DeltaKeeper

A PROJECT OF SAN FRANCISCO BAYKEEPER

5 November 2003

Dan Ray
California Bay-Delta Authority
650 Capitol Mall, 5th Floor
Sacramento, CA 95814

RE: Comments on CalFed Directed Action Proposal, Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen, Proposal No. 262DA

Dear Mr. Ray,

On behalf of DeltaKeeper, WaterKeepers Northern California, San Joaquin Audubon Society and the California Sportfishing Protection Alliance (hereinafter DeltaKeeper), thank you for this opportunity to comment on the CalFed Directed Action Proposal: Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen, Proposal No. 262DA (Proposed Project).

Unlike all other studies recommended for CalFed funding by the San Joaquin River Dissolved Oxygen Steering Committee, the Proposed Project was not "vetted" by the Technical Advisory Committee. When the Proposed Project was initially brought before the Steering Committee in January 2003, Drs. Chris Foe (Central Valley Regional Water Quality Control Board) and G. Fred Lee raised serious concerns regarding technical inadequacies and questioned whether the project would meet its stated goals and objectives. The Steering Committee's subsequent recommendation was conditioned on the belief that the Proposed Project would be revised to address the concerns of Drs. Foe and Lee and that their critical comments would be reviewed during the CalFed peer-review process. SJR DO TMDL Steering Committee Notes, 27 February 2003. This did not occur and the Proposed Project remains seriously flawed and should not be funded at this time.

Recently, DeltaKeeper asked Dr. G. Fred Lee to review the Proposed Project, in light of current conditions, and assess whether the previous inadequacies had been remedied. Dr. Lee's review is attached.

The proposed Project represents a sizable allocation of limited public resources. Funded projects must be technically valid, cost-effective and designed to develop solutions to real-world problems. DeltaKeeper believes that Proposed Project in its present format:

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1. is technically deficient,
2. failed to evaluate the existing monitoring database,
3. does not adequately consider the effects of flow,
4. is duplicative of other regulatory monitoring requirements,
5. fails to evaluate the San Joaquin River-Delta carbon budget,
6. does not address and prioritize controllable factors,
7. ignores headwater drains,
8. does not flexibly accommodate the changing dynamics of the Dissolved Oxygen TMDL, and
9. ignores pesticide impacts on zooplankton.

Accordingly, DeltaKeeper believes the Proposed Project is premature and should not be approved until it is revised.

If you have questions or require clarification, please contact me at 209-464-5090 or deltakeep@aol.com.

Sincerely,

Bill Jennings, DeltaKeeper

Cc: Dr. G. Fred Lee
Leo O'Brien, Esq., WaterKeeper Northern California
Jim Crenshaw, CSPA
Waldo Holt, San Joaquin Audubon
Mark Gowdy, CVRWQCB

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October 28, 2003

Via email: DeltaKeep@aol.com

William Jennings
DeltaKeeper

Subject: Review of "CALFED Directed Action Proposal: Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen," Proposal Number 262DA

Dear Bill:

In response to your request for a review of the appropriateness of CBDA supporting the funding of the "CALFED Directed Action Proposal: Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen," please find presented below my assessment of this proposal.

Based on my extensive experience in problems of this type, and on the current information pertinent to the development of a TMDL to control the low-DO problem in the SJR DWSC, I conclude that the proposal submitted by agricultural interests for Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen should not, at this time and under the current project proposal, be funded. Information on my qualifications to make this recommendation is provided in the attachment. Additional information is available on my website, www.gfredlee.com.

There are two aspects of conducting the review of the appropriateness of funding the upstream monitoring proposal that should be addressed. These include a review of the "bigger picture" issues of how well the anticipated results of the project will support the development of the final TMDL to control the low-DO problem in the DWSC. The comments presented below focus on this issue. The other major issue is the need for review of the deficiencies in the specific components of the proposed project. I cannot comment on these issues since there is need to develop the components of the final proposal that is to be submitted to the CBDA for review.

As you know, the review and development of this proposal did not follow the SJR DO TMDL Steering Committee approaches that have been used in the past. The SJR DO TMDL Technical Advisory Committee (TAC) development of the proposal was done without incorporating some TAC members' comments on the significant technical deficiencies in the draft proposal. In December 2002 I attended the first TAC meeting that was held at a time when I could attend. Following the meeting I immediately contacted the Chair of the SJR DO TMDL Steering

Committee (L. Ploss) and indicated that the proposed project had significant technical deficiencies that needed to be addressed in finalizing the proposal.

