

DWR Aeration Facility- 2008 Performance Testing Results

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For DWR South Delta Staff

(Report is being reviewed by DWR and should be
available in April 2010)



**Navigation
Light 48**

**Navigation
Light 43**

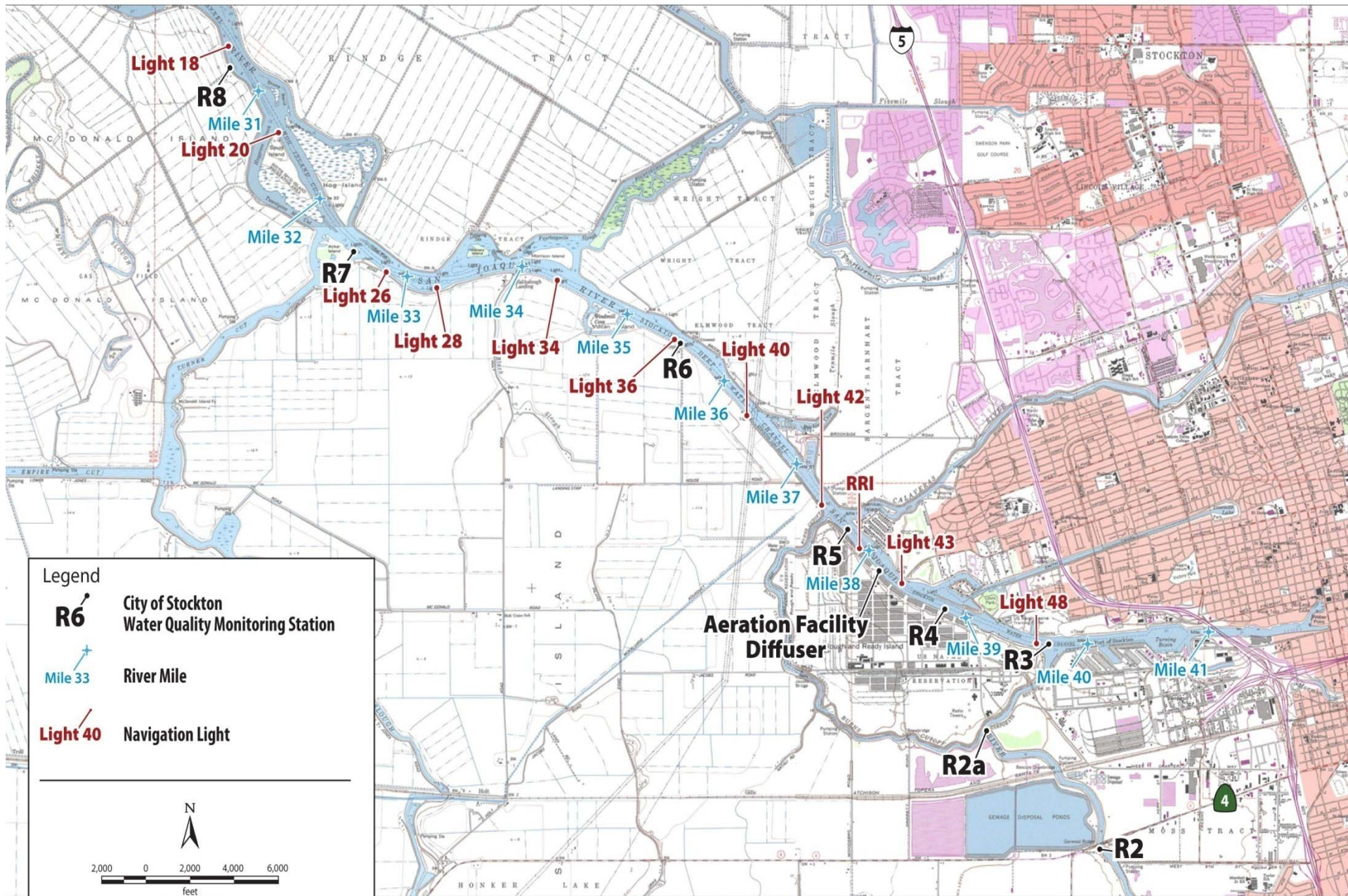
**Approximate
Diffuser Location**

RRI Monitoring Station

Aeration Facility

Demonstration Objectives

- Determine how well the existing RRI DO monitoring station represents natural DO conditions in the DWSC.
- Determine whether the Aeration Facility diffuser location is appropriate for adding DO to the DWSC to alleviate the low DO conditions.
- Determine how much DO can be added to the DWSC from the Aeration Facility under a variety of flows (i.e., 250 cfs to 1,000 cfs) at maximum Aeration Facility capacity (7,500 lb/day).
- Determine how the added DO will be distributed along the DWSC at high tide and low tide.
- Determine the effects of natural surface reaeration on the downstream DO and added DO increments.
- Determine the ability of the Aeration Facility to maintain DWSC DO above the Basin Plan objectives of 5 mg/l during December–August, and 6 mg/l during September–November.



Legend

- R6** City of Stockton Water Quality Monitoring Station
- Mile 33** River Mile
- Light 40** Navigation Light

N

2,000 0 2,000 4,000 6,000

feet

Scale = 1:48,000

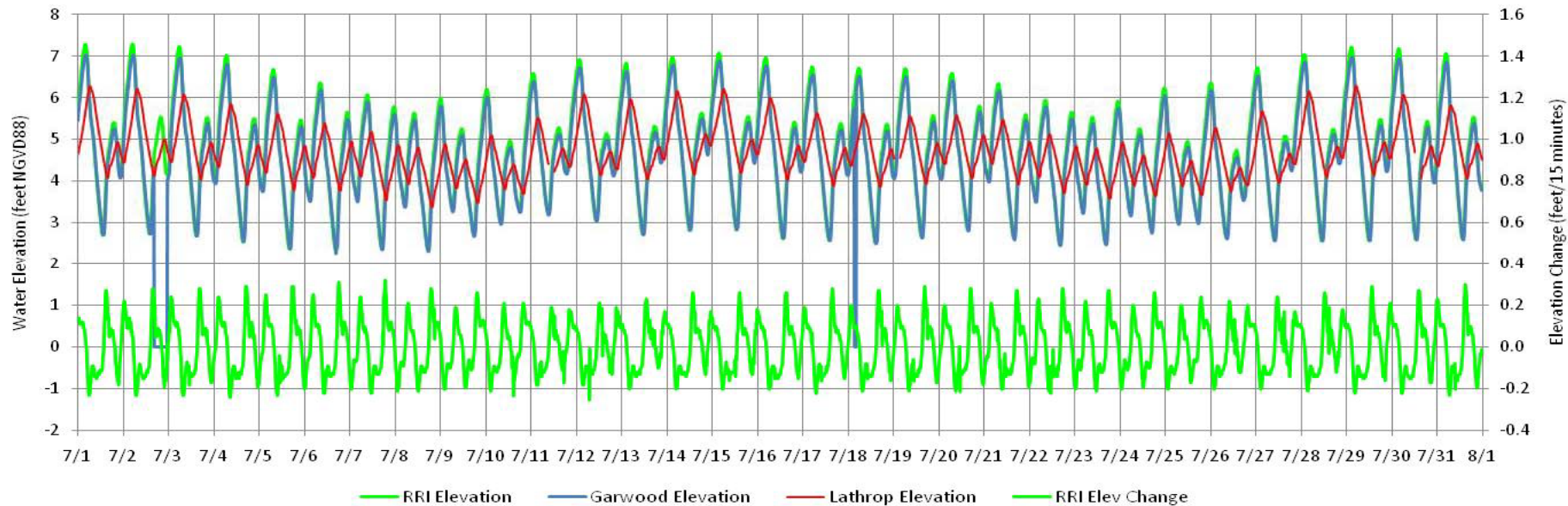
Base Map: USGS 7.5' series Terminus, Lodi South, Holt and Stockton West quadrangles, California

Map created with TOPOFR ©2001 National Geographic (www.nationalgeographic.com/topo)

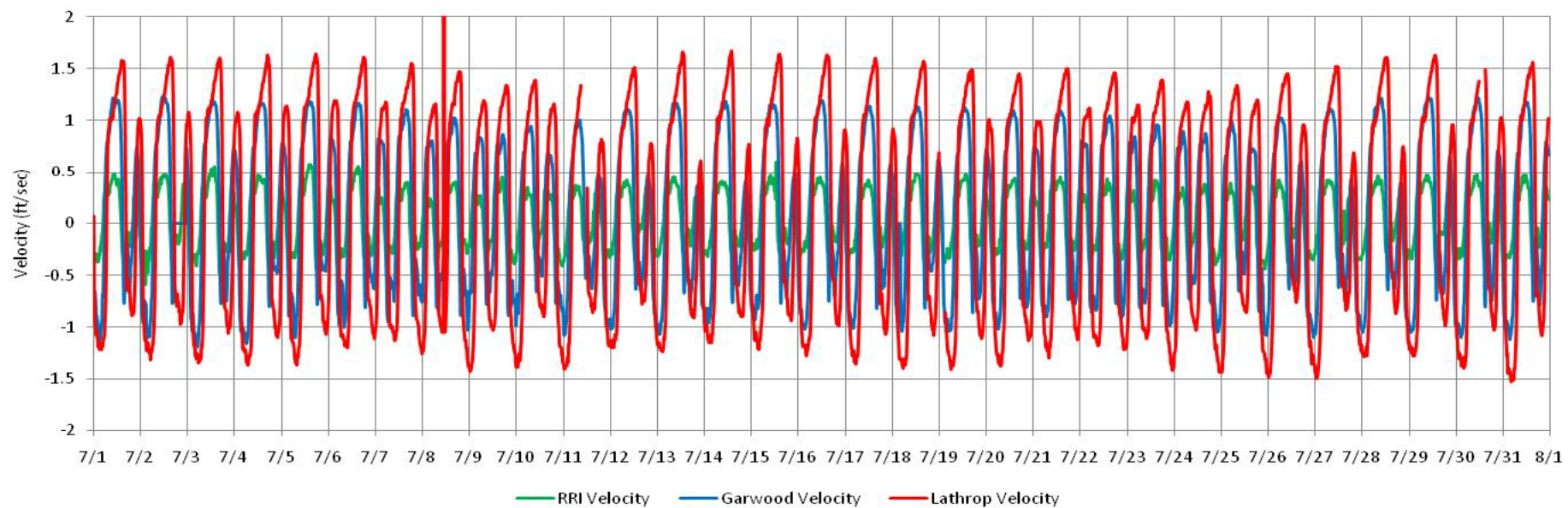
Performance Testing Methods

- Evaluate tidal movement and spreading of added DO from the Aeration Facility diffuser,
- Evaluate DWSC DO measurements from the DWR *San Carlos* boat surveys,
- Evaluate measured DO at the five DWR DO monitoring stations (RRI and 4 DWSC stations) during the pulsed operations,
- Evaluate UOP boat survey measurements of DO profiles from three depths in the DWSC, and
- Combine UOP boat surveys and DO monitoring station data to determine the distribution of the added DO in the DWSC.

