



## Memorandum

<b>Date:</b>	July 13, 2015
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<b>cc:</b>	Rita Koehnen Environmental Coordinator Port of Stockton
<b>From:</b>	Michael Wingfield Project Manager ICF International
<b>Subject:</b>	<b>Summary of Aeration Facility Operations, Maintenance, and Costs—2014</b>

## Introduction

In 2012 the *Agreement for Funding & Operation of Dissolved Oxygen Aeration Facility* (the Agreement) was executed in which the Port of Stockton (Port) and other stakeholders in the San Joaquin River Dissolved Oxygen (DO) Control Program expressed their commitment to fund the operation and maintenance of the Stockton Deep Water Ship Channel (DWSC) Aeration Facility located at Dock 20 at the Port.

In 2014 the aeration facility was operated on behalf of all parties signatory to the Agreement for the purpose of meeting the Central Valley Basin Plan water quality objective<sup>1</sup> for DO. This report provides a summary of DO conditions in the DWSC, operations and maintenance of the aeration facility that occurred January 1, 2014 through December 31, 2014 and the allocation of costs to all parties signatory to the Agreement.

## Maintenance and Repairs

In preparation for 2014 aerator operations staff performed a general inspection of the facility and checked all system components for excessive or abnormal wear and proper function. Lubricant levels and conditions were also checked. During the inspection it was documented that the pipes and hoses that feed the intake and discharge DO probes were partially obstructed by algae. The parts were disassembled, cleaned, and reassembled. The DO probes were also reconditioned and

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<sup>1</sup> 5.0 milligrams per liter (mg/L) December through August, 6.0 mg/L September through November

calibrated. The DO probes were field calibrated prior to each start of the system during the operational period.

During an inspection on October 15 an irregular noise was observed emanating from pump A. The pump was shut down and plans were made to remove it to diagnose the problem. Subsequent inspection of the pump revealed abnormal wear and partial disintegration of the pump bowl. The reason for the wear is unknown however it is possible that a gritty material such as sediment was drawn into the pump during operation. Fortunately the problem was detected in time to prevent further damage which could've resulted in a catastrophic failure of the pump. As of the end of 2014 replacement parts were on order and the repairs had yet to be completed.

## **Ambient Dissolved Oxygen Monitoring and Conditions**

DO is monitored daily using data collected by the California Department of Water Resources (DWR). Previously, DO was monitored at a single depth (1 meter) using data collected at the Rough and Ready Island station (RRI), located on Dock 20 at the Port. In 2012 DWR added DO sensors at additional depths and created a new station called the Stockton Deep Water Ship Channel DO station (SDO). The SDO station is at the same location as the RRI station but has DO sensors at depths of 1, 3, and 6 meters. In August of 2014 the Central Valley Regional Water Quality Control Board requested that the facility be operated to meet the objective for DO at all 3 depths measured at the SDO station.

Data collected at the SDO station is published on the California Data Exchange Center (CDEC) website in 15-minute increments and can be viewed at [http://cdec.water.ca.gov/cgi-progs/staMeta?station\\_id=SDO](http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SDO). The DO sampling devices are maintained and calibrated by DWR staff on a weekly basis.

DO concentrations in the DWSC were above the objective for most of 2014. Episodes of DO excursions below the objective were limited to the months of September and October and no aeration was needed during other months. SDO station DO data for September and October are shown in Figures 1 and 2 below.

