South Bay Salt Pond Restoration Project

2011 Annual Self-Monitoring Report

Prepared for:

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TABLE OF CONTENTS

Section | Page

LIST OF APPENDICES

Appendix

LIST OF FIGURES

Figure Page

LIST OF TABLES

Table Page

SECTION I
REPORT OVERVIEW

This South Bay Salt Pond Restoration Project (Project) 2011 Annual Self-Monitoring Report (Report) has been prepared to provide: 1) an update of Project Phase I activities that were completed or began implementation in 2011; 2) information on on-going operations of the Alviso and Ravenswood Ponds; 3) results of the 2011 water quality monitoring conducted at the Alviso Ponds; 4) results of fisheries monitoring and applied studies; 5) a description of the proposed 2012 applied studies; and 6) Phase II planning efforts.

In previous years, this annual report has focused on water quality monitoring results and has been submitted to the California Regional Water Quality Control Board (Water Board) to comply with the Self-Monitoring Program (SMP) as described in the Final Order (No. R2-2008-0078). This is the second year the report will also be submitted to NOAA's National Marine Fisheries Service (NMFS) because we have included additional fisheries monitoring conducted as part of the Science Program's Applied Studies, which are intended to fill the most important gaps in our knowledge about South San Francisco Bay (South Bay) ecosystem

It is anticipated that both water quality and fisheries information will help the Water Board and NMFS: 1) understand the status of the Project; 2) provide feedback and guidance to the Project Management Team on current and future applied studies and monitoring; and 3) assist in identifying emerging key uncertainties and management decisions required to keep the Project on track toward its restoration objectives.

SECTION 2
PHASE I ACCOMPLISHMENTS

The Phase I of construction projects, launched in 2009, is now nearing completion. In 2011, significant milestones were accomplished contributing towards the Project's goals to restore and enhance wetlands in South San Francisco Bay as habitat for federally endangered species and migratory birds while providing for flood management and wildlife-oriented public access and recreation.

2.1 MILESTONES

Tidal Marsh Restoration

- Three ponds, E9, E8A and E8X, totaling 630 acres, were breached to tidal action, the first Project construction in the Eden Landing Ecological Reserve, which is owned and managed by the California Department of Fish and Game (CDFG).

- The first of eight tide gates at Alviso Pond A8 was opened to allow tides into this 400-acre area. Scientists continue to monitor concentrations of toxic mercury that remain in South Bay sediments near San Jose from upstream mercury mining. Scientists are testing for mercury in sediment, water and animals; they are comparing the results to the surrounding area, and to loads coming downstream to the Project site. Results from the comprehensive study will be available in 2013.

- The Island Ponds (Alviso Ponds A19, A20, and A21), restored to the tides in 2006, are developing habitat faster than expected, allowing for healthy growth of pickleweed and other native salt marsh plants that will eventually provide habitat for endangered species such as the California clapper rail and salt marsh harvest mouse.

Enhanced Ponds

Shorebirds came to nest at newly constructed Ravenswood Pond SF2 nesting islands. The habitat attracted 192 avocet nests and 5 nests of the threatened western snowy plover. Thousands of shorebirds and waterfowl roosted and foraged in this pond during the winter and migratory seasons. Studies will continue in 2012 to further determine how birds and fish are using Pond SF2.

Public Access

In 2011, more than 1,000 people participated in bike tours, photography safaris, history lectures, educational field trips, restoration work and project tours provided by Project volunteer docents and Service interpretive staff. This included the 75 people who helped pull more than 1 ton of invasive plants at a Ravenswood restoration event offered with partner Save the Bay.

2.2 FLOOD PROTECTION

Parts of the Project cannot be completed until levees are in place to protect low-lying parts of the South Bay. The Project has closely coordinated with a related but separate effort, the Congressionally-authorized South San Francisco Bay Shoreline Study (Shoreline Study). This U.S. Army Corps of Engineers feasibility study, conducted with the State Coastal Conservancy and the Santa Clara Valley Water District as non-federal partners, will identify and recommend for federal funding flood risk management and ecosystem restoration projects.

In 2011, the Shoreline Study team identified a set of levee options to protect the Alviso area and took feedback from the public. Shoreline Study agencies will choose a preferred set of Alviso-area levee alignments in 2012 (the Shoreline Study is also working with the Project to develop restoration plans for Alviso Ponds A9 - A15).

In addition, Project partners at the Alameda County Flood Control District are conducting detailed modeling of tidal flood risks near Eden Landing and proposing innovative ways to ameliorate these risks in conjunction with restoration.

2.3 SCIENCE

In 2011, the Science Program hosted its third Science Symposium, drawing more than 200 people to learn about the Project's latest scientific findings, which include:

- Preliminary data indicating sufficient sediment to support marsh development for the life of the Project;
- Wildlife is returning to restored habitats - 30 species of fish, almost all native, are using newly restored ponds;
- Increasing populations of shorebirds and dabbling ducks and maintained diving duck populations;
- A decrease in hatching success of western snowy plovers. Managers are working to limit the impact of nest-raiding predators; and
- Researchers believe increased nest predation and lack of upland refugia during winter high tides are causing California clapper rail mortality.

2.4 Progress Toward Our 3 Goals

Goal 1: Restore & Enhance Habitat

2910 Acres of Habitat Restored - In 2011, CDFG opened three ponds, totaling 630 acres, to tidal action. Under the 50/50 scenario of 50% wetlands and 50% managed ponds, 7,500 acres of former salt ponds will be restored to tidal marsh. The Project has accomplished about 40% of that goal.

Designs Completed on 240 Acres of Enhanced Ponds - At the other end of our adaptive management strategy, the Project's 90/10 scenario of 90% wetlands and 10% managed ponds calls for 1,600 acres of former salt ponds to be improved to provide optimal habitat for a variety of avian species. The more birds that our enhanced ponds can provide for, the more other ponds we will be able to restore to tidal marsh. The project has enhanced 240 pond acres and in 2011 prepared to launch construction to build 16 nesting islands on an additional 240 acres.

Goal 2: Provide Public Access

Planning and Design Proceeds - The Project has identified trails and other public improvements to build. The Project's vision is to establish an interrelated trail system; provide viewing and interpretation opportunities; create small watercraft launch points; and continue to allow for waterfowl hunting. The Project to date has created 2.9 trail miles. In 2011, work progressed on planning Bay Trail extensions and design was completed for a new overlook and interpretive panels in the Alviso area.

Goal 3: Provide Flood Risk Management

Flood Protection Progress Maintained - A goal of the Project is to provide for flood risk management, with the objective of maintaining or improving existing South Bay area levels of flood protection. Project managers are committed to ensuring that flood hazards to adjacent communities and infrastructure do not increase as a result of the restoration. Tidal marsh restoration completed to date will increase scour and existing channels, thereby increasing flood flow capacity. However, tidal marsh restoration in flood-critical parts of the Project area will not occur until inboard flood protection is established.

SECTION 3
POND OPERATIONS

3.1 SUSTAINABILITY OF MANAGED PONDS

Maintaining adequate dissolved oxygen (DO) levels in the Alviso Ponds has been the major water quality challenge for the Service. A number of actions have been implemented in previous years to raise DO in the ponds, including:

- Pond A2W - Increased the flows in the pond system by opening the inlet further. If increased flows were not possible, the Service fully opened the discharge gate to allow the pond to become a muted tidal system until pond DO levels revert to levels at or above conditions in the Bay or slough.

- Pond A3W - 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.

- Pond A7 - Installed solar aerators used to circulate waters.

- Pond A14 - Closed discharge gates completely until DO levels met standards.

- Pond A16 - Closed discharge gates completely for a period of time each month when low tides occurred primarily at night when DO levels are typically at their lowest.

- Discontinued nighttime discharges due to diurnal patterns. This was a daily operation of the discharge gates - closing the discharge gates at night (when the DO is typically at the lowest) and then opening them in the morning when the DO levels have reverted to higher levels. However, this was determined not to be a feasible long-term solution for resolving DO issues.

- Another method discussed was to mechanically harvest dead algae. Mechanically harvesting algae would be very difficult and expensive considering the large size of the ponds. This might work on a very limited basis such as removing the dead algae from around the discharge structure, but it is difficult to find a place to dry and dispose of the harvested algae in a highly urban environment.

Based on the previous lessons learned, the Service has been operating the ponds as continuous flow-through systems to try and reduce the water resident time as much as possible. This was the case in 2011 and the Service intends to operate the ponds similarly in 2012 according to the Pond Operations Plans.

3.2 2012 Pond Operations Plans

Pond System A2W

The objectives for the Alviso Pond A2W system is to maintain full tidal circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 parts per thousand (ppt) and meet the other water quality requirements in the Water Board's Waste Discharge Permit. 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. The 2012 Operation Plan for Pond A2W is included in Appendix A.

Pond System A3W

The objectives for the Alviso Pond A3W system are to: 1) maintain full tidal circulation through ponds AB1, AB2, 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; 2) maintain pond A3N as a seasonal pond; and 3) maintain water surface levels lower in winter to reduce potential overtopping of A3W levee adjacent to Moffett Field. 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. The 2012 Operation Plan for Pond A3W is included in Appendix B.

Pond System A8

The Phase I action at Alviso Pond A8 is one of the initial actions for implementation under the Project. Pond A8 is identified as tidal habitat in the long-term programmatic restoration of the Project. The Pond A8 system will be operated to maintain muted tidal circulation through ponds A5, A7, A8N and A8S 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. The 2012 Operation Plan for Pond A8 is included in Appendix C.

Pond System A14

The objectives of the Alviso Pond A14 systems are to: 1) maintain full tidal circulation through ponds A9, 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; 2) maintain pond A12, A13 and A15 as batch ponds - operating batch ponds at a higher salinity (80 – 120 ppt) during summer to favor brine shrimp; 3) minimize entrainment of salmonids by limiting inflows during winter; and 4) maintain water surface levels lower in winter to reduce potential overtopping. During the winter, Pond A9 and Pond A14 intakes will not be open due to possible fish entrainment. The 2012 Operation Plan for Pond A14 is included in Appendix D.

Pond System A16

Alviso Pond A16-A17 is the final Phase I action that will be implemented in 2012. Construction of Ponds A16-A17 would allow Pond A17 to become tidal marsh with uninhibited hydraulic connection to Coyote Creek (and therefore South Bay) and Pond A16 would become a managed pond that would include nesting islands for birds and shallow water habitat for shorebird foraging. Public access and recreation are also included as part of the Pond A16-A17 project. Because Ponds A16-A17 are dewatered to prepare for construction in a few weeks, we have not included a Pond A16-A17 Operation Plan in this report. Once completed, the Service will prepare an Operation Plan for the newly restored pond complex.

Pond System SF2

Ravenswood Pond SF2 is another Phase I action that was completed in 2010 to enhance 240 acres of managed pond habitat. A 155-acre pond was created with 30 nesting islands for nesting and resting shorebirds and shallow water habitat for foraging shorebirds. In addition, 85 acres of habitat was preserved for nesting western snowy plovers. Pond SF2 includes three management cells; the eastern and middle cell will be managed pond habitat and the western-most cell will be managed seasonal wetland. Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the Bay, and between cells, for shorebird foraging habitat and to meet water quality objectives. Another component of Pond SF2 created 0.7 mile of trail between the pond and the Bay and two new viewing platforms near the Dumbarton Bridge. The 2012 Operation Plan for Pond SF2 is included in Appendix E.

SECTION 4
WATER QUALITY MONITORING

This section summarizes 2011 water quality monitoring conducted at the Alviso Ponds in Santa Clara County, California, which are part of the South Bay Low Salinity Salt Ponds, and the Ravenswood Pond SF2 in San Mateo County. Operations occurred from June through October 2011. Sampling was performed on a continuous, weekly, monthly, or bi-monthly schedule as required by the Water Board Order, as modified in a letter dated June 29, 2010. Sampling was performed by the United States Geological Survey (USGS) on behalf of the United States Fish and Wildlife Service (Service) in accordance with the waste discharge requirements.

The Final Order for the South 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 4-1) and the Ravenswood Pond SF2. The systems are maintained and operated by the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). The California Department of Fish and Game (CDFG) will submit a report for the Eden Landing Ponds under a separate report.

The ponds are generally being operated as flow-through systems with Bay or slough water 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.

In 2010, the Service submitted a monitoring proposal to direct Service resources towards a more robust Applied Study of Pond A3W to better understand the causal factors of low dissolved oxygen (DO) in managed ponds. The Water Board modified the Self-Monitoring Program (SMP) in a letter, dated June 29, 2010, so that it was consistent with the Service's proposal to focus efforts on Pond A3W. To accommodate this shift in resources, the Water Board no longer requires the Service conduct continuous monitoring at Pond A7.

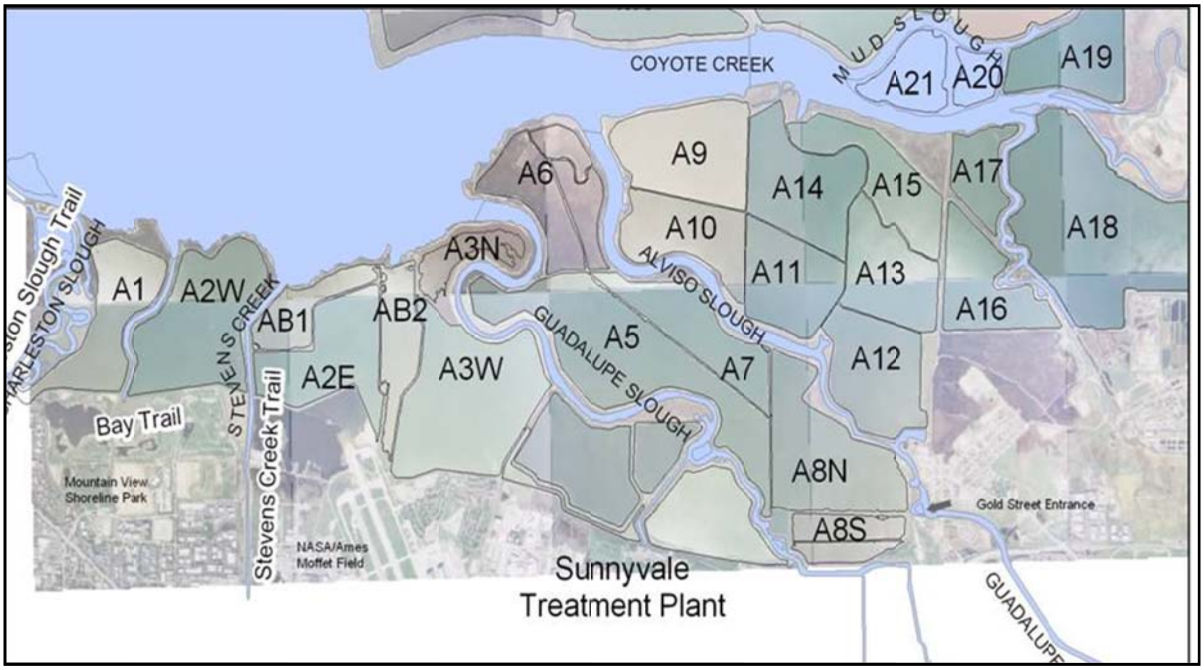


Figure 4-1: Alviso Pond Complex

4.1 WATER QUALITY MONITORING METHODOLOGY

4.1.1 Continuous Pond Discharge Sampling

USGS installed continuous monitoring datasondes (Hydrolab-Hach Company, Loveland, CO) at the discharge structures for Alviso Ponds A3W and A8 and Ravenwood Pond SF2. These datasondes began logging on 1 June 2011 and continued logging until 31 October 2011. The datasonde at the discharge location for Pond A3W was installed inside the pond on the water control structure where it was secured within a submerged perforated ABS tube. At Pond A8, the datasonde was installed on the western wall of the discharge notch and was housed within a steel cage. As with Pond A3W, the datasonde at the discharge structure of Pond SF2 was installed within a submerged, perforated ABS tube which was fastened to a wooden support that was sunk into the discharge channel. This location was chosen so the instrument could measure water quality at the outflow of the discharge into the adjacent slough and/or the South San Francisco Bay. Two additional datasondes were deployed within Unit 1 and Unit 2 of Pond SF2. These internally- located datasondes were deployed within stilling wells that were sunk into the pond plateau. Datasondes were installed at a depth of at least 25 centimeters to ensure that all sensors were submerged and to ensure there was free water circulating around all sensors. Depths were monitored and adjusted to maintain constant submersion as the pond water level fluctuated. Stilling wells were cleaned and wiped-free of debris as needed to maintain adequate water flow around each datasonde.

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 the datasonde was serviced to check battery voltage and data consistency. A recently calibrated Hydrolab minisonde (Hydrolab-Hach Company, Loveland, CO) 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 minisonde to confirm data consistency throughout the procedure (initial, de-fouled, and post-calibration). The initial and de-fouled readings were also used to detect shifts in the data due to accumulation of biomaterials and sediment buildup on the sensors.

Both internally located datasondes within Pond SF2 were housed inside of a stilling well which were sunk into the pond's plateau. This deployment strategy allowed for the datasondes' sensors to record water quality data for the shallow layer of water covering the plateau. To prevent excessive algal and/or sedimentation buildup within the stilling wells, nylon stockings were stretched around each well. Stilling wells were wiped-free of debris as need to ensure proper water flow around the datasondes' sensors.

4.1.2 Alviso Receiving Water (IRP/CCM):

Beginning 26 July 2011, samples were collected monthly from A3W receiving water (Guadalupe Slough, 8 sites), A7 and A8 receiving water (Alviso Slough, 13 sites), A16 receiving water (Artesian Slough, 5 sites) and A14 (Coyote Creek, 3 sites) through October 2011. Slough sampling sites were accessed via boat from San Francisco Bay and a boat-mounted GPS unit was used to navigate to sampling locations. When the boat was approximately 50-25 meters from the site, the engine was turned off which allowed the boat to drift (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, 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 for 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); and

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 at the beginning and ending of each slough, unless it had changed significantly.

4.1.3 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. We mitigated problems of algae and other substances interfering with moving parts, such as the self-cleaning brush and circulator 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 was 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. We maintained a calibration and maintenance log for each pond.

4.2 Continuous Circulation Monitoring

4.2.1 Pond A3W Discharge Samples

Data collected at discharge waters in 2011 were compared to water quality data collected in previous years (2005-2010) during the same period and at the same location(Figure 4.2-1). Daily averages for salinity, temperature, dissolved oxygen, as well as the weekly tenth-percentiles values for DO were most similar to data collected in 2010. Daily averages for pH levels within Pond A3W's discharge waters were higher this year than during any previous year of monitoring, at least until mid-September.

Figure 4.2-1: Datasonde Location in Pond A3W during 2011

Over the five-month monitoring program, the pH levels at Pond A3W's discharge structure ranged from 7.8-10.1 units. Monthly pH averages increased from June through July then decreased steadily from July through October. From the onset of the monitoring program, pH levels within Pond A3W were recorded above 8.5 units. These concentrations continued to increase during June and July then decreased steadily until the end of the monitoring program. Daily pH averages recorded from June through mid-September of 2011 show much higher pH concentrations at Pond A3W's discharge structure than pH levels recorded during previous monitoring years (2005-2010). After mid-September, pH levels within Pond A3W began to most closely resemble pH values recorded in 2010 (Figures 4.2-2 and 4.2-3). Tidal influences had an effect on the pH levels of discharge waters at Pond A3W. Although fluctuations in pH levels were obvious throughout the 2011 season, the most dramatic daily range in pH levels occurred on the 6th and 11th of June where there was a 1.5 unit difference in daily min/max values. These two dates in June also logged the highest pH levels, both around 10.1 units (Figure 4.2-4). For unknown reasons, daily pH fluctuations at Pond A3W decreased in amplitude after the 16th of September. With only a 0.1 unit difference in daily min/max pH values, occurring on the 25th of September, the smallest fluctuation of pH levels was recorded (Figure 4.2-5).

Figure 4.2-2: Daily Mean pH at Pond A3W Discharge from 2005-2011

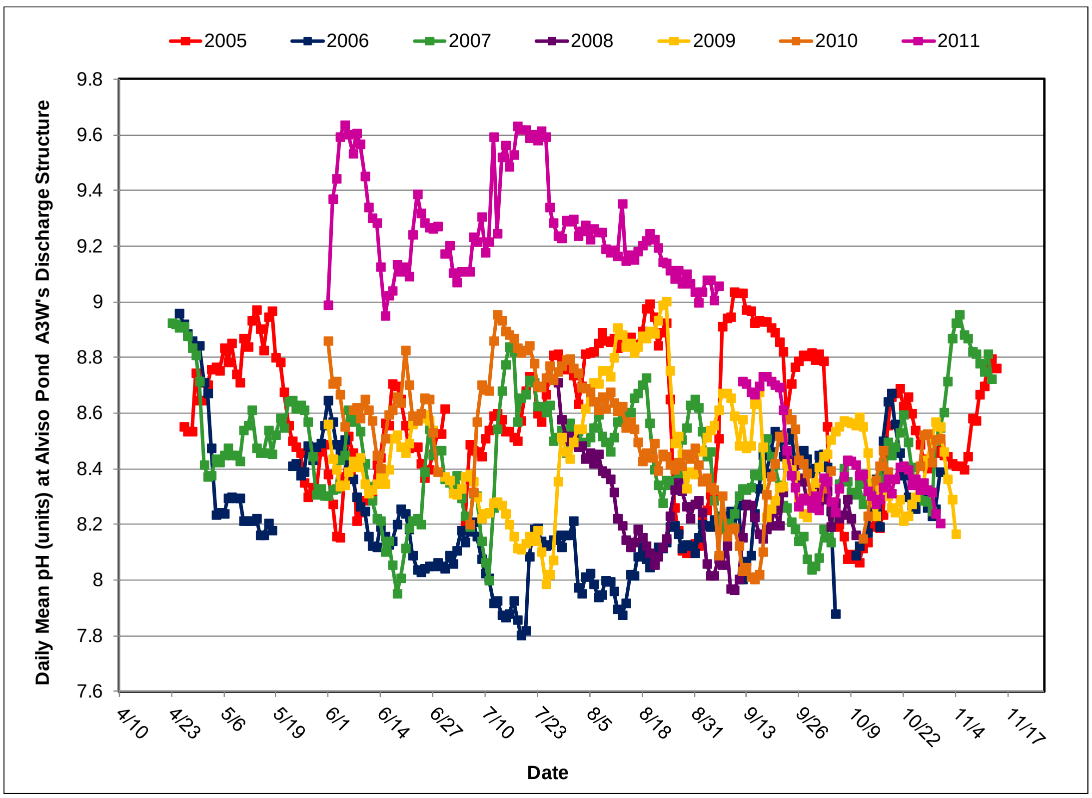


Figure 4.2-3: Daily Mean pH at Pond A3W Discharge from 2008-2011

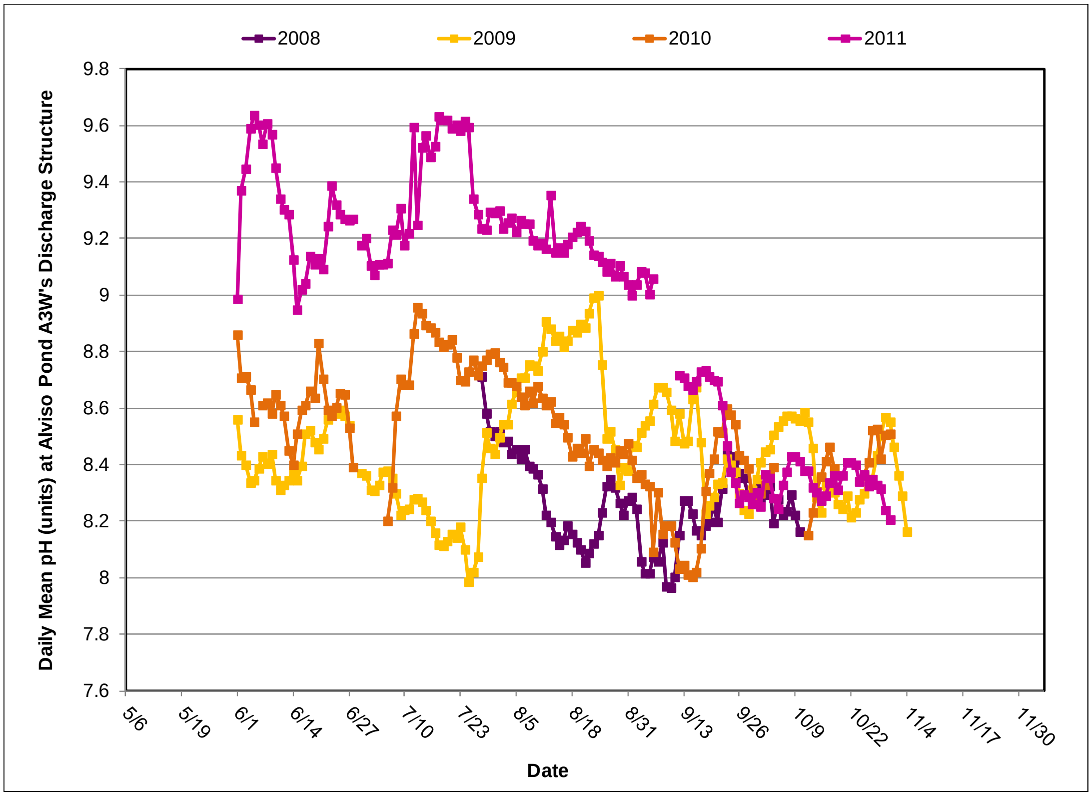


Figure 4.2-4: pH in Pond A3W from 1 June – 15 June 2011

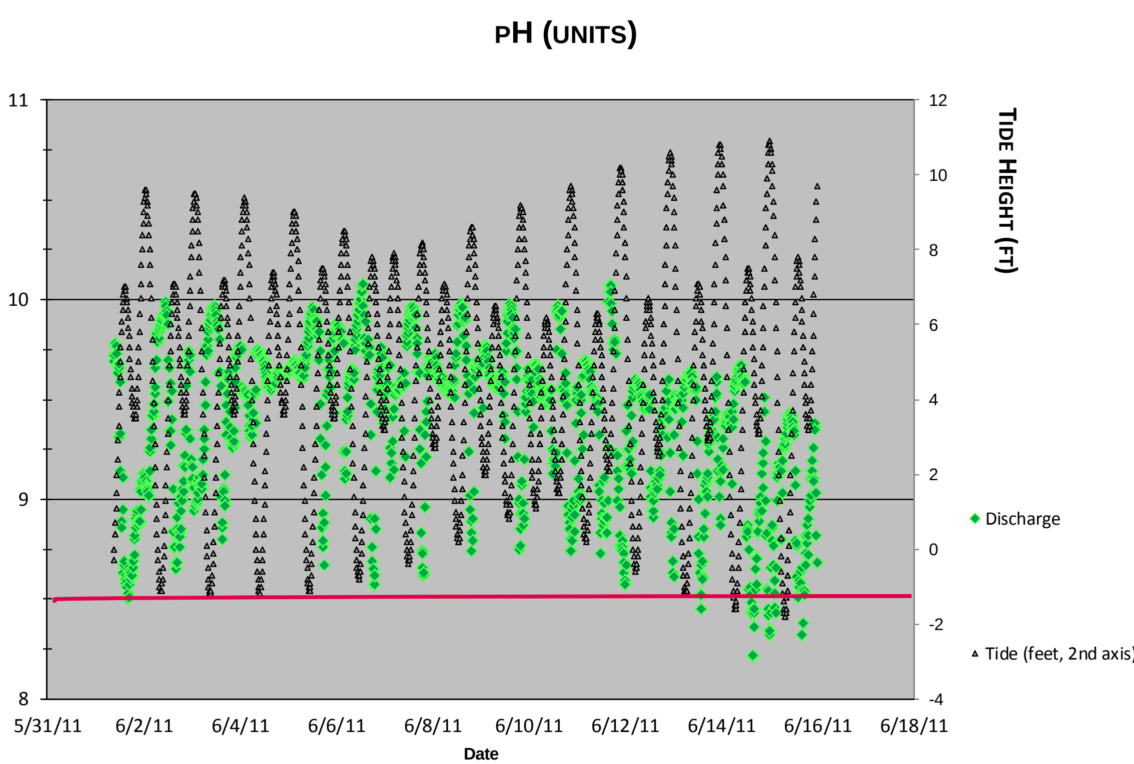
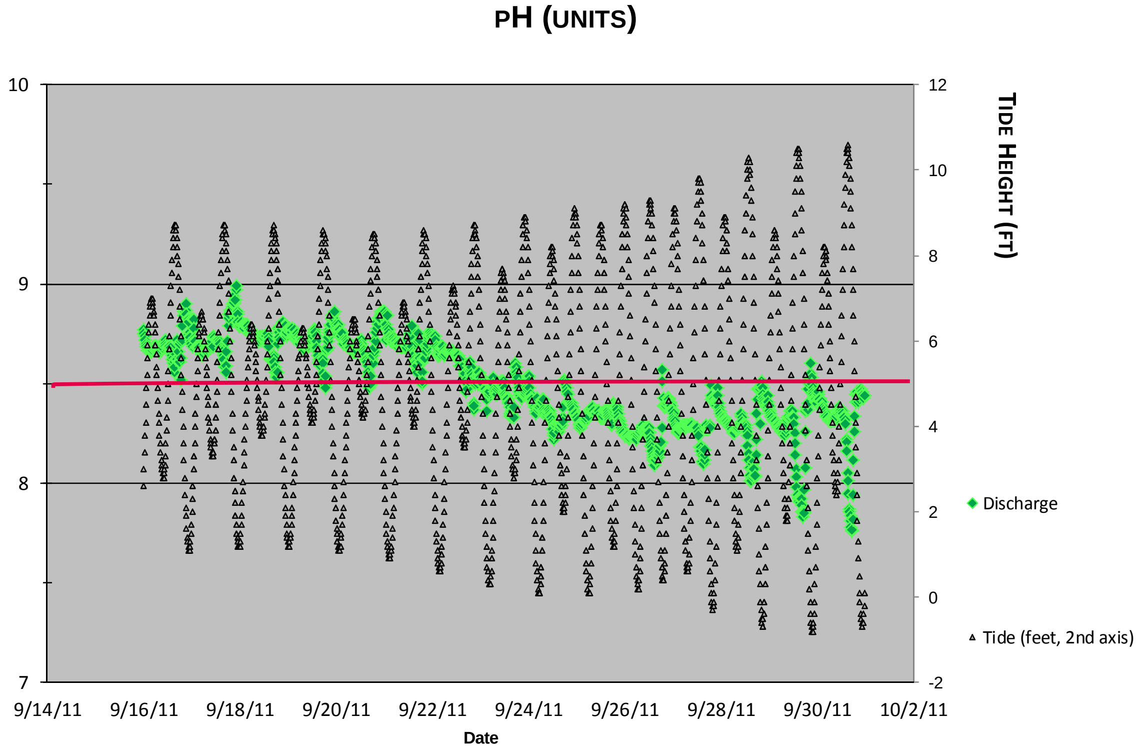


Figure 2.4-5: pH in Pond A3W from 16 September – 30 September 2011



As with pH concentrations at Pond A3W's discharge structure, the salinity at this location was also influenced by tidal cycling. These influences were most obvious during June, July, and August where the difference in daily min/max salinity levels was greatest. The greatest daily difference in salinity levels occurred on the 24th of August where a 4.5 ppt difference in the daily max/min salinity level was recorded (Figure 4.2-6). On the 3rd and the 21st of October, as little as a 0.3 ppt difference was recorded in the daily max/min salinity values. Although salinity levels at Pond A3W's discharge structure did fluctuate on a daily basis, these salinity shifts were generally small (Figures 4.2-7 and 4.2-8). After the 24th of September, the effects of tidal cycling on salinity levels of Pond A3W are reduced. Average daily salinity levels recorded this year at the discharge structure of Pond A3W were very similar in value to salinity levels recorded during the 2010 season and ranged from 12.5 to 24.5 ppt. From June to September, monthly salinity averages increased steadily at the discharge structure and a small decrease in monthly salinity level can be seen from September to October. Increasing salinity levels over the 2011 continuous monitoring program may be, in part, due to increasing air temperatures and lack of a precipitation during this same time frame. Besides the 2010 monitoring data recorded at Pond A3W, the 2005 monitoring data was most similar to this year's recorded salinity data (Figures 4.2-9 and 4.2-10).

