Appendix D
Condensed from

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

REGIONAL TOXIC HOT SPOT CLEANUP PLAN

APRIL 1999

Part I

I. INTRODUCTION

In 1989 the California State legislature established the Bay Protection and Toxic Cleanup Program (BPTCP). The BPTCP has four major goals: (1) to provide protection of present and future beneficial uses of the bays and estuarine waters of California; (2) identify and characterize toxic hot spots; (3) plan for toxic hot spot cleanup or other remedial or mitigation actions; (4) develop prevention and control strategies for toxic pollutants that will prevent creation of new toxic hot spots or the perpetuation of existing ones within the bays and estuaries of the State.

This Regional Toxic Hot Spot Cleanup Plan (Cleanup Plan) is intended to provide direction for the remediation or prevention of toxic hot spots in the Central Valley Region (pursuant to Water Code Sections 13390 et seq.). Pursuant to Sections 13140 and 13143 of the Water Code, this Cleanup Plan is necessary to protect the quality of waters and sediments of the State from discharges of waste, in-place sediment pollution and contamination, and any other factor that can impact beneficial uses of enclosed bays, estuaries and coastal waters.

Part III

High Priority Candidate Toxic Hot Spot Characterization
San Joaquin River Dissolved Oxygen Cleanup Plan

Background
Low dissolved oxygen concentrations in the San Joaquin River in the vicinity of the City of Stockton has been identified in Part II of the cleanup plan as constituting a candidate BPTCP hot spot. In January 1998 the Central Valley Regional Water Quality Control Board (Regional Board) adopted a revised 303(d) list which identified low dissolved oxygen levels in the lower San Joaquin River ("Delta waterways") as a high priority problem and committed to developing a waste load allocation (TMDL) by the year 2011. The purpose of the Bay Protection Plan is to develop a strategy to collect the information necessary to implement the TMDL.

The San Joaquin River near the City of Stockton annually experiences violations of the 5.0 and 6.0 mg/l dissolved oxygen standard[1]. Violations are variable in time but usually occur over a ten mile River reach between June and November. Dissolved oxygen concentrations in the mainstem can be chronically below the water quality objective and can reach below 2.5 mg/l.

In 1978 the Board adopted more stringent biochemical oxygen demand (BOD) and total suspended solid (TSS) effluent limits for the Stockton Regional Wastewater Control Facility (RWCF) with the intent of reducing or eliminating the low dissolved oxygen conditions in the San Joaquin River. The plant has constructed the necessary additional treatment facilities and has complied with the more stringent effluent limitations. Despite the Cities best efforts, the low dissolved oxygen conditions persist.

The City completed a river model (Schanz and Chen, 1993) assessing the impact of the Stockton RWCF on receiving water quality. Water quality parameters considered included TSS, BOD, ammonia, nitrate and dissolved oxygen. The model suggested that (1) low dissolved oxygen conditions occur in the fall and spring due to a high mass loading of BOD and ammonia, (2) the current Stockton RWCF contributions are a significant portion of the oxygen demand of the River during critical low dissolved oxygen periods and (3) the San Joaquin River would not meet the receiving water dissolved oxygen standards even if the entire discharge from the Stockton RWCF were eliminated from the River.

Taking these facts into consideration, the Board adopted a stricter permit in 1994 requiring the Stockton RWCF to further reduce CBOD and ammonia concentrations. Stockton appealed the permit to the State Board on a variety of grounds including that hydraulic conditions had changed in the River since the Board had considered the permit. The State Board remanded the permit back to the Regional Board for consideration of new Delta flow standards.

In the interim the Stockton RWCF refined the dissolved oxygen model for the River (Chen and Tsai, 1997). The model suggests that the principal factors controlling in-stream oxygen concentration are temperature, flow, upstream algal production, sediment oxygen demand (SOD), and discharge from the Stockton RWCF. Obviously, only one of these factors is within the ability of the Stockton RWCF to control. Solutions to the dissolved oxygen problem will require a more holistic watershed approach. Each factor is described briefly below.

Dissolved oxygen problems are most acute at high temperature in the San Joaquin River in late summer and early fall. Temperature is important because the oxygen carrying capacity of water decreases with increasing temperature while biotic respiration rates increase. Water temperature is controlled by air temperature and reservoir releases.

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[1]The 5.0 mg/l standard applies between 1 December and 30 August while the 6.0 mg/l standard is for the period of 1 September through 30 November.

Flow of the San Joaquin River at Stockton is regulated by upstream reservoir releases and pumping at the state and federal pumping facilities at Tracy. Net flows at the City of Stockton are often zero or negative in late summer. The lowest dissolved oxygen levels in the River occur during prolonged periods of no net flow.

