aquatic Index.

References

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