United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
9500 Thornton Avenue
Newark, California 94560

March 5, 2009

Mr. Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA. 94612

Subject: 2008 Annual Self-Monitoring Report For South San Francisco Bay Low Salinity Salt Ponds Order No. R2-2004-0018, WDID No. 2 019438001.

Dear Mr. Wolfe:

This letter transmits the 2008 Annual Self-Monitoring Report and Revised Operations Plans for the subject project at the U.S. Fish and Wildlife Service's (FWS) Alviso Salt Ponds in Santa Clara County. The California Department of Fish and Game will be submitting a separate report covering the Eden Landing Salt Ponds in Alameda County.

The report provides information on the main parameters of concern including salinity, metals, dissolved oxygen (DO), pH, and temperature. Note that we provided the raw monitoring data to your staff as it became available in order that both our agencies might learn about the operating conditions in these ponds. This report summarizes that data and provides some additional information.

Please contact me at (510) 792-0222 if you have questions regarding this report.

"I certify under penalty of law that this document and all attachments have been prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. The information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

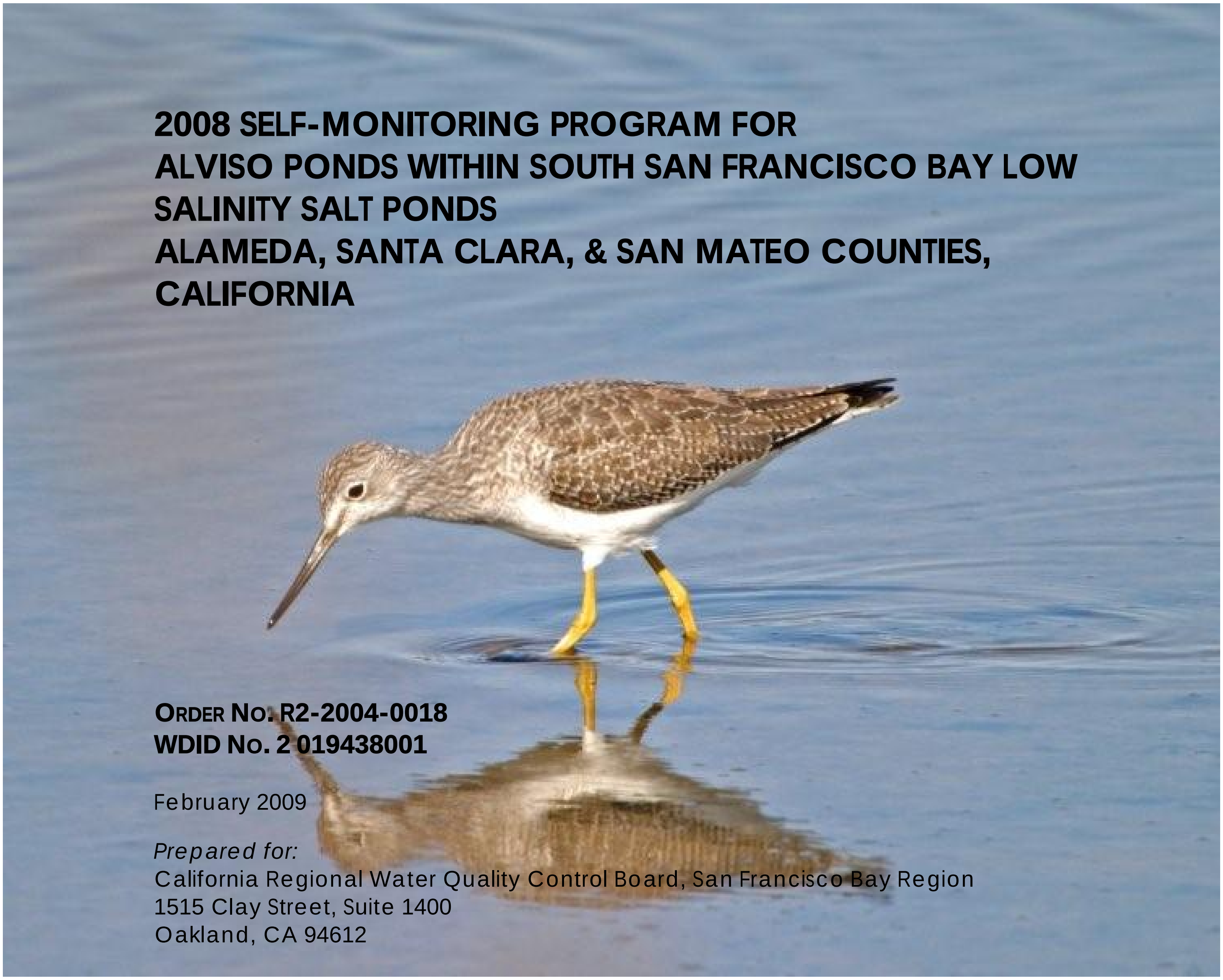
Sincerely yours,

Eric C. Mruz

Eric Mruz
Don Edwards SF Bay NWR
Refuge Manager

Enclosures

1. Self Monitoring Report



2008 SELF-MONITORING PROGRAM FOR ALVISO PONDS WITHIN SOUTH SAN FRANCISCO BAY LOW SALINITY SALT PONDS ALAMEDA, SANTA CLARA, & SAN MATEO COUNTIES, CALIFORNIA

ORDER NO. R2-2004-0018
WDID NO. 2 019438001

February 2009

Prepared for:
California Regional Water Quality Control Board, San Francisco Bay Region
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TABLE OF CONTENTS

Section Page

LIST OF APPENDICES

Appendix

LIST OF FIGURES

Figure Page

LIST OF TABLES

Table Page

LIST OF ACRONYMS

Acronym or Abbreviation	Full Phrase
ACOE	Army Corp of Engineers
Bay	South San Francisco Bay
cm	Centimeters
CCM	Continuous Circulation Monitoring
DANR	University of California, Davis Department of Agriculture and Natural Resources laboratory
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
FWS	United States Fish and Wildlife Service
Hg	Mercury
IRM	Initial Release Monitoring
ISP	Initial Stewardship Plan
LDO	Luminescent Dissolved Oxygen
meHg	Methymercury
mg/L	Milligrams per Liter
MLLW	Mean Low Lower Water
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
ppt	Parts per Thousand
RW	Receiving Water
RWQCB	California Regional Water Quality Control Board
THg	Total Mercury
TSS	Total Suspended Solids
USGS	United States Geological Survey

WCS	Water Control Structure
WQO	Water Quality Objective

ACKNOWLEDGMENTS:

We thank John Takekawa, David H. Schoellhamer, Nicole D. Athearn, Kathleen D. Henderson, William Chan, Stacy Moskal, Sara Piotter, Polly Gibson, Carmen Daggett, Kristin Brailsford, Joel Shinn, Lacy Smith, Seth Lanning, Tara Schraga, Sarah Foster, Caitrin Phillips, Sara Swanson, Jim Kuwabara, and Francis Parchaso, of USGS, Mendel Stewart, Clyde Morris, Juan Flores, Norm Winkler, John Bradley, Cindy Ballard and staff of the Don Edwards San Francisco Bay National Wildlife Refuge, Steve Ritchie of the CA Coastal Conservancy, and Erin King

A special thanks to Gregory Shellenbarger, and Brent Topping of USGS for providing there provisional data for this report.

Disclaimer for this Provisional Data: These data from the USGS have not received Director's approval and as such are provisional and subject to revision. The data are released on the condition that neither the USGS nor the United States Government may be held liable for any damages resulting from its authorized or unauthorized use.

SECTION 1
PROJECT OVERVIEW

This annual report summarizes the results of the 2008 water quality sampling conducted at the Alviso Ponds in Santa Clara County, California, which are part of the South San Francisco Bay Low Salinity Salt Ponds. Operations occurred from May through October 2008. Sampling was performed on a continuous, weekly, monthly, or bi-monthly schedule as required by the California Regional Water Quality Control Board (RWQCB) Final Order (No. R2-2004-0018). Sampling was performed by the United States Geological Survey (USGS) on behalf of the United States Fish and Wildlife Service (FWS) in accordance with the waste discharge requirements.

The Final Order for the South San Francisco Bay Low Salinity Salt Ponds concerned 15,100 acres of ponds in Alameda, Santa Clara, and San Mateo Counties. The area encompasses the Alviso Pond Complex (Figure 1-1). This report covers the following pond systems within the complex: A2W, A3W, A7, A14, and A16. The systems are operated by the Don Edwards San Francisco Bay National Wildlife Refuge in Santa Clara County. The California Department of Fish and Game will submit a report for the Eden Landing (Baumberg) Ponds under a separate cover.

The ponds are generally being operated as flow-through systems with Bay or slough waters entering an intake pond within each pond system at high tides through a tide gate, passing through one or more ponds, and exiting the particular system's discharge pond to either a tidal slough or the Bay at low tides. The ponds only discharge at low tides for about 6 or 8 hours per day. Two ponds in the A3W and A7 systems, Ponds A3N and A8, respectively, were operated as seasonal ponds during 2008 and were not connected to this flow-through system. Also, Ponds A12, A13, and A15, part of the A14 pond system, are designed as batch ponds. Discharge occurs from Pond A15 to Pond A16 when salinity reaches over 130 ppt; it was not discharged on a batch basis in 2008.

The Final Order recognized two periods of discharges from the ponds. The first covered the Initial Release Period (IRP) when salinity levels would decrease from the initial levels in the ponds. The second period is the Continuous Circulation Monitoring (CCM) period after salinities went below the 44 parts per thousand (ppt) salinity discharge limit. Different monitoring plans were identified in the Final Order by RWQCB and revised in 2005 (March 25, 2005 letter) and 2008 (June letter) for each specific period and are reiterated below.

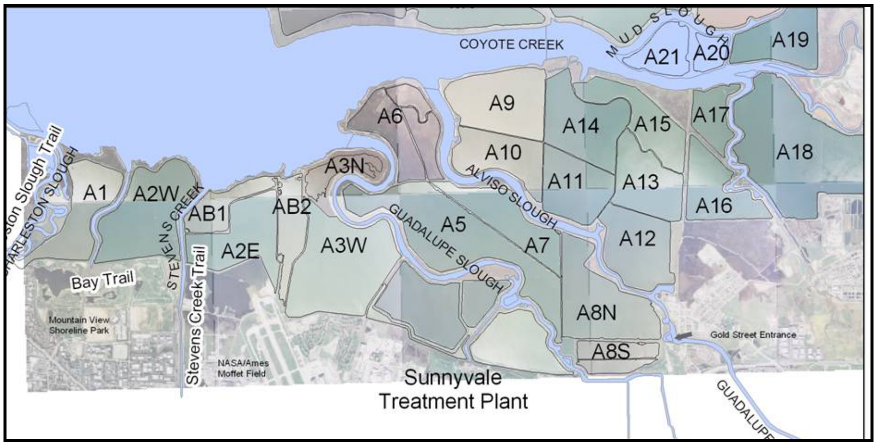


Figure 1-1: Alviso Pond Complex

1.1 RWQCB INITIAL RELEASE PERIOD MONITORING PLAN

Receiving water samples from the slough and Bay were collected at discrete locations near the water surface and bottom from downstream and upstream of the discharge point. This occurred one week before initiating discharge, one day after the initial discharge, three days later, and then seven days later. Sampling continued on a weekly basis until the FWS was able to document that the discharge salinity levels were below 44 ppt. Once discharge began, discharge pond samples were collected prior to pond water mixing with receiving water using a continuous monitoring device. Dissolved oxygen (DO) levels in the pond water during discharge, calculated on a weekly basis, were required to remain above a 10th percentile of 3.3 mg/L. If the dissolved oxygen levels fell below this requirement, the FWS was required to accelerate receiving water monitoring in the slough and/or Bay to weekly, notify RWQCB Staff, and implement best management practices to increase dissolved oxygen levels in discharged water, including within pond monitoring. For days it collects receiving water samples, the FWS also reported standard observations and documented what tidal phase samples were collected in. Additionally, the FWS made daily estimates of the quantity and time-period of discharge from the ponds and the strength of tides. All notes were recorded on standard monitoring sheets.

Samples for benthos were collected from discrete locations at the convenient stage of the tide at the following frequency: One week before initiating discharge; fourteen days after the initial discharge; 28 days following the second sampling; once in the late summer (August); and finally once in the late summer of the following year. Salinity samples were collected within ponds at least twice per month for at least the previous two months before discharges commenced. Dissolved oxygen samples were collected between 8:00 am and 10:00 am, with the times being recorded on the standard monitoring sheets.

1.2 RWQCB CONTINUOUS CIRCULATION PERIOD MONITORING PLAN

In order to provide a better balance between within pond water quality and receiving water quality, the Final Order was revised in June 2008 to help better understand what modifications should be made to managed ponds to improve dissolved oxygen levels in the longer term.

Receiving water samples from the slough and Bay were collected at discrete locations near the water surface and bottom from downstream and upstream of the discharge point. Samples were collected on a monthly basis between July and October 2008 as close to low tide as practicable. For days it collects receiving water samples, the FWS also reported standard observations and documented what tidal phase samples were collected in. Additionally, the FWS made daily estimates of the quantity and time-period of discharge from the ponds and the strength of tides. All notes were recorded on standard monitoring sheets.

To provide an examination of both spatial and temporal variability of water quality parameters within ponds and across seasons from early summer through fall, each pond, (A3W, A14, and A16) were divided into four sampling areas (intake, discharge, borrow ditch, shallow) with a continuous monitor device in each location for a period of two weeks for three times during the season.

For each of the four sampling areas, a continuous monitoring device was installed for a period of two weeks and recorded: pH, temperature, dissolved oxygen, and salinity every 15 minutes. Also collected during each sampling period were dissolved oxygen transects, nutrients, chlorophyll a, water discharge flow, pore water profiles, and meteorological measurements.

From July 28 to October 10, 2008, a continuous monitoring device was installed at the discharge points for Ponds A3W and A7. Discharge pond samples were collected before pond water mixed with receiving water using a continuous monitoring device.

SECTION 2
ANNUAL SUMMARY

This section summarizes the monitoring activities conducted by FWS during the 2008 calendar year at the Alviso Pond Complex to comply with the Final Order.

2.1 WATER QUALITY MONITORING METHODOLOGY

2.1.1 Continuous Pond Discharge Sampling (Initial Release and Continuous Circulation Phases)

USGS installed continuous monitoring Datasondes (Hydrolab-Hach Company, Loveland, CO) in Alviso ponds A3W and A7; the meters were installed and began logging on 28 July 2008 through 10 October 2008. Datasondes were installed inside the ponds on the water control structures, where they could measure water quality at the outflow of the discharge into the slough and/or San Francisco Bay. They were secured within submerged perforated ABS tubes attached to water control structures to allow for free water circulation around the sensors. The devices were installed at a depth of at least 25cm to ensure that all sensors were submerged, and these depths were monitored and adjusted to maintain constant submersion as the pond water level fluctuated (Figure 2-1).

Salinity, pH, temperature, and dissolved oxygen were collected at 15-minute intervals with a sensor and circulator warm-up period of 2 minutes. Data were downloaded weekly and sondes were serviced to check battery voltage and data consistency. A recently calibrated Hydrolab Minisonde was placed next to the Datasonde in the pond at the same depth, and readings of the two instruments were compared. Any problems detected with the Datasonde were corrected through calibration or replacement of parts or instruments. The sensors on the Datasonde were calibrated prior to deployment into the salt pond and were calibrated and cleaned on a biweekly schedule unless otherwise noted in service records. During the cleaning and calibration procedure, simultaneous readings were collected with a recently calibrated Hydrolab Minisonde (Hydrolab-Hach Company, Loveland, CO) to confirm data consistency throughout the procedure (initial, de-fouled, post-cleaned, and post-calibration). The initial and de-fouled

Figure 2-1: Datasonde holder within Weir Structure

readings were also used to detect shifts in the data due to accumulation of biomaterials and sediment on the sensors.

In addition to the continuous monitoring Datasondes used in Alviso ponds A3W and A7, the USGS conducted intensive In-Pond Dissolved Oxygen Investigations in Alviso ponds A3W, A16 and A14 from 25 May 2008 through 21 November 2008 on a rotating, 2-week cycle.

Table 2-1: Sampling Periods

Season	Pond	Sampling Period (2008)
Early – Mid-Summer	A3W A16 A14	25 May - 6 June 16 June - 27 June 7 July - 18 July
Mid – Late Summer	A3W A16 A14	28 July - 8 August 18 August - 29 August 8 September - 19 September
Fall	A3W A16 A14	29 September - 10 October 20 October - 31 October 10 November - 21 November

During each 2-week cycle the following sample types were collected:

- Datasonde – Six continuous sampling devices were installed within the following pond sections: intake (1), discharge (1), ditch (deep water; 2), and interior (shallow water; 2). These sondes recorded salinity, pH, temperature, and DO at 15-minute intervals.

- DO transects – To examine spatial variability across the ponds, DO transects were conducted twice during each sample period. One sampling event coincided with the lowest past DO readings during early morning (pre- or early dawn), while the second coincided with the highest past DO readings during mid to late afternoon. In most cases these transects were conducted on the same day and a minimum of 20 data points were collected during two perpendicular transects.

- Nutrients – To examine spatial variability across the ponds, representative nutrient samples were collected from each of the 4 pond sections at least once during each sample period. The number of samples collected varied between ponds and sampling period. These were analyzed for NO_3-N, NH_4-N, and total and soluble phosphorus.

- Chlorophyll a – To examine spatial variability across the ponds representative chlorophyll a samples were collected from each of the 4 pond sections at least once during each sample period. The number of samples collected varied between ponds and sampling period. These were filtered and analyzed for chlorophyll a and phaeopigments.

- Discharge (flow) – In order to determine volume of inflow to the pond and outflow from the pond discharge from the upstream pond into the study pond, from the study pond into the slough, and stage in each pond was measured for each pond during at least two of the sampling cycles. Discharge was measured using a 1200 KHz RD Instruments ADCP (acoustic Doppler current profiler) on a sled on the upstream side of a culvert.

- Pore-water profilers – Non-metallic pore-water profilers were deployed in each pond between 27 August and 1 October 2008. In each pond profilers were deployed in triplicate at two sites (1) a shallow (< 1 meter) and a deep site (>2 meters). Samples were analyzed to determine the diffusive flux of oxygen either into or out of the sediments, and the strength of the sediment oxygen demand or supply.

- Meteorological measurements – A portable weather station was installed at Alviso Pond A7 (chosen as a central location) and was used to collect meteorological data. Wind speed and direction, air temperature, relative humidity, Photosynthetically Active Radiation (PAR) and solar radiation were collected at 15-minute intervals during each sample period.

2.1.2 Alviso Receiving Water (IRP/CCM):

Beginning 29 July 2008, samples were collected monthly from A3W receiving water (Guadalupe Slough, 8 sites), A7 receiving water (Alviso Slough, 7 sites), A16 receiving water (Artesian Slough, 5-6 sites) and A14 (3 sites) through October 2008. We accessed slough sampling sites via boat from San Francisco Bay and used a GPS to navigate to sampling locations. When the boat was approximately 50-25 meters from the site, the engine would be cut or reduced to allow for drifting caused by current and wind to the site location. Every effort was made to ensure that the sample reading was collected from the center of the slough. A recently calibrated Hydrolab Minisonde was used to measure salinity, pH, turbidity, temperature, and dissolved oxygen at each location. Samples were collected from the near-bottom of the water column in addition to the near-surface (25 cm) at each sampling location. Depth readings of sample locations were collected at the completion of each Minisonde measurement to account for drift during the reading equilibration period. The specific gravity of each site was additionally measured with a hydrometer (Ertco, West Paterson, New Jersey) scaled for the appropriate range. This sample was collected concurrently with the near-surface Minisonde measurement. The majority of the samples were collected on the rising or high tide in order to gain access to the sampling sites, which were not accessible at tides less than 3.0 ft MLLW. Standard observations were collected at each site. These were:

A. Observance of floating and suspended materials of waste origin.

B. Description of water condition including discoloration and turbidity.

C. Odor – presence or absence, characterization, source and wind direction.

D. Evidence of beneficial use, presence of wildlife, fisherpeople and other recreational activities

E. Hydrographic conditions – time and height of tides, and depth of water column and sampling depths.

F. Weather conditions – air temp, wind direction and velocity, and precipitation

Sections A, B, C, D and E were recorded at each sampling location. Section F was recorded only at the beginning and end of each slough sampling session, unless it had changed significantly during the sampling period.

2.1.3 Calibration and Maintenance:

All the instruments used for sampling as part of the South Bay Salt Pond Initial Stewardship Plan's Self-Monitoring Program were calibrated and maintained according to the USGS standard procedures. Datasondes were calibrated pre-deployment and maintained on a biweekly cleaning and calibration schedule unless they required additional maintenance. The problem of algae and other substances interfering with the moving parts such as on the self-cleaning brush and circulator was improved with the use of nylon stockings. This allowed for maximum water flow past the sensor but stopped algae from wrapping around and binding the moving parts. Copper mesh and wire were used to inhibit growth in ponds with high concentrations of barnacles and hard algae, which could interfere with sensor function. We performed a biweekly fouling check to detect shifts in data due to the accumulation of biomaterial and sediment on the sensors. A calibration and maintenance log was maintained for each pond.

We estimated times of actual discharge as the period when the water surface elevation in the receiving waters was lower than the water surface elevation of the ponds. We converted NGVD29 pond staff gage readings to NAVD88 using Corpscon program (ACOE), and then converted NAVD88 to MLLW using estimated conversion values for the specific discharge location (G. Hovis, pers. comm.). Slough water surface elevation was estimated using Coyote Creek Station tide estimates, provided as MLLW feet (Tides and Currents Pro software). The pond was assumed to be discharging when the water surface elevation of the slough was less than that of the pond.

2.2 CONTINUOUS CIRCULATION MONTORING

Pond systems A2W, A3W, and A7 have been opened to the Bay and slough since 2004 and were being monitored during their Continuous Circulation Phases. Pond Systems A14 and A16 were opened to the sloughs on March 31, 2005 and were also being monitored under Continuous Circulation. During the 2008 monitoring season, only Pond A3W and Pond A7 (28 July 2008 through 10 October 2008.), were monitored for discharge since these two ponds have typically shown low DO throughout the summer months. . The results of the 2008 sampling events in the pond systems are documented below.

2.2.1 Pond A3W Discharge Samples

Average daily salinity, pH, temperature, and dissolved oxygen at the A3W discharge structure were compared with data collected on the same dates in previous years (2005-2007) and were found to be consistent with data collected during 2007 on the same calendar dates (Table 2-2). Salinity during 2007 and 2008 was somewhat higher than was recorded during the same dates in 2006 and 2005. Although pH was highly variable during all years, it has declined since 2005. Temperature has been generally consistent across years. Dissolved oxygen has been highly variable across years, but average daily DO concentrations were lower in 2007 and 2008 than they were in previous years, with many weekly 10th percentile values below 3.3 mg/L. (refer to figure A-1 in Appendix A)

2.2.2 Pond A7 Discharge Samples

Average daily salinity, pH, temperature, and dissolved oxygen at the A7 discharge structure were also compared with data collected on the same dates in previous years (2005-2007) and showed similar patterns to the A3W discharge data. Data collected during 2008 were found to be consistent with data collected during 2007 on the same calendar dates (Table 2-3). As with pond A3W, salinity during 2007 and 2008 was somewhat higher than was recorded during the same dates in 2006 and 2005, and pH was lower in 2007 and 2008 than it was in 2005. Temperature was generally consistent across years.

Dissolved oxygen has been highly variable across years, but average daily DO concentrations were lower during the summers of 2007 and 2008 than they were in previous years. Average daily summer DO concentrations in 2008 were consistently lower than 3.3 mg/L. Although this also occurred in previous years, the period of lowest DO in previous years began around the beginning of September and continued through the first three weeks of October. In 2008, DO was consistently low beginning when discharge data were first collected in July, and did not improve significantly through the cessation of data collection in mid-October. (refer to figure A-3 in Appendix A)

2.3 RECEIVING WATER SAMPLING

2.3.1 Receiving Water Analyses

The receiving water data was collected for the Alviso Complex from May – October 2008 (Figure 2-2). Samples that were taken just outside the discharge point of the Ponds which show

Table 2-2: 10th Percentiles for Dissolved Oxygen During Discharge in Pond A3W, 2008

Start Date	End Date	2008 data mg/L	2007 data mg/L	2006 data mg/L	2005 data mg/L	2004 data mg/L
4/23	4/30	n/a	1.7	4.7	5.1	n/a
5/1	5/5	n/a	2.7	4.2	3.5	n/a
5/6	5/12	n/a	3.1	4.3	3.8	n/a
5/13	5/19	n/a	2.6	3.2	4.4	n/a
5/20	5/26	n/a	1.7	5.2	3.8	n/a
5/27	6/2	n/a	0.0	5.4	3.6	n/a
6/3	6/9	n/a	0.0	5.0	3.8	n/a
6/10	6/16	n/a	0.2	3.5	3.5	n/a
6/17	6/23	n/a	1.0	2.7	3.9	n/a
6/24	6/30	n/a	1.6	2.3	3.6	n/a
7/1	7/7	n/a	1.6	2.7	3.7	n/a
7/8	7/14	n/a	0.6	2.7	4.5	n/a
7/15	7/21	n/a	0.4	2.3	1.7	0.1
7/22	7/28	n/a	0.7	0.5	1.9	0.7
7/29	8/4	0.1	0.8	2.6	2.6	0.1
8/5	8/11	0.1	1.3	2.9	3.6	0.4
8/12	8/18	0.3	0.8	2.9	3.5	0.1
8/19	8/25	0.5	0.2	3.4	3.6	0.1
8/26	9/1	0.1	0.4	2.5	1.9	0.1
9/2	9/8	0.8	0.3	1.9	0.6	0.1
9/9	9/15	0.4	0.7	2.5	3.6	0.1
9/16	9/22	0.1	1.1	4.7	2.2	0.1
9/23	9/29	0.1	1.3	3.2	3.8	0.1
9/30	10/6	0.3	2.1	2.8	1.4	0.1
10/7	10/13	0.3	2.0	4.0	4.0	0.1
10/14	10/20	n/a	3.4	4.6	4.0	1.1
10/21	10/27	n/a	2.7	2.8	3.5	2.0
10/28	11/3	n/a	3.4	5.7	5.6	2.5
11/4	11/10	n/a	4.9	n/a	5.2	4.2
11/11	11/13	n/a	7.0	n/a	n/a	n/a

* Data is based on a 10th percentile with 3.3 mg/L being the trigger for reporting non-compliance

Table 2-3: 10th Percentiles for Dissolved Oxygen During Discharge in Pond A7, 2008

Start Date	End Date	2008 data mg/L	2007 data mg/L	2006 data mg/L	2005 data mg/L	2004 data mg/L
4/24	4/30	n/a	n/a	5.9	3.2	n/a
5/1	5/6	n/a	n/a	4.8	1.3	n/a
5/7	5/12	n/a	3.5	5.5	2.2	n/a
5/13	5/19	n/a	4.8	4.9	1.9	n/a
5/20	5/26	n/a	3.9	5.3	2.5	n/a
5/27	6/2	n/a	3.6	5.9	2.7	n/a
6/3	6/9	n/a	4.0	2.7	3.5	n/a
6/10	6/16	n/a	3.6	3.4	3.1	n/a
6/17	6/23	n/a	4.0	3.5	4.0	n/a
6/24	6/30	n/a	3.9	4.0	2.8	n/a
7/1	7/7	n/a	3.6	5.4	3.8	n/a
7/8	7/14	n/a	3.2	4.5	4.7	n/a
7/15	7/21	n/a	3.8	4.4	4.7	n/a
7/22	7/28	n/a	3.5	3.9	4.7	0.7
7/29	8/4	0.1	3.6	5.3	4.7	0.2
8/5	8/11	1.0	4.7	6.0	4.7	2.5
8/12	8/18	0.0	4.6	5.9	4.6	2.7
8/19	8/25	0.3	2.8	5.8	5.1	2.7
8/26	9/1	0.0	1.5	4.1	4.1	1.5
9/2	9/8	0.0	0.1	3.5	2.8	0.6
9/9	9/15	n/a	0.1	4.1	3.2	0.5
9/16	9/22	1.1	2.2	4.4	2.1	1.2
9/23	9/29	1.0	0.3	2.9	1.2	0.4
9/30	10/6	0.1	0.6	2.4	1.4	2.3
10/7	10/13	2.0	0.2	3.5	2.8	3.3
10/14	10/20	n/a	1.5	4.0	2.7	3.0
10/21	10/27	n/a	3.3	4.1	2.4	2.2
10/28	11/3	n/a	1.3	5.7	4.5	0.9
11/4	11/10	n/a	3.4	n/a	4.2	2.5
11/11	11/17	n/a	5.8	n/a	n/a	3.8
11/18	11/19	n/a	5.0	n/a	n/a	4.5

* Data is based on a 10th percentile with 3.3 mg/L being the trigger for reporting non-complianc

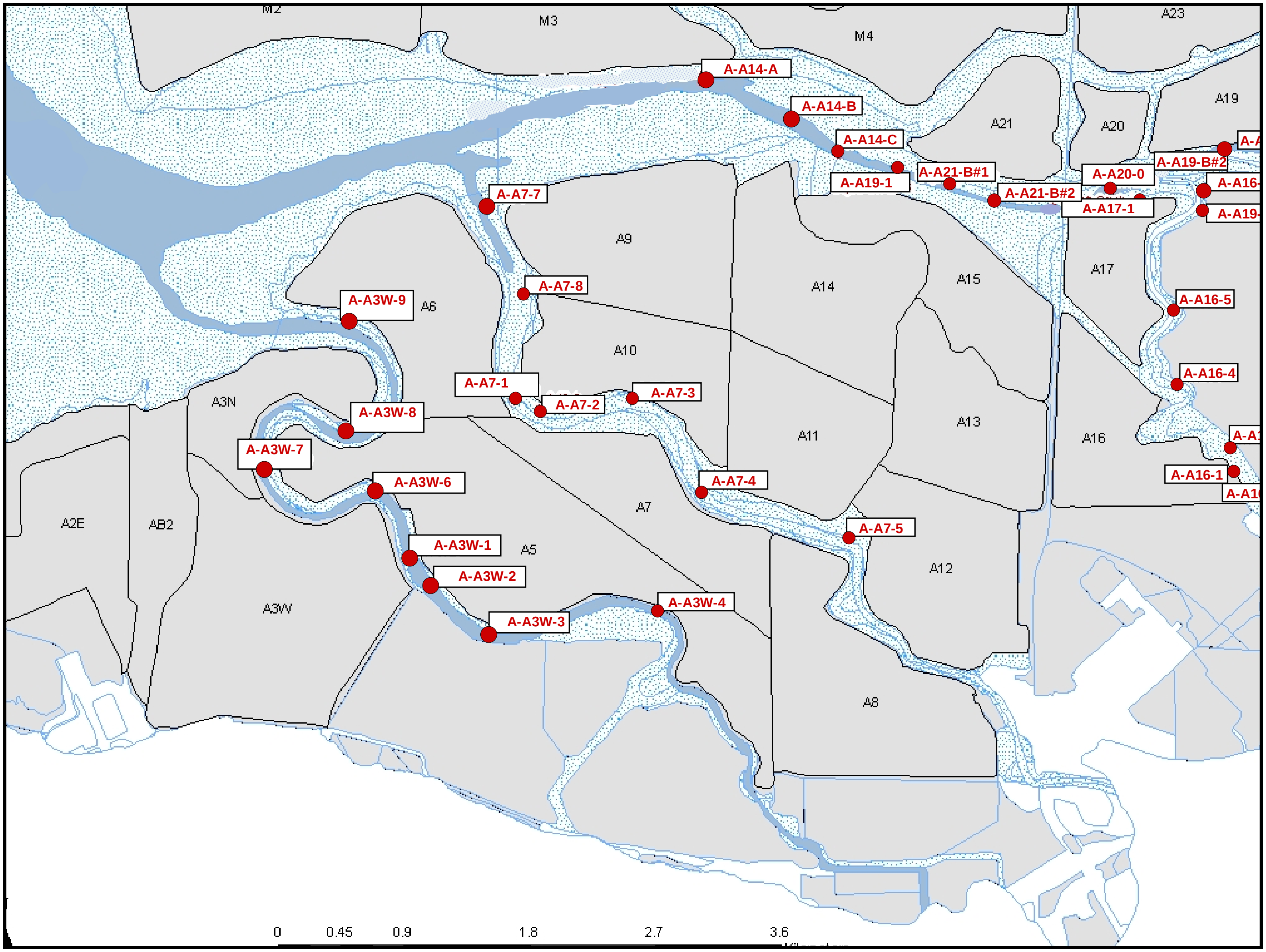


Figure 2-2: Receiving Water Sampling Locations

some salinity stratification between the surface and bottom samples that are most likely caused from the Ponds discharge. Figures A1 – A25 in Appendix A, plots the receiving water samples collected and the Pond discharge for water quality parameters of salinity, temperature, pH, and DO for each system in the Alviso Complex. Therefore, it may be assumed that water entering into a Pond system may already have depreciated DO values which may result in further depressed oxygen levels due to high nutrient levels and other biotic factors functioning in the Pond systems. USGS further evaluated the water quality in and around the Pond systems which state that the discharge from Pond A3W sometimes increased the DO concentrations in the receiving waters.

2.3.2 Pond A3W Receiving Water Samples

Data collected during receiving water sampling was compared to average daily values for the same parameter collected at the pond discharge location. Salinity in Guadalupe Slough was lower than pond discharge salinity. There was moderate vertical stratification, with bottom salinities 1-6 mg/L higher than values taken from the surface waters. There was a similar trend for pH values, with pond discharge pH higher than that measured in the slough, and bottom pH 0 – 0.3 units higher than surface waters. Temperature in the receiving waters was generally similar to or slightly lower than that at the pond discharge point, with no consistent trend in stratification. Dissolved oxygen was variable at the discharge point and slough readings were consistent with those measured in the pond, with surface DO slightly higher than bottom readings. (Refer to figure A-2 in Appendix A)

2.3.3 Pond A7 Receiving Water Samples

Data collected during receiving water sampling was compared to average daily values for the same parameter collected at the pond discharge location. Salinity in Alviso Slough was lower than pond discharge salinity. There was moderate vertical stratification, with bottom salinities 5 -11 mg/L higher than values taken from the surface waters. There was a similar trend for pH values, with pond discharge pH higher than that measured in the slough, and bottom pH 0.1 – 0.3 units higher than surface waters. Temperature in the receiving waters was generally similar to that at the pond discharge point, with no consistent trend in stratification. Dissolved oxygen was variable at the discharge point and slough readings were similar to or higher than those measured in the pond, with surface DO generally higher than bottom readings. (Refer to figure A-4 in Appendix A)

2.3.4 Pond A14 and A16 Receiving Water Samples

Salinity and pH in A14 and A16 receiving waters were generally stratified, with higher values near the bottom of the water column. DO and temperature showed the opposite trend, with higher values near the surface. Stratification was more pronounced in A16 receiving waters (Artesian Slough) than in A14 receiving waters (Coyote Creek mouth), likely due to greater mixing in A14 receiving waters (Table 2-4).

2.3.5 Nutrients and Chlorophyll

Nutrient and chlorophyll measurements were highly variable within pond A3W (Table 2-5) and are currently being analyzed for spatial and temporal patterns in conjunction with water quality and meteorological data.

Table 2-4: Receiving Water Quality Values

POND	Date	Depth	Salinity (ppt)	Dissolved Oxygen (mg/L)	Temperature (ºC)	pH (Units)
A14	7/29/2008	Bottom	n/a	5.8 ± 0.1	21.4 ± 0	7.4 ± 0
		Surface	24.4 ± 5.8	6.2 ± 0.5	22.0 ± 0.2	7.4 ± 0.1
	8/22/2008	Bottom	18.7 ± 2.3	2.7 ± 0.4	22.6 ± 0.2	7.7 ± 0.2
		Surface	14.7 ± 1.3	3.4 ± 0.1	24.2 ± 0.5	7.6 ± 0
	9/9/2008	Bottom	28.2 ± 0.8	4.9 ± 0.3	22.6 ± 0	8.0 ± 0
		Surface	23.4 ± 2.3	5.3 ± 0.8	23.0 ± 0.2	7.9 ± 0.1
	10/7/2008	Bottom	23.8 ± 3.4	3.7 ± 1.0	14.4 ± 10.1	7.6 ± 0
		Surface	16.1 ± 1.2	3.8 ± 0.3	21.5 ± 0.4	7.5 ± 0
A16	7/29/2008	Bottom	n/a	3.0 ± 0.8	22.7 ± 0.7	7.4 ± 0.2
		Surface	7.9 ± 9.5	5.4 ± 0.9	25.3 ± 1.7	7.2 ± 0.2
	8/22/2008	Bottom	17.4 ± 2.4	3.6 ± 1.2	24.7 ± 0.5	8.1 ± 0.3
		Surface	5.7 ± 2.2	5.7 ± 0.9	26.5 ± 0.3	7.5 ± 0.1
	9/9/2008	Bottom	20.5 ± 2.4	1.5 ± 0.9	23.8 ± 0.7	8.0 ± 0.3
		Surface	4.8 ± 2.9	5.2 ± 0.7	25.9 ± 0.9	7.5 ± 0.1
	10/7/2008	Bottom	20.1 ± 2.4	3.6 ± 2.0	22.3 ± 0.5	8.1 ± 0.2
		Surface	3.0 ± 2.2	5.9 ± 0.8	25.5 ± 0.7	7.0 ± 0.5
Salinity on 29 July 2008 was measured by hydrometer only and surface values only were available						

Table 2-5: Summarized Chlorophyll and Nutrient Values for Pond A3W

Sampling Date	CHL µg/L	PHEO µg/L	Nitrate + Nitrite (NO_3 + NO_2) µM	Ammonium (NH_4) µM	DIN µM	Phosphate (PO_4) µM
4 and 6 June 2008	10.99 ± 4.27	9.94 ± 3.91	9.02 ± 20.32	8.11 ± 13.41	17.12 ± 26.02	11.47 ± 4.60
6 August 2008 AM	16.59 ± 9.46	7.98 ± 8.13	17.41 ± 29.79	22.97 ± 24.09	40.38 ± 42.82	22.57 ± 6.89
6 August 2008 PM	31.61 ± 26.98	9.70 ± 7.40	24.32 ± 34.26	16.03 ± 14.28	40.35 ± 43.62	17.45 ± 2.58
9 October 2008	71.81 ± 16.80	47.56 ± 28.98	47.22 ± 87.83	29.81 ± 42.68	77.03 ± 127.69	21.35 ± 8.86

2.3.6 Meteorological Measurements

Meteorological data were relatively consistent during and across study periods, with no precipitation and wind primarily from the west (Table 2-6). Photosynthetically active radiation (PAR) and solar radiation were variable during the study period, but largely due to diurnal cycling.

Table 2-6: Summarized Weather Values (Mean ± Standard Deviation) by Study Period for Pond A3W

Sampling Period	Temperature (°C)	Relative Humidity (%)	Rainfall (cm)	Primary Wind Direction	Wind Speed (mph)	PAR Light (uM/m²s)	Solar Radiation (wat/m²)
25 May – 6 June 2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
28 July – 8 August 2008	16.94 ± 2.67	80.72 ± 11.41	0.00 ± 0.00	West	7.04 ± 6.00	1168.49 ± 750.73 Max: 2265	469.43 ± 347.79 Max: 983
29 September – 10 October 2008	17.79 ± 2.96	76.73 ± 14.56	0.00 ± 0.00	West	5.00 ± 5.02	790.17 ± 546.53 Max: 1747	341.10 ± 239.30 Max: 757
Wind direction determined from wind speed >5mph; PAR and solar radiation averages were calculated from values > 0 to exclude nighttime values.							

2.3.7 Pore Water Profilers (Data provided by B. Topping)

Estimates of Benthic Oxygen Flux in ponds A16, A14, and A3W

Three sets of sampling trips were coordinated in late summer 2008 to sample the interstitial and overlying bottom waters of three shallow (averaged depth <1 meter) ponds, previously used in commercial salt production, but more recently reclaimed for wetland restoration and management in areas adjacent to the southern component of San Francisco Bay (herein referred to as South Bay). A pore-water profiler, modified for dissolved-oxygen sampling, was used to obtain the first centimeter-scale estimates of the vertical concentration gradients for diffusive-flux determinations.

Within hours of recovering the samplers, each glass syringe was placed in a syringe pump which dispensed the sample at a steady rate. Dissolved oxygen (0.2 micron) was measured as the sample passed through a 1/8 inch acrylic 0.9-mL flow-through cell fitted with a microelectrode (Microelectrodes, Inc., Bedford, New Hampshire). The microelectrode was calibrated initially with helium-sparged water and sloped with air-saturated water. Periodic calibration checks were performed using oxygen-free helium and air in place of water.

Benthic flux of dissolved (0.2-micron filtered) oxygen was consistently negative (that is, drawn from the water column into the sediment) and ranged between 0.5 x 10^{-6} and 37 x 10^{-6} micromoles per square centimeter per second. Assuming a pond area of 1.0, 1.4, and 2.3 square kilometers for ponds A16, A14 and A3W, respectively, this converts to an oxygen mass flux into the ponds' sediment ranging from -1 to -72 kilograms per day. (See Tables 2-7 and 2-8.)

Table 2-7: Summary of Dissolved-oxygen Diffusive for Ponds A3W, A14, and A16

Site Name	Date	Site Average (µmole/cm²/s)	Site StDev (µmole/cm²/s)	Site Average (kg/d)	Site StDev (kg/d)
A16 Shallow #2	8/27/2008	-2.6E-05	7.8E-06	-23	7
A16 Deep #1	8/27/2008	-3.5E-05	1.3E-05	-30	11
A14 Shallow #1	9/11/2008	-5.4E-07	4.6E-07	-1	1
A14 Inlet	9/11/2008	-1.8E-06	1.4E-06	-2	2
A3W Shallow #2	9/30/2008	-3.4E-05	3.2E-06	-67	6
A3W Inlet	9/30/2008	-3.7E-05	1.3E-05	-72	25

Table 2-8: Individual Replicate DO

Site	Replicate	Dissolved Oxygen (µmole/cm²/s)
A16 Shallow #2	A	-3.38E-05
	B	-1.82E-05
	C	-2.73E-05
A16 Deep #1	A	-3.26E-05
	B	-4.87E-05
	C	-2.27E-05
A14 Shallow #1	A	-1.04E-06
	B	-1.75E-07
	C	-3.91E-07
A14 Inlet	A	-3.41E-06
	B	-9.22E-07
	C	-1.18E-06
A3W Shallow #2	A	-3.79E-05
	B	-3.35E-05
	C	-3.17E-05
A3W Inlet	A	-2.77E-05
	B	-5.13E-05
	C	-3.13E-05

2.3.8 Pond Flow Measurements (Data Provided by G. Shellenbarger)

Background

During the summer and fall of 2008, the USGS conducted detailed studies in three former salt ponds in the Alviso complex that are currently maintained by the US Fish and Wildlife Service as part of the Don Edwards National Wildlife Refuge. These studies were designed to explore sources and sinks of (dissolved) oxygen in Ponds A3W, A14, and A16 with a goal to develop a rough oxygen budget for each pond.

One critical component of an oxygen budget for the ponds is a pond water budget – quantifying the inflow and outflow of water to understand the residence time for water in each pond. The goal of this portion of the study is to develop equations that allow the prediction of inflow to and outflow from each pond based on the difference in water surface elevation between the discharging and receiving waters.

Methods

Alviso Ponds A3W, A14, and A16 were selected for this study. Flow rates were measured on the upstream end of each flow structure (Table 2-9) using a sled-mounted Acoustic Doppler Current Profiler (ADCP) as described in Shellenbarger et al. (2007). Head differences across a flow structure were determined by recording water surface elevations from pre-existing NGVD staff plates that are in the ponds and sloughs. A bottom-mounted ADCP was deployed in the inlet channel to Pond A16 from 21 October-11 November to provide a detailed time-series of flow in the channel.

Since the study ponds discharge water into tidal sloughs, the outflow rate from the ponds changes with the slough tidal stage. Outflow measurements for each pond were collected repeatedly between times when the slough tidal height was high and there was no outflow and lower tidal heights in the slough when the outflow through the discharge structure was roughly steady. Inflow rate to each pond was assumed to be a function of the difference in water surface elevation between two ponds (i.e., head). The pond water surface elevations are not tidally-driven and tend to be stable on a weekly time-scale, so inflow rates were measured until a study inflow rate was obtained (measurements were typically collected for 15 minutes to one hour for each sample). Over the entire study period, inflow to each pond was measured six times and outflow from each pond was measured twice (Table 2-9).

Table 2-9: Dissolved Oxygen Inflow for Sampling Periods at Flow Structures, Source Water, and Receiving Waters at Ponds A3W, A14, and A16

	A3W	A14	A16
Inflow structure	One 48" culvert	One 48" culvert	Open channel
Inflow source	Pond B2	Pond A11	Pond A17
Outflow structure	Three 48" culverts	One overflow weir	One overflow weir
Receiving water	Guadalupe Slough	Coyote Creek	Artesian Slough
Table depicts data for sampling periods 5-6 August, 19-20 August, 10-11 September, 30 September-1 October, 27-28 October, and 10-11 November 2008. Sampling periods 5-6 August and 30 September-1 October 2008 were periods when outflow was measured for a specific pond.			

Preliminary results

Inflow and outflow for each pond were successfully measured, and the results are displayed in Figures 2-3 through 2-10. Outflow rate from each pond changed with tidal stage in the receiving waters (sloughs). Inflow rates through culverts were more steady in time, while inflow through the open channel to A16 was highly variable in time.

Outflow: The relationship between culvert outflow rate and head for Pond A3W is displayed in Figure 2-3. Outflow became somewhat constant for heads over 1.1'. Measurements taken on 6

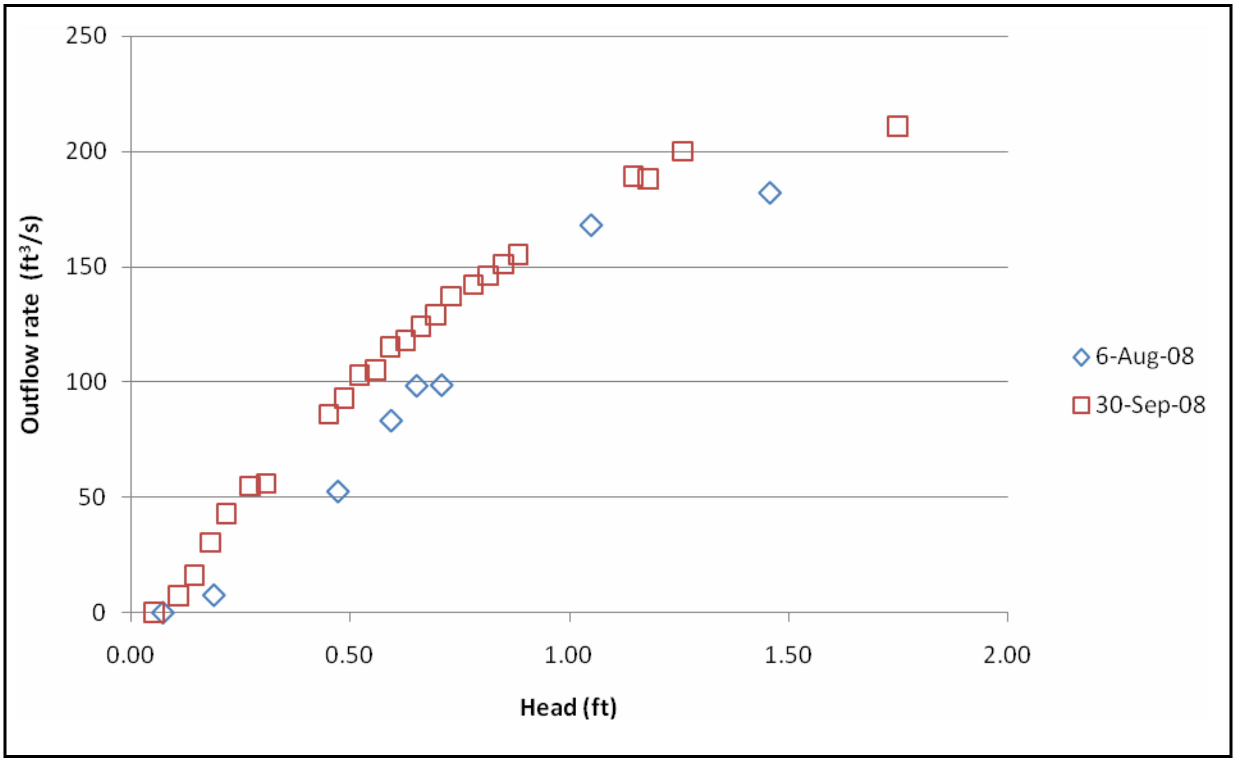


Figure 2-3: Three-Culvert Outflow Rate Vs. Head for the 2008 Sampling Periods at Pond A3W
(Flow is from Pond A3W into Guadalupe Slough.)