Algal blooms occasionally develop in the faster moving shallow upper River and are carried down past the City to the deeper slower moving deep- water ship channel. Respiration exceeds photosynthesis here resulting in net oxygen deficits. Upstream algal blooms are controlled by turbidity and nutrient inputs from other NPDES dischargers, the dairy industry, erosion, stormwater runoff, and agricultural inputs.

Finally, the model identified discharge from the Stockton RWCF as contributing to the dissolved oxygen problem. The model indicates that improvements in effluent quality would increase dissolved oxygen levels in the River during critical periods. However, the model confirmed that exceedance of the dissolved oxygen water quality objective would persist if the entire discharge of the Stockton RWCF were removed from the River. The City of Stockton has expressed the concern that the estimated costs for the additional treatment are disproportionate to the benefits and that more cost-effective improvements in dissolved oxygen levels are possible.

Adult San Joaquin fall run Chinook salmon migrate up river between September and December to spawn in the Merced, Tuolumne, and Stanislaus Rivers (Mills and Fisher, 1994). The Basin Plan dissolved oxygen water quality objective was increased from 5.0 to 6.0 mg/l between 1 September and 30 November to aid in upstream migration. The San Joaquin population has experienced severe declines and is considered a 'species of concern' by the U.S. Fish and Wildlife Service. Low dissolved oxygen may act as a barrier preventing upstream spawning migration. Also, low dissolved oxygen can kill or stress other aquatic organisms present in this portion of the Delta.

In conclusion, the San Joaquin River near the City of Stockton annually experiences dissolved oxygen concentrations below the Basin Plan water quality objective in late summer and fall. A model has been developed which identifies river flow and temperature, upstream algal blooms, SOD, and discharge from the Stockton RWCF as controlling variables. Only the latter variable is within the ability of the plant to influence. Fall run Chinook salmon migrate upstream during this critical time period.

A. Areal Extent

The areal extent of the water quality exceedance is variable but may in some years be as much as 10 miles of mainstem River. The temporal extent is also variable but can be for as long as 4 months. Dissolved oxygen concentrations are often less than 2.5 mg/l in the mainstem River.

B. Sources

A computer model developed for the Stockton RWCF identified ammonia and BOD as the primary cause of the low dissolved oxygen concentration. The sources are discharges from the Stockton RWCF and surrounding point and non point source discharges. River flow and water temperature were identified as two other variables strongly influencing oxygen concentrations.

C. Summary of Actions

Low dissolved oxygen levels near the City of Stockton in late summer and fall are a well known problem. In 1978 the Regional Board adopted more stringent effluent limits which the RWCF met but these did not correct the in-stream problem. A model developed for the Stockton RWCF suggested that further decreases in effluent BOD and ammonia would improve in-stream dissolved oxygen concentrations during critical periods but would not completely correct the problem. In 1994 the Regional Board further tightened BOD and ammonia permit limits to protect water quality. The permit was appealed to State Board because River hydrology had changed since the permit was adopted. State Board remanded the permit back to the Regional Board to reevaluate the modeling based upon new Delta flow conditions. In the interim, the Stockton RWCF installed a gauge at their discharge point to measure River flow and refined their computer model. The model concluded that the primary factors controlling dissolved oxygen concentration in the critical late summer and fall period were River flow and temperature, upstream algal blooms, SOD, and discharge from the Stockton RWCF. The model also made a preliminary evaluation of placing aerators in the River during critical periods. The results appeared promising. Finally, simulations coupling the dissolved oxygen and the San Joaquin River daily input-output model should be run. It may be possible by coupling the two models to predict exceedances of the Basin Plan dissolved oxygen standard about two weeks in advance. This could be valuable in that it raises the possibility of being able to conduct "real time management" to aid in correcting the problem.

D. Assessment of Actions Required

In January 1998 the Central Valley Regional Board adopted a revised 303(d) list which identified low dissolved oxygen levels in Delta Waterways near Stockton as a high priority impairment. The goal of the TMDL is to ensure that the San Joaquin River achieves full compliance with the Basin Plan Water Quality Objective for dissolved oxygen. To meet this objective, the Central Valley Regional Board intends to develop a strategy for collecting the information necessary to develop a TMDL.

According to the U.S. EPA (1998), "*the goal of the TMDL is the attainment of water quality standards. A TMDL is a written quantitative assessment of water quality problems and the contributing pollutant sources. It specifies the amount of reduction needed to meet water quality standards, allocates load reductions* *among sources ... and provides the basis for taking actions to restore a water body*".