Figure 4.2-6: Pond A3W Salinity from 16 August – 31 August 2011

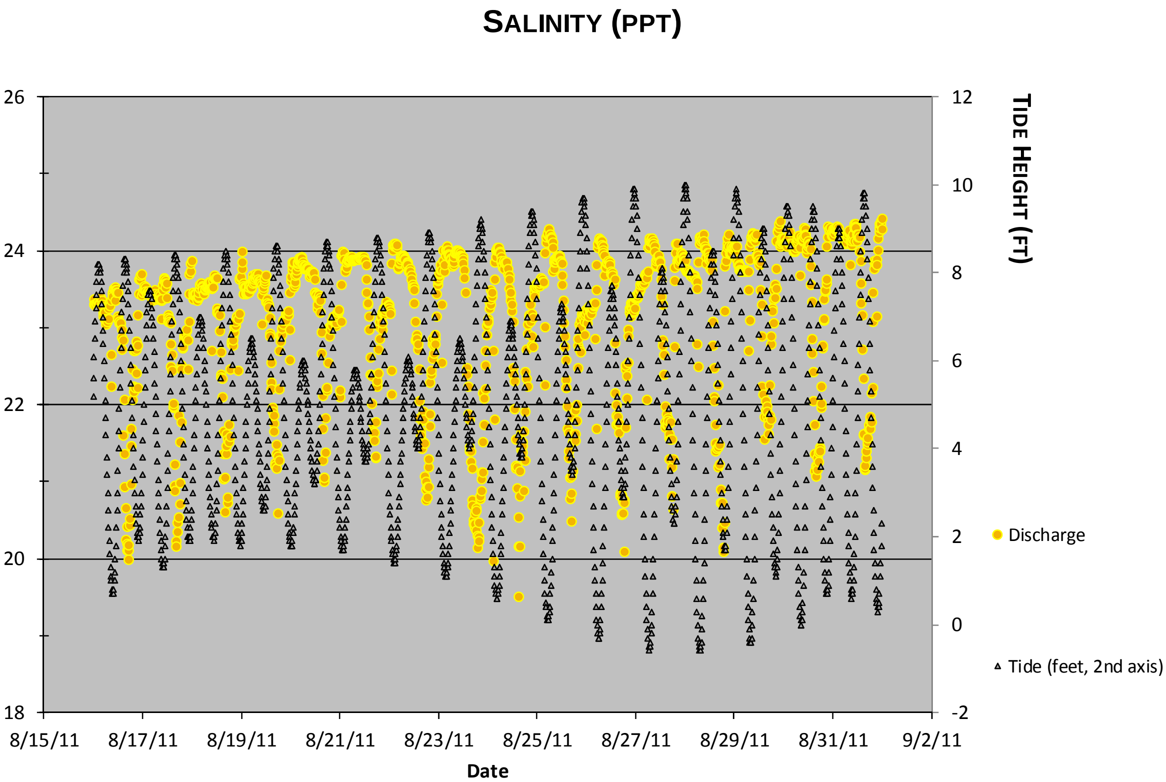


Figure 4.2-7: Pond A3W Salinity from 1 October – 15 October 2011

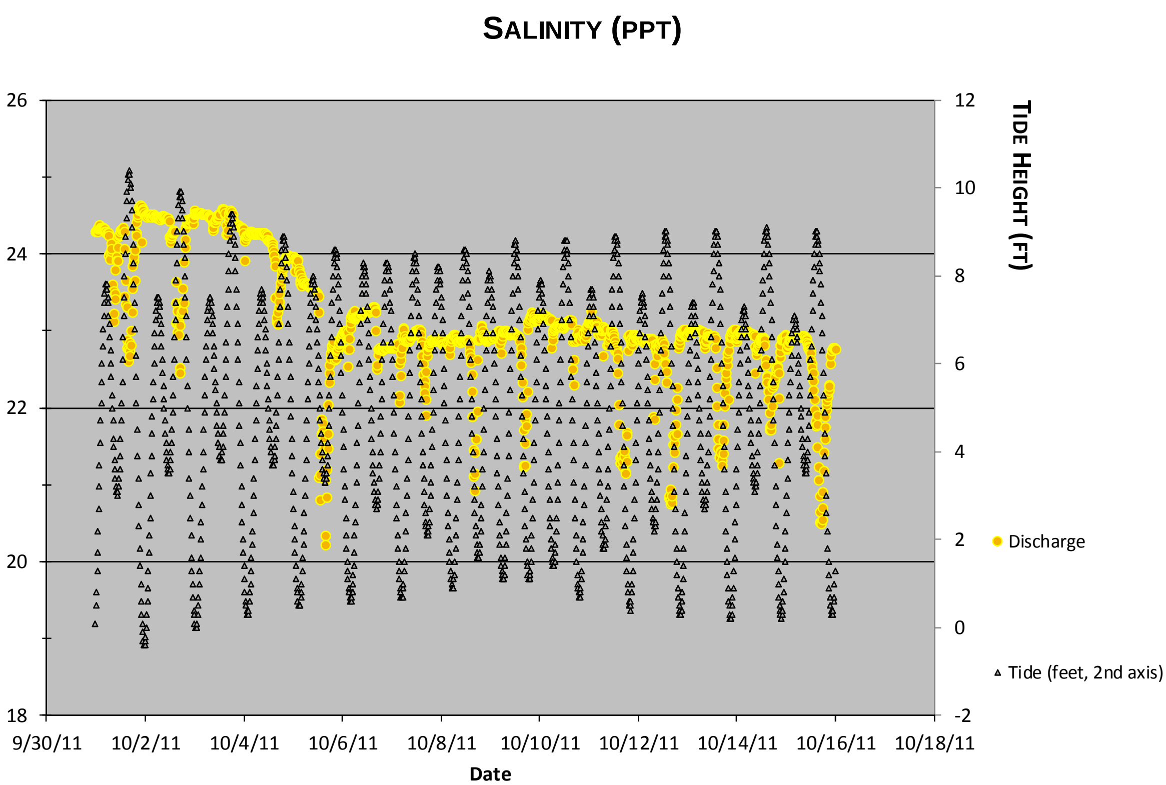


Figure 4.2-8: Pond A3W Salinity from 16 October – 30 October 2011

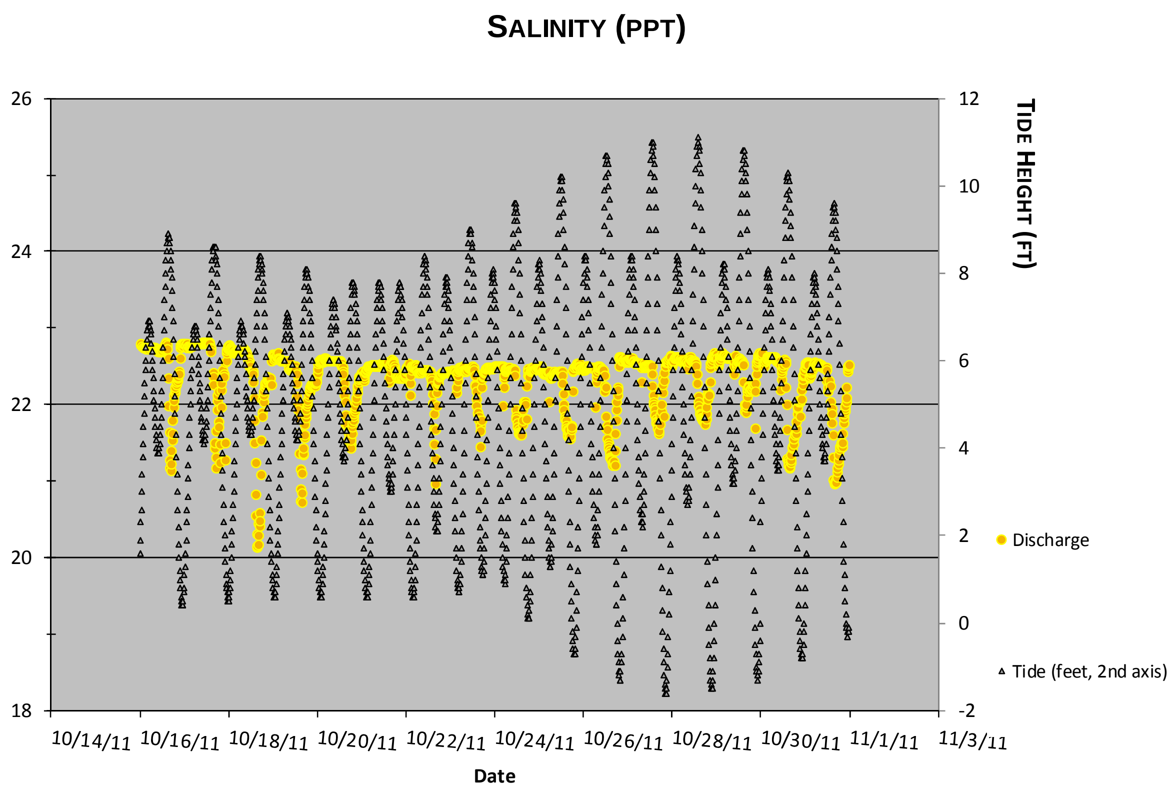


Figure 4.2-9: Pond A3W Daily Mean Salinity 2005 – 2011

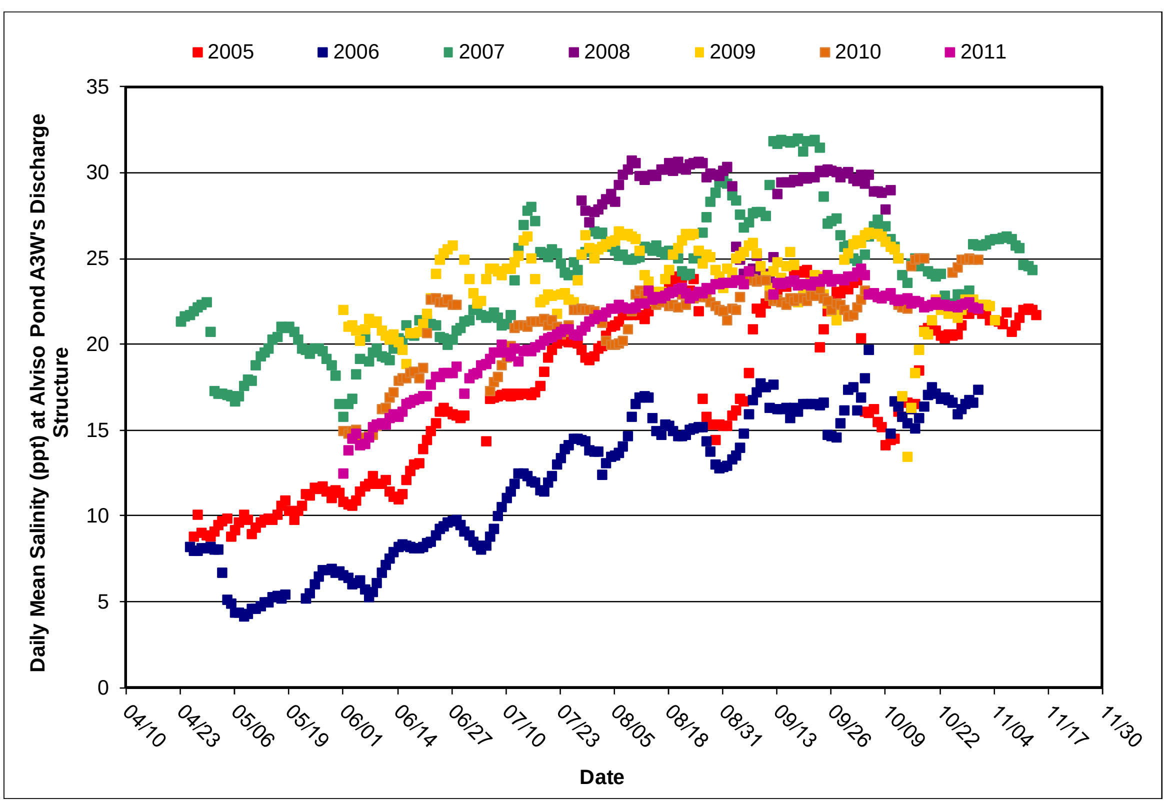
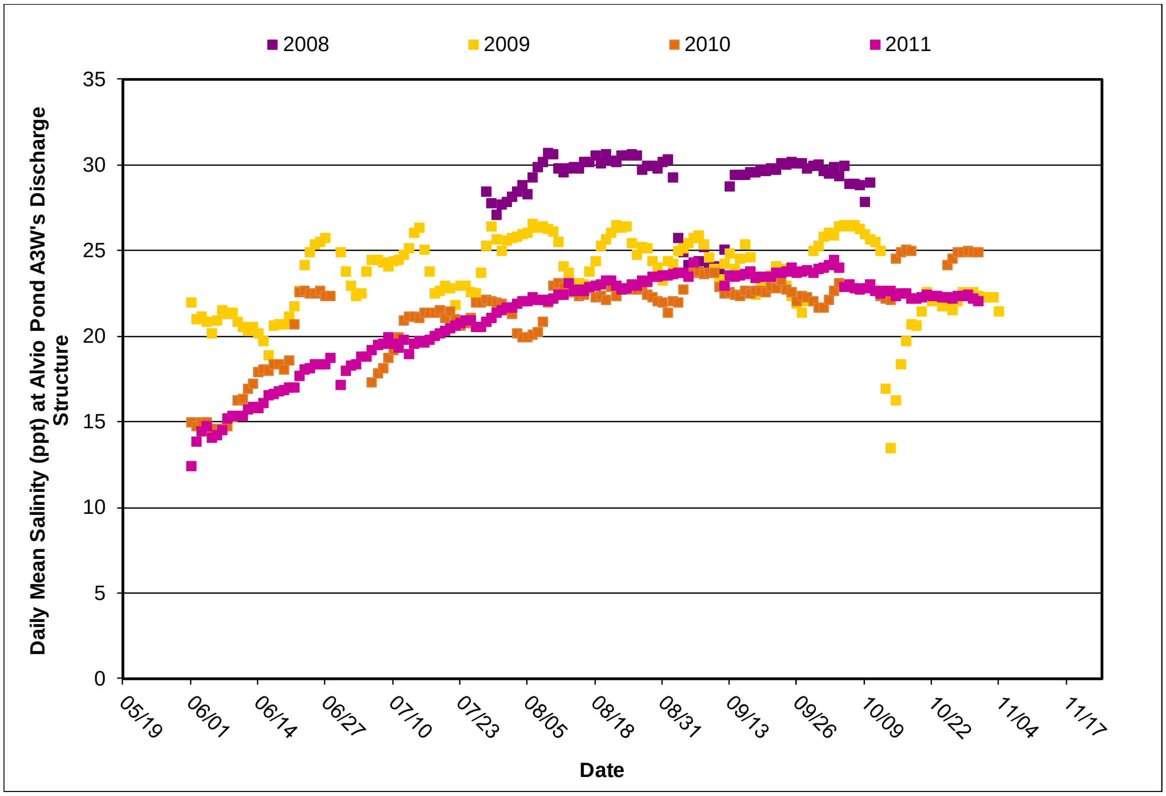


Figure 4.2-10: Pond A3W Daily Mean Salinity 2008 – 2011



Water temperatures recorded at Pond A3W's discharge structure were very similar to temperatures logged in all previous years. As with monthly pH averages of Pond A3W's discharge waters, monthly water temperatures increased from June to July yet decreased from July through October (Figures 4.2-11 and 4.2-12). Water temperatures at Pond A3W ranged from 14.0 degrees Celsius, occurring on the 7th of October, to 29.0 degrees Celsius, which was recorded on the 21rd of June. Temperature fluctuations at the discharge structure of Pond A3W may be, at least partially, due to the effects of diurnal and tidal cycling. As expected, daily minimum temperatures were recorded during morning hours whereas daily high values were recorded late afternoon to early evening. Daily mean temperatures were compared from 2005 through 2011 (Figures 4.2-13 and 4.2-14).

Figure 4.2-11: Pond A3W Temperature from 16 June – 30 June 2011

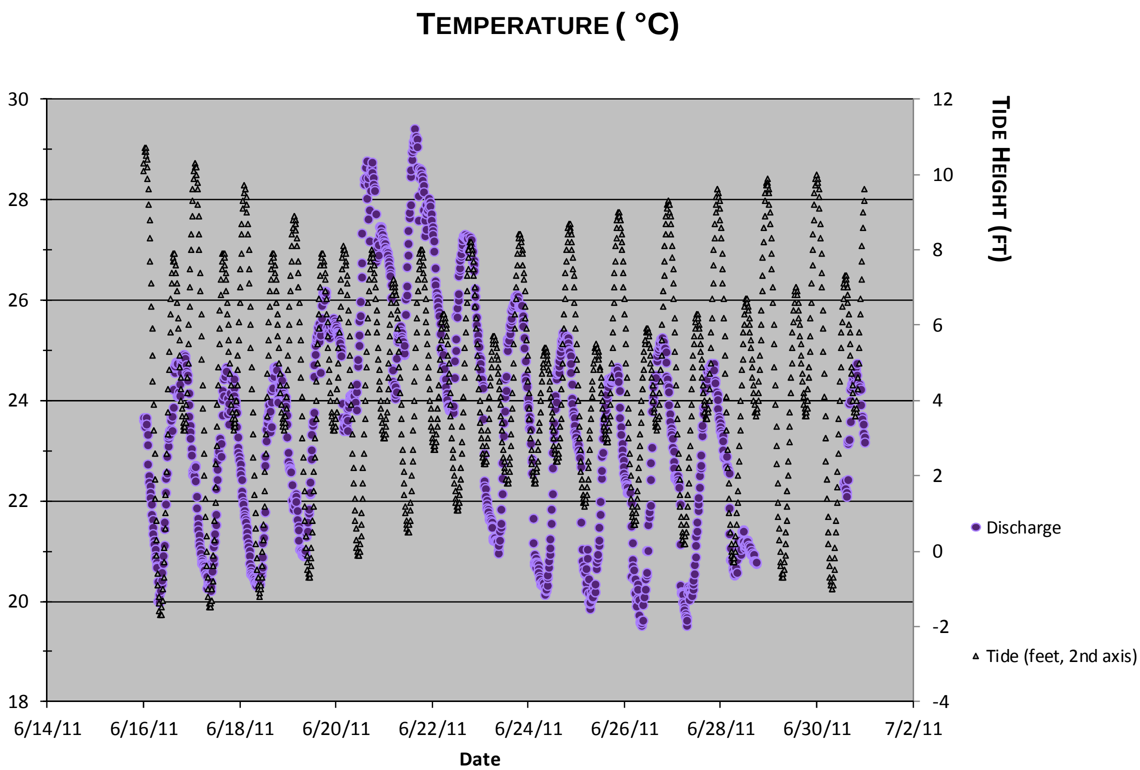


Figure 4.2-12: Pond A3W Temperature from 1 October – 15 October 2011

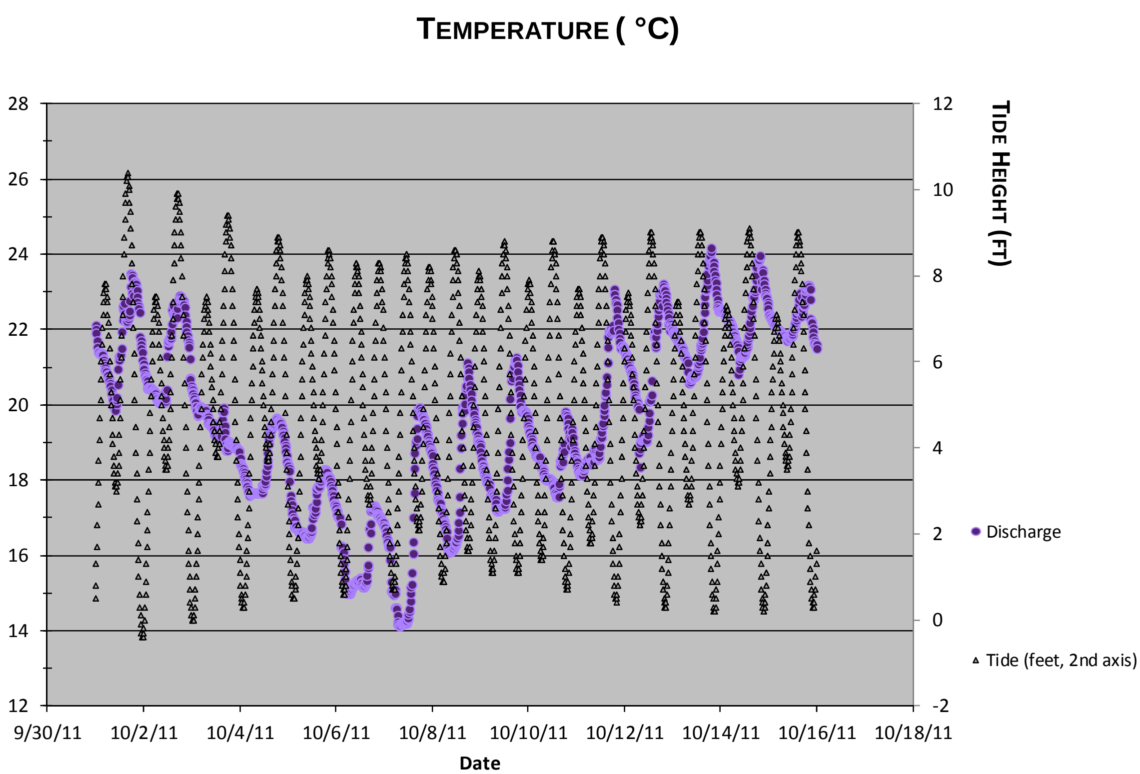


Figure 4.2-13: Pond A3W Daily Mean Temperature from 2005 – 2011

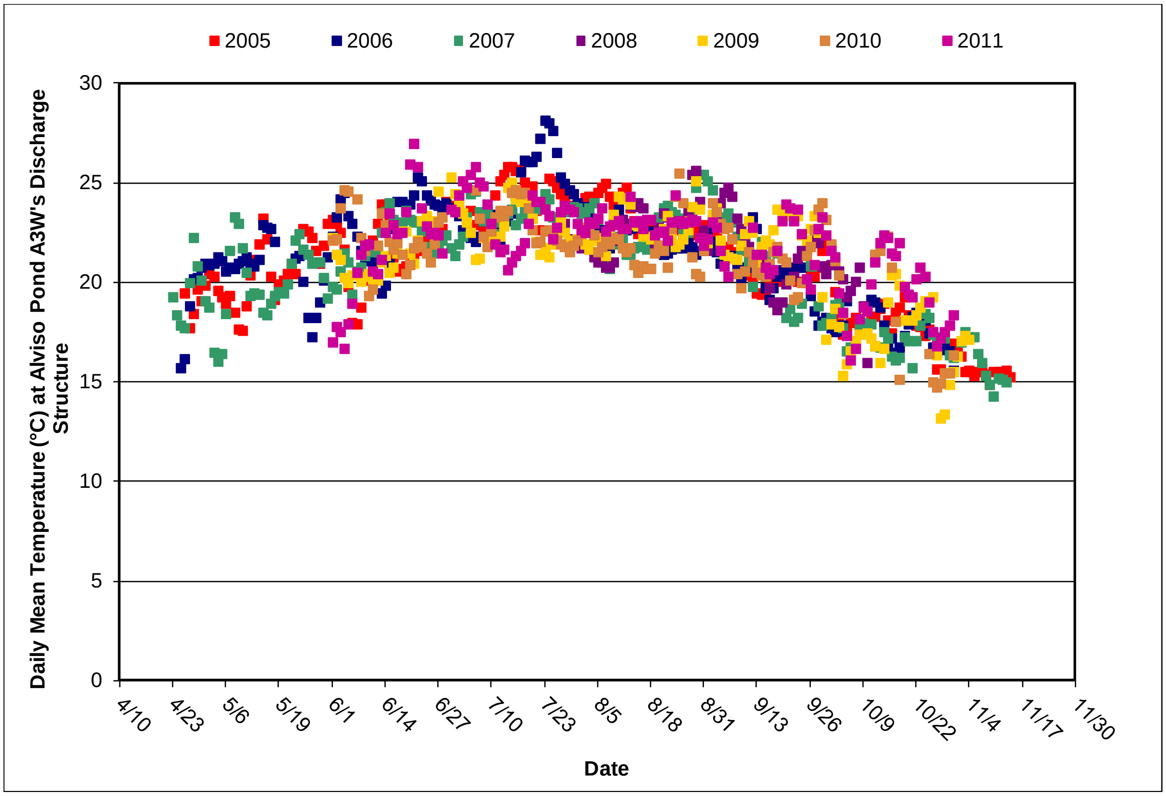
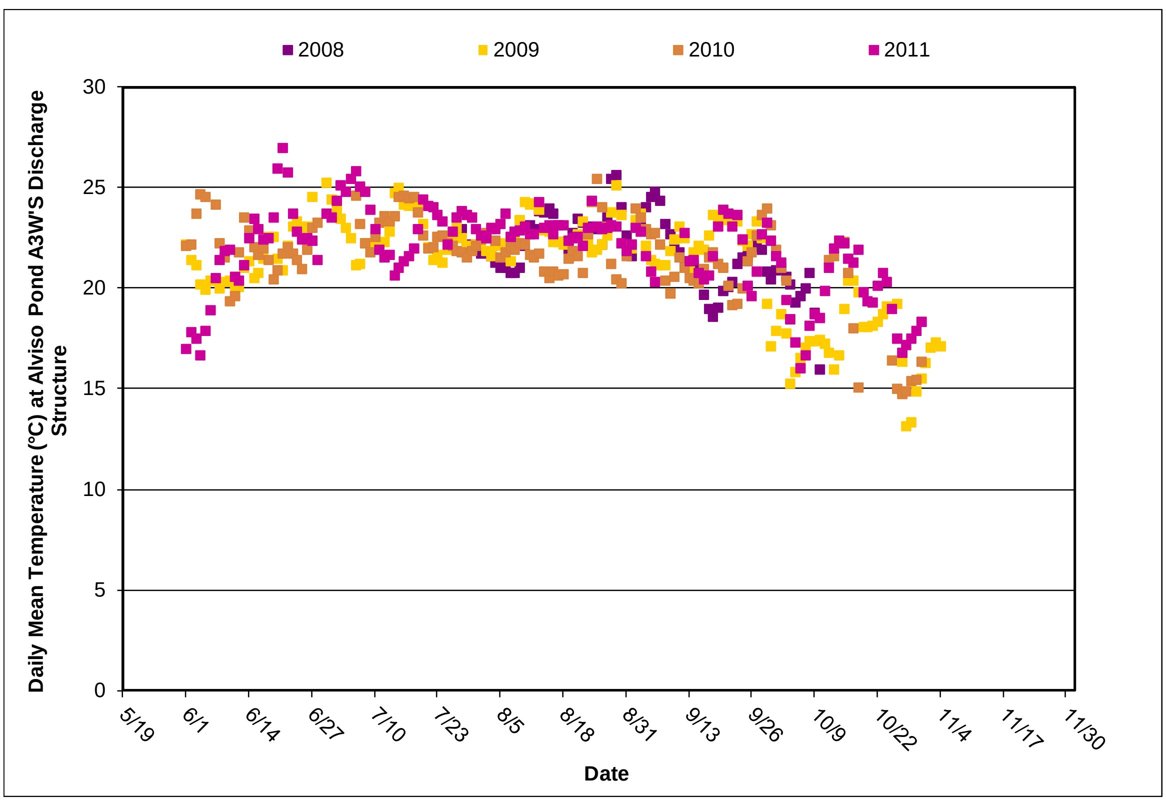


Figure 4.2-14: Pond A3W Daily Mean Temperature 2008 – 2011



Throughout the study period, from 1 June to 31 October 2011, dissolved oxygen (DO) concentrations had a strong cyclical pattern at the discharge location of pond A3W, likely following both diurnal and tidal cycles (Figures 4.2-15 through 4.2-18). From the start of the 2011 monitoring season, DO concentrations began to fall below the threshold of 3.33 mg/L and continued to fall below, or hover around, this threshold on an almost-daily basis. Generally, these very low DO levels occur during early morning hours when Photosynthetically Active Radiation (otherwise known as PAR) levels are either very low or non-existent. Although DO level increased once PAR levels begin to decline, this continued increase is most likely due to a lag in time the photosynthetic process. DO concentrations logged at Pond A3W fluctuated daily and on the 10th of June there was roughly a fourteen-point difference in daily min/max values, the largest difference recorded during the 2011 season. By comparison, on the 31st of October, there was only a four-point difference in daily min/max values for DO.