August show slightly lower outflows for the same head conditions as those collected on 30 September. There was no difference in gate operations between the two periods (Eric Mruz, personal communication), so there is not an obvious explanation for the slight difference between the two sets of measurements. However, these data agree reasonably well with data that were collected from this location in 2005 (Shellenbarger et al., 2007). Outflow from Ponds A14 and A16 was controlled by overflow weirs. Outflow from Pond A14 (Figure 2-4) was higher for the same head than outflow from Pond A16 (Figure 2-5), which is likely the result of the weirs being managed differently (Eric Mruz, personal communication). The weirs in both ponds exhibited reasonably constant flow at heads higher than 1'. The second sampling period in Pond A16 showed slightly lower maximum flow than the first sampling period (Figure 2-5). It is not immediately clear why this small difference exists. Note that there was positive outflow for Pond A14 at negative heads (Figure 2-4), which should be a physical impossibility. This issue is addressed below.

Inflow: The inflow for Ponds A3W and A14 are both through 48" culverts, but the inflow versus head relationships are different (Figures 2-6 and 2-7). This result is likely due to differing management of the gates on the culverts, but additional analysis will be required to confirm this. The inflow to Pond A16 occurs through an open channel and should follow a simple head-flow relationship. However, as seen in Figure 2-8, it is not possible to predict the inflow to Pond A16 based on the difference in water surface elevations in Ponds A16 and A17. This means that the flow in the channel results from physical forcing other than head. A 3-week, continuous time-

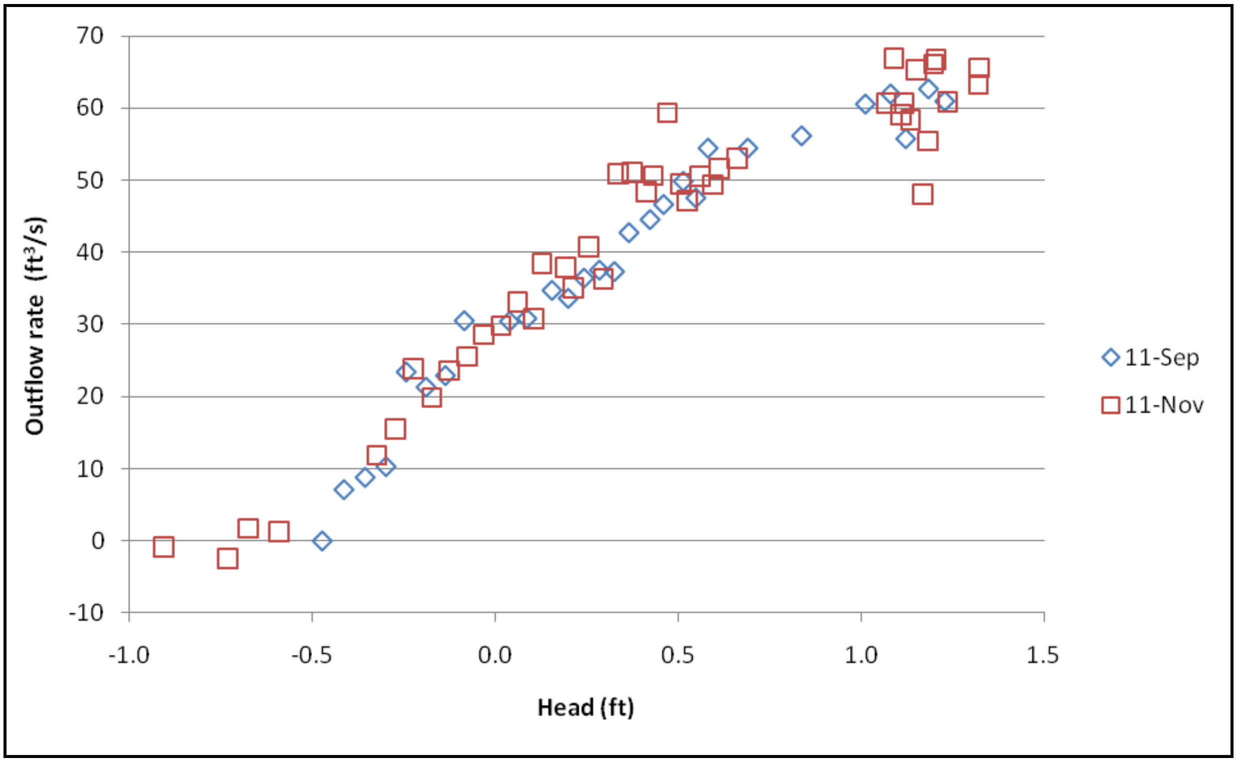


Figure 2-4: Weir Outflow Rate Vs. Head for the 2008 Sampling Periods at Pond A14
(Flow is from Pond A14 into Coyote Creek)

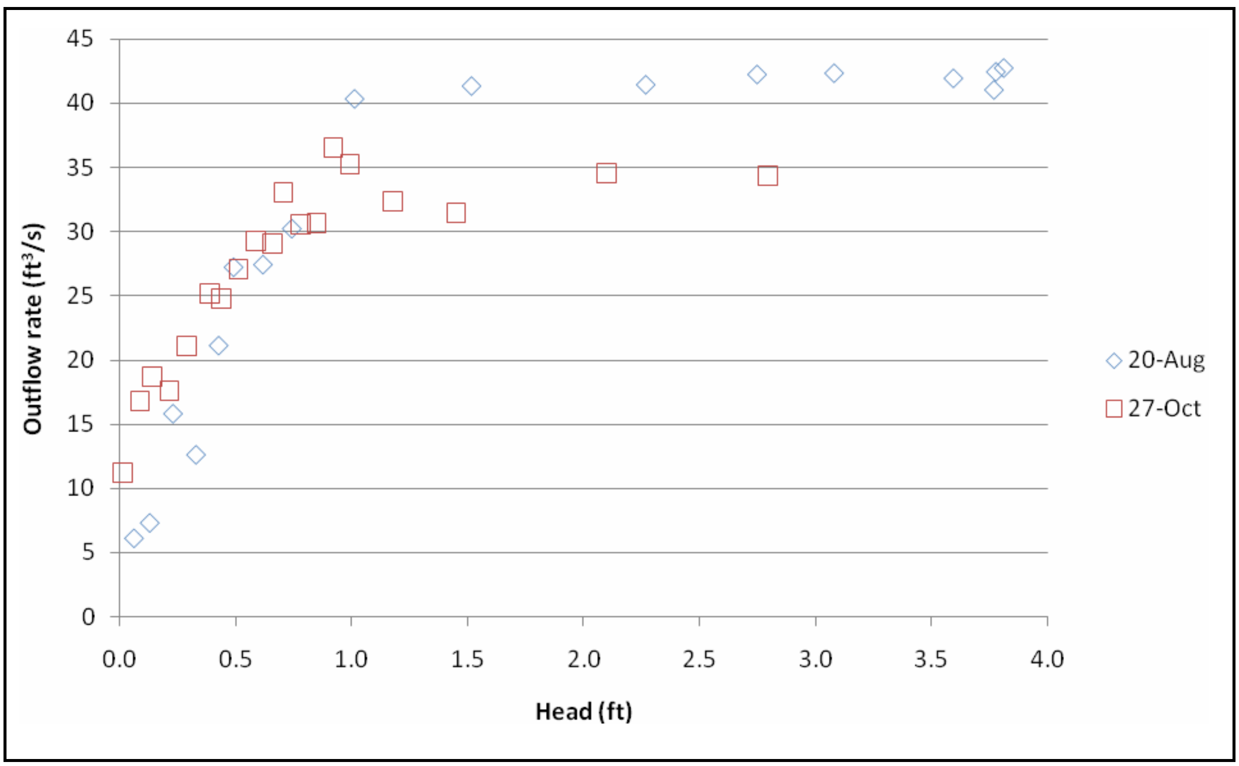


Figure 2-5: Weir Outflow Rate Vs. Head for the 2008 Sampling Periods at Pond A16
(Flow is from Pond A16 into Artesian Slough.)

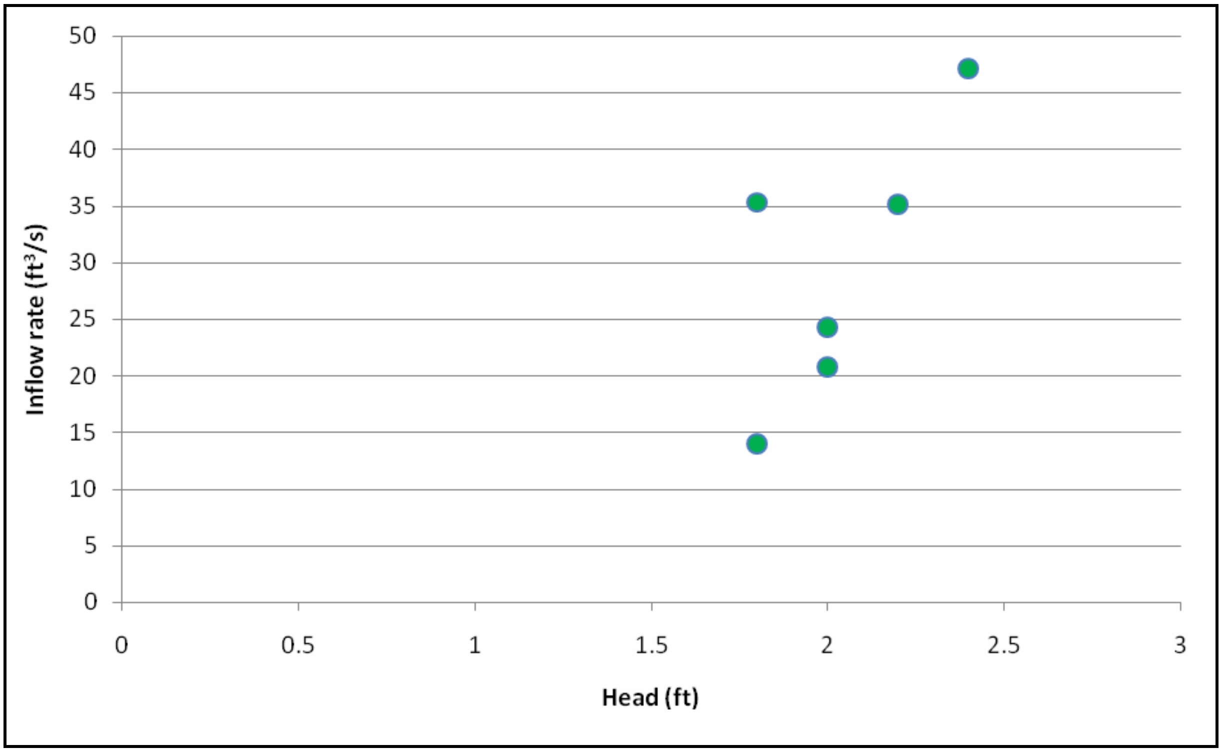


Figure 2-6: Inflow Rate Vs. Head for the 2008 Sampling Periods at Pond A3W
(Flow is through a 48" culvert from Pond B2 into A3W.)

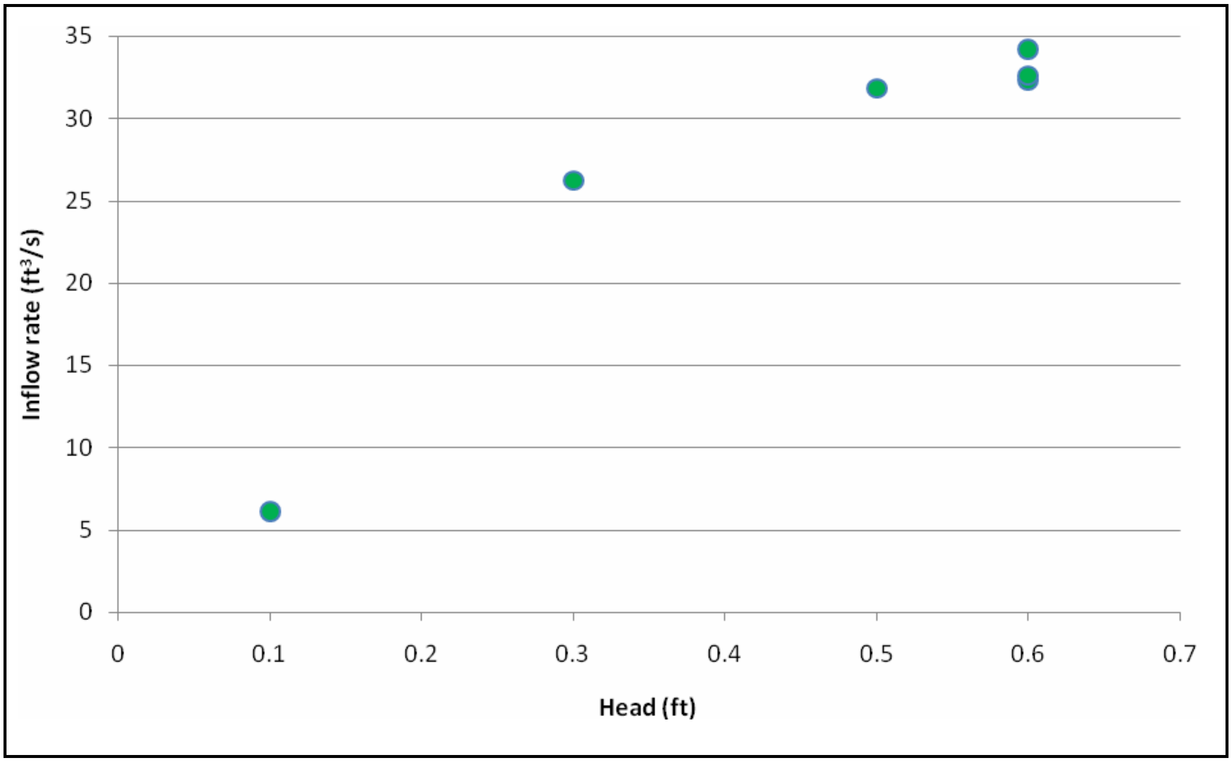


Figure 2-7: Inflow Rate Vs. Head for the 2008 Sampling Periods at Pond A14
(Flow is through a 48" culvert from Pond A11 into A14.)

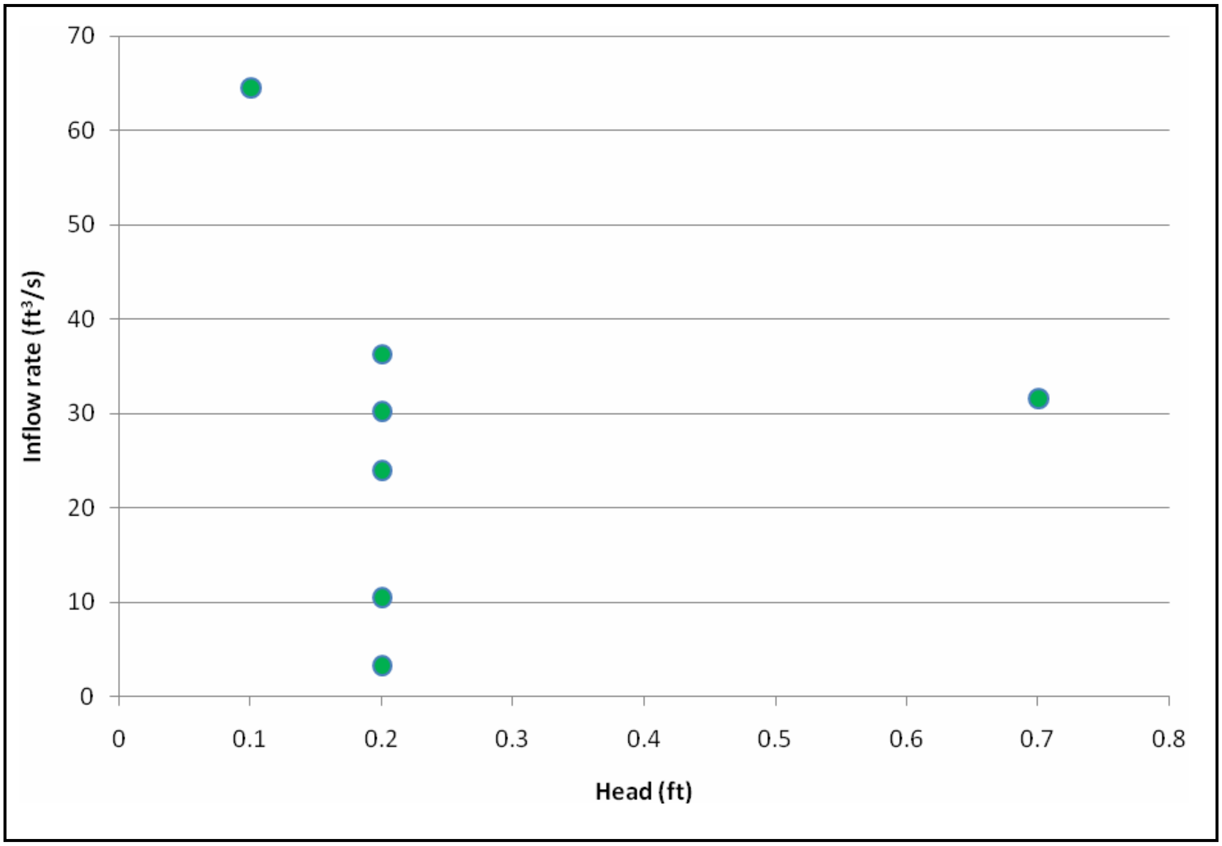


Figure 2-8: Inflow Rate Vs. Head for the 2008 Sampling Periods at Pond A16
(Flow is through an open channel from Pond A17 into A16.)

series of velocity in the A16 inlet channel is shown in Figure 2-9. Three issues are immediately apparent: 1) velocities are highly variable and water usually flows from A17 into A16; 2) there is a semi-diurnal (twice daily) signal in the velocity record; and 3) there are periods where there is rapid and substantial flow from Pond A16 into A17. The semi-diurnal signal is likely a tidal signal, even though these ponds are not truly opened to tidal action. However, Pond A17 takes in water during higher tidal stages and Pond A16 discharges water during lower tidal stages. This temporal asymmetry in intake/discharge between the ponds is the probable cause of the semi-diurnal signal in the velocity record. The periods of strong reverse flow (A16 into A17) are likely related to specific wind conditions, but more analysis will be required to confirm this.

Issues affecting the water budgets

Several issues were identified during the course of this study that affect our ability to accurately determine and predict water budgets for these three ponds.

1) A16 inlet channel flow is not controlled by a simple head relationship (Figures 2-8 and 2-9). Since flow was continuously measured only during three weeks near the end of the study, it will be difficult to predict accurately inflow to Pond A16. We will attempt to model the flow based on tide and wind.

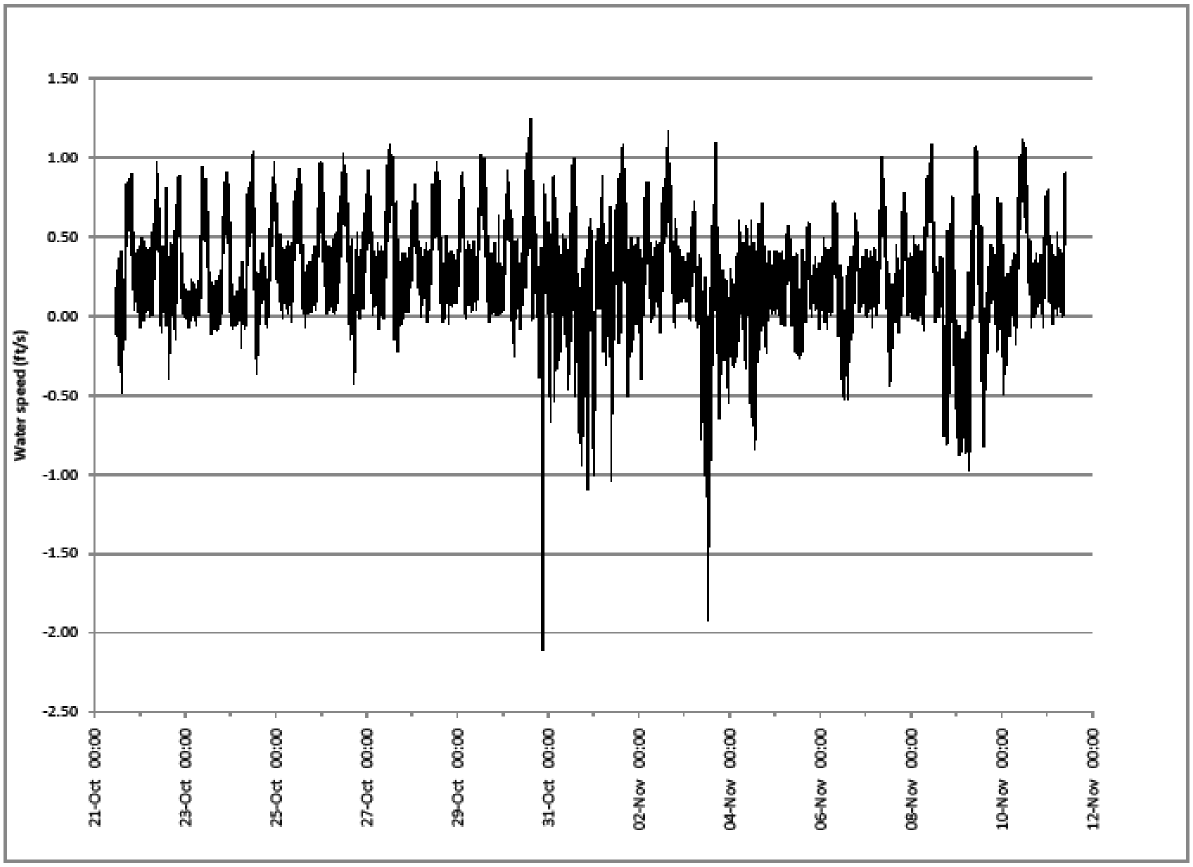


Figure 2-9: Depth-Averaged Water Speed in the Open Channel Between Ponds A16 and A17
(Positive values represent flow from A17 into A16, while negative values show flow from A16 into A17. Flow between the ponds displays a strong semi-diurnal [twice-daily tidal] signal, and periods of strong reverse flow are periods when the flow is likely responding to wind and/or storm events.)

2) The NGVD staff plates are not accurate at several locations. The two staffs in Pond A11 differ by about 1', so the water surface elevation in Pond A11 is not known. In addition, the staff plates at the A14 discharge structure (pond and weir sides) are not level with each other, and the staff plate in Pond A14 at the weir is located where it is affected by weir flow. These issues are likely responsible for the data that show negative heads leading to outflow mentioned above. USGS-BRD plans to check the elevation of all NGVD staff plates used in this study with an RTK-GPS system to eliminate this issue.

3) Changing management activities during the study period may affect our predictions of flow.

Future analysis

Where possible, the measured relationships between head and flow will be used to determine coefficients in standard engineering flow equations for culverts and weirs. These equations will then be used to predict inflow or outflow based on water surface elevations measured weekly in the ponds by US Fish and Wildlife Service and predictions of tidal elevations in the sloughs (similar to calculations used in Shellenbarger et al., 2007). If it is not possible to adequately estimate the coefficients required for the equations, then measured flow versus head relationships can be used to estimate flow for a range of different head conditions (Figure 2-10). Weekly values of inflow and outflow, in conjunction with pond volume estimates, will be used to determine water budgets for each of the three study ponds between 30 May and 21 November 2008. The information from the water budgets will be combined with data collected by USGS-BRD (dissolved oxygen concentrations, phytoplankton concentrations, solar irradiance, temperature, and wind data) and USGS-Menlo Park (sediment oxygen demand) to develop rough oxygen budgets for each pond. A draft report detailing this work is scheduled tentatively to be completed by 30 June 2009.

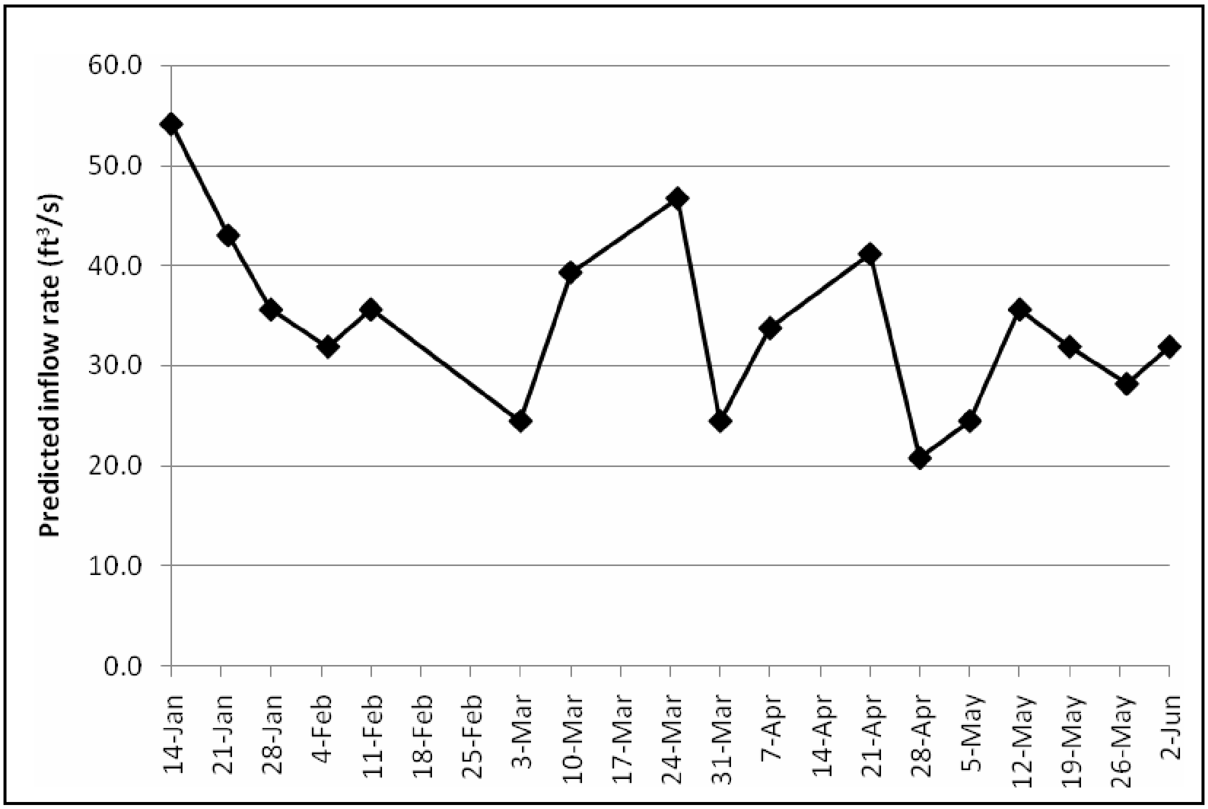


Figure 2-10: Example of Predicted Weekly Inflow Rate from Pond B2 into Pond A3W
(The prediction is based on a simple linear equation derived from measured flow and head differences in the two ponds applied to an example period between 14 January – 2 June 2008.)

Literature cited

Shellenbarger, G.G., Schoellhamer, D.H., and Lionberger, M.A., 2007, *PONDCALC—A Tool to Estimate Discharge from the Alviso Salt Ponds, California: U.S. Geological Survey Scientific Investigations Report 2007–5005*, 12 p. Available at: http://pubs.usgs.gov/sir/2007/5005/pdf/sir_2007-5005.pdf.

SECTION 3
POND A3W IN-POND SAMPLING

This section summarizes and analyses of water quality data are being conducted to characterize spatial variability and patterns with respect to flow patterns and pond management. This more detailed information will be provided as separate reports or manuscripts to provide guidance for 2009 data collection procedures. A brief description of our initial findings is presented below:

3.1 CONTINUOUS WATER QUALITY MONITORING

Sondes were deployed at 6 locations in Pond A3W (Figure 3-1) during three study periods (Table 3-1). Water quality differences will be statistically analyzed between study periods, but mean values suggest that the largest change was between the first study period (25 May – 6 June 2008) and the two later study periods (28 July – 8 August 2008 and 29 September – 10 October 2008), when temperature and salinity increased while pH and dissolved oxygen decreased. These overall shifts were consistent with full-season observations at the discharge point during previous years (2004-2007).

Table 3-1: Summarized Water Quality Values for Pond A3W

Sampling Period	Dissolved Oxygen (mg/L)	pH (Units)	Specific Conductance (mS/cm)	Temperature (ºC)	Salinity (ppt)
25 May - 6 June 2008	4.56 ± 4.0	8.99 ± 0.5	36.13 ± 3.0	18.71 ± 1.6	22.83 ± 2.1
28 July - 8 August 2008	3.05 ± 3.1	8.42 ± 0.2	45.69 ± 1.9	21.87 ± 1.6	29.67 ± 1.4
29 September – 10 October 2008	3.93 ± 3.5	8.28 ± 0.2	45.32 ± 1.3	20.32 ± 1.6	29.40 ± 0.9

Figure 3-1: Pond A3W Sonde Locations

Water quality values differed at the 6 sonde locations where readings occurred simultaneously. Daily minima and maxima for measured parameters tended to cycle with tides in the intake and discharge waters and thus were reached at about the same time for all 6 sondes, but the magnitude of the maxima tended to differ the most. For example, dissolved oxygen was generally highest at the intake and at the shallow sonde locations, particularly during daylight hours and near high tide (Figures 3-2 through 3-4). However, dissolved oxygen decreased to similar levels at all sonde locations during morning hours and near low tide. Sondes located in deep water and at the discharge point generally recorded lower dissolved oxygen values.

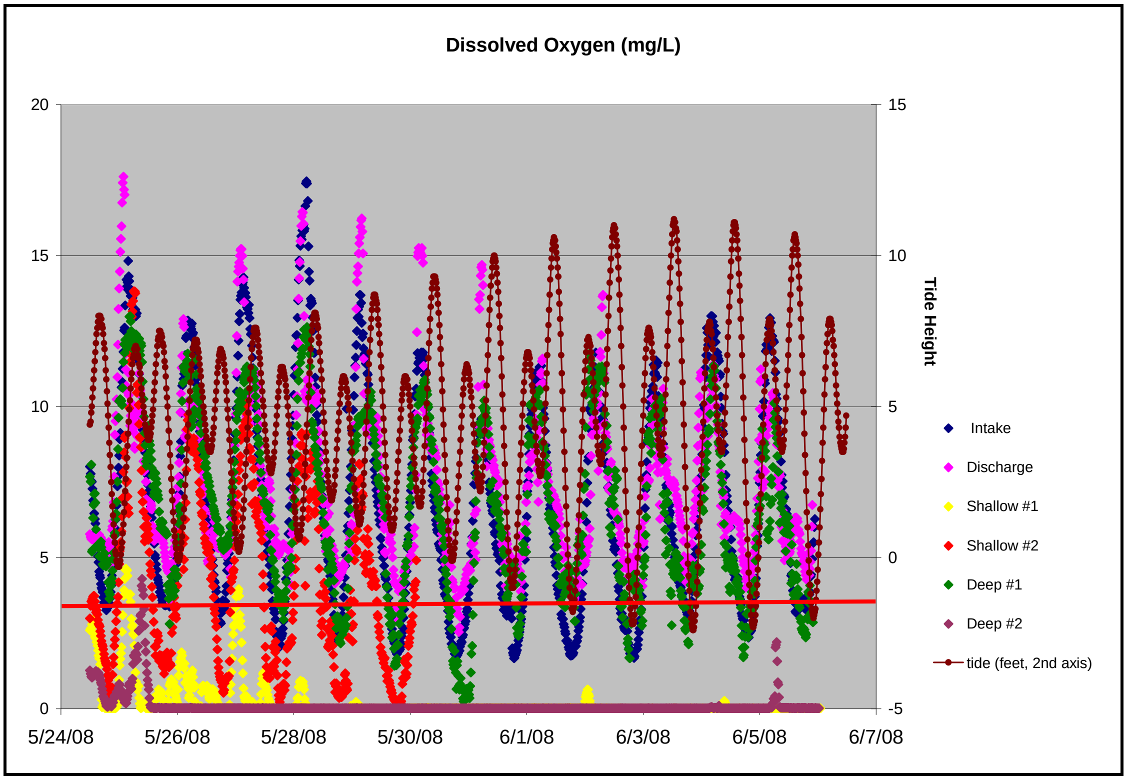


Figure 3-2: Dissolved Oxygen Values at Pond A3W Sondes, 25 May – 6 June 2008

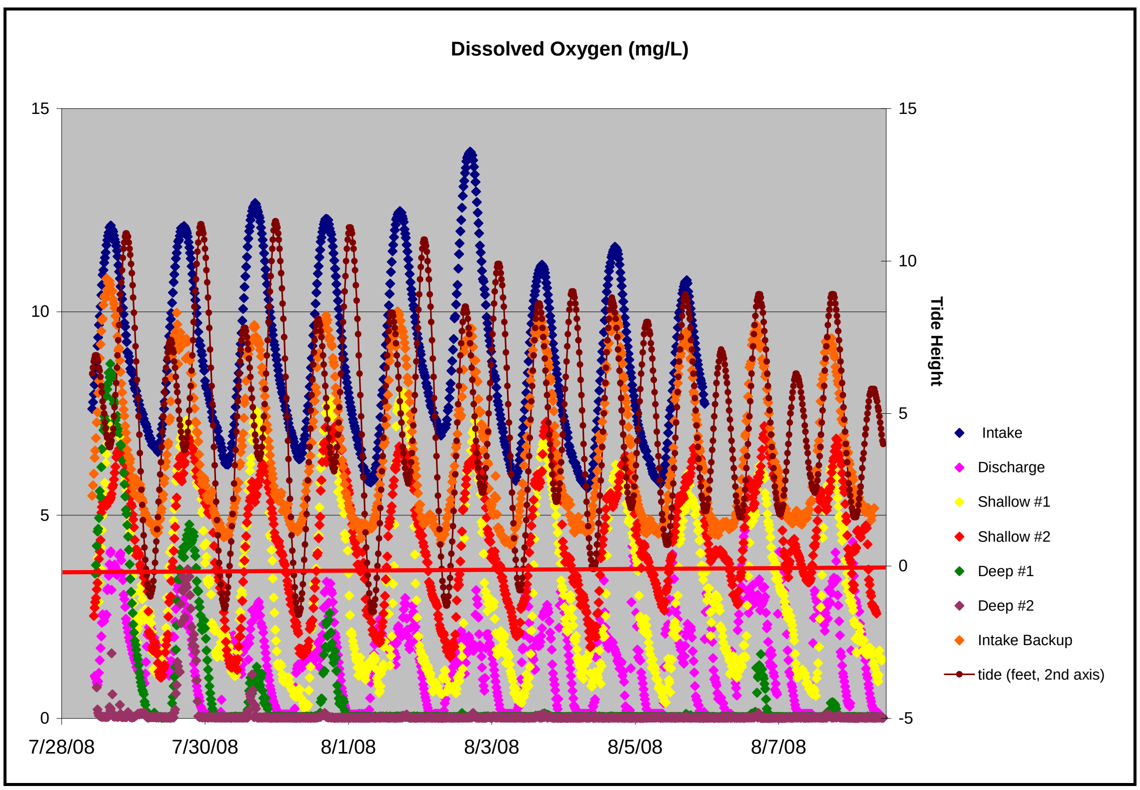


Figure 3-3: Dissolved Oxygen Values at Pond A3W Sondes, 28 July – 8 August 2008

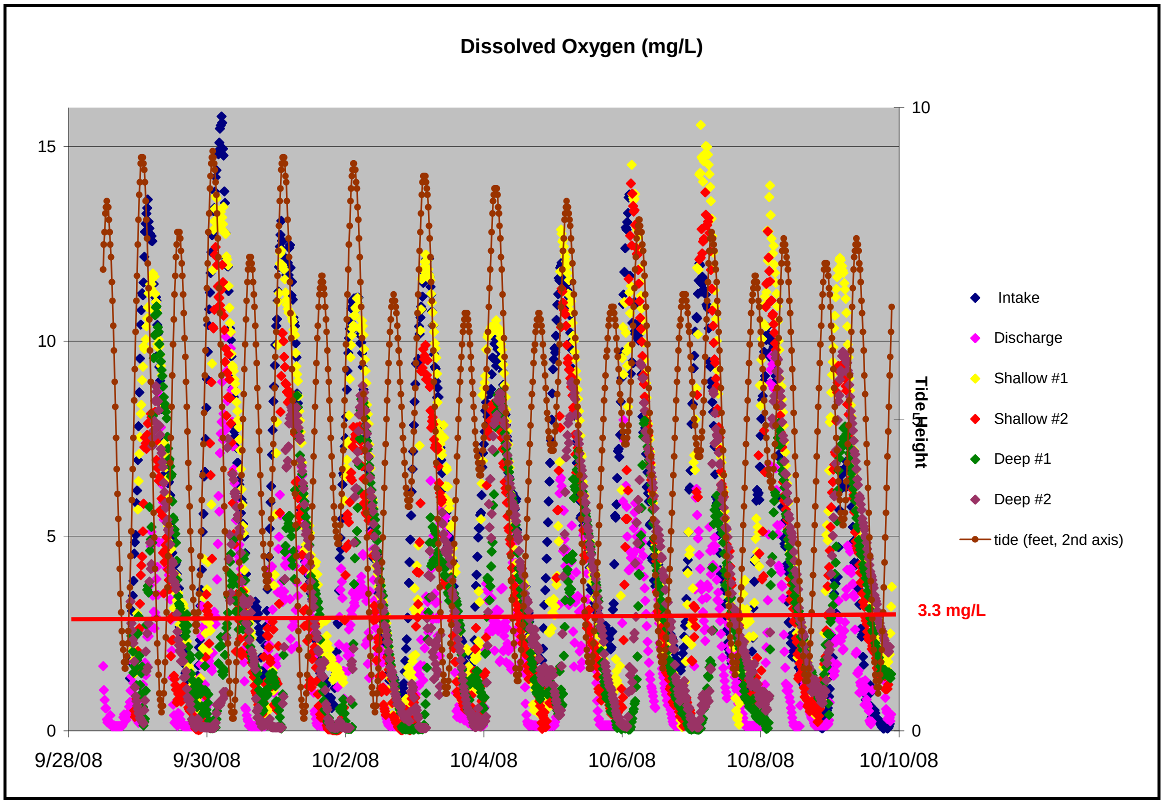


Figure 3-4: Dissolved Oxygen Values at Pond A3W Sondes, 29 September – 10 October 2008

3.2 SALINITY

Salinity within Pond A3W responded noticeably to tide height in the intake and receiving waters, with lowest values near the intake and highest near the discharge and pond interior. Intake and discharge salinity fluctuated more than other locations in response to tidal exchange, whereas salinity at interior pond locations was more consistent (Figures 3-5 through 3-7).

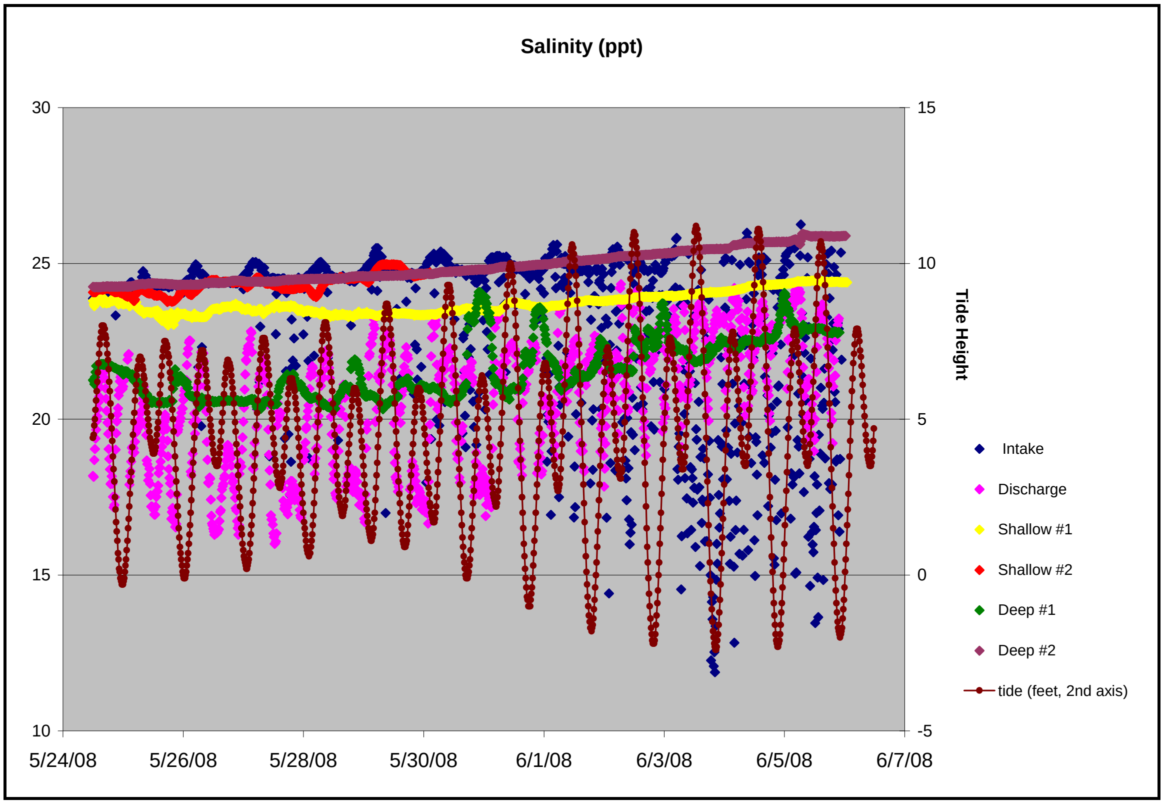


Figure 3-5: Salinity Values at Pond A3W Sondes, 25 May – 6 June 2008

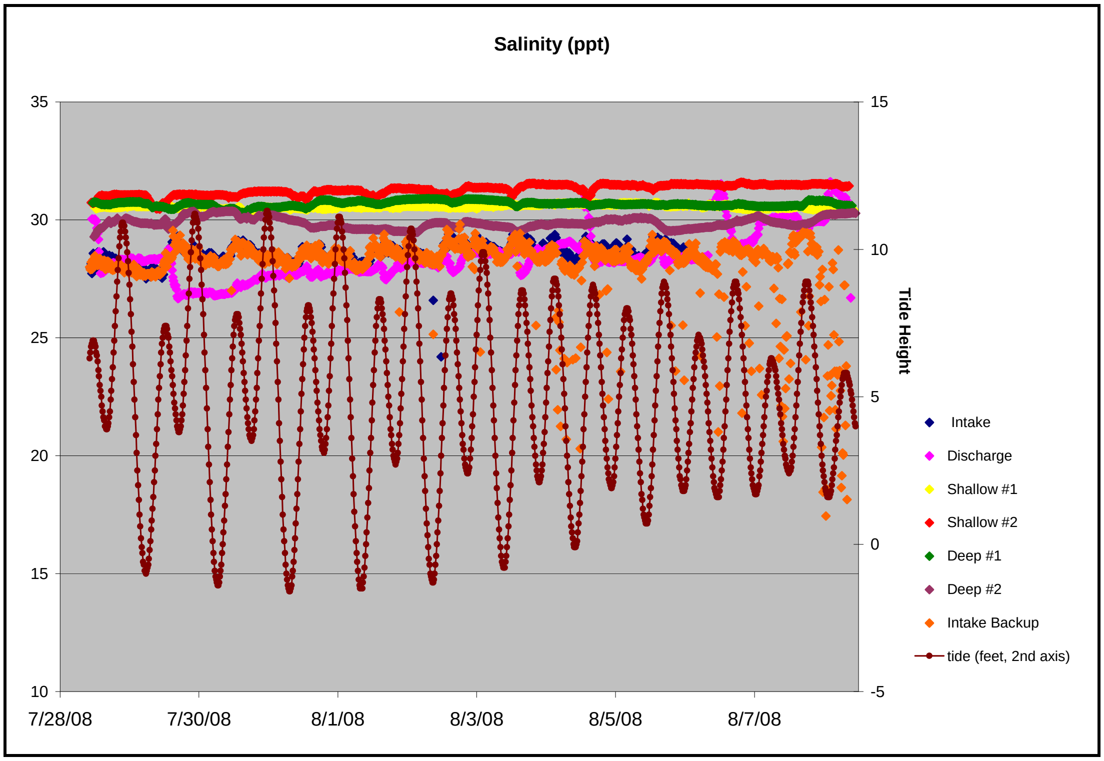


Figure 3-6: Salinity Values at Pond A3W Sones, 28 July – 8 August 2008

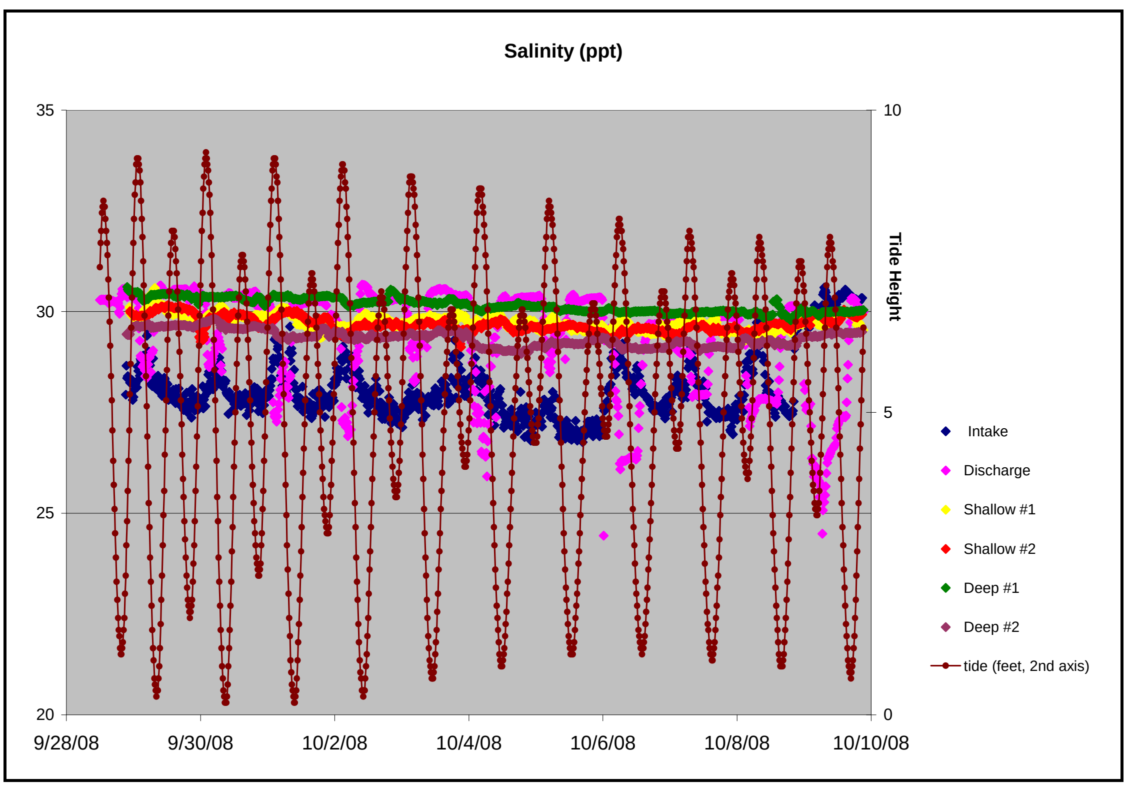


Figure 3-7: Salinity Values at Pond A3W Sondes, 29 September – 10 October 2008

3.3 pH

Pond A3W pH ranged from 7.5 to 10.2, but values greater than 8.8 were recorded only during the 25 May to 6 June 2008 study period (Figure 3-8). There was consistent spatial variability in pH, as highest values were recorded at the interior shallow pond locations while values closest to neutrality were recorded at deeper and intake locations. All sites showed cyclic pH response which was similar to the tidal cycle period, and unlike salinity, the magnitude of the cycles was similar for all pond locations (Figures 3-9 and 3-10).

