San Joaquin River Dissolved Oxygenation Total Maximum Daily Load Technical Working Group Meeting

April 21, 2005

Meeting Notes

Meeting Attendance

Name	Organization
Russ Brown	Jones & Stokes
Byron Buck	San Joaquin River Water Quality Management Group
Mike Christenson	California Department of Water Resources
Sergio Escobar	California Department of Water Resources
Mark Gowdy	Central Valley Regional Water Quality Control Board
Russ Grimes	Jones & Stokes
John Hains	USACE Trotter's Shoals Limnological Research Facility
John Headlee	U.S. Army Corps of Engineers
John Henderson	U.S. Fish and Wildlife Service
Jennifer Heyd	Central Valley Regional Water Quality Control Board
Corey Hiraisuka	California Department of Water Resources
Claire Hsu	Bureau of Reclamation
W.R. Johnston	Modesto Irrigation District
Gene Lee	Bureau of Reclamation
Matt Parker	California Department of Water Resources
Lowell Ploss	San Joaquin River Group Authority
Hari Rajbhandari	California Department of Water Resources
Craig Stevens	Jones & Stokes
Will Stringfellow	Lawrence Berkeley National Lab
Tom Trexler	Jones & Stokes
Jim Wilde	California Department of Water Resources

Welcome and Introductions/Purpose of the Meeting

Danielle Wilson, Jones & Stokes, facilitated the meeting. The meeting began with announcements and a review of the agenda. Aside from the regular SJR DO TMDL Technical Working Group–related updates, the purpose of this meeting was to provide an opportunity for a special presentation, by Dr. John Hains, on the Richard B. Russell Lake Oxygenation System.

Updates

San Joaquin River Water Quality Management Group (SJRWQMG) Plan

Byron Buck, SJRWQMG, provided background on the purpose and goals of the SJRWQMG. B. Buck discussed the Group's current efforts and the current focus on the Vernalis and

Brandt Bridge objectives. B. Buck shared that the SJRWQMG's efforts for the last year have been on selecting a preferred alternative for these projects and how this alternative might differ or interact with the California Department of Water Resource's (DWR's) barrier project. He further explained that the SJRWQMG is currently evaluating the DWR barrier project's impacts on setting the benchmark for some of the State's flow levels. SJRWQMG is comparing these runs for purposes of making future adjustments at Vernalis and Brandt Bridge. SJRWQMG is confident that their preferred alternative can meet the Vernalis and Brandt Bridge objectives further downstream with minimal recirculation. The modeling phase of these efforts is expected to occur during the next couple of weeks. Additionally, B. Buck indicated that a meeting of the SJRWQMG would be held next month to discuss the results of these efforts and a subsequent memorandum of understanding (MOU) among the participating agencies, for purposes of managing these projects and moving forward toward the next phase.

Central Valley Regional Water Quality Control Board Action on DO
Mark Gowdy, on behalf of the CVRWQCB, provided an update on the CVRWQCB's actions on dissolved oxygen. M. Gowdy indicated that the State Water Resources Control Board (State Water Board) is having a workshop on May 3, 2005, to receive input on the DO TMDL and will consider adoption later in May. In the meantime, CVRWQCB staff is providing support to the State Water Board and participating with groups to facilitate progress in the study.

Upstream Studies Contract
Will Stringfellow, Lawrence Berkeley National Lab, provided an update on the efforts related to the Upstream Studies contracts. W. Stringfellow indicated that the sampling of core sites had been completed in March, and, to date, the modeling team had held two organizational meetings. W. Stringfellow shared that the objective of this effort is to work cohesively as a unit, and the larger organizational objective is to create an adaptive management plan to respond to information resulting from these efforts. W. Stringfellow also indicated that an internal committee had been developed to organize changes within the structure of how the team operates.

Demonstration Project
Steve Seville, Jones & Stokes, provided an update on the Demonstration Project. S. Seville indicated that the design is nearly complete, with final review forthcoming. Additionally, S. Seville highlighted some of the difficulties the project was facing, such as a small space at its current location, as well as working with other stakeholders.

Richard B. Russell Lake Oxygenation System Presentation by John Hains, Ph.D.

Background
The Richard B. Russell Lake Oxygenation System is the largest hydrology facility west of the Mississippi. The system resides on the Savannah River near Calhoun Falls, South Carolina.