Figure 4.2-15: Pond A3W DO from 1 June – 15 June 2011

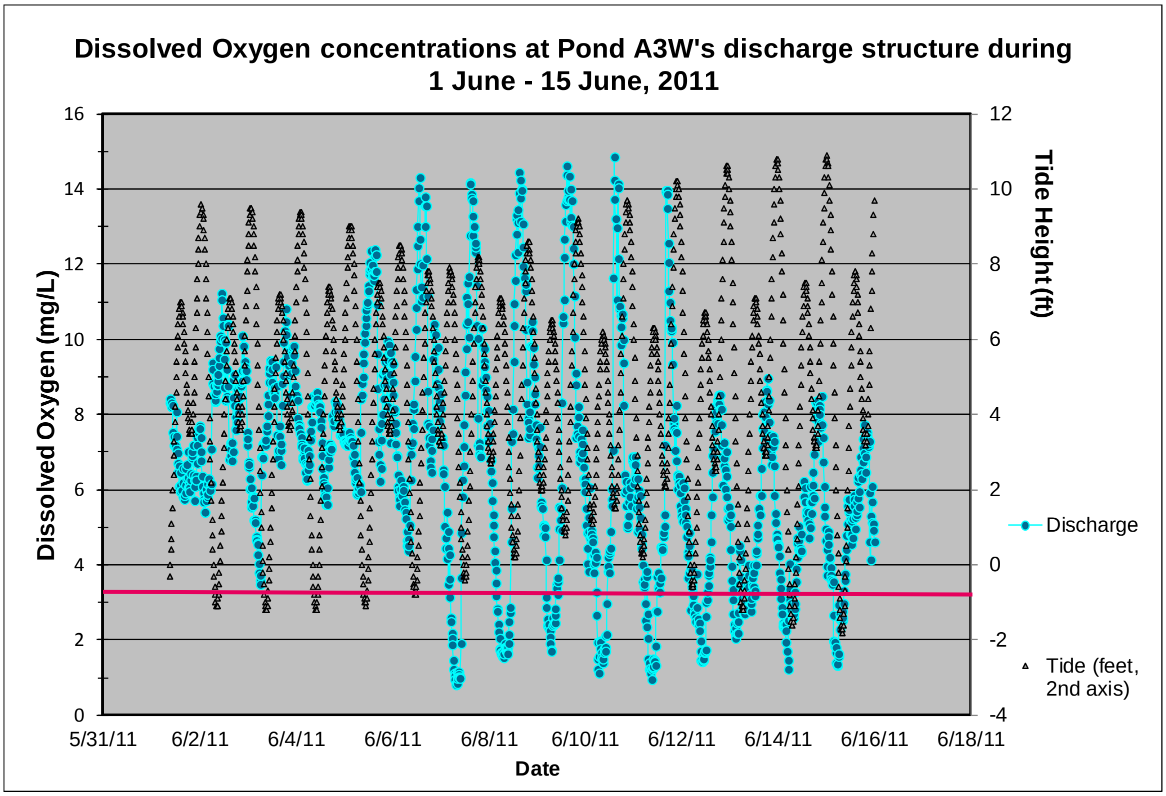


Figure 4.2-16: Pond A3W DO from 16 October – 31 October 2011

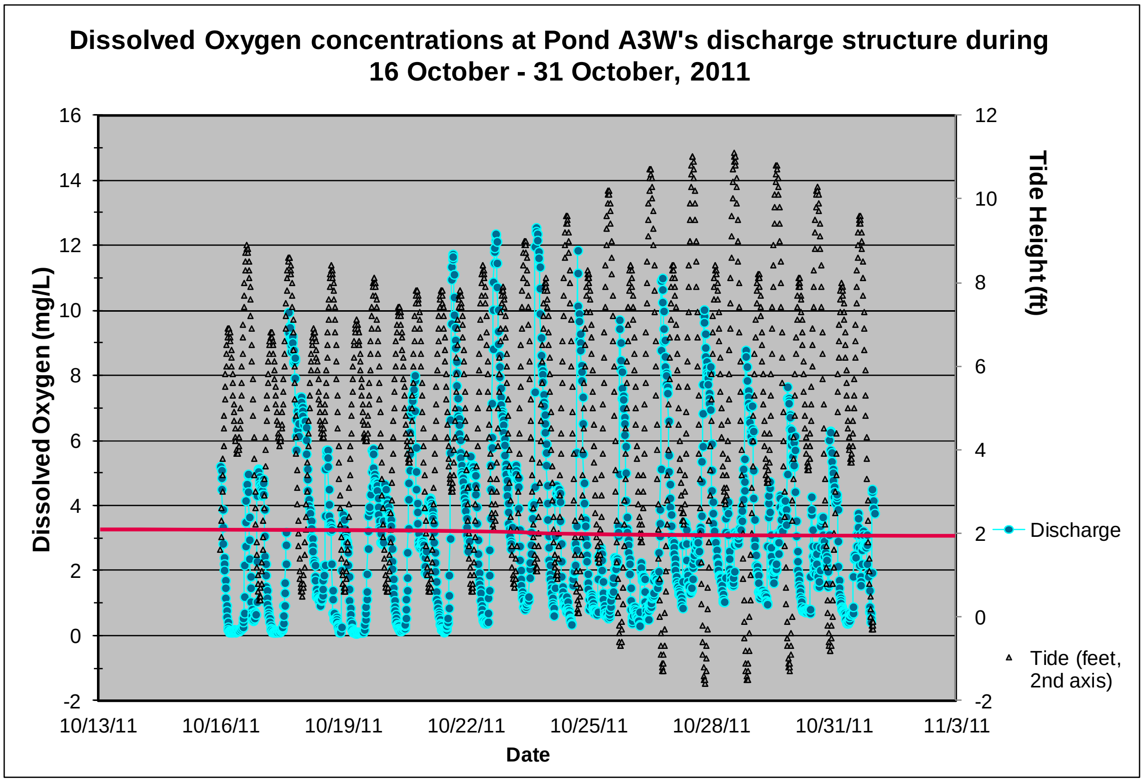


Figure 4.2-17: Pond A3W Daily Mean DO 2005 – 2011

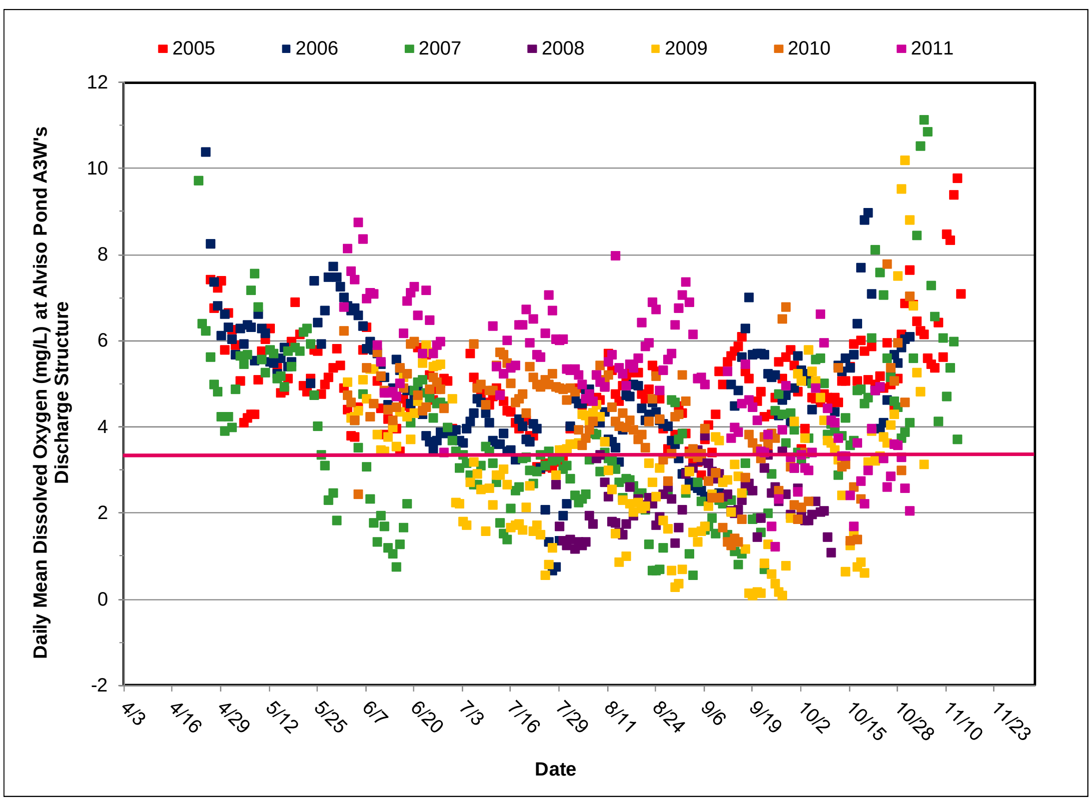
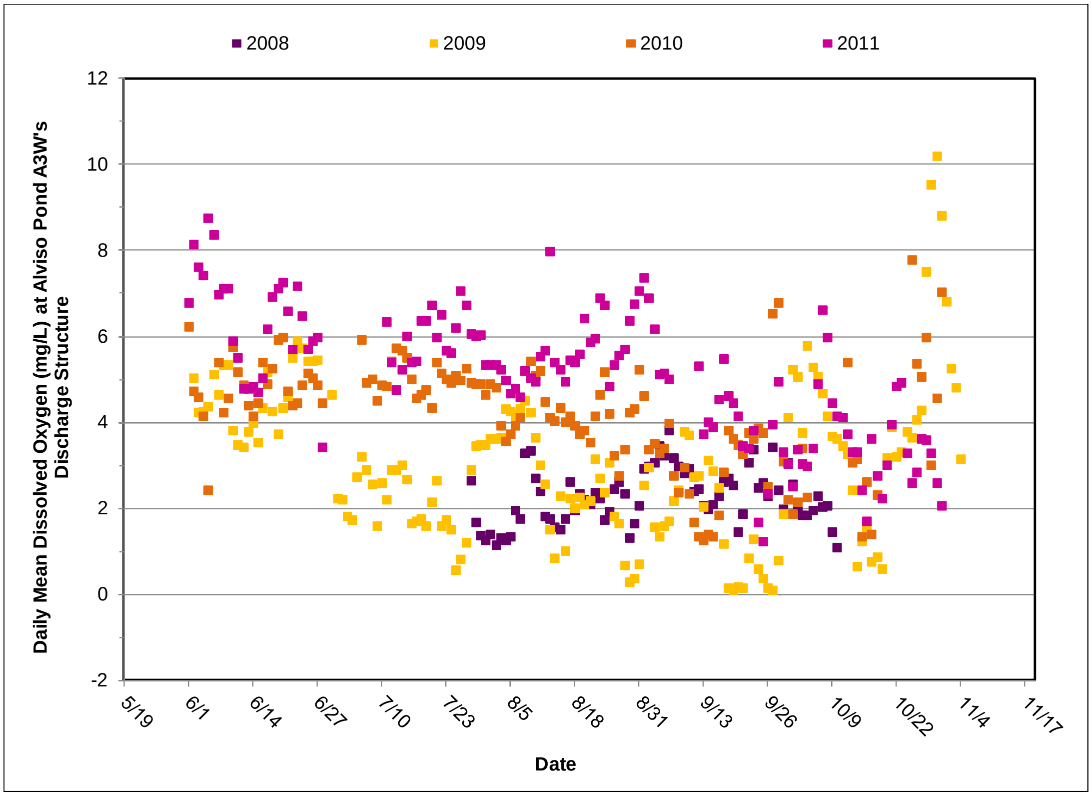


Figure 4.2-18: Pond A3W Daily Mean DO 2008 – 2011



Monthly averages for DO concentrations at the discharge structure of Pond A3W declined steadily from June (monthly average of 6.4 mg/L) through October (monthly average of 3.5 mg/L). Although DO levels within Pond A3W declined over the monitoring period, no monthly average fell below the 3.33 mg/L threshold. However, over the five-month long monitoring program, the DO concentration at Pond A3W's discharge structure fell below this threshold almost daily. There were also eleven days where the DO concentrations recorded at the discharge structure fell below 0.50 mg/L. Most of these extremely low DO events occurred during the last five weeks of the monitoring program. The one exception being on the 22nd of June at 5:45 am, when the DO level recorded was 0.30 mg/L (Figure 4.2-19). Prior to the DO crash starting on the 24th of September, the DO concentration at Pond A3W's discharge structure spiked to a high of 12.78 mg/L early in the evening of the 23rd, which was a concentration more than 3.0 mg/L higher than had been recorded during the previous seven days (Figures 4.2-20 through 4.2-22).

Figure 4.2-19: Pond A3W DO from 16 June – 30 June 2011

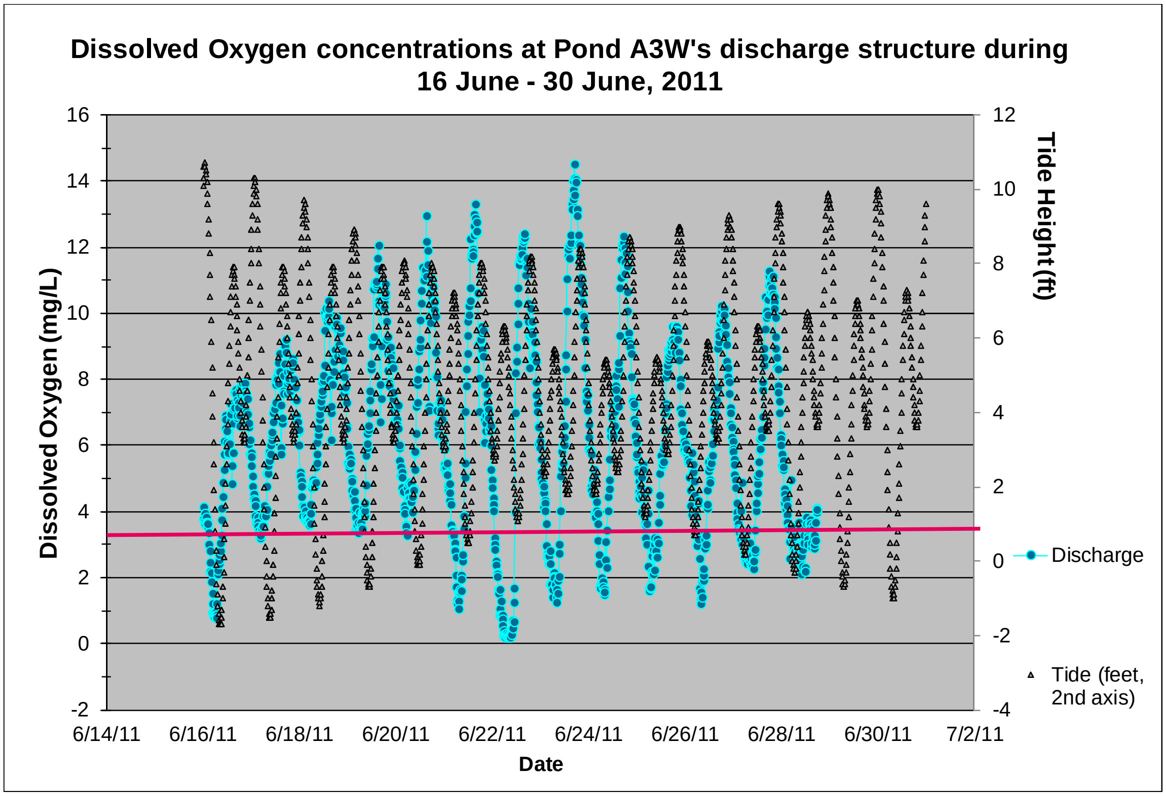


Figure 4.2-20: Pond A3W DO from 16 September – 30 September 2011

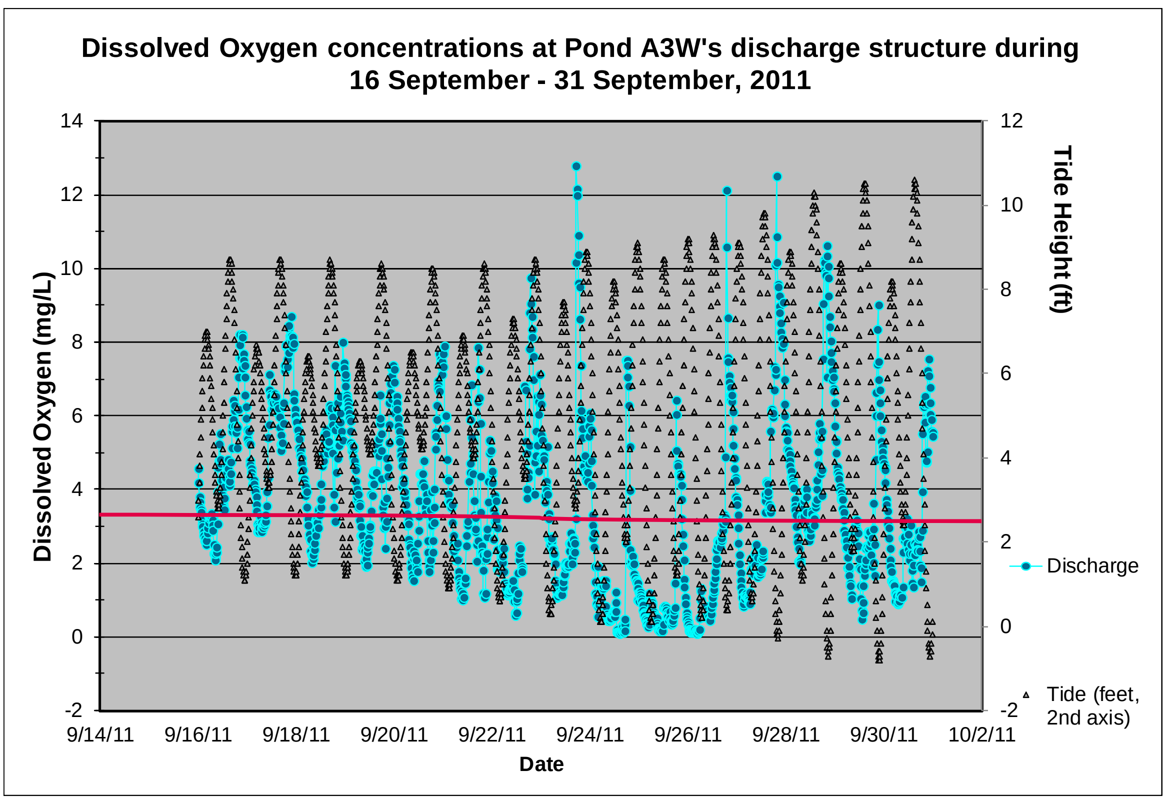


Figure 4.2-21: Pond A3W DO from 1 October – 15 October 2011

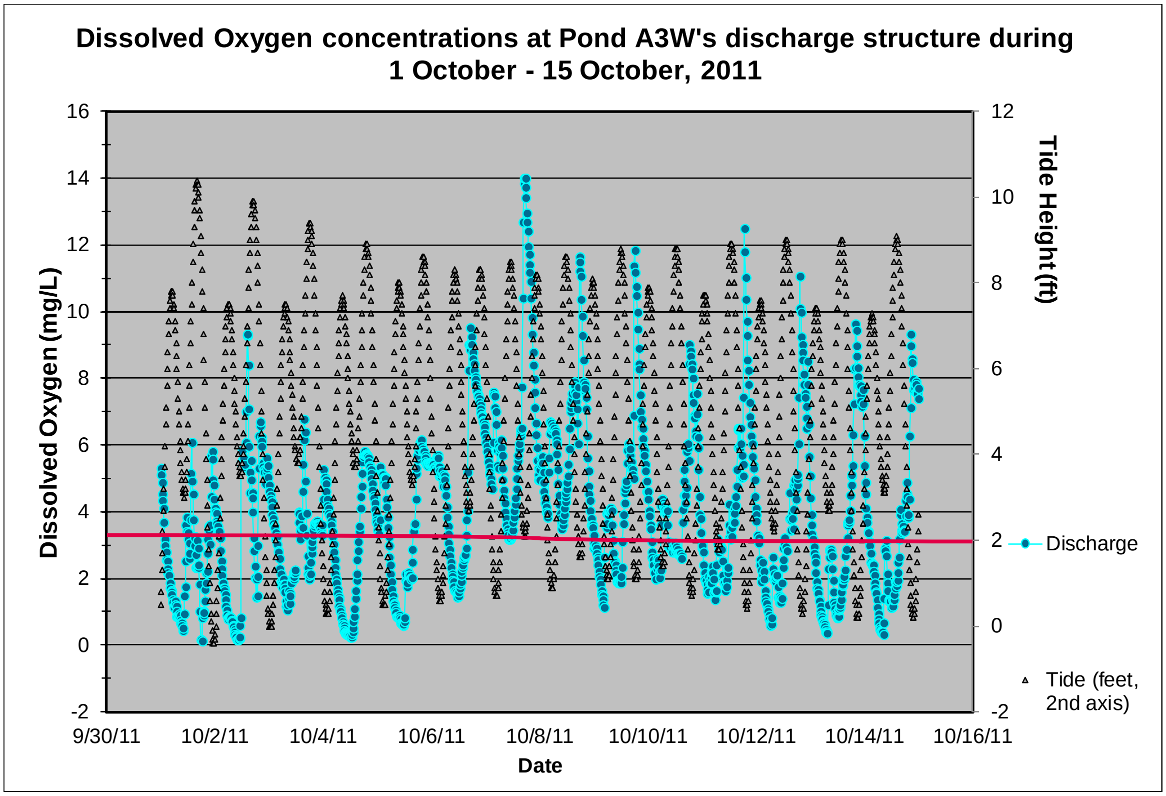
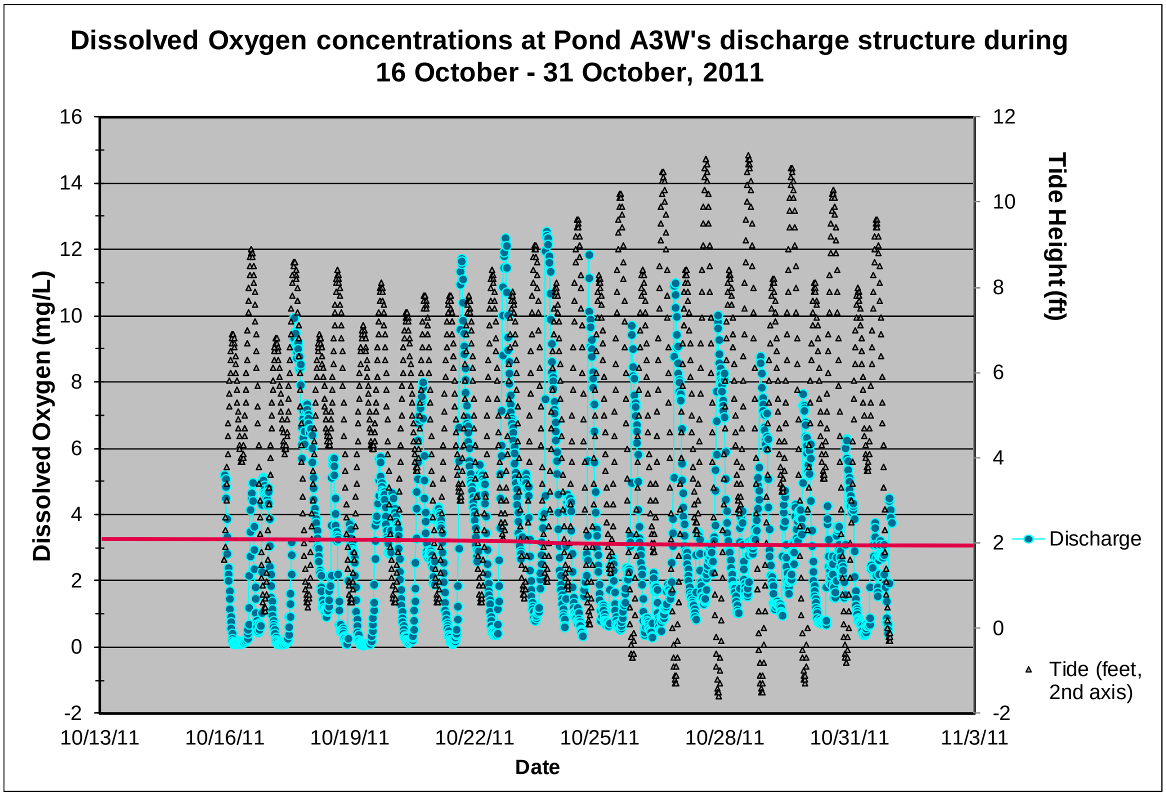


Figure 4.2-22: Pond A3W DO from 16 October – 31 October 2011



In contrast with monthly averages, daily mean DO concentrations of discharge waters at Pond A3W generally decreased throughout the five-month period (Figures 4.2-23 and 4.2-24). These DO levels ranged from a low of 1.23 mg/L, logged on the 25th of September, to a high of 8.75 mg/L, recorded on the 5th of June. DO concentrations remained above the 3.33 mg/L threshold until late September, when daily mean DO levels began to fluctuate around this concentration until the end of the 2011 monitoring program. DO levels recorded this season appear to be slightly elevated from those recorded in 2010. When comparing average daily DO concentrations at Pond A3W's discharge structure, the daily average DO values this year were slightly higher in value than those recorded in all other years, until early September. Starting in September, DO levels from 2011 were most similar to concentrations recorded in 2007, 2009, and 2010. On August 13th, the DO concentrations logged at Pond A3W's discharge structure spiked to a daily average of 8.00 mg/L, more than 2.6 mg/L higher than the previous or following day. Although a shift in only 2.6 mg/L is not a large amount, it is close to 4.5 times higher than the average daily difference in DO concentrations recorded at Pond A3W's discharge structure. In fact, over the past four years, the average difference in daily mean DO concentrations amounted to only a 0.56 mg/L shift in daily averages. There were also a few instances in 2010 where the daily shift in DO concentrations was even greater than 2.6 mg/L. For example, between the 28th and 29th of September the DO concentration at Pond A3W's discharge structure dropped by 3.7 mg/L over the course of one day.

Figure 4.2-23: Pond A3W Daily Mean DO 2005 – 2011

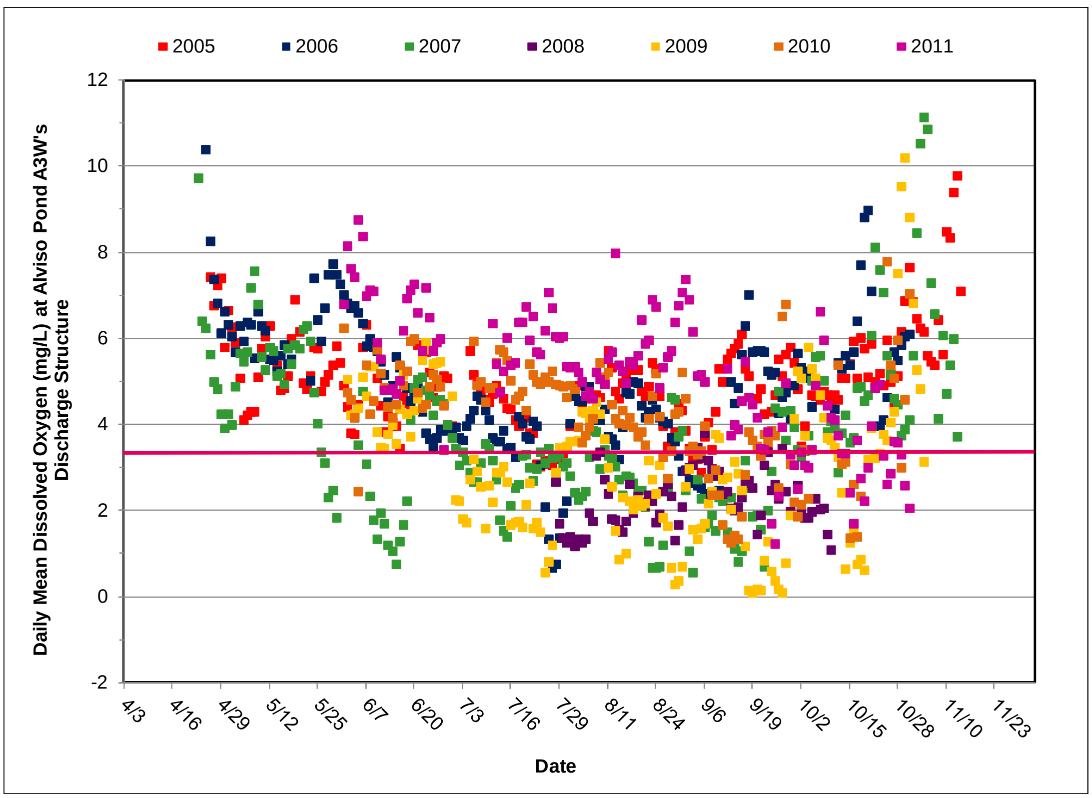
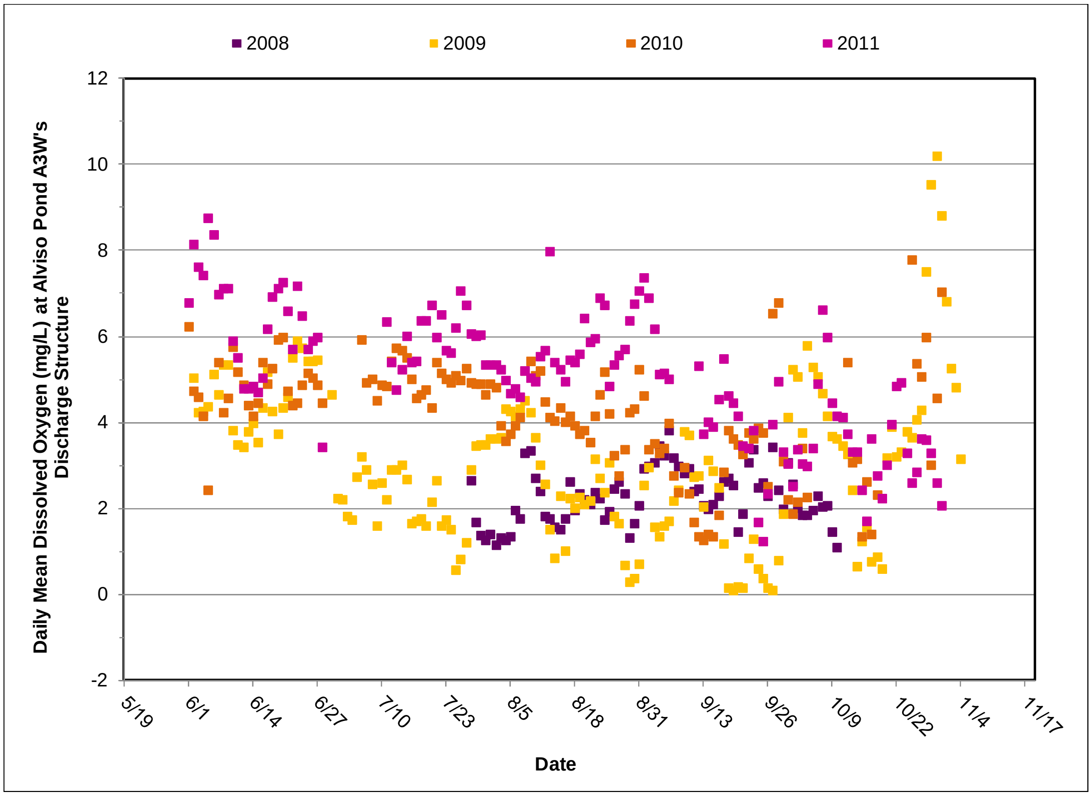


Figure 4.2-24: Pond A3W Daily Mean DO 2008 – 2011



Weekly tenth-percentile values for the 2011 season were similar to those recorded in 2010. Over the past few monitoring seasons, these weekly tenth-percentile values decreased over the length of the monitoring program. However, less of these weekly tenth-percentile values for Pond A3W fell below the 3.33 mg/L threshold than in the previous few years. During the 2010 monitoring program, these weekly tenth-percentile values fell and remained below the 3.33 mg/L threshold after mid-August. Conversely, weekly tenth-percentile values calculated from Pond A3W's continuous monitoring program for the 2011 season show more of these tenth-percentile values above the 3.33 mg/L threshold late in the season than in the past several years (Figures 4.2-25 and 4.2-26). Table 4.2-1 identifies the Pond A3W summarized water quality values by month for 2011.