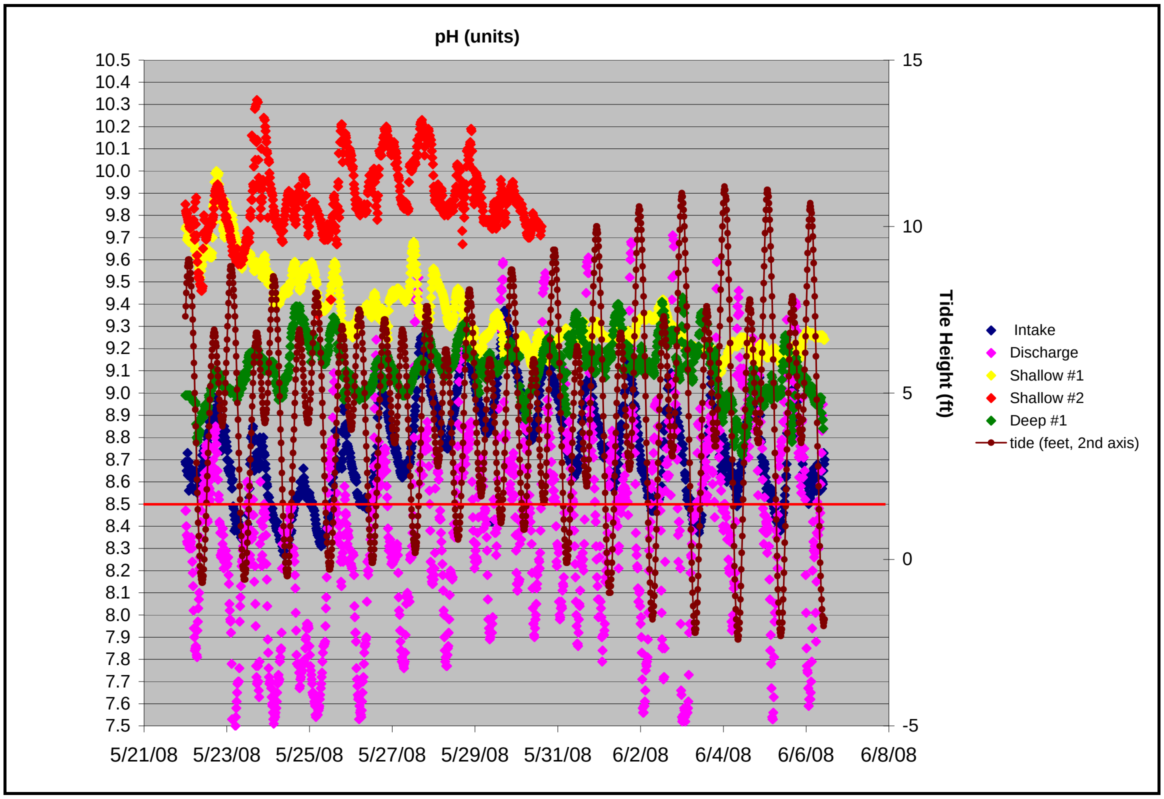


Figure 3-8: pH Values at Pond A3W Sondes, 25 May – 6 June 2008

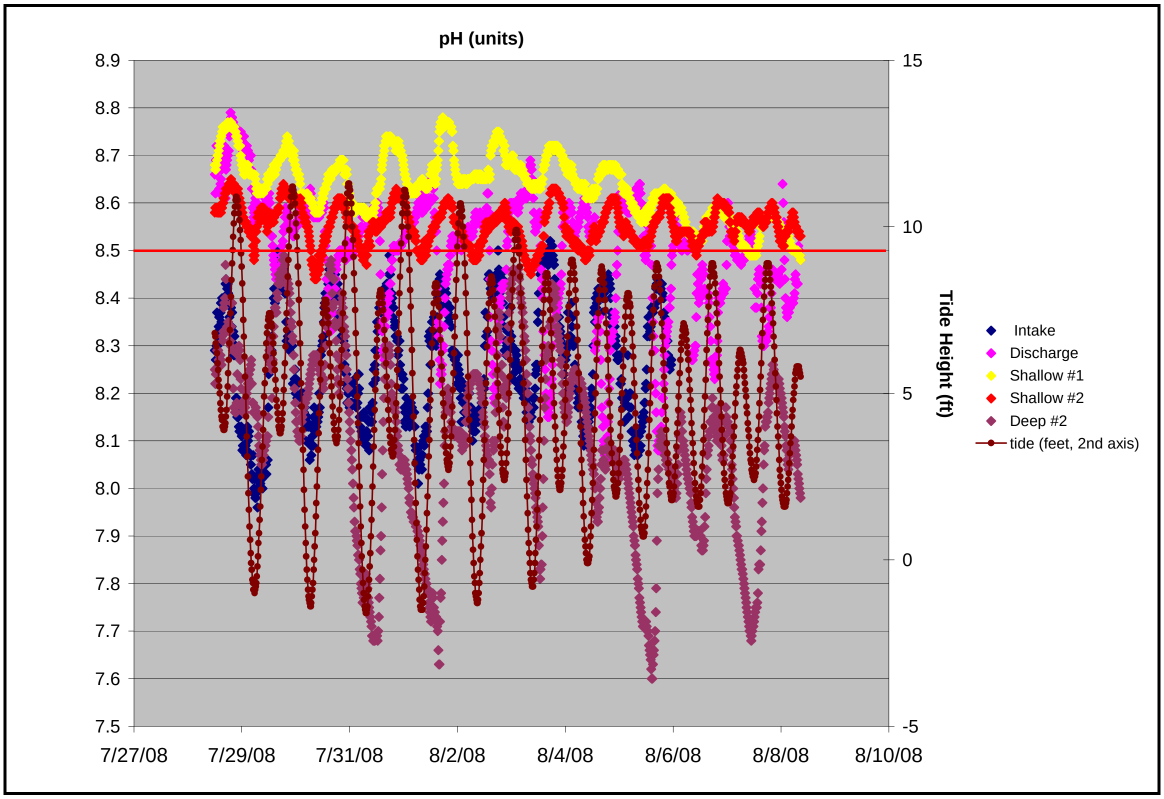


Figure 3-9: pH Values at Pond A3W Sondes, 28 July – 8 August 2008

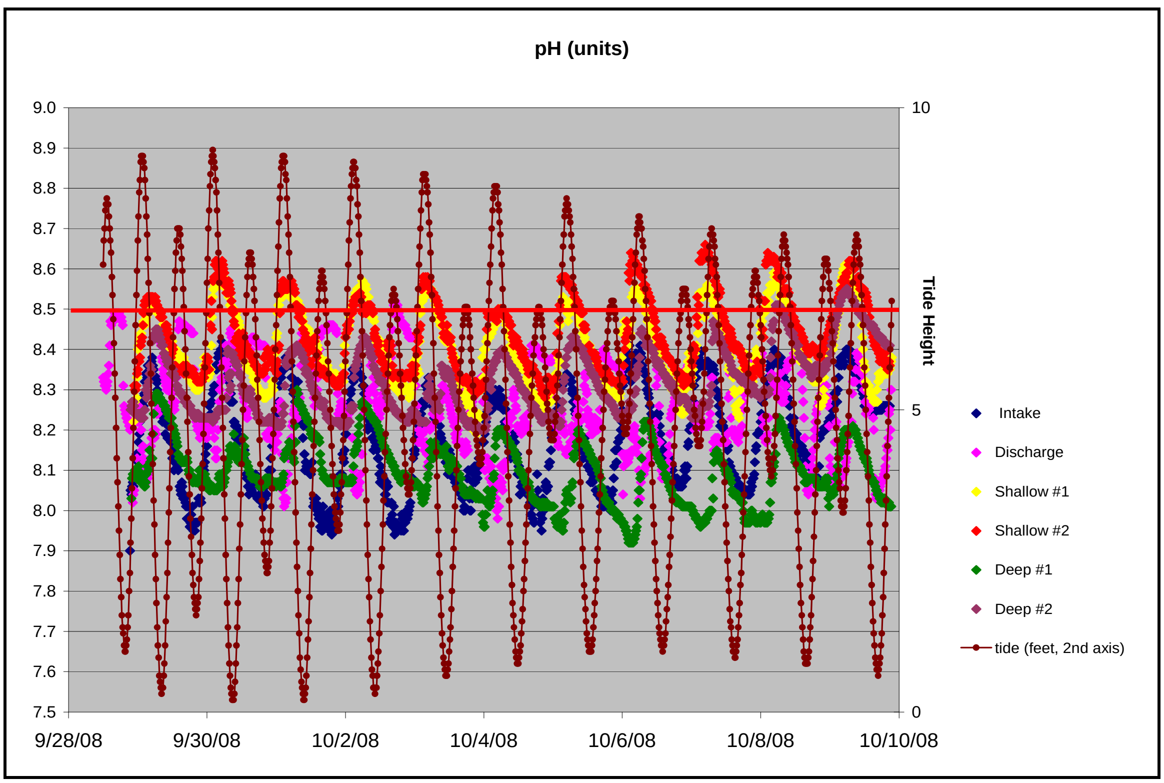


Figure 3-10: pH Values at Pond A3W Sondes, 29 September – 10 October 2008

3.4 TEMPERATURE

Temperature similarly cycled consistently with tidal cycles. Early in the season, the magnitude of the fluctuations was higher at intake and discharge locations (Figure 3-11), but later sampling periods showed more consistent readings among all sonde locations (Figures 3-12 and 3-13).

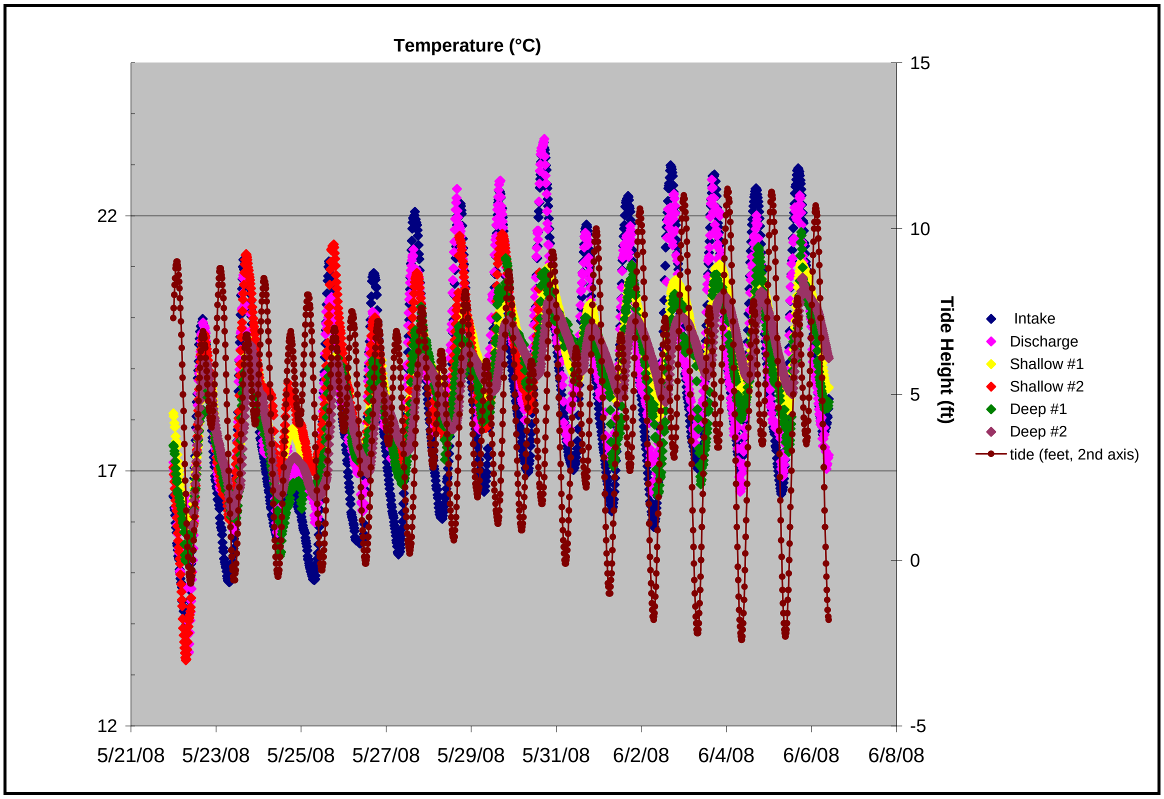


Figure 3-11: Temperature Values at Pond A3W Sondes, 25 May – 6 June 2008

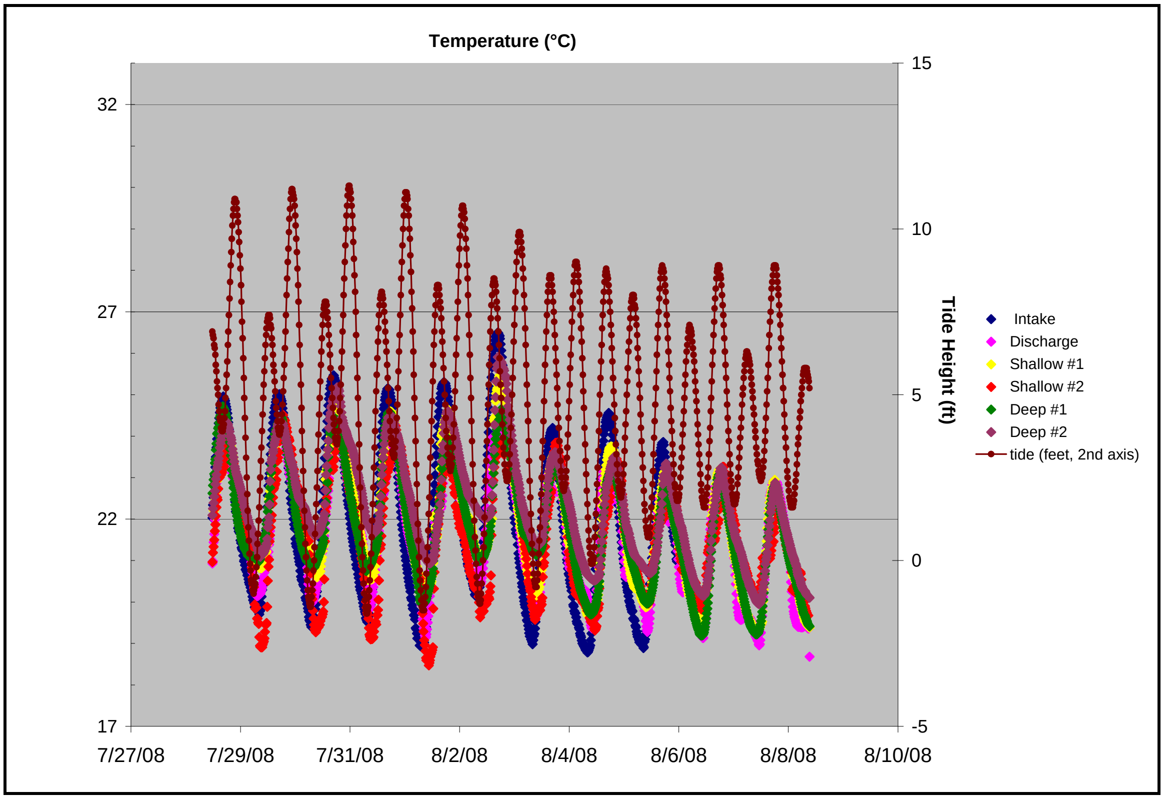


Figure 3-12: Temperature Values at Pond A3W Sondes, 28 July – 8 August 2008

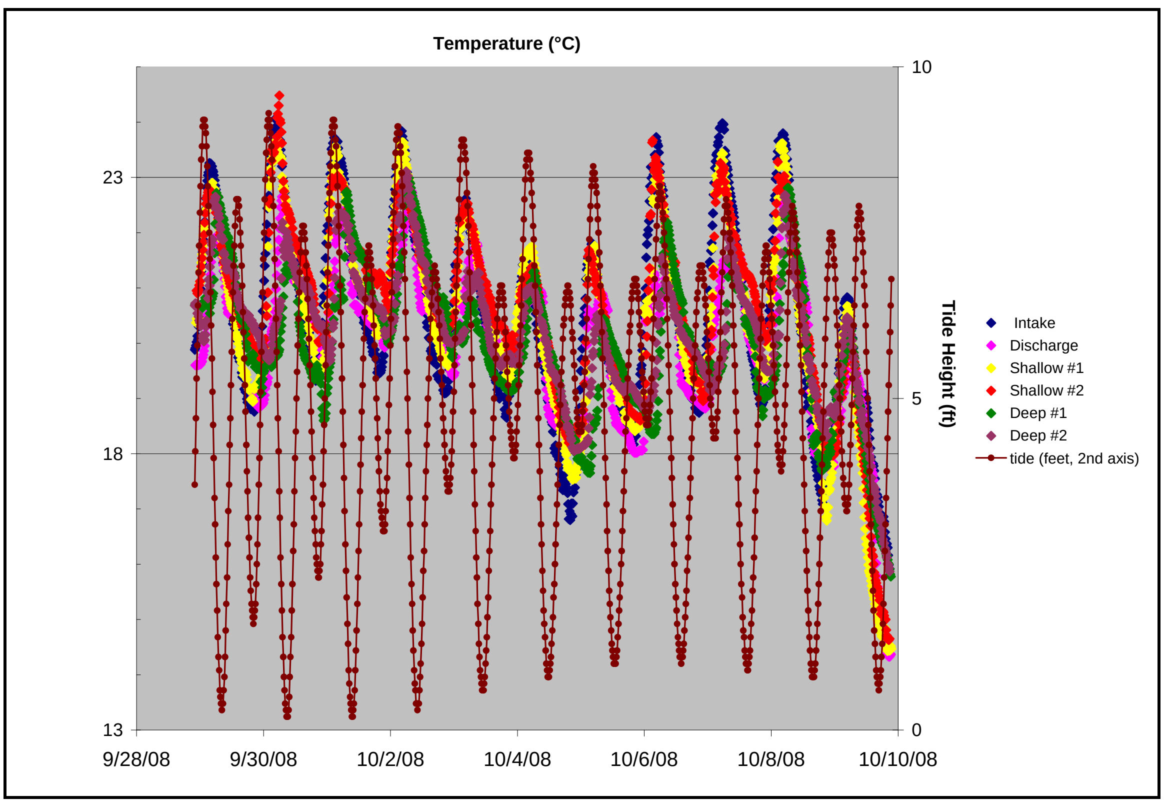


Figure 3-13: Temperature Values at Pond A3W Sondes, 29 September – 10 October 2008

3.5 DISSOLVED OXYGEN TRANSECTS

Dissolved oxygen transect data are being analyzed in conjunction with flow, sonde, and sediment pore water data. In general, with the exception of the 4 June 2008 sample (Figure 3-14), morning samples were less than 3.3 mg/L (Figures 3-16 and 3-18) and afternoon samples were greater than 5.0 mg/L (Figures 3-15, 3-17, and 3-19).

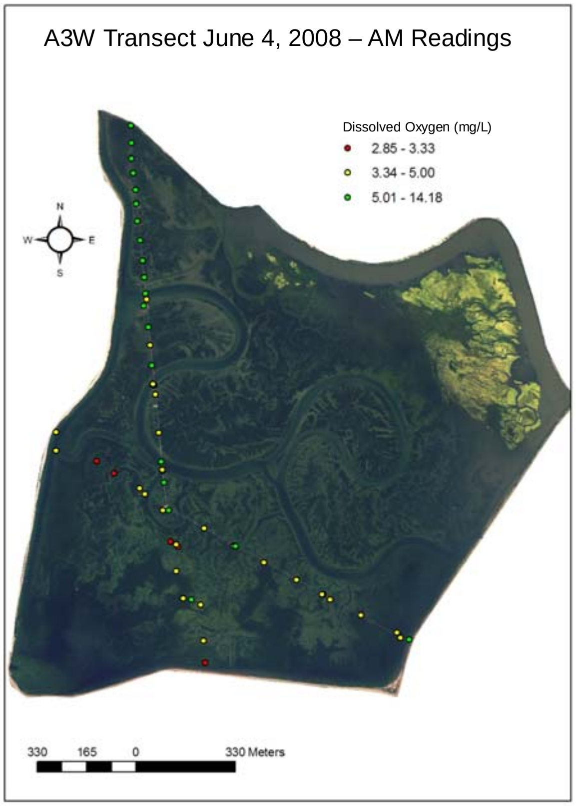


Figure 3-14: Dissolved Oxygen Transects in Pond A3W, AM 4 June 2008

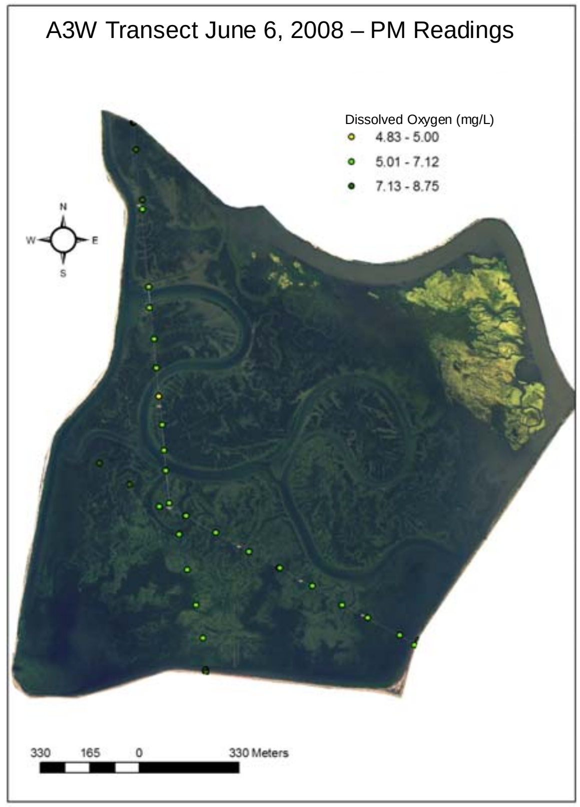


Figure 3-15: Dissolved Oxygen Transects in Pond A3W, PM 6 June 2008

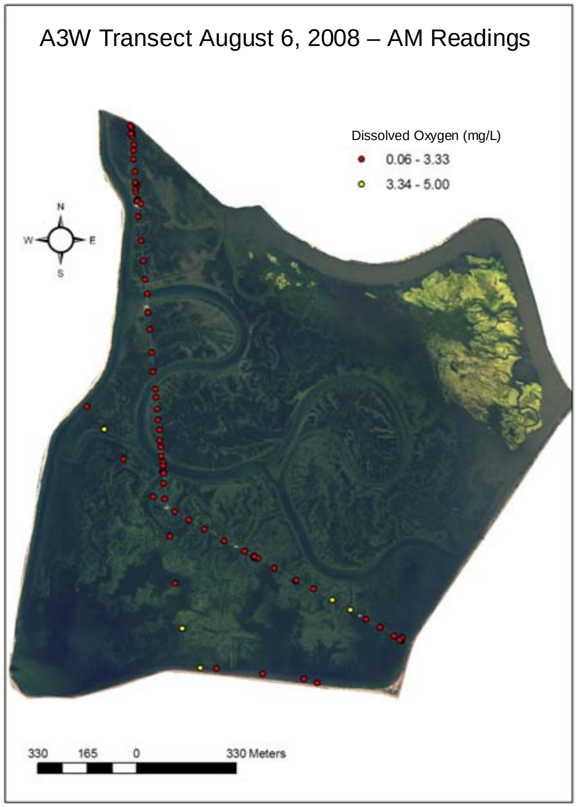


Figure 3-16: Dissolved Oxygen Transects in Pond A3W, AM 6 August 2008

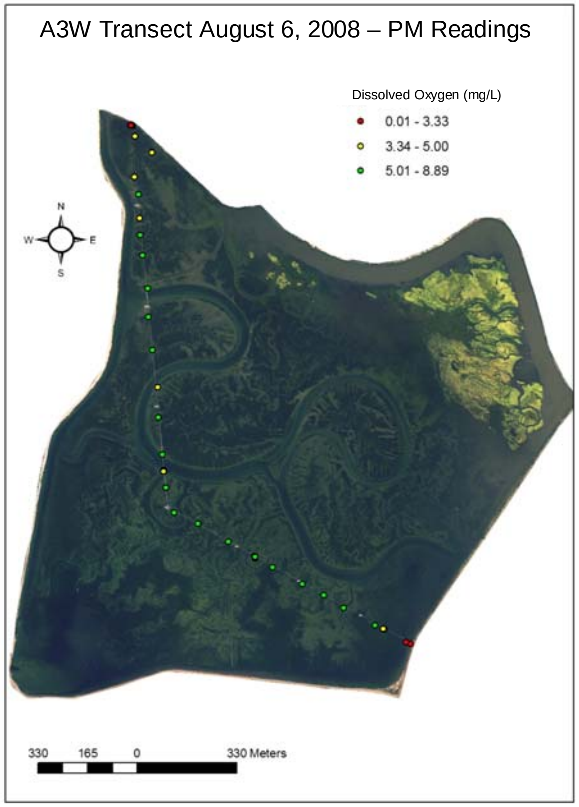


Figure 3-17: Dissolved Oxygen Transects in Pond A3W, PM August 2008

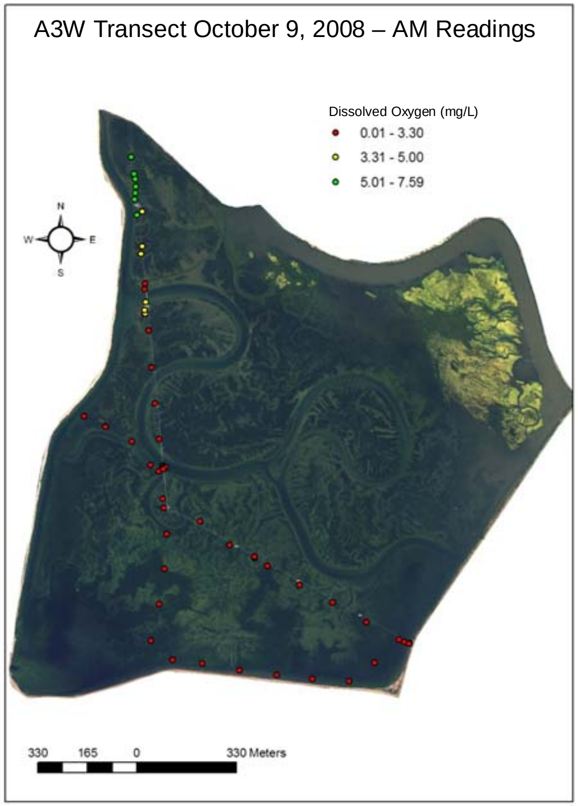


Figure 3-18: Dissolved Oxygen Transects in Pond A3W, AM 9 October 2008

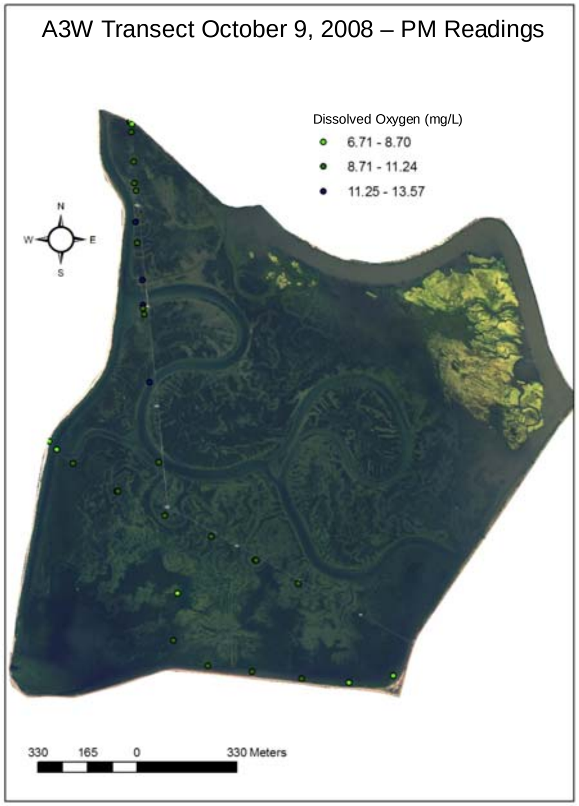


Figure 3-19: Dissolved Oxygen Transects in Pond A3W, PM 9 October 2008

SECTION 4
POND A14 IN-POND SAMPLING

This section summarizes and analyses of water quality data are being conducted to characterize spatial variability and patterns with respect to flow patterns and pond management. This more detailed information will be provided as separate reports or manuscripts to provide guidance for 2009 data collection procedures. A brief description of our initial findings is presented below:

4.1 CONTINUOUS WATER QUALITY MONITORING

Sondes were deployed at 6 locations in Pond A14 during three study periods (Table 4-1 and Figure 4-1). Water quality differences will be statistically analyzed between study periods. Dissolved oxygen was the most variable parameter. Temperature declined from the first study period to the last, but there were no other consistent temporal trends.

Table 4-1: Summarized Water Quality Values for Pond A14

Sampling Period	Dissolved Oxygen (mg/L)	pH (Units)	Specific Conductance (mS/cm)	Temperature (ºC)	Salinity (ppt)
7 July – 18 July 2008	3.8 ± 3.4	8.46 ± 0.17	53.9 ± 2.4	23.9 ± 2.4	35.7 ± 1.8
8 September – 19 September 2008	3.4 ± 2.9	8.10 ± 0.30	55.0 ± 1.0	21.0 ± 1.7	36.5 ± 0.8
10 November – 21 November 2008	7.1 ± 3.9	8.44 ± 0.20	48.2 ± 3.6	16.4 ± 1.2	31.5 ± 2.6

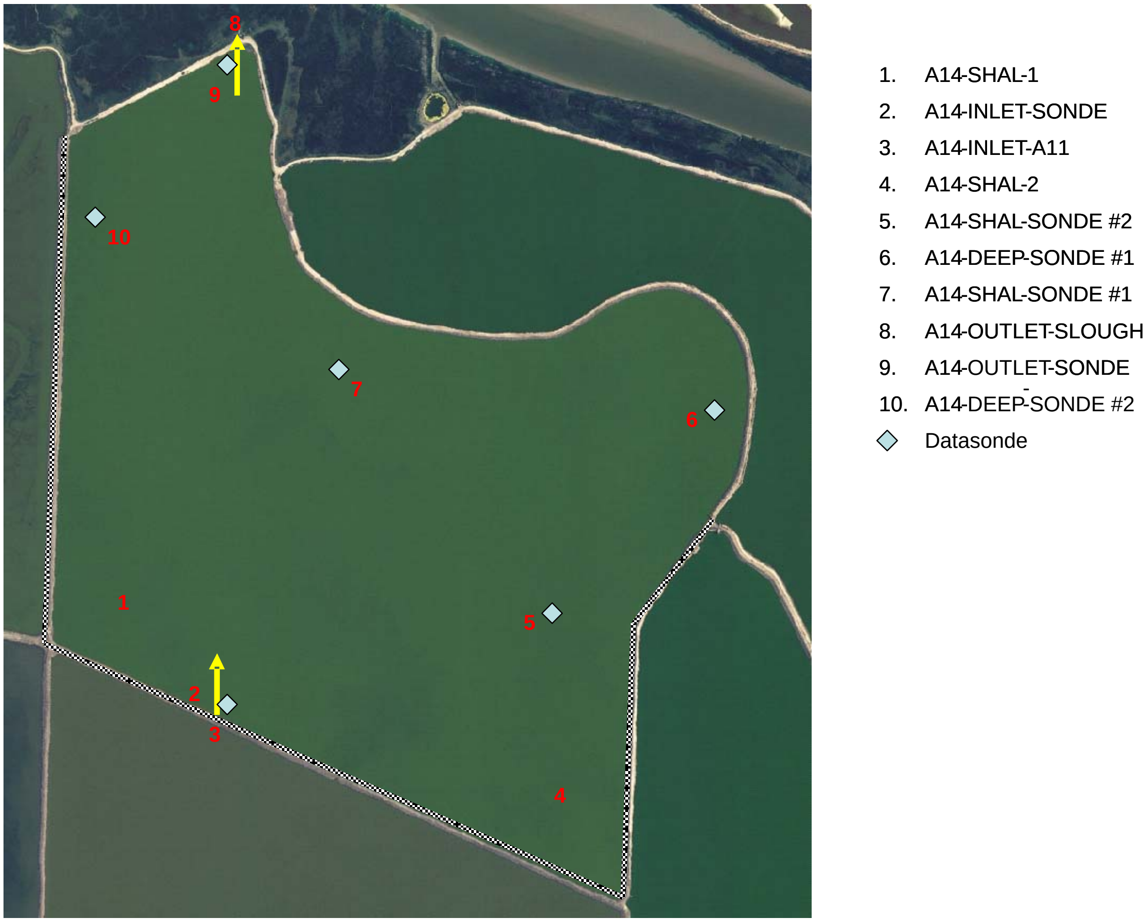


Figure 4-1: Pond A14 Sonde Locations

Water quality values differed at the 6 sonde locations where readings occurred simultaneously. Daily minima and maxima for measured parameters tended to cycle with tides in the intake and discharge waters and thus were reached at about the same time for all 6 sondes, but the magnitude of the maxima tended to differ. Dissolved oxygen was generally highest at the intake and at the shallow sonde locations, particularly during daylight hours and near high tide (Figures 4-2 and 4-3), except during the last sampling period (10-21 November), when DO recorded at the intake sonde was considerably lower than that recorded at the two shallow sonde locations (Figure 4-4). Minimum DO values often differed by location, with higher minimum values at the shallow and intake sondes. Sondes located in deep water and at the discharge point generally recorded lower dissolved oxygen values.

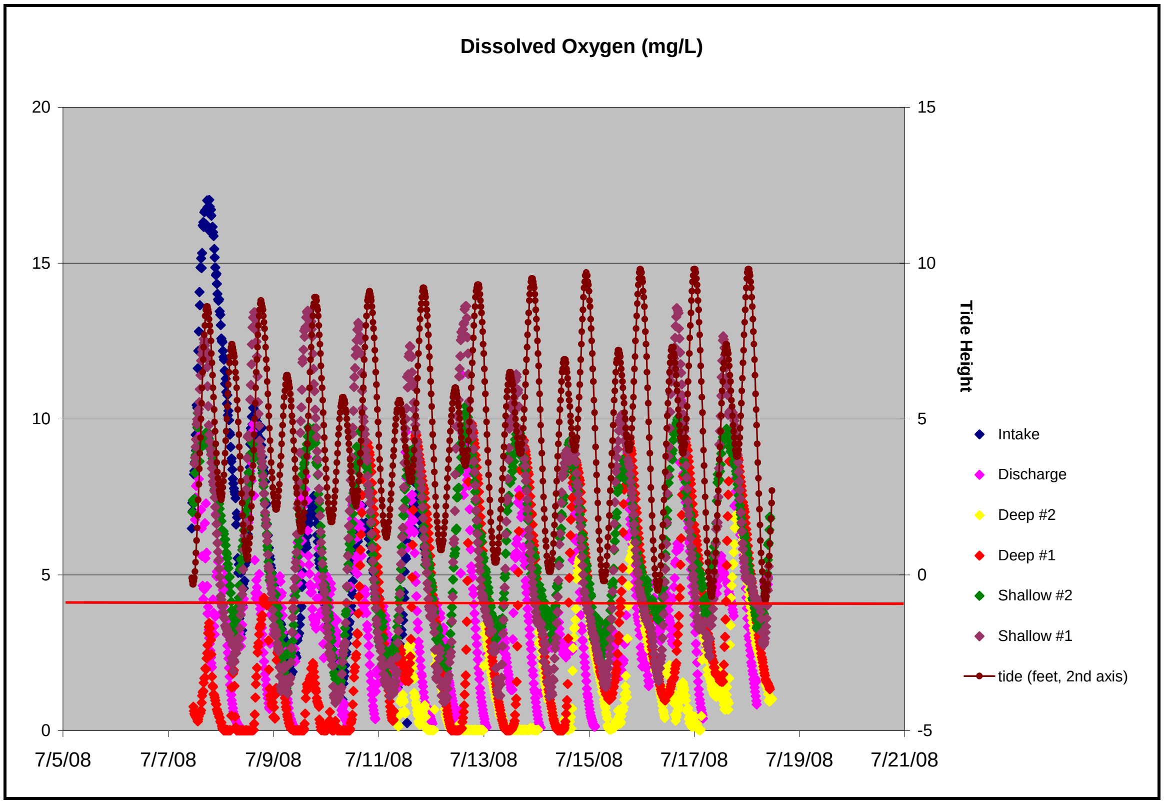


Figure 4-2: Dissolved Oxygen Values at Pond A14 Sondes, 7-18 July 2008

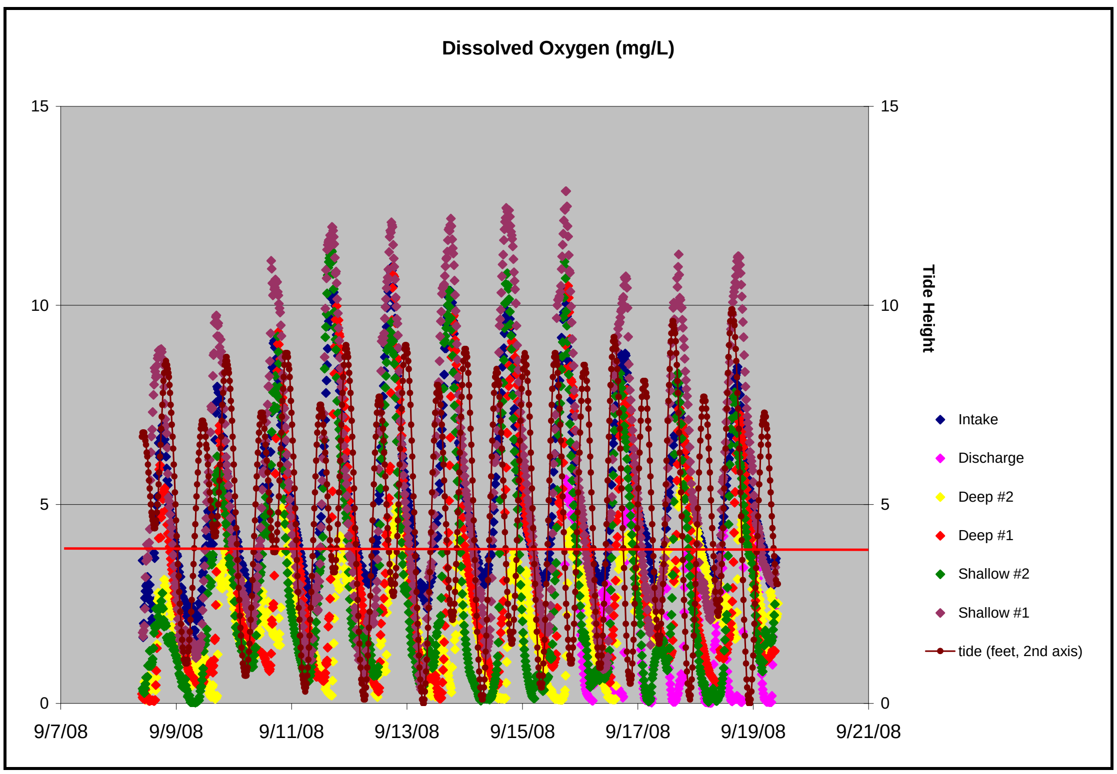


Figure 4-3: Dissolved Oxygen Values at Pond A14 Sondes, 8-19 September 2008

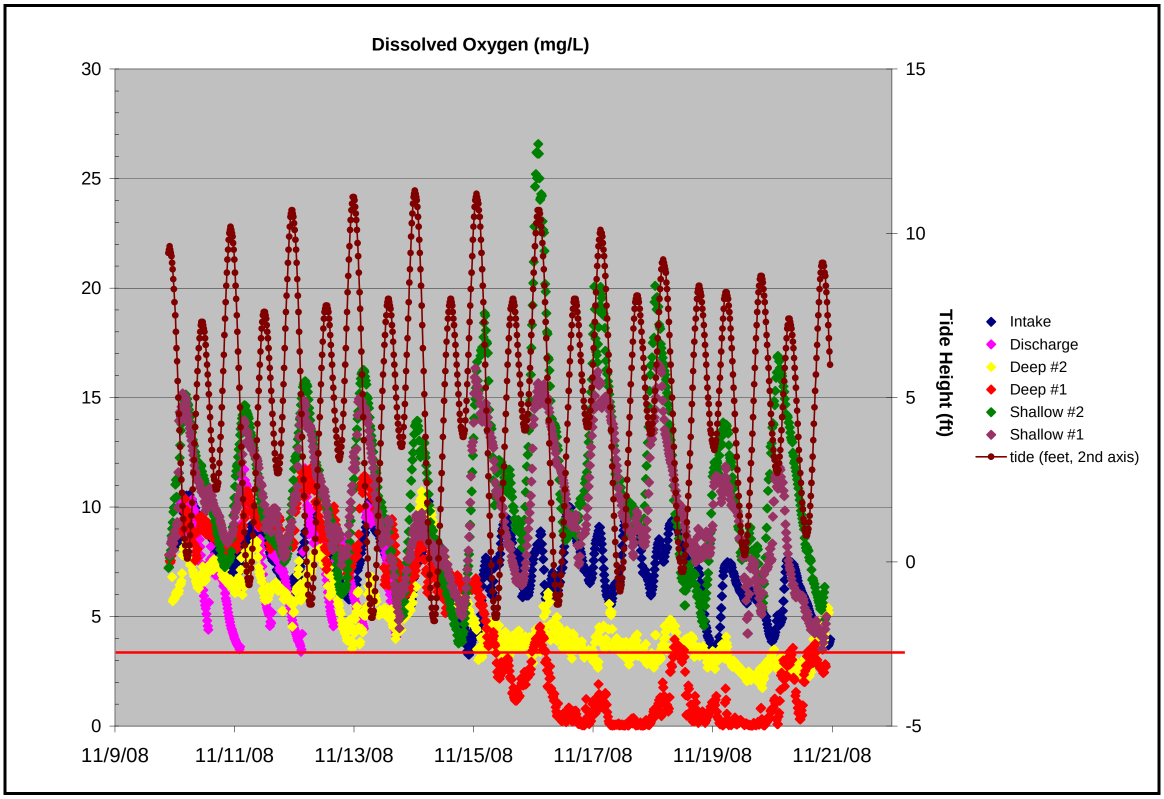


Figure 4-4: Dissolved Oxygen Values at Pond A14 Sondes, 10-21 November 2008

4.2 SALINITY

Salinity within Pond A14 responded noticeably to tide height. Spatial variability was most apparent during the 7-18 July study period, when intake salinity was consistently lower than other locations (Figure 4-5). During September, intake salinity was lower than other locations, but salinity values at all of the other locations were consistent with one another (Figure 4-6), and salinity remained relatively consistent across locations through November (Figure 4-7)

