Memorandum

Date:	March 30, 2016
To:	Jason Cashman Environmental Manager Port of Stockton 2201 W. Washington Street Stockton, CA 95203
cc:	Rita Koehnen Environmental Specialist Port of Stockton
From:	Michael Wingfield Project Manager ICF International
Subject:	**Summary of Aeration Facility Operations, Maintenance, and Costs—2015**

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 2015 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[1] for DO. This report provides a summary of DO conditions in the DWSC, operations and maintenance of the aeration facility that occurred January 1, 2015 through December 31, 2015 and the allocation of costs to all parties signatory to the Agreement.

Maintenance, Repairs, and Upgrades

In preparation for aerator operations staff performed a general inspection of the facility in April and checked all system components for excessive or abnormal wear and proper function. Lubricant levels and conditions were checked and the pipes and hoses that feed water to the intake and

[1] 5.0 milligrams per liter (mg/L) December through August, 6.0 mg/L September through November

discharge DO probes were disassembled, cleaned, and reassembled. The DO probes were also reconditioned and calibrated.

Repair of pump A, continued from 2014, was completed prior to the start of 2015 operations. The repairs were a significant undertaking that required a crane to remove the entire pump assembly to allow access to the drive shaft, impeller, and pump bowls. The work included a rebuild of the pump bowl assembly including new wear rings, bearings, and machining of the bowl housing.

In addition, telemetry system hardware and software was purchased and installed in an attempt to bring the data loggers online. The system was originally designed to allow for remote monitoring of operational data however the hardware/software has never been fully functional. Though progress was made the upgrade was not completed by the end of the year and those efforts will continue in 2016.

Ambient Dissolved Oxygen Monitoring and Conditions

DO is monitored daily using data collected by the California Department of Water Resources (DWR). DO is data collected at three depths (1, 3, and 6 meters) at the Stockton Deep Water Ship Channel DO station (SDO), located on Dock 20 at the Port.

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. The DO sampling devices are maintained and calibrated by DWR staff on a weekly basis. There were several periods during 2015 that the SDO data was intermittently unavailable, most notably from August 15th to 25th for the 1-meter sensor.

DO concentrations in the DWSC were above the objective for most of 2015 with episodes of DO below the water quality objective occurring in July, August, September, and October. SDO station DO data for July through October are shown in Figures 1 through 4 with the red lines indicating the applicable water quality objective for DO.

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 54 days in 2015. 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 were calculated using the measured DO increment and equation 3 from *Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project Final Report*.

Oxygen capacity (lb/day) = 28.317 lb/cf x (lb /4.536 x 10^5 mg) x 86,400 sec/day x DO increment (mg/l) x water flow (cfs)

= 5.4 x DO increment (mg/l) x water flow (cfs)

Operational data was typically 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 through 3 provide a summary of the periods of operation and the estimated oxygen inputs.

Table 1. Dock 20 Aerator Operations Data— July/August 2015

Date	Duration (hours)	Water Flow (cfs)[1]	Oxygen Flow (scfh)	Gas/Water Ratio (%)	Added DO Increment (mg/L)	O_2 Input (lbs)
31-Jul	13.5	45	5400	3.3	25	3413
1-Aug	24	45	5400	3.3	25	6075
2-Aug	24	45	5400	3.3	25	6075
3-Aug	11	45	5400	3.3	25	2781
3-Aug	13	25	2700	3.0	25	1826
4-Aug	9.5	25	2700	3.0	25	1334
18-Aug	10	25	2700	3.0	25	1405
19-Aug	24	25	2700	3.0	25	3375
20-Aug	10	25	2700	3.0	25	1405
31-Aug	15.5	45	6600	4.1	30	4703

cfs = cubic feet per second
scfh = standard cubic feet per hour
mg/L = milligrams per liter
lbs = pounds
[1] 25 cfs = one pump in operation, 45 cfs = both pumps