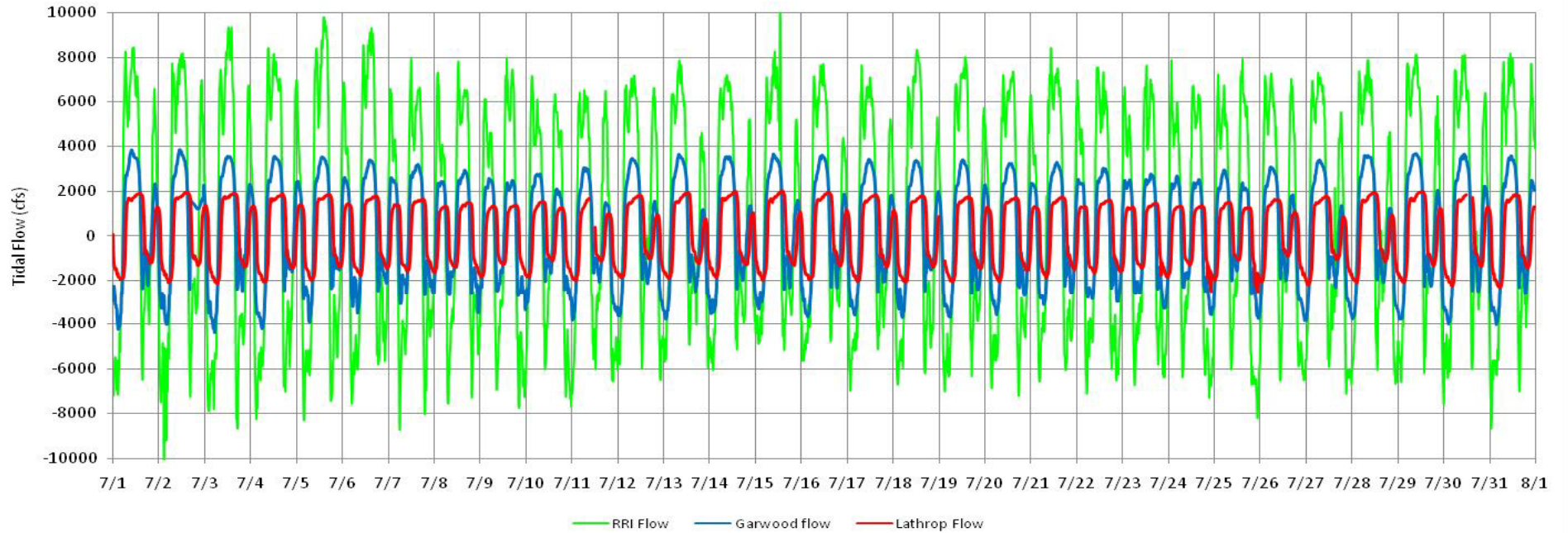
Tidal Elevation at RRI and Garwood



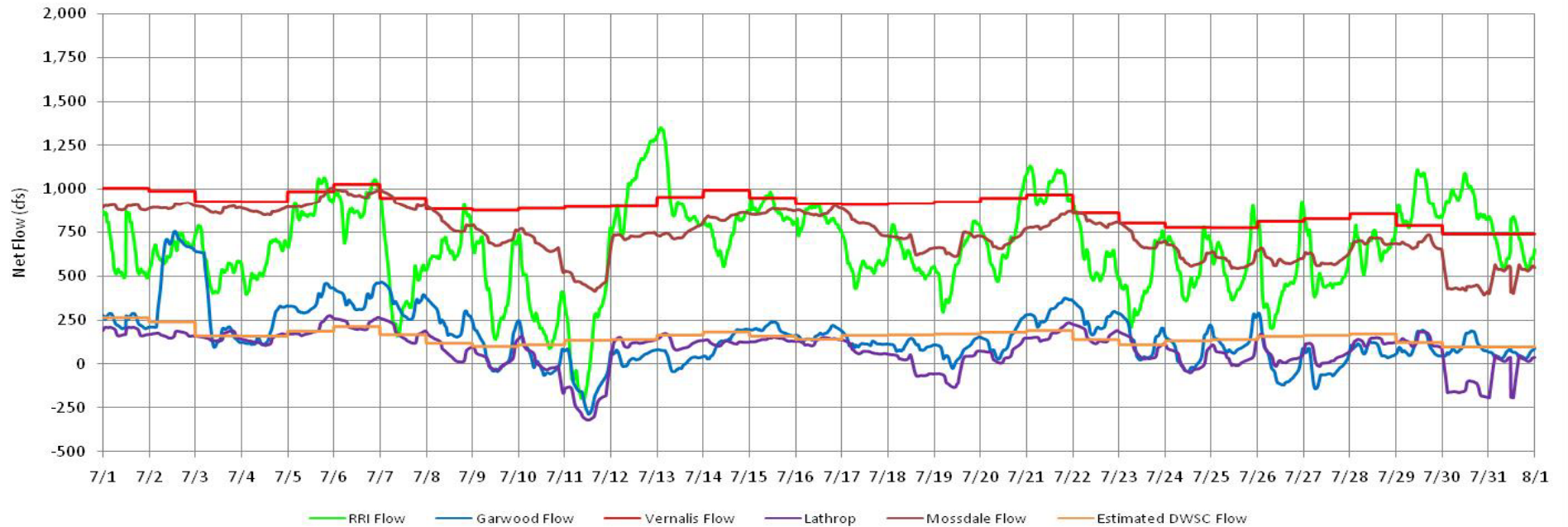
Tidal Velocity at RRI and Garwood and Lathrop



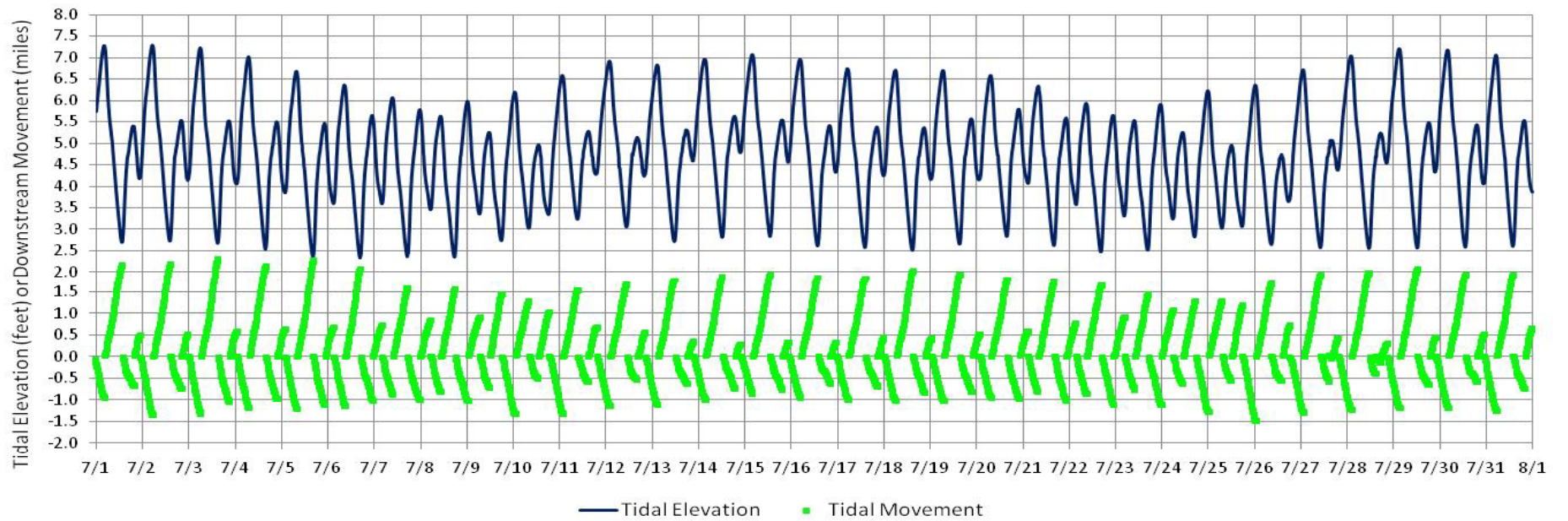
Tidal Flows at RRI and Garwood and Lathrop



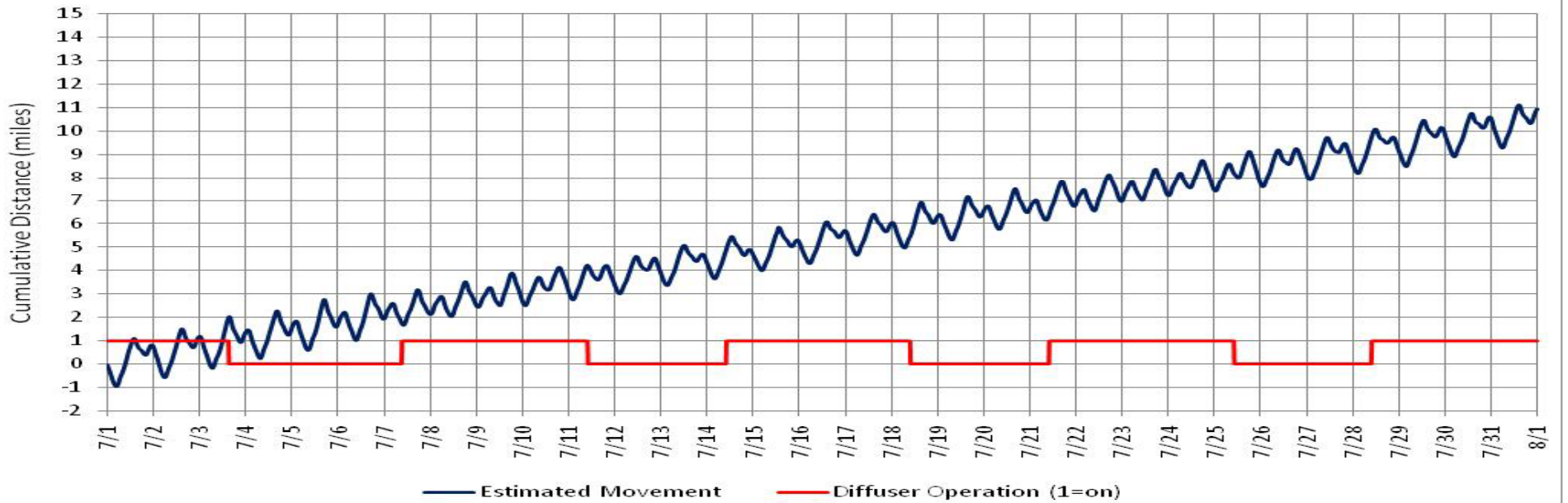
Comparison of Net Daily San Joaquin River Flows