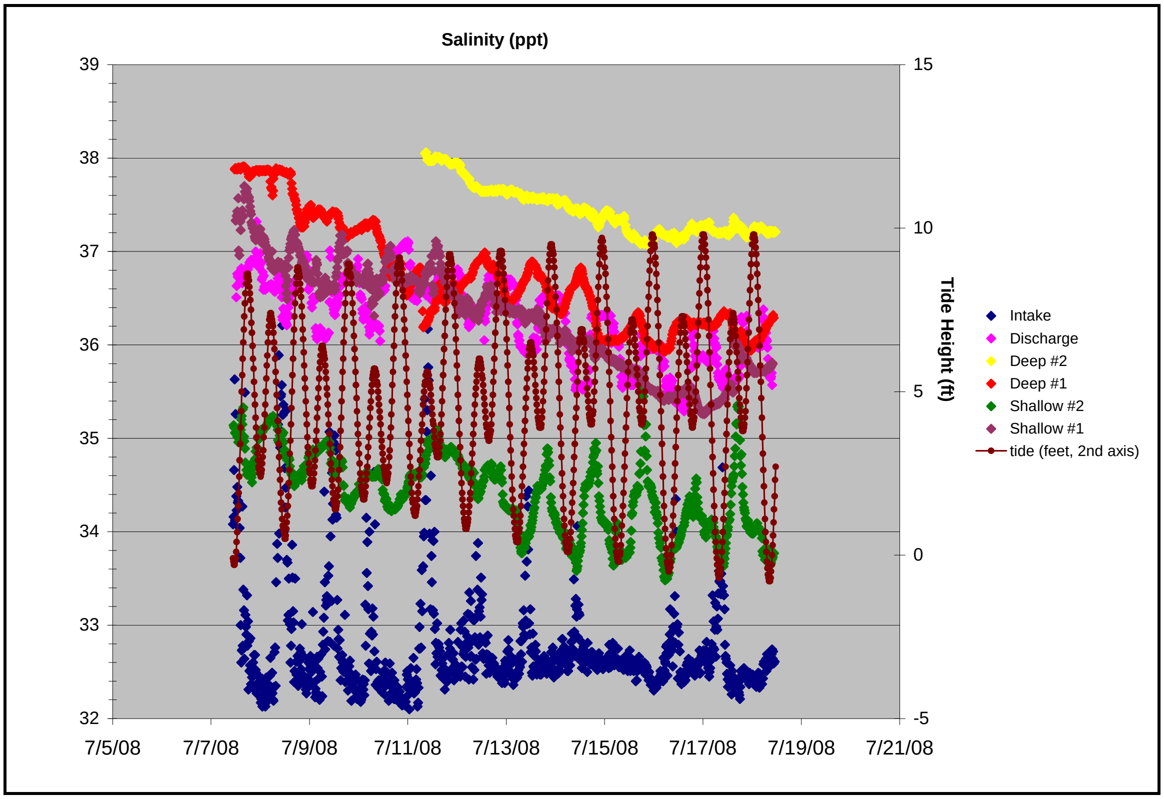


Figure 4-5: Salinity Values at Pond A14 Sondes, 7-18 July 2008

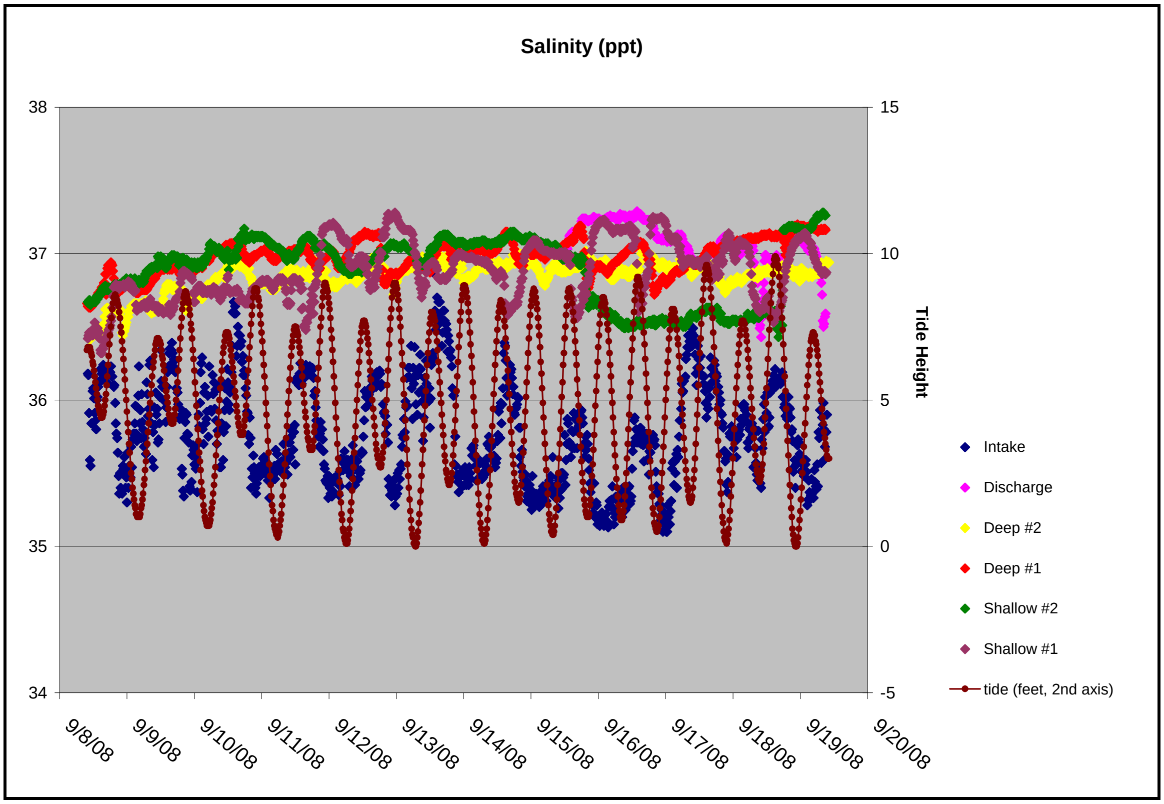


Figure 4-6: Salinity Values at Pond A14 Sondes, 8-19 September 2008

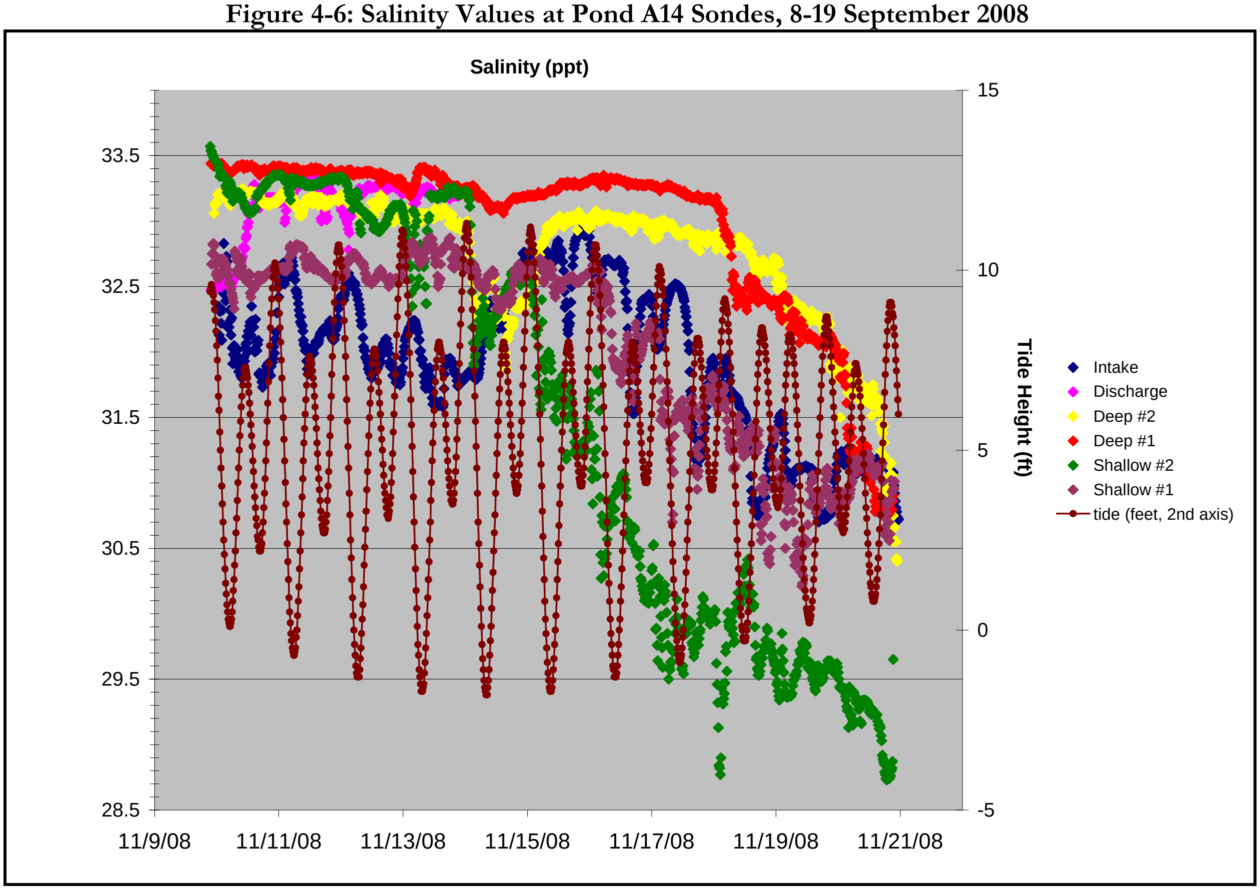


Figure 4-7: Salinity Values at Pond A14 Sondes, 10-21 November 2008

4.3 pH

pH at pond A14 ranged from 7.9 to 9.2. There was consistent spatial variability in pH, as highest values were recorded at the interior shallow pond locations while values closest to neutrality were recorded at deeper and intake locations. All sites showed cyclic pH response which was similar to the tidal cycle period. The magnitude of the cycles was similar for all pond locations except for the Deep #2 location, which had cycles of lower magnitude (Figure 4-8 through 4-10).

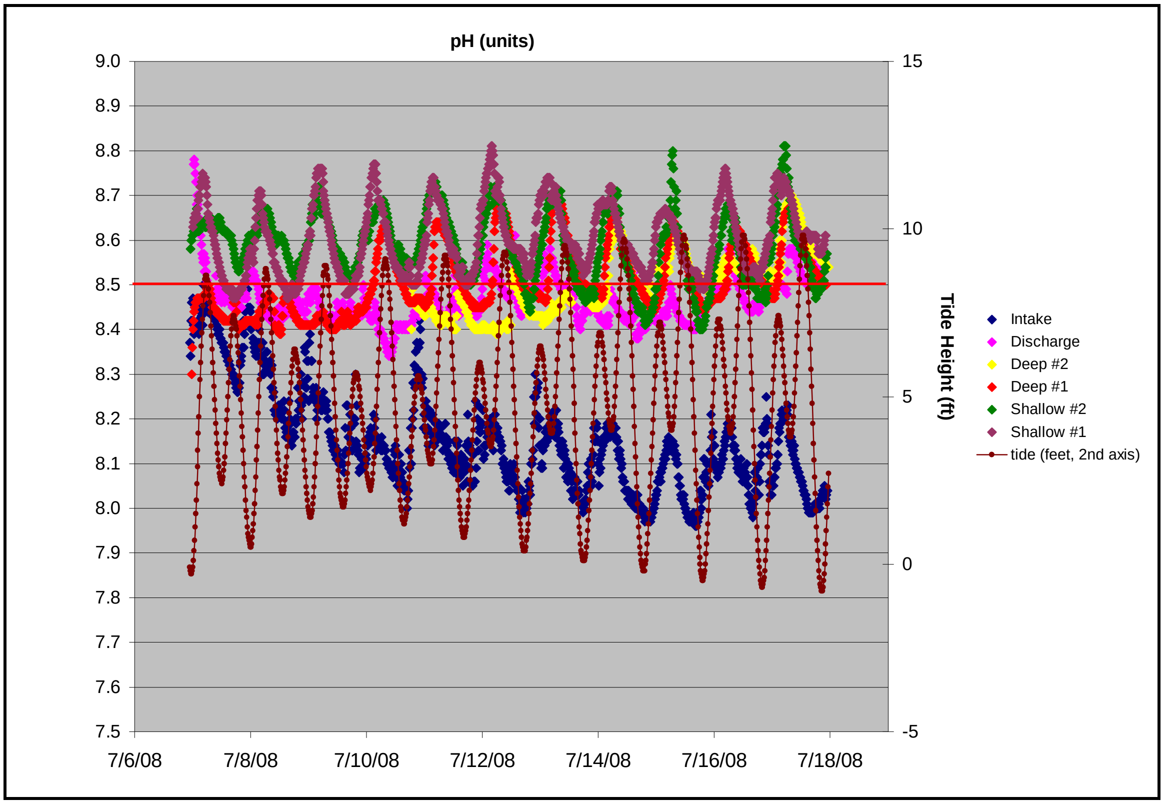


Figure 4-8: pH Values at Pond A14 Sondes, 7-18 July 2008

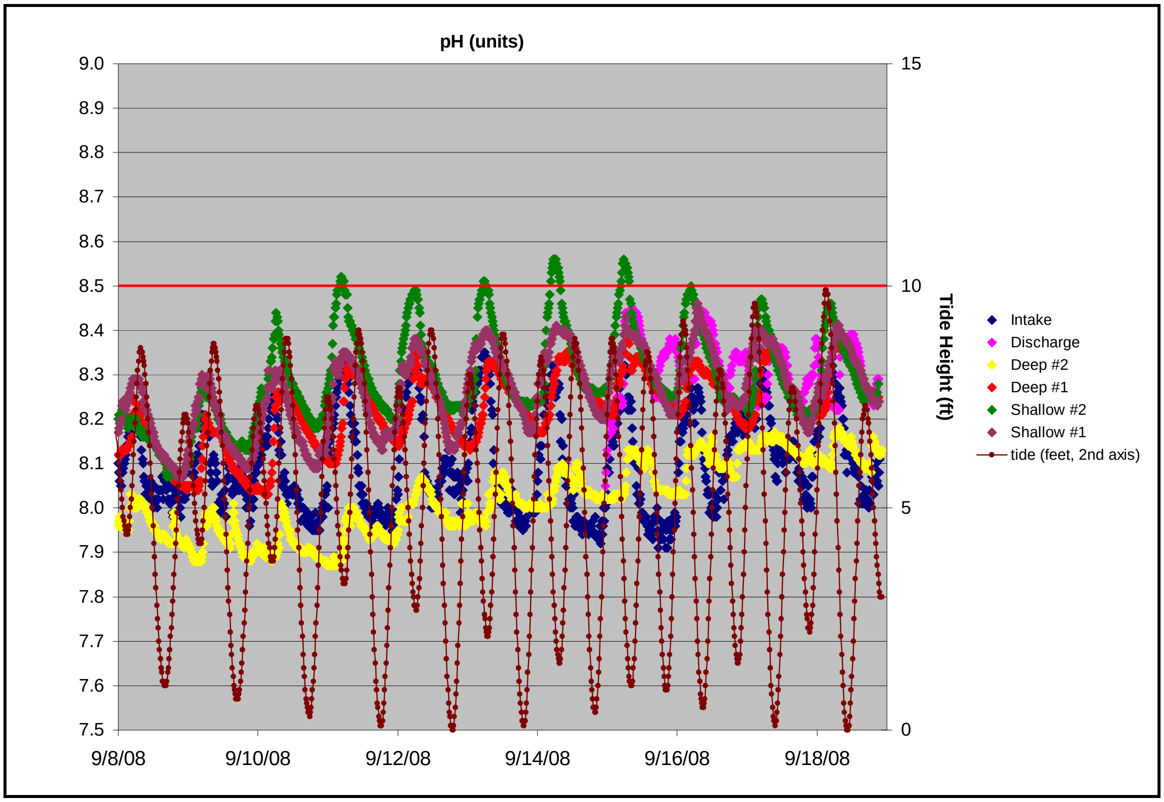


Figure 4-9: pH Values at Pond A14 Sondes, 8-19 September 2008

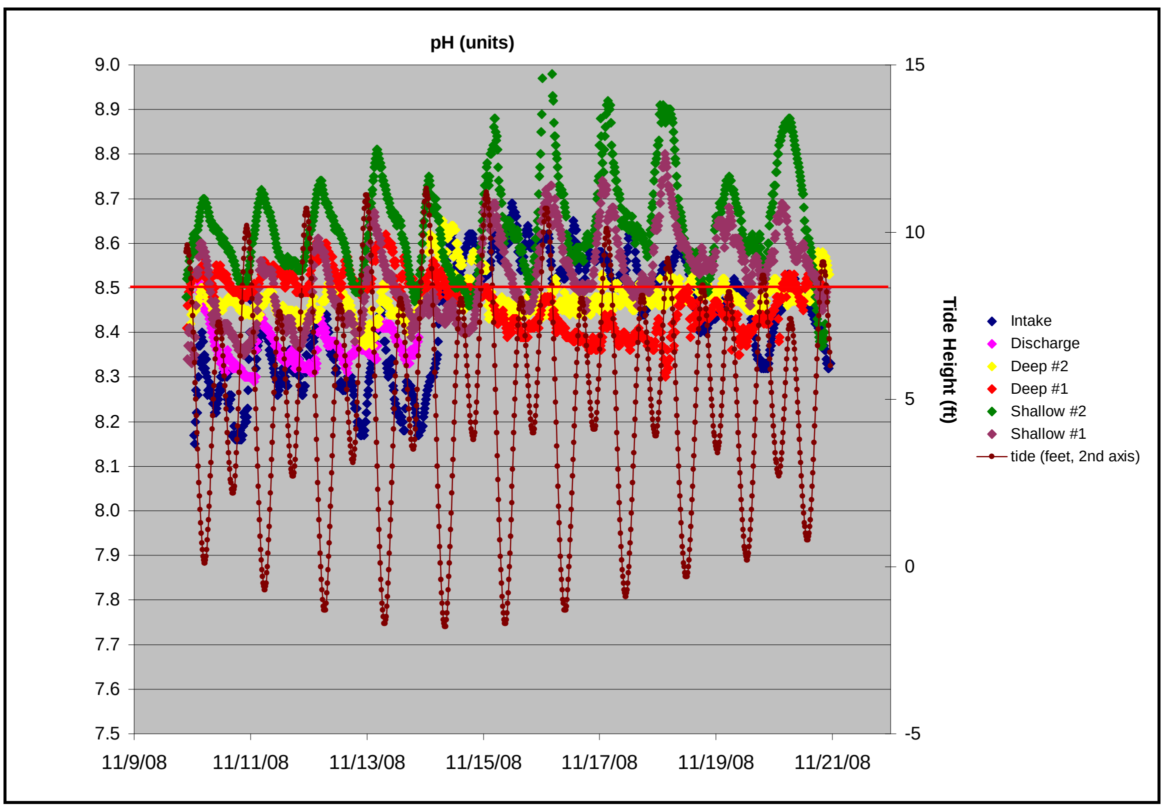


Figure 4-10: pH Values at Pond A14 Sondes, 10-21 November 2008

4.4 TEMPERATURE

Temperature similarly cycled consistently with tidal cycles. The Deep #2 location was generally cooler and less variable than the other locations (Figure 4-11 through 4-13)

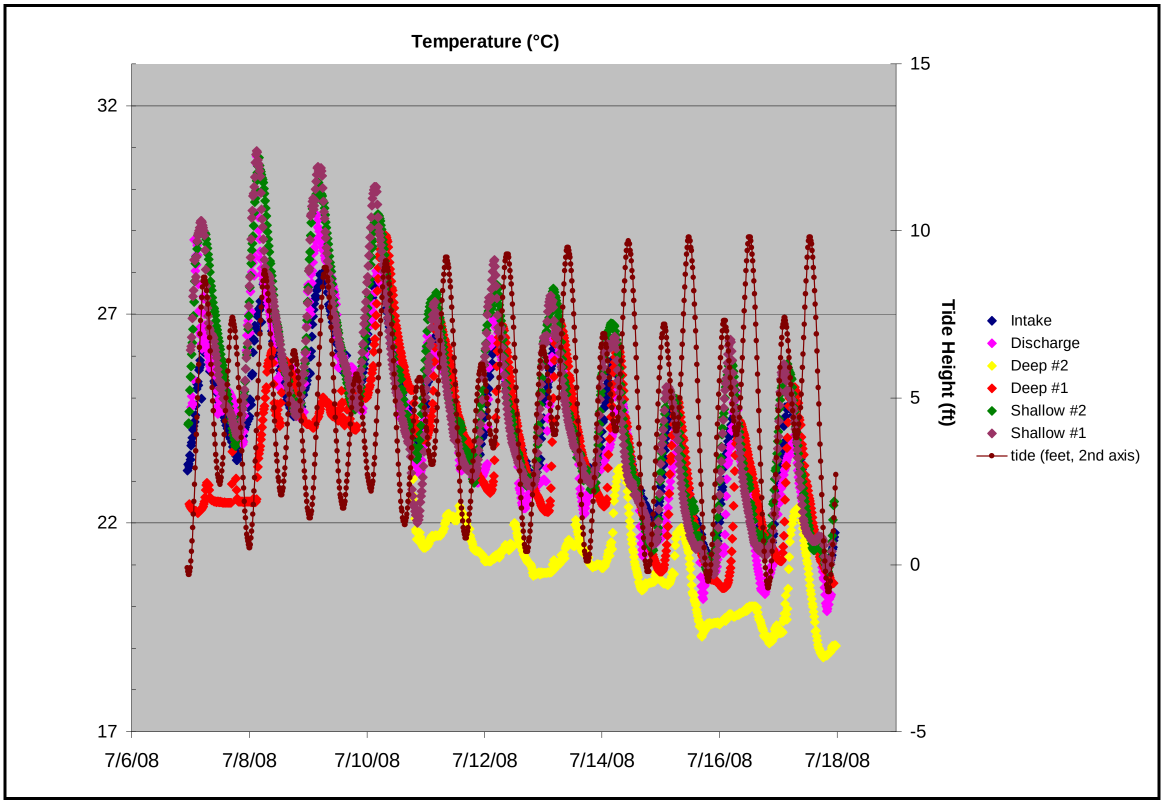


Figure 4-11: Temperature values at Pond A14 Sondes, 7-18 July 2008

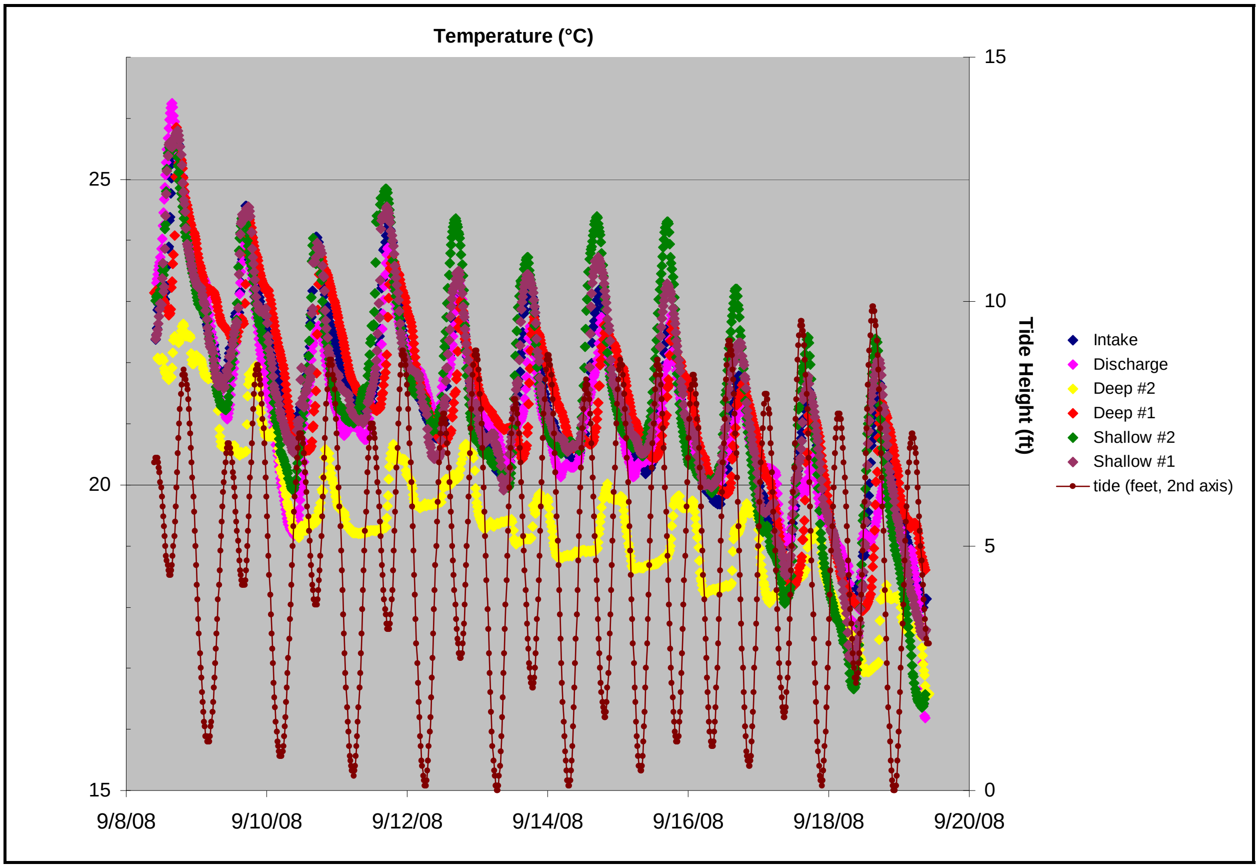


Figure 4-12: Temperature values at Pond A14 Sondes, 8-19 September 2008

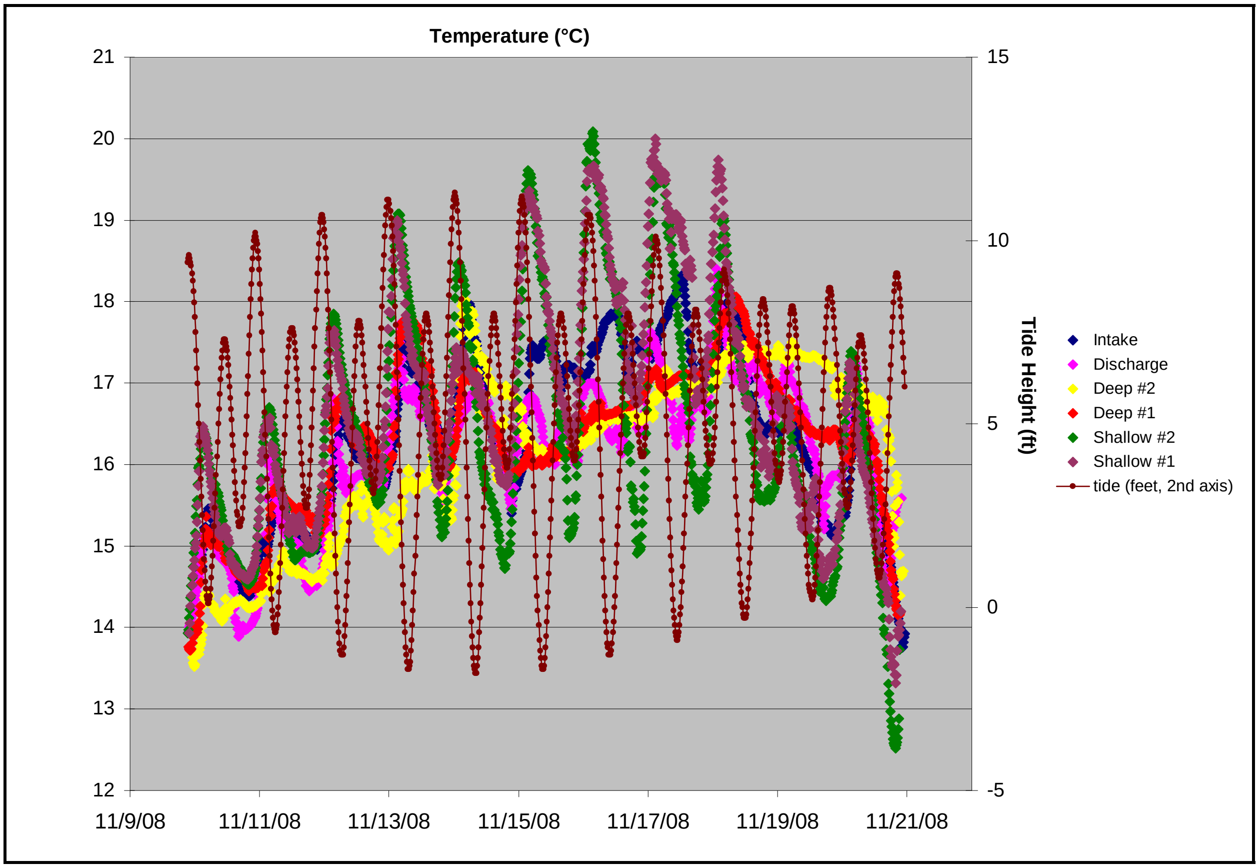


Figure 4-13: Temperature values at Pond A14 Sondes, 10-21 November 2008

4.5 DISSOLVED OXYGEN TRANSECTS

Dissolved oxygen transect data are being analyzed in conjunction with flow, sonde, and sediment pore water data. In general, morning samples were greater than 3.3 mg/L and afternoon samples were less than 5.0 mg/L (see Figures 4-14 through 4-19).

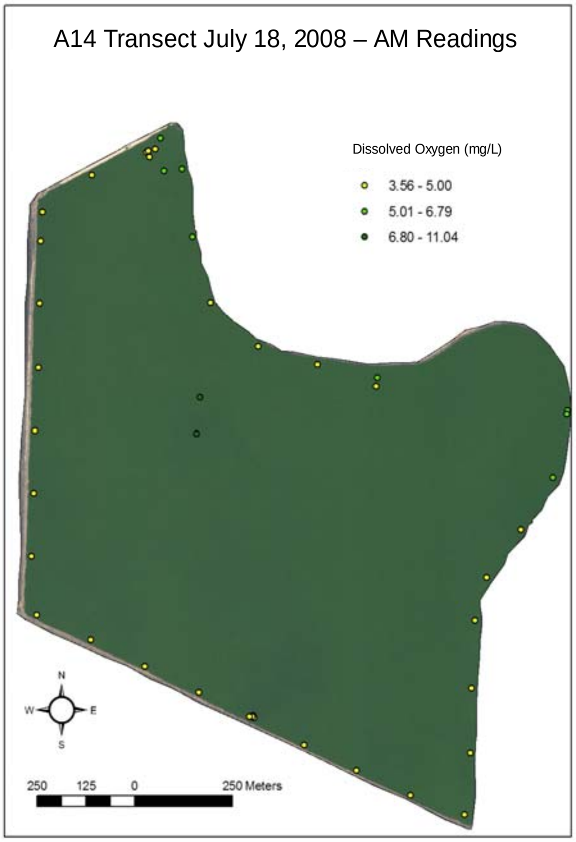


Figure 4-14: Dissolved Oxygen Transects in Pond A14, AM 18 July 2008

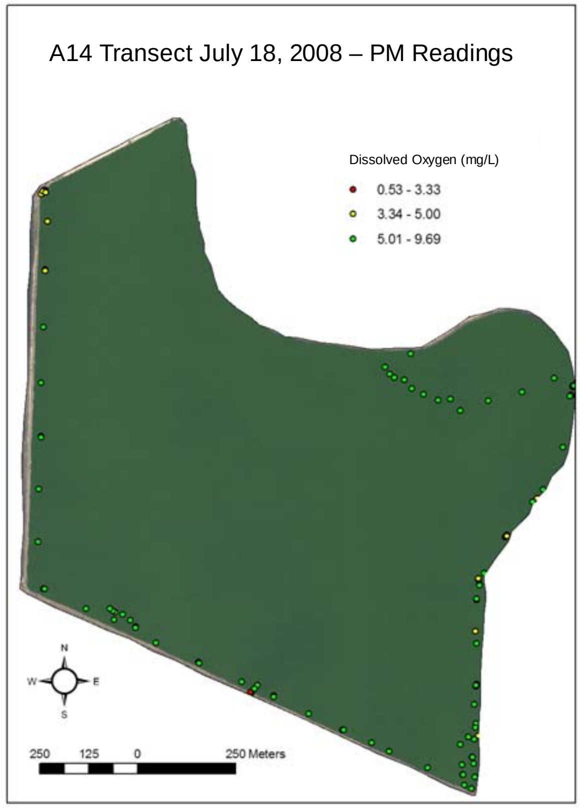


Figure 4-15: Dissolved Oxygen Transects in Pond A14, PM 18 July 2008

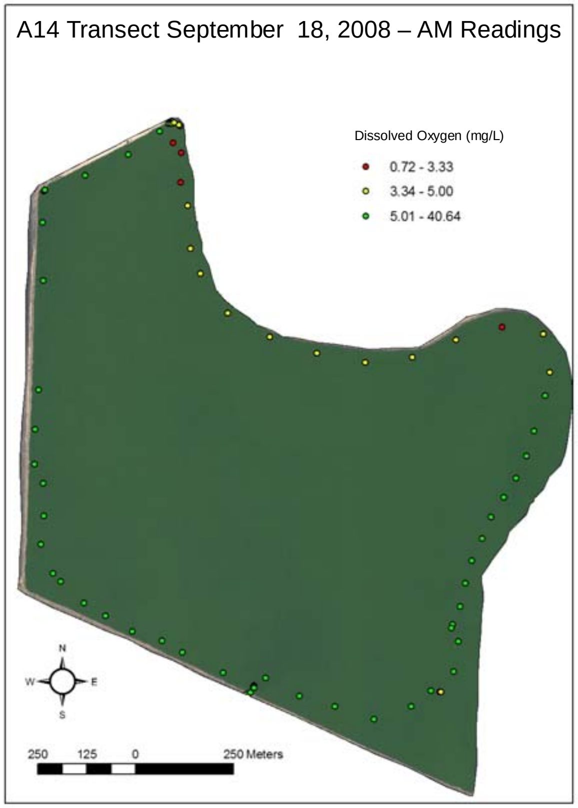


Figure 4-16: Dissolved Oxygen Transects in Pond A14, AM 18 September 2008

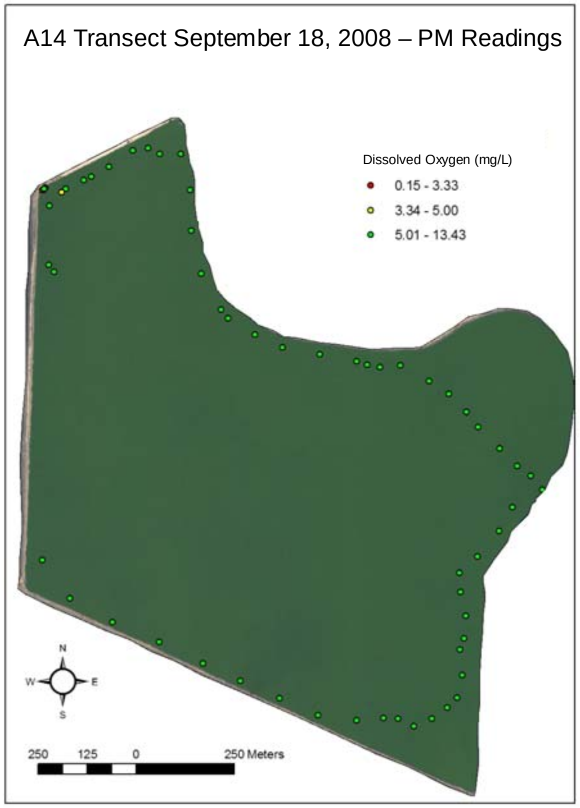
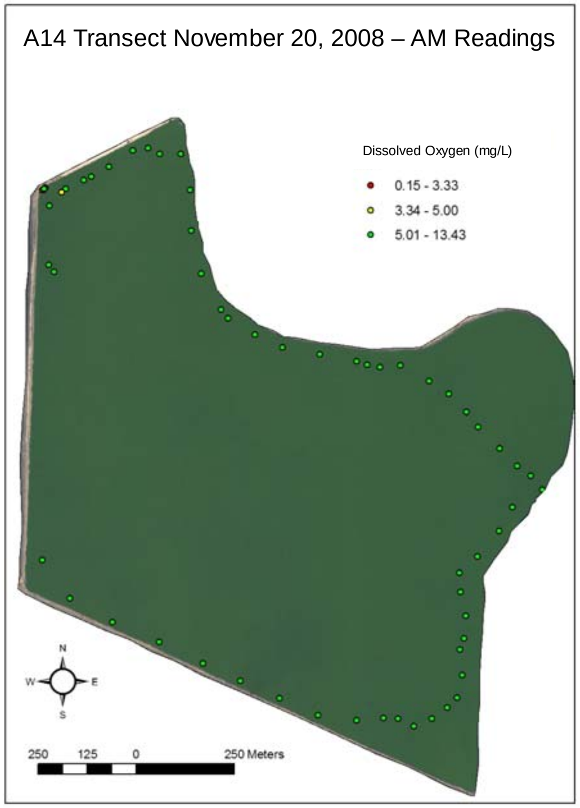


Figure 4-17: Dissolved Oxygen Transects in Pond A14, PM 18 September 2008



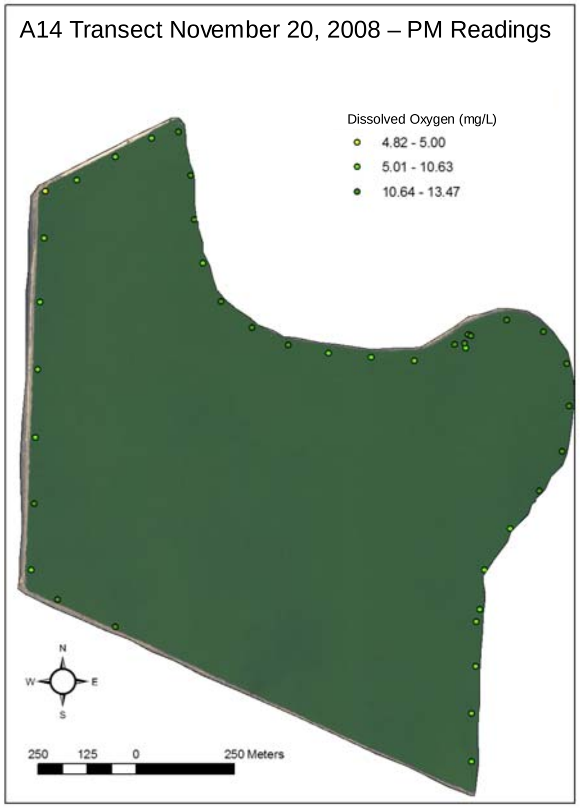


Figure 4-18: Dissolved Oxygen Transects in Pond A14, AM 20 November 2008

Figure 4-19: Dissolved Oxygen Transects in Pond A14, PM 20 November 2008

4.6 NUTRIENTS AND CHLOROPHYLL

Nutrient and chlorophyll measurements were highly variable within pond A14 (Table 4-2) and are currently being analyzed for spatial and temporal patterns in conjunction with water quality and meteorological data.

Table 4-2: Summarized Chlorophyll and Nutrient Values for Pond A14

Sampling Date	CHL µg/L	PHEO µg/L	Nitrate + Nitrite (NO_3 + NO_2) µM	Ammonium (NH_4) µM	DIN µM	Phosphate (PO_4) µM
17 July 2008 - AM	11.76 ± 4.11	6.43 ± 2.49	2.26 ± 3.68	5.93 ± 7.00	8.19 ± 10.47	11.89 ± 3.01
17 July 2008 - PM	9.96 ± 2.05	5.92 ± 2.28	12.05 ± 30.81	5.53 ± 6.65	17.58 ± 35.71	11.16 ± 3.60
18 September 2008	24.99 ± 8.28	7.21 ± 2.60	1.84 ± 4.58	3.90 ± 6.25	5.73 ± 10.83	11.67 ± 2.22
11 November 2008	18.61 ± 17.71	8.46 ± 6.59	29.64 ± 38.61	12.13 ± 9.13	41.77 ± 46.17	12.99 ± 1.61

4.7 METEOROLOGICAL MEASUREMENTS

Meteorological data were relatively consistent during and across study periods, with no precipitation and wind primarily from the west or northwest (Table 4-3). A decline in air temperature across study periods was consistent with the observed decline in water temperature. Photosynthetically active radiation and solar radiation were variable during the study period, but largely due to diurnal cycling.

Table 4-3: Summarized Weather Values for Pond A14

Sampling Period	Temperature (°C)	Relative Humidity (%)	Rainfall (cm)	Primary Wind Direction	Wind Speed (mph)	PAR Light (uM/m²s)	Solar Radiation (wat/m²)
7 July – 18 July 2008	19.78 ± 3.75	76.75 ± 12.44	0.00 ± 0.01	North-West	6.88 ± 5.05	N/A	461.73 ± 321.84 Max: 969
8 September – 19 September 2008	16.78 ± 2.58	78.88 ± 11.50	0.00 ± 0.00	West	5.30 ± 4.62	942.82 ± 704.65 Max: 1969	398.98 ± 318.12 Max: 880
10 November – 21 November 2008	15.49 ± 3.38	78.62 ± 17.98	0.00 ± 0.00	West	2.57 ± 3.19	568.88 ± 377.20 Max: 1250	195.24 ± 186.65 Max: 552

Wind direction determined from wind speed >5mph; PAR and solar radiation averages were calculated from values > 0 to exclude nighttime values.

SECTION 5
POND A16 IN-POND SAMPLING

This section summarizes and analyses of water quality data are being conducted to characterize spatial variability and patterns with respect to flow patterns and pond management. This more detailed information will be provided as separate reports or manuscripts to provide guidance for 2009 data collection procedures. A brief description of our initial findings is presented below:

5.1 CONTINUOUS WATER QUALITY MONITORING

Sondes were deployed at 6 locations in Pond A16 during three study periods (see Table 5-1 and Figure 5-1). Water quality differences will be statistically analyzed between study periods. Dissolved oxygen was the most variable parameter. Temperature declined from the first study period to the last, but there were no other consistent temporal trends.

Table 5-1: Summarized Water Quality Values for Pond A16

Sampling Period	Dissolved Oxygen (mg/L)	pH (Units)	Specific Conductance (mS/cm)	Temperature (ºC)	Salinity (ppt)
16 June – 27 June 2008	4.0 ± 4.1	8.75 ± 0.38	40.8 ± 8.2	22.1 ± 2.6	26.2 ± 6.0
18 August – 29 August 2008	2.5 ± 3.4	8.44 ± 0.35	47.0 ± 7.3	23.6 ± 1.3	30.7 ± 5.4
20 October – 31 October 2008	4.7 ± 5.0	8.19 ± 0.73	43.3 ± 6.0	18.1 ± 1.2	28.0 ± 4.4

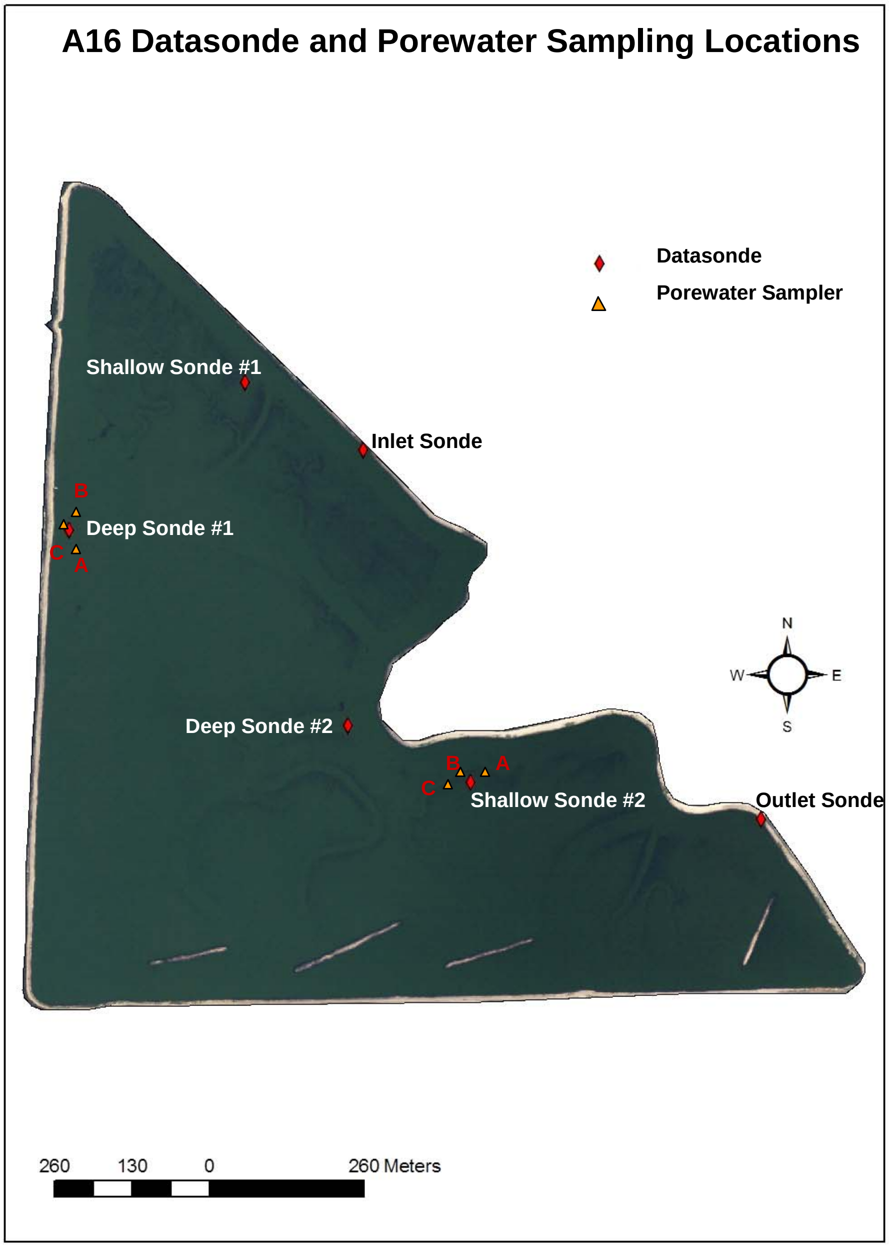


Figure 5-1: Pond A16 Sonde Locations

Water quality values differed at the 6 sonde locations where readings occurred simultaneously. Daily minima and maxima for measured parameters tended to cycle with tides in the intake and discharge waters and thus were reached at about the same time for all 6 sondes, but the magnitude of the maxima tended to differ. Dissolved oxygen was generally highest at the intake and at the shallow sonde locations, particularly during daylight hours and near high tide (Figures 5-2 and 5-3), except during the last sampling period (20-31 October), when DO recorded at the intake sonde was often lower than that recorded at the shallow sonde location (Figure 5-4). Minimum DO values sometimes differed by location, with higher minimum values at the shallow and intake sondes. Sondes located in deep water generally recorded lower dissolved oxygen values.

