Updated Recommended Approach for Controlling the Low-DO Problem in the SJR DWSC

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As part of updating the Lee and Jones-Lee (2003) Synthesis Report completed in March 2003, and the Synthesis Report Supplement (Lee and Jones-Lee, 2004a), we have prepared the following discussion of the approach that we recommend should be adopted to solve the low-DO problem that occurs in the San Joaquin River (SJR) Deep Water Ship Channel (DWSC) near the Port of Stockton.

Lee and Jones-Lee (2003), as part of developing the Synthesis Report of the 1999 through 2003 SJR DO TMDL studies, included discussions of the various approaches for solving the low-DO problem in the DWSC that had evolved out of the four years of studies. These approaches were largely based on Dr. Lee's experience in working on similar problems over the past 40 years in various parts of the US and in other countries. They included extensive review and comment by Dr. Chris Foe of the CVRWQCB. The alternative approaches were made available to the SJR DO TMDL Steering Committee, email listees and external peer reviewers in the spring 2002 external peer review version of the Synthesis Report. In the winter 2003, with the update of the Synthesis Report, the Steering Committee and email listees were provided with an additional opportunity to comment on the Synthesis Report's discussion of alternative approaches for solving the low-DO problem. The final Synthesis Report of March 2003 incorporated reviewers' comments on these issues.

In April 2004 Gowdy and Grober (2004a) presented a draft Basin Plan Amendment to establish a TMDL for controlling dissolved oxygen concentrations so that they do not fall below the water quality objective (WQO) in the San Joaquin River Deep Water Ship Channel. In May 2004 Gowdy and Grober (2004b) presented a revised draft Basin Plan Amendment to solve the SJR DWSC low-DO problem. The original and revised Basin Plan Amendments focused on a so-called "three-legged stool" approach, in which the responsibility for controlling the low-DO problem is divided equally among the stakeholders responsible for controlling flow of the SJR through the DWSC, the stakeholders concerned about DWSC geometry (existence and maintenance of the DWSC), and the stakeholders responsible for oxygen demand loads to the DWSC. With respect to the latter, Gowdy and Grober (2004b) assigned a 60 percent responsibility to those stakeholders who contribute nutrients that develop into algae that become oxygen demand loads in the DWSC and a 30 percent responsibility to the city of Stockton's domestic wastewater discharges of ammonia. Ten percent of the load responsibility was reserved for "unknown or insignificant impacts."

Gowdy and Grober propose that the stakeholders for each of the stool's "legs" develop and conduct studies over the next several years that will provide the information needed to

control the low-DO problem in the DWSC. The Gowdy and Grober three-legged stool approach fails to properly incorporate the current state of knowledge of the causes of the low-DO problem in the DWSC and approaches that need to be evaluated to develop the most technically valid, cost-effective approach for solving this problem. Basically, this approach delays initiating action that it is now known will need to be undertaken to control the low-DO problem in the DWSC.

Lee and Jones-Lee (2003) discussed the range of alternatives that are available for solving the low-DO problem in the DWSC. This discussion was updated by Lee (2003) in the fall of 2003 to include the new information that had been developed over the previous summer. A critical review of the various alternative approaches for solving the low-DO problem shows that there are only a few that have potential for significantly controlling it.

Presented below is a recommended focused plan of action that should be implemented immediately to develop the information needed to develop a TMDL for controlling low-DO in the DWSC by December 2008. This plan of action immediately initiates the major studies/activities that need to be conducted so that a final TMDL can be formulated by December 2008. In general, the recommended approach presented herein is compatible with the Gowdy and Grober (2004b) proposed Basin Plan Amendment. However, it eliminates the four-year delay in initiating action that will occur if the Gowdy and Grober (2004b) study approach is followed.

Establishing Minimum SJR DWSC Flow

Lee and Jones-Lee (2003) have shown in the Synthesis Report and in the supplemental reports developed over the past year (Lee and Jones-Lee, 2004a) that the key issue in controlling the low-DO problem in the DWSC is the need to increase flows of the SJR through the DWSC. These issues have been further discussed in the Lee and Jones-Lee (2004b) comments on the CBDA draft Delta Improvements Package. From the information available, it appears that substantial increases in SJR DWSC flow can be achieved without significantly adversely impacting the interests of various stakeholders in the San Joaquin River, South Delta or Central Delta.

The recommended approach for developing the management program to control dissolved oxygen concentrations in the San Joaquin River Deep Water Ship Channel so that they do not fall below the water quality objective focuses on first, the stakeholders and the regulatory agencies working together to establish the minimum flow of the SJR through the DWSC that can be assured during all but critically dry years. The target value of 1,500 cfs has been established based on the observation that SJR DWSC flows above this amount rarely are associated with DO concentrations below the WQO. This minimum flow is to occur throughout the year, since, as demonstrated in the Lee and Jones-Lee (2003) Synthesis Report and in the followup discussions presented in the Supplement to the Synthesis Report (Lee and Jones-Lee, 2004a), low flows of the SJR through the DWSC can result in severe DO problems in the DWSC at any time of the year. As discussed in the Synthesis Report and the Supplement, there are a variety of potential approaches for achieving the desired minimum flow. There is need for the stakeholders in the low-DO problem to aggressively mount a coordinated effort to establish a significantly increased minimum SJR DWSC flow.

