Final Project Report

San Luis and Delta Mendota Water Authority

AGRICULTURAL DISCHARGE MANAGEMENT PROGRAM MONITORING AND EVALUATION-WEST STANISLAUS COUNTY

July 15, 2008

San Joaquin River

Orestimba Creek and Del Puerto Creek Sub-Watersheds

Project Type: WC § 79114

Reduce the discharge of pollutants to state waters from non-point sources

Funded by: Proposition 13 Funds

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Task 2.7 Analyze Four BMPs Active within WSC

The project focused on examining and evaluating four BMPs currently being practiced within WSC---vegetative ditches, retention ponds, wetlands and on-field practices such as the use of polyacrylamide (PAM). A map of the BMP Study sites is provided in Figure 11.

Retention Ponds

The pond study site (see Figure 18) is a reservoir constructed in 2003 as part of a water-reuse project. This pond has a surface area of 12 acres, an approximate volume of 96 acre-feet (AF), and receives flow from approximately 2,000 acres of farmland. The reservoir consists of three ponds. Entering flow is split evenly into two small ponds at the north end and then recombined in the large southern pond. The reservoir is designed for sediment excavation and sediment is removed from the pond annually. The reservoir is not managed as a biologically active system. Plant growth along the edges of the pond is controlled by the application of herbicide. The reservoir is drained and excavated each year to a nominal depth of eight to ten feet and any biologically active sediment is removed as part of this maintenance. Documentation of field work at this site and presentation of continuous monitoring data is presented in Appendix 11.

Figure 18: Aerial view of retention pond used for BMP study

Mean concentration data for seven water quality parameters (dissolved organic carbon (DOC), mineral suspended solids (MSS), ammonia nitrogen (NH_4N), nitrate and nitrite nitrogen (NO_3-N), soluble phosphate (PO_4-P), biochemical oxygen demand (BOD) and chlorophyll-a (Chl-a) as measure by phytoplankton biomass) measured at the inlet and outlet of the reservoir are presented in Table 13. DOC, NH_4-N, NO_3-N, and chl-a concentrations were not statistically different between the inlet and outlet of the reservoir (probabilities > 0.10 by both the parametric *t*-test and nonparametric Z-test).

Table 13: Water quality changes occurring in pond system.

Parameter[1]	Level	Number	Mean (mg/L)	Std Dev (mg/L)	Probability[2] > |t|	Probability[2] >|Z|
DOC	in	5	3.7	1.1	0.893	0.531
	out	5	3.8	0.5		
MSS	in	5	233	278	0.254	0.060
	out	5	67	61		
NH4-N	in	5	0.04	0.02	0.308	0.296
	out	5	0.06	0.04		
NO3-N	in	5	2.08	0.83	0.629	0.835
	out	5	1.86	0.51		
PO4-P	in	5	0.15	0.02	0.003	0.012
	out	5	0.09	0.03		
BOD	in	2	4.0	0.7	nd[3]	Nd
	out	2	12.4	10.0		
Chl-a	in	5	0.036	0.021	0.363	0.835
	out	5	0.058	0.045		

[1] DOC: dissolved organic carbon, MSS: mineral suspended solids, NH4-N: ammonia nitrogen, NO3-N: nitrate and nitrite nitrogen, PO4-P: soluble reactive phosphate as P, BOD: 10 day biochemical oxygen demand, Chl-a: chlorophyll-a as a measure of phytoplankton biomass. [2] Probability that inlet and outlet are different by parametric (*t*) and nonparametric (Z) test (see methods for explanation). For example, a probability value of 0.050 indicates the inlet and outlet have a 95% probability of being different. [3] nd: non-detected

Suspended sediment (measured as MSS) averaged a 71% reduction between the inlet and the outlet. The MSS data from the pond is not normally distributed, has a very broad variation, and the parametric analysis (student t test) could not differentiate the means. Using nonparametric analysis (Z-test), which does not rely on data conforming to a normal distribution (Lehmann, 2006), indicates that the inlet and outlet are truly different (at 94% probability). The pond is drained each year and excavated. Excavation records indicate that the pond traps approximately 2,000 cubic-yards of sediment per year. The ability of the nonparametric statistical methods to identify water quality changes, when the more familiar parametric *t*-test could not, demonstrates the utility of nonparametric methods for evaluating BMP performance and water quality data.

The other significant change in water quality that occurred in the pond was the removal of soluble phosphate. PO_4-P was reduced by a mean of 40% between the inlet and outlet. Removal was statistically consistent as indicated by the similar results in both the parametric and non-parametric analyses (probabilities < 0.05 by both the parametric *t*-test and nonparametric Z-test). Aqueous concentrations of phosphate are influenced by a number of processes in surface waters, including sorption and desorption on sediments (House, 2003). Sediment removal could account for most of the observed reduction in PO_4-P, but there may also be some biological removal from algal or bacterial activity.

Although specific data on the removal of pesticides by retention ponds was not generated in this project, it is expected that there would be some pesticide removal as sedimentation occurs. Pesticides that are highly hydrophobic (such as the organochlorine and pyrethroid insecticides) would readily bind to sediment and would probably match the 70+% removal rate as observed for the sediment in this study. On the other hand, the mitigation of water soluble compounds (such as the organophosphates) by non-vegetated ponds would be limited (although some occlusion would occur). Rose et al (2005) demonstrated a reduction of 22-90% for the herbicides, diuron and fluometuron, and the insecticides, aldicarb and endosulfan in an open pond.

Disclosure: Funding for this project has been provided in full or in part through an Agreement with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto. The contents of this document do not necessarily reflect the views and policies of the SWRCB. Information regarding equipment and other entities was provided solely for presenting testing materials required for the work and does not imply an endorsement of the entities or products.