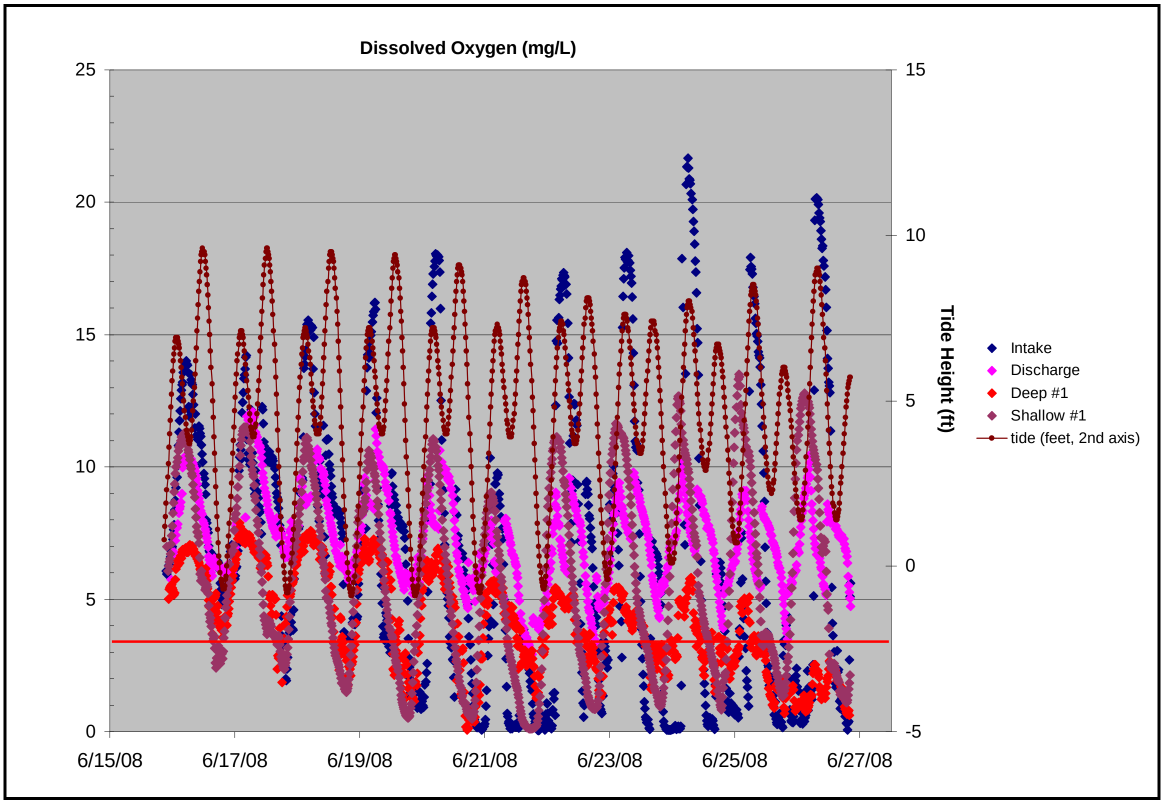


Figure 5-2: Dissolved Oxygen Values at Pond A16 Sondes, 16-27 June 2008

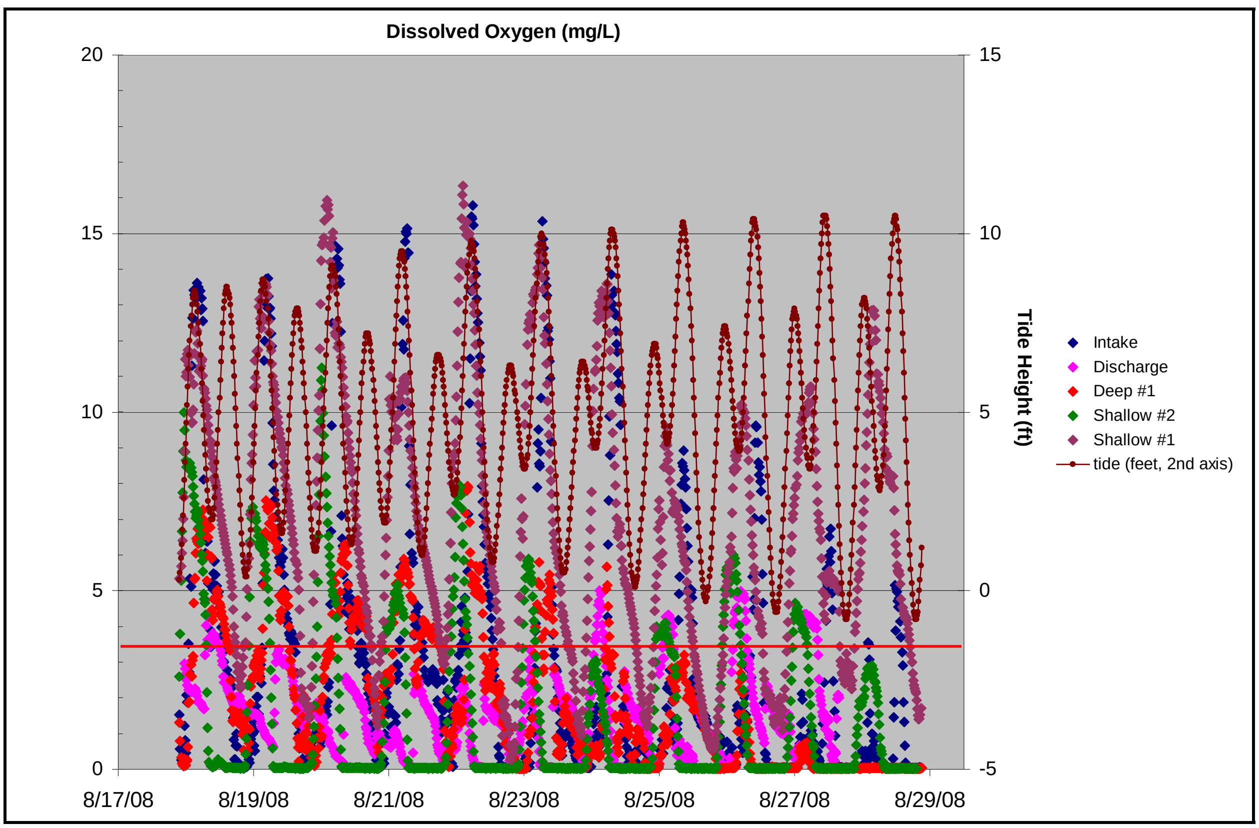


Figure 5-3: Dissolved Oxygen Values at Pond A16 Sondes, 18-29 August 2008

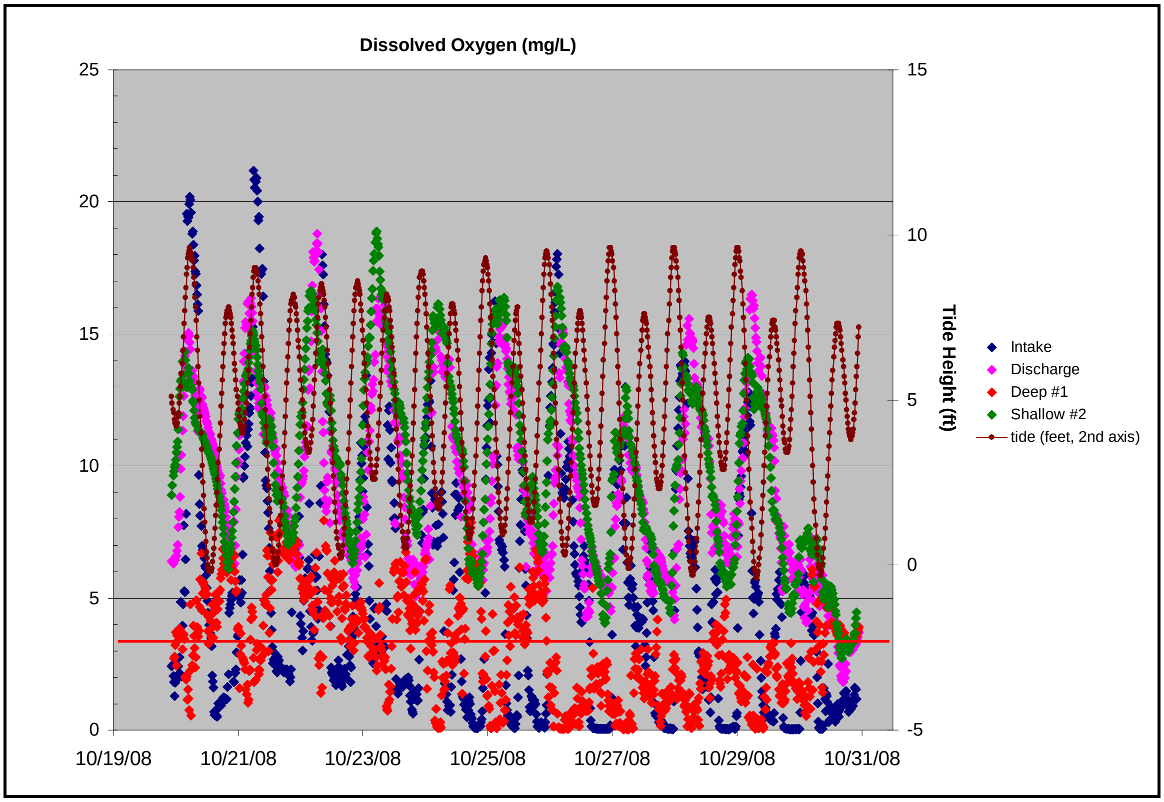


Figure 5-4: Dissolved Oxygen Values at Pond A16 Sondes, 20-31 October 2008

5.2 SALINITY

Salinity within Pond A16 responded noticeably to tide height, and this was most pronounced at the intake location, which also recorded the lowest salinities. Other sonde locations were consistent with one another except at one deep sonde location (Deep #2), which was consistently more saline than other pond locations (Figure 5-5 through 5-7).

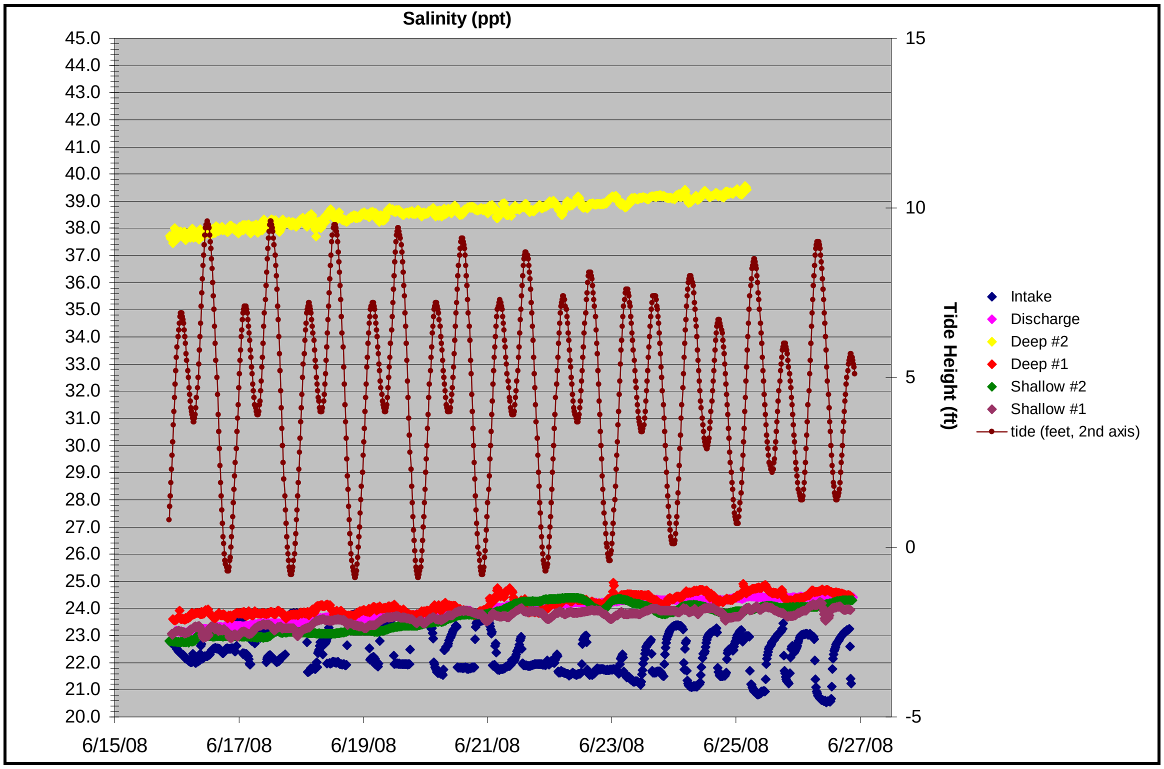


Figure 5-5: Salinity Values at Pond A16 Sondes, 16-27 June 2008

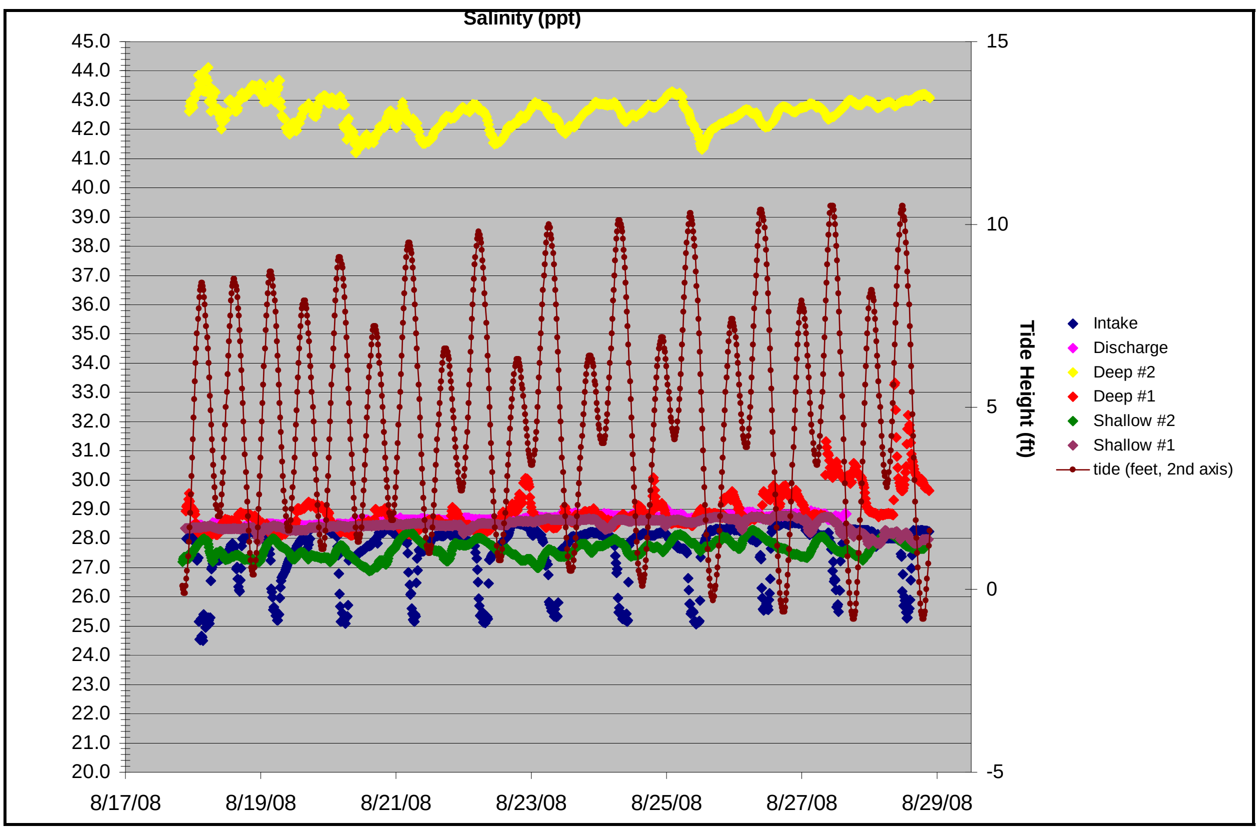


Figure 5-6: Salinity Values at Pond A16 Sondes, 18-29 August 2008.

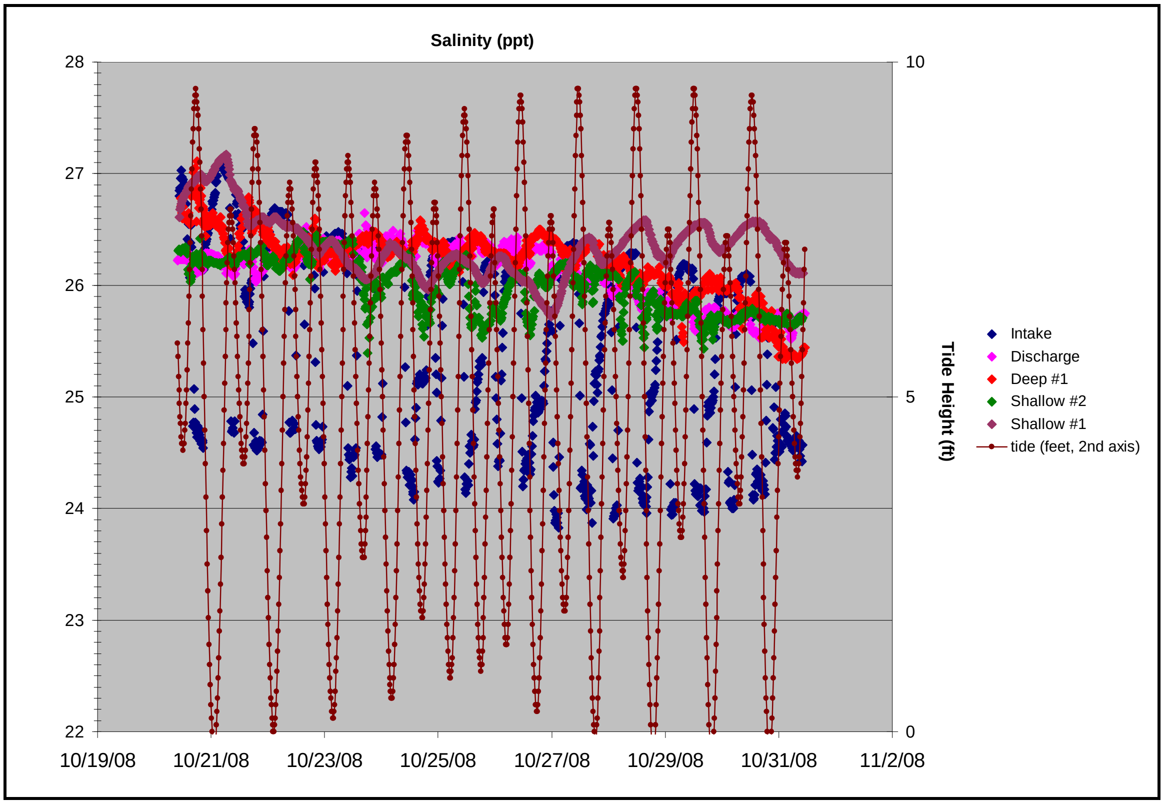


Figure 5-7: Salinity Values at Pond A16 Sondes, 20-31 October 2008.

5.3 pH

At pond A16, pH at ranged from 7.4 to 9.3. There was consistent spatial variability in pH, as values closest to neutrality were recorded at deep location #2. At the discharge location, pH tended to be high. All sites showed cyclic pH response which was similar to the tidal cycle period (Figures 5-8 through 5-10).

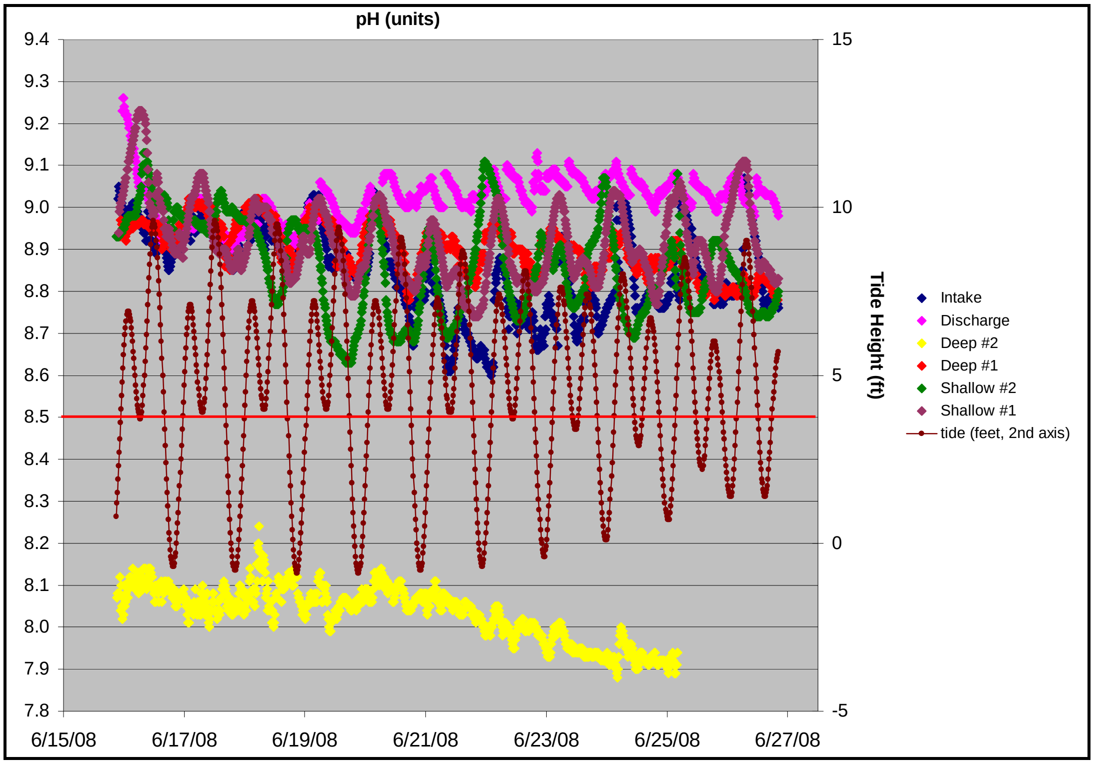


Figure 5-8: pH Values at Pond A16 Sondes, 16-27 June 2008

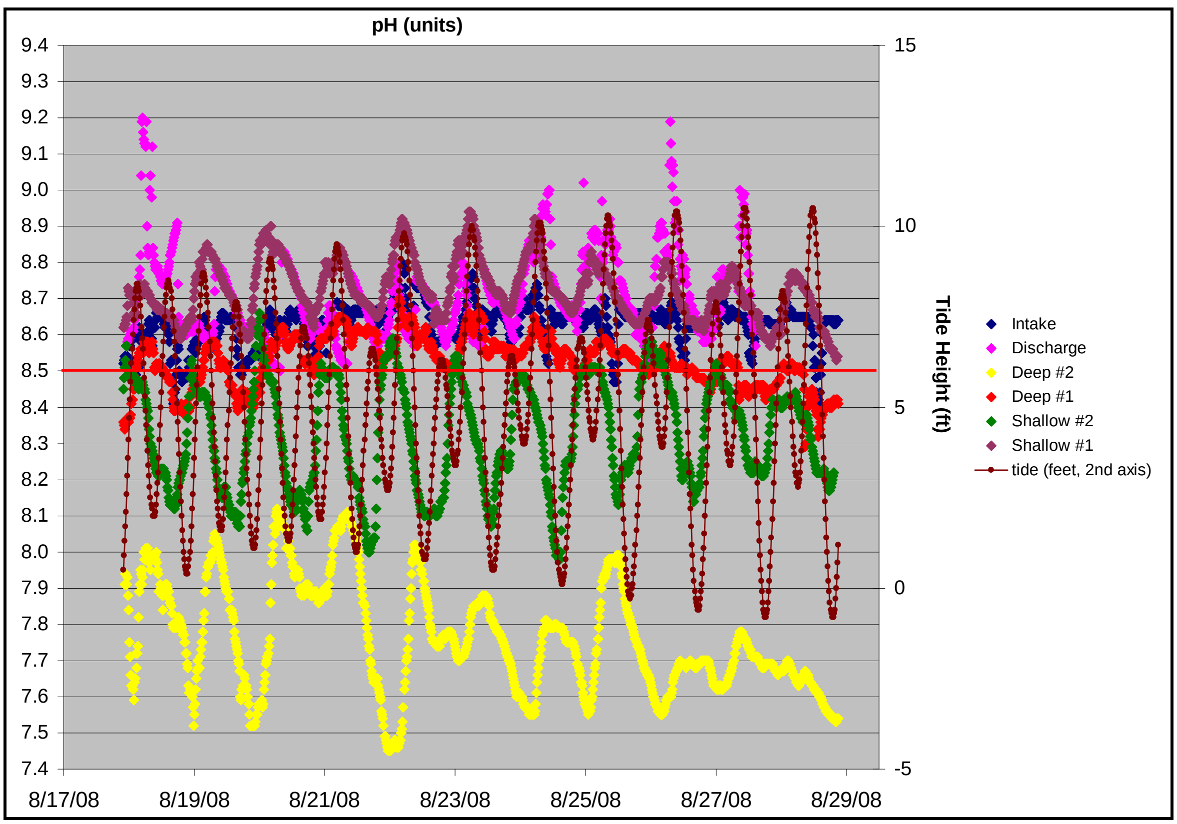


Figure 5-9: pH Values at Pond A16 Sondes, 18-29 August 2008

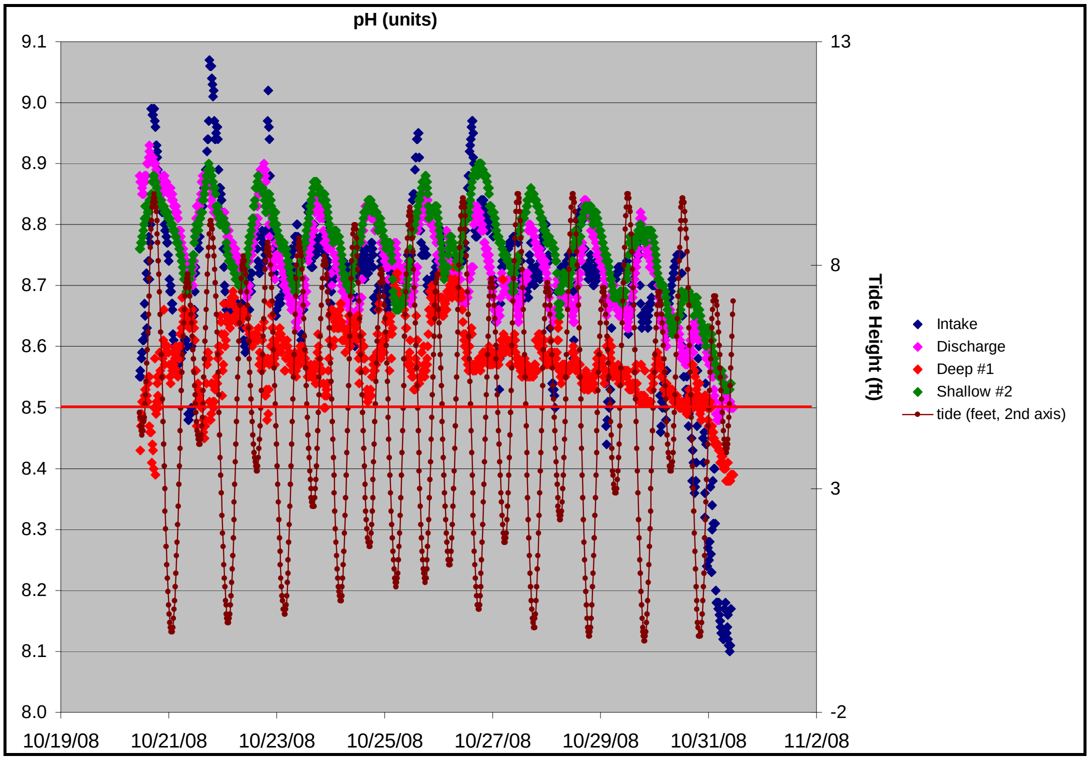


Figure 5-10: pH Values at Pond A16 Sondes, 20-31 October 2008

5.4 TEMPERATURE

Temperature similarly cycled consistently with tidal cycles. The Deep #2 location was generally cooler and less variable than the other locations (Figure 5-11 through 5-13).

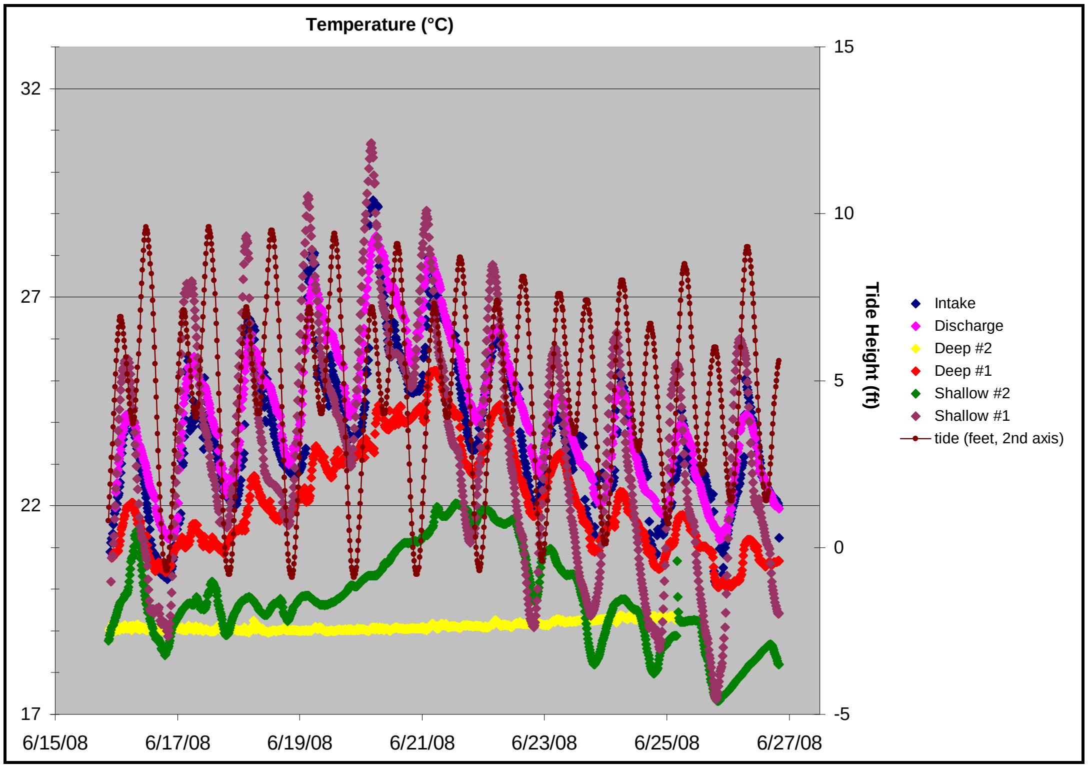


Figure 5-11: Temperature Values at Pond A16 Sondes, 16-27 June 2008

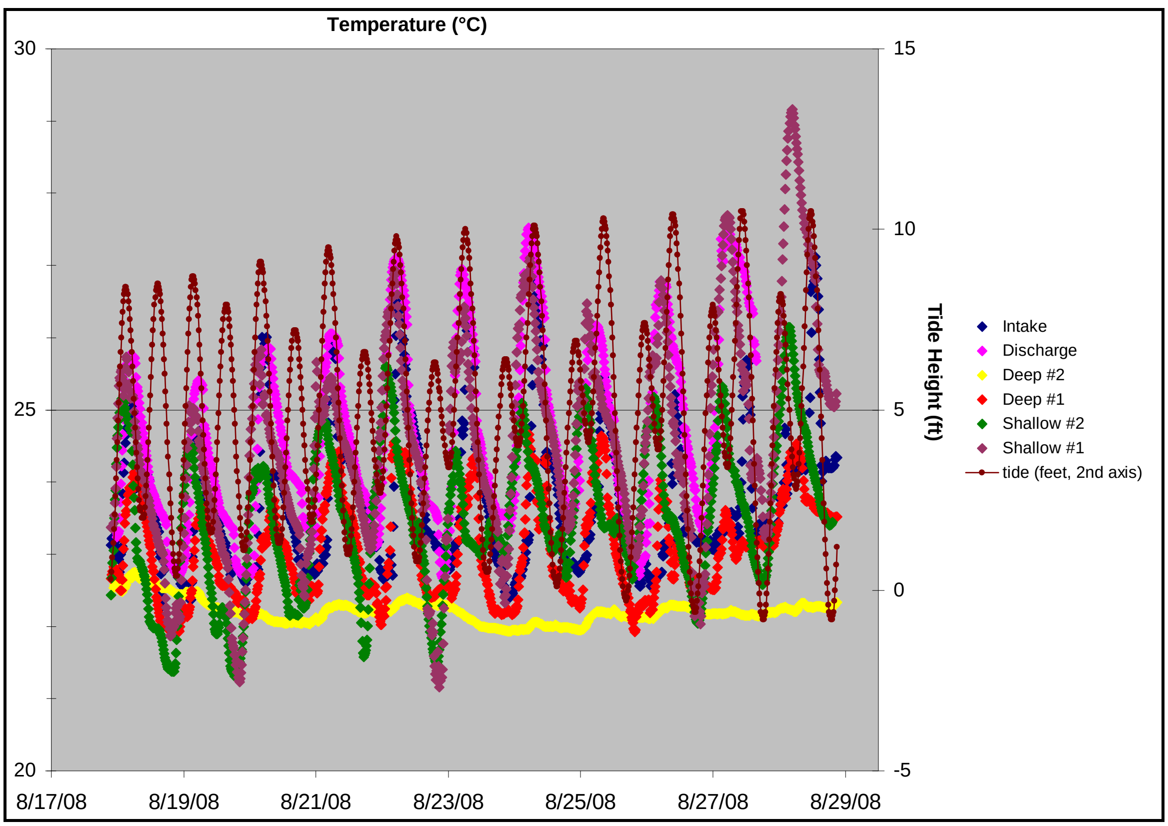


Figure 5-12: Temperature Values at Pond A16 Sondes, 18-29 August 2008

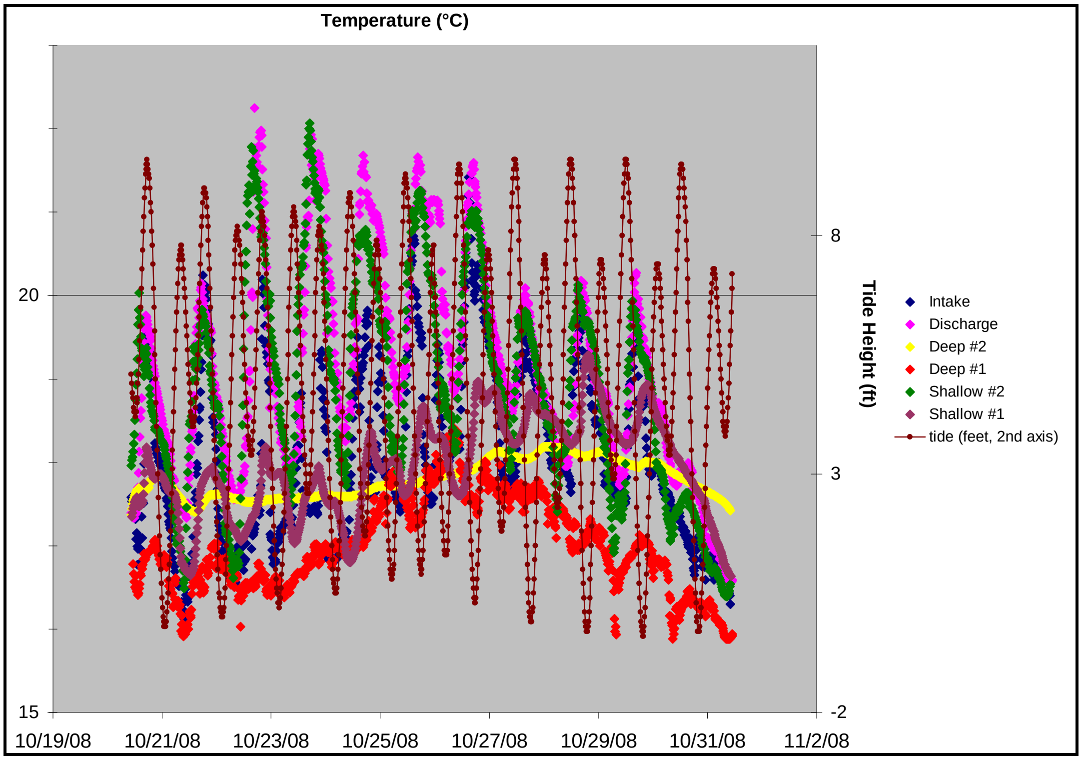


Figure 5-13: Temperature Values at Pond A16 Sondes, 20-31 October 2008.

5.5 DISSOLVED OXYGEN TRANSECTS

Interior sites were generally inaccessible by boat, but water quality data were collected by sampling towards the pond interior from a boat on the borrow ditch. Dissolved oxygen transect data are being analyzed in conjunction with flow, sonde, and sediment pore water data. DO data were variable. Most samples collected on 25 June 2008 were greater than 5.0 mg/L (Figures 5-13 and 5-14). During morning sampling on 27 August, DO was highly variable, with higher values (>5.0 mg/L) in the northwest portion of the pond, moderately low values (3.3 – 5.0 mg/L) in the southwest portion of the pond, and low values (<3.3 mg/L) in the southern and southeastern portions of the pond (Figure 5-15). During the afternoon sampling the same day, most values were greater than 5.0 mg/L with the exception of some lower values in the northwest portion of the pond (Figure 5-16). DO values on 29 October were generally moderately low to higher values (Figures 5-17 and 5-18).

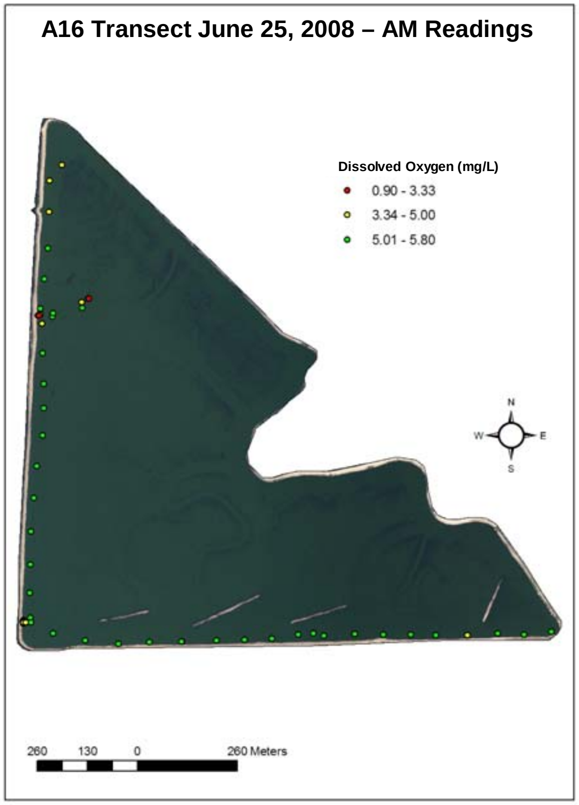


Figure 5-14: Dissolved Oxygen Transects in Pond A16, AM 25 June 2008

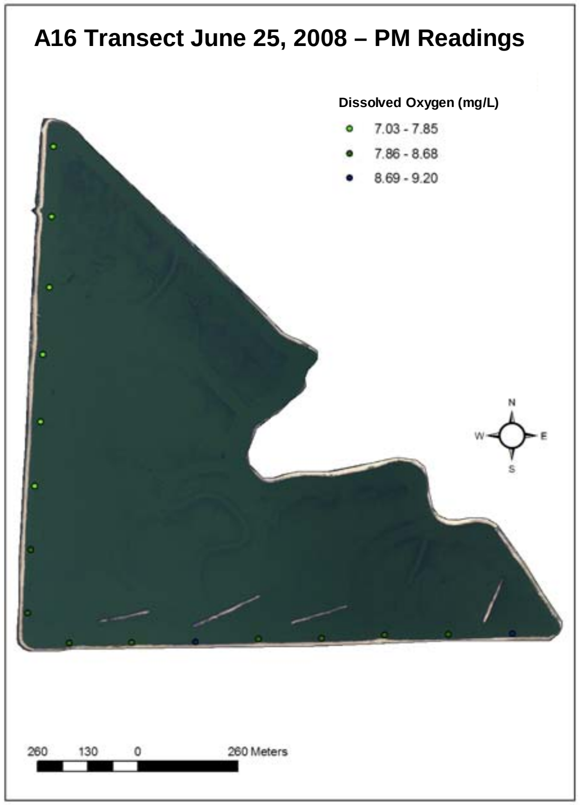


Figure 5-15: Dissolved Oxygen Transects in Pond A16, PM 25 June 2008

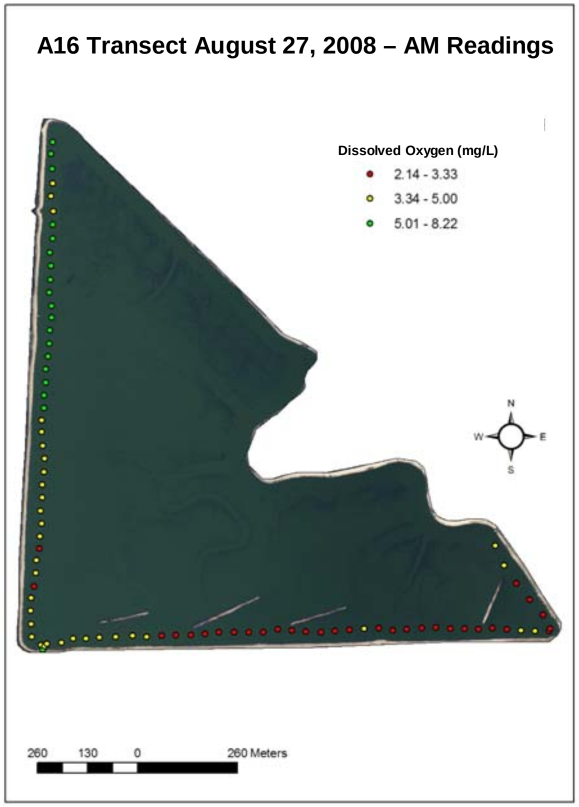


Figure 5-16: Dissolved Oxygen Transects in Pond A16, AM 27 August 2008

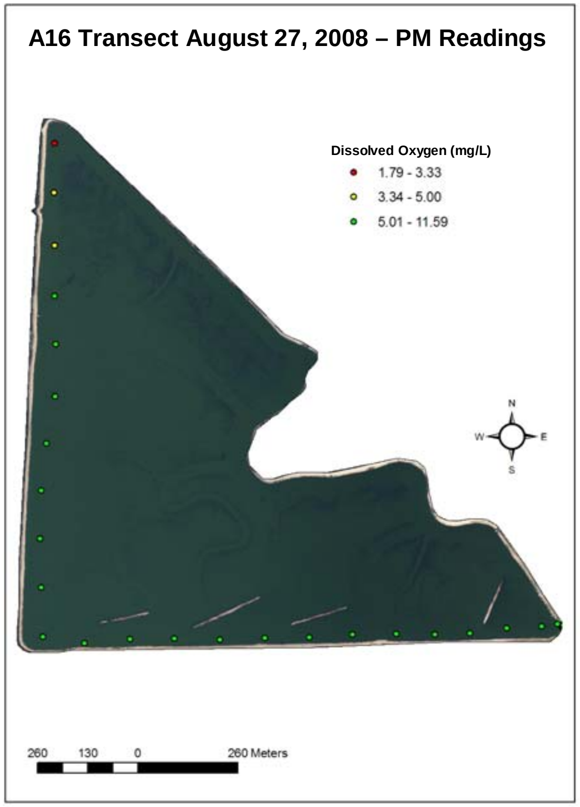


Figure 5-17: Dissolved Oxygen Transects in Pond A16, PM 27 August 2008

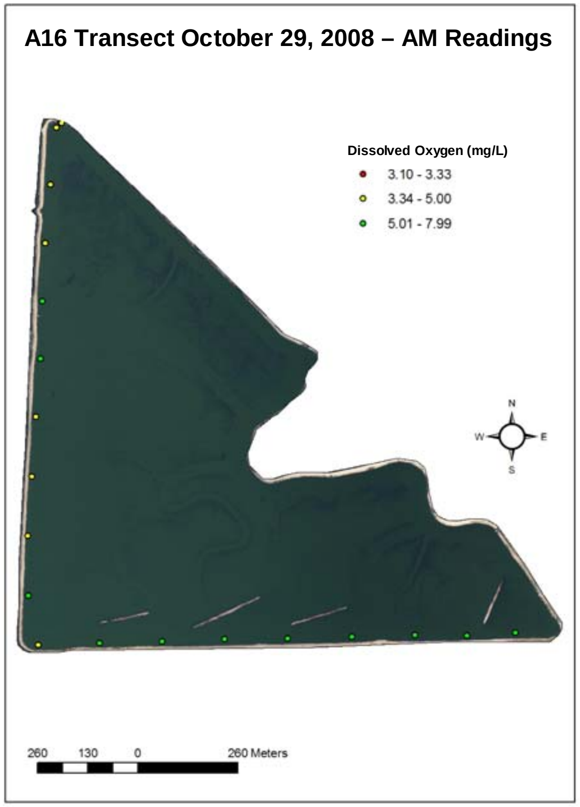


Figure 5-18: Dissolved Oxygen Transects in Pond A16, AM 29 October 2008

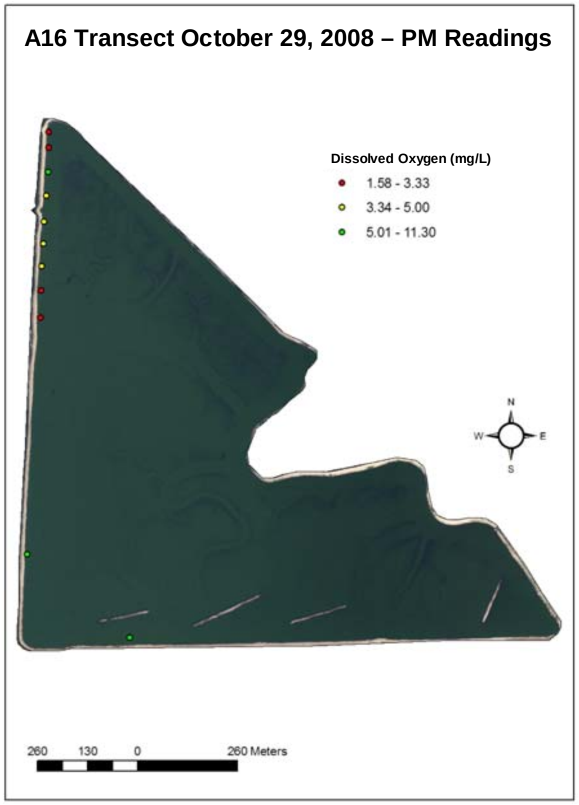


Figure 5-19: Dissolved Oxygen Transects in Pond A16, PM 29 October 2008

5.6 NUTRIENTS AND CHLOROPHYLL

Nutrient and chlorophyll measurements were highly variable within pond A16 (Table 5-2) and are currently being analyzed for spatial and temporal patterns in conjunction with water quality and meteorological data.

Table 5-2: Summarized Chlorophyll and Nutrient Values for Pond A16

Sampling Date	CHL µg/L	PHEO µg/L	Nitrate + Nitrite (NO_3 + NO_2) µM	Ammonium (NH_4) µM	DIN µM	Phosphate (PO_4) µM
25 June 2008 - AM	21.65 ± 12.48	19.93 ± 17.18	.09 ± .26	2.70 ± 2.30	2.79 ± 2.24	9.56 ± 3.03
25 June 2008 - PM	34.55 ± 38.34	16.92 ± 15.00	6.49 ± 18.36	2.88 ± 1.23	9.37 ± 18.55	8.10 ± .73
27 August 2008	72.19 ± 89.76	12.87 ± 27.28	22.05 ± 100.39	32.66 ± 122.79	54.71 ± 158.35	24.86 ± 31.41
29 October 2008	113.13 ± 46.74	22.15 ± 15.45	3.94 ± 6.07	2.91 ± 2.58	6.84 ± 8.43	17.06 ± 1.75

5.7 METEOROLOGICAL MEASUREMENTS

Meteorological data were relatively consistent during and across study periods, with no precipitation and wind primarily from the west (Table 5-3). A decline in air temperature across study periods was consistent with the observed decline in water temperature. Photosynthetically active radiation (PAR) and solar radiation were variable during the study period, but largely due to diurnal cycling.

Table 5-3: Summarized Weather Values for Pond A16

Sampling Period	Temperature (ºC)	Relative Humidity (%)	Rainfall (cm)	Primary Wind Direction	Wind Speed (mph)	PAR Light (uM/m^2s)	Solar Radiation (wat/m2)
16 June – 27 June 2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18 August – 29 August 2008	20.40 ± 4.11	74.07 ± 17.08	0.00 ± 0.00	West	5.86 ± 5.78	1114.37 ± 728.55 Max: 2079	410.65 ± 347.11 Max: 912
20 October – 31 October 2008	16.56 ± 3.90	73.64 ± 21.07	0.00 ± 0.00	West	3.31 ± 4.23	664.61 ± 483.12 Max: 1443	290.28 ± 223.96 Max: 646

Wind direction determined from wind speed >5mph; PAR and solar radiation averages were calculated from values > 0 to exclude nighttime values.