Figure 4.2-25: Pond A3W Weekly 10th Percentile for DO 2005 – 2011

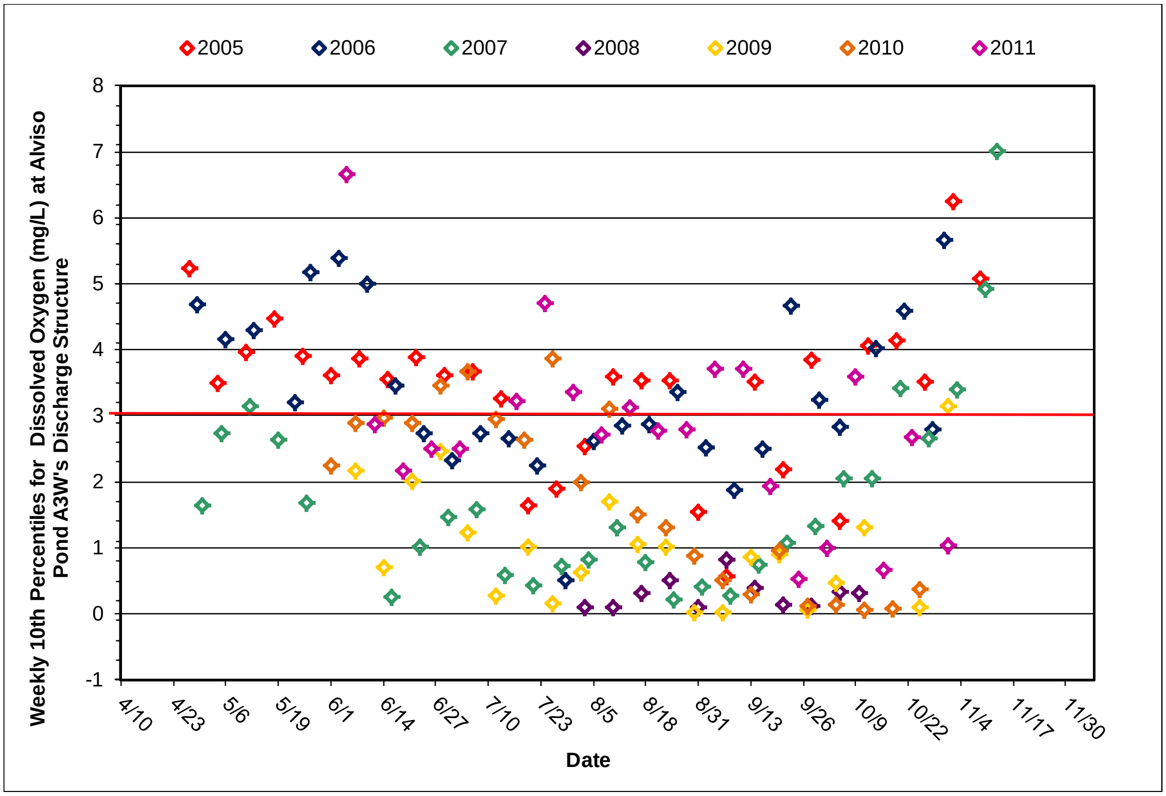


Figure 4.2-26: Pond A3W Weekly 10th Percentile for DO 2008 – 2011

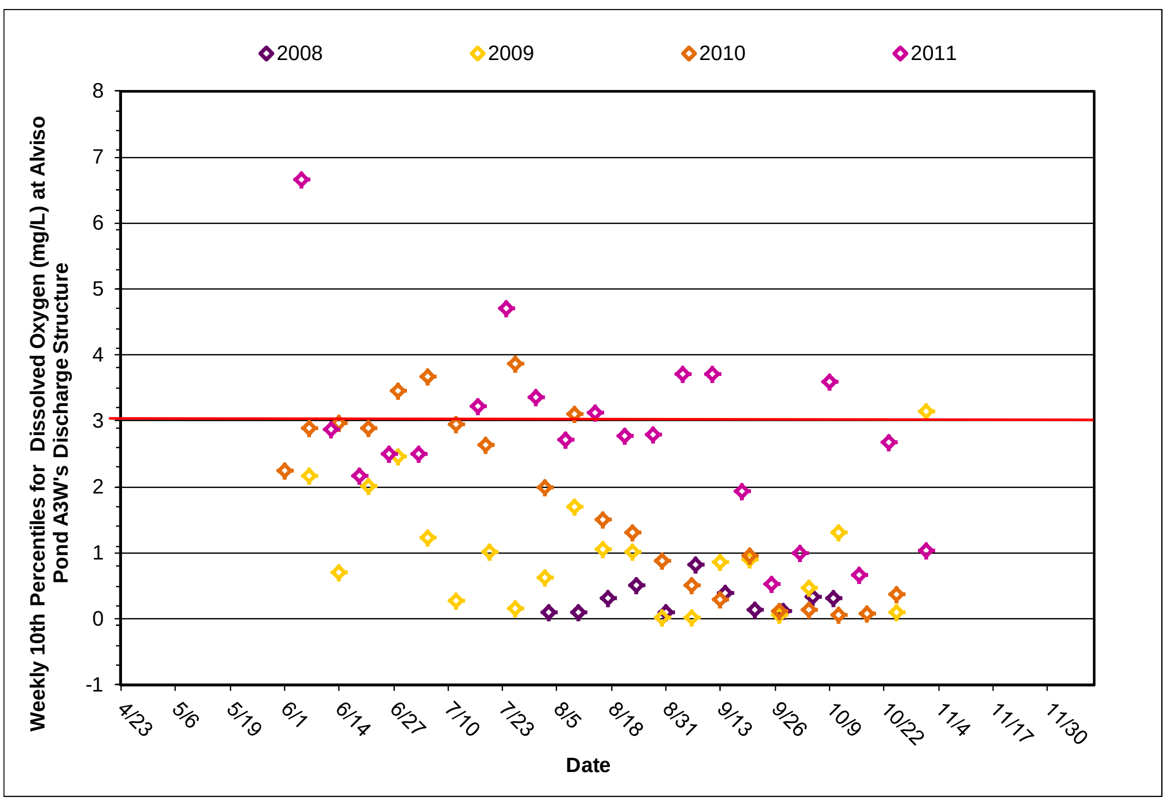


Table 4.2-1: Pond A3W Summarized Water Quality Values (Mean ± Standard Deviation) By Month

Pond	Month	Dissolved Oxygen (mg/L)	pH (Units)	Temperature (°C)	Salinity (ppt)
A3W	**June**	6.40 ± 3.1	9.30 ± 0.4	21.70 ± 3.0	16.20 ± 1.7
	July	6.00 ± 2.0	9.40 ± 0.3	23.30 ± 2.0	20.00 ± 1.2
	August	5.60 ± 2.2	9.20 ± 0.2	23.00 ± 1.5	22.70 ± 1.0
	September	4.30 ± 2.4	8.70 ± 0.3	22.00 ± 1.8	23.70 ± 0.8
	October	3.50 ± 2.6	8.30 ± 0.1	19.40 ± 2.1	22.70 ± 0.8

4.2.2 Pond A8 Discharge Samples

Data collected at the newly constructed discharge notch in Pond A8 was compared to water quality data collected in previous years (2005-2009) during the same time frame. Data collected prior to the 2011 season was recorded at Pond A7's discharge structure. As this was this first year of monitoring at the newly designed notch in Pond A8, the yearly comparisons will be between Pond A7 and A8 (Figure 4.2-27).

Figure 4.2-27: Datasonde Location in Pond A8 during 2011

Daily averages for salinity at Pond A8's discharge notch were most similar to salinity levels recorded at Pond A7 in 2006 (Figure 2.4-28). In 2006, daily salinity averages at Pond A7's discharge structure ranged from 6.0 to nearly 20.0 ppt. During the 2011 season, average daily salinity ranged from 7.0 to 14.0 ppt. Although data recorded this year was most similar to salinity levels recorded at Pond A7 during the 2006 season, the 2006 season began in late-April and monitoring at this location ended on the 12th of June. From June to September of 2011, salinity concentrations decreased steadily at the discharge structure then increased from September to October (Figures 4.2-29 and 4.2-30). In comparison, between the monitoring years of 2007-2009, salinity levels at Pond A7 increased until mid-September then decreased through October. Influences of tidal cycling can be seen on salinity levels recorded at Pond A8's discharge notch. On the 29th of September, there was a 13 ppt difference in daily salinity min/max concentrations with a daily high of 17.4 ppt and a daily low of 4.4 ppt. In contrast, on the 10th of October there was only 3.5 ppt difference between the daily high, of 11.0 ppt, to a low of 7.4 ppt.

Figure 4.2-28: Pond A7/A8 Salinity from 2005 - 2011

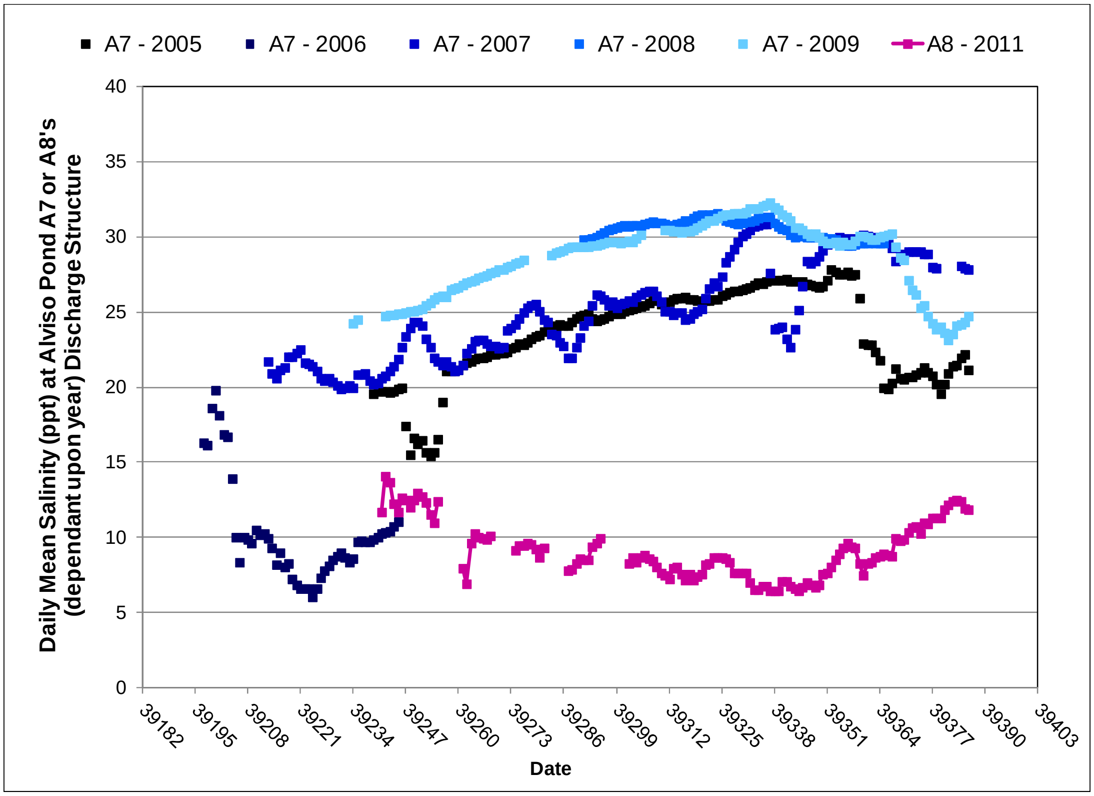


Figure 4.2-29: Pond A8 Salinity from 16 Sept – 30 Sept 2011

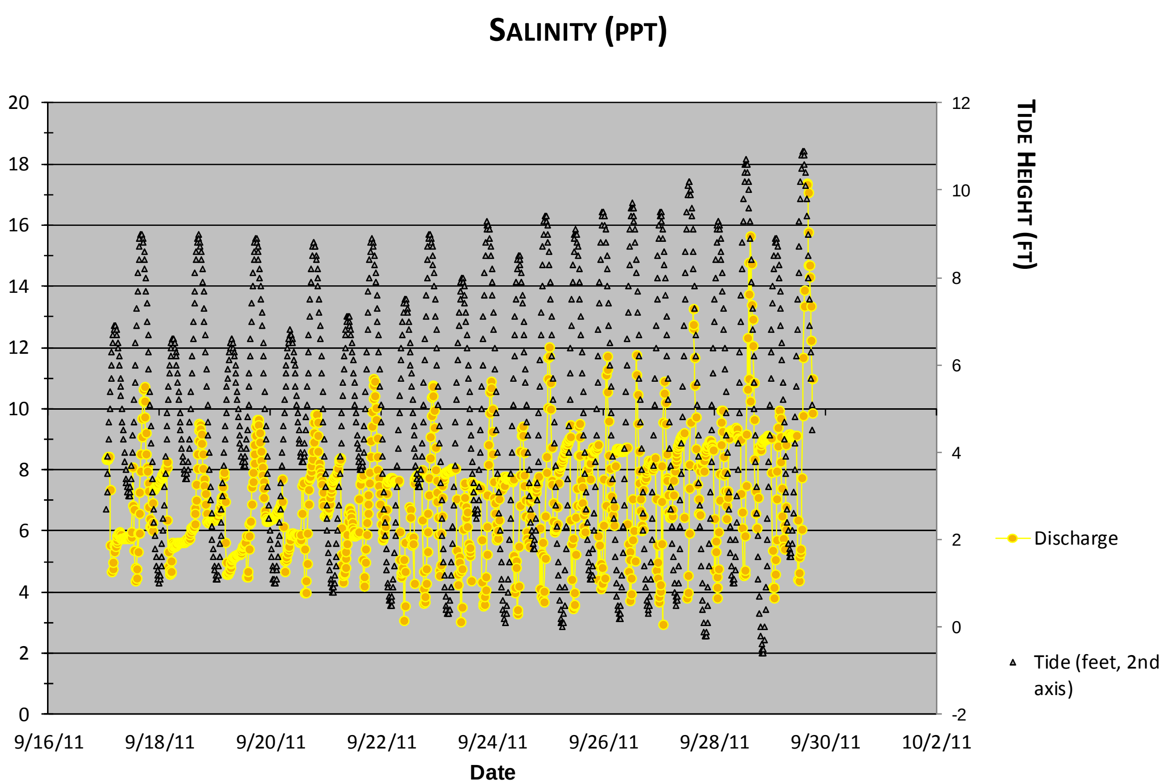
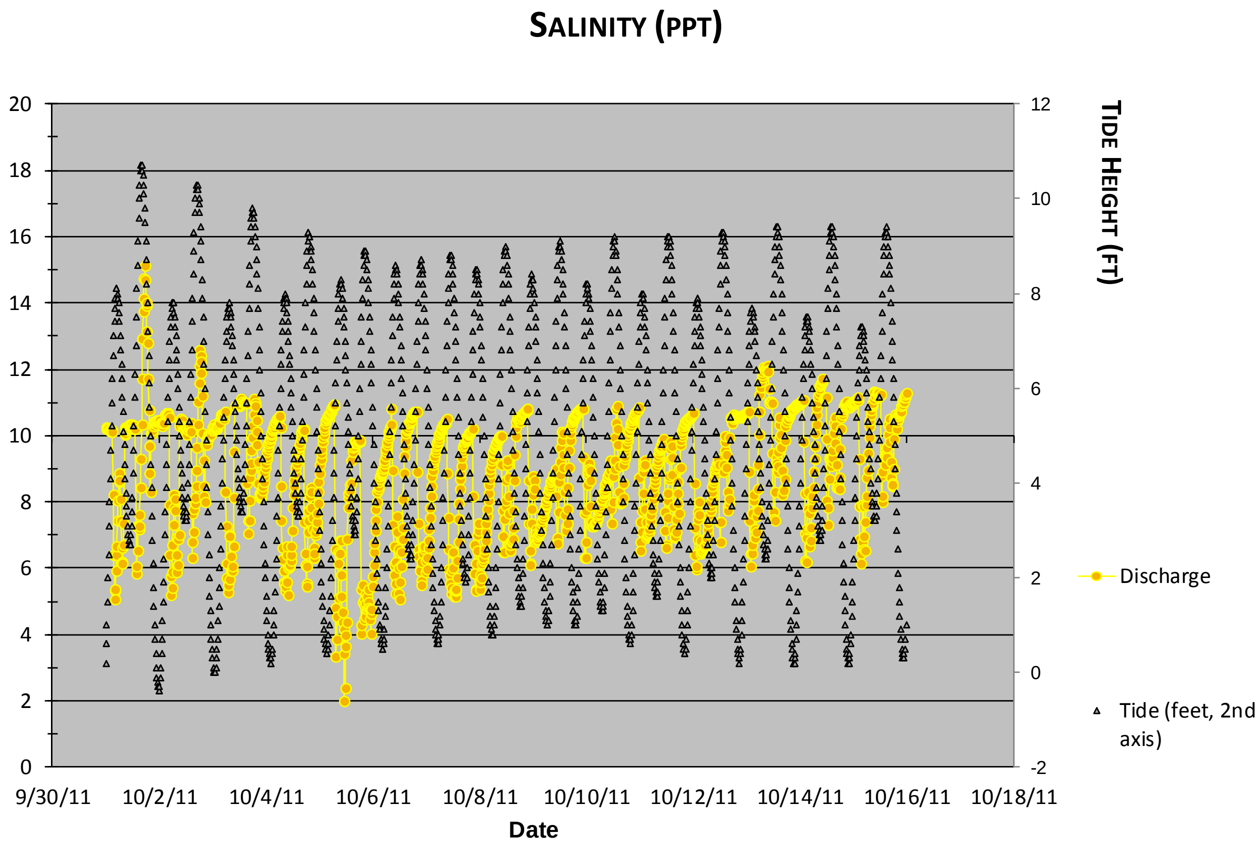


Figure 4.2-30: Pond A8 Salinity from 1 October – 15 October 2011



Tidal cycling also seemed to have an effect on pH concentrations within Pond A8 although daily min/max values for pH concentrations differed by no more than 0.5 to 1.0 units. Data logged at Pond A8's discharge structure show daily pH averages ranging from 8.0 - 9.0 units during the 2011 monitoring season (Figure 4.2-31). Within the first few weeks of the 2011 season, pH levels logged at Pond A8 oscillated around 8.5 units but soon increased to a high of 9.5 units, recorded on the 26th of July (Figure 4.2-32). This elevated pH concentration at Pond A8's discharge notch was short-lived and pH levels decreased after this date until late-September, when pH concentrations once again began to increase. Comparing data collected this year at Pond A8, pH concentrations were most similar to data collected at Pond A7 during 2008 and 2009. As seen this year at Pond A8, pH levels recorded at Pond A7 during 2008 and 2009 decline steadily until late in the monitoring season. Around October, pH concentrations increase slightly at Pond A7 during both years.

Figure 4.2-31: Pond A7/A8 pH from 2005-2011

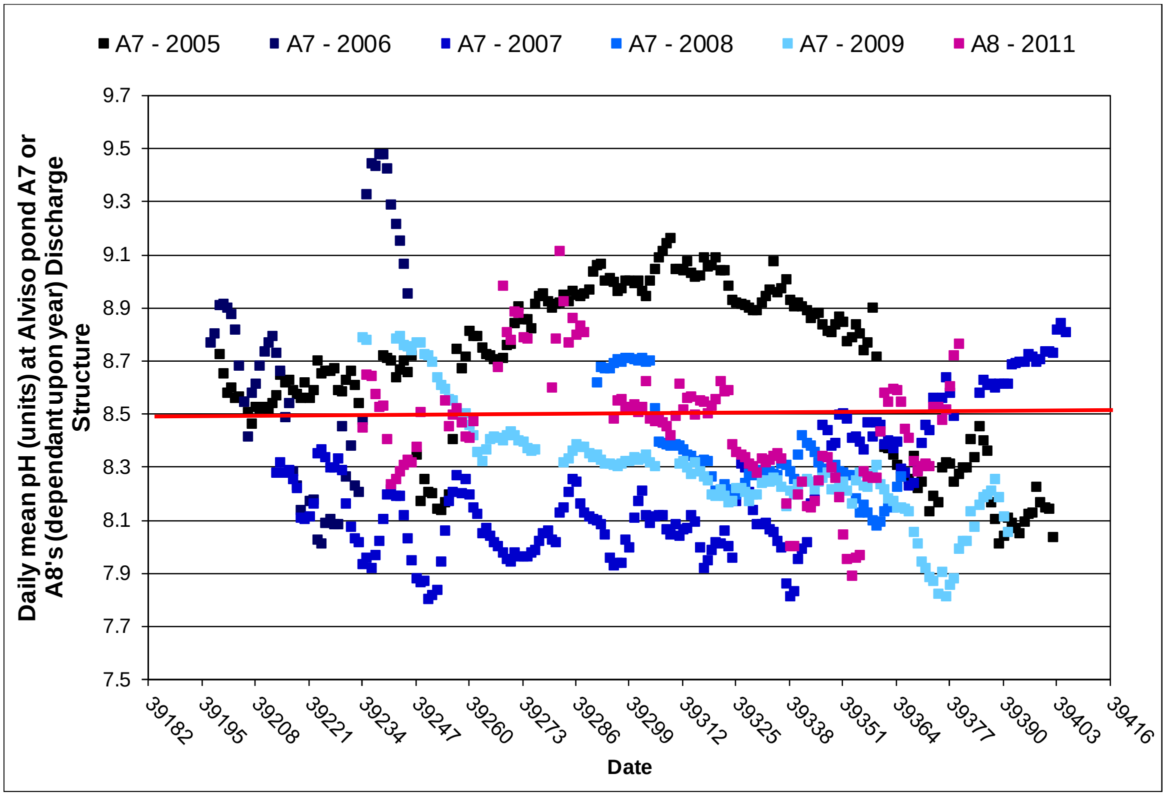
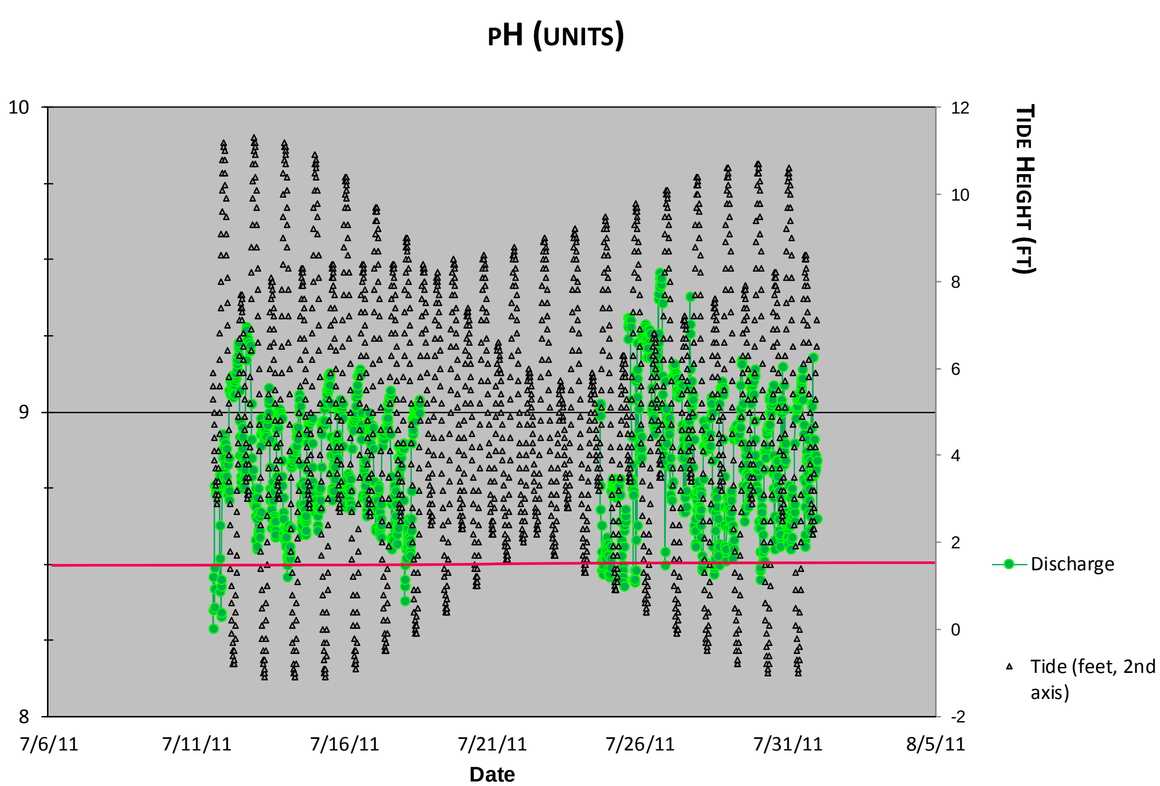


Figure 4.2-32: Pond A7/A8 pH from 11 July – 31 July 2011



Temperatures recorded at Pond A8's discharge notch during the 2011 monitoring program were similar to all other monitoring years but most closely mirror water temperatures logged at Pond A7's discharge structure during the 2009 season (Figure 4.2-33). For both years, water temperatures logged at both locations during June, the first month of monitoring, ranged between 19.0 – 26.0 degrees Celsius. This range in temperature values occurring in June is nearly identical to the overall range in water temperature values (18.0 – 26.0 degrees Celsius) recorded during the 2011 season (Figure 2.4-34). Diurnal and tidal cycling both appear to have an influence on water temperatures logged at Pond A8 during the 2011 season. As expected, the majority of daily low temperatures were recorded during early morning hours. The smallest range in daily temperature values, at a mere 1.14 degree Celsius difference, occurred on the 11th of October while the largest range in daily temperatures, at an almost 7.70 degree Celsius difference, was recorded on the 20th of June (Figure 4.2-35).