In January 2003, at the request of several stakeholders, a preliminary draft of the proposal was posted on the SJR DO TMDL website. Several individuals, including Dr. Chris Foe and myself, provided comments on the deficiencies in the draft proposal. Dr Foe and I had worked as a team over the past 3.5 years in helping to develop the project and especially in reviewing the project research. We both have extensive experience and expertise in the project areas. Our comments on the deficiencies in the proposal are posted on the SJR DO TMDL website, www.sjrtmdl.org. In late January 2003, the proposal that had the significant deficiencies was reviewed by the SJR DO TMDL Steering Committee. Based on the statements by W. Stringfellow (the primary proposal developer), that the deficiencies found by Dr. Foe and myself would be addressed in finalization of the proposal, the Steering Committee recommended support. However, the Steering Committee never saw the final proposal before it was submitted to CALFED.

Since a revised proposal was not made available by mid-February 2003, my comments on the draft proposal were included in the draft Synthesis Report that was made available to the SJR DO TMDL stakeholders (including the authors of the draft proposal) for review, with an invitation for comments. No comments on the draft Synthesis Report were received that indicated that my assessment of deficiencies in the proposal were inappropriate. When the final proposal was made available in March, it was found that the deficiencies that were found and reported on in early January were still in the proposal. When I discovered this, I included the comments on the deficiencies in the proposal that were presented to the stakeholders in the draft Synthesis Report, in the final Synthesis Report (Lee and Jones-Lee, 2003a). This report, with the comments on the deficiencies, is available from the www.sjrtmdl.org website.

As you may recall, when I tried to bring this material to the attention of the proposal peer reviewers selected by CALFED, CALFED staff told them not to consider my comments in their peer review. This approach is strongly contrary to a proper peer review of a research proposal. Based on the comments made at the recent SJR DO TMDL Steering Committee and Technical Advisory Committee meetings, the external peer reviewers reported on some of the same deficiencies that I had reported first in January 2003, then again in February 2003 in the draft Synthesis Report, and again in March 2003 in the final Synthesis Report.

As I understand the current situation, revisions of the proposal will have to be made before it can be submitted to CBDA for funding. I recommend that you request that the final proposal be brought back for an additional 30-day public review. When the revised proposal is made available, I will provide comments on any remaining deficiencies in the proposed project.

With respect to reviewing the "bigger picture" aspects of supporting this proposal, this proposal requests funds to continue subwatershed monitoring of oxygen demand loads. There are several reasons for not supporting the funding of this proposal. These include:

- The upstream monitoring loads from various subwatersheds and the transformations that occur in the SJR to the DWSC will likely change significantly by the time the SJR DO TMDL is formulated. The net result is that the data generated over the next couple of

years as a result of this upstream monitoring proposal will likely have little or no applicability to the development of the final SJR DO TMDL five years or so from now.

- There is a substantial database that has been collected on upstream subwatershed oxygen demand loads that has not been analyzed and presented in a final report for public review. It is technically invalid to continue monitoring of the SJR subwatersheds when the existing monitoring database has not been analyzed and reported on. All future monitoring should be based on an in-depth full public review of the existing database.

- Both Chris Foe and I have been critical of the upstream monitoring proposal, since it does not include gathering information that could be used to determine whether the agricultural nutrient discharges in the headwaters of Mud and Salt Sloughs that lead to the "seed" algae, which are the key to the algal related oxygen demand load entering the DWSC, are potentially controllable at the source. This information is an essential part of the formulation of the final TMDL for potentially controlling the algal associated oxygen demand load which leads to low DO in the DWSC. There are significant questions about whether it is possible to reduce nutrient loads to the headwaters of Mud and Salt Sloughs sufficiently to limit the algal biomass discharged by these sloughs to the SJR DWSC. This issue is much more important to formulating the final TMDL than further subwatershed assessments of oxygen demand loads.

- The proposed monitoring will be duplicative of some of the CVRWQCB requirements for agricultural waiver monitoring that is to be funded and conducted by the agricultural dischargers.

- From the information available at this time, it appears that it may be possible to control the low-DO problem in the DWSC through a combination of elevated SJR flow through the DWSC, control of the city of Stockton ammonia loads to the CVRWQCB NPDES-permitted limit of 2 mg/L N monthly average, and selective aeration.

- Studies conducted this summer with DeltaKeeper support have shown that increased flow of the SJR through the DWSC and the concomitant transfer of much of the algal related oxygen demand load from the SJR DWSC watershed into the Central Delta will not likely lead to low-DO problems in the Central Delta.