SECTION 6
PLAN TO ACHIEVE COMPLIANCE

Maintaining dissolved oxygen levels in the ponds has been the major water quality challenge for the ISP. A number of corrective actions were implemented in 2005 through 2007 to raise dissolved oxygen in the ponds. Some of these actions improved DO levels, and some did not. Based on the lessons learned, for the 2009 season, the FWS once again plans on changing methods of operation as the need arises to improve water quality compliance.

6.1 POND SYSTEM A2W

Starting in May of 2009, the FWS plan to operate Pond A2W system as continuous flow through system with Pond A1 as the intake and Pond A2W as the discharge. Through trial and error, the gates will need to be adjusted to find equilibrium of water in-flow and discharge to account for evaporation during the summer. The back portions of the Ponds A1 and Pond A2W will need to be monitored closely when warmer weather patterns occur.

6.2 POND SYSTEM A3W

Flow diversion baffles will once again remain in place during the 2009 season. The baffles have proven to raise the DO concentrations at the discharge in 2005. At the discharge point in Pond A3W, one of the three gates has the ability to allow water in-flow as a partial muted tidal operation. Although Pond A3W was being operated minimally as partially muted tidal, the FWS will attempt to increase the muted tidal capabilities by further opening the intake at Pond A3W.

Water levels in Pond AB1 and Pond AB2 of Pond A3W system may be temporarily lowered during the summer to improve shorebird nesting and foraging habitat.

6.3 POND SYSTEM A7

This Pond System will be operated as a continuous flow through, the in-flow gates at Pond A5 will remain partially open to fully open through the season. The gates and weir boards at Pond A7 will be adjusted through the season to find the optimum balance of water level and levee freeboard. During the winter, Pond A7 intakes will not be open due to possible fish entrainment. As part of the South Bay Salt Pond Restoration, Pond system A7 will be changed dramatically how the water is circulated through the pond and water level heights. Currently, we are still in the design phase for the changes, but expect construction to occur in the summer of 2009.

6.4 POND SYSTEM A14

In 2009, Pond A14 system will be operated similar to the 2008 water quality season. Pond A14 and Pond A9 will be operated as partially muted tidal to allow better inflow, and also help prevent sedimentation from occurring in the intake/ discharge channel. During the winter, Pond A9 and Pond A14 intakes will not be open due to possible fish entrainment.

6.5 POND SYSTEM A16

Due to observations and lessons learned in 2006, it will be recommended to open this system to continuous flow mode year round. The intake will be from Pond A17 and the discharge point at Pond A16. Pond A17 may be operated partially muted tidal during certain time periods to increase DO, and reduce sediment buildup around the trashrack. The water levels will be set by adjusting weir boards at the water control structures. Due to fish distress in August 2005 and May 2006 in Pond A16, it is recommended to not shut this system gates completely or operate as muted tidal at Pond A16 which could cause detrimental impact to the pelagic and benthic organisms. During the winter, Pond A17 intakes will not be open due to possible fish entrainment.

SECTION 7

MONITORING PLAN MODIFICATIONS

In the Final Order it states that the DO instantaneous minimum for discharge is 5.0 mg/L. This "limitation applies when receiving waters contain at 5.0 mg/L of dissolved oxygen. In cases where receiving waters do not meet the Basin Plan objectives, pond discharges must be at or above the dissolved oxygen level in the receiving water:." Since the initial release of the Alviso Pond Complex, the discharges from these ponds have historically shown fluctuating diurnal DO values throughout the monitoring season. The receiving waters in the adjacent sloughs and Bay to the Pond discharges have also some recorded values less than 5.0 mg/L. In 2007, additional water quality sampling was done in Newark slough which is independent of any discharge coming from the Salt Ponds, has shown DO values being lower than the limit for one third of the observed recordings for the past three years

USGS has also conducted additional receiving water sampling in Newark, Mowry, and Guadalupe sloughs, which indicates that there seems to be a natural variability of slough DO that is virtually unaffected by pond discharge. This sampling (which was done in August and September 2007) also indicates that at times the pond discharge actually increases DO concentrations in the sloughs. This report will be provided to the RWQCB when it becomes available.

While the FWS will continue to collect and report the results of sampling that occurs in the Ponds as well as the Bay / sloughs, there seems to be evidence that Pond discharges may not be contributors to variable receiving water DO concentrations. It is the FWS suggestion that the RWQCB re-evaluate or revise the objectives for DO in the South Bay sloughs and consider a site specific objective based on recent data.