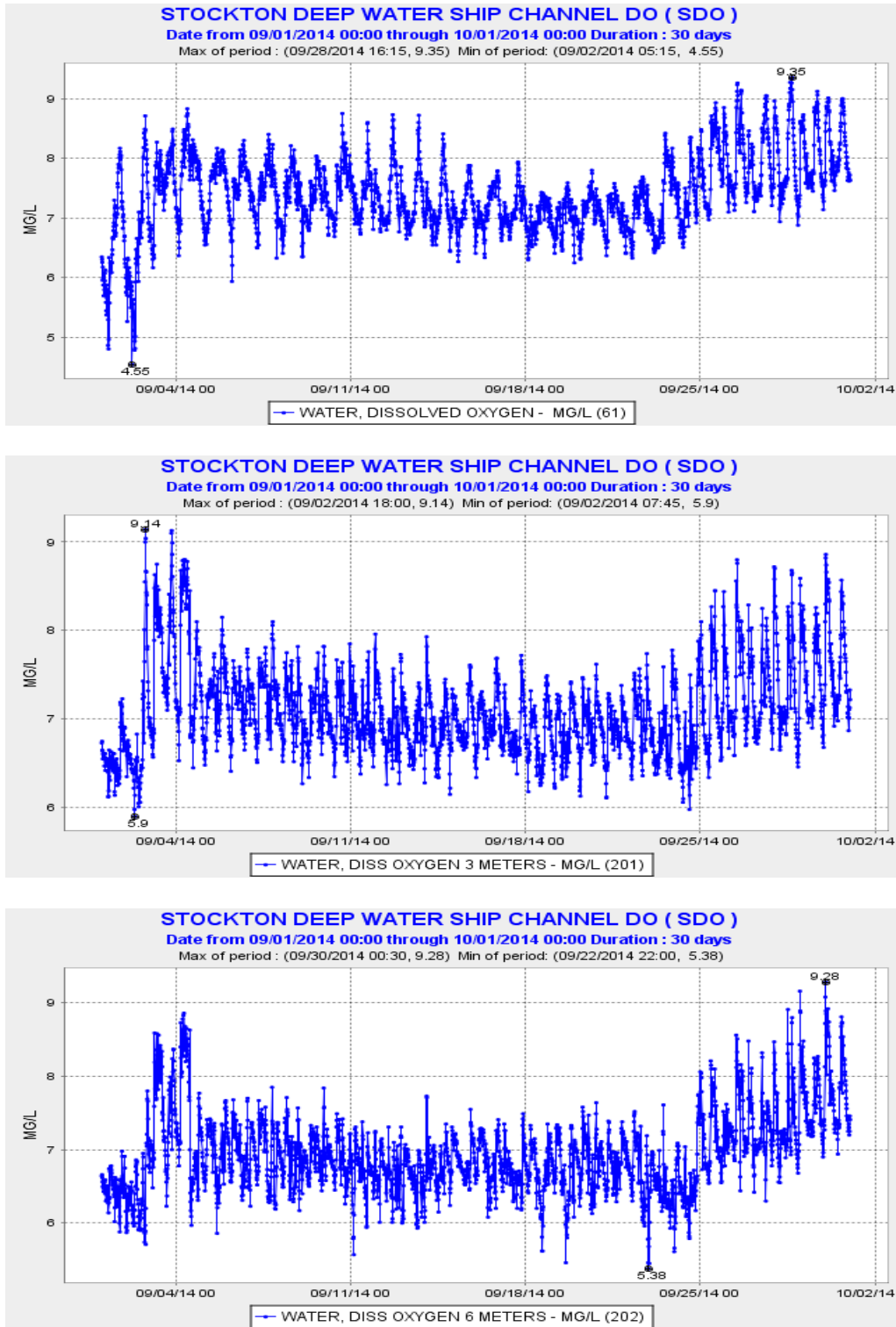


Figure 1. SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—September 2014

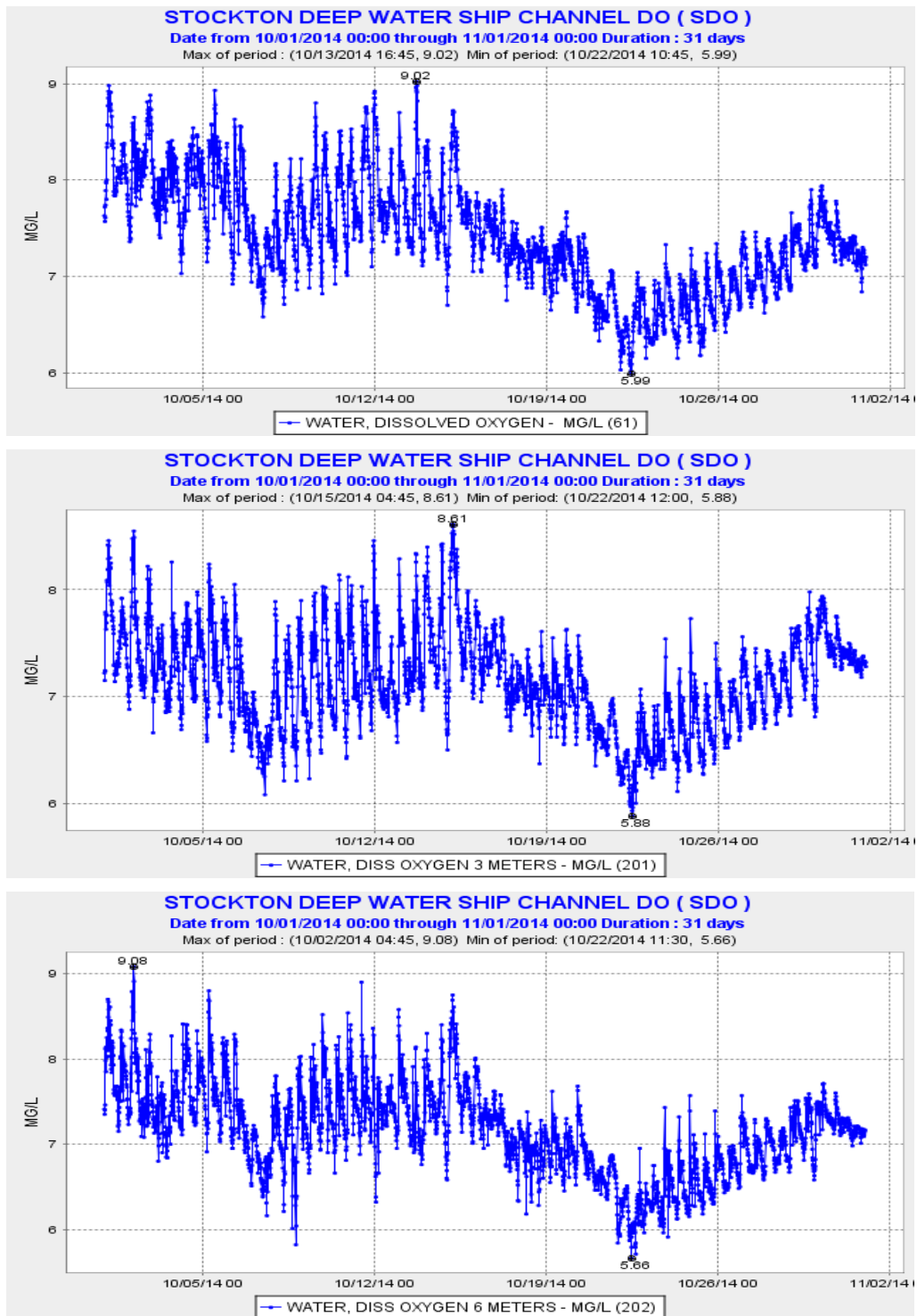


Figure 2. SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—October 2014

## Facility Monitoring

During periods of operation the facility was inspected daily during the work week to check for potential problems and ensure proper function. Gages and meters were checked to confirm proper function and normal readings. The water and oxygen systems were checked for any signs of wear or damage that could affect performance. Operational data were logged during all periods of operation including intake and discharge DO concentrations, water flow and pressure, oxygen flow and pressure, and liquid oxygen tank level and pressure.