- The Delta, including the Central Delta, is recognized as being assimilable carbon deficient at the primary trophic level. This, in turn, transfers through the Delta food web to lower productivity of fish and other desirable forms of aquatic life. Introduction of assimilable carbon in the form of algal cells through Turner Cut and Columbia Cut, associated with increased SJR flow through the DWSC, would help the Central Delta food web and would be in the direction of overall increased Delta higher trophic level productivity.

In summary, there are substantial reasons for CALFED/CBDA to not allocate on the order of six million dollars for upstream monitoring of oxygen demand loads from the SJR subwatersheds.

Additional information on these issues is summarized below. Dr. Jones-Lee and I have prepared a detailed report on these issues (Lee and Jones-Lee, 2003b).

Discussion

Changes in the SJR Watershed

The primary purpose of the proposed SJR DWSC upstream monitoring program is to determine the loads of oxygen-demanding materials to the San Joaquin River that impact low DO in the Deep Water Ship Channel. These loads, in turn, would be used in allocation of responsibility as part of implementing the final SJR DO TMDL that will be developed in five years or so. However, the San Joaquin River watershed is subject to several other TMDLs which will likely cause agricultural interests in the San Joaquin River watershed to significantly change water management (flow) and chemical releases from their agricultural lands. The net result is that the past (and proposed project) monitoring results on oxygen demand loads and their characteristics will not likely be applicable to the conditions five years from now when the SJR DO TMDL will be formulated into a control program, with the result that the past and proposed monitoring will be of little value in addressing nutrient/algal control programs in the SJR watershed.

The Mud and Salt Slough watersheds, which have been identified based on C. Foe and my analysis of the first two years of monitoring data (2000-2001) developed by Dahlgren and Kratzer, are subject to TMDLs for the control of salt, boron, pesticides, selenium and unknown-caused toxicity. With respect to pesticides, salt, boron and selenium, the respective TMDLs are being developed now and will likely cause significant changes in the releases of constituents which become oxygen-demanding materials in the SJR. These changes, according to Joe McGahan, can include the complete termination of discharges from agricultural lands in the Grassland area during the summer and possibly at other times. This, in turn, could lead to significant changes in nutrients that lead to "seed" algae growth in the Mud and Salt Slough watersheds, and therefore the algal oxygen demand loads to the SJR DWSC.

Potential Impacts of Pesticides. Another example of an issue that needs to be considered in evaluating oxygen demand loads from the SJR DWSC watershed is the potential for pesticides currently discharged by agricultural activities to affect algae and/or zooplankton in the SJR tributaries and mainstem. TMDLs are well advanced to control diazinon and chlorpyrifos in the Mud and Salt Slough and other San Joaquin River watersheds. These pesticides are known to be highly toxic to certain forms of zooplankton. Previous peer reviewers (Jassby), as well as Lee and Jones-Lee (2003a) and Jassby, et al. (2003) have discussed the potential for pesticides to affect algal related oxygen demand loads to the DWSC. The upstream monitoring proposal does not include attention to this issue. Since the pesticides present in the agricultural discharges in the SJR watershed will be changing as the result of TMDL implementation, results obtained over the next couple of years from further monitoring studies may have little or no applicability to the situation that will occur in the future.

Failure to Analyze Existing Data

There have already been four years of SJR mainstem and tributary monitoring conducted by R. Dahlgren of the University of California, Davis. While R. Dahlgren made available part of his first two years of monitoring results to the CVRWQCB (Dr. Chris Foe), Dahlgren has not

developed a report on his four years of monitoring data. While Dahlgren had no obligation to make his data available and provide reports in connection with his studies since they were not supported by CALFED, he is now requesting funding from CALFED/CBDA to continue these studies. Before funding is made available, he should provide a comprehensive report on the past four years of studies.

Further, during 2000-2001, there was a coordinated monitoring effort between R. Dahlgren and the USGS staff (Kratzer) on the SJR watershed mainstem and tributaries. The USGS-Kratzer studies were supported by CALFED. It is now two years since the last of the data were collected in that CALFED-supported project, and C. Kratzer has yet to develop a report on the 2000 as well as the 2001 studies. Before any further monitoring of the mainstem and tributaries to the SJR is conducted, the Dahlgren and Kratzer data should be analyzed and presented in a comprehensive public report that can be reviewed as part of planning future monitoring. It is technically invalid to continue to fund monitoring programs on the SJR and its watershed without doing an in-depth critical review of the existing database.