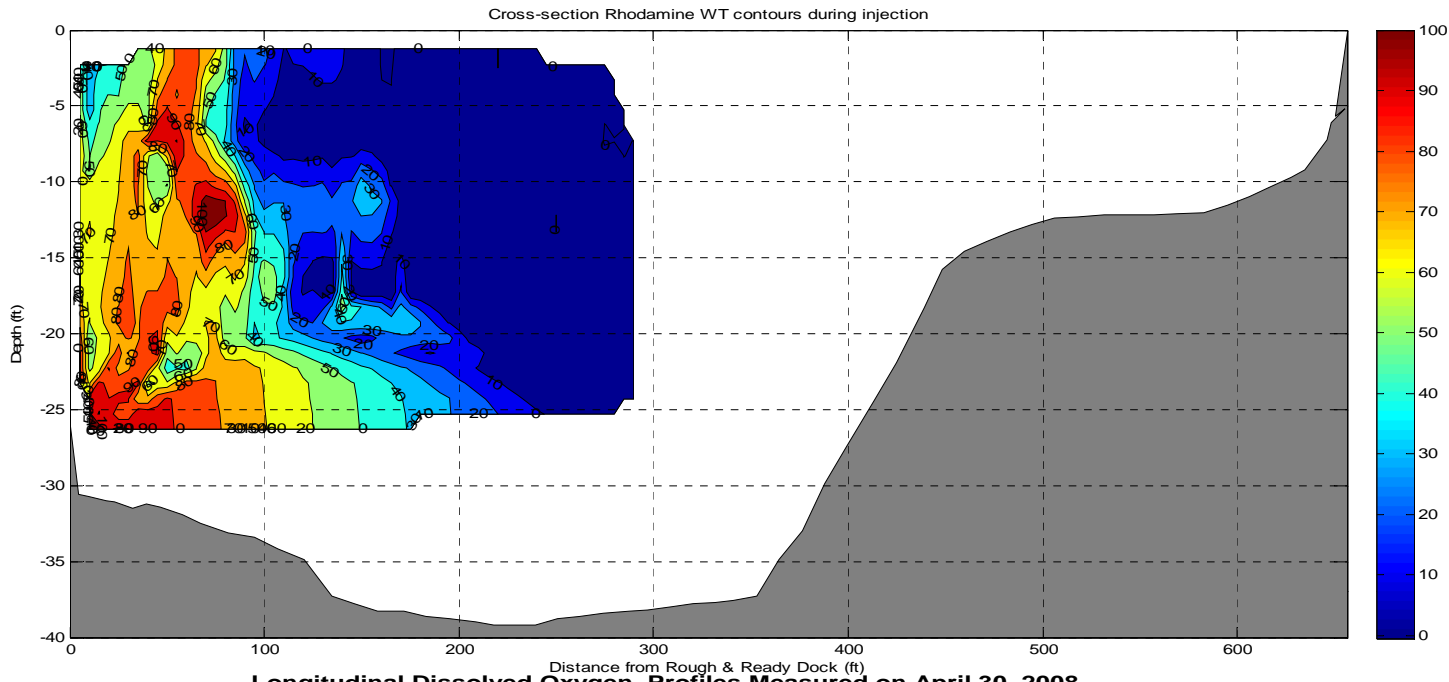


Tidal Elevation and Tidal Movement at RRI



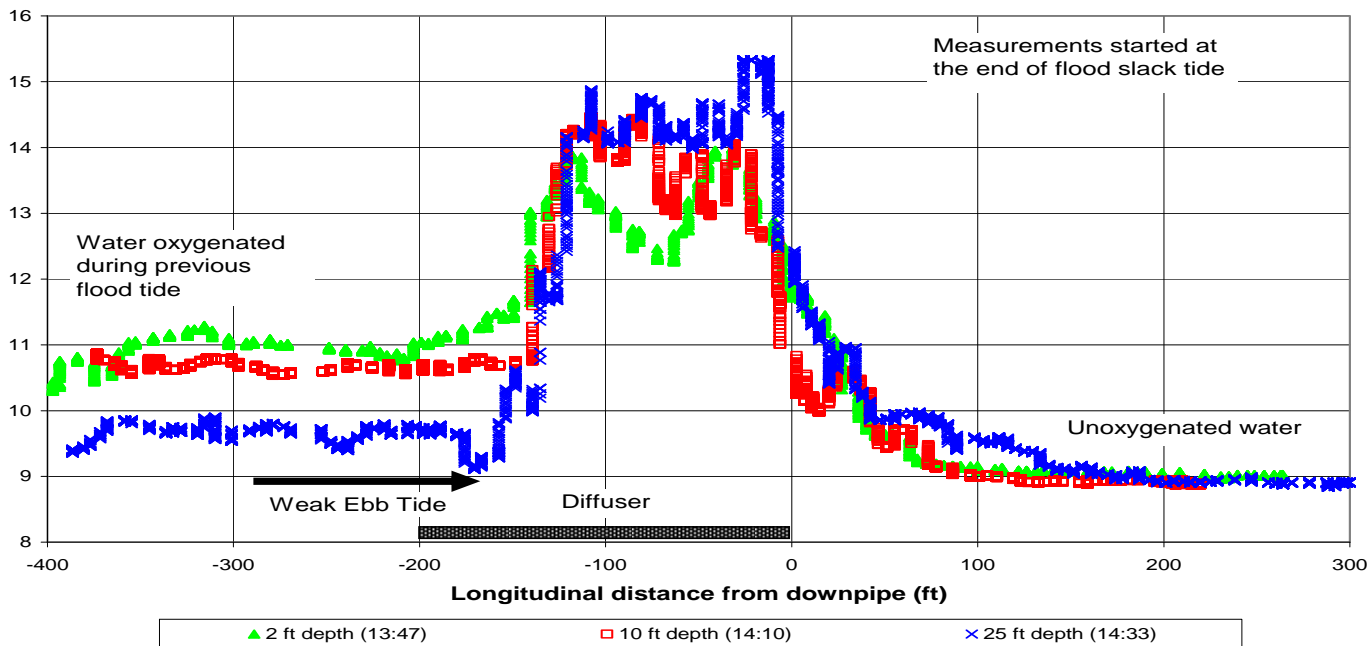
Cumulative Movement for 250 cfs Flow, Deficit=2.5, RR=0.3





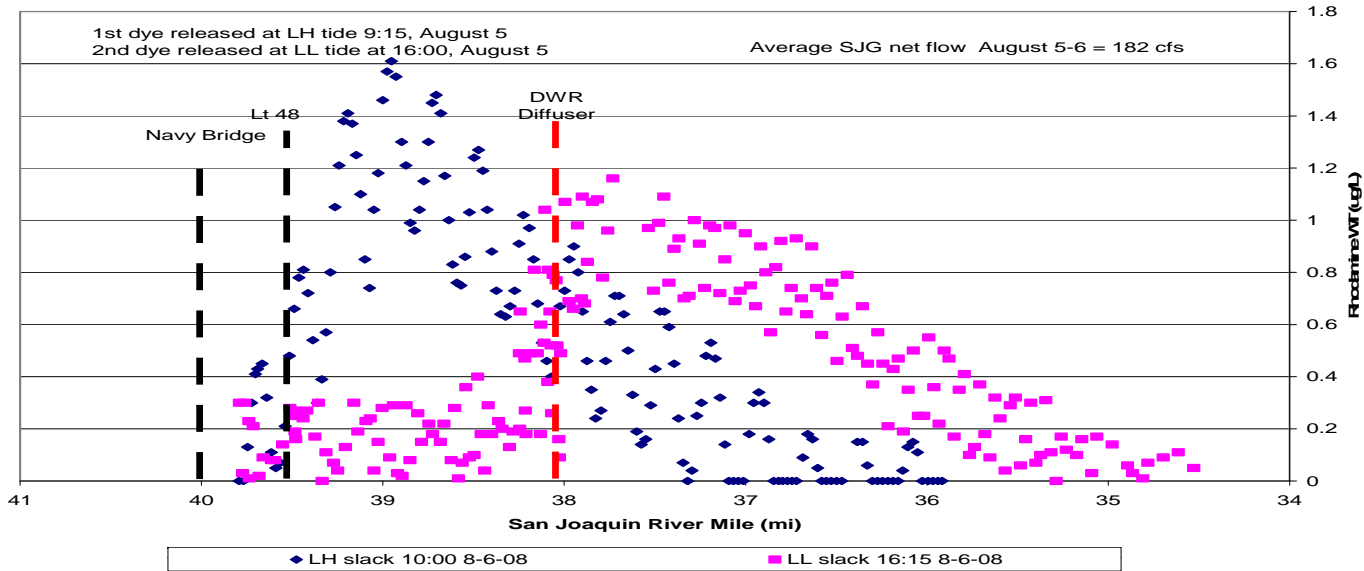
Lateral Dye concentration profile at diffuser on March 18, 2008

Longitudinal Dissolved Oxygen Profiles Measured on April 30, 2008



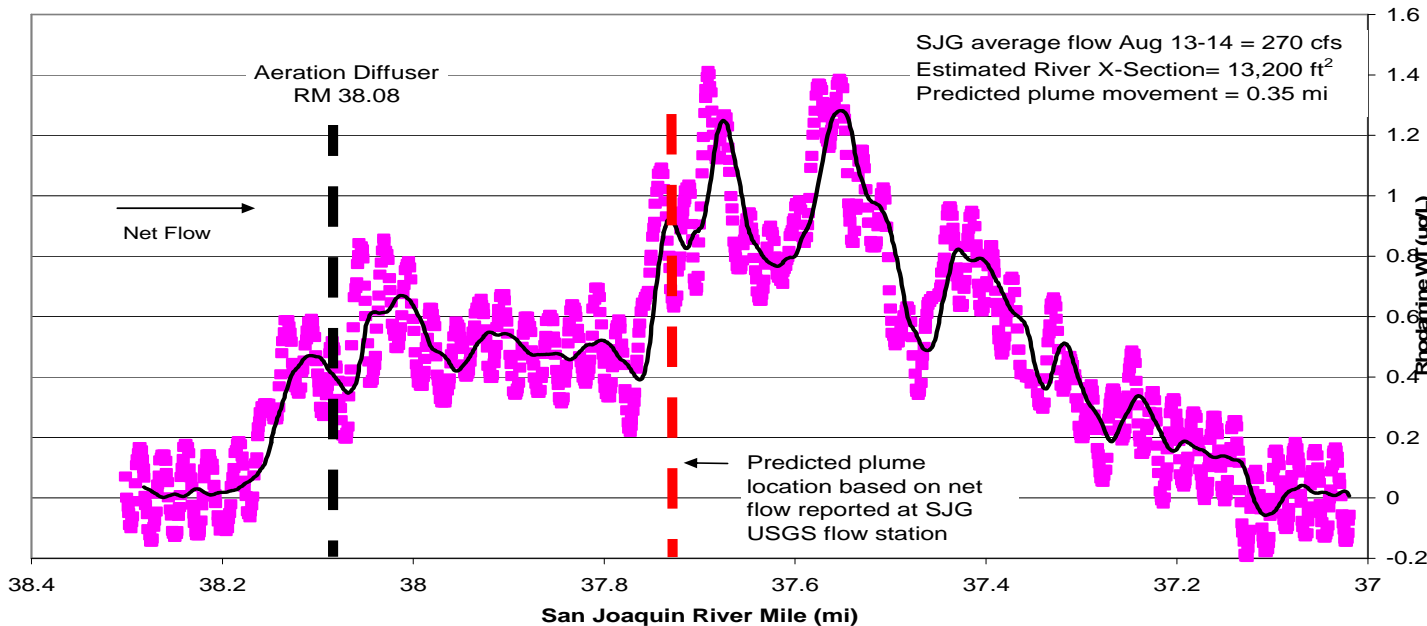
Longitudinal DO Profiles along diffuser dock on April 30, 2008

Longitudinal Profiles of Rhodamine Dye 25 hr After Release, August 6, 2008



Longitudinal Dye Profiles at LH and LL tides on August 6, 2008- one day after LH and LL dye injections

Longitudinal profile of Rhodamine WT dye 25 hours after injection at LL tide, August 14.

