

Introduction

This water quality monitoring fact sheet was prepared by the Irrigated Agriculture Program of the Central Coast Regional Water Quality Control Board (Water Board) and made available on November 30, 2008. The data were delivered by Central Coast Water Quality Preservation, Inc. (CCWQP) to the Water Board as part of the monitoring and reporting requirements for all dischargers enrolled under *Conditional Waiver of Waste Discharge Requirements for Discharge from Irrigated Lands, Order No. R3-2004-0117*. Monitoring stations were selected to represent water quality in predominantly agricultural areas, but in some cases reflect mixed land uses upstream of the sites.

306MOR Moro Cojo Slough

The Cooperative Monitoring Program sampled Moro Cojo Slough 37 times (one sample per month) between January 2005 and December 2007, with an additional sample in February 2005.

Summary of Water Quality Data

Notable Measured Analytes for Water Quality Monitoring

Analyte/Parameter	Average	Range	Water Quality Criteria (WQC) or Guideline ¹	Percent Outside WQC or Guideline
Ammonia as N, Unionized	0.017 mg/l	0.000–0.078 mg/l	<0.025 mg/l ⁺	26%
Nitrate/Nitrite as N	0.3 mg/l	0.0–5.7 mg/l	<10.0 mg/l*	0%
Orthophosphate as P	0.39 mg/l	0.00–2.30 mg/l	<0.12 mg/l*	47%
Turbidity (NTU)	29 NTU	0–139 NTU	<25 NTU*	46%
Conductivity	41.92 mmho/cm	3.66–68.18 mmho/cm	Ranges: * <0.75 No Problem 0.75–3.0 Increasing >3.0 Severe	% in Range: 0% 0% 100%
pH	8.3	7.2–9.2	7.0–8.3 ⁺	54%
Annual Median Dissolved Oxygen (% Saturation)	2005: 64% 2006: 46% 2007: 65%	22–140%	>85% annual median ⁺	Std not met Std not met Std not met
Dissolved Oxygen	5.5 mg/l	1.7–13.4 mg/l	>5.0 mg/l (GEN/WARM) ⁺ >7.0 mg/l (COLD/SPWN) ⁺	51% 81%
Chlorophyll a	11.7 µg/l	0.3–90.7 µg/l	<40 µg/l*	14%
Water Temperature	14.9°C	8.6–21.9°C	Water Basin Specific	--

+ Indicates standard defined in the Water Quality Control Plan, Central Coast Basin (Basin Plan)

* Indicates guideline not described in the Basin Plan or not specifically stated as applicable to the beneficial uses of the site. Origin of the guideline is described in the individual discussion of the analyte/parameter.

The present and potential beneficial uses for **Moro Cojo Slough** as defined in the Basin Plan include Ground Water Recharge (GWR), Water Contact Recreation (REC-1), Non-Contact Water Recreation (REC-2), Wildlife Habitat (WILD), Cold Fresh Water Habitat (COLD), Warm Fresh Water Habitat (WARM), Spawning, Reproduction, and/or Early Development (SPWN), Preservation of Biological Habitats of Special Significance (BIOL), Rare, Threatened, or Endangered Species (RARE), Estuarine Habitat (EST), and Commercial and Sport Fishing (COMM).

¹ Water Quality Criteria (WQC) are defined in the Water Quality Control Plan, Central Coast Basin (also referred to as the “Basin Plan”) to protect beneficial uses such as drinking water, fish habitat, irrigation water, etc. WQC include general water quality standards for some analytes as well as specific criteria based on the defined beneficial uses. Other water quality guidelines were compiled to provide a standard in order to compare sites. Bold indicates beneficial uses that apply to this watershed.

Unionized Ammonia (as N)

Unionized ammonia (as N) is a calculated value based on water temperature, pH, and total ammonium concentration. Ammonia can be toxic in water. With high water temperature and/or high pH, ammonia becomes unionized and is toxic at much lower levels. The Basin Plan general water quality objectives state that unionized ammonia shall not exceed 0.025 mg/l. Over time, ammonia should reduce to nitrate, so long-lasting levels of ammonia may indicate continuous discharges of waste. **Nine of 35 samples (26%) exceeded the standard. There were no apparent cycles. The average unionized ammonia concentration was 0.017 mg/l.**