The U.S. EPA (1998) suggests that the successful development of a TMDL requires information in six general areas: identification of a target, location of sources, quantification of the amount of reduction needed, allocation of loads among sources, an implementation plan and monitoring and evaluation to track results and compliance. Regional Board staff also believe that a seventh element, the formation of a Steering Committee, is needed to help guide the control effort. Each of the elements are described briefly below.

Steering Committee. The Steering Committee shall be composed of representatives from the Stockton RWCF, upstream and adjacent NPDES dischargers, the dairy industry, irrigated agriculture, the environmental community, and state and federal resource agencies. A facilitator/coordinator will be needed to conduct the Steering Committee meetings. A cost estimate for this function is shown in Table 2. The primary role of the Steering Committee will be to establish a Technical Advisory Committee, determine other stakeholders who should be participants on the Steering Committee, review recommendations of the Technical Advisory Committee on what special studies should be performed, how the load reductions should be allocated, and the time schedule and strategy for implementing the TMDL. The Steering Committee will also be responsible for developing a financial plan to secure the funding for collecting the information needed to implement the TMDL.

The responsibilities of the Technical Advisory Committee will be to identify information needs, determine and prioritize special funding needs, recommend load allocations, direct and assist in the review of the Stockton RWCF model, collate and analyze existing data, conduct special studies, critique special study and data analysis results, establish a common data bank, develop cost estimates, draft implementation and monitoring plans, review monitoring data and advise on effectiveness of the implementation plan. Regional Board staff will make final recommendations to the Board about load allocations and the TMDL implementation. If it appears likely that the Steering and Technical Advisory Committees will be unable to make recommendations in a timely fashion, then staff will develop the load allocation and TMDL implementation plan in the absence of this information.

Target. The target of the TMDL is attainment of the Basin Plan dissolved oxygen water quality objective in the lower San Joaquin River. The dissolved oxygen objective for the time period of 1 September through 30 November is 6.0 mg/l and at all other times is 5.0 mg/l.

Sources and Causes. The Stockton RWCF dissolved oxygen model identified the following factors as the cause of the low dissolved oxygen levels: upstream and adjacent algal blooms, SOD, river flow, discharge from the Stockton RWCF and temperature. It is felt that there is a need for independent validation of the

Stockton RWCF dissolved oxygen model. U.S. EPA has committed resources through Tetra Tech to do so. Model evaluation should occur after input has been obtained from both the Steering and Technical Advisory Committees. If validation shows that the model is reliable and that its initial findings are accurate, then the actions listed below are recommended.

Summarize and Compile Data. Collate all pertinent background data on the principle factors which contribute to the dissolved oxygen problem. These include information on all upstream and adjacent point and non-point source BOD and nutrient loads as well as all information on historical dissolved oxygen patterns in the San Joaquin River and changes in fisheries resources that may have been caused by the problem. All information gaps should be identified. Funds necessary for this task are shown in Table 2.

Determine BOD and Nutrient Sources. Collect all additional nutrient and BOD data needed to fill information gaps identified above. This will probably include additional studies on loadings from both local and upstream point and non-point source discharges. In addition, feasibility studies should be undertaken to evaluate the cost and efficacy of load reductions at the most important sources. Funding for this task is identified in Table 2.

Determine Sources and Causes of SOD. The Steering and Technical Advisory Committees will conduct investigations to determine the sources and causes of SOD. Also, feasibility studies will be undertaken to identify the most effective solutions for controlling SOD. Funds necessary for this task are shown in Table 2.

Evaluate Engineered Solutions. The TMDL strategy should include evaluations of creative engineered solutions. At a minimum, the Steering and Technical Advisory Committees should evaluate the feasibility of river aeration and changes in San Joaquin River hydrology. Evaluations of river hydrology may include several options. One is real time management of flows at the head of Old River during critical periods. A second option might be pumping water south through the Delta Mendota Canal for release down Newman Wasteway to augment base flows in the lower San Joaquin River during critical periods. Either option might be significantly enhanced by linking the continuous monitoring data (flow, salinity, temperature, dissolved oxygen and pH) presently collected in the San Joaquin River with measurements of nutrients and chlorophyll to determine sources and timing of high organic loads so that the head of Old River barrier can be operated in an adaptive management framework (Jones and Stokes Associates, 1998). A cost estimate for evaluating these options is shown in Table 2.

Amount of Load Reduction Needed. The load reduction needed is the difference between the load that would fulfill the Basin Plan Water Quality Objective for dissolved oxygen and the load that causes the dissolved oxygen concentrations presently measured in the main channel of the River.