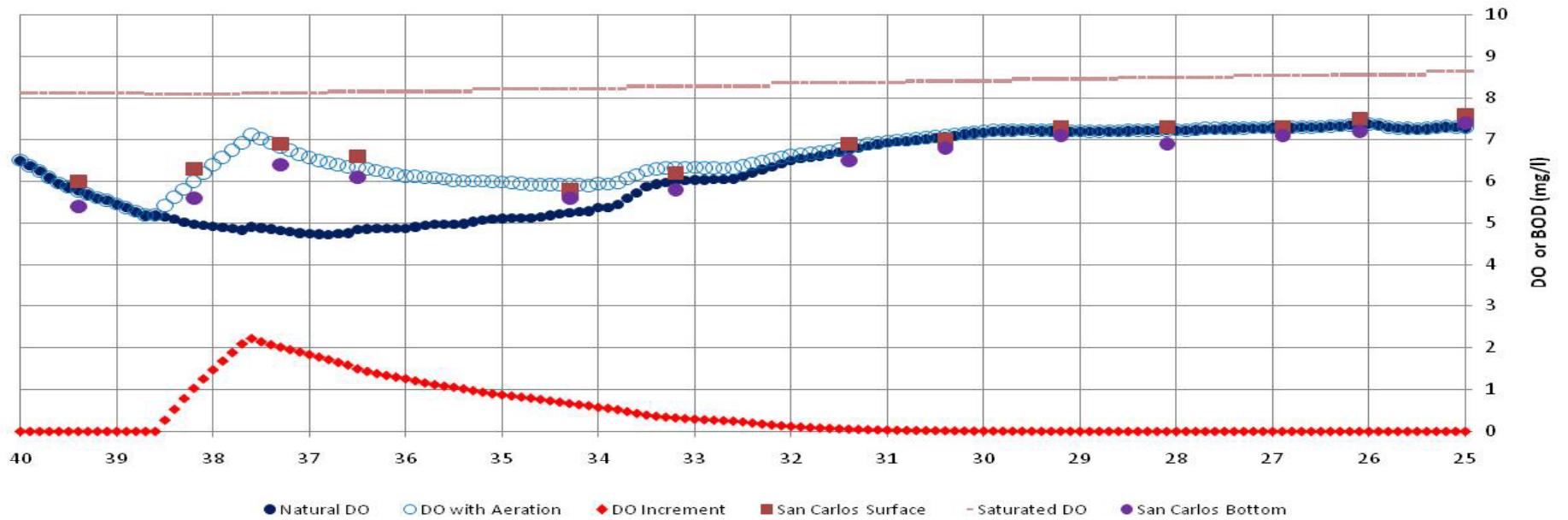


Longitudinal Dye Profile at LL tide on August 14, 2008- one day after LL tide dye injection

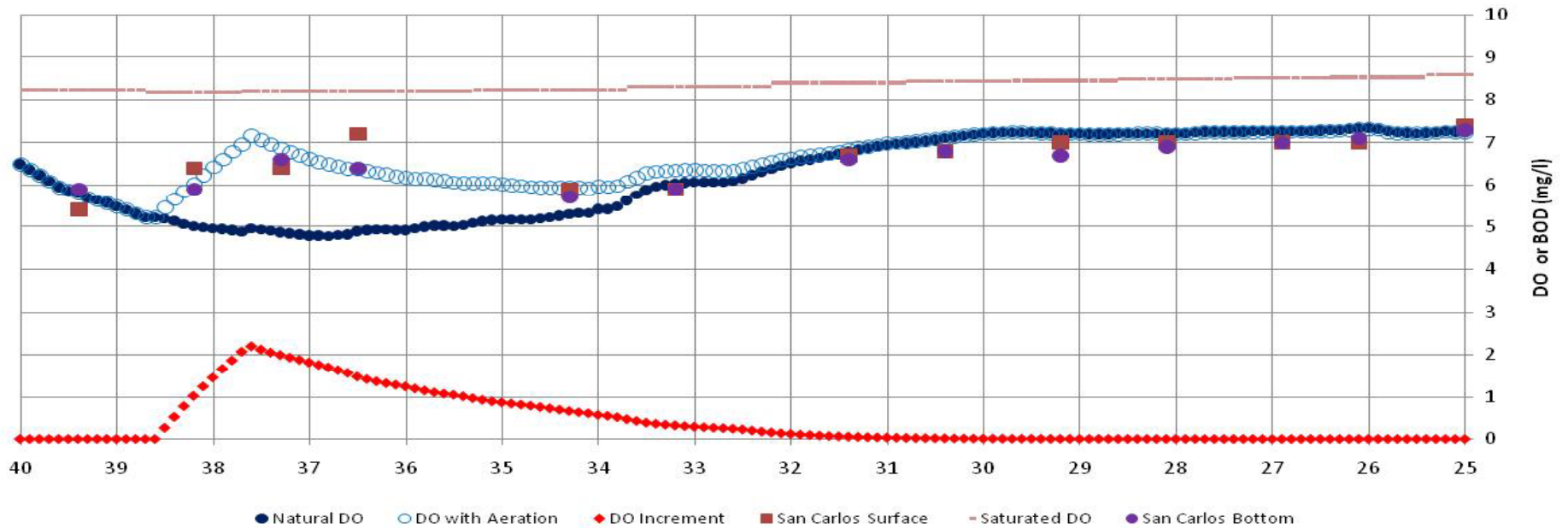
Tidal Movement and Mixing

- Tidal movement is about 1.5 to 2.5 miles each day between high tide and low tide.
- Diffuser mixing is rapid and the added DO (of 30 mg/l) is mixed with 20x DWSC water at RRI, so the incremental DO is about 1.5 mg/l (5%).
- Dye studies indicate that vertical and lateral mixing is nearly complete and longitudinal spreading is about 3 miles after one tidal day.

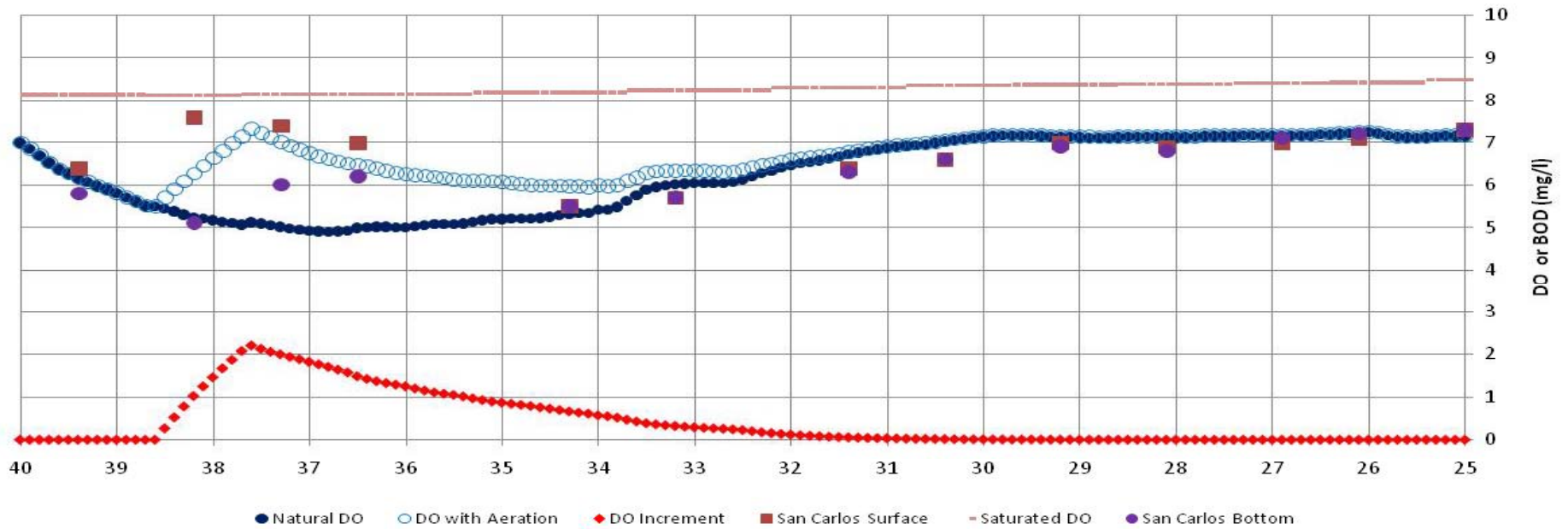
DO in the DWSC for July 16, 2008 with flow of 500 cfs and BOD of 10 mg/l



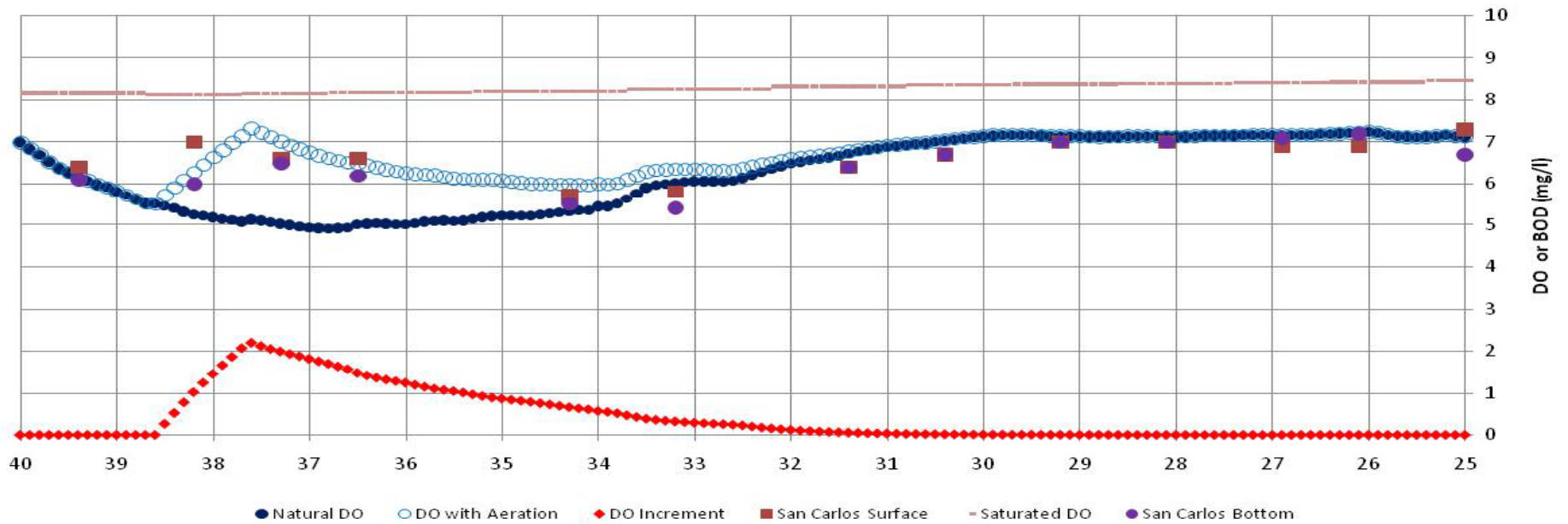
DO in the DWSC for July 30, 2008 with flow of 500 cfs and BOD of 10 mg/l