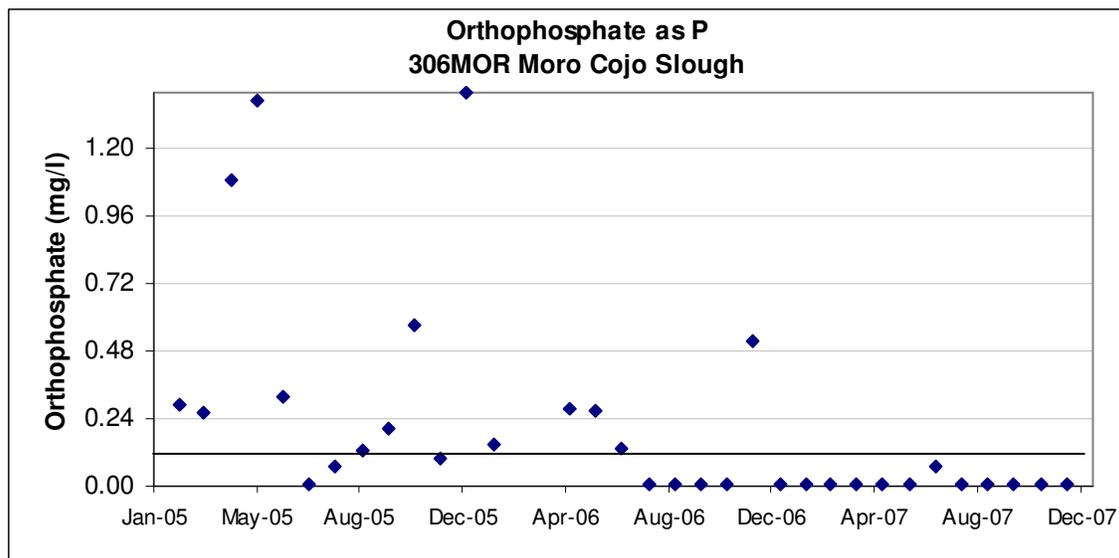
Nitrate/Nitrite as N

The Municipal and Domestic Supply (MUN) objective states in Table 3-2 of the Basin Plan that nitrate as NO_3 shall not exceed 45 mg/l. This value is equivalent to 10 mg/l of nitrate as N. Nitrite accounts for a small percent of total nitrate/nitrite, and therefore, nitrate as N criterion was used as a guideline for nitrate/nitrite samples. **No nitrate/nitrite samples exceeded the guideline. The average concentration was 0.3 mg/l.**

Orthophosphate as P

The Basin Plan does not contain orthophosphate standards. The Central Coast Ambient Monitoring Program (CCAMP) non-regulatory guideline for general water quality objectives states that orthophosphate concentrations shall not exceed 0.12 mg/l. **Orthophosphate concentrations exceeded the guideline in 17 of 37 samples (47%). Three samples exceeded the guideline by more than 17 times. Prior to August 2006, 15 of 18 samples exceeded the guideline, while during and after August 2006, only one of 17 samples exceeds the guideline. The average concentration was 0.39 mg/l. However, the standard deviation was 0.66 mg/l, indicating extreme (high and low) readings.**

The chart below shows the orthophosphate concentrations throughout the sampling period. The guideline for orthophosphate states that its concentration as N shall not exceed 0.12 mg/l, shown by the black horizontal line on the graph.



Turbidity

The Basin Plan states: “Water shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.” Sigler et al.² shows that turbidity levels of 25 NTU or greater caused reduction in juvenile salmonid growth due to interference with their ability to find food. Turbidity is often affected by suspended material in runoff. **Sixteen of 35 turbidity readings (46%) exceeded the guideline. Turbidity levels in Moro Cojo Slough averaged 29 NTU, ranging from 0.01 to 139 NTU.**

² Sigler, J.W., T.C. Bjornn, & F.H. Everst. (1984). *Effects of chronic turbidity on density and growth of steelhead and coho salmon*. Transactions of the American Fisheries Society. 113:142-150.

Conductivity

Conductivity is measured from a water sample. Based on Table 3-3 of the Basin Plan showing Guidelines for Interpretation of Quality of Water for Irrigation, conductivity below 0.75 mmho/cm causes no problems to irrigation, between 0.75 and 3 mmho/cm causes increasing problems, and conductivity above 3 mmho/cm causes severe problems. The conductivity level can be greatly affected by geologic and biological influences and is not necessarily related to agricultural activities. **Measuring conductivity in Moro Cojo Slough would misrepresent its health. Conductivity and salinity fluctuate daily based on the tides; Moro Cojo Slough is greatly influenced by the ocean and therefore shows greater salinity than a similar water body uninfluenced by the ocean. However, all 37 samples indicated severe problems.**