Table 2. Dock 20 Aerator Operations Data— September 2015

Date	Duration (hours)	Water Flow (cfs)[1]	Oxygen Flow (scfh)	Gas/Water Ratio (%)	Added DO Increment (mg/L)	Estimated O_2 Input (lbs/day)
1-Sep	24	45	6600	4.1	30	7290
2-Sep	24	45	6600	4.1	30	7290
3-Sep	24	45	6600	4.1	30	7290
4-Sep	12	45	6600	4.1	30	3641
5-Sep	14	45	5500	3.4	25	3540
6-Sep	24	45	5500	3.4	25	6075
7-Sep	24	45	5500	3.4	25	6075
8-Sep	9	45	5500	3.4	25	2275
8-Sep	15	25	3000	3.3	25	2107
9-Sep	24	25	3000	3.3	25	3375
10-Sep	24	25	3000	3.3	25	3375
11-Sep	10	25	3000	3.3	25	1405
11-Sep	14	45	4500	2.8	25	3540
12-Sep	24	45	4500	2.8	25	6075
13-Sep	24	45	4500	2.8	25	6075
14-Sep	24	45	4500	2.8	25	6075
15-Sep	24	45	4500	2.8	25	6075
16-Sep	24	45	3500	2.2	20	4860
17-Sep	24	45	3500	2.2	20	4860
18-Sep	14	45	3500	2.2	20	2832
18-Sep	10	25	3700	4.1	30	1686
19-Sep	24	25	3700	4.1	30	4050
19-Sep	24	25	3700	4.1	30	4050
20-Sep	24	25	3700	4.1	30	4050
21-Sep	24	25	3700	4.1	30	4050
22-Sep	24	25	3700	4.1	30	4050
23-Sep	24	25	3700	4.1	30	4050
24-Sep	24	25	3700	4.1	30	4050
25-Sep	24	25	3700	4.1	30	4050
26-Sep	24	25	3700	4.1	30	4050
27-Sep	24	25	3700	4.1	30	4050
28-Sep	24	25	3700	4.1	30	4050
29-Sep	24	25	3300	3.7	30	4050
30-Sep	24	25	3000	3.3	25	3375

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Table 3. Dock 20 Aerator Operations Data— October 2015

Date	Duration (hours)	Water Flow[1] (cfs)	Oxygen Flow (scfh)	Gas/Water Ratio (%)	Added DO Increment (mg/L)	Estimated O_2 Input (lbs/day)
1-Oct	24	25	3300	3.7	30	4050
2-Oct	24	25	3300	3.7	30	4050
3-Oct	24	25	3300	3.7	30	4050
4-Oct	24	25	3300	3.7	30	4050
5-Oct	12	25	3300	3.7	30	2023
5-Oct	12	25	3000	3.3	25	1686
6-Oct	24	25	2700	3.0	25	3375
7-Oct	12.75	25	2700	3.0	25	1791
19-Oct	15.5	25	3300	3.7	30	2613
20-Oct	24	25	3300	3.7	30	4050
21-Oct	24	25	3300	3.7	30	4050
22-Oct	24	25	1500	1.7	20	2700
23-Oct	24	25	1500	1.7	20	2700
24-Oct	24	25	1500	1.7	20	2700
25-Oct	24	25	1500	1.7	20	2700
26-Oct	15	25	1500	1.7	20	1686