DO in the DWSC for August 14, 2008 with flow of 500 cfs and BOD of 10 mg/l



DO in the DWSC for August 28, 2008 with flow of 500 cfs and BOD of 10 mg/l



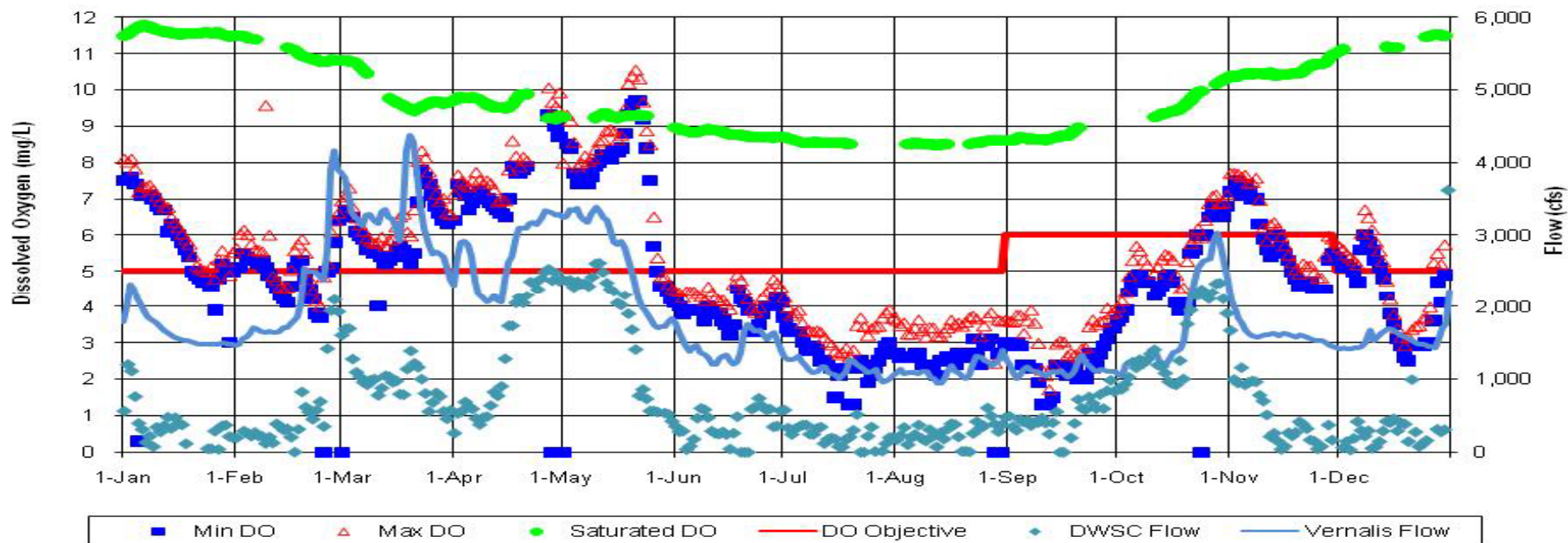
DWR *San Carlos* DWSC DO Surveys

- The longitudinal DO profile is determined by the flow (cfs) and the initial BOD (mg/l).
- A DWSC DO spreadsheet model was developed for this data analysis.
- The surface reaeration is about 20% of the DO deficit (saturated DO – actual DO) per day.
- The added DO from the Aeration Facility will decrease downstream because of reduced surface reaeration- most of the DO increment will be gone within about 5 days.

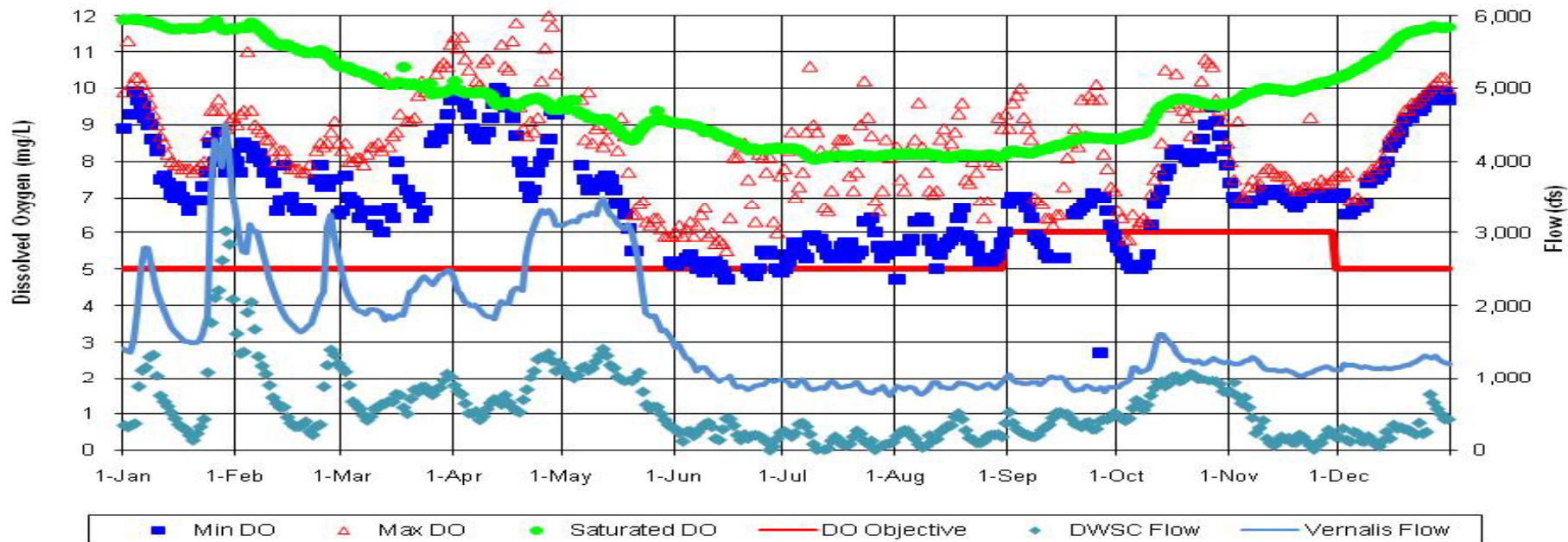
Expected DO Increments from the Aeration Facility

- The fully-mixed added DO increment should be observed at Light 42.
- The daily added DO (7,500 lb/day) will tidally mix with 3 miles of DWSC (3,000 af) and produce a daily DO increment of about 1 mg/l.
- The added DO increment would be 1.25 mg/l with a flow of 1,000 cfs, 2.5 mg/l with a flow of 500 cfs, and 5 mg/l with a flow of 250 cfs.

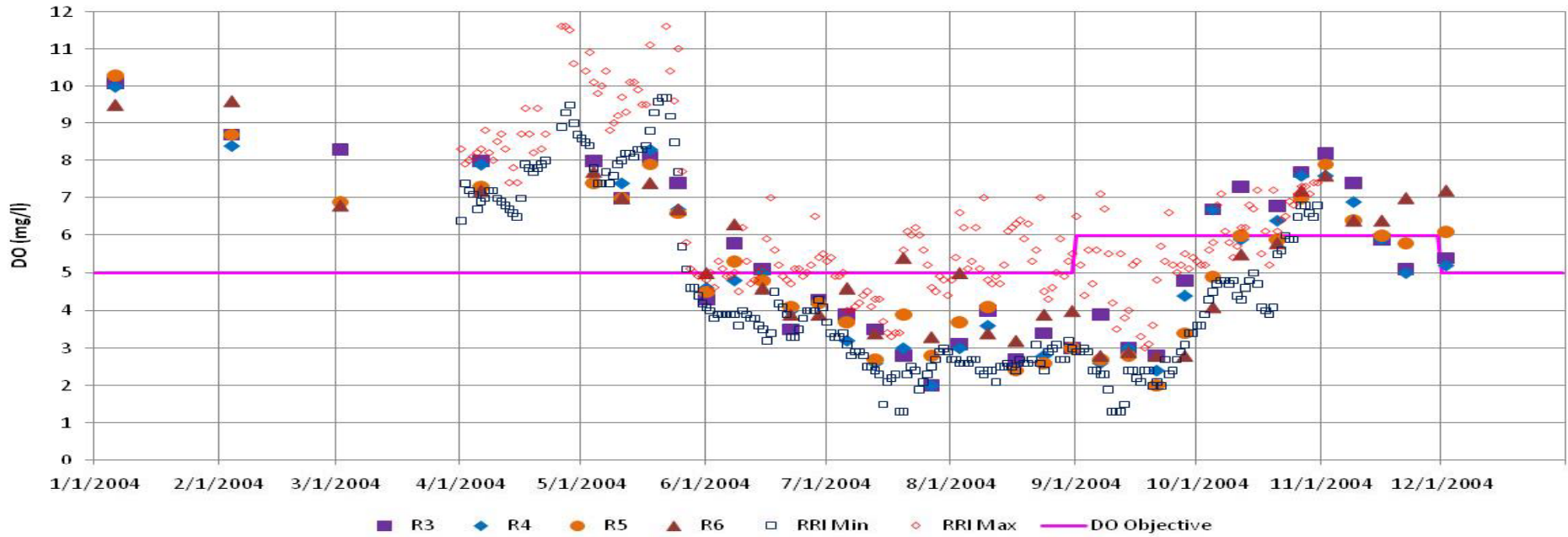
DO in the Stockton DWSC at Rough and Ready Island, 2004