As discussed previously by Lee and Jones-Lee (2003), in establishing the increased SJR flow through the DWSC, there will be need to evaluate potential secondary impacts of the altered flow regime. A specific project should be started immediately to define the potential impacts of increased flow on fisheries, Central Delta water quality and other issues that would evolve out of increasing SJR DWSC flow, since increased flow would mean that there could be decreased or altered flows at some locations, which could have a variety of fisheries and/or water quality impacts. These impacts need to be defined and evaluated. Since these issues will likely take several years to be fully resolved, the investigation of these issues should be started immediately so that the information is available by December 2008.

Aeration

The amount of aeration that will be needed will be dependent on the flow of the SJR through the DWSC. If it should be found that it is not possible to establish a minimum SJR DWSC flow (such as 1,500 cfs) throughout the year, then the evaluation of the cost and use of aeration to control the low-DO problem in the DWSC should be based on various potential flow levels, such as a minimum flow of 50, 500, 1,000, and 1,500 cfs through the DWSC. Based on these flows, the potential for controlling DO WQO violations in the DWSC through aeration should be evaluated. The current aeration studies that are being conducted through CBDA contractors are far too limited in scope to provide the necessary information to properly evaluate the use of aeration at various SJR DWSC flow levels and oxygen demand loads. There is need to immediately expand this effort to cover the full range of issues that have to be evaluated in connection with providing aeration of the DWSC in order to solve the low-DO problem.

Obtaining Funding to Compensate for the Development and Maintenance of the DWSC

As part of developing the three-legged stool approach, Gowdy and Grober (2004b) assigned 20 percent of the responsibility for the low-DO problem to the existence of the SJR DWSC (channel geometry). One of the problems with this approach is the assumption that the channel geometry represents only 20 percent of the problem, when in fact it represents 100 percent of the problem, since there would be few, if any, low-DO problems in the channel if the Deep Water Ship Channel had not been constructed and were not maintained by dredging.

An important aspect of managing the low-DO problem in the DWSC is the potential for obtaining funding from the US Congress to mitigate for the establishment and maintenance of the Deep Water Ship Channel to the Port of Stockton. While some efforts have been made to gain Congressional approval for funds that would enable the Corps of Engineers to perform the necessary mitigation measures, it is felt that an increased stakeholder effort specifically directed toward gaining Congressional support for this funding should be made. To the extent that funds can be obtained from Congress, the costs of controlling the low-DO problem through aeration, oxygen demand source control, etc., that will have to be distributed among stakeholders can be reduced. It is recommended that the efforts to gain funding from the US Congress for the Deep Water Ship Channel mitigation be for 100 percent of the impact – not just 20 percent.

Oxygen Demand Loads to the DWSC

The other important component of controlling the low-DO problem is control of oxygen demand loads to the DWSC. Gowdy and Grober's (2004b) proposed three-legged stool approach, where 20 percent of the responsibility is assigned to the control of oxygen demand

loads, in which the city of Stockton's domestic wastewater ammonia discharge is assigned 30 percent of this 20 percent, is not technically valid and is contrary to an appropriate approach to take in addressing this issue.

City of Stockton Wastewater Effluent Ammonia Discharges. As was clearly demonstrated in the Lee and Jones-Lee (2003) Synthesis Report, the responsibility of the city of Stockton's domestic wastewater ammonia discharges, versus the upstream algae as a source of oxygen demand is a function of flow of the SJR through the DWSC. Under low SJR DWSC flow conditions, the city of Stockton's wastewater ammonia discharges have represented as much as 90 percent of the oxygen demand load to the DWSC; however, under other conditions, when the wastewater effluent concentrations of ammonia are low and the SJR DWSC flow is high, the city of Stockton's contribution of oxygen demand has been less than about 20 percent.

For now, since the CVRWQCB has established a 2 mg/L monthly average allowable ammonia discharge by the City, based on ammonia's toxicity to aquatic life and low SJR DWSC flow, it is recommended that, if this value is achieved by the City, this value be accepted as the city of Stockton's fulfilling its responsibility for contributing to the solution of the low-DO problem in the DWSC. The evaluation of aeration needs should then be conducted, where it is assumed that the City will achieve 2 mg/L monthly average ammonia in its wastewater effluent. If assurances cannot be given by the City that it can and will achieve this level of ammonia control year-round, then the aeration needs should include Stockton ammonia discharge limits ranging up to 20 mg/L. Further, aeration needs for Stockton ammonia discharges of 5, 10 and 15 mg/L ammonia nitrogen should be evaluated at the range of SJR DWSC flows that were suggested above for evaluation (50, 500, 1,000 and 1,500 cfs).