Figure 4.2-33: Pond A7/A8 Temperature from 2005-2011

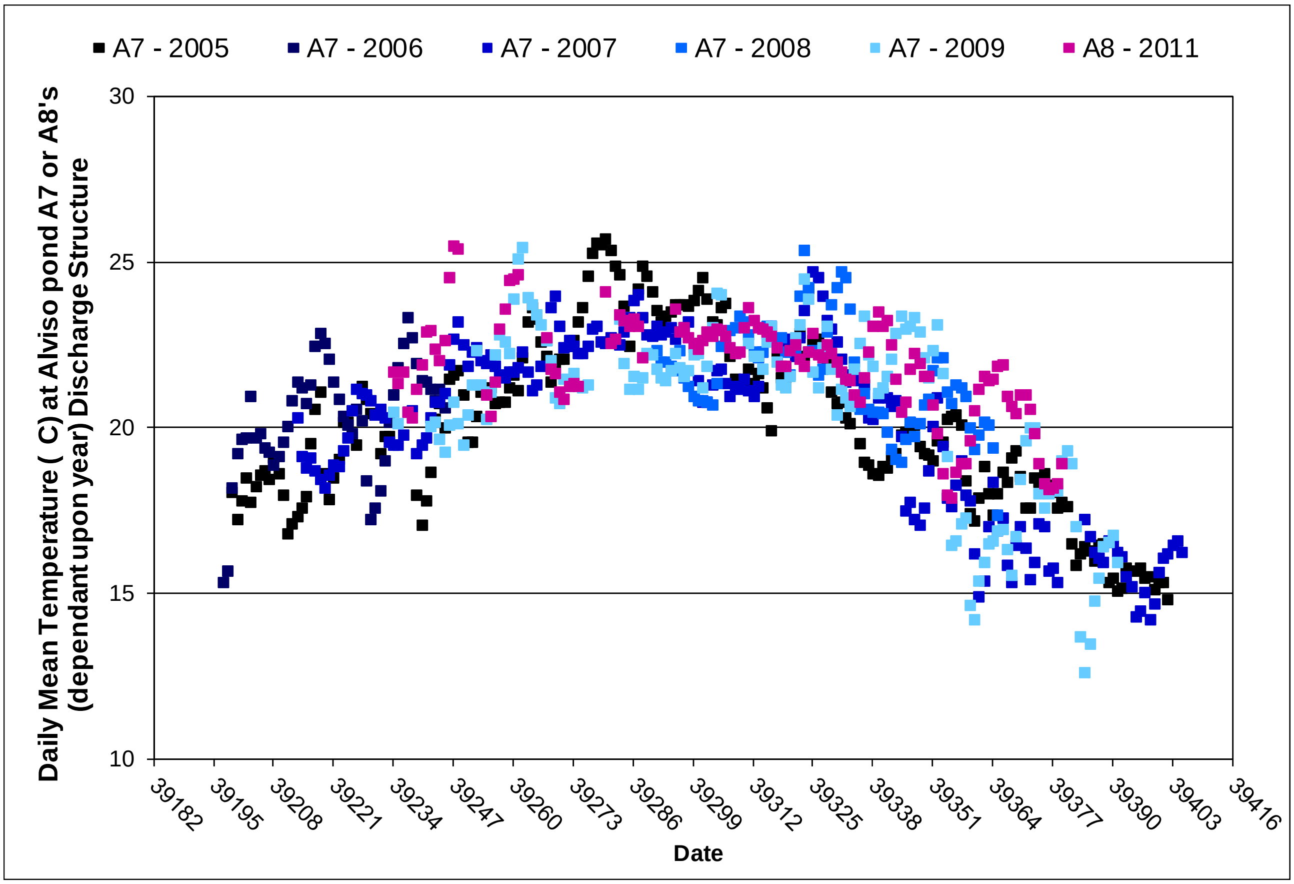


Figure 4.2-34: Pond A7/A8 Temperature from 15 June – 30 June 2011

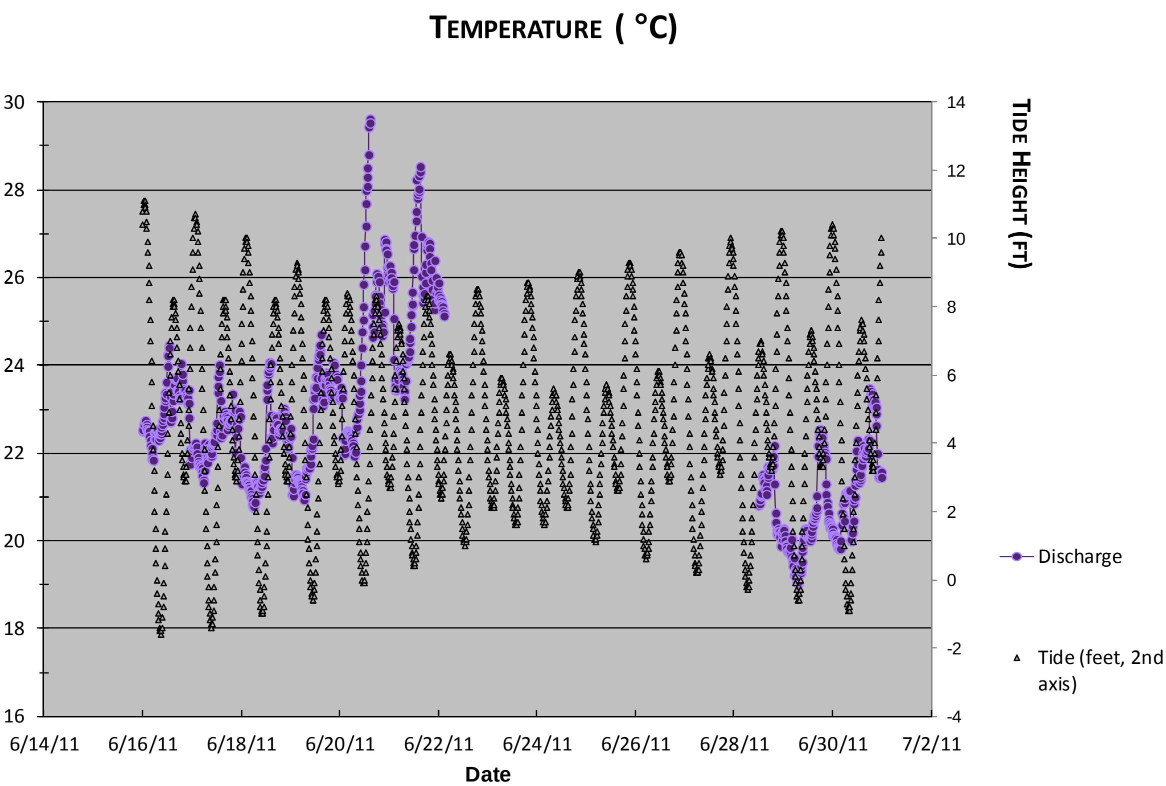
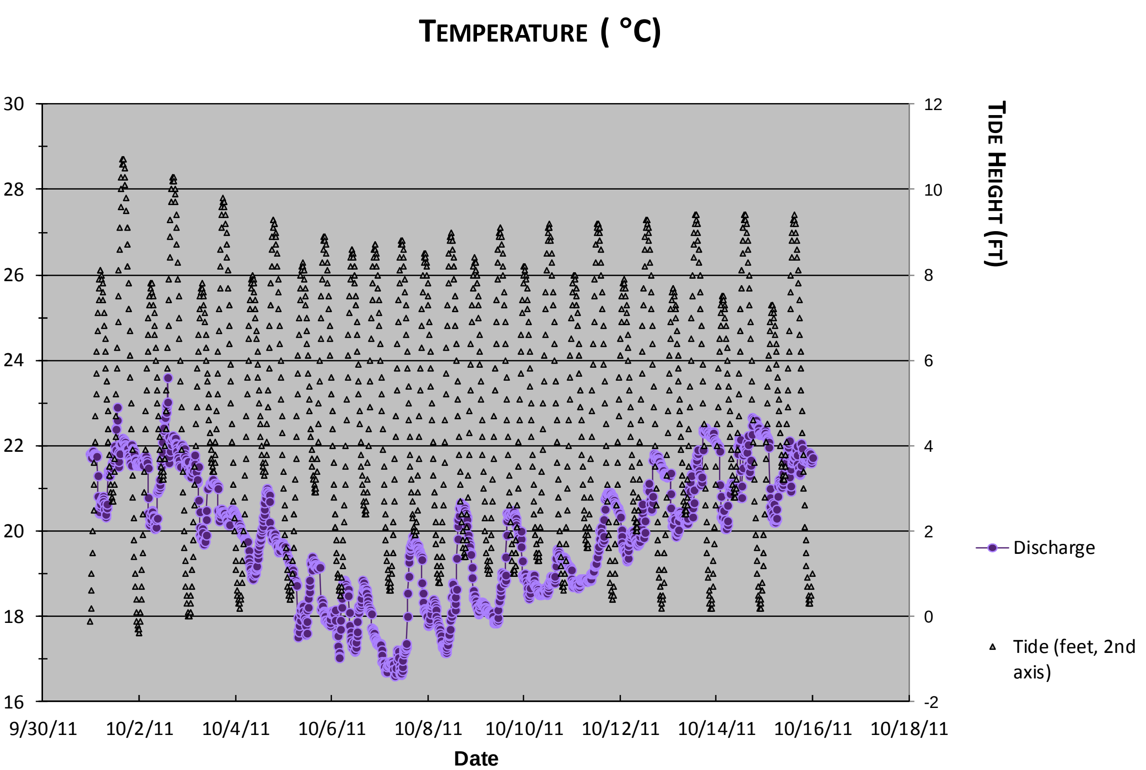


Figure 4.2-35: Pond A7/A8 Temperature from 1 October – 15 October 2011



As with Pond A3W, tidal and diurnal cycling seemed to have a strong influence on DO concentrations within discharge waters of Pond A8. Throughout the monitoring season, DO concentrations at Pond A8's discharge notch display strong cyclic patterns with the lowest DO levels recorded during early morning hours. This may be, in part, due to decreased PAR levels occurring during these same times. On the 5th of October as little as a 3.4 mg/L difference was recorded between daily high and low values. By the end of the month, on the 31st, nearly an 18.0 mg/L difference in daily min/max DO concentrations was recorded. From the start of the 2011 monitoring season, DO levels recorded at Pond A8 were well above the 3.33 mg/L threshold. Dissolved oxygen concentrations logged at Pond A8 remain above the threshold until the last two days in June (Figure 4.2-38). This decrease in DO concentrations was brief and DO levels increase again until mid-August (Figure 4.2-39). After this point, DO levels frequently drop below the 3.33 mg/L threshold and continue to do so until the end of the 2011 monitoring program (Figures 4.2-40 and 4.2-41). Over the length of the 2011 season, DO concentrations ranged from near anoxic conditions (recorded on multiple occasions) to levels near 23.0 mg/L, recorded on the 31st of October. There were a dozen or so days throughout the summer where DO concentrations at Pond A8 fell below 1.0 mg/L. The majority of these extremely low DO concentrations were recorded late in the monitoring season when increasing ambient air temperatures and decreasing wind speeds more than likely contributed to these DO decreases. The one exception being on the 22nd of June at 5:45 am, when the DO level recorded was 0.30 mg/L. Although no monthly DO average fell below the threshold, monthly averages decrease from June to September with a small increase from September to October.

During the 2011 monitoring season at Pond A8's discharge notch, daily DO averages ranged from a low of 2.40 mg/L occurring on the 20th of October to a high of 14.0 mg/L, logged on the 31st of October. Data collected at Pond A7's discharge structure during the 2009 season shows daily averages for DO concentration ranged from 1.20 mg/L, logged in August, to 6.10 mg/L, logged on the 1st of June. Average daily DO concentrations at Pond A8 this season rarely fell below the 3.33 mg/L threshold; only once in late-September and twice during late-October did daily DO averages drop below the threshold.

Weekly 10th percentiles logged at Pond A8 this year remained above the 3.33 mg/L threshold until late-August (Figure 4.2-42). From late-August until the end of the monitoring program, there was an equal amount of weekly tenth-percentile values above and below the 3.33 mg/L threshold. The 2011 monitoring season shows weekly 10th percentiles for DO were higher at Pond A8 this season than those recorded at Pond A7 during the majority of all other monitoring years (2005-2009). Table 4.2-2 summarizes the Pond A8 water quality values by month for 2011.

Figure 4.2-36: Pond A7/A8 Daily Mean DO from 2005-2011

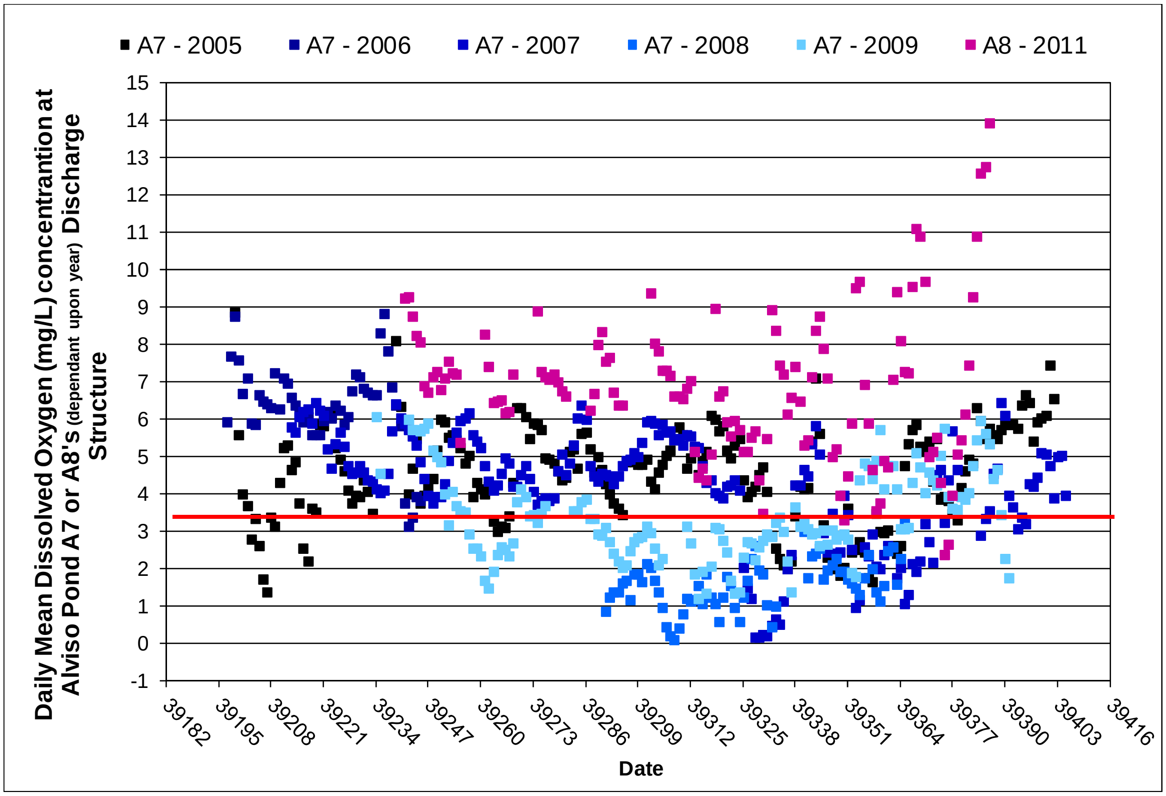


Figure 4.2-37: Pond A7/A8 DO from 8 June – 15 June 2011

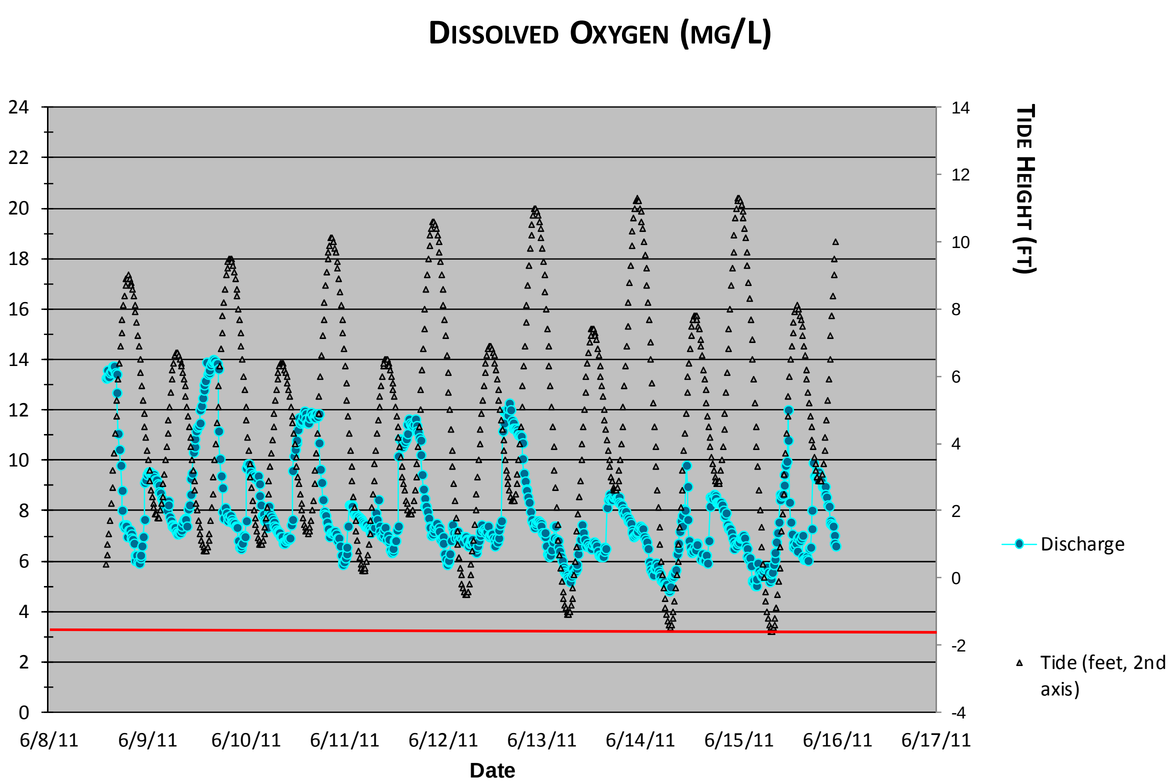


Figure 4.2-38: Pond A7/A8 DO from 16 June – 30 June 2011

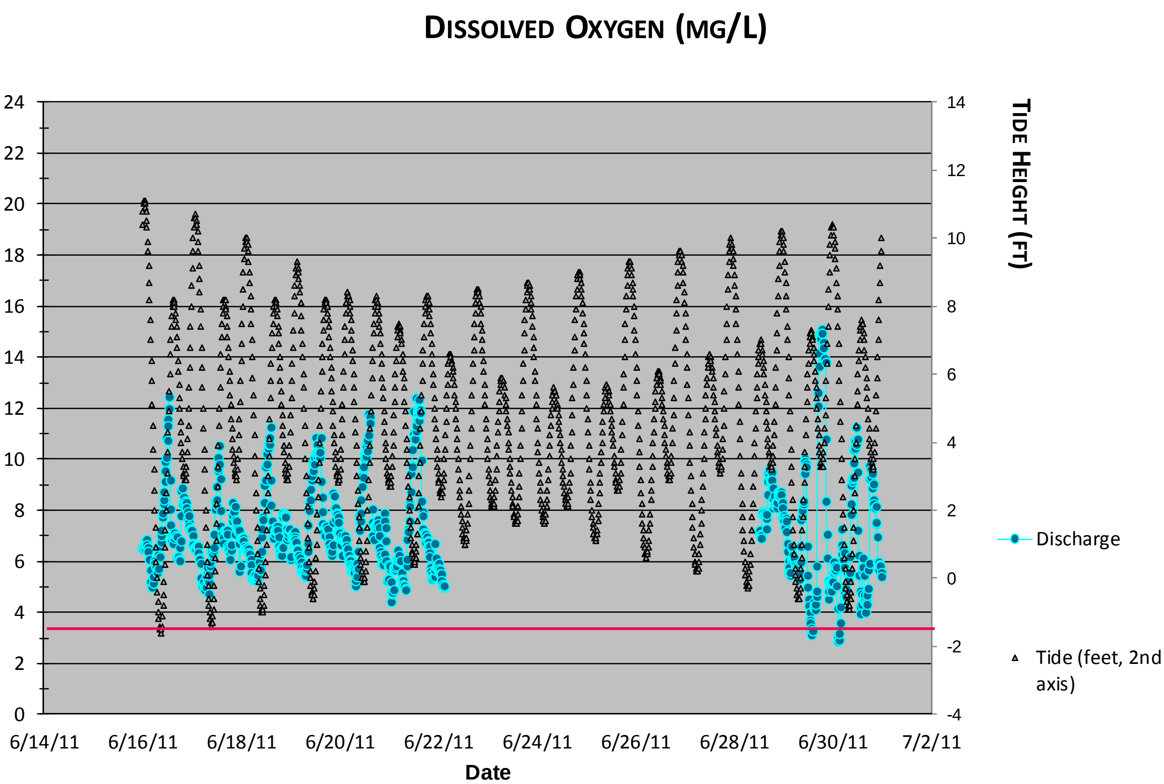


Figure 4.2-39: Pond A7/A8 DO from 15 August – 31 August 2011

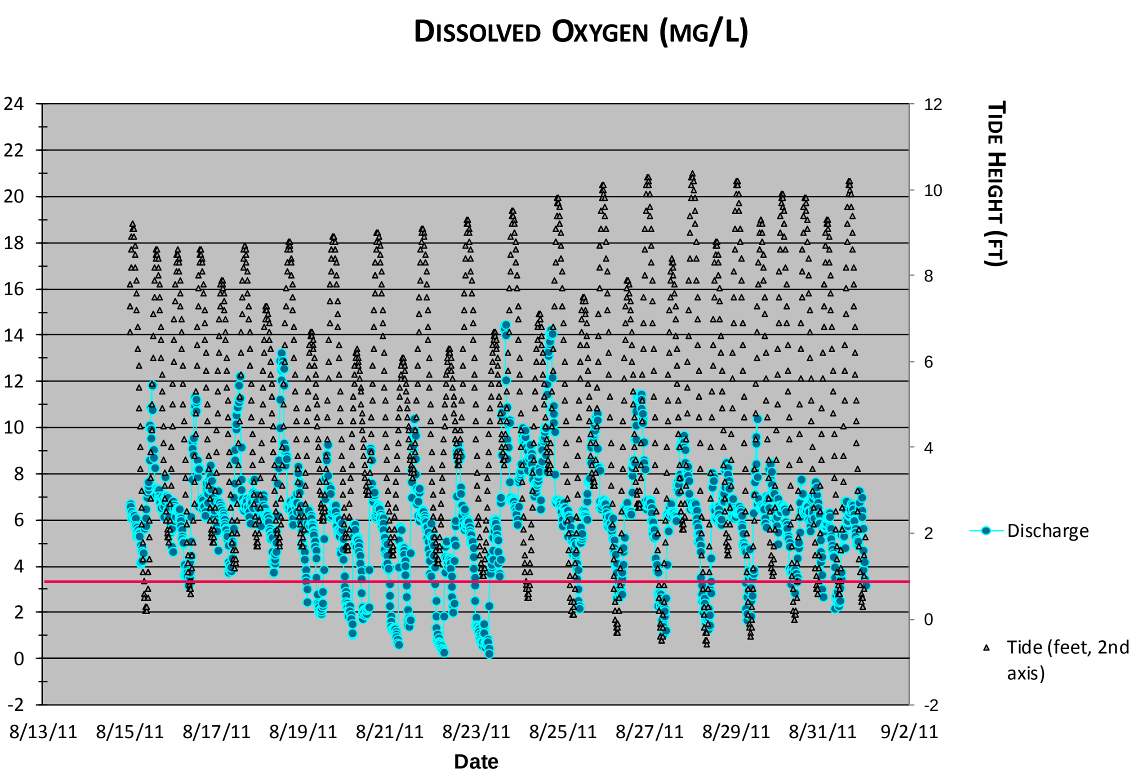


Figure 4.2-40: Pond A7/A8 DO from 1 October – 15 October 2011

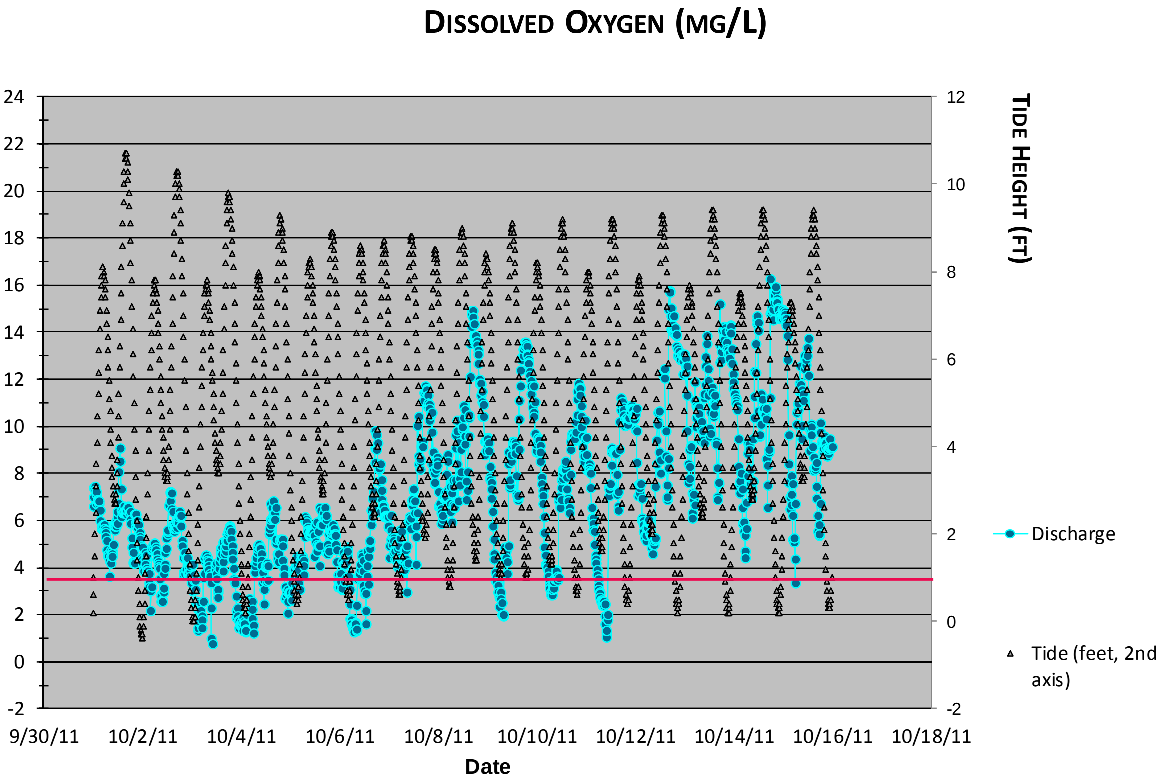


Figure 4.2-41: Pond A7/A8 DO from 16 October – 31 October 2011

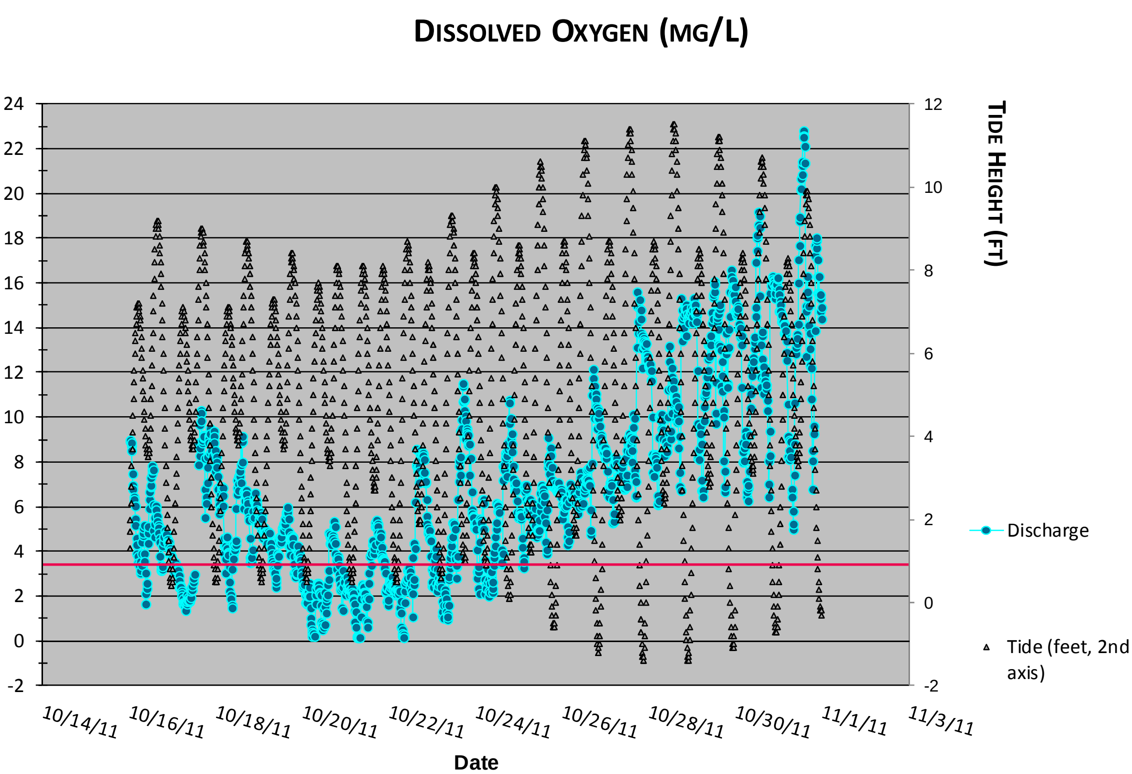


Figure 4.2-42: Pond A7/A8 Weekly 10th Percentile DO Values

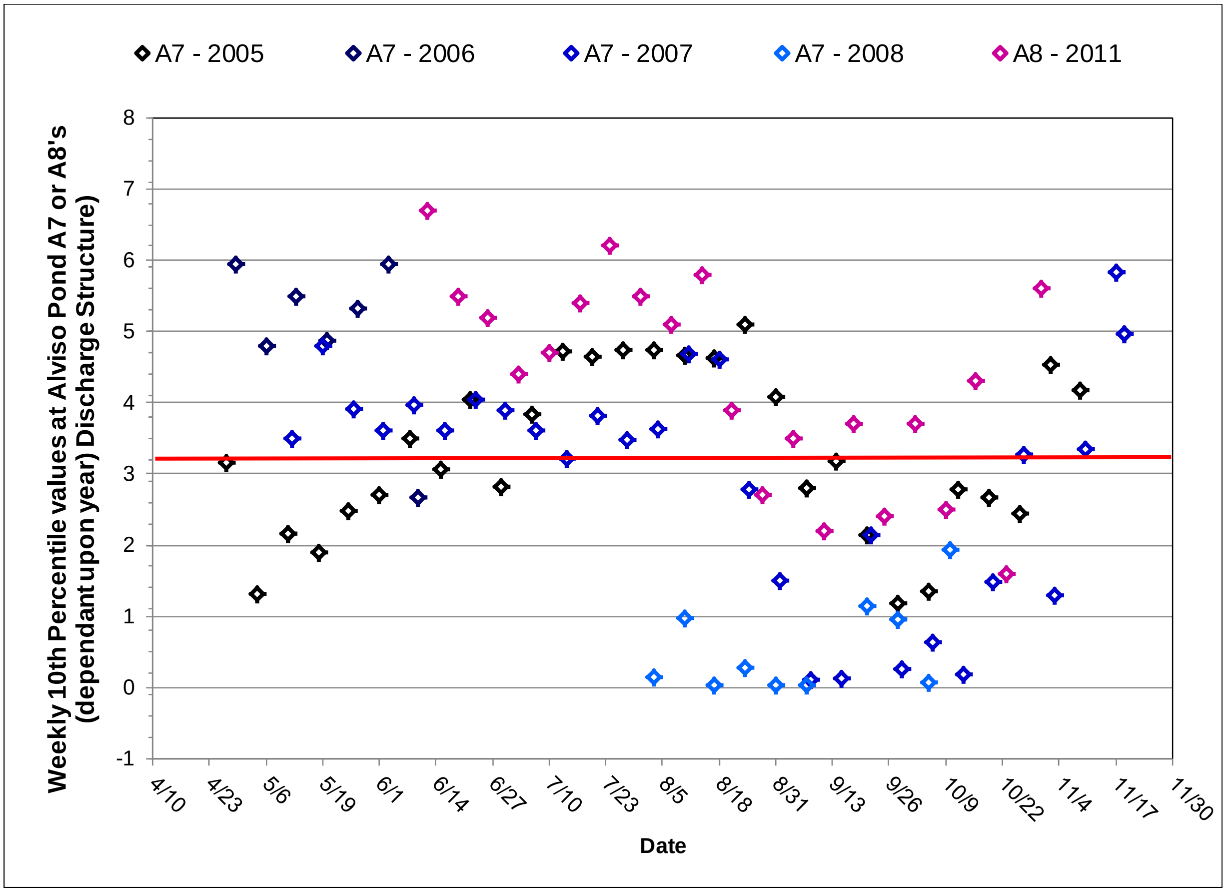


Table 4.2-2: Pond A8 Summarized Water Quality Values (Mean ± Standard Deviation) By Month

Pond	Month	Dissolved Oxygen (mg/L)	pH (Units)	Temperature (°C)	Salinity (ppt)
A8	June	7.60 ± 2.0	8.40 ± 0.3	22.10 ± 1.8	11.80 ± 3.8
	July	7.10 ± 1.9	8.80 ± 0.3	22.70 ± 1.5	9.30 ± 2.5
	August	6.40 ± 2.3	8.50 ± 0.2	22.80 ± 0.9	8.10 ± 2.0
	September	6.40 ± 3.2	8.30 ± 0.2	22.00 ± 1.2	7.30 ± 2.0
	October	7.10 ± 4.0	8.40 ± 0.3	20.00 ± 1.5	10.20 ± 2.2

Table 4.2-3: 10th Percentiles for Dissolved Oxygen during Times of Discharge at Pond A3W