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Costs and Cost Allocation

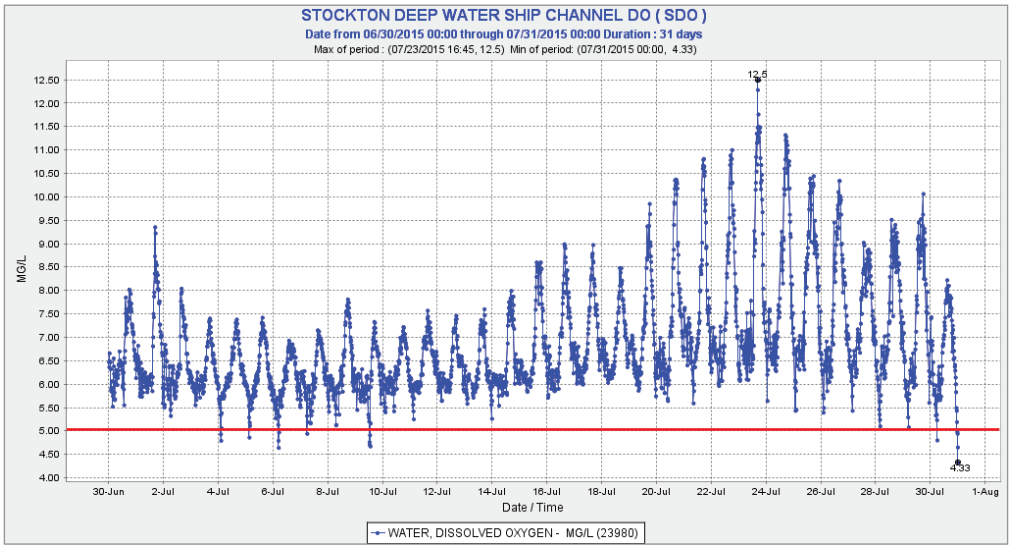
Total costs for 2015 were higher than previous years due primarily to the cost of the pump repair and telemetry system upgrades. Costs for electricity, oxygen, and technical support were consistent with previous years relative to the number of days of operation. Table 4 shows the costs by component and Table 5 shows the breakdown of contributions by each stakeholder.