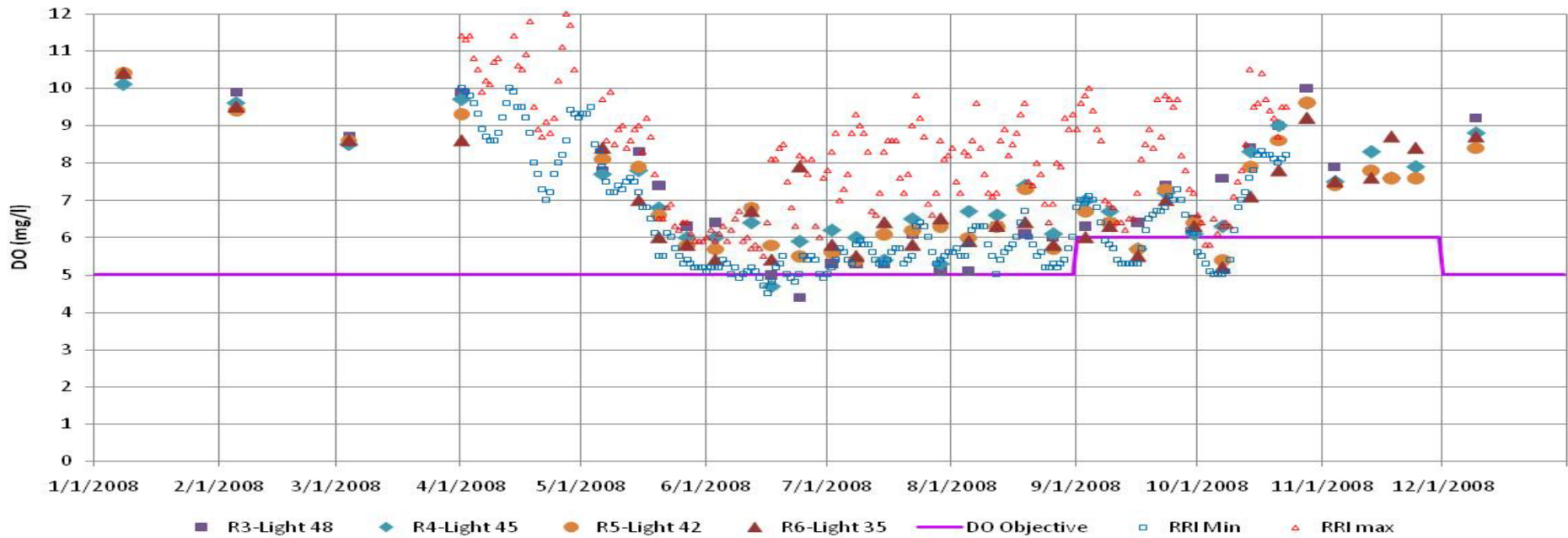
DO in the Stockton DWSC at Rough and Ready Island, 2008



2004 Stockton River Data-DO



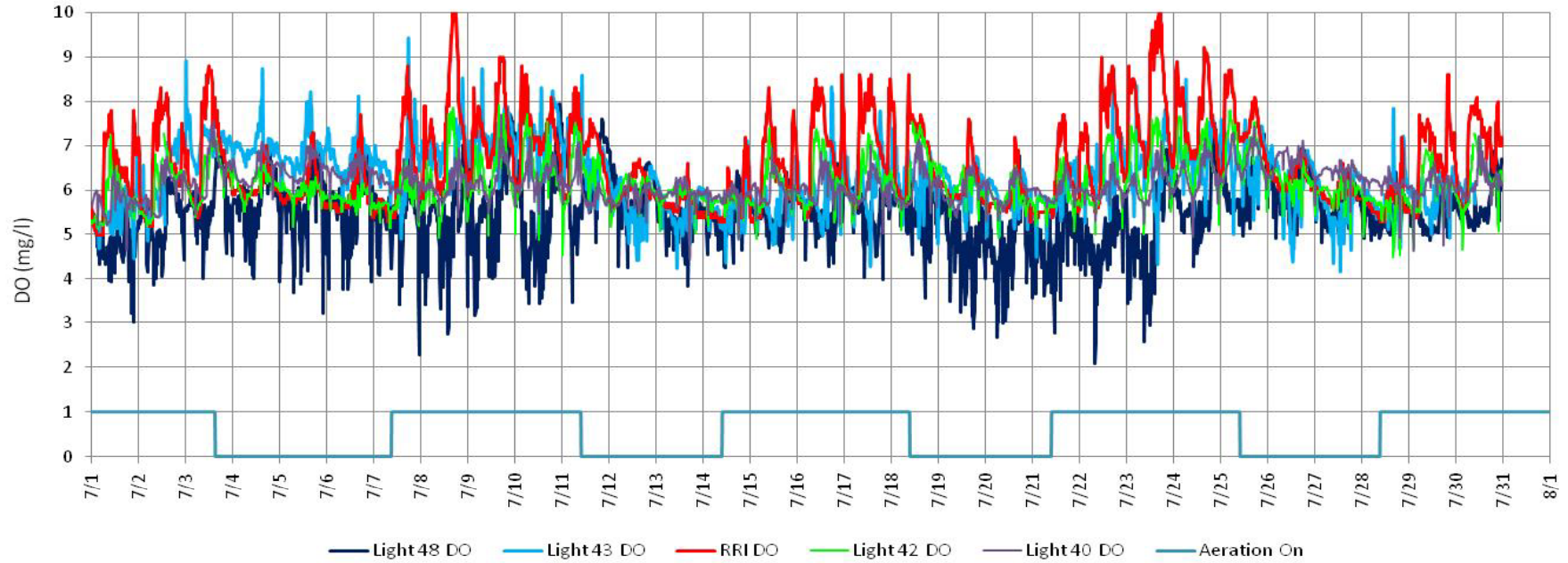
Stockton DWSC Data-DO



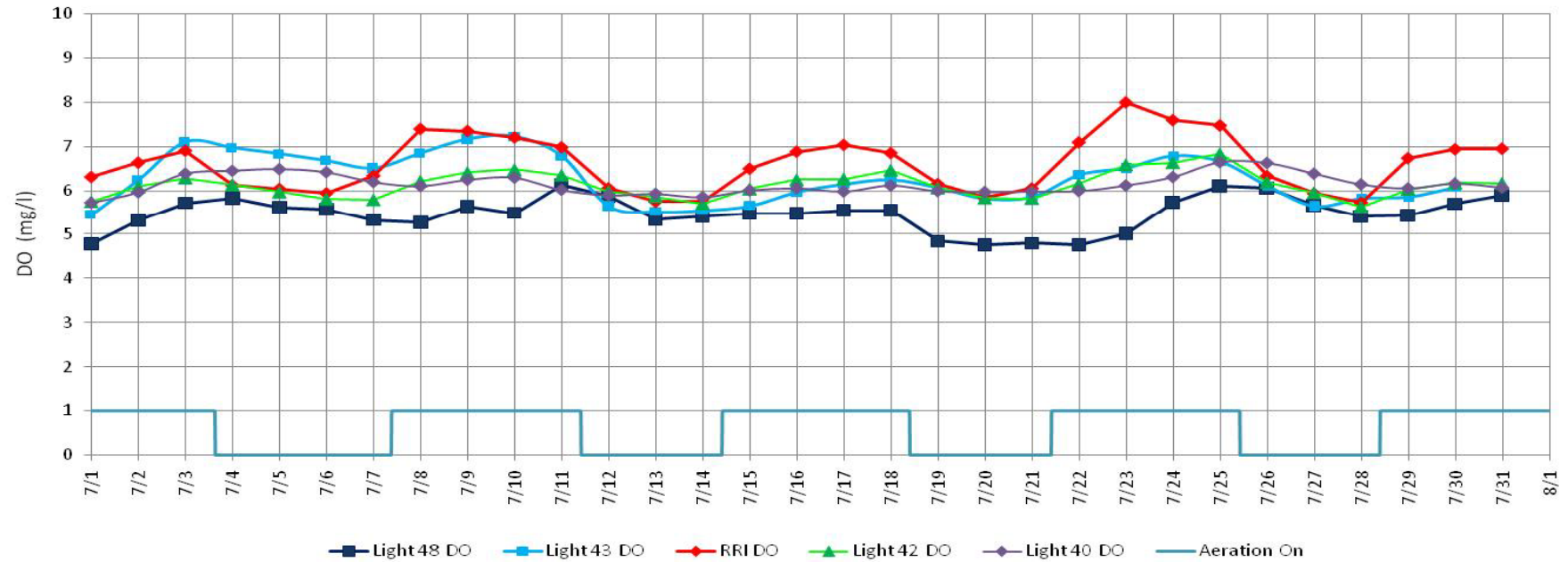
Changes in DWSC DO from City of Stockton RWCF Nitrification Facility (starting in 2007)

- Comparison of 2004 and 2008 DWSC DO concentrations suggests that the inflow BOD was reduced from 15-20 mg/l to 5-10 mg/l.
- The periods and severity of DO deficits (below DWSC DO objectives) will likely be less frequent and smaller in magnitude.
- The current Aeration Facility capacity of 7,500 lb/day should be sufficient to maintain the DWSC DO objectives most of the time.