Lack of Headwater Studies

A component of the upstream monitoring that the agricultural interests have not included (even though it was recommended by C. Foe and myself) is conducting studies in the headwaters of Mud and Salt Sloughs to define whether it is potentially possible to control nutrients to subsurface drains which lead to the development of "seed" algae that ultimately develop to a substantial algal related oxygen demand biomass in the Mud and Salt Slough discharges to the SJR. This is an important topic that should be immediately investigated if the results are to be part of the final TMDL for control of the low-DO problem in the SJR DWSC.

Coordination with the CVRWQCB Agricultural Waiver Monitoring

Since this proposal was first developed about a year ago, the CVRWQCB has finalized the agricultural waiver monitoring requirements. The agricultural waiver monitoring is to be funded by the agricultural dischargers. Some of the monitoring that is proposed to be done under this proposed project is similar to or the same as that required by the agricultural waiver monitoring. This proposal should be coordinated with the agricultural waiver monitoring, and thereby minimize the cost to CBDA for this monitoring program.

Alternative Approaches for Controlling Low-DO Problem

Another reason not to support the proposed project is that there is increasing evidence that there is a potential for solving much of the low-DO problem in the SJR DWSC by operations of the permanent barriers in the South Delta, especially the Head of Old River barrier, so that most of the SJR at Vernalis flow is allowed to pass through the DWSC before being drawn to the State and Federal Project export pumps in the southern Delta. This approach will require reverse flow low-head pumping of western South Delta water across the permanent barriers into the South Delta. As it stands now, based on the work that has been done by Dr. Jones-Lee and myself, as first reported in the Issues report (Lee and Jones-Lee, 2000), and then significantly expanded in the Synthesis Report (Lee and Jones-Lee, 2003a), as well as in supplemental information that has been developed over the past summer (Lee, 2003a; Lee and Jones-Lee, 2003c), the low-DO problem in the SJR DWSC can be essentially solved by a combination of elevated flow of the SJR Vernalis water through the DWSC, with supplemental aeration and the city of Stockton

controlling its wastewater ammonia discharges to the CVRWQCB's NPDES limit of 2 mg/L ammonia nitrogen as a monthly average. As discussed by Lee and Jones-Lee (2000, 2003a) and several of the peer reviewers of the previous studies, there are significant questions as to whether it will ever be economically possible to control nutrients discharged by agricultural sources in the Mud and Salt Slough watersheds to significantly affect the algal loads of oxygen demand discharged by the SJR to the DWSC.

While it might be possible to control, to a limited extent, algal development in Mud and Salt Slough watersheds and thereby reduce the amount of algal associated oxygen demand that reaches the DWSC, with increased SJR DWSC flow, substantial algal oxygen demand will be discharged into the Central Delta via Turner Cut and Columbia Cut. This occurs naturally in some years, such as 1998 and 2000. During these years, high algal oxygen demand was discharged to the DWSC from the SJR watershed; however, there were few DO water quality objective violations. The residence time of this algal oxygen demand in the DWSC was sufficiently short so that it was transported into the Central Delta through Turner Cut and Columbia Cut.

Over the past summer, with DeltaKeeper support, we have made a number of sampling runs through the Central Delta to examine whether low-DO situations are occurring in Turner Cut, Columbia Cut and the side channels, such as Whiskey Slough. It has been found that, under the conditions of the studies (which approached near-worst-case conditions in the September run), there are no low-DO problems in the Central Delta related to the substantial algal oxygen demand load that enters Turner Cut and Columbia Cut from the DWSC.

Algal Available Carbon Deficiency in the Central Delta

An issue that is emerging as important in managing Delta aquatic resources is the deficiency in available organic carbon to support the Delta aquatic food web. Jassby and Cloern (2000), Jassby, et al. (2002), Jassby, et al. (2003), Müller-Solger, et al. (2002), Sobczak, et al. (2002) and Jassby (pers. comm., 2003) have presented a series of papers on the importance of algal TOC added to the Delta as a component of the Delta aquatic food web. As a result of their work, a different approach to managing the low-DO problem in the DWSC has evolved, where rather than trying to limit algal TOC entering the Delta through upstream nutrient/algal control (which may not be technically and economically feasible), it may be better for the Delta to allow the algae that are present in the SJR as it enters the DWSC to be a source of available carbon to support the aquatic food web in the Central Delta.