Start Date	End Date	2011 data (mg/L)	2010 data (mg/L)	2009 data (mg/L)	2008 data (mg/L)	2007 data (mg/L)	2006 data (mg/L)	2005 data (mg/L)
1-Jun	6-Jun	6.7	2.2	2.2	N/A	0.0	5.4	3.6
7-Jun	13-Jun	2.9	3.5	0.7	N/A	0.2	5.0	3.8
14-Jun	20-Jun	2.2	3.1	2.0	N/A	N/A	3.5	3.5
21-Jun	27-Jun	2.5	2.7	2.5	N/A	1.6	2.7	3.9
28-Jun	4-Jul	2.5	2.8	1.2	N/A	1.6	2.3	3.6
5-Jul	11-Jul	N/A	2.7	0.3	N/A	0.6	2.7	3.7
12-Jul	18-Jul	3.2	3.2	1.0	N/A	0.4	2.7	4.5
19-Jul	25-Jul	4.7	2.8	0.2	N/A	0.7	2.3	1.7
26-Jul	1-Aug	3.4	2.9	0.6	0.1	0.8	0.5	1.9
2-Aug	8-Aug	2.7	3.0	1.7	0.1	1.3	2.6	2.6
8-Aug	15-Aug	3.1	2.6	1.1	0.3	0.8	2.9	3.6
16-Aug	22-Aug	2.8	1.8	1.0	0.5	0.2	2.9	3.5
23-Aug	29-Aug	2.8	1.3	0.0	0.1	0.4	3.4	3.6
30-Aug	5-Sep	3.7	0.6	0.0	0.8	0.3	2.5	1.9
6-Sep	12-Sep	3.7	0.4	0.9	0.4	0.7	1.9	0.6
13-Sep	19-Sep	2.0	0.6	0.9	0.1	1.1	2.5	3.6
20-Sep	26-Sep	0.5	1.1	0.1	0.1	1.3	4.7	2.2
27-Sep	3-Oct	1.0	0.3	0.5	0.3	2.1	3.2	3.8
4-Oct	10-Oct	3.6	0.2	1.3	0.3	2.0	2.8	1.4
11-Oct	17-Oct	0.7	0.6	0.1	N/A	3.4	4.0	4.0
18-Oct	24-Oct	2.7	0.1	0.1	N/A	2.7	4.6	4.0
25-Oct	31-Oct	1.0	5.5	3.1	N/A	3.4	2.8	3.5

* Data is based on a 10th percentile with 3.33 mg/L being the trigger for reporting non-compliance

Table 4.2-4: 10th Percentiles for Dissolved Oxygen during Times of Discharge at Pond A7/A8

Start Date	End Date	A8 2011 DO (mg/L)	A7 2009 DO (mg/L)	A7 2008 DO (mg/L)	A7 2007 DO (mg/L)	A7 2006 DO (mg/L)	A7 2005 DO (mg/L)	A7 2004 DO (mg/L)
1-Jun	6-Jun	6.7	4.4	N/A	3.6	3.4	3.1	N/A
7-Jun	13-Jun	5.5	3.1	N/A	4.0	3.5	4.0	N/A
14-Jun	20-Jun	5.2	1.9	N/A	3.9	4.0	2.8	N/A
21-Jun	27-Jun	4.4	0.8	N/A	3.6	5.4	3.8	N/A
28-Jun	4-Jul	4.7	3.3	N/A	3.2	4.5	4.7	N/A
5-Jul	11-Jul	5.4	4.0	N/A	3.8	4.4	4.7	N/A
12-Jul	18-Jul	6.2	2.8	N/A	3.5	3.9	4.7	0.7
19-Jul	25-Jul	5.5	1.5	0.1	3.6	5.3	4.7	0.2
26-Jul	1-Aug	5.1	1.8	1.0	4.7	6.0	4.7	2.5
2-Aug	8-Aug	5.8	0.4	0.0	4.6	5.9	4.6	2.7
8-Aug	15-Aug	3.9	0.3	0.3	2.8	5.8	5.1	2.7
16-Aug	22-Aug	2.7	0.9	0.0	1.5	4.1	4.1	1.5
23-Aug	29-Aug	3.5	1.2	0.0	0.1	3.5	2.8	0.6
30-Aug	5-Sep	2.2	0.9	N/A	0.1	4.1	3.2	0.5
6-Sep	12-Sep	3.7	0.8	1.1	2.2	4.4	2.1	1.2
13-Sep	19-Sep	2.4	0.9	1.0	0.3	2.9	1.2	0.4
20-Sep	26-Sep	3.7	1.4	0.1	0.6	2.4	1.4	2.3
27-Sep	3-Oct	2.5	1.1	1.9	0.2	3.5	2.8	3.3
4-Oct	10-Oct	4.3	1.5	N/A	1.5	4.0	2.7	3.0
11-Oct	17-Oct	1.6	5.0	N/A	3.3	4.1	2.4	2.2
18-Oct	24-Oct	5.6	1.8	N/A	1.3	5.7	4.5	0.9
25-Oct	31-Oct	N/A	N/A	N/A	3.4	N/A	4.2	2.5

* Data is based on a 10th percentile with 3.33 mg/L being the trigger for reporting non-compliance

Table 4.2-5: 10th Percentiles for Dissolved Oxygen during Times of Discharge at Pond SF2

Week Of	Discharge channel: 10th percentiles for DO (mg/L)	Unit 1: 10th percentiles for DO (mg/L)	Unit 2: 10th percentiles for DO (mg/L)	Discharge Only: 10th percentiles for DO (mg/L)
6/1 - 6/5	5.6	3.5	5.0	5.8
6/6 - 6/12	4.5	0.5	3.4	5.9
6/13 - 6/19	4.2	0.2	3.8	4.3
6/20 - 6/26	2.3	0.0	1.9	2.8
6/27 - 7/3	2.6	0.8	3.0	3.0
7/4 - 7/10	1.5	0.0	1.8	3.0
7/11 - 7/17	2.6	1.9	2.4	3.0
7/18 - 7/24	1.4	0.0	1.0	1.5
7/25 - 7/31	1.8	1.7	NA	2.3
8/1 - 8/7	2.9	3.1	0.0	3.1
8/8 - 8/14	1.6	2.5	0.2	2.1
8/15 - 8/21	1.5	2.5	0.4	1.9
8/22 - 8/28	1.1	1.8	0.7	1.8
8/29 - 9/4	1.4	2.7	2.0	1.8
9/5 - 9/11	1.2	2.8	1.1	2.0
9/12 - 9/18	1.0	3.3	0.0	2.6
9/19 - 9/25	0.3	2.4	0.3	1.6
9/26 - 10/2	2.0	2.4	0.1	3.1
10/3 - 10/9	1.0	3.2	0.1	1.3
10/10 - 10/16	0.5	2.1	0.0	1.6
10/17 - 10/23	0.5	2.3	0.0	1.5
10/24 - 10/31	1.8	4.3	0.4	3.1

* Data is based on a 10th percentile with 3.33 mg/L being the trigger for reporting non-compliance

4.3 RECEIVING WATER SAMPLING

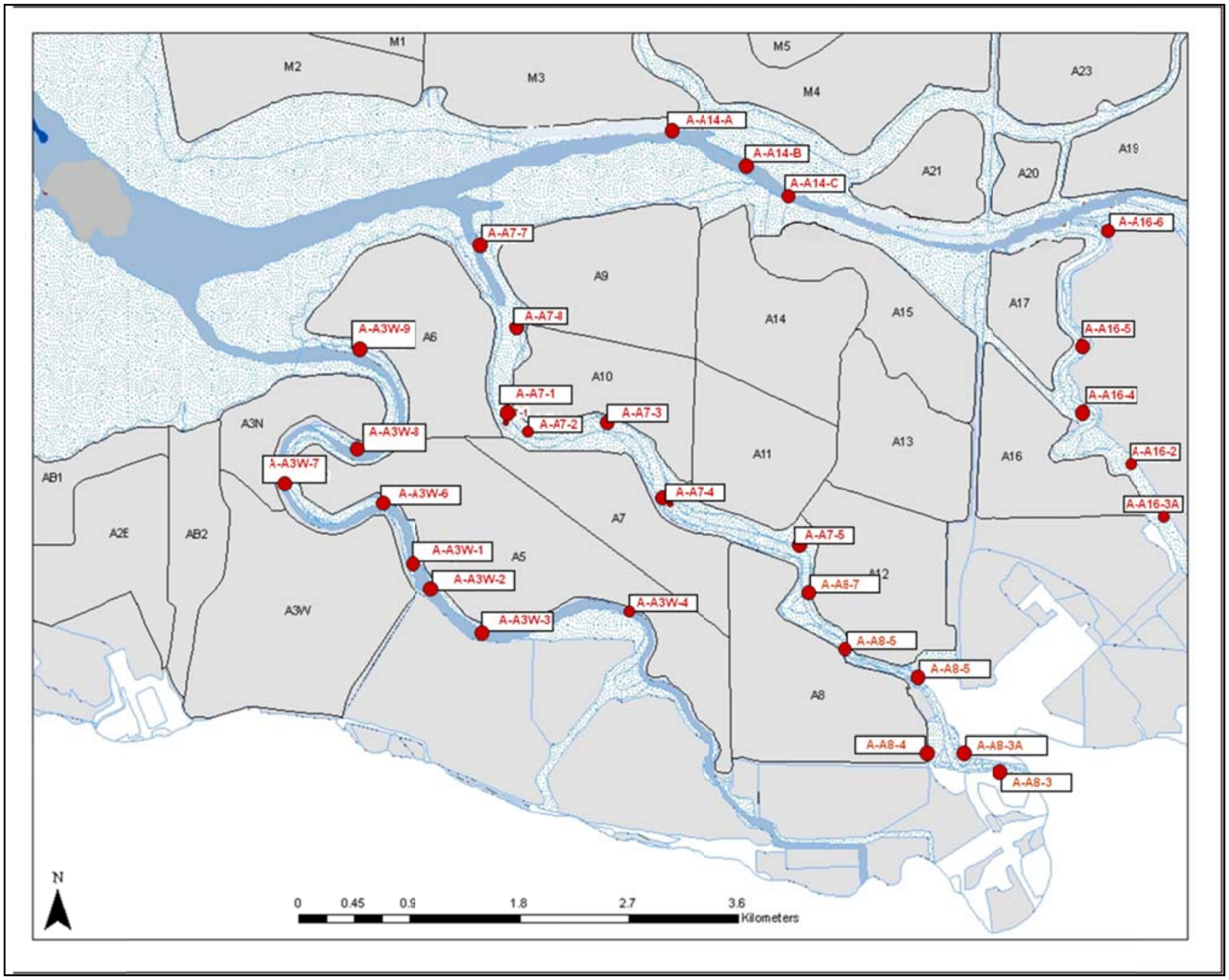
4.3.1 Receiving Water Analyses

Receiving water data were collected for the Alviso Complex from July through October 2011. Here we plot 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 (Figure 4.3-1).

4.3.2 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 was higher within the pond than in the Guadalupe Slough. In fact, this year salinity within Pond A3W was between 5.5 to 10.6 ppt higher than values logged within Guadalupe Slough. Generally speaking, salinity levels were higher in Pond A3W than in Guadalupe during the past several monitoring seasons (Figures 4.3-2 through 4.3-7). As seen during previous monitoring seasons, vertical stratification was apparent this year and became more pronounced throughout the season.

Figure 4.3-1: 2011 Receiving Water Sampling Locations



Starting in July, the difference in salinity concentrations between bottom and surface readings was less than 0.30 ppt. Just three months later, October sampling reported a 4.0 ppt difference in salinity levels between bottom and surface readings. Differences between surface and bottom receiving waters in 2010 were also minor.

Figure 4.3-2: Daily Mean Salinity for Pond A3W 2011

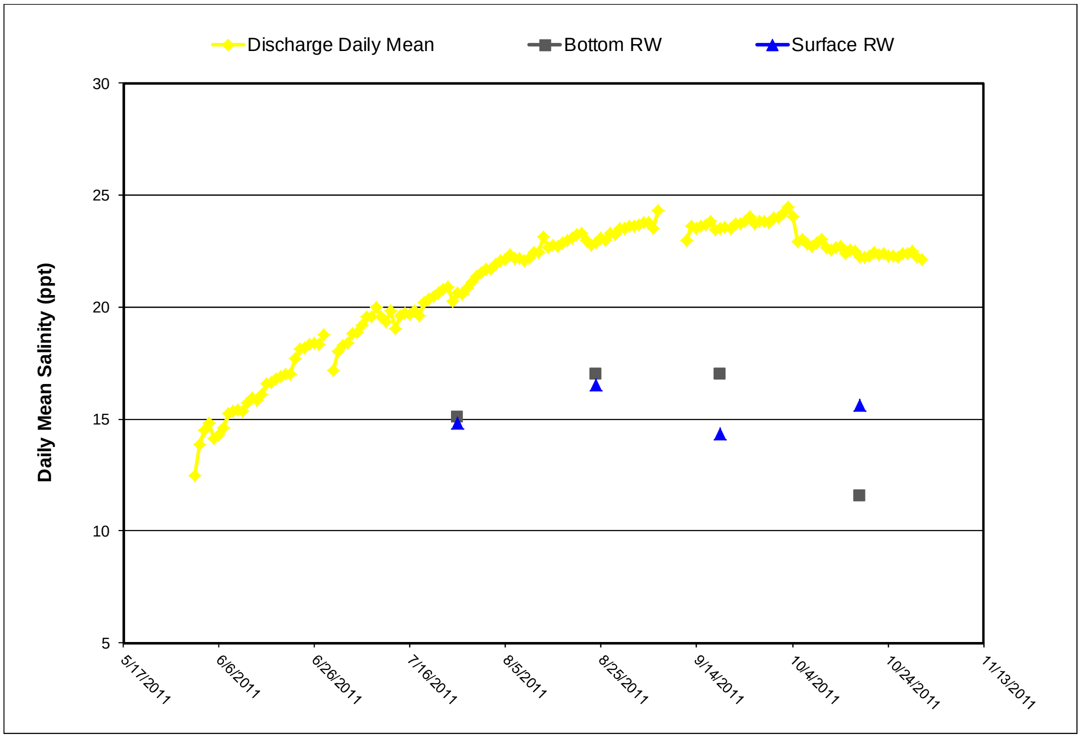


Figure 4.3-3: Daily Mean Salinity for Pond A3W 2010

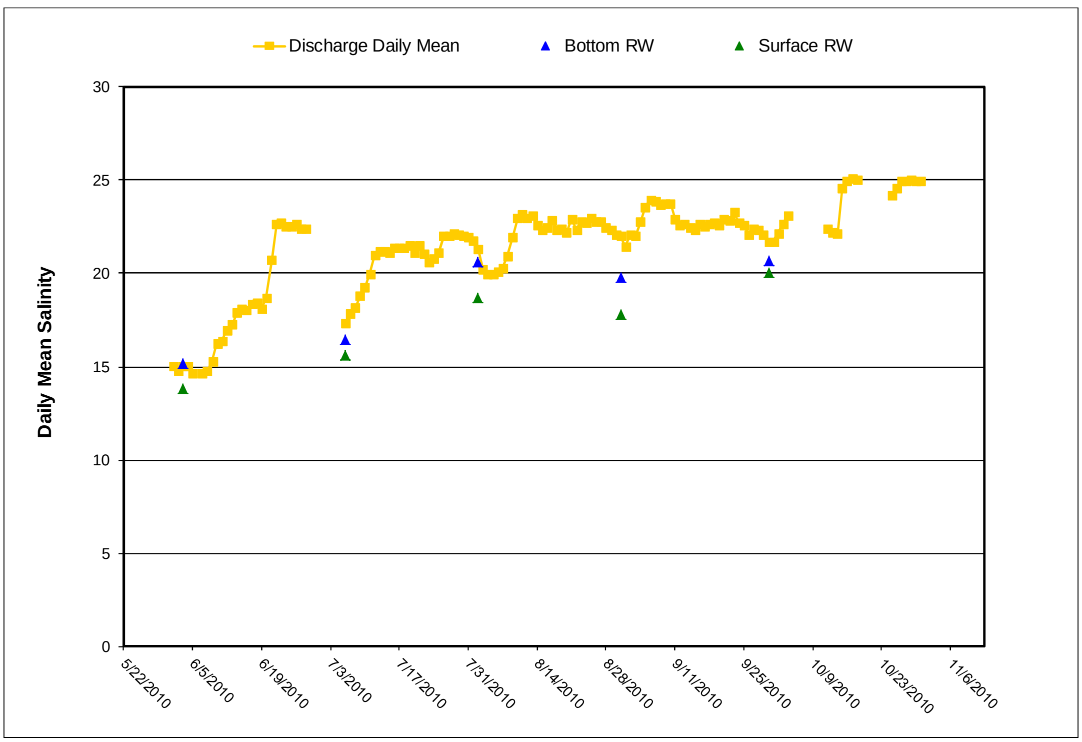


Figure 4.3-4: Daily Mean Salinity for Pond A3W 2009

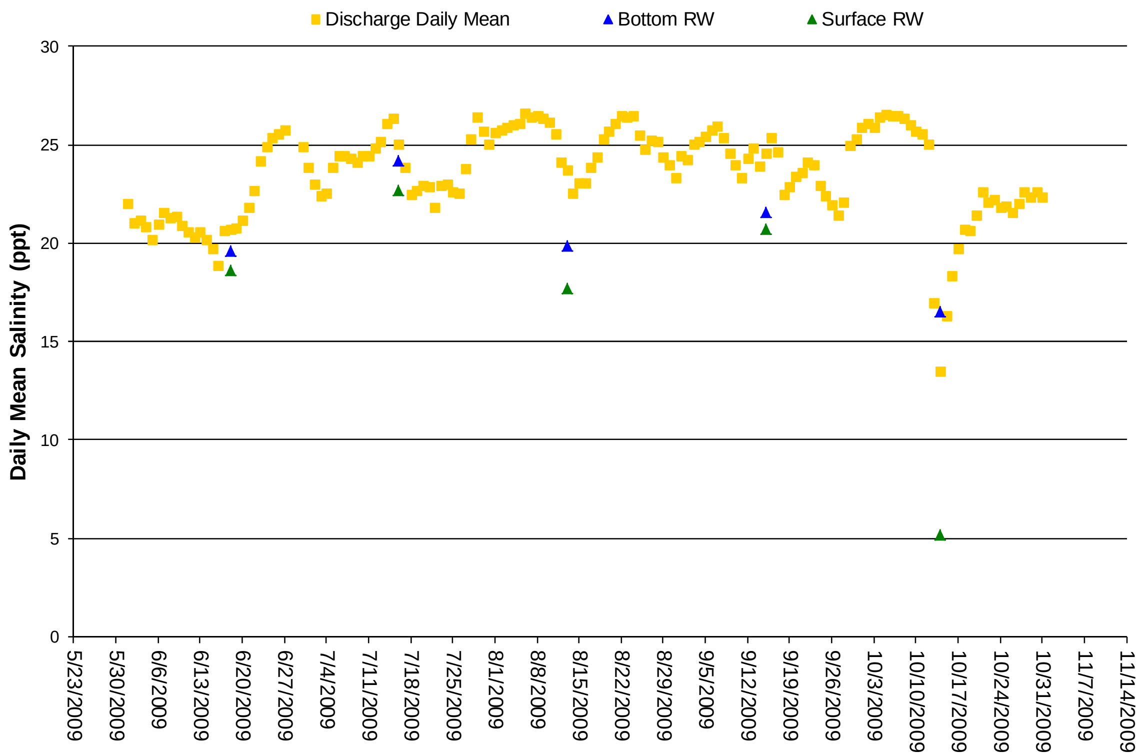


Figure 4.3-5: Daily Mean Salinity for Pond A3W 2008

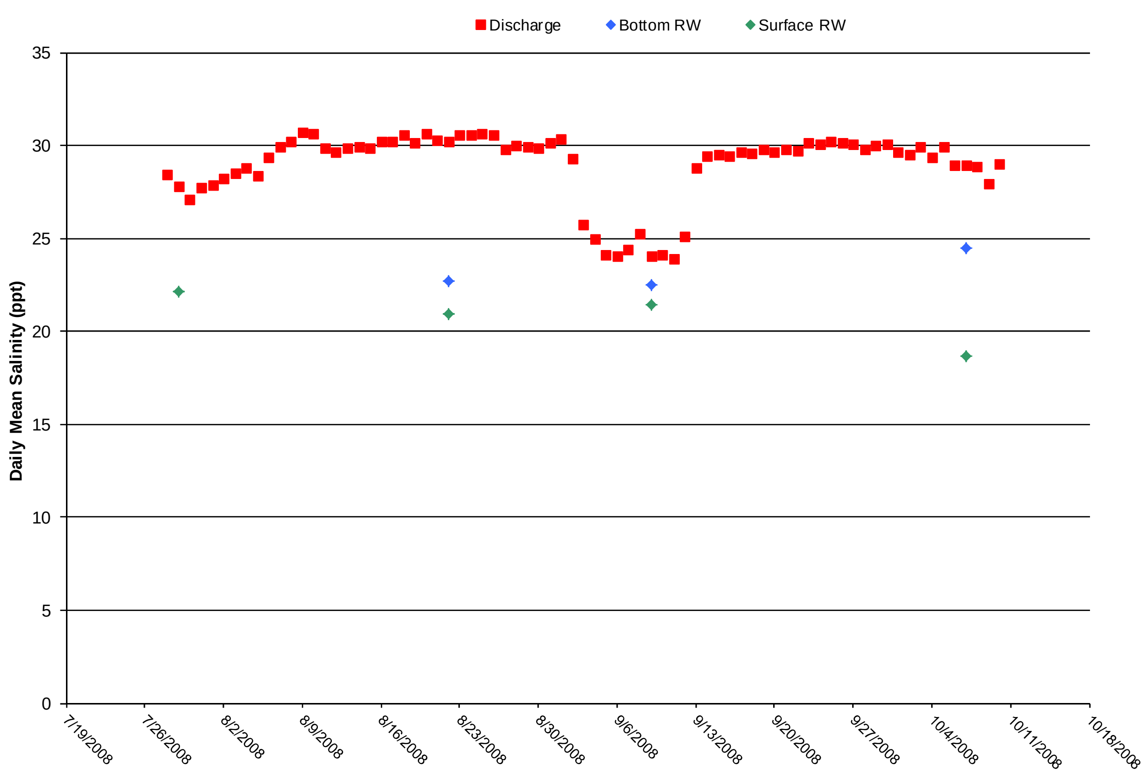


Figure 4.3-6: Pond A3W Daily Mean Salinity from 2005 – 2011

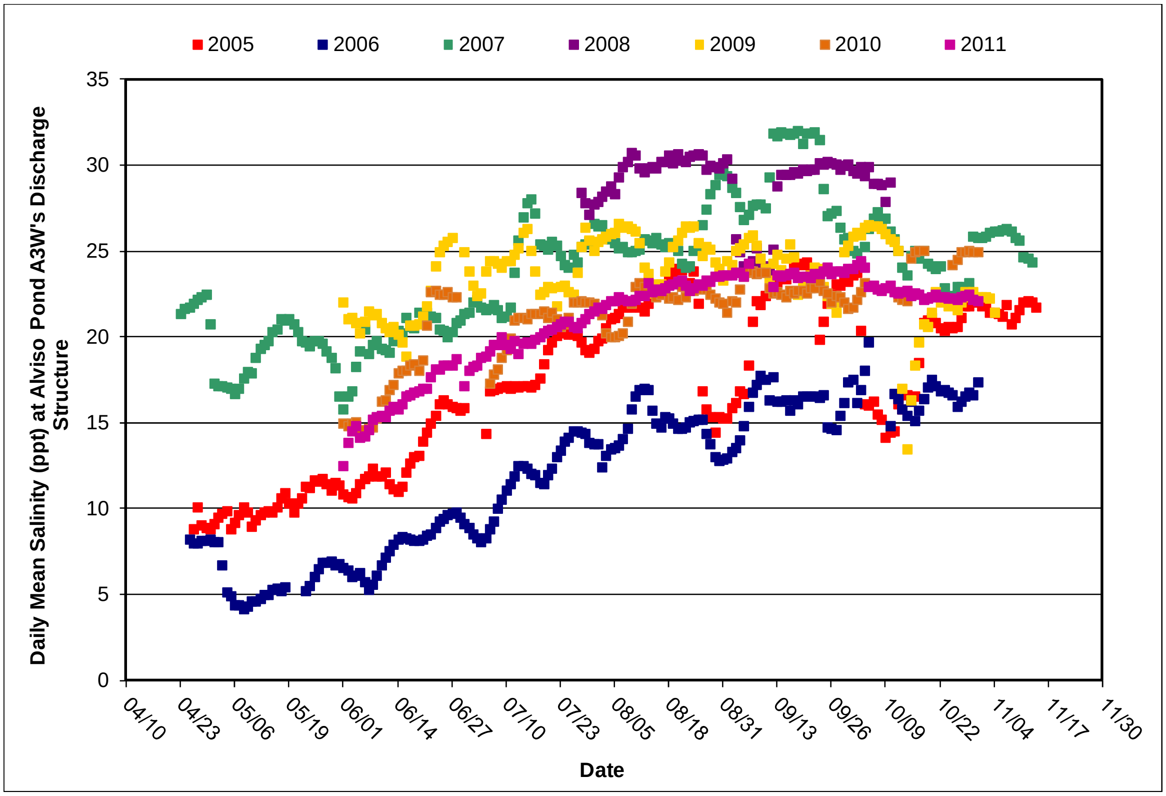
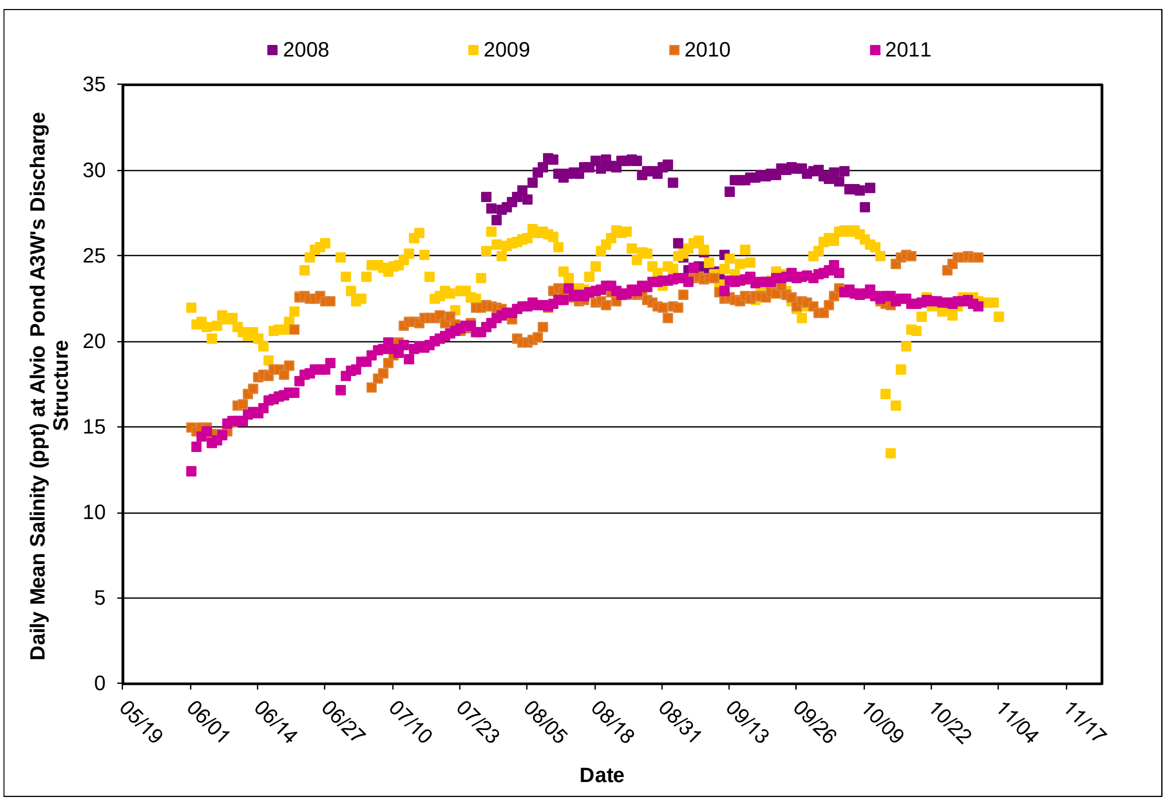


Figure 4.3-7: Pond A3W Daily Mean Salinity from 2008 – 2011



Throughout 2011, pH levels at Pond A3W were variable but generally decreased over the five-month long monitoring period. Daily averages for pH levels ranged from a low of 8.21 units, recorded on the 31st of October, to a high of 9.64 units which occurred on the 5th of June. During the 2009 and 2010 season, pH levels within Pond A3W ranged from 8.0 to 9.0 units. Values for pH have been highly variable throughout sampling years with discharge waters logging higher pH values than receiving waters (Figures 4.3-8 through 4.3-13). For receiving waters, the overall trend has shown that pH values are higher at surface waters than at bottom waters. Sampling conducted this year fits the general trend, where discharge waters were consistently higher in pH than slough water. Vertical stratification in pH values between bottom and surface receiving waters this year was almost non-existent. Sampling conducted in September shows the most vertical stratification with less than a 0.1 unit difference in surface and bottom readings.