HydroQual Modeling. The HydroQual modeling that is being conducted should immediately change its focus to developing a tuned model to the data for the SJR to relate discharges from Mud and Salt Sloughs to oxygen demand loads in the SJR at Mossdale, based on the 2000 dataset. This model then should be used without tuning to determine how well it matches the 2001 dataset. The results from this effort should be a new tuned model that considers both datasets, and it should then be determined how well this new tuned model predicts the 2002 and 2003 datasets. Based on this information, it will be possible to define the additional SJR DWSC watershed studies that should be done to improve the ability to relate oxygen demand loads from Mud and Salt Sloughs to the oxygen demand loads at Mossdale.

Control of Algal-Related Oxygen Demand. As indicated in previous reports, based on our having worked on nutrient control issues for over 40 years in a wide variety of situations, it is questionable whether a nutrient control program can be developed in the Mud and Salt Slough watersheds that would be effective in significantly impacting the oxygen demand loads to the DWSC. There is an urgent need for information on the cost to control various amounts of oxygen demand that originates in the Mud and Salt Slough watersheds.

Since these same watersheds must control their total salt discharges as part of the salt TMDL that is being developed, it is essential that the evaluation of the ability to control oxygen demand from the Mud and Salt Slough watersheds be conducted in light of the potential range of approaches that will be used by the stakeholders in these watersheds to control salts. However,

as discussed by Lee and Jones-Lee (2004b) and Lee et al. (2004), the current salt TMDL 700 µmhos/cm EC objective for the SJR at Vernalis will have to be lowered in order to protect South Delta agricultural interests, associated with tailwater discharges to South Delta channels causing violations of the EC objective. The evaluation of the changes in oxygen demand load from Mud and Salt Slough watersheds should consider the more restrictive EC objective that will have to be adopted in the SJR at Vernalis, since this will ultimately become the controlling factor in both salt and oxygen demand load discharges. The HydroQual modeling that is done must be directed toward developing the information that will be used to relate oxygen demand loads from Mud and Salt Sloughs to the SJR as influenced by salt control.

With respect to evaluating the potential for controlling the oxygen demand loads to the DWSC that are derived from algae that are produced in the SJR DWSC watershed, there is need to reprogram the funding that CBDA has made available for the upstream monitoring studies so that the funds are being used to provide the kinds of information needed to evaluate the technical and economic feasibility of controlling algal-related oxygen demand loads from the Mud and Salt Slough watersheds. The current upstream monitoring studies will not provide the information needed. In fact, a considerable part of the funding will provide little in the way of useful information in helping to formulate a program for control of the low-DO problem in the DWSC.

Lee and Jones-Lee (2003) have provided detailed guidance on the kinds of studies that need to be done in the headwaters of the Mud and Salt Slough watersheds to determine the cost of controlling the seed algae that ultimately lead to the high concentrations of algae discharged from Mud and Salt Sloughs, which in turn lead to the high algal concentrations and associated oxygen demand that reaches Mossdale. The Lee and Jones-Lee (2003) recommended studies should be initiated in the immediate future.

The studies proposed by Litton in the upstream monitoring proposal of the SJR between Mossdale and the DWSC should be conducted to help refine the understanding of the oxygen demand sources and transformations in this reach of the SJR. The currently supported isotope analysis work in the upstream monitoring studies should not be funded, since it will not provide useful information needed for control of the low-DO problem.

Organization of the Studies

The Gowdy and Grober (2004a,b) draft Basin Plan Amendment requires that the stakeholders for each of the "legs" of the "stool" develop, conduct and report on studies that develop information that could be used to manage their percent responsibility for the low-DO problem in the DWSC. This is not an appropriate approach to follow. There is need for strong oversight of all studies conducted during the Phase 1 TMDL, which are designed to develop information that can be used to finalize the TMDL. It will be important to appoint an advisory panel that will actively work with each of the investigators during the next several years of studies to ensure that appropriate study plans are developed and everything is progressing as it should during the course of the studies, to recommend changes in the program based on new information that is developed, and to critically review draft and final reports to ensure that they reliably present information derived from the studies. This advisory panel should be composed

of experts who understand the issues and are thoroughly familiar with the low-DO problem. The members of this panel should be funded for the time and effort that they devote to this activity.

Overall Assessment

If an aggressive program is initiated to develop the information discussed in this recommended approach, it will be possible in several years to formulate a technically valid, cost-effective and politically implementable SJR DWSC low-DO control program. Additional information on any of the issues discussed herein is available in various reports by Lee and Jones-Lee (see http://www.gfredlee.com/psjriv2.htm) and upon request.

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