Therefore, rather than focusing on trying to limit algal growth in Mud and Salt Sloughs or any of the other tributaries, as well as in the mainstem of the SJR, as part of trying to limit oxygen demand load to the DWSC, it would be far better to allow the currently undefinable loads that will occur in the future after the other TMDLs are implemented, under conditions where there is an elevated SJR DWSC flow through control of the Head of Old River barrier, supplemental pumping across the permanent barriers into the South Delta and control of the city of Stockton wastewater ammonia loads. The short residence time of the algal oxygen demand loads that enter the DWSC under elevated SJR DWSC flow will transfer most of the algal oxygen demand loads to the Central Delta where they will not cause an oxygen demand problem and will serve as a source of assimilable carbon to the aquatic food web. Any remaining oxygen depletion

problems in the DWSC will be controlled through aeration. The SJR upstream dischargers would still be held responsible for helping to pay for aeration to eliminate DO WQO violations that occur that are not eliminated by the elevated flows of the SJR through the DWSC and the control of the city of Stockton ammonia loads.

HydroQual Modeling

With respect to the modeling of the SJR DWSC, it is my understanding (from CALFED/CBDA staff) that the HydroQual project, which has been hung up for a considerable period of time because of contracting difficulties, will be funded. It is suggested that HydroQual proceed with tuning the SJR oxygen demand transport and transformations modeling based on the four years of existing monitoring data. Once the modeling has been done as far as it can be done based on the existing database, the modeling effort can provide guidance as to what, if any, additional monitoring is needed. Once the model is tuned to the existing database, through sensitivity analysis, it will be possible to define the areas where there may be need for additional data, should it prove necessary to try to reduce the oxygen demand loads to the DWSC from the SJR watershed. Monitoring should not proceed, however, until such time as there has been a thorough analysis of the existing database, and the deficiencies in this database are understood.

Overall Assessment

Developing an upstream monitoring program several years from now that specifically focuses on the conditions that will exist at that time after the existing database has been analyzed and the preliminary modeling is done, and there is an understanding of how the current TMDLs in the SJR watershed will be implemented, is the technically valid, cost-effective approach for developing the upstream monitoring studies. Basically, my recommendation is to not fund the proposal as currently formulated, but postpone any upstream monitoring until the other factors that will influence the DO TMDL implementation are better understood. At that time, CBDA funds can be more appropriately focused on obtaining the data that are needed to fill any information gaps that exist in formulating the final TMDL to solve the low-DO problem in the DWSC.

It is important to note that the primary issues raised above were not reviewed by the CALFED-selected peer review panel for the proposed project. It is doubtful that many of the peer reviewers are even aware of these issues since, while these issues were well known at the time the proposal was developed, they were not discussed in the proposal as a potentially significant limitation on the utility of the results obtained from the proposed studies.

If you or others have questions about these comments, please contact me.

G. Fred Lee, PhD, DEE

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Appendix A
Qualifications to Undertake this Review

G. Fred Lee's qualifications to undertake this review include obtaining a PhD at Harvard University in environmental engineering and environmental sciences in 1960, 30 years of university graduate-level teaching and research at several major US universities, during which time he conducted in excess of $5 million of research and published over 500 papers and reports on these activities. His work on issues of the type that occur in the SJR DWSC low-DO problem began in 1960, while he held the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison. He was involved in some of the pioneering research on investigating excessive fertilization of waterbodies, focusing of the causes and their control.

In the 1970s he was awarded the US EPA contract for the OECD eutrophication studies, which involved examining the data from about 100 US waterbodies on their nutrient load eutrophication response relationships. He was also part of the steering committee for the $50-million, five-year international OECD studies, which involved 22 countries in western Europe, North America, Japan and Australia, investigating about 200 waterbodies' nutrient load eutrophication response relationships. Dr. Anne Jones-Lee (his wife) and he have been involved since the late 1970s in cooperative studies throughout the world on excessive fertilization problems, including serving as advisors to various agencies and entities in the US, Canada, Norway, Spain, the Netherlands, France, Italy, the USSR, Argentina, Puerto Rico, the Dominican Republic, Mexico, Israel, Jordan, Tunisia, India, Japan and South Africa. Drs. Lee and Jones-Lee have published extensively on their work. Their recent papers and reports are available from their website, www.gfredlee.com, in the Excessive Fertilization section. Over his 43-year career Dr. Lee has frequently been invited to present lectures on excessive fertilization issues at international, national, state and local professional society groups.