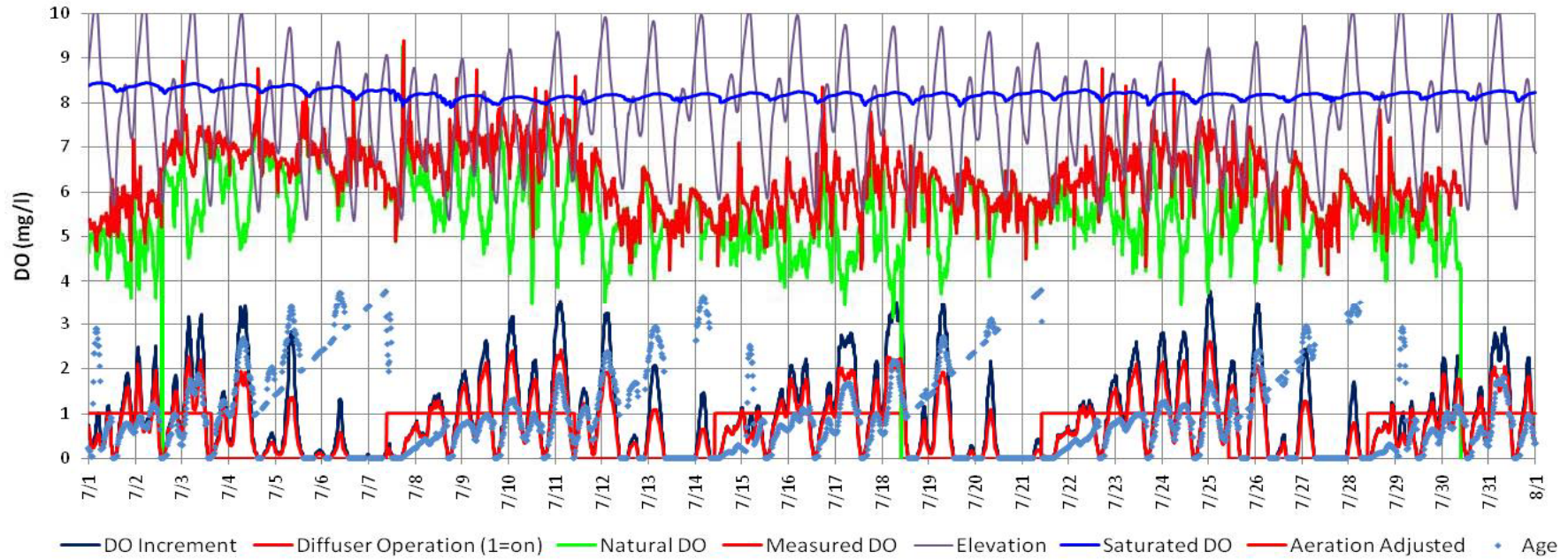
Measured DO in the DWSC for July 2008



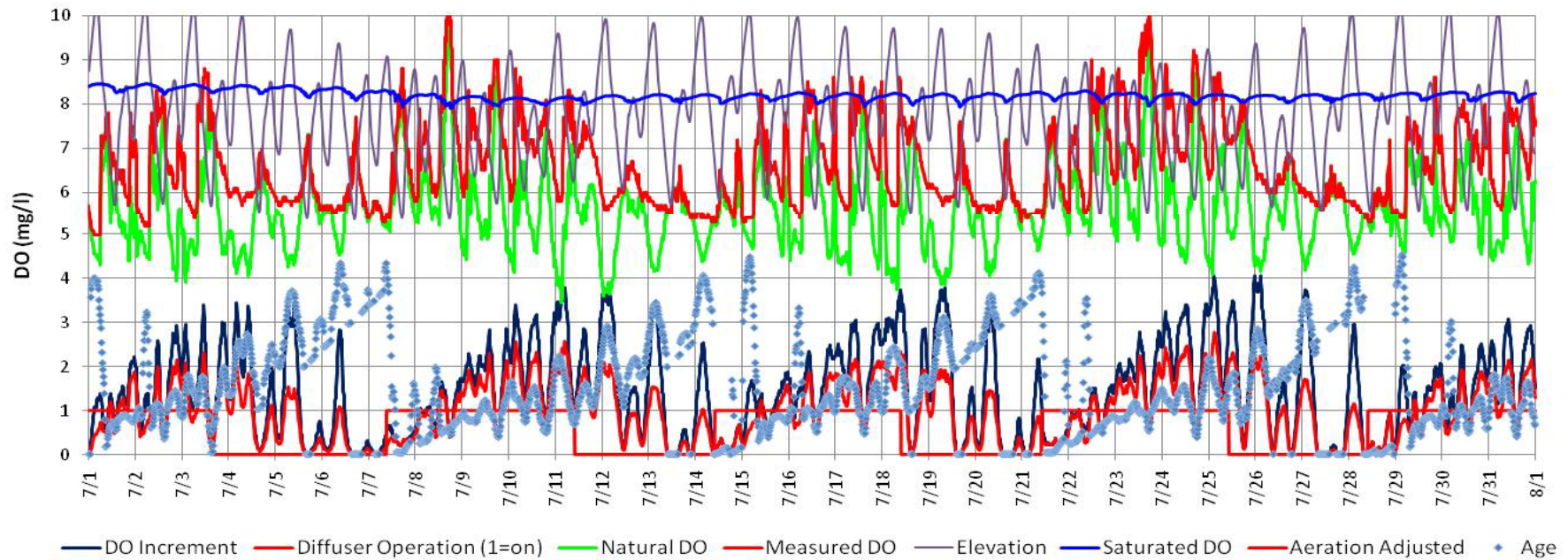
DWSC Daily Average Measured DO for July 2008



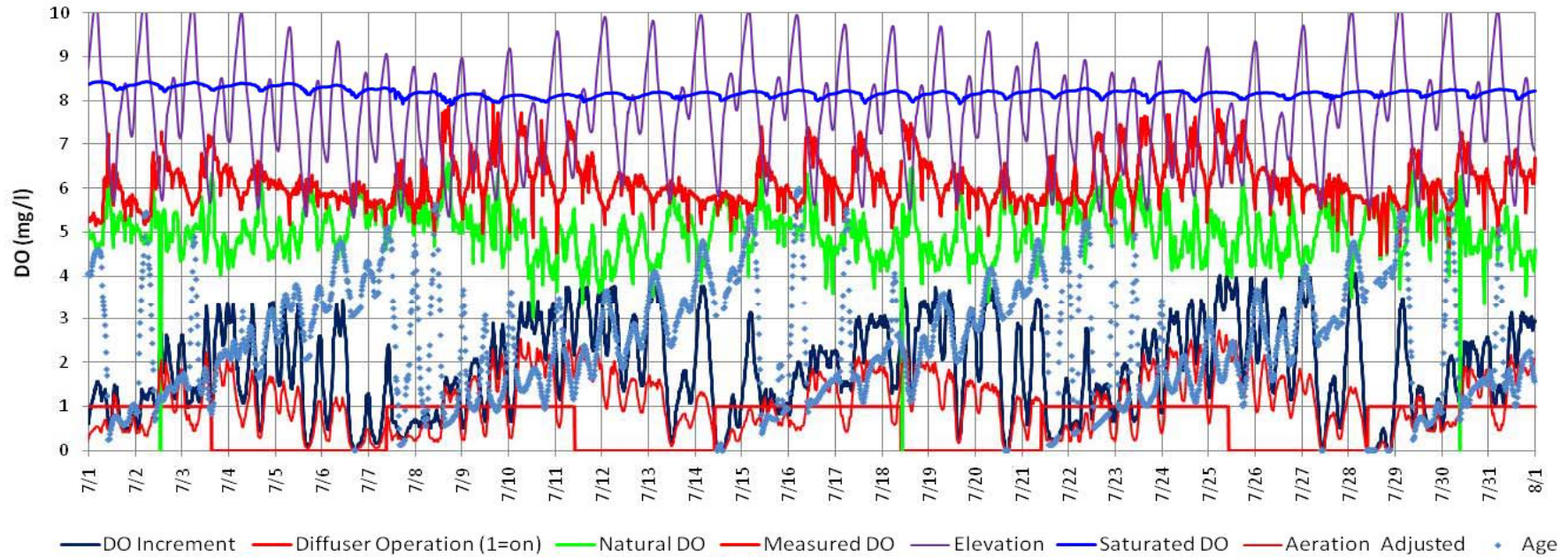
DO at Light 43 (0.2 mile upstream) for Flow=250 cfs, RR=0.2



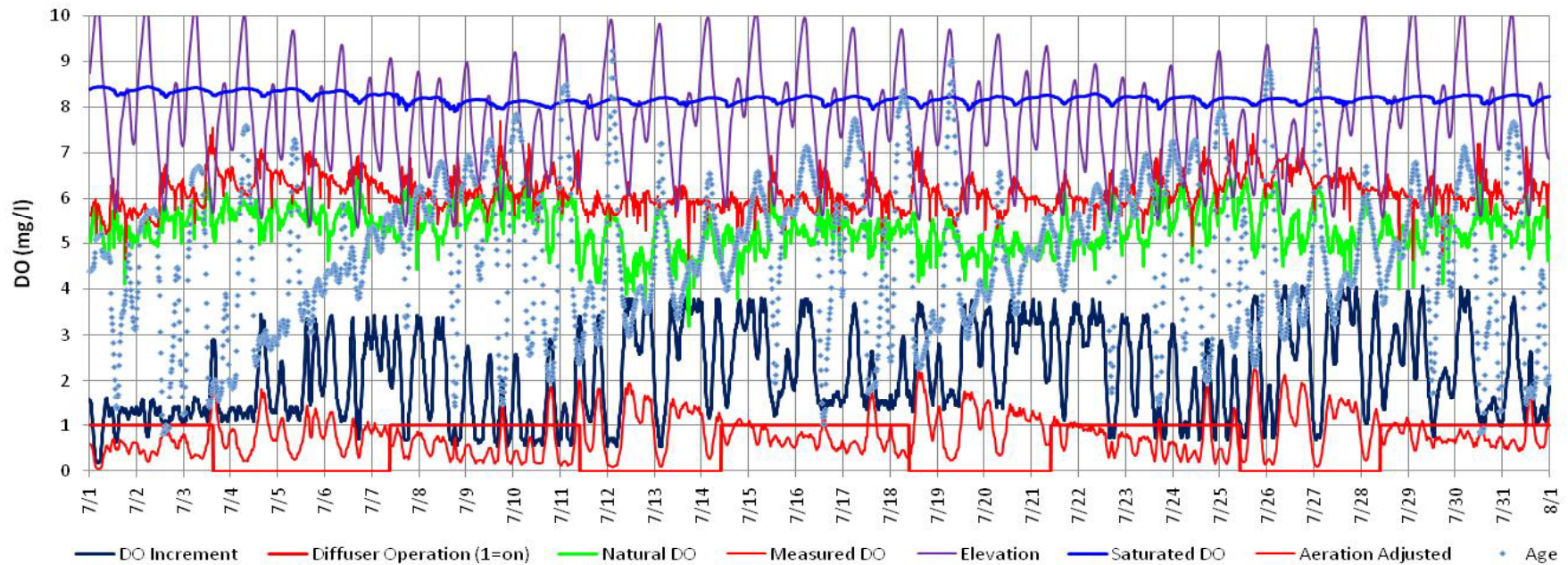
DO at RRI (0.2 mile downstream) for Flow=250 cfs, RR=0.2