Figure 4.3-8: Daily Mean pH for Pond A3W_2011

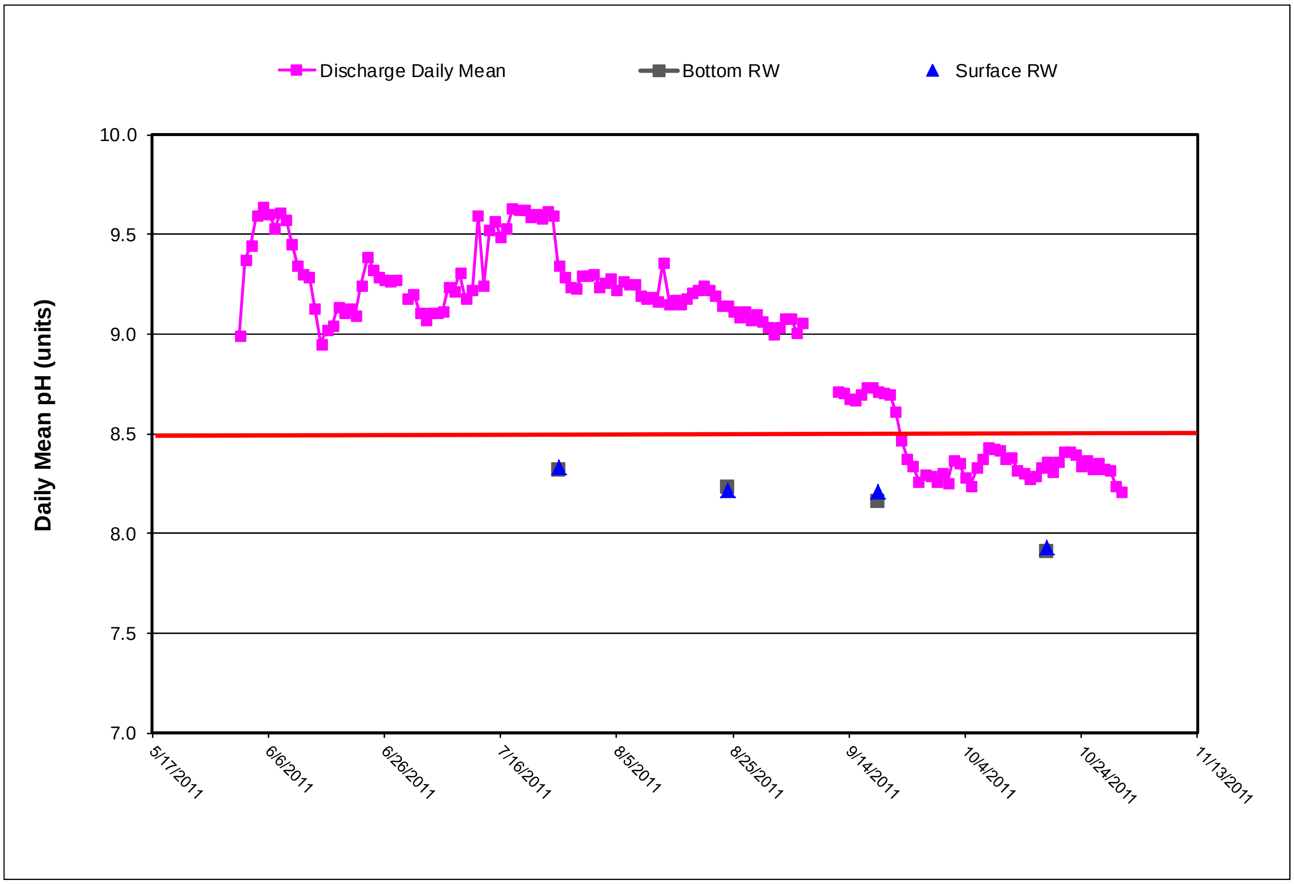


Figure 4.3-9: Daily Mean pH for Pond A3W_2010

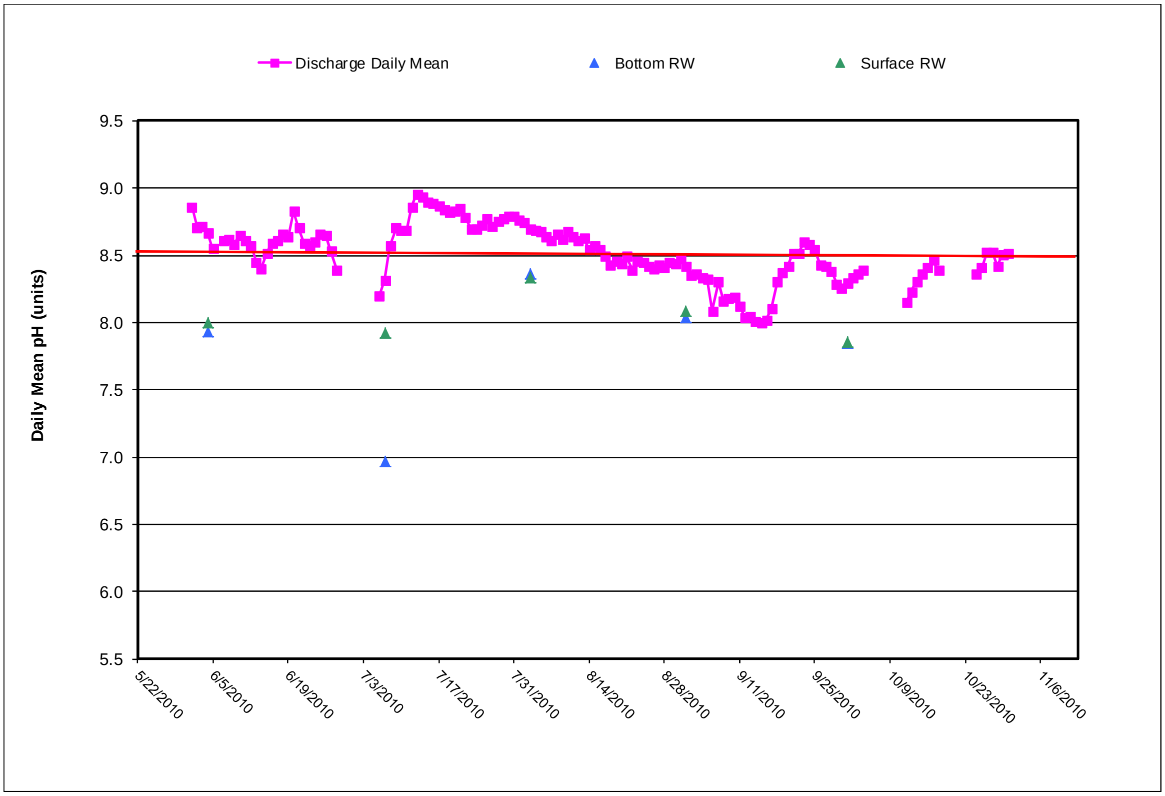


Figure 4.3-10: Daily Mean pH for Pond A3W_2009

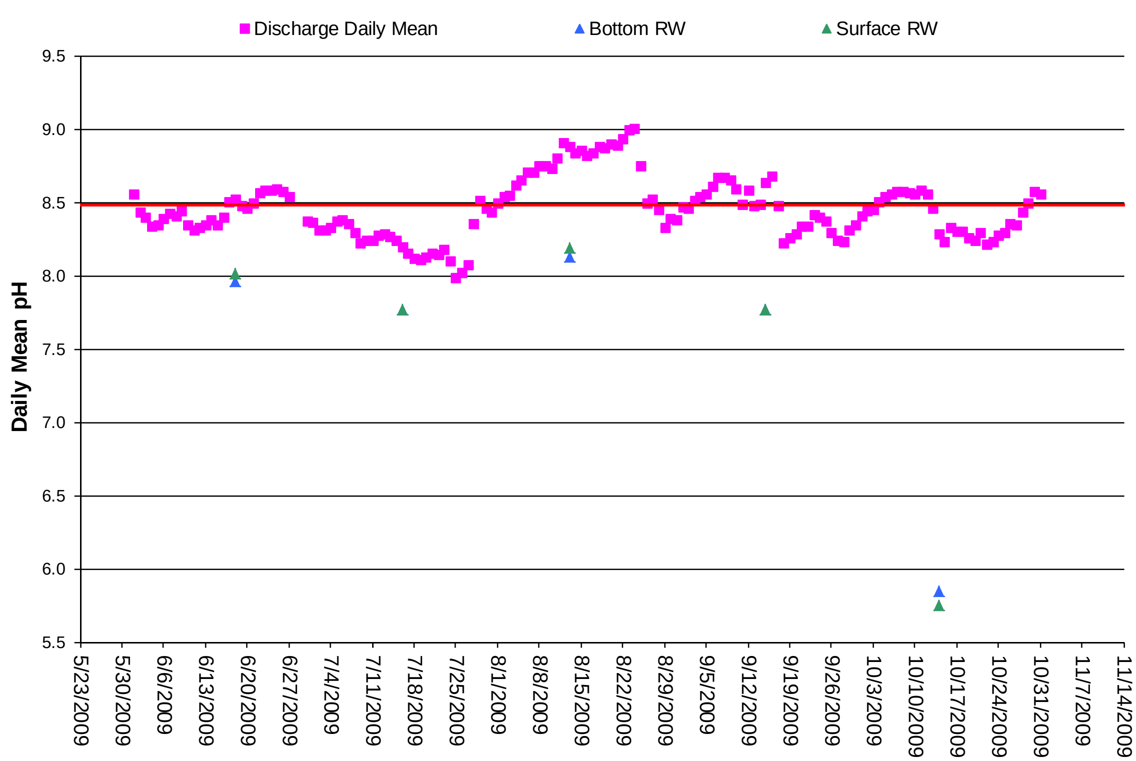


Figure 4.3-11: Daily Mean pH for Pond A3W_2008

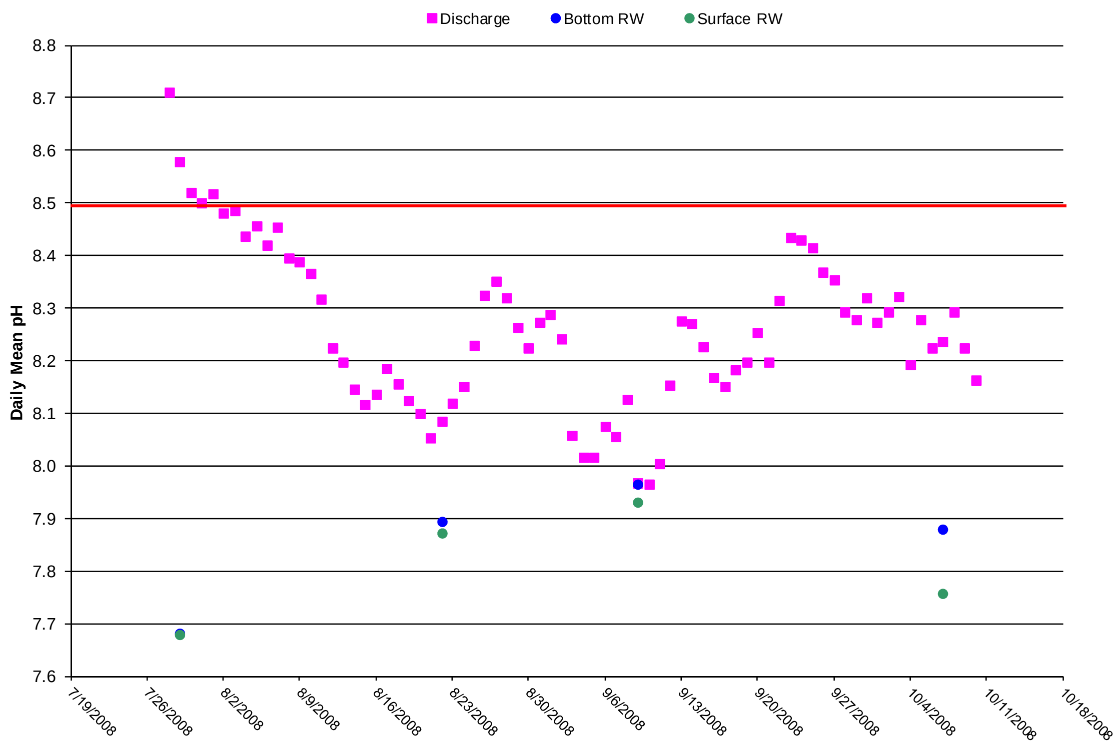


Figure 4.3-12: Daily Mean pH for Pond A3W_2005-2011

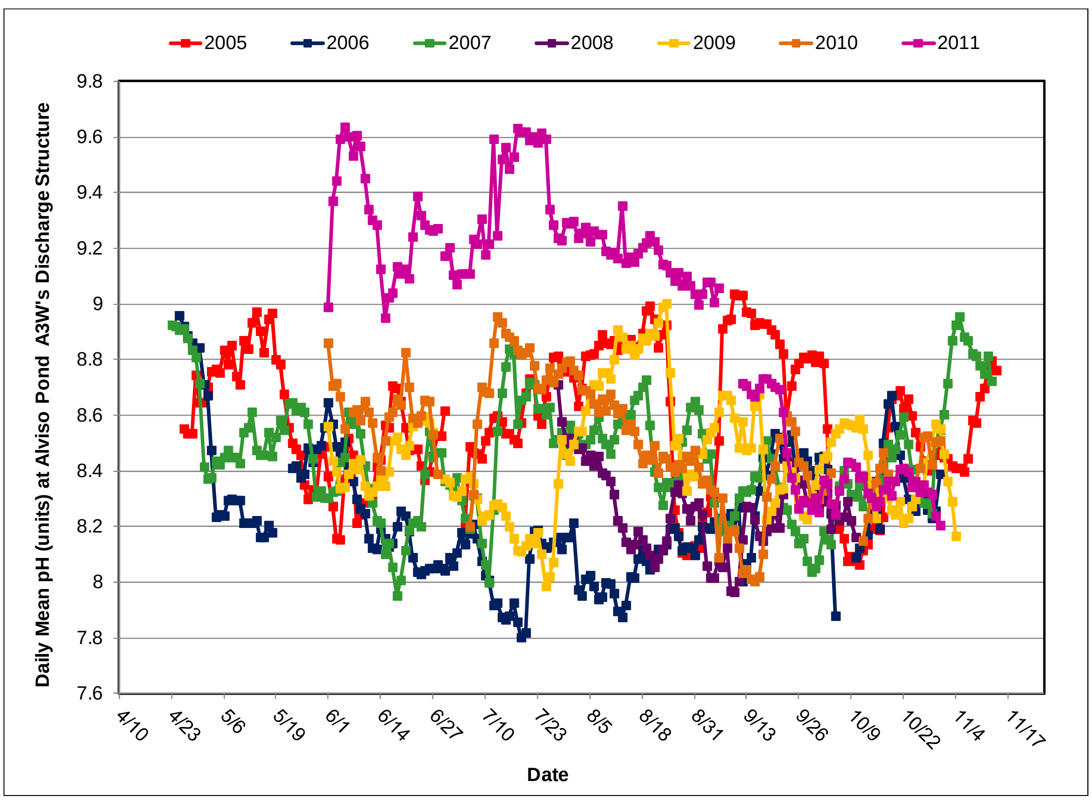
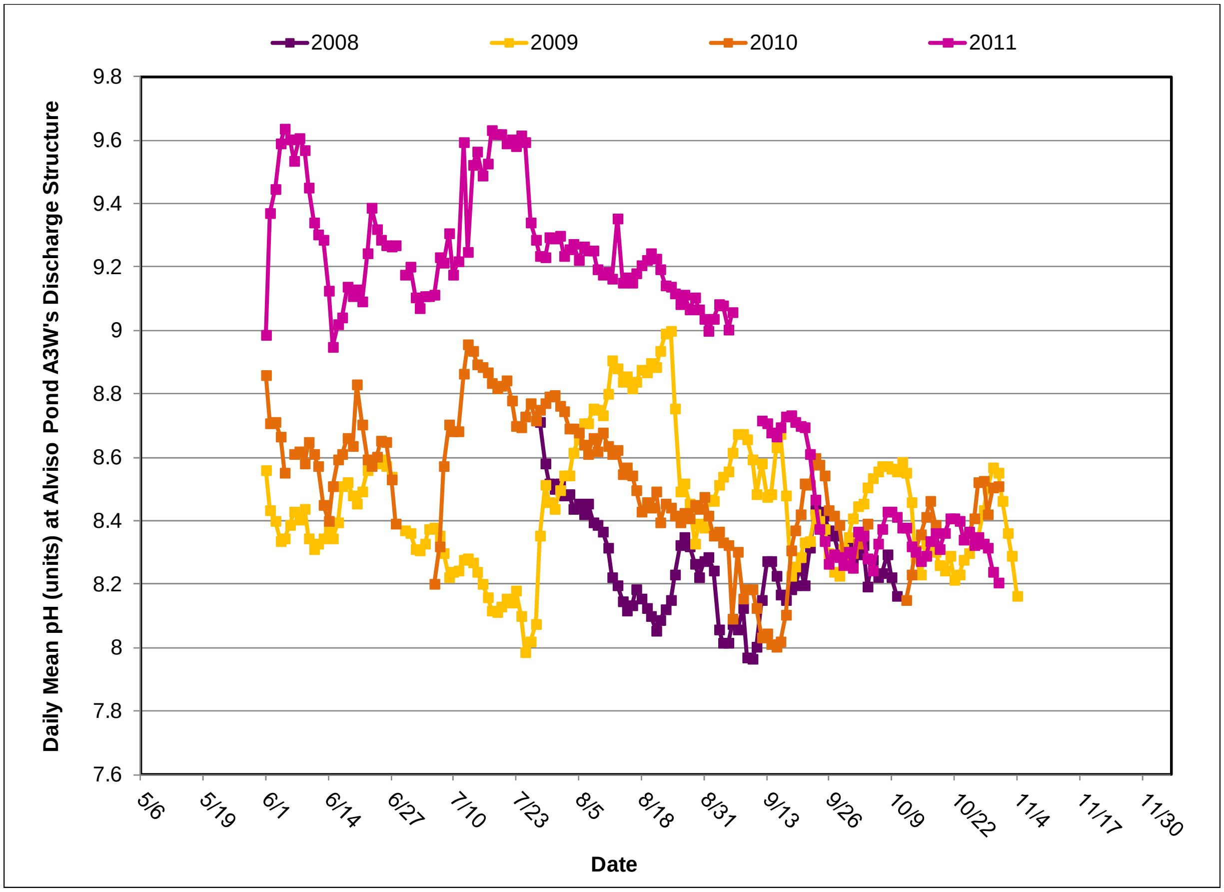


Figure 4.3-13: Daily Mean pH for Pond A3W_2008-2011



Temperatures recorded during the 2011 season at Pond A3W's discharge structure were very similar to temperatures recorded during past monitoring seasons in which temperatures ranged from roughly 15.0 to 25.0 degrees Celsius (Figures 4.3-14 through 4.3-19). There did seem to be a slight increase in overall water temperatures this year at Pond A3W as temperatures ranged from 16.0 to 27.0 degrees Celsius, elevated by just a few degrees from past seasons. Although daily water temperature averages vary a bit, they generally decrease throughout the season, as in all other years of monitoring.

Vertical stratification of water temperatures logged within Guadalupe Slough during the 2011 season, as with pH concentrations, was almost negligible. The greatest vertical stratification of water temperature logged within the slough this year occurred during September sampling when a 0.20 degree difference in bottom and surface waters was recorded. As with the 2011 season, vertical stratification between bottom and surface water temperatures within Guadalupe Slough has been minimal during the last several years of monitoring.

Figure 4.3-14: Daily Mean Temperature for Pond A3W 2011

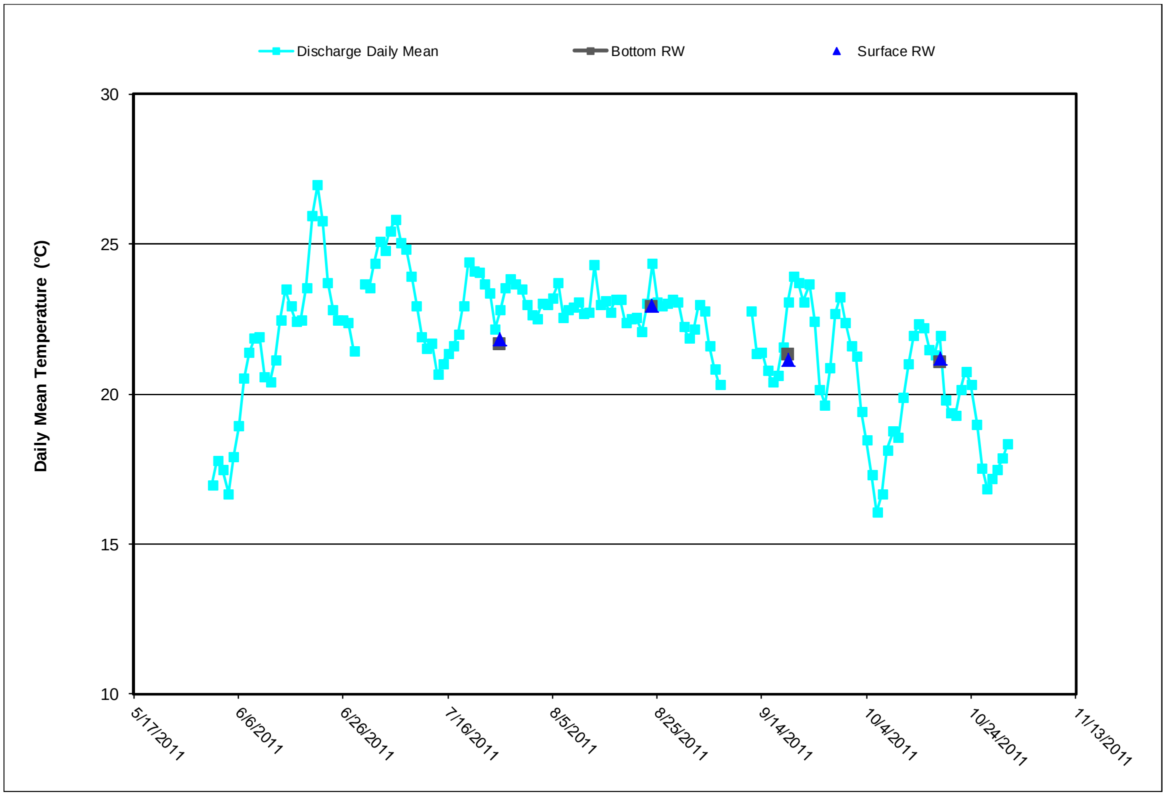


Figure 4.3-15: Daily Mean Temperature for Pond A3W 2010

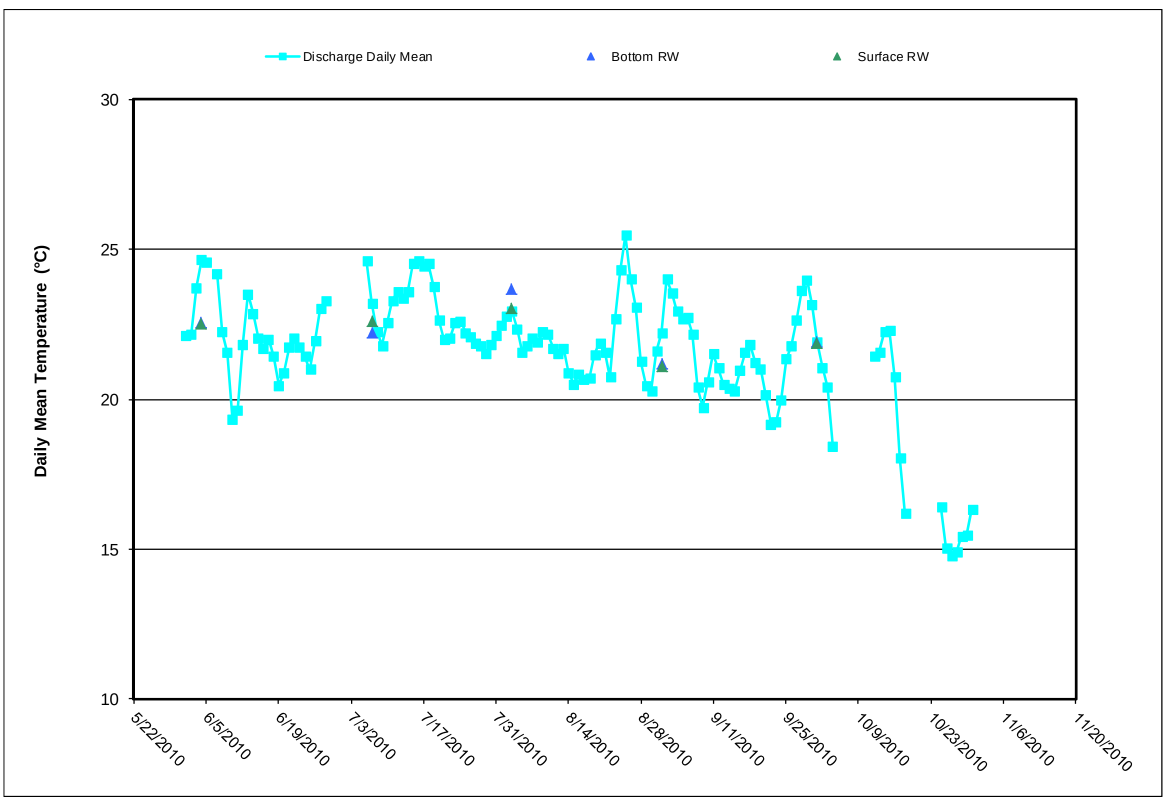


Figure 4.3-16: Daily Mean Temperature for Pond A3W 2009

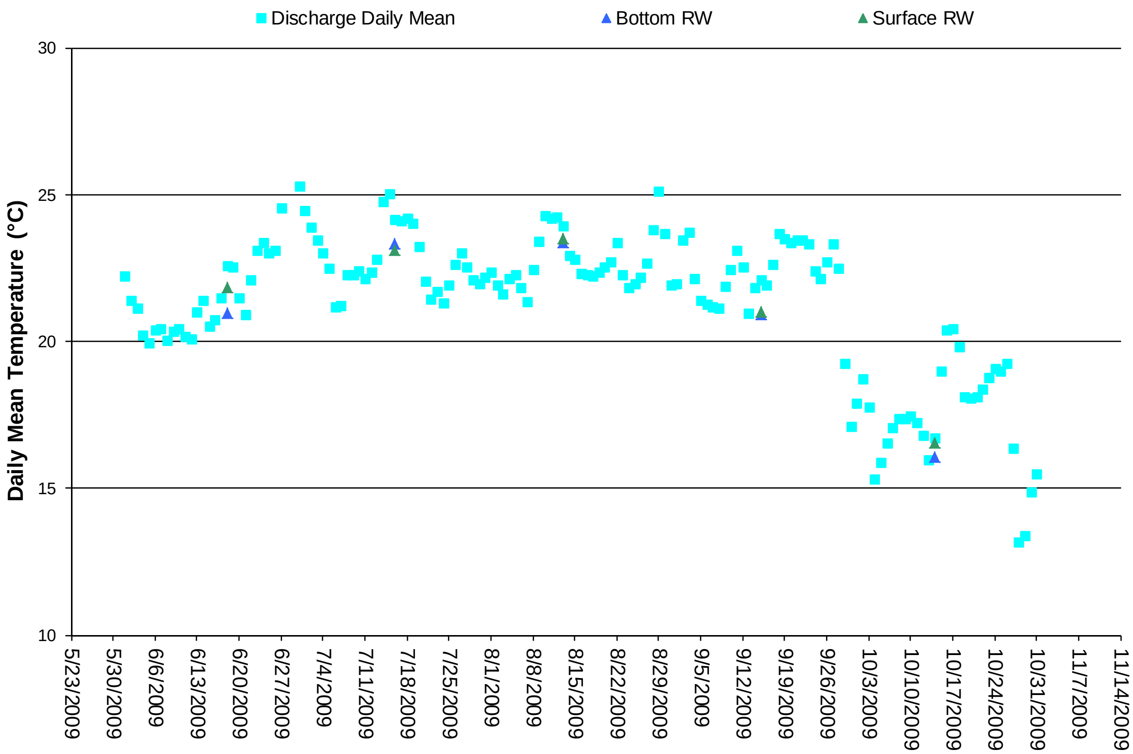


Figure 4.3-17: Daily Mean Temperature for Pond A3W 2008

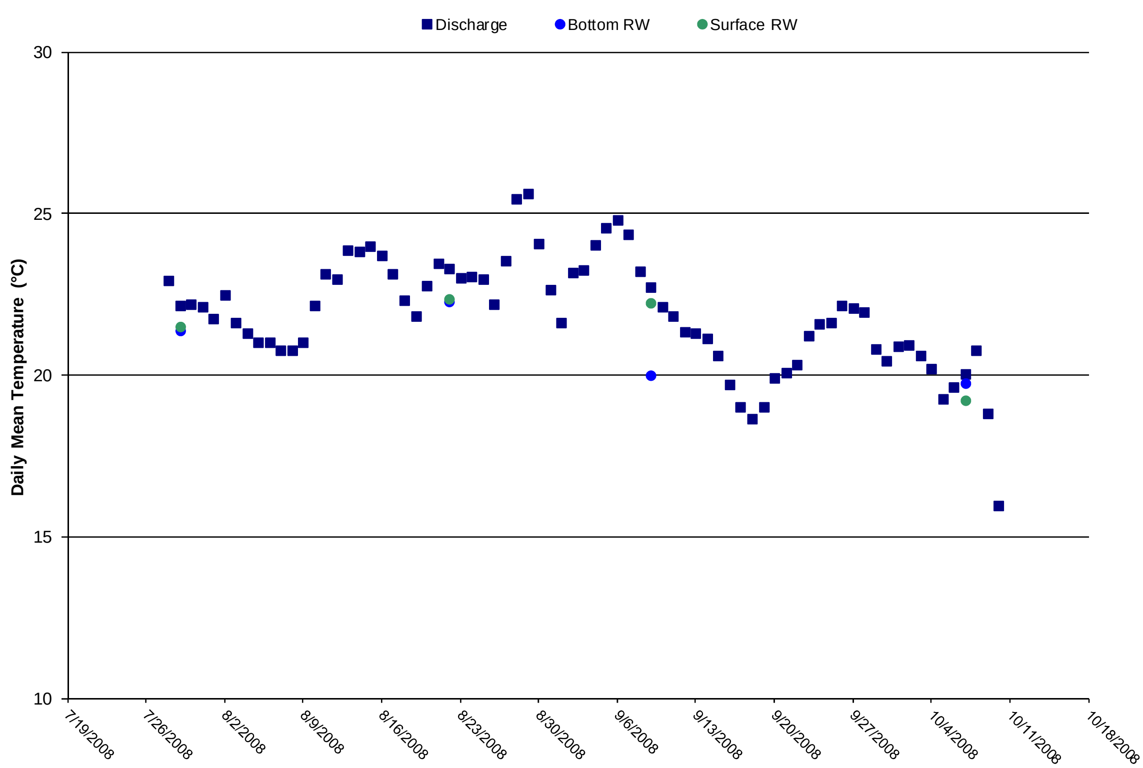


Figure 4.3-18: Daily Mean Temperature for Pond A3W 2005-2011

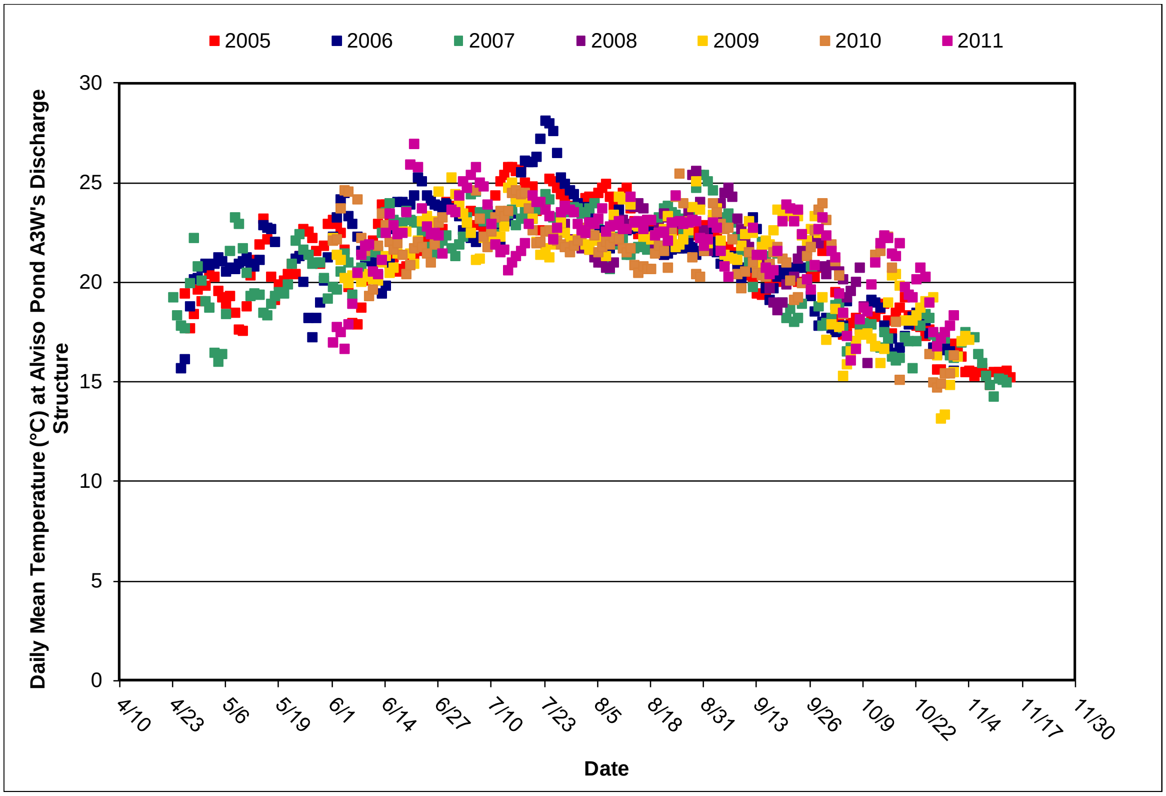
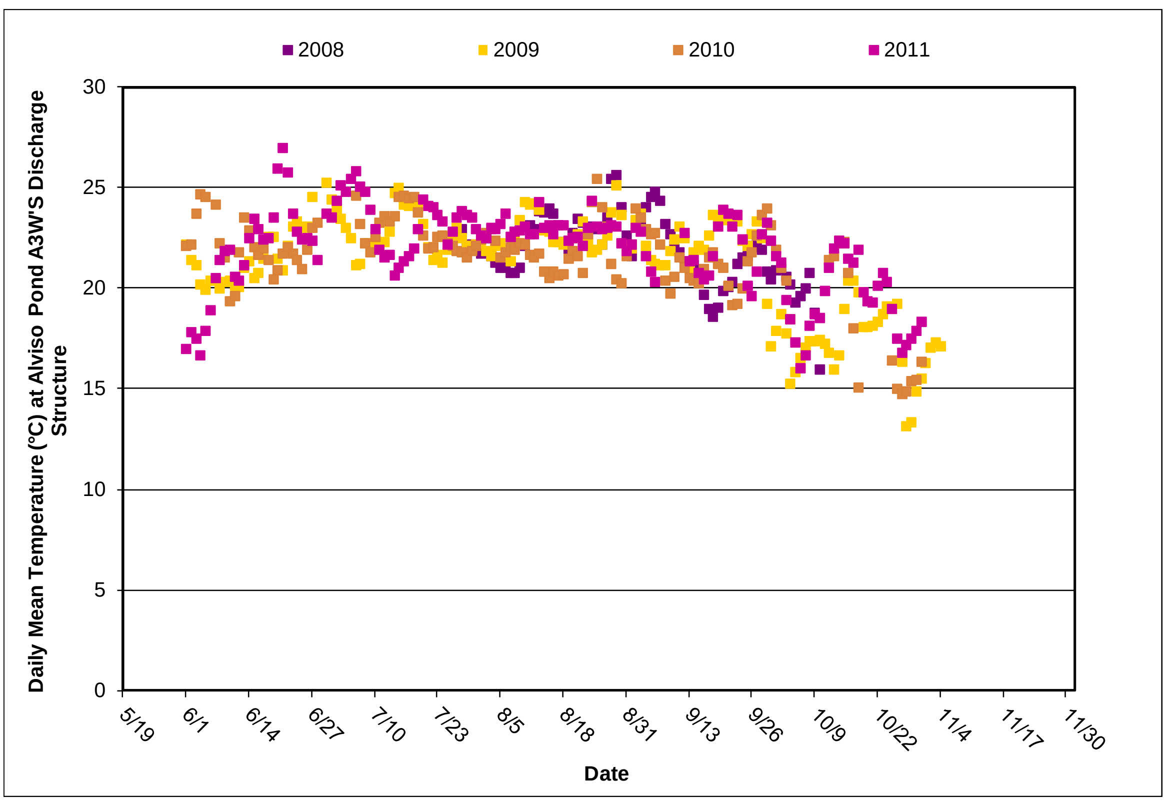