## Facility Operations and Dissolved Oxygen Inputs

The facility was operated on 58 days in 2014. In order to operate efficiently the facility was turned on and off as conditions warranted and the response in the DWSC was monitored. The decision to turn the aeration facility on or off was based on several factors including current DO concentrations, the trend of DO over the previous 7-10 days, current and anticipated water flow in the DWSC, and forecasted weather conditions.

Typically one or two DO data points below the objective, at a single monitoring depth, in a 24-hour cycle was not deemed enough to warrant operation of the facility.

Efforts were made to operate the two pumps equally to avoid uneven wear to the system. If only one pump was needed for an extended period the operator would periodically switch which pump was being operated.

Due to variable conditions in the DWSC the water and oxygen flow rates needed to maintain DO above the water quality objective fluctuate. Therefore, the process of monitoring and adjusting oxygen inputs was ongoing during periods of operation.

DO inputs for 2014 were calculated using the measured DO increment and equation 3 from *Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project Final Report*.

$$\begin{aligned}\text{Oxygen capacity (lb/day)} &= 28.317 \text{ lb/cf} \times (\text{lb} / 4.536 \times 10^5 \text{ mg}) \times 86,400 \text{ sec/day} \times \text{DO increment (mg/l)} \times \text{water flow (cfs)} \\ &= 5.4 \times \text{DO increment (mg/l)} \times \text{water flow (cfs)}\end{aligned}$$

Operational data was recorded once per day during the work week. The facility was not monitored on weekends or holidays so daily DO inputs on those days were assumed to be the same as the most recent day data was recorded. Tables 1 and 2 provide a summary of the periods of operation and the estimated oxygen inputs.

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**Table 1. Dock 20 Aerator Operations Data— September 2014**

Date	Duration (hours)	Water Flow (cfs) <sup>1</sup>	Oxygen Flow (scfh)	Gas/Water Ratio (%)	Added DO Increment (mg/L)	Estimated O <sub>2</sub> Input (lbs/day)
2-Sep	12.25	45	5,300	3.3	27.9	3,456
3-Sep	24	45	5,300	3.3	26	6,318
4-Sep	9.75	45	5,500	3.4	26.2	2,583
4-Sep	14.25	25	2,250	2.5	24.4	1,954
5-Sep	24	25	2,250	2.5	25.7	3,465
6-Sep	24	25	2,250	2.5	25.7	3,470
7-Sep	24	25	2,250	2.5	25.7	3,470
8-Sep	24	25	2,250	2.5	26.7	3,605
9-Sep	24	25	2,250	2.5	25.2	3,402
10-Sep	24	25	2,250	2.5	25.2	3,402
11-Sep	24	25	2,250	2.5	23.7	3,200
12-Sep	24	25	2,250	2.5	23.6	3,186
13-Sep	24	25	2,250	2.5	23.6	3,186
14-Sep	24	25	2,250	2.5	23.6	3,186
15-Sep	24	25	2,250	2.5	24.2	3,267
16-Sep	24	25	2,250	2.5	23.5	3,173
17-Sep	24	25	2,250	2.5	24.5	3,308
18-Sep	24	25	2,250	2.5	23.3	3,146
19-Sep	24	25	2,250	2.5	23	3,105
19-Sep	24	25	2,250	2.5	23	3,105
20-Sep	24	25	2,250	2.5	23	3,105
21-Sep	24	25	2,250	2.5	23	3,105
22-Sep	24	25	2,250	2.5	23	3,105
23-Sep	24	25	2,250	2.5	23.5	3,173
24-Sep	10	25	2,250	2.5	23.9	1,343
24-Sep	14	45	3,800	2.3	23.9	3,384
25-Sep	24	45	3,800	2.3	22.9	5,565
26-Sep	24	45	3,800	2.3	22.5	5,468
27-Sep	24	45	3,800	2.3	22	5,346
28-Sep	24	45	3,800	2.3	21.7	5,273
29-Sep	24	45	3,800	2.3	21.4	5,200
30-Sep	24	45	3,800	2.3	21.7	5,273