In 1989 Dr. G. F. Lee retired, after 30 years of university graduate-level teaching and research, to expand his part-time consulting activities into a full-time activity. Dr. Jones-Lee (who was also a university professor) and he moved from New Jersey to El Macero (adjacent to Davis), California, as part of providing consulting services to a client concerned with Delta water quality issues. They have been involved in Delta water quality issues since that time, and have published a number of papers and reports on this work, which are on their website in the San Joaquin River Watershed, Domestic Water Supply and Excessive Fertilization sections.

Drs. Lee and Jones-Lee have been involved in the SJR DWSC low-DO problem since the summer of 1999, first as interested parties, contributing unsponsored technical support to the SJR DO TMDL Steering Committee. DeltaKeeper, through litigation settlement, in which Drs. Lee and Jones-Lee were not involved, provided funds so that they could continue to be active as advisors to the Steering Committee. One of their first tasks was to develop an "Issues" report (Lee and Jones-Lee, 2000) on the technical issues that would need to be addressed as part of conducting studies on the SJR DO TMDL problem. This effort was supported by the Central Valley Regional Water Quality Control Board.

The Steering Committee requested that Drs. Lee and Jones-Lee develop the SJR DO TMDL CALFED Directed Action proposal when the proposal that was originally submitted by the SJR DO TMDL Technical Advisory Committee was found to be technically deficient. Dr. Lee served as the coordinating PI for the $2-million Directed Action project. Further, Drs. Lee and Jones-Lee developed a 280-page Synthesis Report (Lee and Jones-Lee, 2003a) of the almost $4 million in studies conducted over four years. In addition, during the summer 2003, with DeltaKeeper boat, skipper and staff support, Dr. Lee conducted a number of cruises on the Central and Southern Delta to better define water quality issues as they may be impacted by various approaches for managing the low-DO problem in the DWSC.

NATURAL RESOURCES DEFENSE COUNCIL

CENTRAL DELTA WATER AGENCY

November 7, 2003

Mr. Dan Ray
Grants Officer
California Bay-Delta Authority
650 Capital Mall, 5th Floor
Sacramento, CA 95814

Re: Review of "CALFED Directed Action Proposal: Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen," Proposal Number 262DA.

Dear Mr. Ray:

The long standing dissolved oxygen problem related to the Stockton Deep Water Ship Channel is one of the most significant water quality and environmental problems in the Central Valley. This study proposal has the potential to be an important step forward in addressing this problem; however, the current proposal has a glaring -- indeed fatal -- flaw: it fails to investigate the role of flows (or lack thereof) in the river, despite the obvious importance of this factor. The drying-up of the mainstem San Joaquin River particularly in summer and fall months caused by the Bureau of Reclamation's operation of Friant Dam is a major cause of the D.O. problem. Restoration of flows in the river, including flows into the Ship Channel to reduce the residence time of water in the Ship Channel from Stockton to Turner Cut, is an essential part of the solution.

According to the proposal, the four major contributing factors include the deepening of the ship channel, increased ammonia discharges from the Stockton Waste Water Treatment Plant, transport of oxygen consuming materials from the Upper San Joaquin River and production of oxygen consuming matter in the channel. The proposal goes on to state the obvious: that each of these factors is flow dependent. As such, the inclusion of the current and future potential San Joaquin River flows is absolutely essential to creating a technically sound study which truly addresses the problems and provides a basis for a long term solution.

The overall goal of this proposed study is to focus on the areas of greatest uncertainty and to better quantify the proportional contribution of each factor in creating the DO problem. Failure to include San Joaquin River flows as a significant contributing factor will unfairly place the burden of mitigation on others in order to meet the final DO TMDL, resulting in future conflicts and, ultimately, failure to solve the problem. It is our recommendation that this proposal be required to address the flow-related impacts or deferred until the need for restoration of flow is clearly defined.

Sincerely,

Jared Huffman, Senior Attorney
Natural Resources Defense Council

Dante John Nomellini, Manager and Co-Counsel
Central Delta Water Agency

Comments on G. F. Lee letter to DeltaKeeper, 20 October 2003

Alan Jassby

November 14, 2003

These remarks are in response to a request by the CBDA to comment on Dr. Lee's letter. They are not meant to support or oppose any particular solution to the DWSC DO problem, or the proposal in question, but rather to provide additional information and perspective on some of the issues raised in the letter.