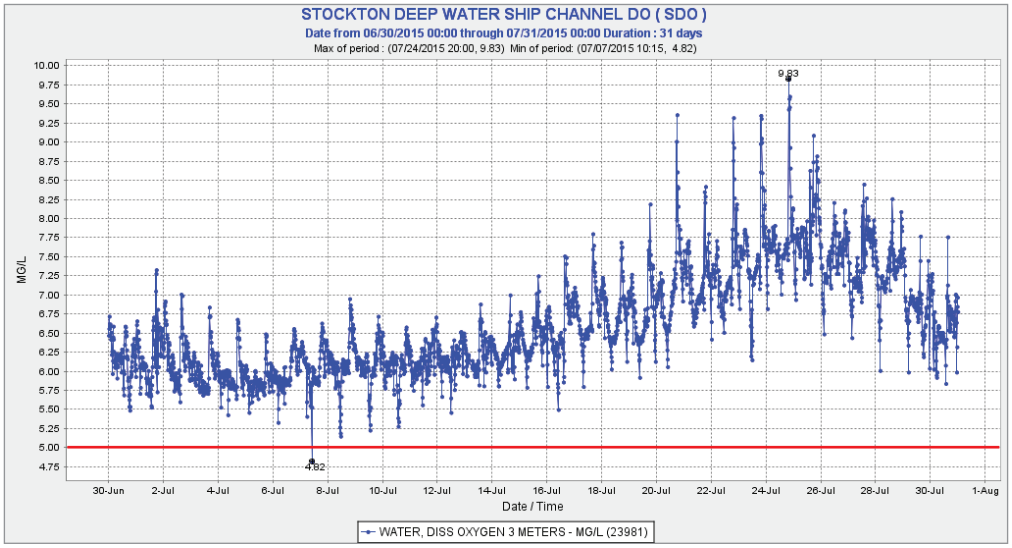
Table 4. Operations Costs—2015

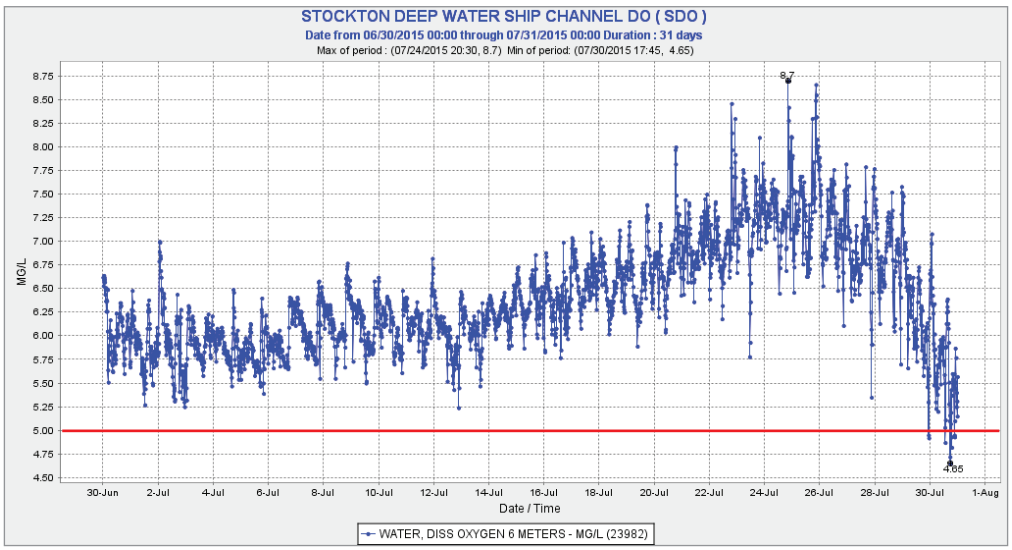
Operations Component	Cost
Technical services, including daily DO monitoring, routine maintenance and operation, and reporting	$ 28,978.46
Bulk liquid oxygen	$ 15,158.75
Electric utility	$ 33,292.00
Maintenance, Repairs, and Upgrades	$ 41,422.56
Total	$ 118,851.77

Table 5. Stakeholder Funding Allocations—2015

Stakeholder	Contribution
Port of Stockton—33.33%	$39,613.80
San Joaquin River Group—25.00%	$29,712.94
San Luis & Delta-Mendota Water Authority and San Joaquin Valley Drainage Authority—25.00%	$29,712.44
State Water Contractors—16.67%	$19,812.59
Total	$ 118,851.77