DO at Light 42 (0.7 mile downstream) for Flow=250 cfs, RR=0.2

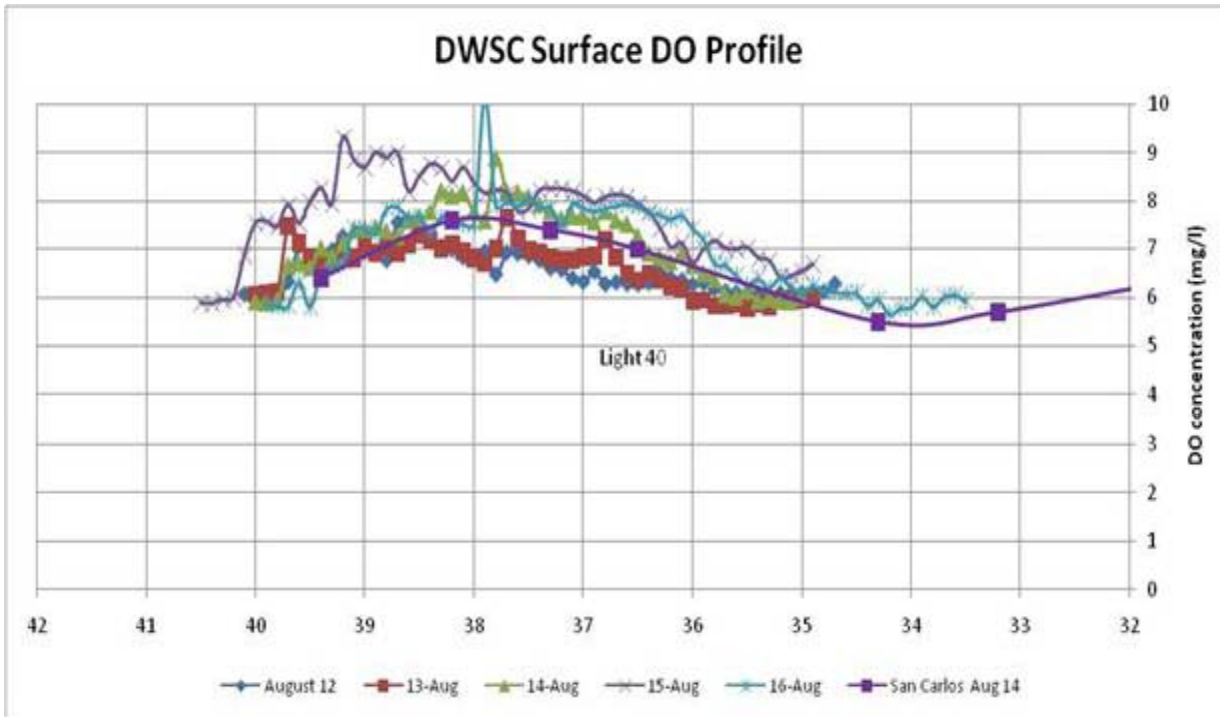


DO at Light 40 (1.6 miles downstream) for Flow=250 cfs, RR=0.2

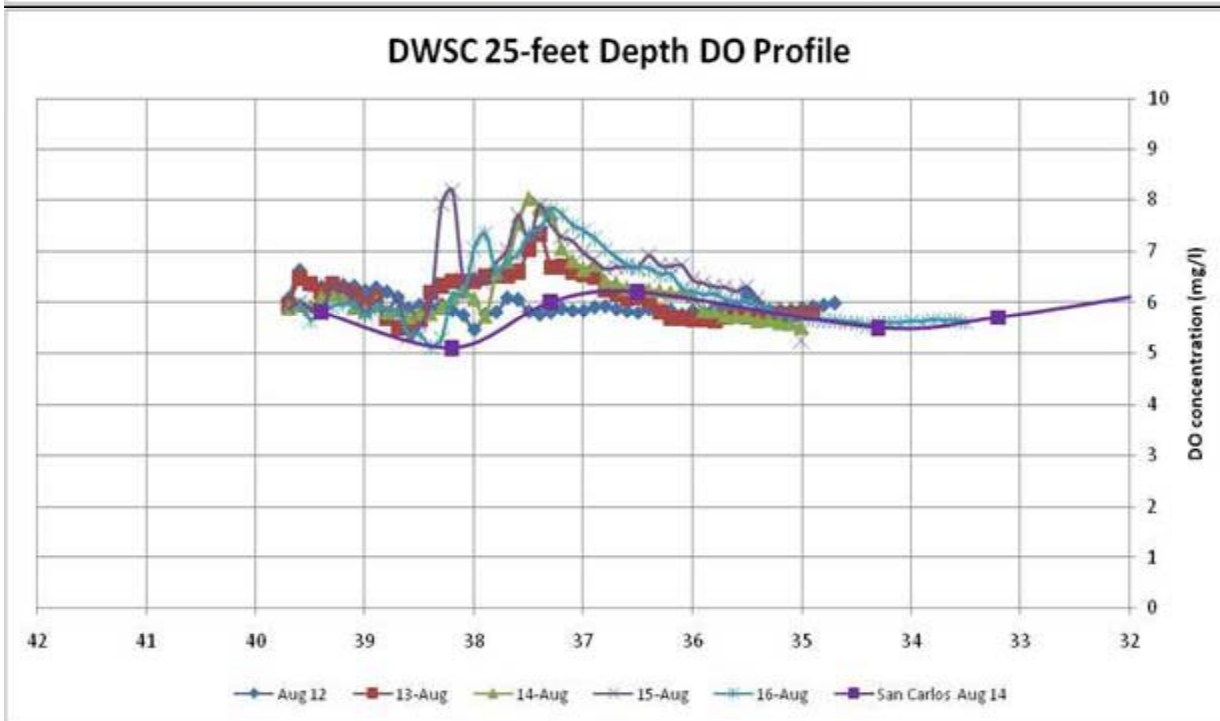


DO Increments at DO Monitoring Stations

- The tidal movement measured at the RRI tidal flow meter was used to track the 15-minute DO increments upstream and downstream past the five DWSC DO monitoring stations.
- A spreadsheet model was developed to estimate these DO increments compared to the measured DO data.
- Because the DWSC flow was low (250 cfs) several days are required for the added DO to reach Lights 42 and 40, and several days are required after aeration stops before the natural DO is measured at Light 42 and 40.
- The DWSC surface reaeration of about 20% per day reduces the downstream wedge of added DO and limits the added DO increment in the DWSC to about 4 days of Aeration capacity ($4 \times 7,500 = 30,000$ lbs).

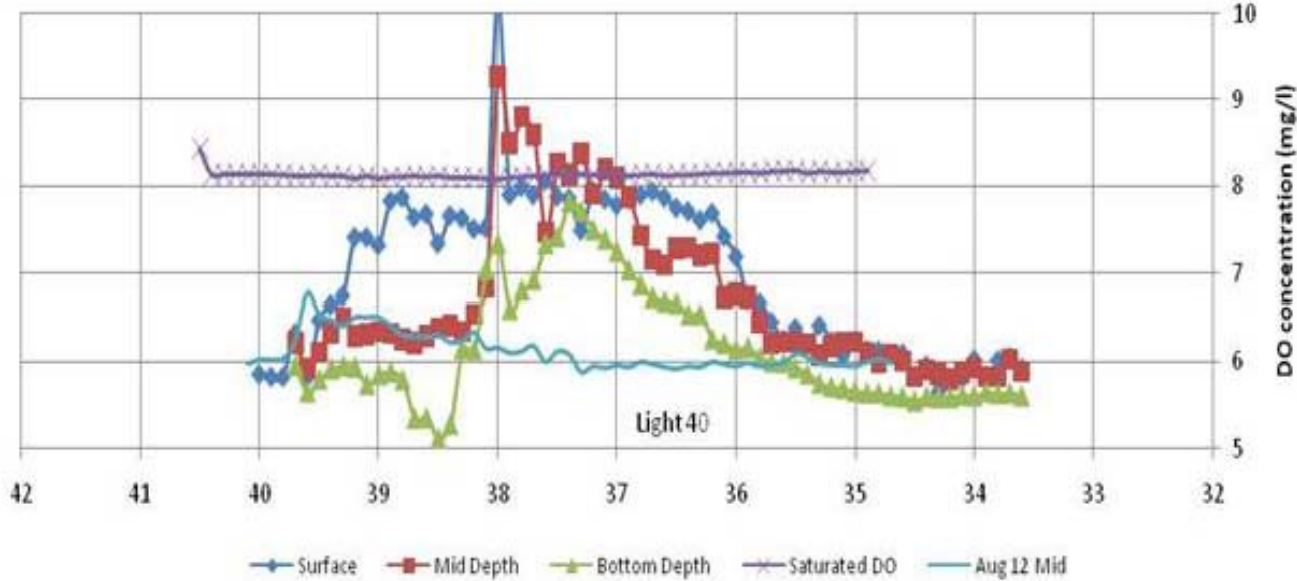


Comparison of UOP profiles and DWR *San Carlos* DO measurements in the DWSC on August 14, 2008



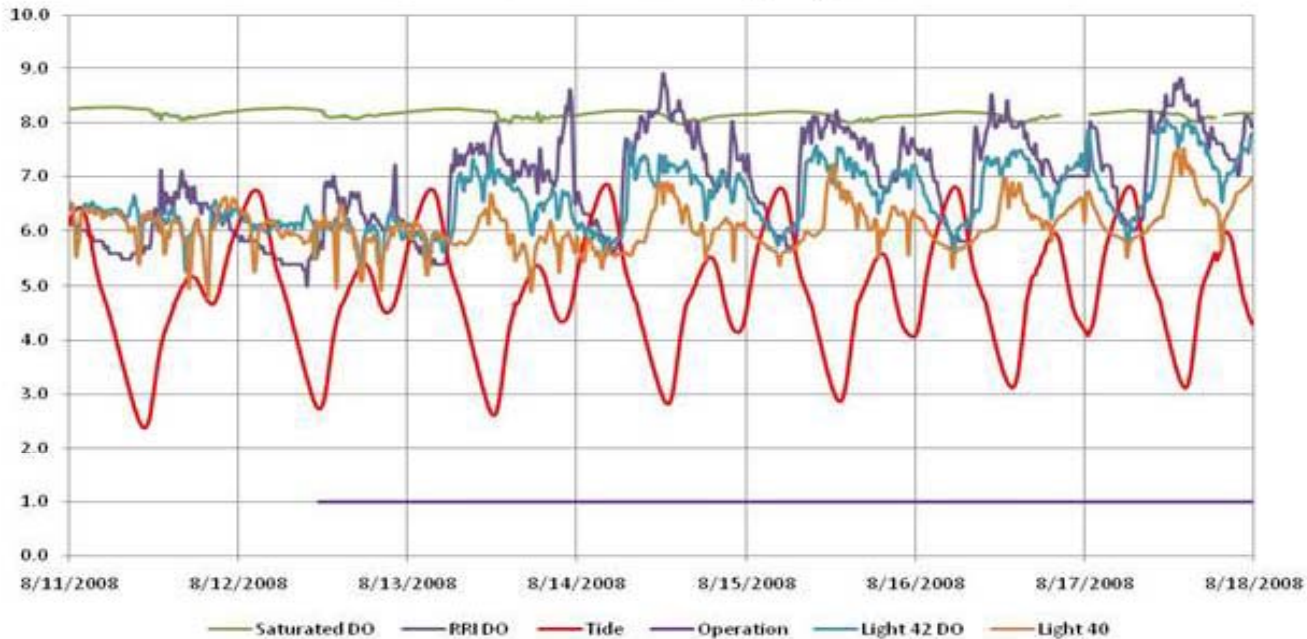
The sequential UOP profiles indicate the added DO from the Aeration Facility since the August 12, 2008 natural DO profile

DWSC DO Profile on Aug 16, 2008



UOP Boat DO profiles after 4 days of operations

Downstream DO During Aug 11-17



Downstream DO monitoring at RRI, Light 42 and Light 40 during August 11-17, 2008

Recommendations

- Adjustments in the Aeration Facility are needed to improve the oxygen gas transfer efficiency and increase the capacity.
- Adjustments in the diffuser are needed to increase the jet velocity and provide back pressure at the Aeration Facility.
- Testing of tidal operations (on during flood tide) are needed to shift the distribution of added DO upstream toward Light 48.
- A long-term DWSC DO monitoring plan should be developed to track natural DO and the added DO from the Aeration Facility.
- An operational strategy for the Aeration Facility should be developed to maintain the DWSC DO objectives, using upstream flow and water quality data from Mossdale.
- The integration of the Port of Stockton aeration facilities at Dock 13 with operation of the DWR Aeration Facility should be evaluated as part of the SJR-DO TMDL implementation plan.