APPENDIX A
ADDITIONAL FIGURES

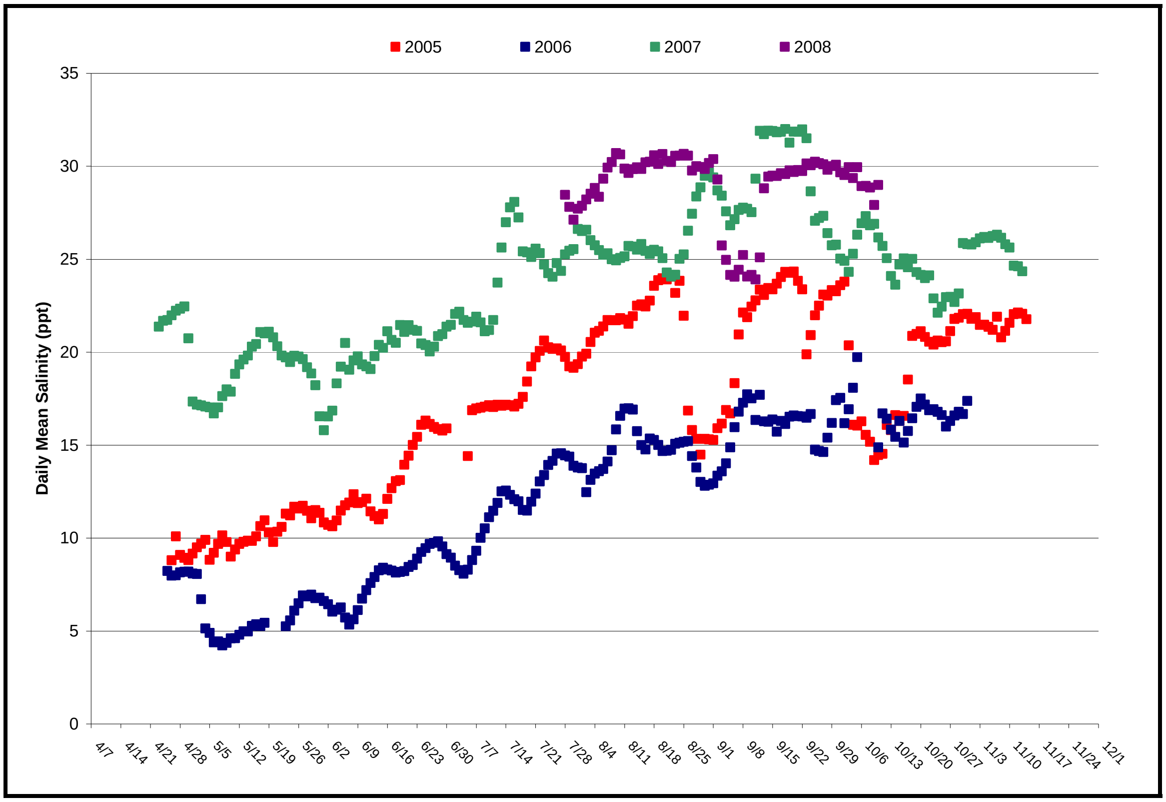


Figure A-1: Salinity of Pond A3W

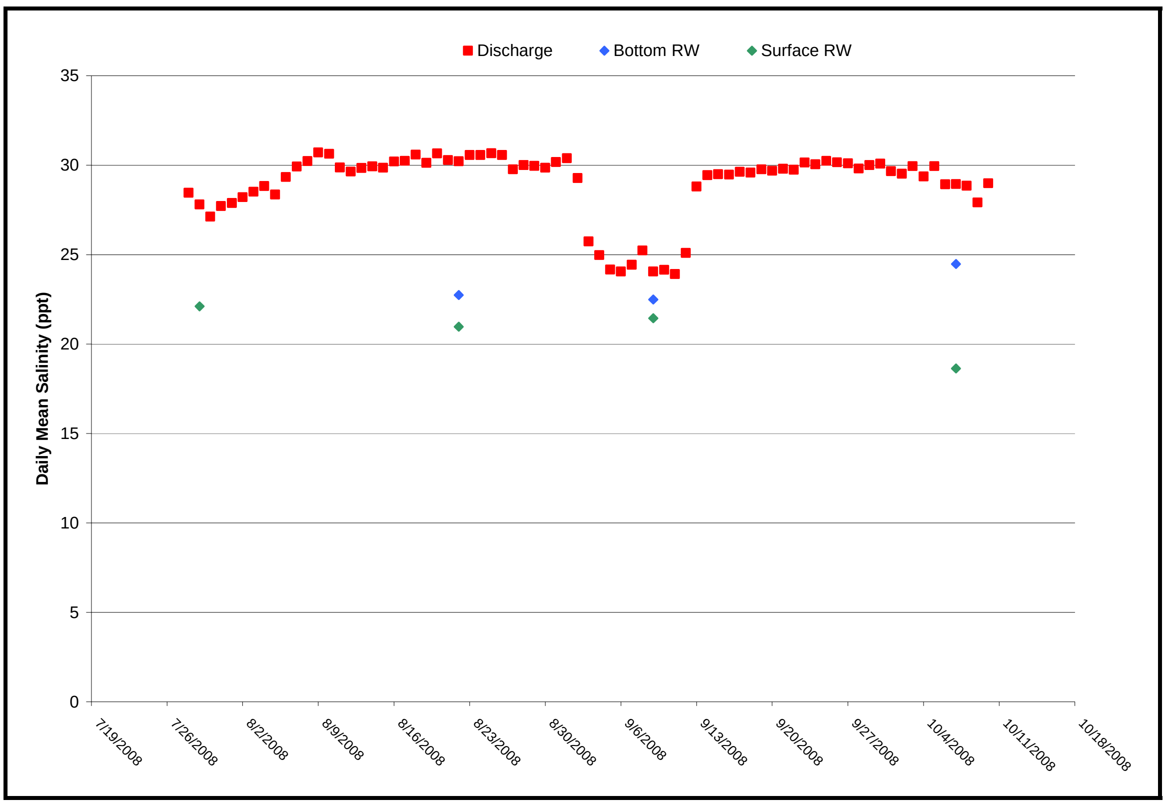


Figure A-2: Salinity of Pond A3W vs. Guadalupe Slough

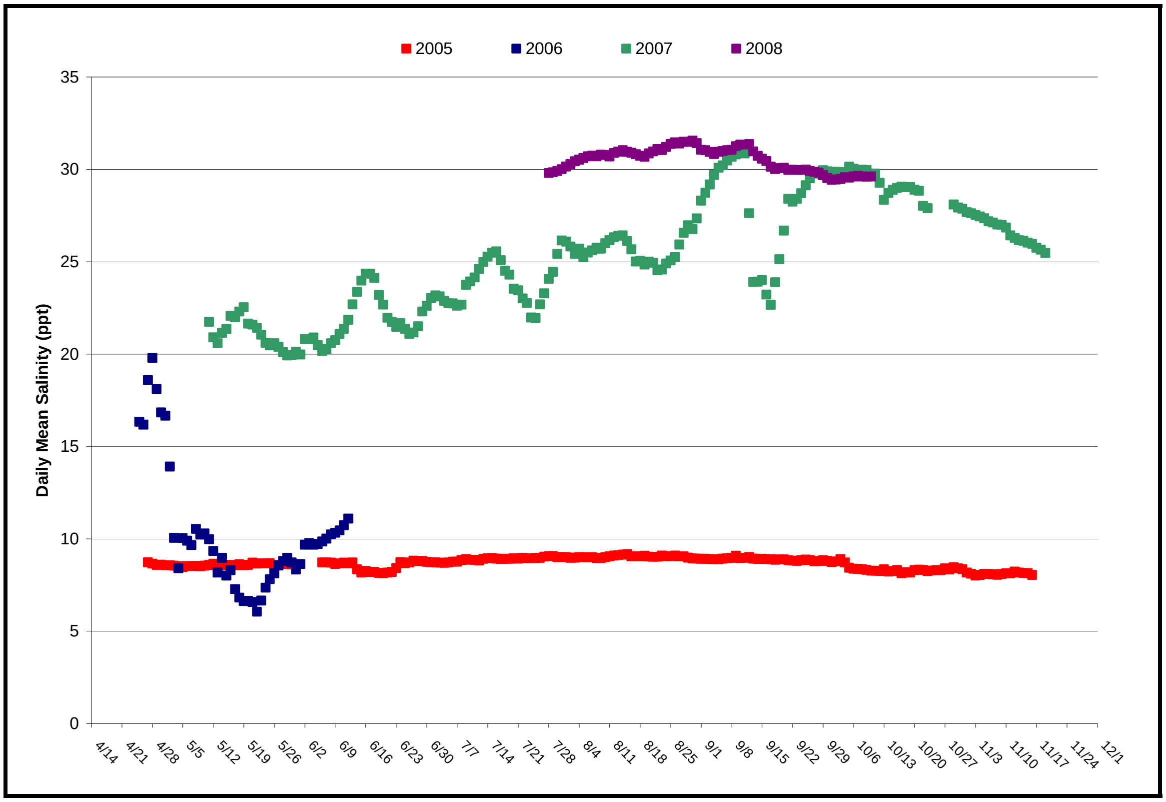


Figure A-3: Salinity of Pond A7

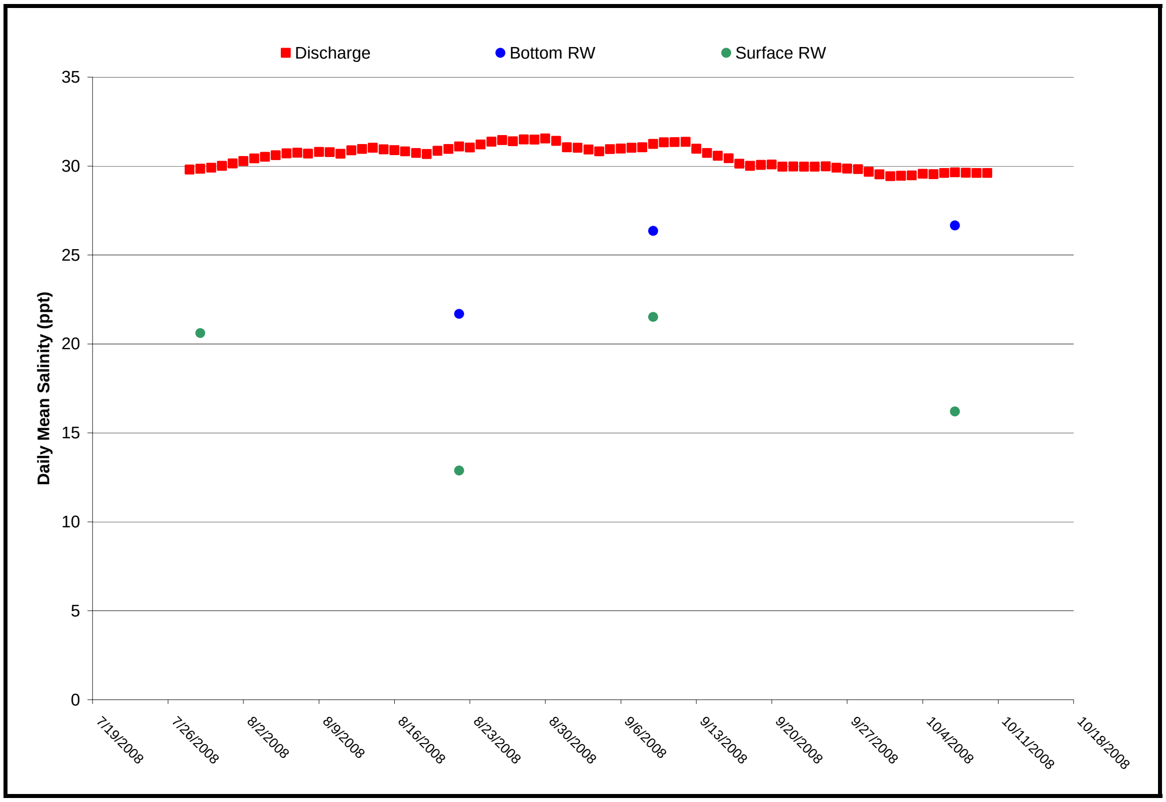


Figure A-4: Salinity of Pond A7 vs. Alviso Slough

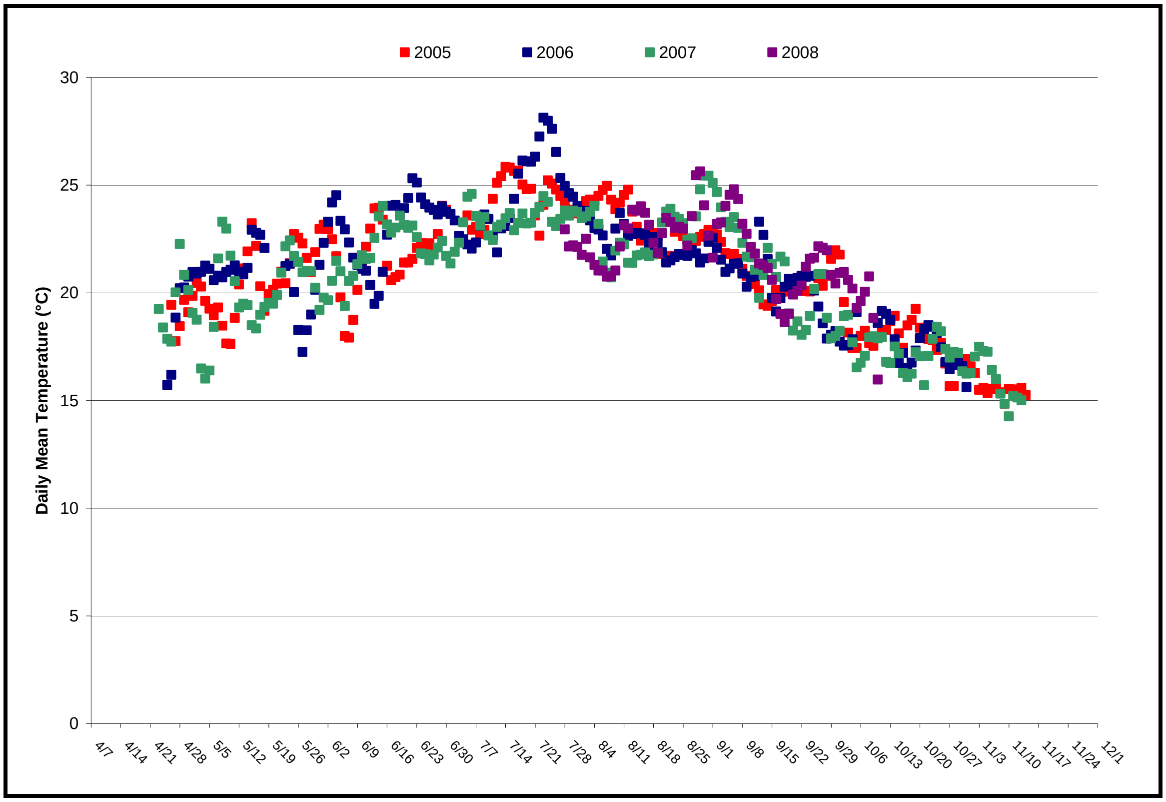


Figure A-5: Temperature of Pond A3W

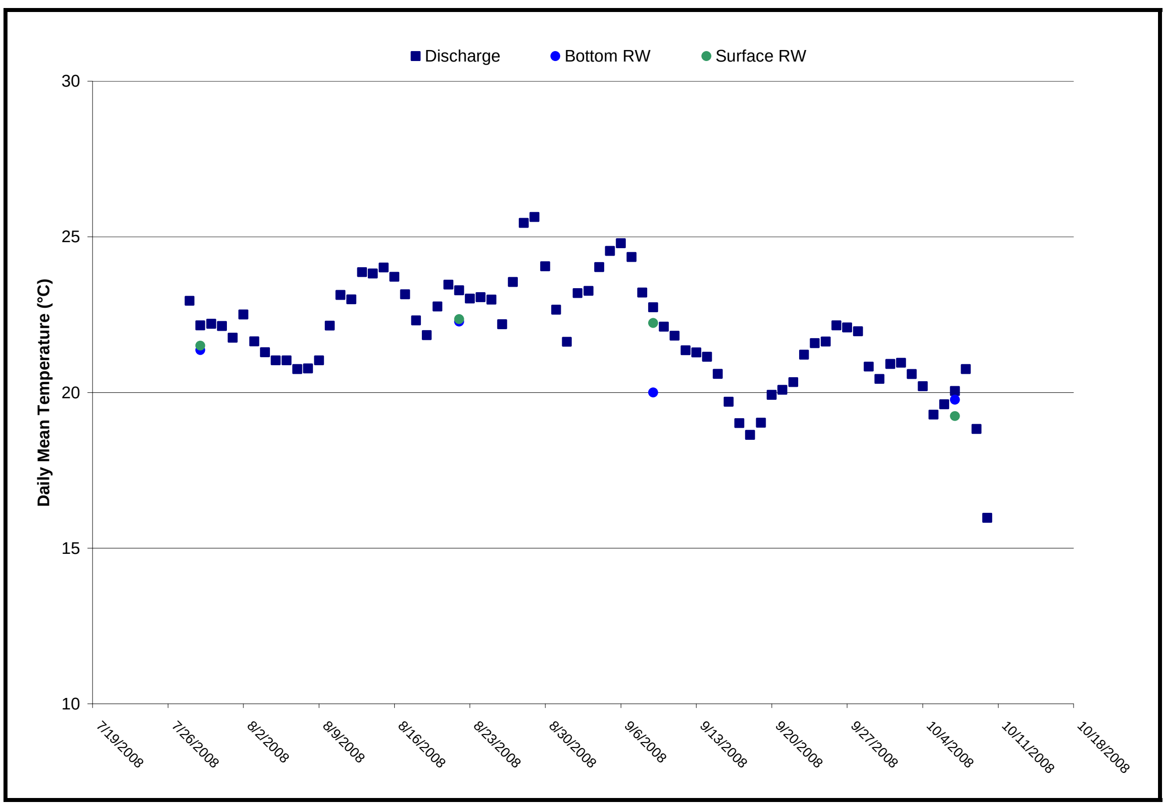


Figure A-6: Temperature of Pond A3W vs. Guadalupe Slough

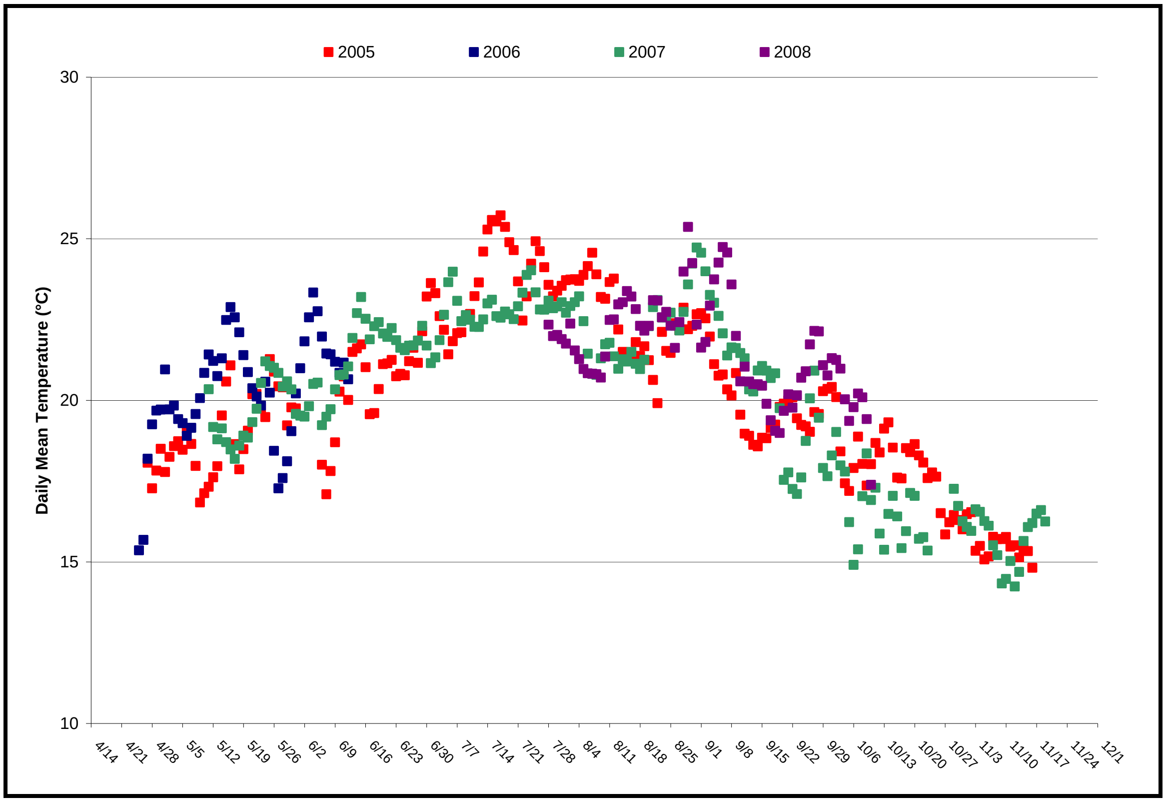


Figure A-7: Temperature of Pond A7

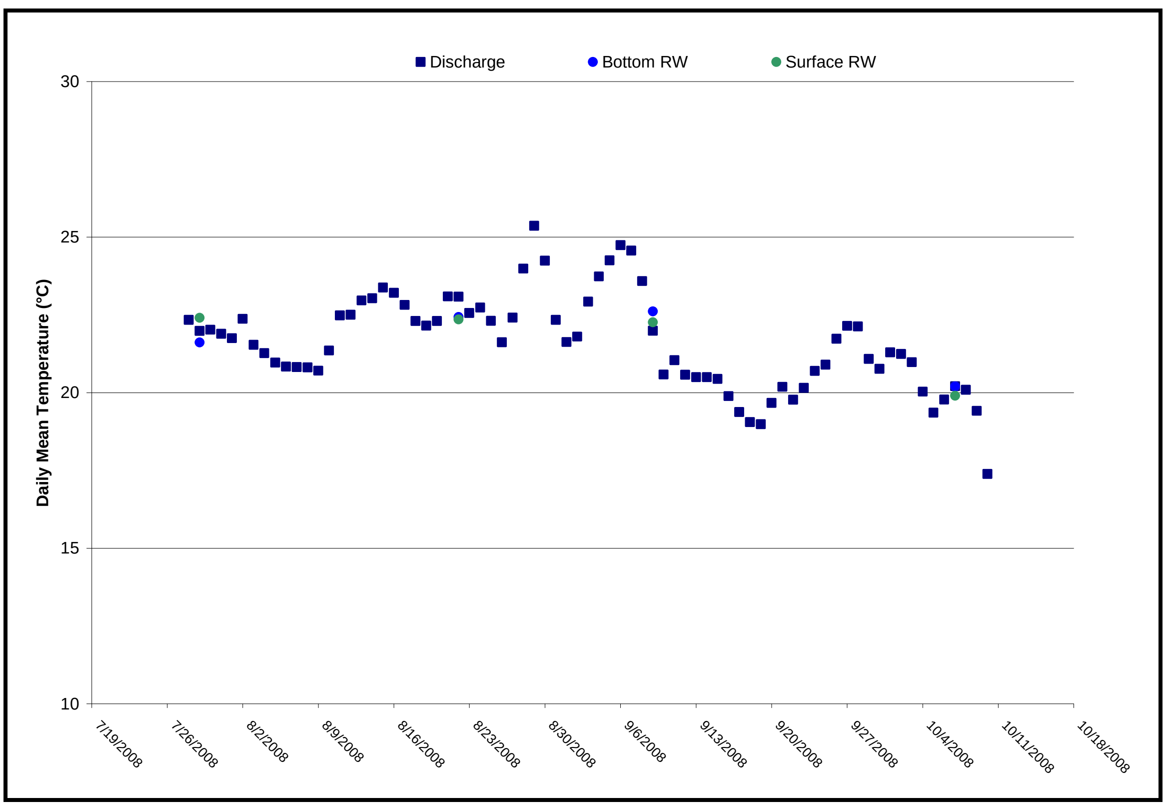


Figure A-8: Temperature of Pond A7 vs. Alviso Slough

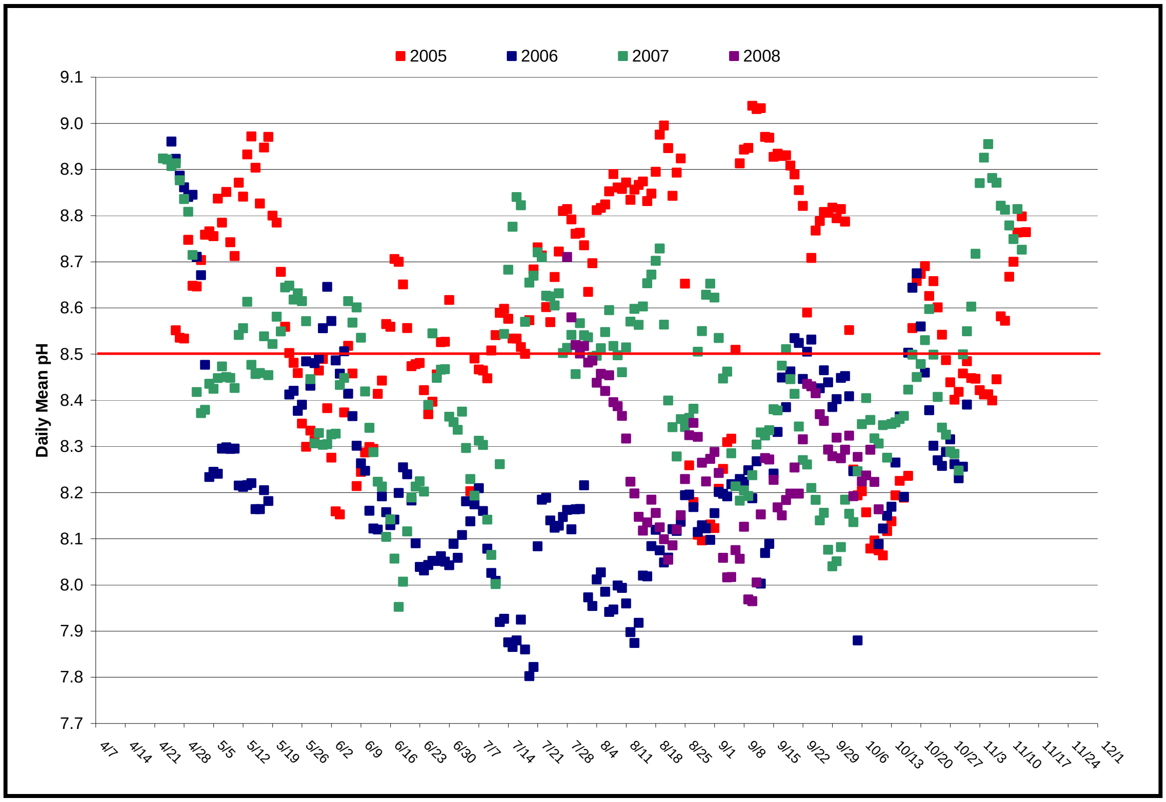


Figure A-9: pH of Pond A3W

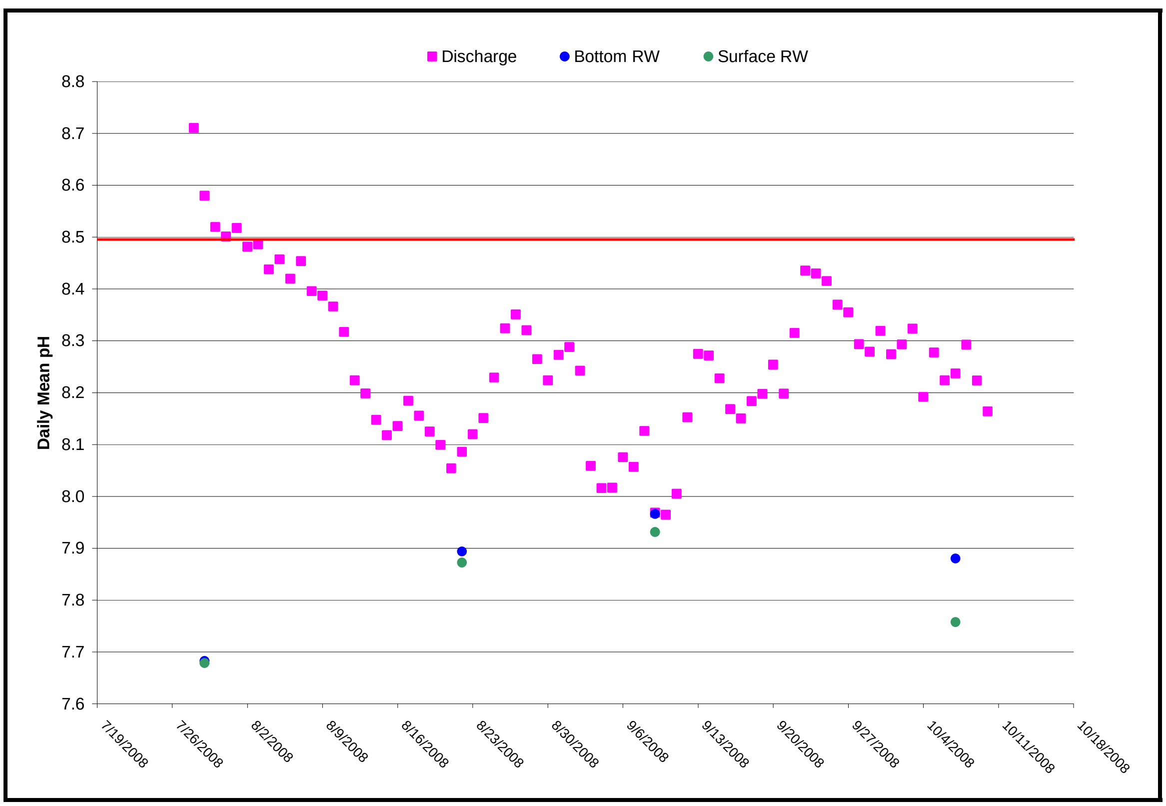


Figure A-10: pH of Pond A3W vs. Guadalupe Slough

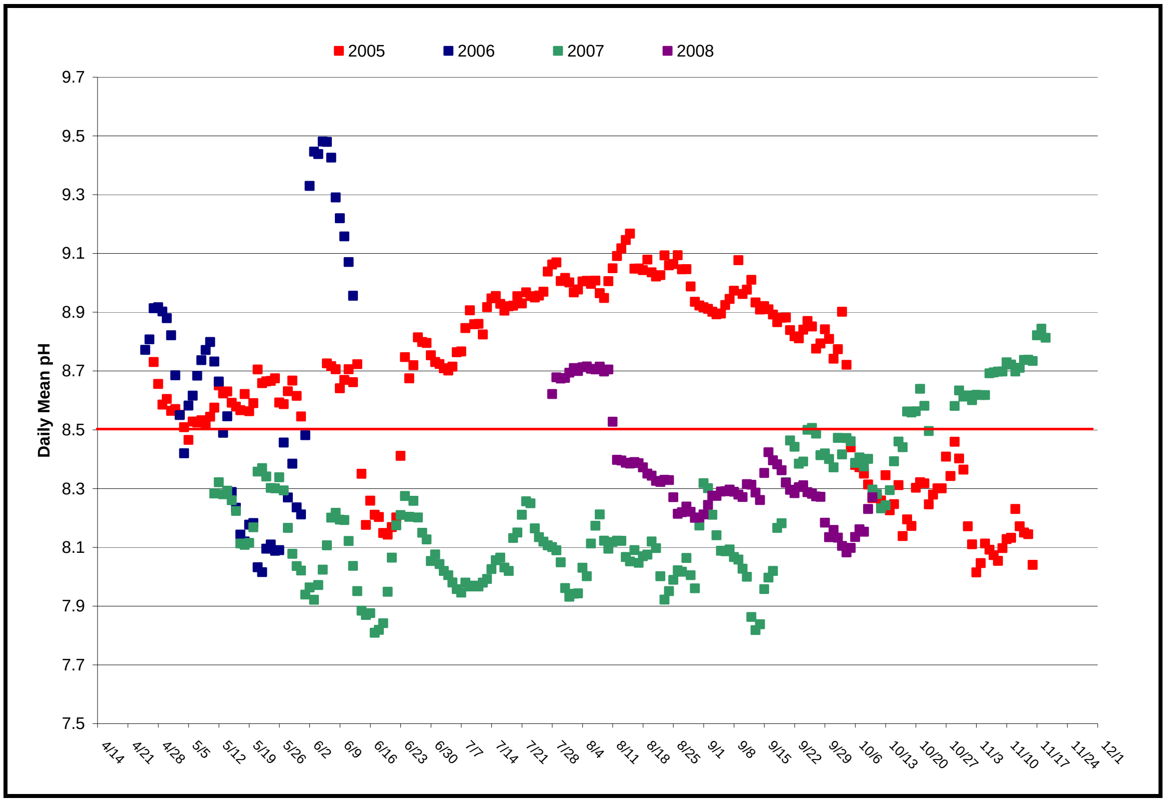


Figure A-11: pH of Pond 7

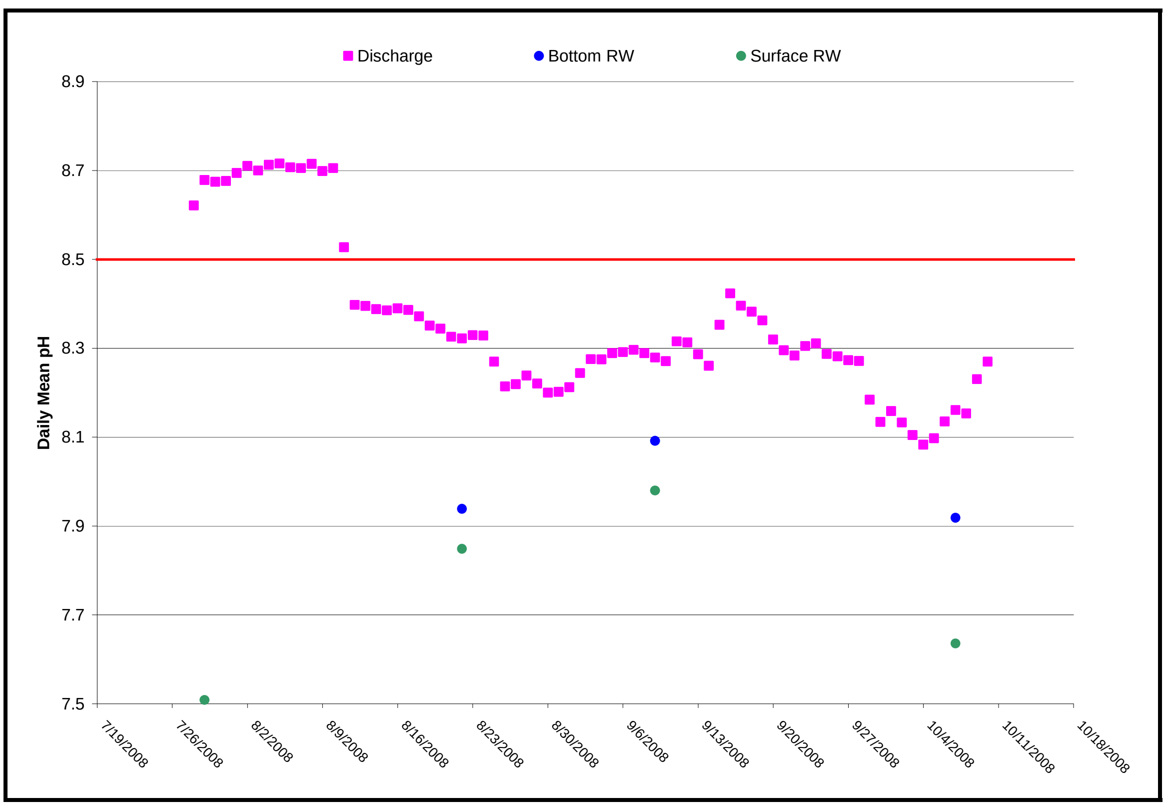


Figure A-12: pH of Pond A7 vs. Alviso Slough

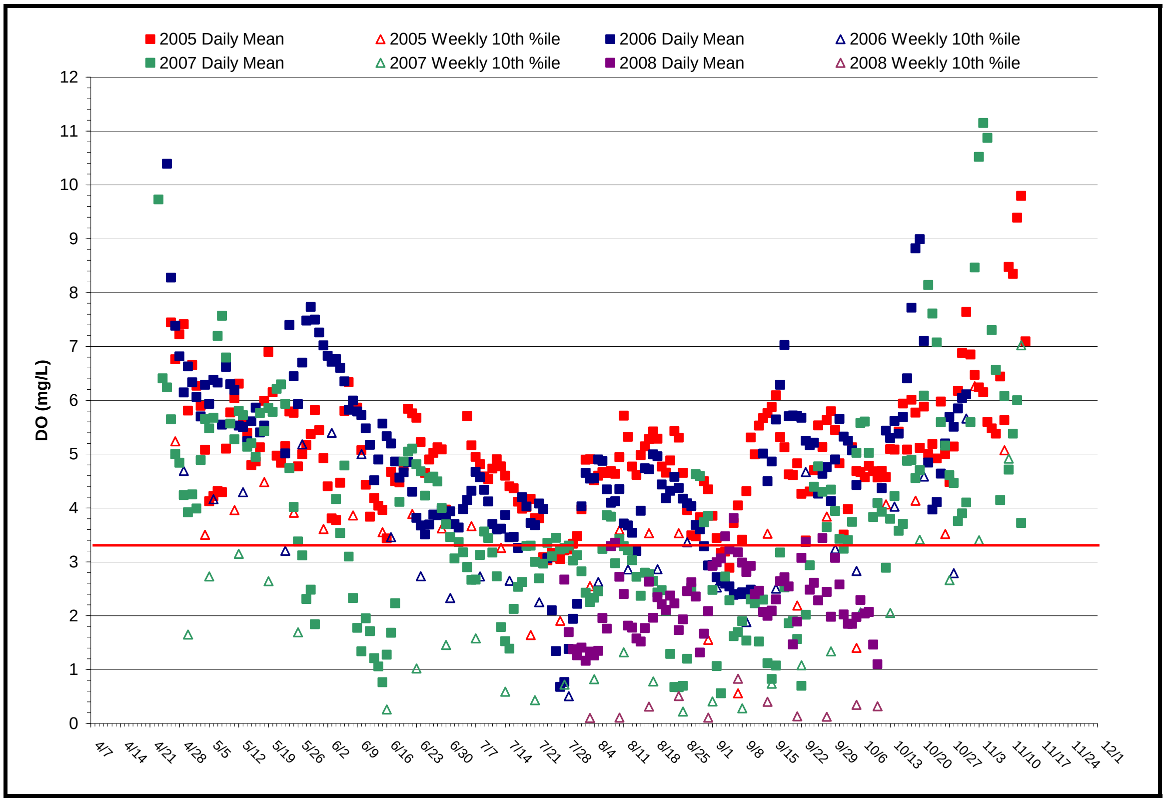


Figure A-13: Dissolved Oxygen of Pond A3W

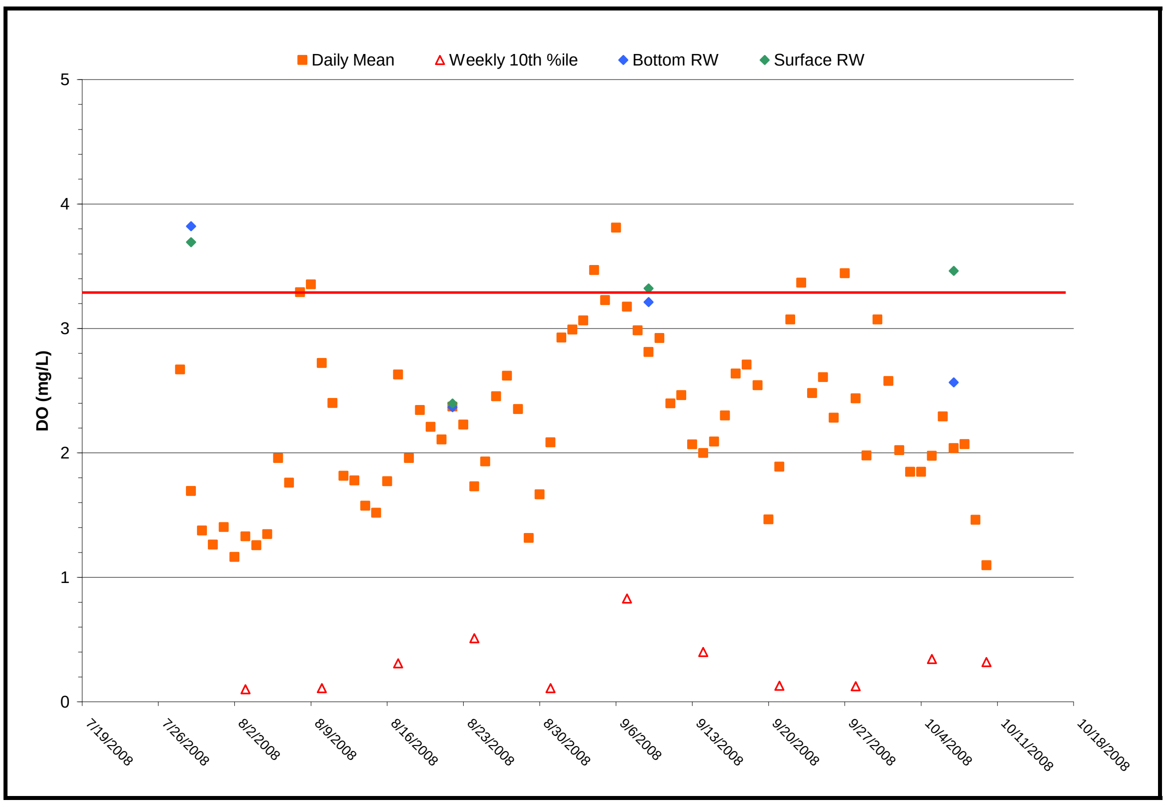


Figure A-14: Dissolved Oxygen of Pond A3W vs. Guadalupe Slough

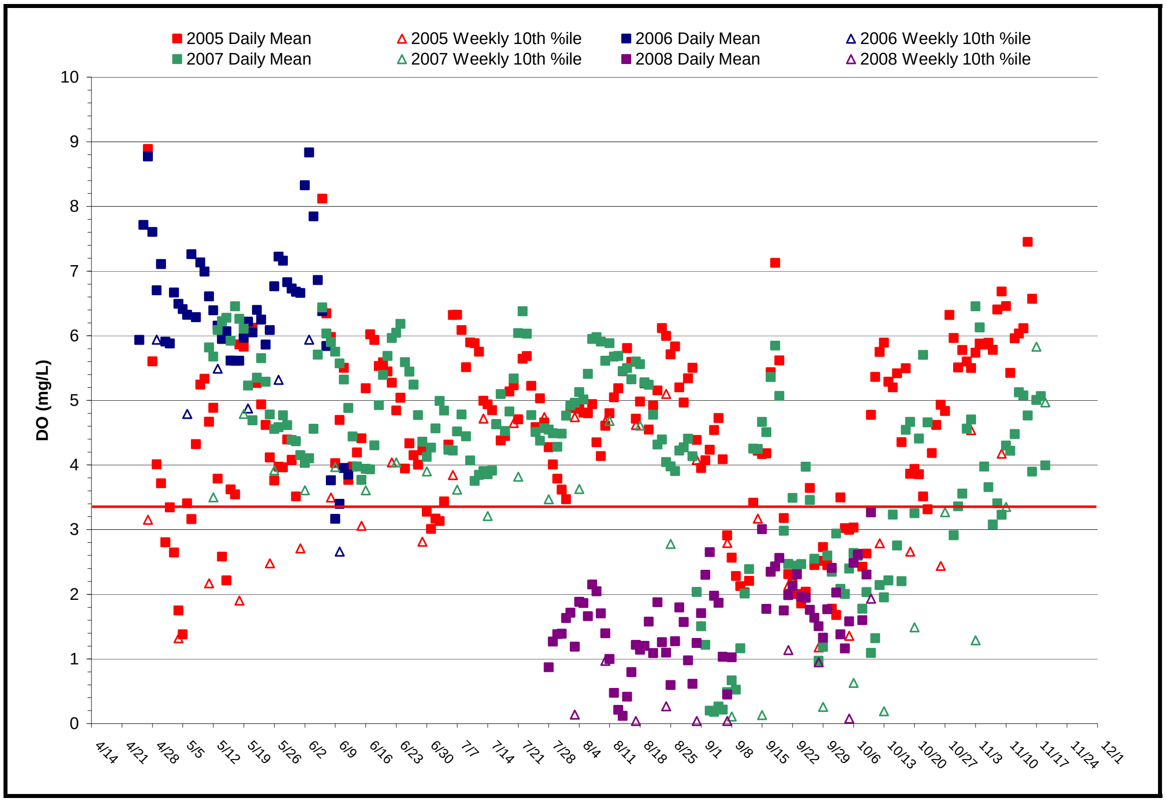


Figure A-15: Dissolved Oxygen of Pond A7

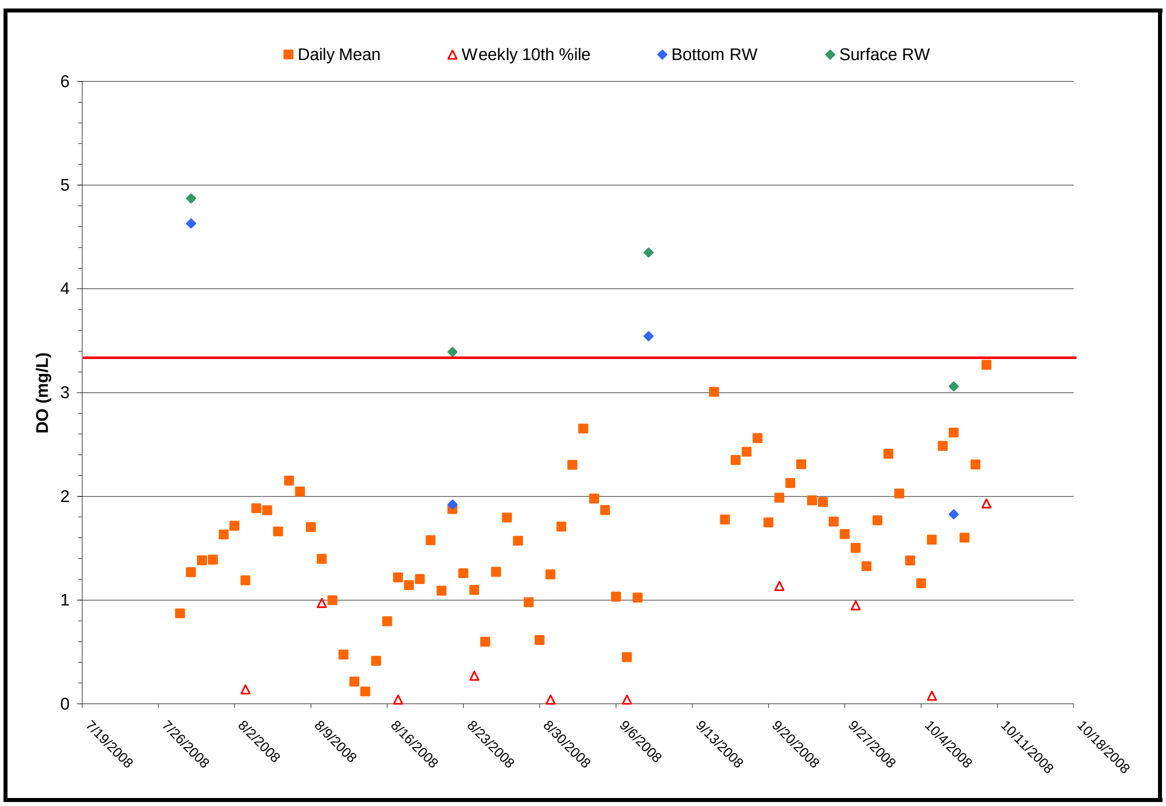


Figure A-16: Dissolved Oxygen of Pond A7 vs. Alviso Slough

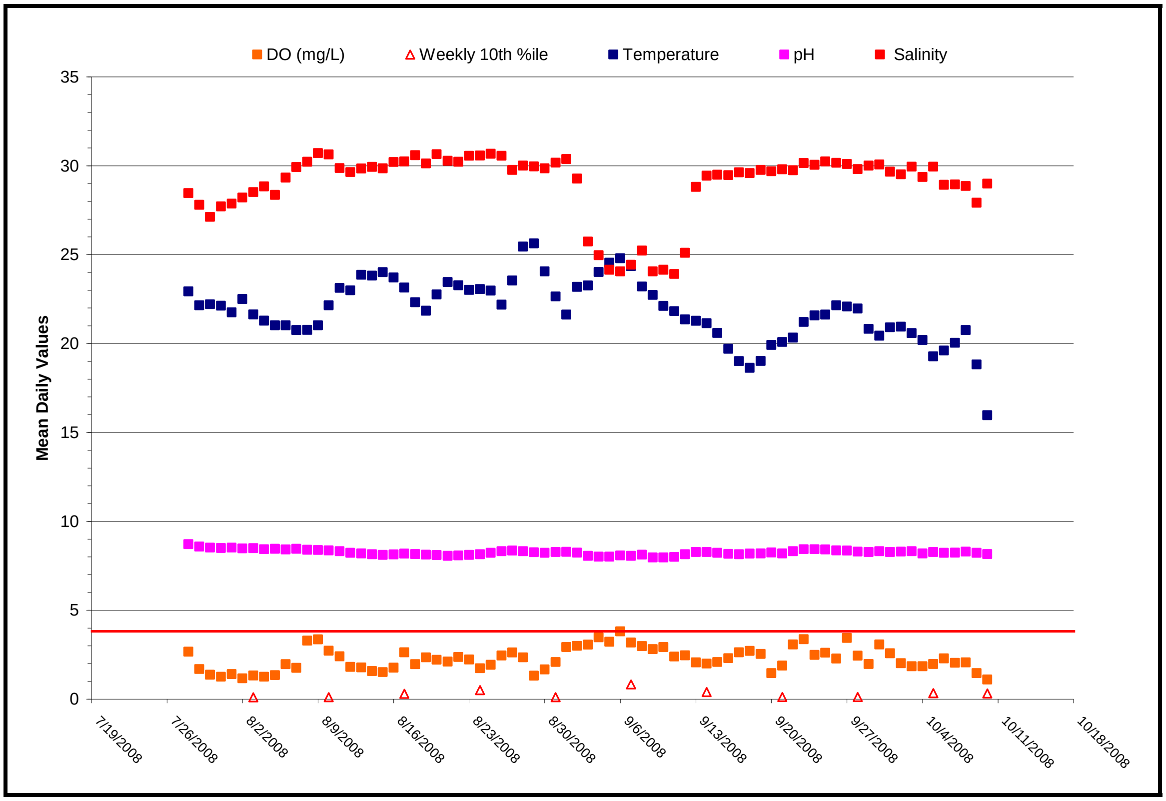


Figure A-17: Mean Values of Pond A3W for All Water Quality Parameters

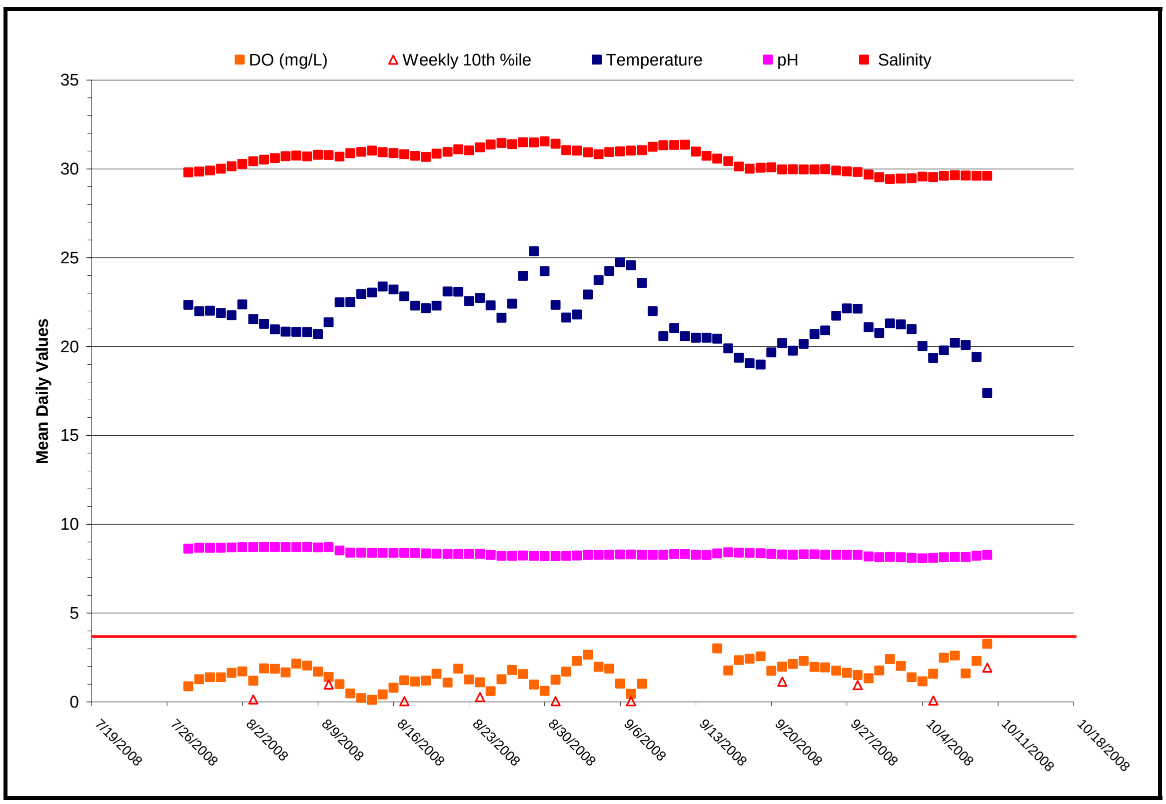


Figure A-18: Mean Values of Pond A7 for All Water Quality Parameters

APPENDIX B
WATER MANAGEMENT OPERATION PLAN
POND SYSTEM A2W

Pond System A2W Water Management Operation Plan – Alviso System 2009

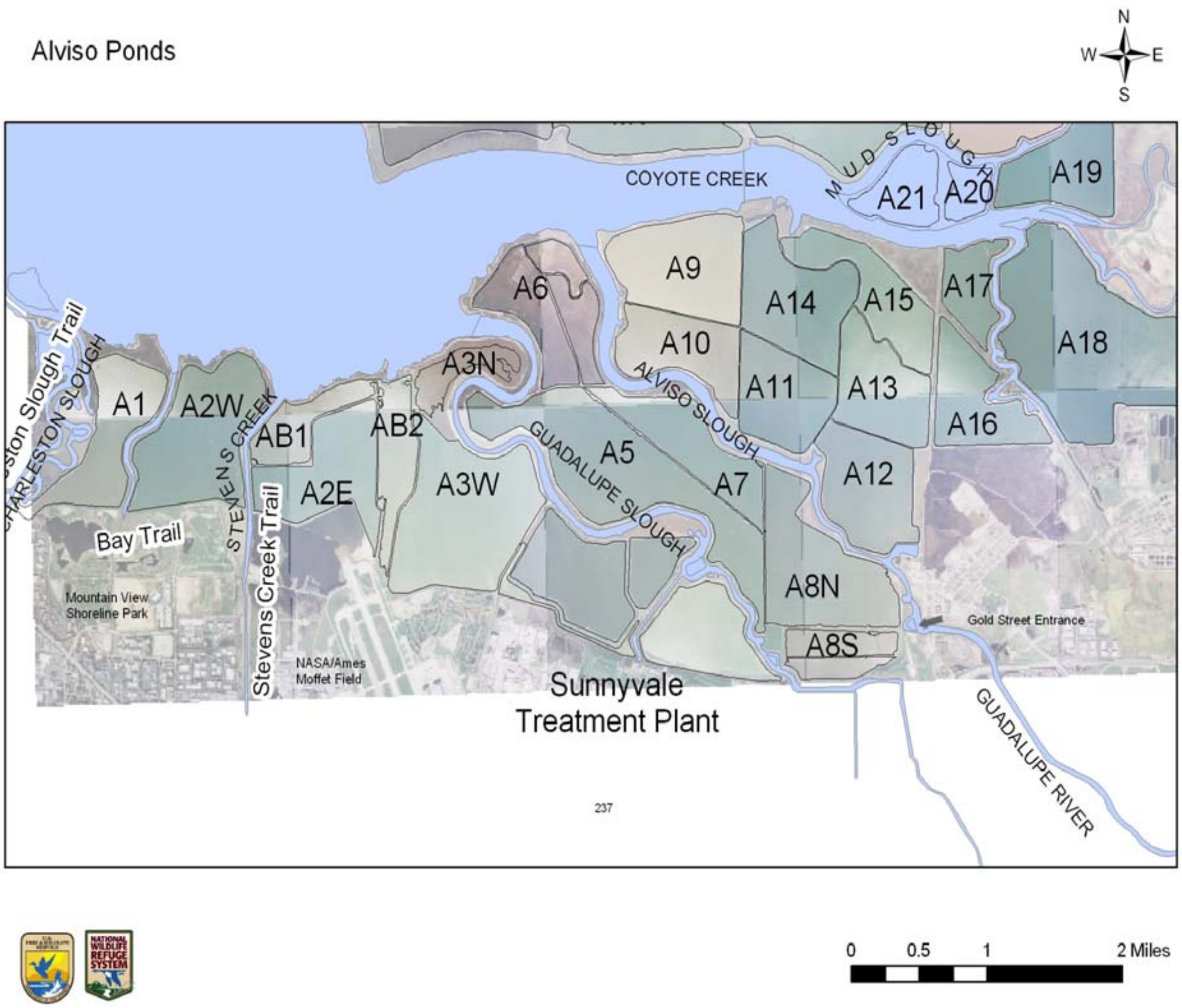
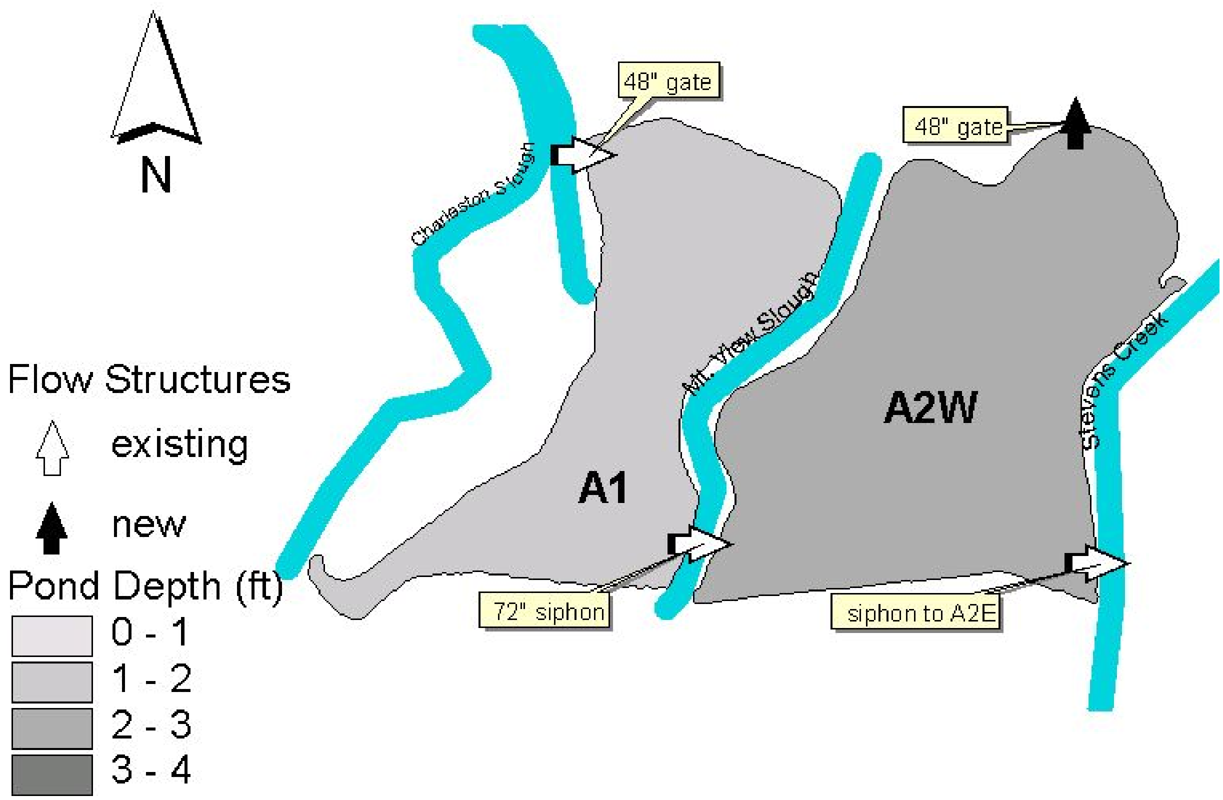


Table of Contents



Objectives

Maintain full tidal circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 ppt and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for pH, dissolved oxygen, temperature, avian botulism, and potential for inorganic mobilization.

Structures

The A2W system includes the following structures needed for water circulation in the ponds:

- Existing 48" gate intake at A1 from lower Charleston Slough
- New NGVD gauge at A1
- Existing 72" siphon under Mountain View Slough between A1 and A2W
- Existing staff gauge (no datum) at A1
- New 48" gate outlet structure with 24' weir box at A2W to the Bay
- New NGVD gauge at A2W

- Note that existing siphon to A2E should be closed

System Description

The intake for the A2W system is located at the northwest end of pond A1 and includes one 48" gate from lower Charleston Slough near the Bay. The system outlet is located at the north end of pond A2W, with one 48" gate to the Bay. The flow through the system proceeds from the intake at A1 though the 72" siphon under Mountain View Slough to A2W. An existing siphon under Stevens Creek to Pond A2E was used for salt pond operations. It should remain closed for normal operations, though it is available for unforeseen circumstances.

Operations of the A2W system should require little active management of gate openings to maintain appropriate flows. Summer and winter operations are described below to indicate predicted operating levels during the dry and wet seasons. The system will discharge when the tide is below 3.6 ft. MLLW.

Summer Operation

The summer operation is intended to provide circulation flow to makeup for evaporation during the summer season. The average total circulation inflow is approximately 19 cfs, or 38 acre-feet/day, with an outlet flow of about 14 cfs (28 acre-feet/day). The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A1	277	-1.8	-0.4	2.0
A2W	429	-2.4	-0.5	NA

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A1 intakes	50	19
A2W	100	48
Weir	-1.2 ft NGVD	6 boards

Water Level Control

The water level in A2W is the primary control for the pond system. The outlet at A2W includes both a control gate and control weir. Either may be used to limit flow through the system. The system flow is limited by the outlet capacity. Normal operation would have the outlet gates fully open, and the weir set at elevation -1.2 ft NGVD, approximately 0.7 feet below the normal water level. The normal water level in A2W should be at -0.5 ft NGVD in summer. The level may vary by 0.2 due to the influence of weak and strong tides.

The A1 intake gate can be adjusted to control the overall flow though the system. The maximum water level in either A1 or A2W should generally be less than 1.2 ft NGVD. This is to maintain freeboard on the internal levees, limit wind wave erosion, and to preserve existing islands within the system used by nesting birds.

Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
A1	-0.4	1.2	3.6	-0.6	1.8
A2W	-0.5	1.1	NA	-0.7	NA

The minimum and maximum water levels are based on our observations in the ponds for the period 2005.

There is no existing staff gage in pond A2W. Therefore, there is no record of existing minimums and maximums. Based on system hydraulics, pond A2W would typically be about 0.1 feet below pond A1.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A1	-0.4	-0.7	1.7
A2W	-0.5	NA	NA

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Salinity Control

The summer salinity in the system will increase from the intake at A1 to the outlet at A2W, due to evaporation within the system. The design maximum salinity for the discharge at A2W is 40 ppt. The intake flow at A1 should be increased when the salinity in A2W is close to 35 ppt. If the gate at A1 is fully open, the flow can be increased by lowering the weir elevation at the A2W outlet structure. Increased flow will increase the water level in A2W. Water levels above elevation 1.1 ft NGVD should be avoided as they may increase wave erosion of the levees.

Dissolved Oxygen and pH Control

If summer monitoring shows that DO levels in discharges from the Pond A2W fall below a 10^{th} percentile of 3.3 mg/L (calculated on a calendar weekly basis), the FWS will conduct within-pond monitoring and notify and consult with the Water Board as to which Best Management Practices described below for increasing dissolved oxygen levels in discharge water should be implemented:

1. Increase the flows in the system by opening the A1 inlet further. If increased flows are not possible, open the A2W gate to allow the pond to become fully muted or partially muted tidal system until pond DO levels revert to levels at or above conditions in the Creek.

2. Set in a series of flow diversion baffles at the pond discharge for directing the water from more suitable DO water levels to achieve maximum oxygen uptake.

3. Cease nighttime discharges due to diurnal pattern.

4. Close discharge gates completely until DO levels meet standards.

5. Close discharge gates completely for a period of time each month when low tides occur primarily at night.

6. Mechanically harvest dead algae.

To help minimize significant downtime on continuous monitoring devices used for DO and pH, the FWS will:

1. Have an extra monitor on hand, in case there is a break down.
2. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.
3. Work with Hydrolab to insure a quick repair of monitors (within 2 weeks).

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. If summer monitoring shows that DO levels in the pond drop the BMPs listed under the section on Dissolved Oxygen and pH Control will be implemented to increase the DO. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter. The winter operation is intended to limit large inflows during storm tide periods and to allow rain water to drain from the system.

The average total circulation inflow is approximately 9 cfs, or 18 acre-feet/day, with an outlet flow of about 9 cfs (18 acre-feet/day). The winter operation period would normally extend from November through April. The proposed gate settings are intended to limit the intake flow, and flow within the system.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A1	277	-1.8	-0.6	1.8
A2W	429	-2.4	-0.6	NA

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A1 intakes	30	12
A2W	100	48
Weir	-1.2 ft NGVD	6 boards

Water Level Control

The water level in A2W is the primary control for the pond system. The system flow is limited by the both the intake and outlet capacities. Normal winter operation would have the intake gate partially open to reduce inflow during extreme storm tides. Water levels in the ponds are controlled by the outlet weir setting. The normal winter water level in A2W should be at -0.6 ft NGVD, approximately 0.6 ft above the outlet weir. The pond water level may vary by 0.2 ft due to the influence of weak and strong tides, and over 0.5 ft due to storms

During winter operations, the water levels should not fall below the outlet weir elevation. If the elevation does decrease in April, it may be necessary to begin summer operation in April instead of May.

During winter operations, if the water levels exceed approximately 1.2 ft NGVD, the A1 intake should be closed to allow the excess water to drain. Note that without rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds.

Salinity Control

The winter salinity in the system may decrease from the intake at A1 to the outlet at A2W, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 11 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A1 intakes	Salinity
A1	Depth, Salinity, Observations
A2W	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the formal monitoring listed below.

APPENDIX C
WATER MANAGEMENT OPERATION PLAN
POND SYSTEM A3W

Pond System A3W Water Management Operation Plan – Alviso System 2009

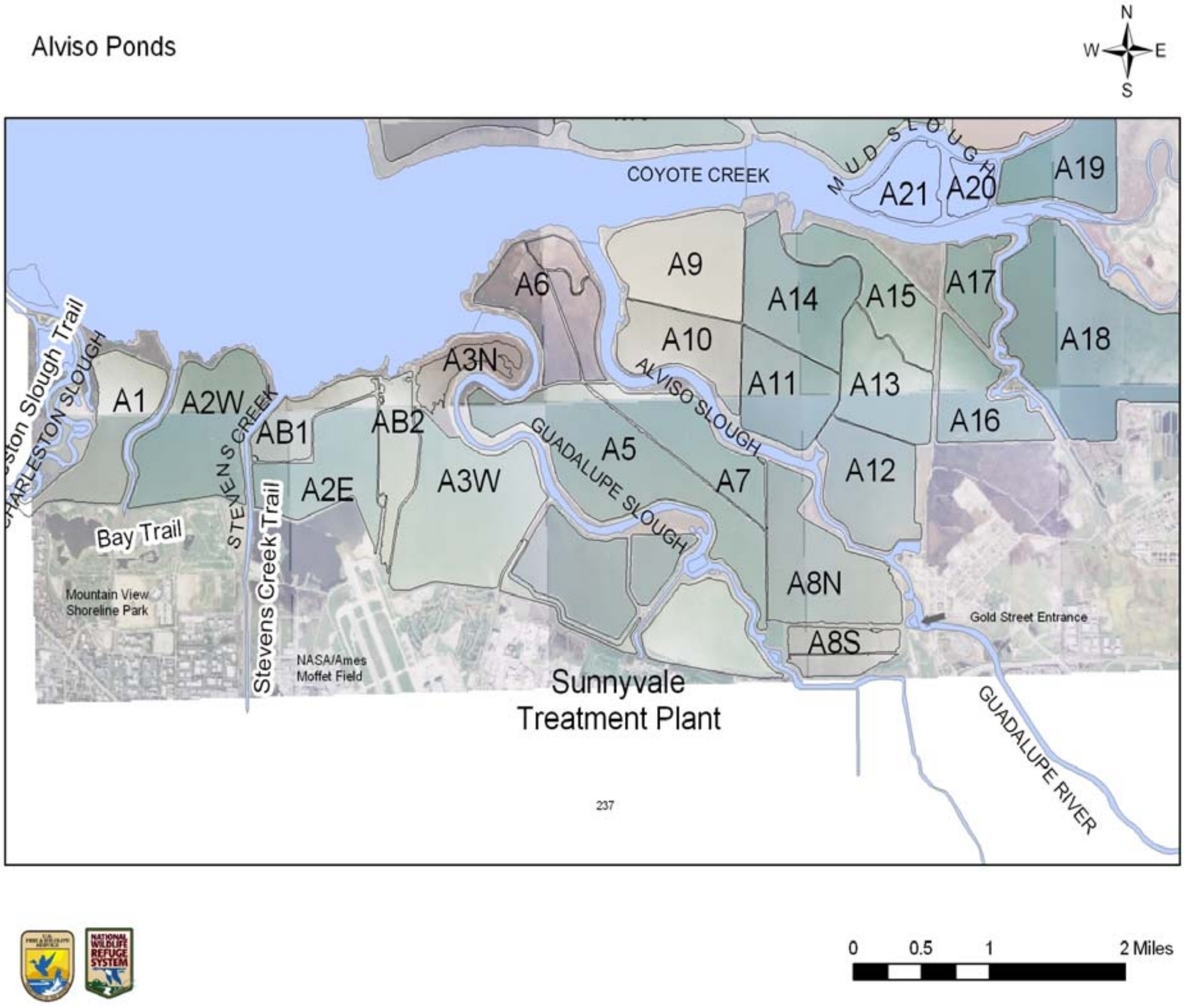
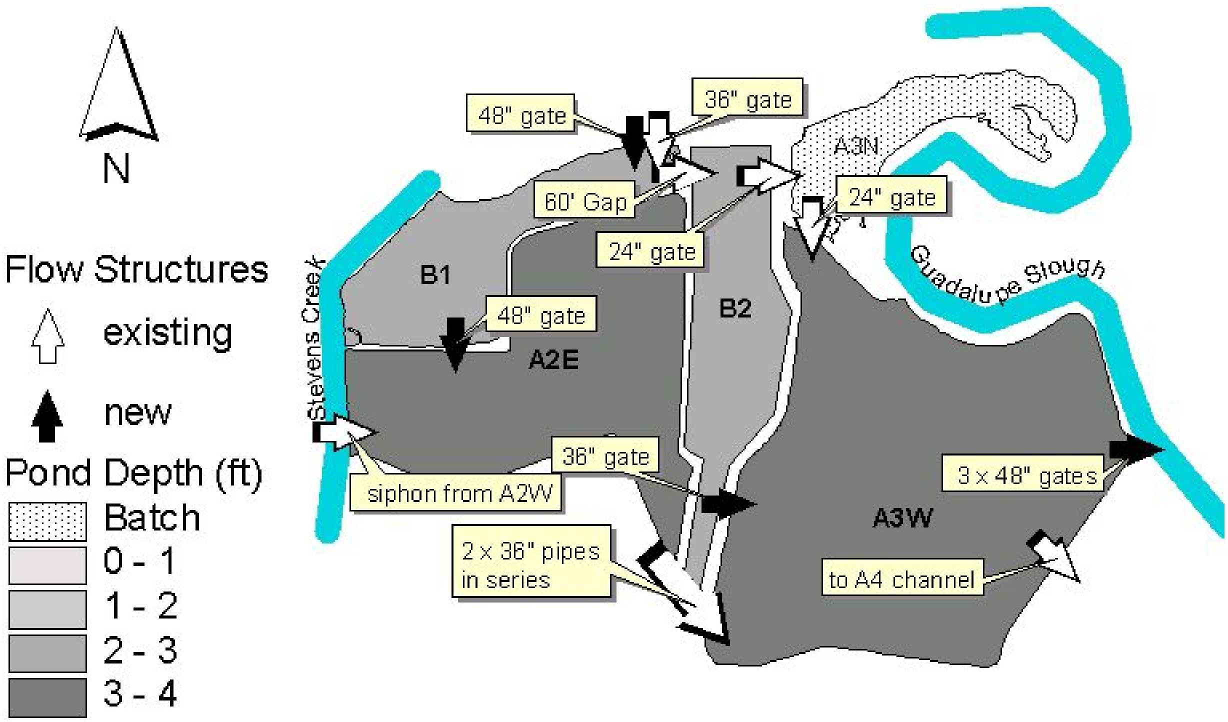


Table of Contents



Objectives

Maintain full tidal circulation through ponds B1, B2, A2E, and A3W while maintaining discharge salinities to Guadalupe Slough at less than 40 ppt and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for pH, dissolved oxygen, temperature, avian botulism, and potential for inorganic mobilization.

Maintain pond A3N as a seasonal pond. If results of wildlife population monitoring indicate the need, operate pond A3N as a batch pond (i.e., at higher salinities).

Maintain water surface levels lower in winter to reduce potential overtopping of A3W levee adjacent to Moffett Field.

Structures

The A3W system includes the following structures needed for water circulation in the ponds:

- Existing 36" gate intake structure from the Bay at B1
- New 48" gate intake from the Bay at B1
- New 48" gate between B1 and A2E
- Existing 2x36" pipes in series between A2E and A3W (no gates).
- New 36" gate between B2 and A3W

- Existing gap between B1 and B2
- Existing 24" gate between B2 and A3N
- Existing 24" gate between A3N and A3W
- New 3x48" gate outlet at A3W to Guadalupe Slough. Two are outlet only, and one allows both inflow and outflow, no weir.
- Existing staff gauges at all ponds and new NGVD gauges at all ponds
- Existing siphon from A2W is closed, but available if needed

System Description

The intake for the A3W system is located at the northeast end of pond B1 and includes one 48" gate and one 36" gate from the bay. The system outlet is located at the eastern end of pond A3W, with three 48" gates into Guadalupe Slough. The normal flow through the system follows two parallel routes. One route is from B1 to A2E and then to A3W. The second route is from B1 to B2 and then to A3W. Flow through the two routes is controlled by gates from B1 to A2E, and from B2 to A3W. There is an uncontrolled gap between ponds B1 and B2. Due to the size of pond A2E, the majority of the flow should be through A2E, with only minimal circulation flow through B2. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 3.1 ft. MLLW.

Pond A3N is a seasonal pond. Therefore, for the ISP period, the pond will be drained, and left to partially fill with rain water during the winter and to evaporate completely during the summer. However, if wildlife population monitoring during this period indicates the need for additional higher salinity habitats or if mercury monitoring indicates an increase in methylation due to reduction in water levels, Pond A3N could be operated as a batch pond.

Summer Operation

The summer operation is intended to provide circulation flow to makeup for evaporation during the summer season. The average total circulation inflow is approximately 35 cfs, or 70 acre-feet/day. The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
B1	142	-0.8	0.4	1.3
B2	170	-0.6	0.4	1.3
A2E	310	-3.1	-0.5	3.0
A3W	560	-3.2	-1.4	2.1
A3N	163	-1.4	NA	NA

* Pond B1 and B2 will be operated at lower water levels on an experimental basis in an attempt to improve shorebird nesting and foraging habitat. If water quality or operations are jeopardized from lower water levels in Ponds B1 or B2, the system will be reverted back to normal operating levels.

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
B1 west intake	100	36
B1 east intake	90	39
B1 – A2E	38	14
A2E – A3W	NA	NA
B2 – A3W	41	12
A3W outlets	100	48
A3W intake	0	0
B2 – A3N	0	0
A3N – A3W	0	0

Water Level Control

The water level in A3W is the primary control for the pond system. The system flow is limited by the outlet capacity. Normal operation would have the outlet gates fully open. Water levels are controlled by the intake gate settings. The normal water level in A3W should be at -1.4 ft NGVD (2.1 ft gage). The level may vary by 0.2 due to the influence of weak and strong tides.

The flow through B2 to A3W is only required to maintain circulation through B2. This circulation prevents local stagnant areas which may create areas of higher salinity or algal blooms. The gate can be set to a standard opening and would not require frequent adjustment.

The flow through A2E is controlled by the gates from B1 to A2E. The partial gate opening is to maintain the water level differences between A2E and B1. Again, the setting should not require frequent adjustment. There are no gates on the culverts between A2E and A3W, therefore the water levels in those two ponds should be similar.

The B1 intake gates should be adjusted to control the overall flow though the system. The water levels in B1 (and therefore B2) will change due to the change in inflow. The maximum water level should be less than 1.6 ft NGVD (2.5 ft gage). This is to maintain freeboard on the internal levees and limit wind wave erosion.

Water levels in Pond AB1 and Pond AB2 of Pond A3W system will be lowered during the summer to improve shorebird nesting and foraging habitat

Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
B1	0.4	1.6	2.5	-0.2	0.7
B2	0.4	1.6	2.5	-0.2	0.7
A2E	-0.5	-0.2	3.3	-2.0	1.5
A3W	-1.4	-0.2	3.3	-2.0	1.5
A3N	NA	NA	2.6	NA	NA

The minimum and maximum water levels are based on our observations in the ponds for the period 2005.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
B1	0.4	-0.8	0.1
B2	0.4	-0.8	0.1
A2E	-0.5	-2.2	1.3
A3W	-1.4	-2.7	0.8
A3N	NA	NA	NA

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Salinity Control

The summer salinity in the system will increase from the intake at B1 to the outlet at A3W, due to evaporation within the system. The design maximum salinity for the discharge at A3W is 40 ppt. The intake flow at B1 should be increased when the salinity in A3W is close to 35 ppt. Increased flow will increase the water level in A3W. Water levels in pond A3W above elevation -0.2 ft NGVD (3.3 ft gauge) should be avoided as they may increase wave erosion of the levees.

Dissolved Oxygen and pH Control

If summer monitoring shows that DO levels in discharges from the Pond A3W fall below a 10th percentile of 3.3 mg/L (calculated on a calendar weekly basis), the FWS will accelerate receiving water monitoring to weekly, conduct within-pond monitoring and notify and consult with the Water Board as to which Best Management Practices described below for increasing dissolved oxygen levels in discharge water should be implemented:

1. Increase the flows in the system by opening the B1 inlet further. If increased flows are not possible, open A3W gate to allow the pond to become fully muted tidal or partially muted tidal system until pond DO levels revert to levels at or above conditions in the slough.

2. Set in a series of flow diversion baffles at the pond discharge for directing the water from more suitable DO water levels to achieve maximum oxygen uptake.

3. Cease nighttime discharges due to diurnal pattern.

4. Close discharge gates completely until DO levels meet standards.

5. Close discharge gates completely for a period of time each month when low tides occur primarily at night.

6. Mechanically harvest dead algae.

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The pH of the discharge is related to the DO of the discharge. If the pH of the discharge falls outside the range of 6.5 – 8.5, an analysis of the impact of discharging pH on the receiving waters will be performed. If it is determined that discharge is impacting receiving water pH outside the range of 6.5 – 8.5, ammonia monitoring in the receiving water will be done to document potential toxicity affects associated with unionized ammonia.

To help minimize significant downtime on continuous monitoring devices used for DO and pH, the FWS will:

1. Have an extra monitor on hand, in case there is a break down.
2. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.
3. Work with Hydrolab to insure a quick repair of monitors (within 2 weeks).

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. If summer monitoring shows that DO levels in the pond drop the BMPs listed under the section on Dissolved Oxygen and pH Control will be implemented to increase the DO. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter. The winter operation is intended to limit large inflows during storm tide periods and to allow rain water to drain from the system.

The average total circulation inflow is approximately 16 cfs, or 32 acre-feet/day, with an average outflow of approximately 18 cfs (36 acre-feet per day). The winter operation period would normally extend from November through April. The proposed gate settings are intended to limit the intake flow, and flow within the system.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
B1	142	-0.8	0.9	1.8
B2	170	-0.6	0.9	1.8
A2E	310	-3.1	-1.8	1.7
A3W	560	-3.2	-1.8	1.7
A3N	163	-1.4	NA	NA

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
B1 west intake	34	10
B1 east intake	25	10
B1 – A2E	16	6
A2E – A3W	NA	NA
B2 – A3W	21	6
A3W outlets	100	48
A3W intake	0	0
B2 – A3N	0	0
A3N – A3W	0	0

Water Level Control

The water level in A3W is the primary control for the pond system. The system flow is limited by the outlet capacity. Normal winter operation would have the A3W outlet gates fully open. Water levels are controlled by the intake gate settings. The normal water level in A3W should be near -1.8 ft NGVD (1.7 ft gage). The level may vary by 0.2 due to the influence of weak and strong tides, storm tides, and rainfall inflows.

The water levels in A3W are important to prevent levee overtopping. The south levee separates the pond from the Moffit Field drainage ditch. The levee is low, and subject to erosion with high water levels. If the water level in A3W exceeds -0.6 ft NGVD (2.9 ft gage), the intake gate openings at B1 should be reduced or closed. The internal gates from B1 and B2 would also require adjustment. If the water level in A3W exceeds -0.2 ft NGVD (3.3 ft gauge), the intake gates and all internal gates should be closed until the water level in A3W is back to normal. This may take one to two weeks depending on the weather. The water levels in the upper ponds (B1, B2, and A2E) may increase due to rainfall during this period, but are less sensitive to higher water levels. The historic high elevation in pond A3W has been -0.2 ft NGVD (3.3 ft gauge).

Whenever possible, the system intake at B1 should be closed in anticipation of heavy winter rains and high tides. When the system intake gates are closed, the internal gates from B1 to A2E and from B2 to A3W should also be closed to keep water in the upper ponds (B1 and B2).

There is no gate between A2E and A3W. During winter operations with reduced flows through the system, the A2E water level will be similar to the A3W water level. During the summer, the higher flows will establish approximately 0.9 ft difference due to the head loss through the two pipes in series which connect the ponds.

Salinity Control

The winter salinity in the system may decrease from the intake at B1 to the outlet at A3W, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 10 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings, as well as to inspect water control structures, siphons and levees. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
B1 intakes	Salinity
B1	Depth, Salinity, Observations
B2	Depth, Salinity, Observations
A2E	Depth, Salinity, Observations
A3W	Depth, Salinity, Observations
A3N	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the formal monitoring listed below.

Location	**Frequency**	**Parameters**
A3W(discharge)	Continuous (May-Oct)	DO, pH, Temp., Salinity
Guadalupe.Sl.	Monthly (July –Oct)	DO, pH, Temp., Salinity

APPENDIX D
WATER MANAGEMENT OPERATION PLAN
POND SYSTEM A7

Pond System A7 Water Management Operation Plan – Alviso System 2009

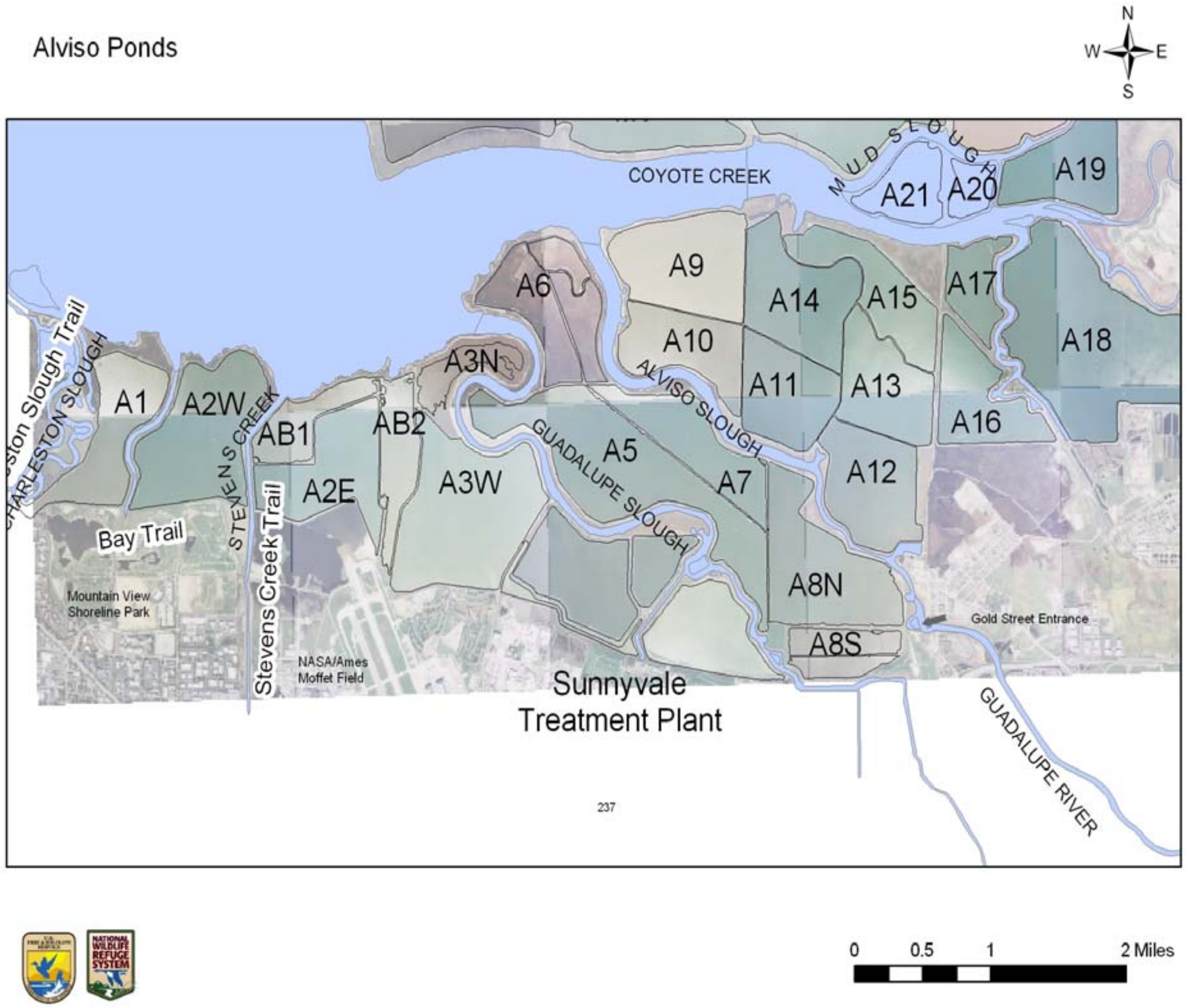
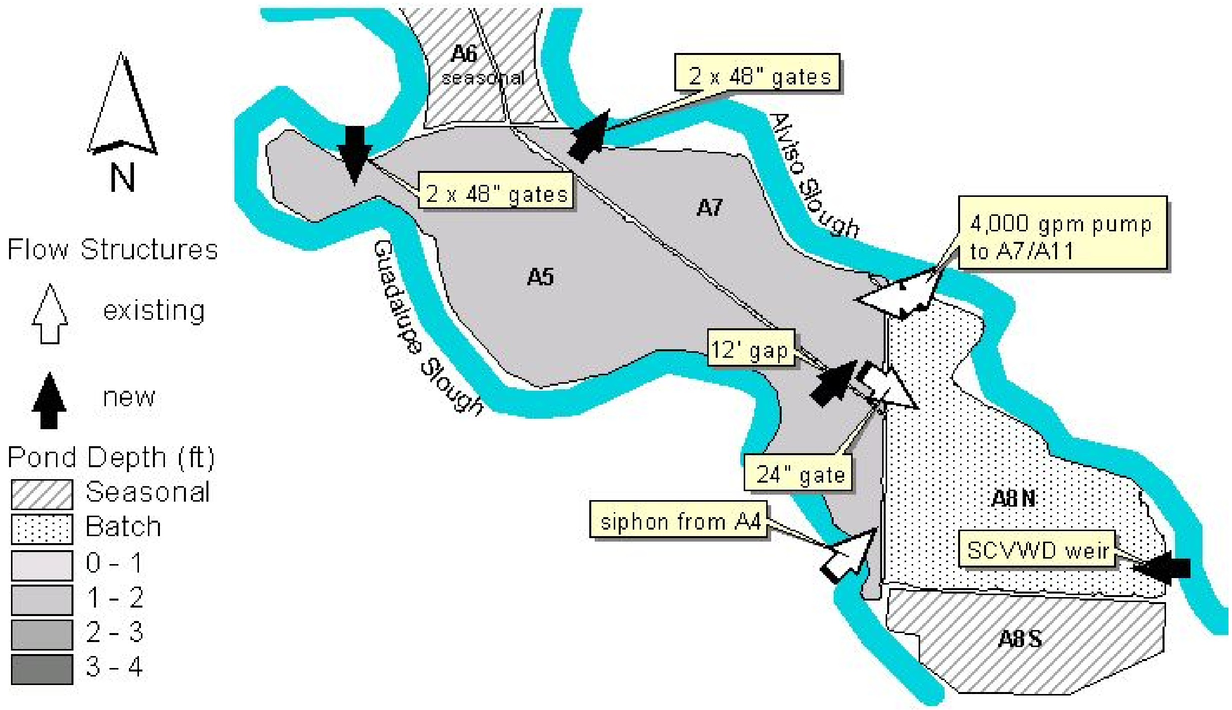


Table of Contents



Objectives

Maintain full tidal circulation through ponds A5 and A7 while maintaining discharge salinities to the Bay at less than 40 ppt. and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for pH, dissolved oxygen, temperature, avian botulism, and potential for inorganic mobilization.