Algal Availability in the Central Delta

On a Delta-wide average basis, algal (mostly phytoplankton) production is low compared to many other estuaries. The main known reasons for low production in the Delta are high turbidity due to mineral suspensoids and, since 1986, grazing pressure exerted by the invasive clam *Potamocorbula amurensis*. The latter is located primarily in Suisun Bay but appears to affect the western Delta through tidal mixing. Although the long-term trend in production and biomass for 1975-1995 (the longest period for which continuous Delta-wide data were available) was downward, primarily due to the clam, there is much interannual variability and so we cannot say that there is currently any ongoing trend in either direction. A non-technical summary of this and related work can be found in the current issue of *California Agriculture.*[1]

Based on the work of Scott Nixon and many others (including Dr. Lee), we know that low primary production usually implies low fish production. It is also fair to say that the long-term, two-fold decrease in primary production between the 1970s and the 1990s probably affected fish populations. Based on cross-system data from many water bodies, one would expect about a corresponding two-fold decrease in fish production. Because of the difficulty of estimating fish populations and the presence of other factors, however, a two-fold change is often not readily detectable. A recent study by Wim Kimmerer showed that, of eight shrimp and fish species examined, only two (starry flounder and longfin smelt) reflected the effects of the *Potamocorbula* invasion and resulting lower phytoplankton biomass. Nonetheless, although many other factors may well be involved and direct evidence from the Delta is limited, the cross-system data and Wim's study suggest that primary production in the Delta is limiting population biomass for at least some fish species.

So the question naturally arises: should we encourage primary production in the Delta and refrain from actions that might limit it? More specifically, will higher flow rates in the San Joaquin River transport needed phytoplankton

[1] `http://californiaagriculture.ucop.edu/0304OND/pdfs/Delta_Phytoplankton.pdf`

from the San Joaquin River upstream of the DWSC—where phytoplankton are relatively plentiful—into the central Delta? I believe that higher flow rates will not ensure a greater phytoplankton supply downstream. The main reason is that phytoplankton biomass in the San Joaquin River is controlled largely by flow.[2] Because biomass goes down (nonlinearly) as flow goes up, the mass transport (*load*) of phytoplankton, which is essentially the product of the two, cannot be predicted *a priori*. In fact, I just re-examined the historical data through 2002 and it turns out that the phytoplankton load moving downstream in the San Joaquin River shows no relationship with discharge below 10,000 cfs (discharge rates of 1500–2000 cfs are necessary to ensure that no DO depletion below the water quality objective occurs in the DWSC). Perhaps even more important to inhabitants of the central Delta's flowing water systems, phytoplankton biomass and production (as opposed to phytoplankton load) will probably decrease as San Joaquin River flows increase. The San Joaquin River carries other forms of organic matter besides phytoplankton and these may very well be carried through to the central Delta more efficiently by higher flows. However, Anke Müller-Solger's recent feeding bioassays suggest that phytoplankton in particular, and not organic matter in general, is required to boost zooplankton growth rates in the Delta.[3] Note that higher flows have many effects, including beneficial ones, and my claim is only that neither phytoplankton loading nor biomass nor production in the central Delta will go up as a result of increased flows.

Mud and Salt Sloughs

Mud and Salt sloughs have been identified as potential sources of *seed* algae for phytoplankton populations in the San Joaquin River. From a theoretical point of view, the size of the seed population is fundamental in determining the load of phytoplankton biomass to the DWSC. Any reduction in seed size should result in a comparable reduction in load. Based on the work of Colin Reynolds and others, however, we know that river phytoplankton populations are seeded by multiple sources, especially from quiescent areas where—because of bed morphometry or vegetation—phytoplankton cells experience a longer residence time and have the chance to build up their populations before being swept out into the mainstream. I also pointed out in last year's peer review of this program that the Mud Slough load constituted only about 25% of the "potential" load at Maze and the Salt Slough load may be largely nonalgal. So there is reason on both counts to question the importance of these sloughs as seed sources, although I have not examined the data in detail and perhaps there

[2] Jassby, A. D., and T. M. Powell. 1994. Hydrodynamic influences on interannual chlorophyll variability in an estuary: Upper San Francisco Bay-Delta (California, USA). *Estuarine Coastal and Shelf Science* 39:595-618.