Since 1985, pure oxygen has been used and distributed in the reservoir to meet water quality requirements in the hydropower releases. Through an agreement with the states of South Carolina and Georgia, the U.S. Army Corps of Engineers (USACE) agreed that releases would contain a minimum of 6 milligrams per liter (mg/l) of dissolved oxygen. The project uses up to

$1 million worth of oxygen each year (approximately $60–$100 per ton), to maintain dissolved oxygen levels.

The initial oxygen diffuser system included diffuser lines immediately upstream of the dam to operate with turbine use, and 2,000 feet of diffuser lines approximately one mile further upstream of the dam to operate continuously. All of these diffusers were originally equipped with ceramic diffuser heads that required chemical cleaning and frequent maintenance. Over the years, the use of the diffusers immediately upstream of the dam was discontinued, and about one half of the ceramic diffuser heads on the continuous diffuser were replaced with membrane diffusers to reduce clogging. Even with these system revisions, leaks and uneven oxygen distribution continued to be a problem. In 1999, a decision was made to significantly alter the system.

A newly designed line diffuser system was installed in 2001. The newly designed porous hose line diffuser consisted of ten 4,000-feet lines, extending along the river channel upstream of the Richard B. Russell Dam. Through the new system, oxygen is distributed throughout each line during operation and spread evenly over a larger area of the facility. Specifically, the new design:

- obtains high oxygen transfer efficiencies through an even distribution of oxygen bubbles;
- uses separate lines to spread oxygen input further upstream of the dam;
- locates lines at specific elevations above the reservoir bottom;
- ensures that oxygen outflow is distributed along the length of the lines and controlled with engineered orifice sizes; and
- is much less expensive to operate, repair, and maintain.

In addition, a monitoring system is used to provide control and monitoring functions as the diffuser operations are adjusted to match turbine operation, total water flow, and seasonal oxygen demands in the reservoir. The oxygen system has operated successfully since 2002.

Prior to the question and answer period, Dr. Hains implored that unless the SJR DO TMDL Technical Working Group has an equivalent hydropower facility, one would not be able to transport the results found at the Richard B. Russell Dam to a project requiring an aeration device.

Dr. Hains' presentation is available through the SJR DO TMDL TWG Web site at: <http://www.sjrdotmdl.org/>.

Question and Answers
The question and answer section is a culmination of questions addressed to Dr. Haines that occurred during and after the presentation.

What is the sampling scheme of this stage of the project?
The first sampling was initiated in 1983, which consisted of in and out flow and tributary sampling. There were 20 sampling locations throughout the 25,000-acre lake. The frequency of sampling during this period occurred monthly; however, during stratified seasons sampling was done weekly.

How has the system performed?
There were some initial issues with the hardware, which manifested huge boils of oxygen rising to the surface rather than small bubbles. 100 tons of oxygen was used per day. Operation technicians had to be very careful with how they would ramp up/down the system. Because of the inefficiencies, only 20 percent of the oxygen was actually going into the lake. In 1985, oxygen costs were $1.2 million. The major problem with this system was the ceramic diffuser heads.

Are there any temperature impacts related to operation of the diffuser?
Dr. Hains discussed temperature impacts related to the diffuser. He indicated that if the system is operating to specification, there is no impact to lake temperature and habitat. In fact, Dr. Hains indicated that there was interest in creating a fish hatchery once the project was underway.

Is there any concern regarding a super-saturation of oxygen relative to fish habitat?
Related to fish habitat, Dr. Hains indicated out that there is no documentation of fish mortality related to an overabundance or saturation of oxygen—that is why oxygen was utilized instead of air. Dr. Hains further stated that these types of issues and questions were addressed many years ago and the project team deemed they were not of consequence.

Were measurements taken at all depths?
Yes, measurements were taken at all depths up until the point of injection.

Did the oxygen stay at the point of delivery or did it travel?
We know that oxygen did move substantially, but we did not track it to great specificity to determine how far. However, we believe that the oxygen was distributed evenly. It moved substantially, but not specifically.

Was the lake elevation constant during each of those years?
Yes, the maximum draw down level for the lake is five feet.

Was there a trigger mechanism instituted for shutting the system off?
It was based on weather patterns, which helped us anticipate when to turn off the system. Models were also used, but sporadically. Atmospheric air was being used.