Maintain pond A8 as a seasonal pond. If results of wildlife population monitoring indicate the need, operate pond A8 as a batch pond.

Maintain option to reverse flows if needed.

Structures

The A7 system includes the following structures needed for water circulation in the ponds:

- New 2x48" gate intake at A5 from Guadalupe Slough.
- New cut at the internal levee between A5 and A7.
- Existing 24" control gate from A7 to A8.
- Existing 4,000 gpm pump from A8 to A11. Outlet piping modified to allow discharge to A7 in addition to A11.
- New 2x48" gate outlet with two 24' weir boxes at A7 into Alviso Slough.
- Existing staff gages in both ponds; New NGVD gages at both new structures
- Existing siphon from A4 should generally be closed.

System Description

The intake for the A7 system is located at the northwest end of pond A5 and includes two 48-inch gates from lower Guadalupe Slough. The system outlet is located at the northeast end of pond A7, with two 48-inch gates to Alviso Slough. In normal operations, the flow through the system starts at the intake at A5 though a cut at the southern end of the levee between A5 and A7, and flows out to Alviso Slough through two 48-inch outlet gates. Both sections of Pond A8 (A8N and A8S) will be operated as seasonal ponds filling with winter rains and generally drying during the summer, though some makeup water can be added A8N through a 24-inch gate from pond A7. If necessary in the future, following bird monitoring studies, A8N may be operated as a batch pond with higher salinities. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 4.8 ft. MLLW.

The Santa Clara Valley Water District has built a weir at Pond A8 to allow flood overflow waters from Alviso Slough to enter the pond during 10-year storm events, or greater. Some flood waters may overtop the levees and enter Ponds A5 and A7 as well. When the ponds fill with floodwaters, the District is responsible for pumping the pond waters back to Alviso Slough or Guadalupe Slough and monitoring for increased mercury levels in sediments/pond waters.

The A7 system can be reversed by changing the control gate settings to intake water from Alviso Slough and release water to Guadalupe Slough. However, the reversed flow circulation does not have an outlet weir at the A5 structure. Therefore, the A5 gates must be set to maintain minimum water levels in the ponds. The reverse flow condition may conflict with the seasonal intake limitations from Alviso Slough for salmonid protection. The A7 structure should not be used as an intake during the winter (December to April) to avoid entrainment of migrating juvenile salmonids. The only reason to use the reversed flow circulation is to avoid potential poor water quality conditions in Guadalupe Slough, if necessary.

The A7 system would require very limited management, unless Pond A8 is operated as a batch pond. Note that for a period of time, the SCVWD may request to continue pumping waters from Pond A4 into Pond A5. At that time, they will provide data analyses and operations plans to assure that A7 discharges will remain below our RWQCB permit limits.

Summer Operation

The summer operation is intended to provide circulation flow to makeup for evaporation during the summer season. The average total circulation inflow is approximately 22 cfs, or 44 acre-feet/day, with an outlet flow of about 16 cfs (32 acre-feet/day). The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A5	615	-0.6	0.4	1.9
A7	256	-0.5	0.4	1.8
A8N	406	-3.4	NA	NA

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A5 intakes	30	12
A7 outlet	100	48
A7/A8	0	0
Weir	0.0 ft NGVD	6 boards

Water Level Control

The bottom elevations in both Ponds A5 and A7 are similar and inlet/outlet capacities are the same. Due to the levee cut to connect the ponds, the water levels are similar in both ponds. Flows will occur in either direction based on inlet and outlet gate settings

The A5 intake gate should be adjusted to control the overall flow though the system. The maximum water level in either A5 or A7 should be less than 0.6 ft NGVD (2.1 ft gage). This is to maintain freeboard on the internal levees and limit wind wave erosion. The maximum water level is also intended to preserve the existing islands within the ponds used by nesting birds.

If a significant volume of water is to be diverted into Pond A8, the A5 inlet structure may need to be open further to bring in additional water. Diversions to A8 are controlled by the A7 to A8 gate. One foot of water in A8 (400 acre-feet) represents approximately 0.5 ft in A5/A7, or the net inflow to the system over approximately 10 days.

Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
A5	0.4	0.6	2.1	-0.3	1.2
A7	0.4	0.6	2.0	-0.3	1.1
A8N	NA	-1.0	0.5	-2.5	-1.0

The minimum and maximum water levels are based on our observations in the ponds for the period 2004.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A5	0.4	0.2	1.4
A7	0.4	0.2	1.4
A8N	NA	-2.5	-1.0

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Salinity Control

The summer salinity in the system will increase from the intake at A5 to the outlet at A7 due to evaporation within the system. The design maximum salinity for the discharge at A7W is 40 ppt. The intake flow at A5 should be increased if the salinity in A7 is close to 35 ppt. Increased flow may increase the water level in A7. Water levels above elevation 0.6 ft NGVD (2.1 ft gage) should be avoided as they may increase wave erosion of the levees.

Dissolved Oxygen and pH Control

If summer monitoring shows that DO levels in discharges from the Pond A7 fall below a 10th percentile of 3.3 mg/L (calculated on a calendar weekly basis), the FWS will accelerate receiving water monitoring to weekly, conduct within-pond monitoring and notify and consult with the Water Board as to which Best Management Practices described below for increasing dissolved oxygen levels in discharge water should be implemented:

1. Increase the flows in the system by opening the A5 inlet further. If increased flows are not possible, open both the A5 and A7 gates to allow the ponds to become fully muted tidal or partially muted tidal systems until pond DO levels revert to levels at or above conditions in the Creek.

2. Set in a series of flow diversion baffles at the pond discharge for directing the water from more suitable DO water levels to achieve maximum oxygen uptake.

3. Cease nighttime discharges due to diurnal pattern.

4. Close discharge gates completely until DO levels meet standards.

5. Close discharge gates completely for a period of time each month when low tides occur primarily at night.

6. Mechanically harvest dead algae.

7. Install solar aeration circulators.

The pH of the discharge is related to the DO of the discharge. If the pH of the discharge falls outside the range of 6.5 – 8.5, an analysis of the impact of discharging pH on the receiving waters will be performed. If it is determined that discharge is impacting receiving water pH outside the range of 6.5 – 8.5, ammonia monitoring in the receiving water will be done to document potential toxicity affects associated with unionized ammonia.

To help minimize significant downtime on continuous monitoring devices used for DO and pH, the FWS will:

1. Have an extra monitor on hand, in case there is a break down.
2. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.
3. Work with Hydrolab to insure a quick repair of monitors (within 2 weeks

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. If summer monitoring shows that DO levels in the pond drop the BMPs listed under the section on Dissolved Oxygen and pH Control will be implemented to increase the DO. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

The winter operation is intended to provide circulation flow and to allow rain water to drain from the system. The proposed winter operation would be the same as the summer operation.
The average total circulation inflow is approximately 22 cfs, or 44 acre-feet/day, with an outlet flow of about 23 cfs (46 acre-feet/day). The winter operation period would normally extend from November through April. The proposed gate settings are intended to limit the intake flow, and flow within the system.

<u>Winter Pond Water Levels</u>

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A5	615	-0.6	0.4	1.8
A7	256	-0.5	0.4	1.8
A8N	406	-3.4	NA	NA

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A5 intakes	30	12
A7 outlet	100	48
A7/A8	0	0
Weir	0.0 NGVD	6 boards

Water Level Control

Consideration may be made to reduce water levels in the ponds prior to winter storm events and high tides by closing or reducing the gate opening at the A5 inlet structure. Approximately three weeks would be needed to reduce pond levels by 0.5 feet. Water levels above elevation 0.6 ft NGVD (2.1 ft gage) should be avoided as they may increase wave erosion of the levees.

Salinity Control

The winter salinity in the system may decrease from the intake at A5 to the outlet at A7, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease below 10 ppt.
If the SCVWD weir has a significant flood spill into pond A8N, the flood water may overflow into A5 and A7. The intake gates and outlet gates can be opened to the maximum after the flood event to aid in lowering the water level in the system. The volume in A8 below the elevation of the cross levee will not drain by gravity, and will need to be pumped from the ponds by the SCVWD.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A5 intake	Salinity
A5	Depth, Salinity, Observations
A7	Depth, Salinity, Observations
A8	Depth, salinity, observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the formal monitoring listed below.

Location	**Frequency**	**Parameters**
A7(discharge)	Continuous (July-Oct)	DO, pH, Temp., Salinity
Alviso Slough	Monthly (May –Oct)	DO, pH, Temp., Salinity

APPENDIX E
WATER MANAGEMENT OPERATION PLAN
POND SYSTEM A14

Pond System A14 Water Management Operation Plan – Alviso System 2009

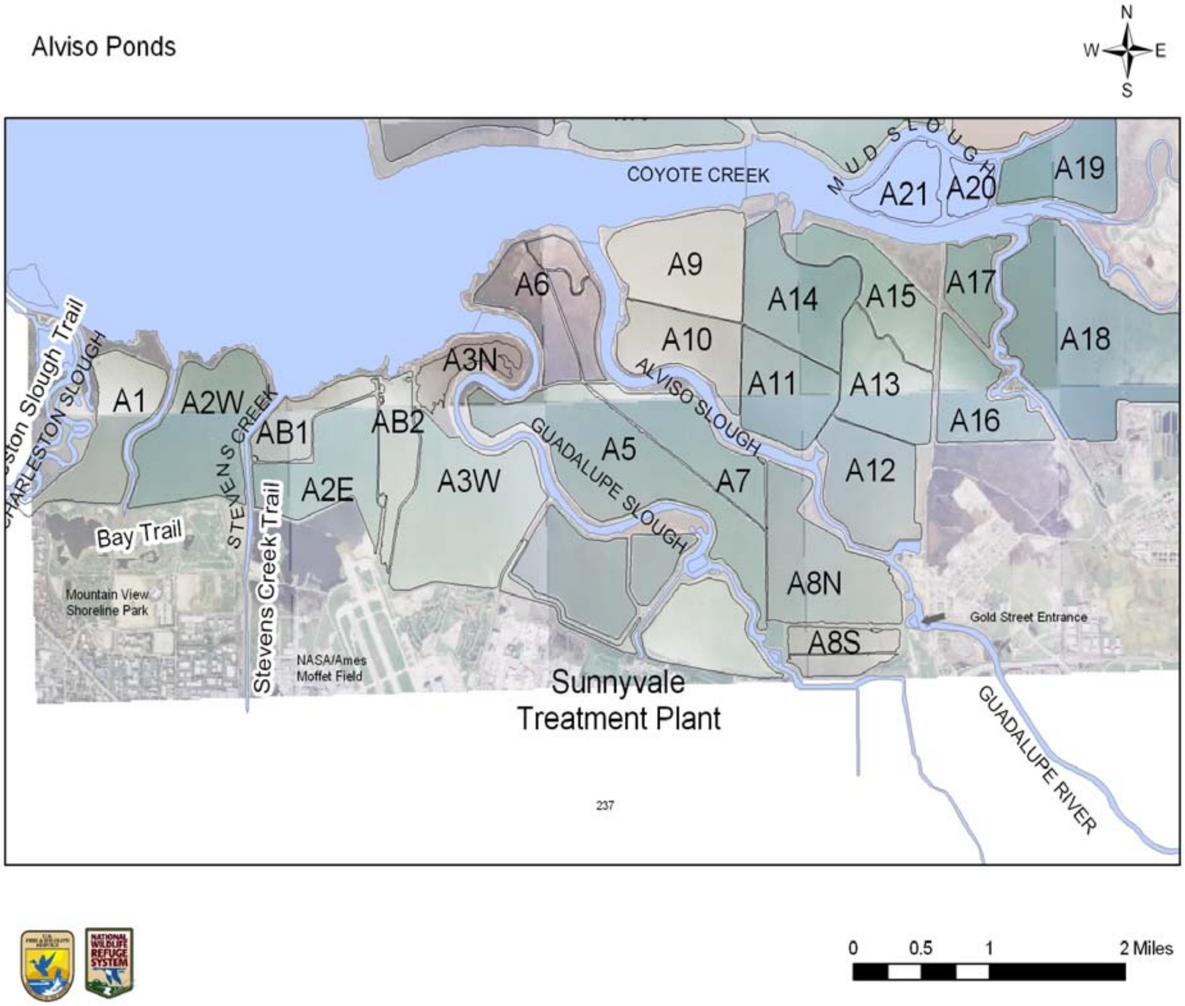
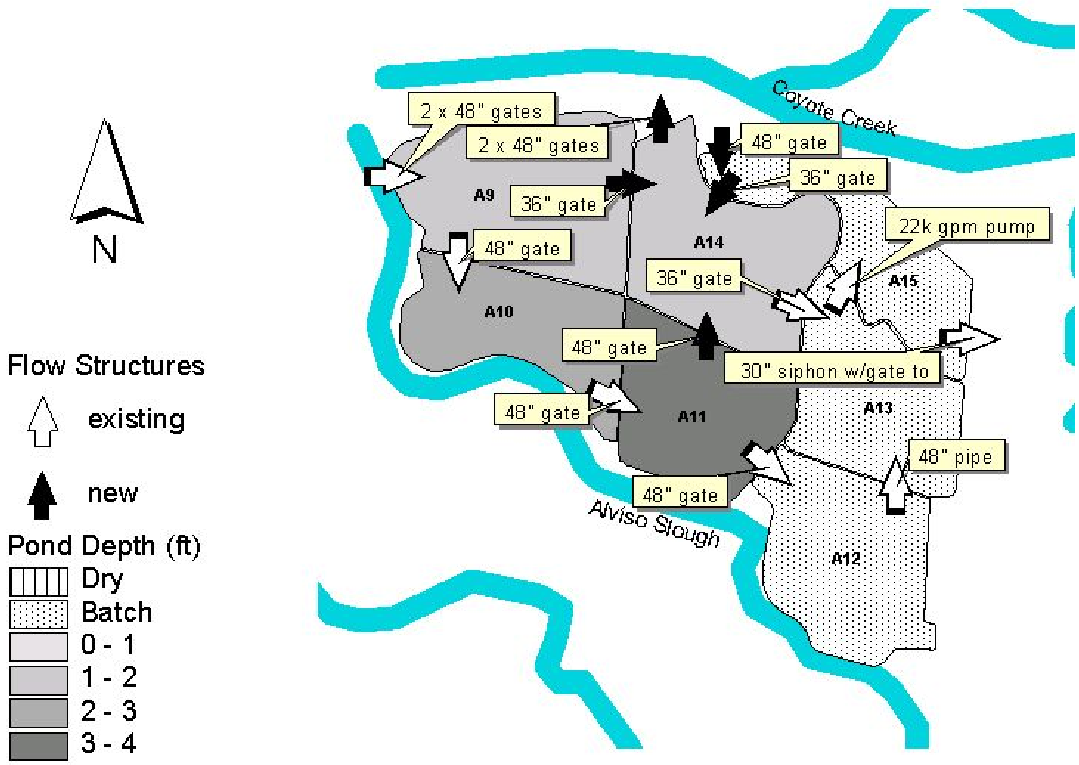


Table of Contents



Objectives

Maintain full tidal circulation through pondsA9, A10, A11 and A14, while maintaining discharge salinities to Coyote Creek at less than 40 ppt. and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for pH, dissolved oxygen, temperature, avian botulism, and potential for inorganic mobilization.

Maintain pond A12, A13 and A15 as batch ponds. Operate batch ponds at a higher salinity (80 – 120 ppt) during summer to favor brine shrimp.

Minimize entrainment of salmonids by limiting inflows during winter.

Maintain water surface levels lower in winter to reduce potential overtopping.

Structures

The A14 system includes the following structures needed for water circulation in the ponds:

- Existing 2 x 48” gate intake at A9 from Alviso Slough
- Existing 48” gate between A9 and A10
- New 48” gate between A9 and A14
- Existing 48” gate between A10 and A11
- New 48” gate between A11 and A14
- Existing 48” gate between A11 and A12
- Existing 48” gate between A12 and A13
- Existing 36” gate between A14 and A13
- Existing siphon from A15 to A16
- Existing 36” gate between A15 and A14
- Existing 22,000 gpm pump from A13 to A15
- New 48” gate intake at A15 from Coyote Creek
- New 2 x 48” gate outlet at A14 into Coyote Creek
- Existing staff gages at all ponds and new NGVD gages at all pond

System Description

The intake for the A14 system is located at the northwest end of pond A9 and includes two 48” gates from Alviso slough near the Bay. The system outlet is located at the northerly end of A14, with two 48” gates into Coyote Creek. The normal flow through the system proceeds from the intake at A9, then flow through A10 and A11 to the outlet at A14. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 6.2 ft. MLLW.

Ponds A12, A13, and A15 will be operated as batch ponds to control the individual pond volumes and salinities.

Operations of the A14 system should require little active management of gate openings to maintain appropriate circulation flows. Summer and winter operations are described below to indicate predicted operating levels during the dry and wet seasons.

Summer Operation

The summer operation is intended to provide circulation flow to makeup for evaporation during the summer season. The average total circulation inflow is approximately 38 cfs, or 17,000 gpm. The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A9	385	-0.2	2.0	3.3
A10	249	-0.8	1.8	3.0
A11	263	-1.8	1.3	2.5
A14	341	-0.0	0.9	2.3
A12	309	-2.0	1.2	2.5
A13	269	-1.1	1.1	2.6
A15	249	0.7	2.8	4.1

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A9 north intake	100	48
A9 south intake	100	48
A9 – A10	100	48
A10 – A11	100	48
A11 – A14	100	48
A14 west outlet	100	48
A14 east outlet	100	48
A9 – A14	0	0
A11 – A12	0	0
A12 – A13	0	0
A13 – A15	0	0
A14 – A13	0	0
A15 – A14	0	0
A15 intake	0	0
A14 weir	0.0 ft NGVD	

Water Level Control

The water level in A14 is the primary control for the pond system. The system flow is limited by the inlet capacity at A9. Normal operation would have the outlet gates fully open. Water levels are controlled by the weir elevation at A14. The A14 weir should be at approximately 0.0 ft NGVD to maintain the summer water level in A14 at 0.9 ft NGVD (2.3ft gage). The level may vary by 0.2 due to the influence of weak and strong tides.

The route of flow through this system will be from A9 to A10 to A11 to A14. The partial gate opening is to maintain the water level differences between the ponds. Again, the setting should not require frequent adjustment.

The A9 intake gates should be adjusted to control the overall flow though the system. The water levels in A9 will change due to the change in inflow. The maximum water level should be less than 2.5 ft NGVD (3.8 ft gage). This is to maintain freeboard on the internal levees and limit wind wave erosion.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A9	2.0	1.6	3.0
A10	1.8	-0.2	1.0
A11	1.3	-0.2	1.0
A14	0.9	0.8	2.2
A12	NA	-0.3	1.0
A13	NA	-0.3	1.2
A15	NA	0.7	2.0

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems. The 100 percent coverage water levels are intended for information purposes only. Operating the ponds at or near minimum depths will interfere with circulation through the ponds and may cause significant increases in pond salinity during the summer evaporation season.

Pond A14 has an estimated average bottom elevation at 0.0 ft NGVD, but portions of the pond bottom are at 0.8 ft NGVD, very near the design water level. The proposed A14 water level may need to be adjusted to maintain circulation through the pond.

Salinity Control

The summer salinity in the system will increase from the intake at A9 to the outlet at A14, due to evaporation within the system. The design maximum salinity for the discharge at A14 is 40 ppt. The intake flow at A9 should be increased when the salinity in A14 is close to 35 ppt. Increased flow may increase the water level in A14. The inflow at A9 is constrained by the tide level in Alviso Slough since the intake gates would be fully open. The inflow can be increased by partially opening the gate from A9 to A14 to lower the water level in A9 and increase the gravity inflow. This would increase the flow through A9 and A14, but reduce the flow through A10 and A11. Water levels in pond A14 above elevation 2.0 ft NGVD (3.4 ft gage) should be avoided as they may increase wave erosion of the levees.

Batch Ponds A12, A13, and A15 summer salinity levels should be between 80 and 120 ppt, to provide habitat for brine shrimp and wildlife which feeds on brine shrimp. Salinity control for the batch ponds will require both inflows to replace evaporation losses, and outflows to reduce the salt mass in the ponds and create space for lower salinity inflows. Ponds A12 and A13 would operate as a single unit, with inflow from pond A11 and outflows to either A14 or A15. The water levels in A12 and A13 would generally be between the elevations in A11 (higher than A12) and A14 (lower than A13). Therefore inflows from A11 and outflows to A14 would be by gravity. Outflows from A13 can also be pumped to A15. Water can also be pumped from A13 to A14 if the water levels are low in A13. Pond A15 would operate as a separate batch pond at a higher elevation than A13 or A14. Inflows to A15 would be pumped from A13, or by gravity from Coyote Creek with the supplemental intake at A15. Outflows from A15 would be by gravity to either A14 or A16.

The batch pond operation will require the outflow of approximately 0.5 to 0.7 ft of water from the batch ponds each month. This represents approximately 25 percent of the pond volumes. Because the A14 and A17 system have no circulation inflows from Coyote Creek for dilution from December through April, the outflow would normally occur during the evaporation season. The preferred operation would be to maintain the pond salinities near 100 ppt as much as possible, with consistent small outflows during the month from A13 to A14 and from A15 to A16. These gates should only be open approximately 10 percent, depending on the pond water levels. The inflows would be on a batch basis to add approximately 0.5 ft to the batch ponds about every other week.

If the salinity levels are high in A14 or A16, it may be necessary to reduce or suspend outflows from the batch ponds and allow the batch pond salinity to increase until later in the season. The salinity in a batch pond will increase by approximately 10 ppt per month during the peak evaporation months. If the batch pond salinities are high at the end of the circulation season, it may be necessary to continue to operate the A16 system with reverse flow during the winter continue to dilute the batch pond outflows until a reasonable salinity level is reached to start the next evaporation season.

Dissolved Oxygen and pH Control

If summer monitoring shows that DO levels in discharges from the Pond A14 fall below a 10^{th} percentile of 3.3 mg/L (calculated on a calendar weekly basis), the FWS will accelerate receiving water monitoring to weekly, conduct within-pond monitoring and notify and consult with the Water Board as to which Best Management Practices described below for increasing dissolved oxygen levels in discharge water should be implemented:

1. Increase the flows in the system by opening the A9 inlet further. If increased flows are not possible, open A14 gates to allow the ponds to become fully muted tidal or partially muted tidal systems until pond DO levels revert to levels at or above conditions in the Creek.

2. Set in a series of flow diversion baffles at the pond discharge for directing the water from more suitable DO water levels to achieve maximum oxygen uptake.

3. Cease nighttime discharges due to diurnal pattern.

4. Close discharge gates completely until DO levels meet standards.

5. Close discharge gates completely for a period of time each month when low tides occur primarily at night.

6. Mechanically harvest dead algae.

7. Install solar aeration circulators.

The pH of the discharge is related to the DO of the discharge. If the pH of the discharge falls outside the range of 6.5 – 8.5, an analysis of the impact of discharging pH on the receiving waters will be performed. If it is determined that discharge is impacting receiving water pH outside the range of 6.5 – 8.5, ammonia monitoring in the receiving water will be done to document potential toxicity affects associated with unionized ammonia.

To help minimize significant downtime on continuous monitoring devices used for DO and pH, the FWS will:

1. Have an extra monitor on hand, in case there is a break down.
2. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.
3. Work with Hydrolab to insure a quick repair of monitors (within 2 weeks).

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. If summer monitoring shows that DO levels in the pond drop the BMPs listed under the section on Dissolved Oxygen and pH Control will be implemented to increase the DO. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

During the winter season, the A9 intake will be closed to prevent entrainment of migrating salmonids. The winter operation period would normally extend from December through May 31. During the winter, rainfall would tend to increase the water levels in the ponds. The water levels in the ponds would be set by a weir at the outfall or adjustment of the control gates to avoid flooding of the existing internal levees or wave damage to the levees. The gates from A9, A10, and A11 will be partially open to allow rainfall to drain to A14. Excess water from rainfall would be drained from the system after larger storms and will require additional active management to adjust the interior control gates.

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A9 north intake	0	0
A9 south intake	0	0
A9 – A10	100	48
A10 – A11	100	48
A11 – A14	100	48
A14 west outlet	0	0
A14 east outlet	100	48
A9 – A14	0	0
A11 – A12	0	0
A12 – A13	0	0
A13 – A15	0	0
A14 – A13	0	0
A15 – A14	0	0
A15 intake	0	0

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A9	385	-0.2	1.5	2.8
A10	249	-0.8	1.5	2.7
A11	263	-1.8	1.4	2.6
A14	341	-0.0	1.3	2.7
A12	309	-2.0	1.4	2.7
A13	269	-1.1	1.2	2.7
A15	249	0.7	2.8	4.1

Salinity Control

The winter salinity in the system may decrease from the intake at A9 to the outlet at A14, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 11 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings, as well as to inspect water control structures, siphons and levees. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A9 intakes	Salinity
A10	Depth, Salinity, Observations
A11	Depth, Salinity, Observations
A14	Depth, Salinity, Observations
A12	Depth, Salinity, Observations
A13	Depth, Salinity, Observations
A15	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the formal monitoring listed below.

Location	**Frequency**	**Parameters**
Coyote Creek	Monthly (May –Oct)	DO, pH, Temp., Salinity

APPENDIX F
WATER MANAGEMENT OPERATION PLAN
POND SYSTEM A16

Pond System A16 Water Management Operation Plan – Alviso System 2009

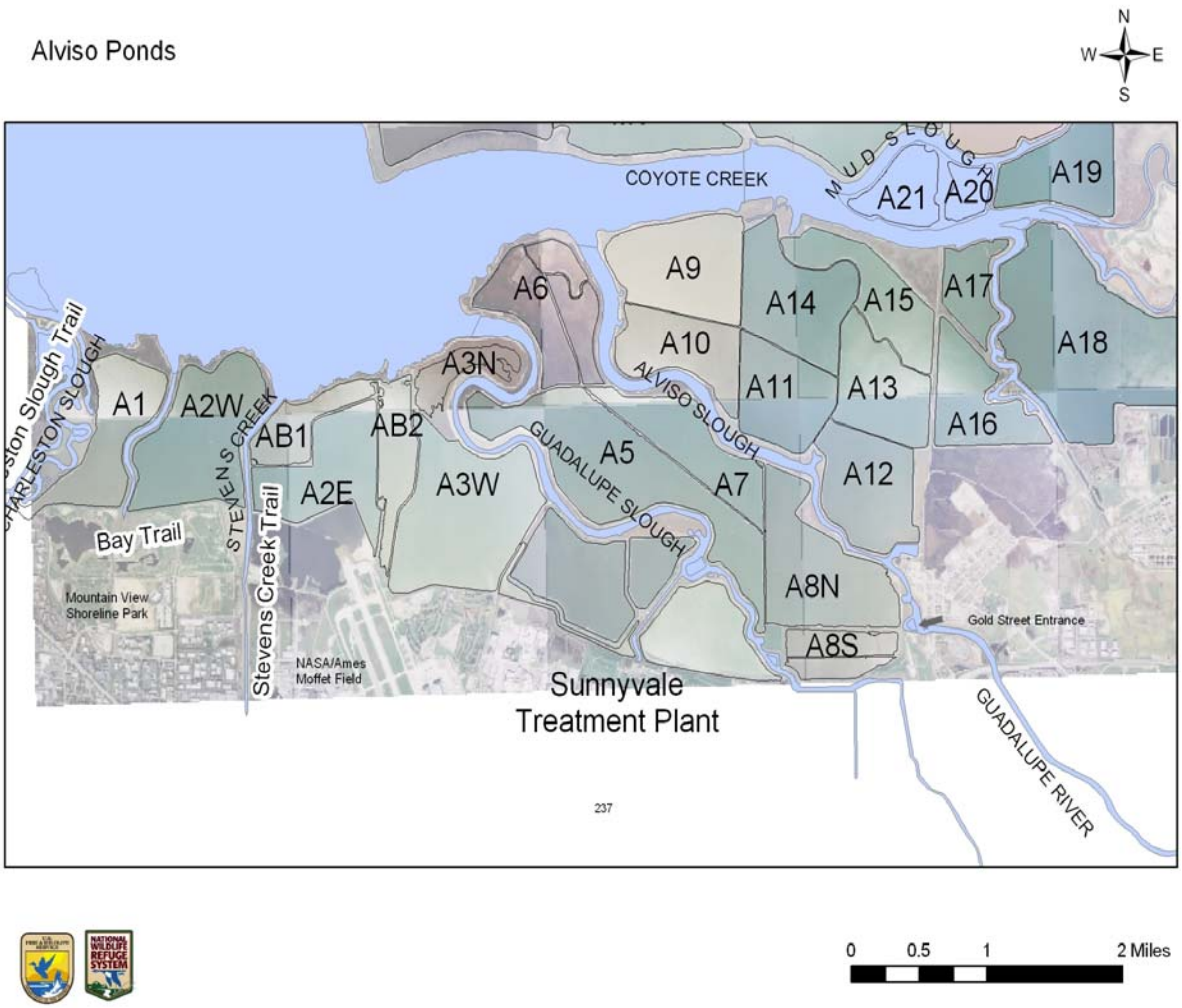
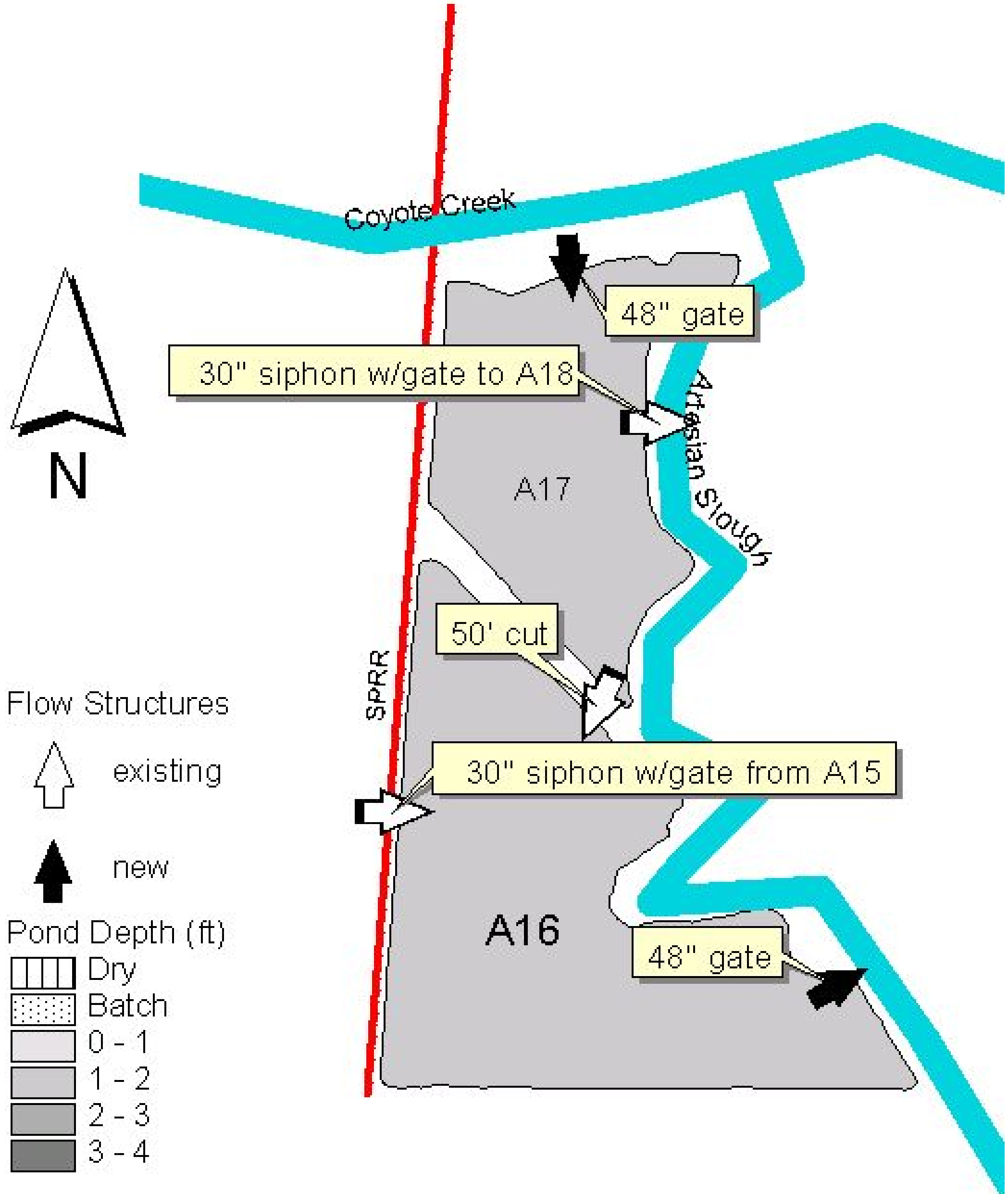


Table of Contents



Objectives

Maintain full tidal circulation through ponds A17 and A16 while maintaining discharge salinities to the Artesian Slough lower than 40 ppt. and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for pH, dissolved oxygen, temperature, avian botulism, mercury methylation, and potential for inorganic mobilization.

Minimize entrainment of salmonids by:

Close A17 intake during winter, or

Reverse of intake and outlet flow during winter.

Structures

The A16 system includes the following structures needed for water circulation in the ponds:

- New 48” gate intake at A17 from Coyote Creek
- New 48” gate outlet structure at A16 into Artesian Slough
- Existing siphon between A15 (from system A14) to A16
- Existing gap between A17 and A16
- Existing siphon between A17 and A18
- Existing staff gauges (no datum) , plus new NGVD gauges to be installed

System Description

The intake for the A16 system is located at the northern end of pond A17 and includes one 48” gate from lower Coyote Creek. The system outlet is located at the southeast end of pond A16, with one 48” gate to the Artesian Slough. The flow through the system proceeds from the intake at A17 though a 50’ cut in the levee between A17 and A16, then through the 48” gate at the outlet A16. An existing siphon from A15 to A16 will be used to release excess water from ponds A12, A13, and A15 on a batch basis. The existing siphon between A17 and A18 will not be used for system circulation, and may be sealed in the future. A18 will be owned and operated by the City of San Jose.

Operations of the A16 system should require limited active management of gate openings to maintain appropriate flows. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 7.2 ft. MLLW. Summer and winter operations are described below to indicate predicted operating levels during the dry and wet seasons.

Summer Operation

The summer operation is intended to provide circulation flow to makeup for evaporation during the summer season. The average total circulation inflow is approximately 15 cfs, or 6,800 gpm, with an outlet flow of about 12 cfs (5,400 gpm). The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A17	131	1.1	2.3	1.3
A16	243	0.6	2.3	0.7

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A17 intake	100	48
A16 outlet	100	48
A16 weir	1.9 ft NGVD	

Water Level Control

The water level in A16 is the primary control for the pond system. The system flow is limited by the outlet capacity. Normal operation would have the outlet gates fully open, and the water level in A16 would be controlled by the elevation of the outlet weir at A16. The estimated weir elevation would be 1.9 ft NGVD to maintain the pond water level at 2.3 ft NGVD in summer. The level may vary by 0.2 feet during a month due to the influence of weak and strong tides.

The A17 intake gate can be adjusted to control the overall flow though the system. The maximum water level in either A17 or A16 should generally be less than 3.0 ft NGVD during the summer. This is to maintain freeboard on the internal levees and limit wind wave erosion. The maximum historic water level in A16 and A17 has been 3.8 ft NGVD during the winter.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A17	2.3	1.1	0.1
A16	2.3	1.6	0.1

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems. The 100 percent coverage water levels are intended for information purposes only. Operating the ponds at or near minimum depths will interfere with circulation through the ponds and may cause significant increases in pond salinity during the summer evaporation season.

Salinity Control

The summer salinity in the system will increase from the intake at A17 to the outlet at A16 due to evaporation within the system. The design maximum salinity for the discharge at A16 is 40 ppt. The discharge permit requires that the discharge salinity not exceed 44 ppt.

The system circulation flow should be increased when the salinity in A16 reaches approximately 35 ppt during the summer. There are two operational measures available to increase the circulation flow. First, the level of the outlet weir can be lowered to lower the pond water level and the gravity inflow to the system. The weir structure includes weir boards on three sides of the structure. In general, the overall weir elevation should not be lowered more than 0.5 ft, but it may be more practical to lower one side by 1.0 ft or less.

The second operational measure to increase the circulation flow would be to adjust the intake gate at the A16 outlet structure to allow inflow from Artesian Slough at high tide. With the A16 intake gate fully open, the overall circulation flow would be approximately double the flow with A17 alone. In addition, the salinity in Artesian Slough at high tide is lower than in Coyote Creek and would directly lower the salinity in A16. The weir level at A16 should be adjusted to increase the outflow from A16 to account for the increased inflow.

The A16 system is intended to be the discharge for flows from pond A15 in the A14 system. A15 is a batch pond with operating salinities in the range of 80 to 120 ppt. Water will be transferred from A15 to A16 to lower the water levels in A15 and provide capacity for lower salinity inflows control the batch pond salinity. The intention is to dilute the higher salinity water with the pond A16 circulation. The siphon from A15 should be approximately 10 to 25 percent open, and the 22,000 gpm pump from A13 to A15 should operate approximately two to 3 days per month. The pump can add approximately 0.4 ft of water to A15 in one day.

Dissolved Oxygen and pH Control

If summer monitoring shows that DO levels in discharges from the Pond A16 fall below a 10th percentile of 3.3 mg/L (calculated on a calendar weekly basis), the FWS will accelerate receiving water monitoring to weekly, conduct within-pond monitoring and notify and consult with the Water Board as to which Best Management Practices described below for increasing dissolved oxygen levels in discharge water should be implemented:

1. Increase the flows in the system by opening the A17 inlet further. If increased flows are not possible, open both the A17 and A16 gates to allow the ponds to become fully

muted tidal or partially muted tidal systems until pond DO levels revert to levels at or above conditions in the Creek.

2. Set in a series of flow diversion baffles at the pond discharge for directing the water from more suitable DO water levels to achieve maximum oxygen uptake.

3. Cease nighttime discharges due to diurnal pattern.

4. Close discharge gates completely until DO levels meet standards.

5. Close discharge gates completely for a period of time each month when low tides occur primarily at night.

6. Mechanically harvest dead algae.

7. Install solar aeration circulators.

The pH of the discharge is related to the DO of the discharge. If the pH of the discharge falls outside the range of 6.5 – 8.5, an analysis of the impact of discharging pH on the receiving waters will be performed. If it is determined that discharge is impacting receiving water pH outside the range of 6.5 – 8.5, ammonia monitoring in the receiving water will be done to document potential toxicity affects associated with unionized ammonia.

To help minimize significant downtime on continuous monitoring devices used for DO and pH, the FWS will:

1. Have an extra monitor on hand, in case there is a break down.
2. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.
3. Work with Hydrolab to insure a quick repair of monitors (within 2 weeks).

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. If summer monitoring shows that DO levels in the pond drop the BMPs listed under the section on Dissolved Oxygen and pH Control will be implemented to increase the DO. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

During the winter season, the A17 intake will be closed to prevent entrainment of migrating salmonids in Coyote Creek. The winter operation period would normally extend from November through April. During the winter, rainfall would tend to increase the water levels in the ponds. The inflow and outflow direction of the system will be reversed, where intake at A16 from Artesian Slough during the winter to minimize potential entrapment of migrating salmonids in Coyote Creek. The outlet at A17 includes both a control gate and control weir. Either may be used to limit flow through the system. The water levels in the ponds would be set by a weir at the outfall of A17 or adjustment of the control gates to avoid flooding of the existing internal levees or wave damage to the levees. The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A17	131	1.1	2.2	1.2
A16	243	0.6	2.2	0.6

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A17 intake	0	0
A16	25	12
Weir	2.1 ft NGVD	

Water Level Control

The water level in A17 is the primary control for the pond system. The A17 water level is controlled by the outlet weir structure. Normal winter operation would have the A16 intake gate partially open to reduce inflow during extreme storm tides. Water levels in the ponds are controlled by the outlet weir setting. The normal winter water level in A17 should be at 2.2 ft NGVD, approximately 0.1 ft above the outlet weir. The pond water level may vary by 0.2 ft due to the influence of weak and strong tides, and over 0.5 ft due to storms.
During winter operations, the water levels should not fall below the outlet weir elevation.

During winter operations, if the water levels exceed approximately 3.0ft NGVD, the A16 gate should be closed to allow the excess water to drain. Note that without rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds.

Salinity Control

The winter salinity in the system may decrease from the intake at A16 to the outlet at A17, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 5 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A17 intake	Salinity
A17	Depth, Salinity, Observations
A16	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the formal monitoring listed below.

Location	**Frequency**	**Parameters**
Artesian Slough	Monthly (May –Oct)	DO, pH, Temp., Salinity

APPENDIX G

2008 LETTER TO RWQCB FOR FISH KILL OCCURANCE ON ALVISO SLOUGH

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
9500 Thornton Ave
Newark, California 94560
(510)792-0222

October 23, 2008

Mr. Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA. 94612

Attention: Robert Schlipf

Subject: Fish Mortality in Alviso Slough in early October 2008

Dear Mr. Wolfe:

This letter transmits reports of observed fish mortality in Alviso Slough. Your staff was notified verbally on October 10, 2008 and this letter is a written submission describing visual observations, timeline of events, and water sampling during the event. The cause of the fish mortality in Alviso Slough is unknown. The discharge from Pond A7 may have contributed to the event, but there are other factors which could have caused or contributed to it as well, such as a toxic spill, waste water run-off, and/or a dinoflagellate bloom.

Timeline of events:

October 7, 2008 morning
United States Geological Survey (USGS) personnel were taking monthly receiving water samples in Alviso Slough as outlined in Order No. R2-2004-0018, WDID No. 2 019438001. The samples were taken approximately from 10:00 a.m. to 11:00 a.m., at seven locations (see Figure 1) up and downstream of the water control structure at Pond A7. Low DO readings were recorded in Alviso Slough during this time (see Table 1) but did not attract extra attention since there have been low DO readings throughout the receiving waters since the Initial Stewardship Project began in 2004. USGS personnel did not observe any dead or stressed fish during their sampling on the morning of October 7, 2008.

Breaking the USGS data set down into 2 separate tables, one showing just the surface samples and one showing just the bottom samples shows two clear patterns. At the surface, the Dissolved Oxygen levels decrease as you move from the mouth of Alviso slough upstream toward the town of Alviso. At the bottom, there is a similar pattern with high values at the mouth of the Slough, decreasing as you proceed upstream, although the bottom concentrations drop dramatically close to the discharge point from A7 and remain low as you progress upstream.

Table 1: Receiving Water Samples in Alviso Slough

Location	Date	Time	B= Bottom S= Surface	Condition mS/cm	Temp. (°C)	pH	D.O. mg/L	Salinity
A-A7-8	10/7/2008	10:05	S	31.79	20.14	7.69	4.21	19.74
A-A7-7	10/7/2008	10:13	S	30.94	20.10	7.70	4.21	19.13
A-A7-1	10/7/2008	10:22	S	30.34	20.18	7.70	3.61	18.86
A-A7-2	10/7/2008	10:29	S	30.29	20.17	7.71	3.56	18.76
A-A7-3	10/7/2008	10:37	S	29.73	20.18	7.70	3.30	18.37
A-A7-4	10/7/2008	10:45	S	16.26	19.22	7.49	1.48	9.57
A-A7-5	10/7/2008	10:54	S	15.68	19.35	7.46	1.04	9.03

Location	Date	Time	B= Bottom S= Surface	Condition mS/cm	Temp. (°C)	pH	D.O. mg/L	Salinity
A-A7-8	10/7/2008	10:07	B	44.15	20.19	7.78	5.25	28.56
A-A7-7	10/7/2008	10:15	B	42.71	20.16	7.73	4.61	27.49
A-A7-1	10/7/2008	10:24	B	41.50	20.09	8.01	0.70	26.68
A-A7-2	10/7/2008	10:31	B	41.48	20.09	8.01	0.62	26.65
A-A7-3	10/7/2008	10:39	B	41.43	20.08	7.99	0.64	26.37
A-A7-4	10/7/2008	10:46	B	40.70	20.86	7.98	0.52	25.94
A-A7-5	10/7/2008	10:56	B	39.14	19.92	7.93	0.45	24.94

October 7, 2008 afternoon

A local duck hunter (Ted Gross) who was testing his boat in Alviso Slough in the evening noticed hundreds of dead fish floating in Alviso Slough. Mr. Gross launched his boat from the Blue Whale Sailing School located between the old marina and the South Bay Yacht Club and proceeded downstream towards the Bay. Mr. Gross reported that hundreds of dead striped bass in the 10" size range and a lesser number of Goby fish were observed from Alviso to half way out to the Bay.

Figure 1: Receiving water sampling locations in Alviso Slough

October 8, 2008
Darrell Slotton and his crew with UC Davis were fish sampling in a series of sites along the Alviso Slough and Guadalupe River. UC Davis crew launched their boat into the Guadalupe Slough from the boat ramp located at the north east corner of Pond A3W. They then traveled downstream towards the Bay and into the mouth of Alviso Slough. Dr. Slotton began to observe hundreds of dead striped bass ranging from 10"-15" in length from approximately one mile downstream of Alviso Marina continuing upstream one mile from the Gold St. Bridge (see Figure 2). They speculated that the fish appeared to have been dead for several days, but that is not consistent with the observations of the USGS crew (no dead fish on the morning of October 7) unless the fish were confined to an upstream area. This is conceivable since the tide was just beginning to ebb when the USGS crew began their sampling run. The USGS crew launched from the San Jose/Santa Clara Water Pollution Control Plant boat ramp located in Artesian Slough.

Figure 2: Fish Kill Observation Area of UC Davis Crew

October 8, 2008 afternoon
Ted Gross reported fish kill to FWS staff via email which the FWS staff then reported in turn to the RWQCB.

October 9, 2008 morning
FWS staff went to Pond A7 system and Pond A9 system and observed no dead fish within either of these Pond systems.

October 16, 2008
UC Davis crew returned to the same area where they observed dead fish on October 8, and observed no signs of dead fish.

Evaluating the Cause of Fish Mortality in Alviso Slough

Pond A7 is the only FWS pond which discharges into Alviso Slough. Data collected from Pond A7 for the week of October 4 - October 9, 2008 showed:

- Water levels within Pond A7 have remained fairly steady at 0.4 -0.6 NGVD through out the year.
- During the week of October 5, 2008, Pond A7 was discharging approximately 22 million gallons per day into Alviso Slough.
- The datasonde stationed at the pond side discharge point recorded DO levels ranging from 0.03 mg/L - 14.55 mg/L
- Salinity level was steady at 29 ppt.
- Water temperature in Pond A7 averaged 19.8 °C
- pH ranged from 8.02 - 8.47

If the cause of the fish mortality was strictly due to the discharge from Pond A7, one would expect to observe dead fish in that pond. Since there were no dead fish observed within Pond A7, FWS staff believes that the incident may have been due at least in part to other causes in Alviso Slough.

Please contact me at (510) 792-0222 ext. 24 if you have questions regarding this letter.

Sincerely yours,

Eric C. Mruz

Eric Mruz
Wildlife Refuge Specialist
Don Edwards NWR