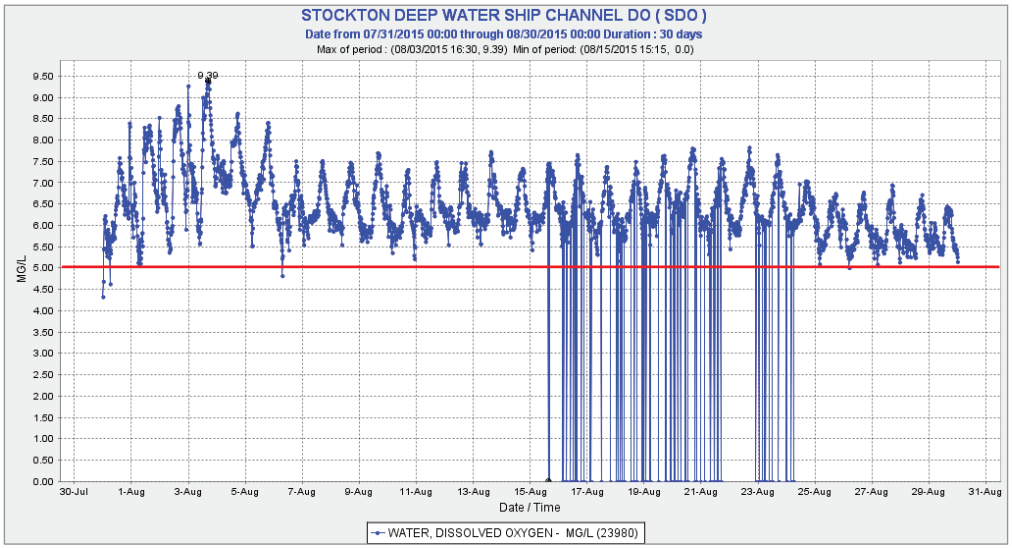


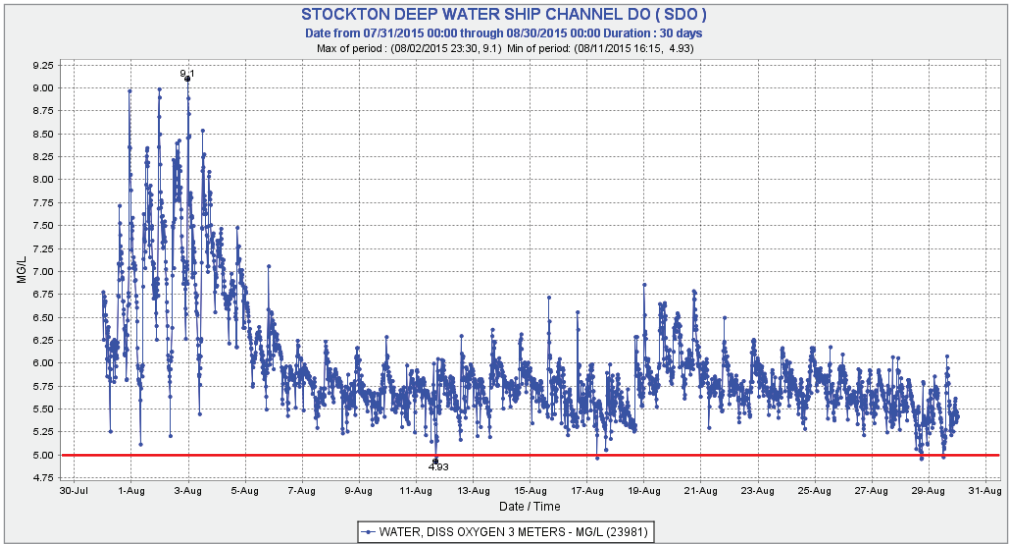


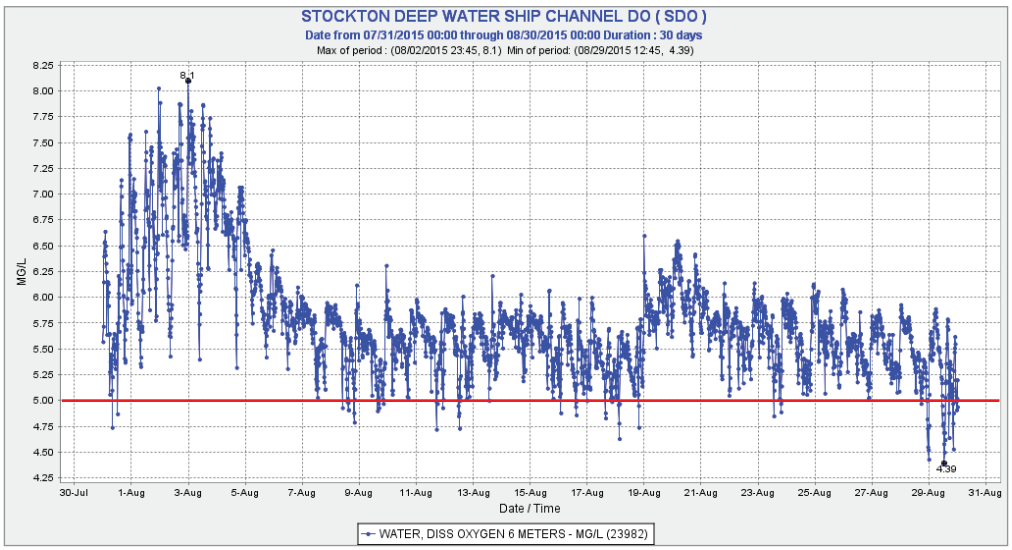


Dissolved Oxygen Water Quality Objective

Figure 1
SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—July 2015