[3] Müller-Solger, A. B., A. D. Jassby, and D. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (Daphnia) in a tidal freshwater system (Sacramento-San Joaquin River Delta, USA). *Limnology and Oceanography* 47:1468-1476.

is more known at this point about the potential role of these sloughs. In any case, the point to be made is that, if one or a few seed sources were dominant, then control of phytoplankton proliferation at these sites would be an efficient way to limit the phytoplankton load into the DWSC. If there is strong evidence that these sloughs are serving as seed sources, then I agree with Dr. Lee that they need immediate attention. The simplest way to determine if the slough populations are actually seeding downstream populations is to compare phytoplankton species composition in the sloughs (or other suspected sites) with those in the San Joaquin River. Similarity in dominant phytoplankton species is a necessary (but not sufficient) condition for establishing a link between a potential seed source and downstream communities. This limited examination of the issue could be done with relatively little expense.

Nutrient Control

Dr. Lee's letter also questions the efficacy of nutrient control as a means to limit phytoplankton loading into the DWSC, an opinion with which I concur. Note that nutrient control to limit a source of seed algae (above) is a separate issue and is feasible in principle. Here we are focusing on nutrient control to limit the multiplication and proliferation of this seed as it moves downstream. Based on data at Vernalis, phytoplankton populations are rarely limited by nitrogen or phosphorus availability (and never by silica). The only years in which nutrient limitation may have occurred were 1977 and 1992, when phytoplankton biomass exceeded 300 μg/L chlorophyll *a*, a huge value. Whether or not a given percent reduction in nutrient loading would have any impact depends on river discharge, which affects both nutrient concentrations and the time available for phytoplankton communities to grow on these nutrients. I estimate that any reduction could induce limitation during the driest years when mean monthly discharge < 500 cfs at the time of peak biomass. A 10-fold reduction could induce some limitation during 18 of 33 years in the case of N, and 24 of 33 years in the case of P. Nutrient control therefore has beneficial effects, but realistic levels of nutrient reduction will probably leave peak phytoplankton levels unchanged in many years. Moreover, this informs us only of the minimum reduction required to induce limitation: it does not tell us how much reduction is necessary to limit phytoplankton biomass to acceptable levels. Ironically, higher river discharge renders nutrient control even less effective because nutrient limitation eases as discharge increases. This occurs because phytoplankton biomass decreases faster than total nutrient concentrations as discharge increases, at least up to about 3000 cfs.[4]

Does this mean that nutrient control has no benefits? I believe that nutrient control is warranted, even though it may not provide an immediate solution

[4]I hope to publish a review soon of these and related phytoplankton issues using the San Joaquin River historical database.

for low DO in the DWSC. Excessive nutrients from agricultural drainage or animal wastewater have promoted huge and harmful phytoplankton blooms in many locations around the world. This is not a major problem in the Delta currently because of high concentrations of suspended sediments and accompanying turbidity. By decreasing transparency and limiting the penetration of sunlight, turbidity slows phytoplankton photosynthesis. However, suspended sediment in the Delta has been decreasing and transparency increasing for decades. There are several possible explanations, including the trapping of sediment behind dams; depletion of channel and floodplain deposits of mining-derived sediments; bank stabilization; and changes in the depositional nature of the lower Sacramento floodplain.[5] The relative importance of these mechanisms is not known precisely but, in any case, given the excess of nutrients in the Delta, decreasing turbidity means that large phytoplankton blooms may become a more common phenomenon.[6] If such nuisance or harmful blooms become common, control of nitrogen and phosphorus inputs from agricultural drainage will become a much more important issue.

Even in the absence of further transparency increases, we may now be experiencing some of the drawbacks of high nutrient concentrations and a harbinger of problems to come. The cyanobacterium ("blue-green alga") *Microcystis aeruginosa* has become much more common in the Delta since blooms started appearing in 1999.[7] Colonies float near the surface where they suffer less light limitation than many other species. They are not as edible or nutritious as diatoms and flagellates, and so they do not contribute efficiently to the metazoan food web. They also produce a liver toxin, microcystin-LR, and are therefore a threat to our water supplies. When such species are involved, any reduction of biomass is welcome, even if it does not solve the DWSC problem.

I welcome any comments or further information on the views expressed above: `adjassby@ucdavis.edu`

[5] Wright, S. A., and D. H. Schoellhamer. In press. Trends in the sediment yield of the Sacramento River, California, 1957–2001. *SF Estuary Watershed Sci.*

[6] Jassby, A. D., J. E. Cloern, and B. E. Cole. 2002. Annual primary production: patterns and mechanisms of change in a nutrient-rich tidal ecosystem. *Limnology and Oceanography* 47:698-712.

[7] Lehman, P. W., and S. Waller. 2003. Microcystis blooms in the Delta. *IEP Newsletter* 16:18-19.