cfs = cubic feet per second

scfh = standard cubic feet per hour

mg/L = milligrams per liter

lbs = pounds

<sup>1</sup> 25 cfs = one pump in operation, 45 cfs = both pumps

**Table 2. Dock 20 Aerator Operations Data— October 2014**

Date	Duration (hours)	Water Flow <sup>1</sup> (cfs)	Oxygen Flow (scfh)	Gas/Water Ratio (%)	Added DO Increment (mg/L)	Estimated O <sub>2</sub> Input (lbs/day)
1-Oct	24	45	3,800	2.3	21.5	5,225
2-Oct	14	45	3,800	2.3	21.6	3,058
2-Oct	10	25	2,750	3.1	24.3	1,365
3-Oct	14	25	2,750	3.1	24.1	1,896
3-Oct	10	45	3,000	1.9	19.9	2,013
4-Oct	24	45	3,000	1.9	19.9	4,836
5-Oct	24	45	3,000	1.9	19.9	4,836
6-Oct	7.75	45	3,000	1.9	19.2	4,666
7-Oct	12.75	45	3,000	1.9	20.6	2,656
8-Oct	24	45	3,000	1.9	19.5	4,739
9-Oct	24	45	3,000	1.9	19.5	4,739
10-Oct	24	45	3,000	1.9	19	4,617
11-Oct	24	45	3,000	1.9	19.5	4,739
12-Oct	24	45	3,000	1.9	19.7	4,787
13-Oct	24	45	3,000	1.9	18.9	4,593
14-Oct	24	45	3,000	1.9	18.5	4,496
15-Oct	9.75	45	3,000	1.9	18.4	1,814
15-Oct	14.25	25	2,000	2.2	19.6	1,569
16-Oct	24	25	2,000	2.2	20.7	2,795
17-Oct	24	25	2,750	3.1	24.9	3,362
18-Oct	24	25	2,750	3.1	24.9	3,362
19-Oct	24	25	2,750	3.1	24.9	3,362
20-Oct	11.75	25	2,750	3.1	24.5	1,617
22-Oct	7	25	2,750	3.1	25.4	999
23-Oct	24	25	2,750	3.1	25.1	1,945
24-Oct	24	25	2,750	3.1	25.3	1,961
25-Oct	24	25	2,750	3.1	25.3	1,961
26-Oct	24	25	2,750	3.1	25.3	1,961
27-Oct	24	25	2,750	3.1	26	2,015
28-Oct	24	25	1,500	1.7	17.5	1,356
29-Oct	24	25	1,500	1.7	17	1,318
30-Oct	15.75	25	1,500	1.7	17.4	1,540

cfs = cubic feet per second

scfh = standard cubic feet per hour

mg/L = milligrams per liter

lbs = pounds

<sup>1</sup> 25 cfs = one pump in operation, 45 cfs = both pumps

## Cost Allocation

Total costs for 2014 were higher than those for 2012 and 2013 due to an increase in the number of days of operation. Expenditures for maintenance and repairs were relatively low however higher repair costs are expected for 2015 as the bulk of the expenses related to the pump repair were not invoiced in 2014. Table 3 shows the costs by component and Table 4 shows the breakdown of contributions by each stakeholder.

**Table 3. Operations Costs—2014**

Operations Component	Cost
Technical services, including daily DO monitoring and onsite maintenance and operation	\$34,685.10
Bulk liquid oxygen	\$15,315.59
Electric utility	\$40,143.96
Maintenance and repairs	\$1,090.00
Total	\$91,234.65

**Table 4. Stakeholder Funding Allocations—2014**

Stakeholder	Contribution
Port of Stockton—33.33%	\$30,408.51
San Joaquin River Group—25.00%	\$22,808.66
San Luis & Delta-Mendota Water Authority and San Joaquin Valley Drainage Authority—25.00%	\$22,808.66
State Water Contractors—16.67%	\$15,208.82
Total	\$91,234.65