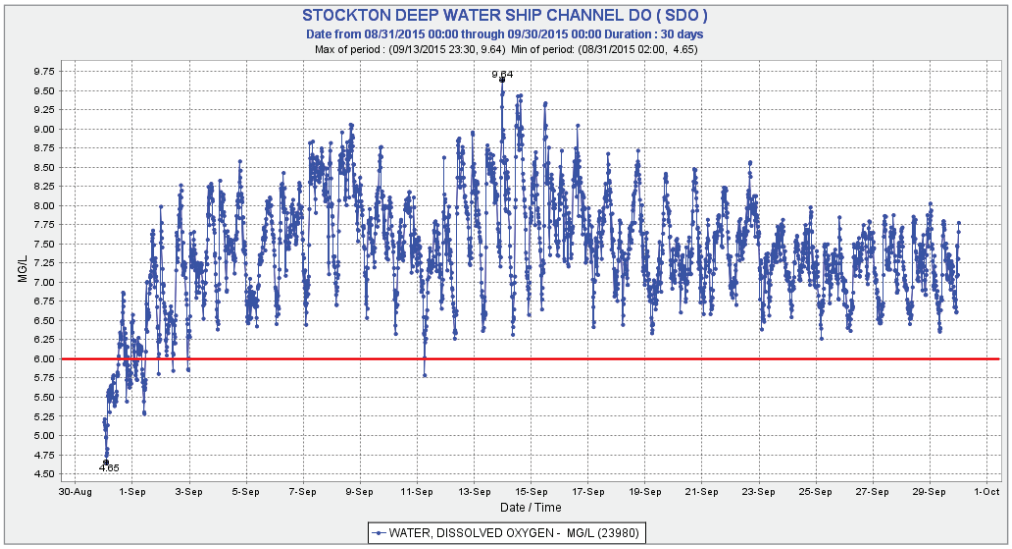


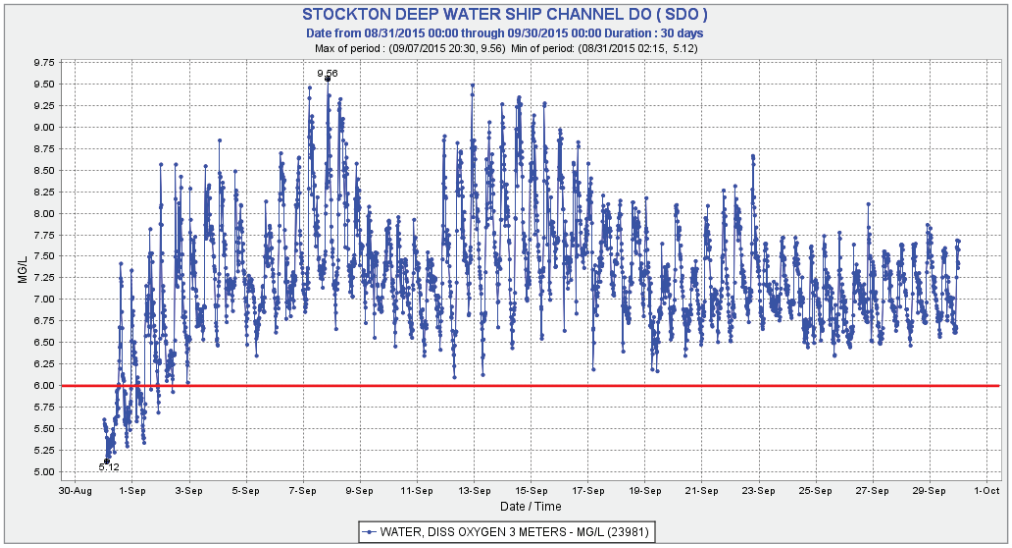


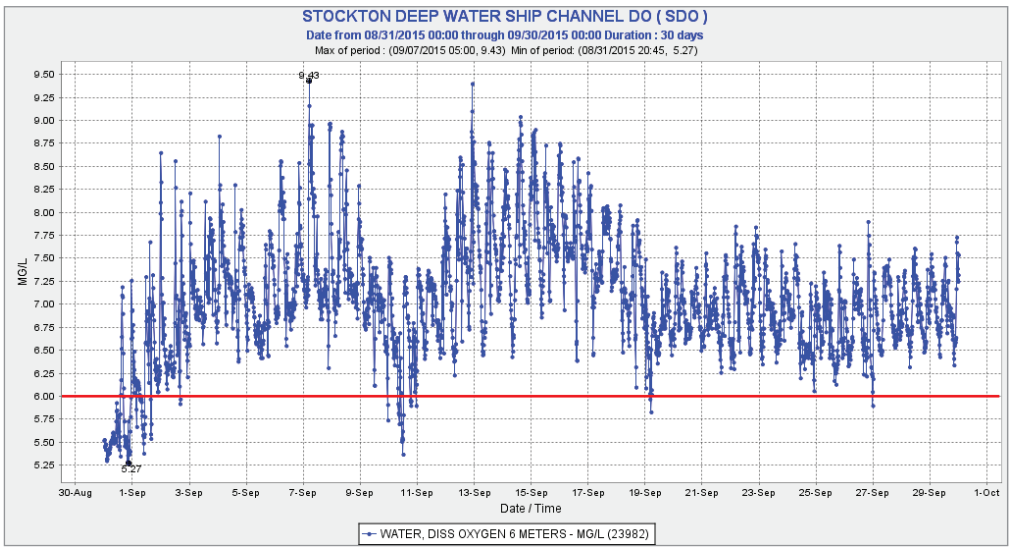


Dissolved Oxygen Water Quality Objective

Figure 2
SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—August 2015

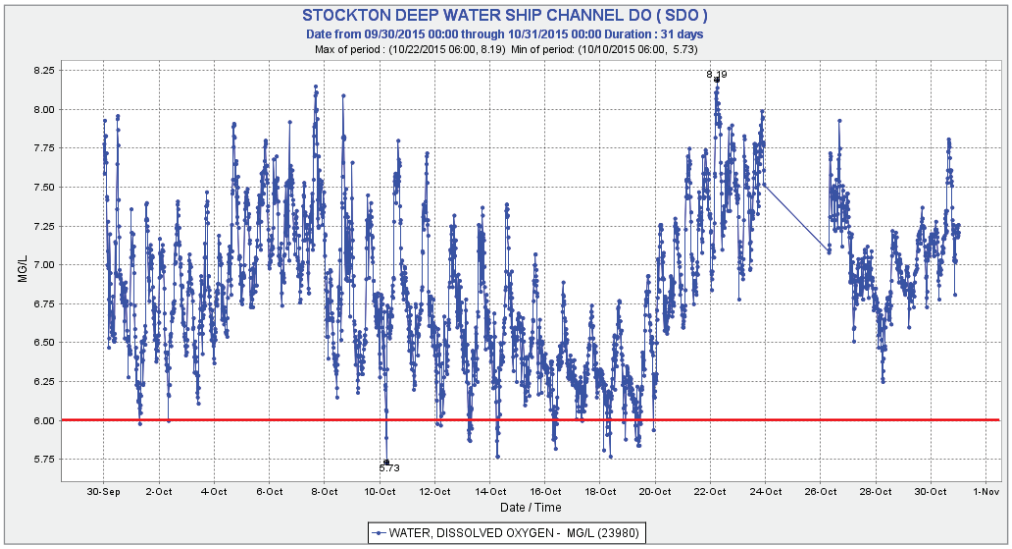


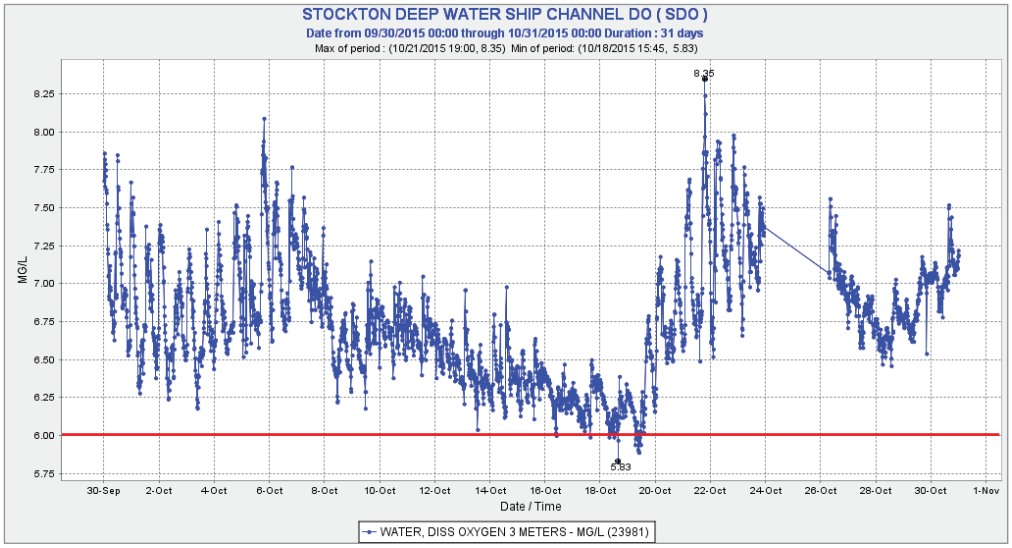


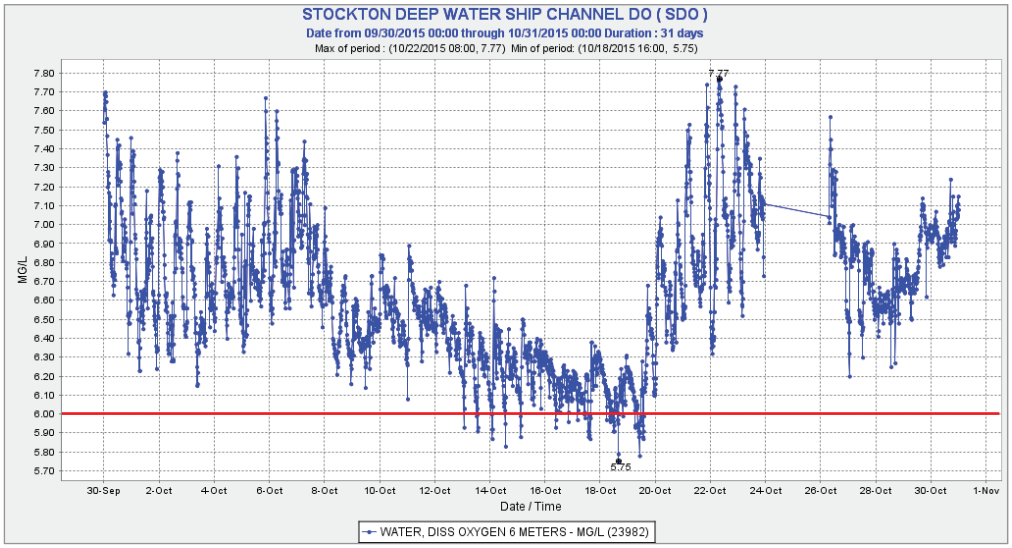


Dissolved Oxygen Water Quality Objective

Figure 3
SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—September 2015







Dissolved Oxygen Water Quality Objective

Figure 4
SDO 15-minute Dissolved Oxygen Data (1, 3, and 6 Meters)—October 2015