Why start in May since problems occur later in the fall?
It depends on the season. The start-up date is precipitated on when the lake begins to stratify. Last year, for instance, the start-up was initiated in early summer. A normal year start-up occurs in May. One concern of not starting on time is that you can potentially miss the target summer season.

At what point in the lake are the plots taken?
Most plots are registered right at the wall of the damn—the deepest point.

What are the oxygen conditions at the upstream reservoir?
Very poor.

How was this project funded and what was the purpose of the lake?
The project was funded using operation and maintenance money through local resource management funds. The purposes for creating the lake are many, most of which are political.

What is the pumping generating cycle?
Assuming commercial operation, there really is no cycle. Also, there is no pumping in April to retain fish habitat and no need for pump storage. Pumping occurs for up to eight hours every night and only utilizes four of the eight turbans. The limitations are power and pump level.

How would you characterize the algae?
It's just not there. There are abundant solar resources, but not enough nutrients to support it.

What is the bubble diameter?
It ranges between one and two milliliters.

Have you considered tracking oxygen?
It is possible to track oxygen and Steve Wilhelm from Coastal Hydrology has significant information pertaining to this question.

Is there a concern regarding free radical oxygen? How would they be manifested?
Dr. Haines indicated that he was unaware of any concerns on this issue. He further stated that the Richard B. Russell Lake facility is the world's largest oxygenation system that utilizes 100 tons of oxygen per day in contrast to the five tons per day projected to be used by the Stockton Deep Water Ship Channel facility. The issue of how free radicals impact habitat has not been raised during his 20 years of work on this and related efforts.

What was the cost?
During the period of time we have discussed, the average cost for oxygen was $400,000 to $600,000 for one year, which equates to $60–$100 per ton. This coming year it will double due to increased transportation costs translated through an increase in the per ton price of oxygen and fuel.

Why are the hoses parallel to the flow?
It appeared that there was some lateral effect because different turbans were releasing different concentrations. To eliminate that, one of ten lines was moved downstream and it curled across the channel, which made the release more predictable and consistent.

What were the damages to the system from boats? Any fish habitat effects?
Damages were primarily related to hooking and anchoring problems from boats, as well as fish habitat effects, including fish mortality. As such, fishing was prohibited in particular areas.

What is the life expectancy of the hose?
It's too early to tell at this point—it's anticipated to last a fairly long time.

Has there been a substantial impact on habitat.
Yes, it appears to have substantially increased habitat in the immediate areas of the hose.

Was sediment oxygen demand done?
It was done for the model, but not done frequently. W2 information can be obtained through Scott Wells at Portland State University.

Do you have a constant oxygen pump main?
Yes.

What kind of environmental documentation was used?
The entire NEPA process was implemented for the damn project. This system was a mitigation effort for that project. The J. Strong Thurman project will not go through the NEPA process, but there will be documentation.

Is there any information regarding the fish population?
A Hydroacustic study done was comparable to a mark-and-capture study. Studies have indicated that while some fish populations have exploded, others have disappeared. However, this phenomenon has not been explained, nor is it of great concern.

What was the basis for the 6 milligram liters parts per million?
The more stringent requirements of the two states involved were adopted. Through a multi-state agreement to be implemented next year, the requirements will be reduced to 5 mg/l parts per million of DO.

What is the time travel for flows?
The time for the old diffuser was about a day. The time travel for the new system is about few hours before one sees a change in the outflows.

What's the difference in the design to decrease Mn and Fe?
It's the same, there's just increase in oxygen.

SJR DO TMDL Technical Working Group Meeting Schedule

A proposal to change the regular TWG meeting schedule from the third Thursday of every other month was made. It was requested to move the date to the third Tuesday of every other month. No objections were made and the decision was made to change the meeting schedule accordingly.

The next TWG meeting is scheduled for May 17, 2005, with the following proposed agenda items:
- Upstream Studies—Monitoring Issues
- South Delta Improvements Program
- Conceptual Model
- Ecosystem Restoration Program Proposal Solicitation Package (ERP PSP)
- TWG Website

Additionally, a proposed SJR DO Modeling Workshop may take place that day beginning at 1:30 p.m.

The meeting adjourned at 11:45 a.m.