pH

Multiple beneficial uses have objectives for pH. The Basin Plan general water quality objective for pH is between 7.0 and 8.5; MUN, AGR, REC-1, and REC-2 pH objectives are between 6.5 and 8.3. The standard, therefore, is 7.0-8.3 if one or more of MUN, AGR, REC-1, and REC-2 is defined as a beneficial use. pH above 9 can cause skin irritation to humans and makes water inhospitable to many species. **Twenty of 37 pH samples (54%) exceeded the standard. The average pH value was 8.3, the upper limit of pH levels for contact recreation uses. The data may indicate a trend of increasing pH, with three of four pH measurements during or after May 2007 above 9, and the only two measurements below 7.5 occurring in January and February 2005.**

High pH can be associated with salinity. Because Moro Cojo Slough is tidally influenced, high pH is more common. The fluctuations in pH did not increase during high dissolved oxygen or salinity samplings, which may indicate an anthropogenic influence. The average salinity content for samples indicating negative flow was 58 ppt, while samples with positive flow downstream average only 40 ppt. Three of the four negative flows had corresponding pH values of at least 8.

Dissolved Oxygen Concentration and Dissolved Oxygen Saturation

The Basin Plan general water quality objectives state annual median dissolved oxygen shall remain above 85% saturation. General and WARM objectives state that the dissolved oxygen concentration must remain above 5.0 mg/l at all times, and SPWN and COLD objectives state that the dissolved oxygen concentration must remain above 7.0 mg/l at all times. **Nineteen of 37 samples (51%) did not meet the general and WARM concentration standard and 30 samples (81%) did not meet the COLD and SPWN concentration standard. Dissolved oxygen did not meet the saturation standard during 2005, 2006 or 2007, with median annual values of 64%, 46%, and 65% saturation, respectively.**

Chlorophyll a

Healthy and appropriate Chlorophyll a levels are not defined in the Basin Plan. Chlorophyll a indicates phytoplankton growth, a necessary component of healthy water bodies. Because turbidity causes interference for the Chlorophyll a probe, measurements of Chlorophyll a may not be accurate when turbidity is above 1000 NTU. Chlorophyll a levels over 40µg/l are considered problematic by North Carolina Administrative Code (NCAC). **Five of 36 Chlorophyll a readings (14%) exceeded this guideline, ranging from 0.3 to 90.7 µg/l.**

Temperature

Sullivan et al.³ state that the maximum weekly average temperatures for protection of steelhead or rainbow trout, and coho salmon are 19.6 and 19.7°C respectively. **The temperature averaged 14.9°C and ranged from 8.6 to 21.9 °C. Though weekly averages were not taken, and Moro Cojo Slough is designated as a warm-water body, the temperatures taken at this site indicate that it may be capable of supporting a cold-water fish habitat.**

³ Sullivan, K., D.J. Martin, R.D. Cardwell, T.E. Toll, & S. Duke. (2000). *An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria*. Portland, OR: Sustainable Ecosystems Institute.

Summary of Toxicity Data

Species with Significant Mortality

	Feb-05	Mar-05	Apr-05	Jul-05	Sep-05	Feb-06	May-06	Aug-06	Sep-06	Feb-07	Mar-07	Apr-07	Oct-07
Invertebrate (Water Column)				No	No	No		No	No	No		No	Yes
Fish (Water Column)	No	No				No		No	No	No	No		No
Invertebrate (Sediment)	No	No	Yes				Yes						
Algae (Water Column)	No					No		No	No	No	No		No

Significant effect is determined by statistically significant rates of mortality, growth, or reproduction compared to a control sample and provides an indication that something is affecting plant or animal life in the stream. Invertebrates show significant sensitivity to organophosphates and pesticides. Significant effect to algae often indicates the presence of herbicides and metals such as copper. Fish are less sensitive to organophosphates but can be impacted by other pollutants such as ammonia and pyrethroid pesticides.

Photos of Site



Above: February 2006

Left: July 2006

QAQC

The data in this water quality monitoring fact sheets meet the quality assurance and quality control requirements of the Water Board's Surface Water Ambient Monitoring Program (SWAMP). Additional surface water monitoring data is available at the Water Board's Central Coast Ambient Monitoring Program website <http://www.ccamp.org>. Any questions regarding the data or analysis should be directed to either **Peter Meertens** at pmeertens@waterboards.ca.gov (805) 549-3869 or **Amanda Bern** at abern@waterboards.ca.gov (805) 594-6197.

Attachment: Monitoring Data