Allocation of Loads Among Sources. The Steering and Technical Advisory Committees will make recommendations on load allocations to Regional Board staff after considering the following: importance of source, cost of correction per unit of dissolved oxygen increase obtained and probability of success of the action. The Steering and Technical Advisory Committees may also consider creative solutions such as funding aeration or hydrologic changes or the development of non-point source management practices. These are suggested as methods for assuring a contribution from other responsible entities who can make no load reductions. Finally, the load allocation process will include a safety factor to account for population growth in the Basin during the next 30 years.

Implementation Plan. While a full discussion of the implementation plan is premature, several facts are worth noting. First, the Steering and Technical Advisory Committees will make recommendations on load reduction allocations and the schedule and funding for implementing the TMDL. Regional Board staff will review these recommendations and propose a dissolved oxygen TMDL to the Board. It is anticipated that Regional Board staff will need about 6 months to review the recommendations and prepare the paperwork for the Basin Plan amendment. Second, the Basin Plan amendment will include load reduction allocations and a time schedule for meeting them. The reductions may necessitate revisions of NPDES permits and development and enforcement of management practices in the agriculture community.

It is anticipated that the TMDL will take three years to develop once funding has been secured. In the interim, the Regional Board will be draft new and revising existing NPDES permits for discharge to the lower San Joaquin River and South Delta. The Clean Water Act requires that NPDES permits contain effluent limits fully protective of receiving water quality, so any permits for discharges to impaired water bodies must contain stringent effluent limits. Where dischargers are a significant contributor to the River's dissolved oxygen problem, improvements in effluent quality may be required prior to completion of the TMDL. For new and expanded discharges, staff will recommend on a case-by-case basis stringent effluent limits to ensure no increase in oxygen demand to the South Delta. The time schedules for implementation of any stricter effluent limits may take into account the TMDL process. However, load reductions from existing dischargers will not be required if satisfactory progress is being made on TMDL development unless it is clear before the process has been completed that the specific load reduction would be required even under the TMDL. It will be assumed that satisfactory progress is being made if the majority of studies to determine load allocations are underway by December 1999 and, it appears likely, that the Steering Committee will recommend a TMDL implementation plan, including load allocations to Regional Board staff by the year 2002.

Monitoring and Reevaluation**.** The implementation plan will include monitoring. The purpose of monitoring is to verify compliance with the Basin Plan Dissolved Oxygen Objective. If monitoring demonstrates that the Water Quality Objective is not being met, then additional load reductions will be required. These new load reductions will be implemented after consultation with the Steering and Technical Advisory Committees. An estimate of funds necessary for monitoring is shown in Table 3.

E. An Estimate of the Total Cost to Develop the TMDL

A cost estimate for developing the TMDL is provided in Table 3. Although there are costs to implement this plan there are also benefits. Currently, beneficial uses are being impacted by the low dissolved oxygen levels in the South Delta. The beneficial uses that are being impacted are ESTUARINE HABITAT (EST) and SPORT FISHING (REC 1). Implementation of the plan would increase dissolved oxygen concentrations and minimize or eliminate the impact on beneficial uses.

F. An Estimate of Recoverable Costs from Potential Dischargers

No immediate funds are available from the discharge community to develop the TMDL. However, once the load reductions are allocated, then the responsible entities will be required to assume the costs of implementation.

G. Two Year Expenditure Schedule Identifying Funds to Implement the Plan that are Not Recoverable from Potential Dischargers.

Clean Water Act 104(b)(3), 106(g), and 319(h) grants are potential sources of funding and have been used in the past by Regional Boards to address such issues. CALFED may also be a source of funding.

Table 3. Cost estimates for developing a dissolved oxygen TMDL in the lower San Joaquin River and an estimate of the time required to complete each task.

Task	Cost	Years from date funds available
Steering Committee		as long as required
Facilitator/Coordinator	$ 12,000[1]	
Problem Statement		
Summarize and compile data	$ 50,000	0.5
Source Analysis		
Validate DO Model	$ 30,000	0.5
Determine BOD and nutrient sources	$ 200,000	2.0
Evaluate feasibility of control options	$ 50,000	
Determine sediment contribution	$ 200,000	2.0
Evaluate feasibility of control options	$ 50,000	
Evaluate engineered solutions	$ 80,000	2.0
Implementation Plan		
TMDL for Regional Board consideration	--	2.5
Monitoring/Reevaluation		annually after
Monitoring to evaluate load	$ 20,000[1]	TMDL adopted

reductions

1: per year

Bibliography

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