Figure 4.3-19: Daily Mean Temperature for Pond A3W 2008-2011



Daily mean DO concentrations of discharge waters at Pond A3W and within Guadalupe Slough generally decrease throughout the five-month long monitoring program. The highest daily average for DO and the highest weekly 10th-percentile value were both recorded within the first few days of monitoring. Logged in late-September, both the weekly 10th-percentile value (0.50 mg/L) and the daily average DO concentration, at nearly 1.0 mg/L, were the lowest recorded all season. Weekly tenth-percentiles for DO for the 2011 season fell mostly below the 3.33 mg/L threshold; however, there were a few weeks when these values did increase to acceptable levels.

Dissolved oxygen concentrations with Guadalupe Slough were very similar to levels recorded at discharge waters of Pond A3W and the level of vertical stratification within the slough, with respect to DO concentrations, is minimal. The same can be said for the 2010 monitoring season. However, throughout the 2008 and 2009 seasons, DO concentrations within Guadalupe Slough are almost always higher than within discharge waters and the vertical stratification within the slough is more apparent than during the 2011 season. Although the range of DO concentrations recorded at Pond A3W's discharge structure is nearly similar to the past few monitoring seasons, the overall range of DO levels recorded was shifted, positively, this year by 1.0 mg/L (Figures 4.3-20 through 4.3-25).

Figure 4.3-20: DO Concentrations for Pond A3W 2011

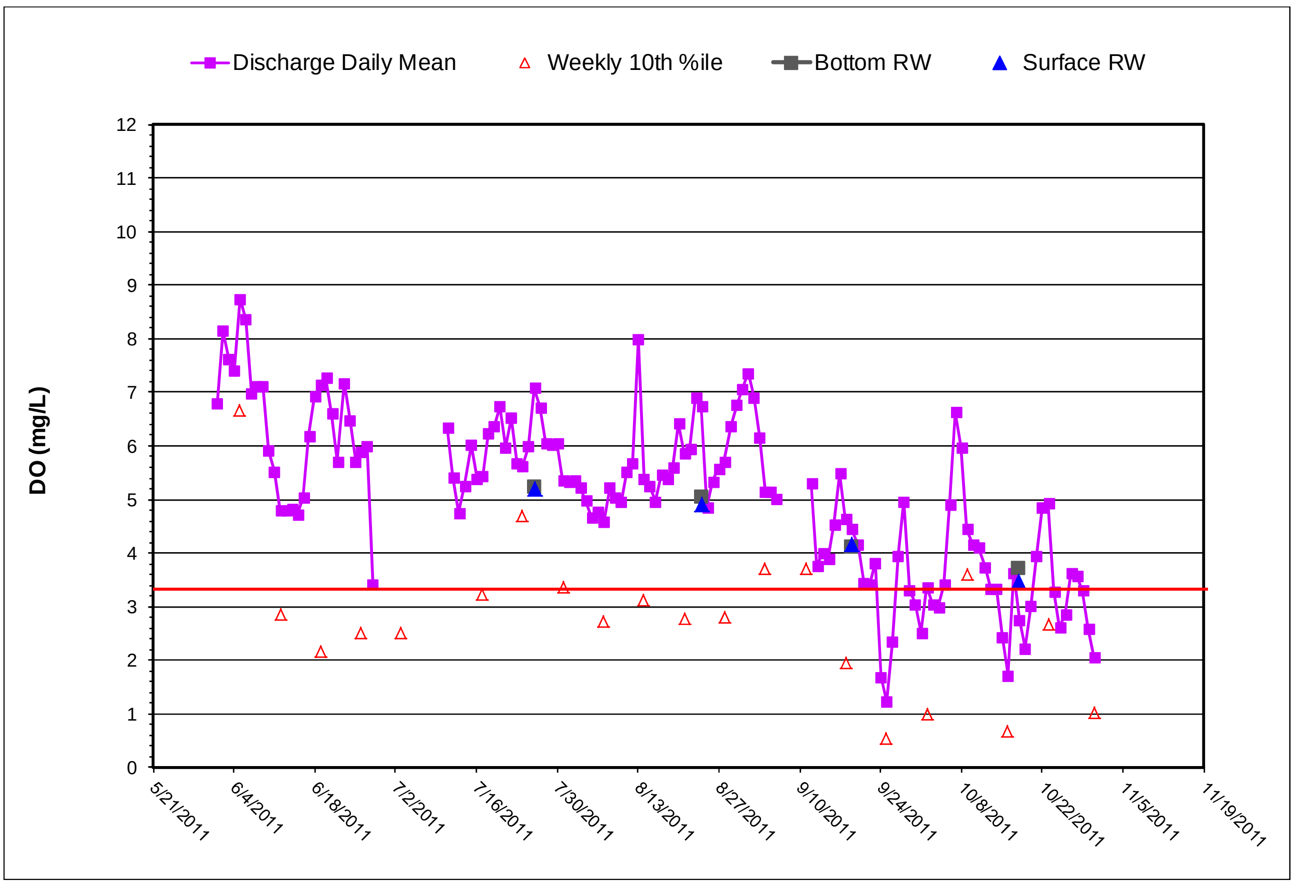


Figure 4.3-21: DO Concentrations for Pond A3W 2010

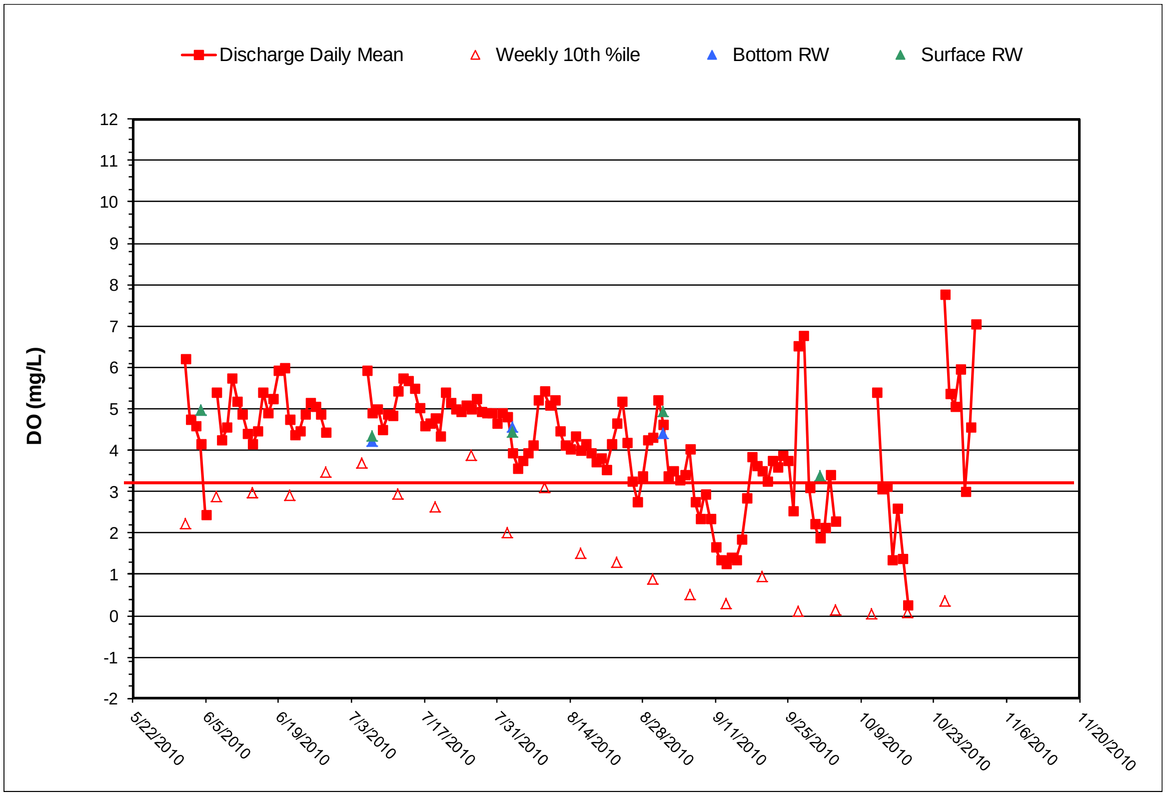


Figure 4.3-22: DO Concentrations for Pond A3W 2009

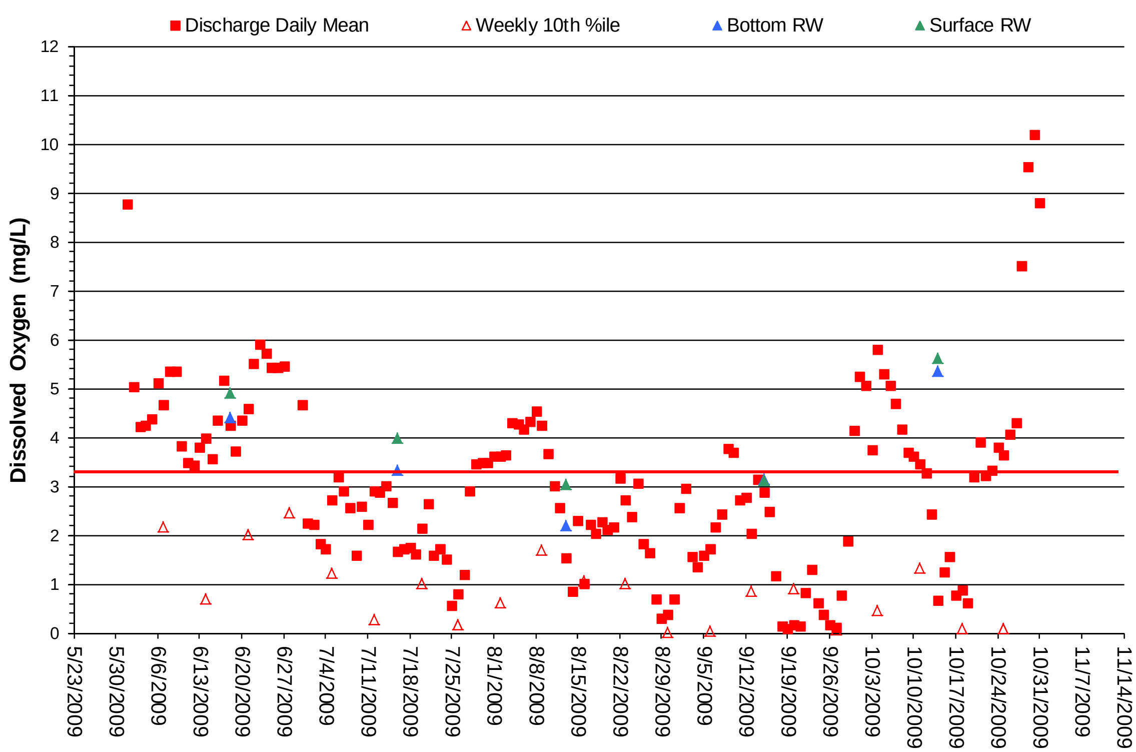


Figure 4.3-23: DO Concentrations for Pond A3W 2008

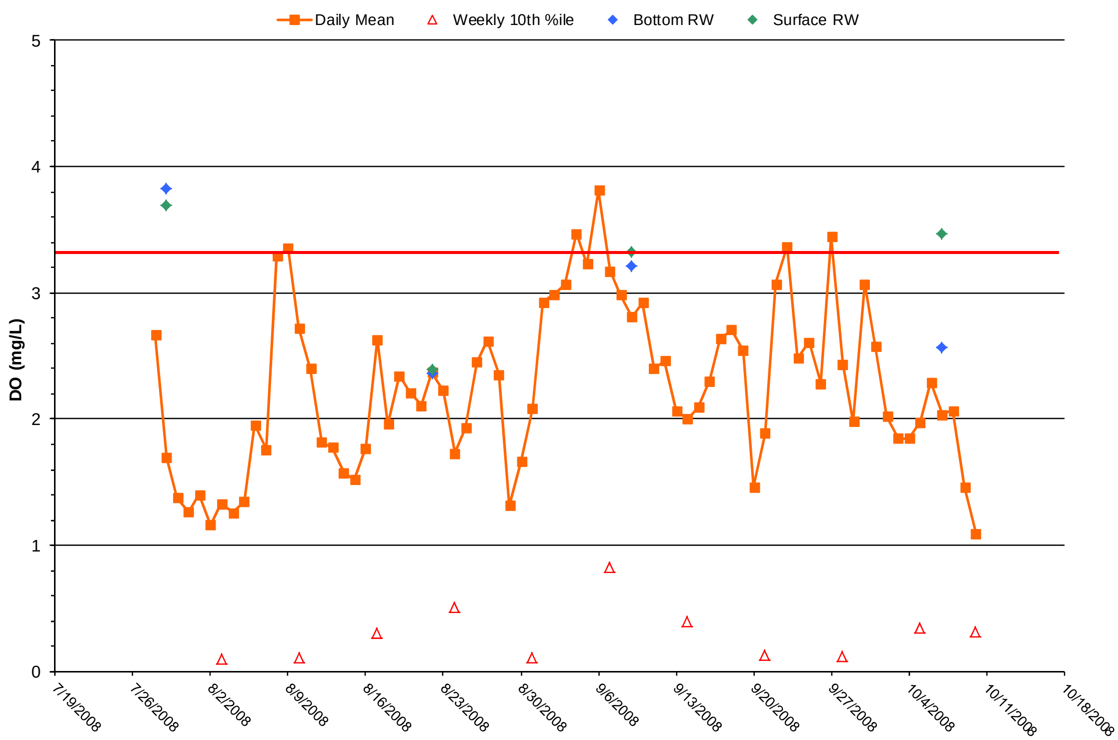


Figure 4.3-24: Daily Mean DO Concentrations for Pond A3W 2005-2011

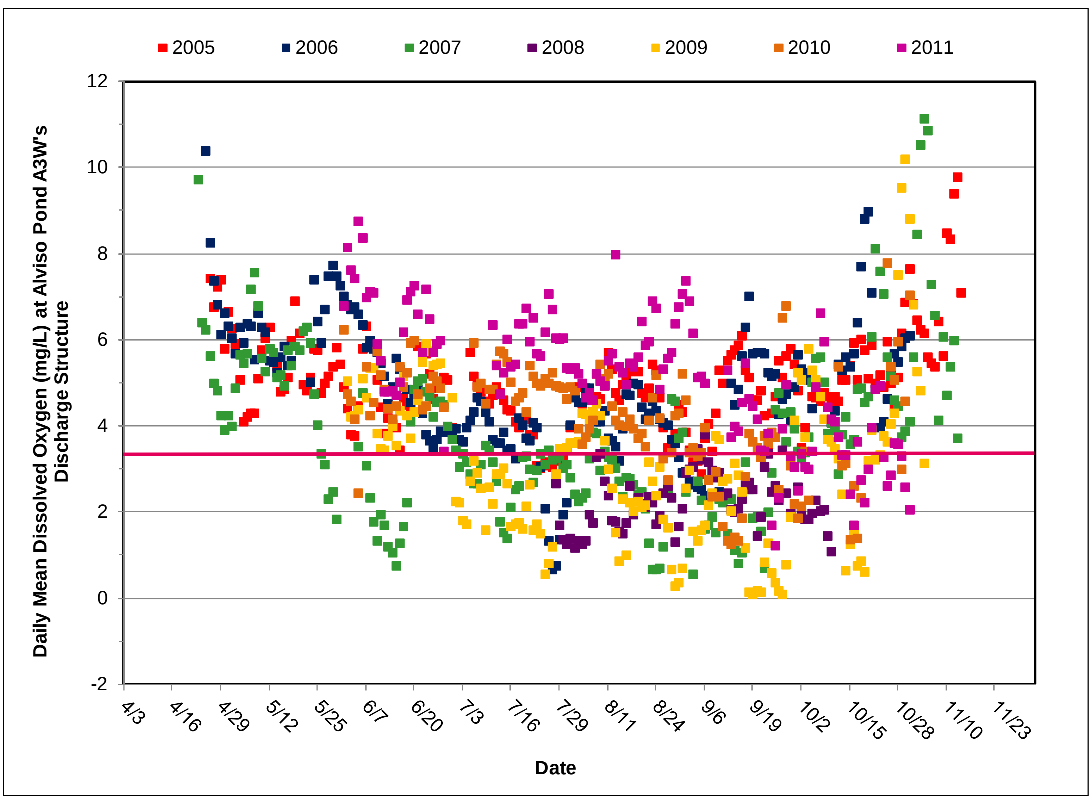


Figure 4.3-25: DO Concentrations for Pond A3W 2008-2011

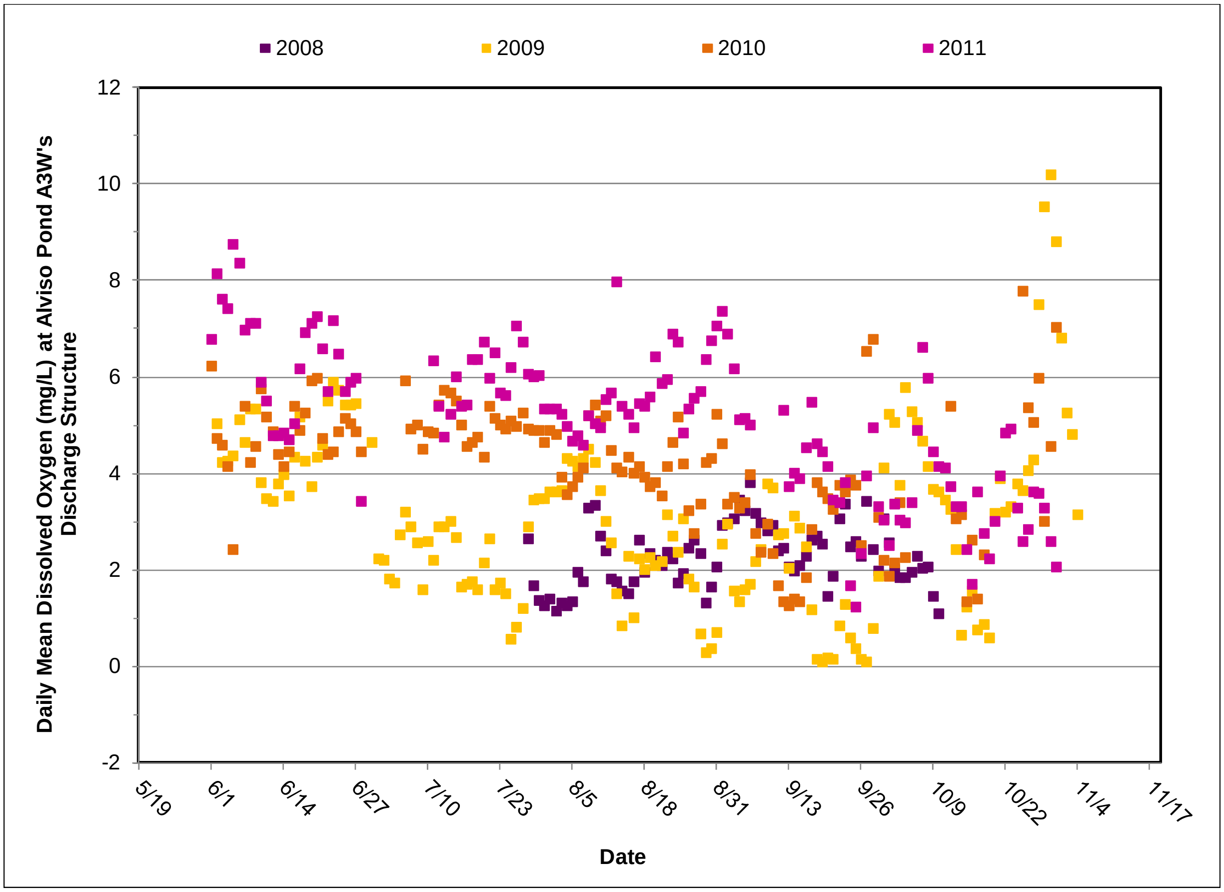


Table 4.3-1: Receiving Water Quality Values (Mean ± Standard Deviation) For Pond A3W

Pond	Date	Depth	Salinity (ppt)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH (Units)
A3W	7/26/2011	Bottom	15.08 ± 2.9	5.24 ± 0.7	21.67 ± 0.2	8.32 ± 0.3
		Surface	14.81 ± 2.7	5.19 ± 0.7	21.84 ± 0.2	8.33 ± 0.3
	8/24/2011	Bottom	16.99 ± 2.2	5.03 ± 0.7	22.92 ± 0.2	8.23 ± 0.3
		Surface	16.51 ± 2.4	4.90 ± 0.7	22.97 ± 0.2	8.22 ± 0.3
	9/19/2011	Bottom	17.03 ± 2.0	4.12 ± 1.0	21.31 ± 0.3	8.16 ± 0.2
		Surface	14.33 ± 2.9	4.16 ± 0.5	21.13 ± 0.1	8.21 ± 0.1
	10/18/2011	Bottom	11.58 ± 2.7	3.72 ± 0.7	21.07 ± 0.1	7.91 ± 0.1
		Surface	15.60 ± 3.0	3.46 ± 1.4	21.18 ± 0.1	7.93 ± 0.1

4.3.3 Pond A7/A8 Receiving Water Samples

Data collected during the 2011 receiving water sampling were compared to average daily values for the same parameter collected at the pond discharge location. For the 2011 season, data was collected at Pond A8's newly installed discharge notch. As this was the first year of monitoring post the initial release, the data collected this year will be compared to data collected at Pond A7's discharge structure from 2005 through 2009 (Figures 4.3-26 through 4.3-30). No continuous monitoring device was installed at Pond A7 during the 2010 season. Salinity concentrations were almost always higher within Pond A7/A8 then within Alviso Slough. The few exceptions to this general rule occurred this year; salinity levels within Alviso Slough during late-July and late-September of the 2011 monitoring season were equal to, or slightly elevated from, salinity concentrations recorded at Pond A8's discharge notch during the same time frame. As seen during monitoring seasons 2008, 2009, and 2010, vertical stratification of salinity concentrations within Alviso Slough was also evident this year. Sampling conducted in July, August, and September of this season show roughly a 4.0 ppt difference between bottom and surface waters. The degree of this stratification is reduced to only a 1.0 ppt difference between bottom and surface waters during sampling conducted in mid-October of 2011. When comparing the degree of stratification recorded within Alviso Slough this year to past monitoring efforts, data recorded during the 2011 seasons show a reduced amount in variability between the salinity concentrations recorded at bottom and surface waters. In previous years, this difference in salinity levels between bottom and surface waters has been as great as 16.7 ppt, which was logged in mid-October during the 2009 season. Overall, salinity concentrations recorded at Pond A8's discharge notch this year were very similar to concentrations logged at Pond A7 during the 2006 monitoring season. However, the length of the 2006 monitoring season, starting on the 25th of April and ending on the 12th of June, was much shorter than all other years of monitoring. Salinity levels recorded at Pond A7's discharge structure during monitoring years 2005, 2007, 2008, and 2009 show salinity levels increasing steadily until early-September. After this point salinity concentrations at Pond A7 decrease until the 31st of October, the last day of monitoring. However, salinity levels recorded this year at Pond A8's discharge notch show decreasing concentrations until early-September. Salinity concentrations then increased steadily until the end of the 2011 monitoring program.

Figure 4.3-26: Salinity from Pond A8 Discharge 2011

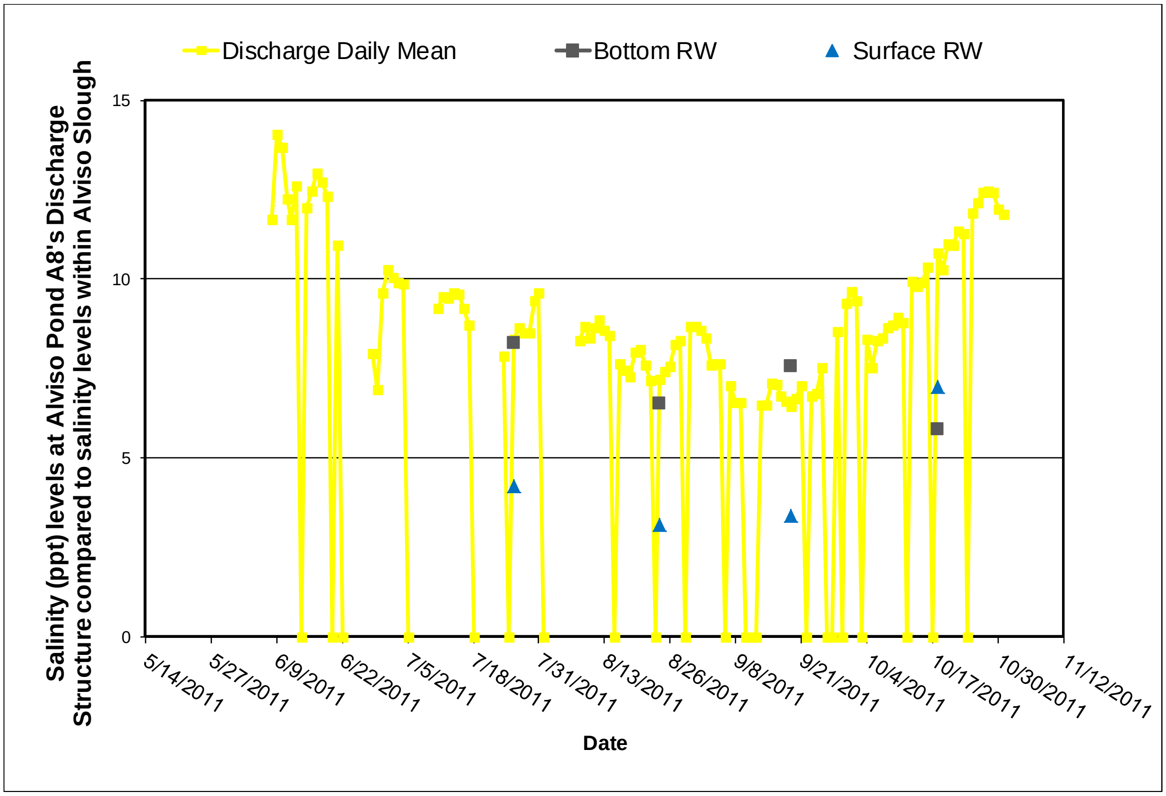


Figure 4.3-27: Salinity from Pond A7 Discharge 2009

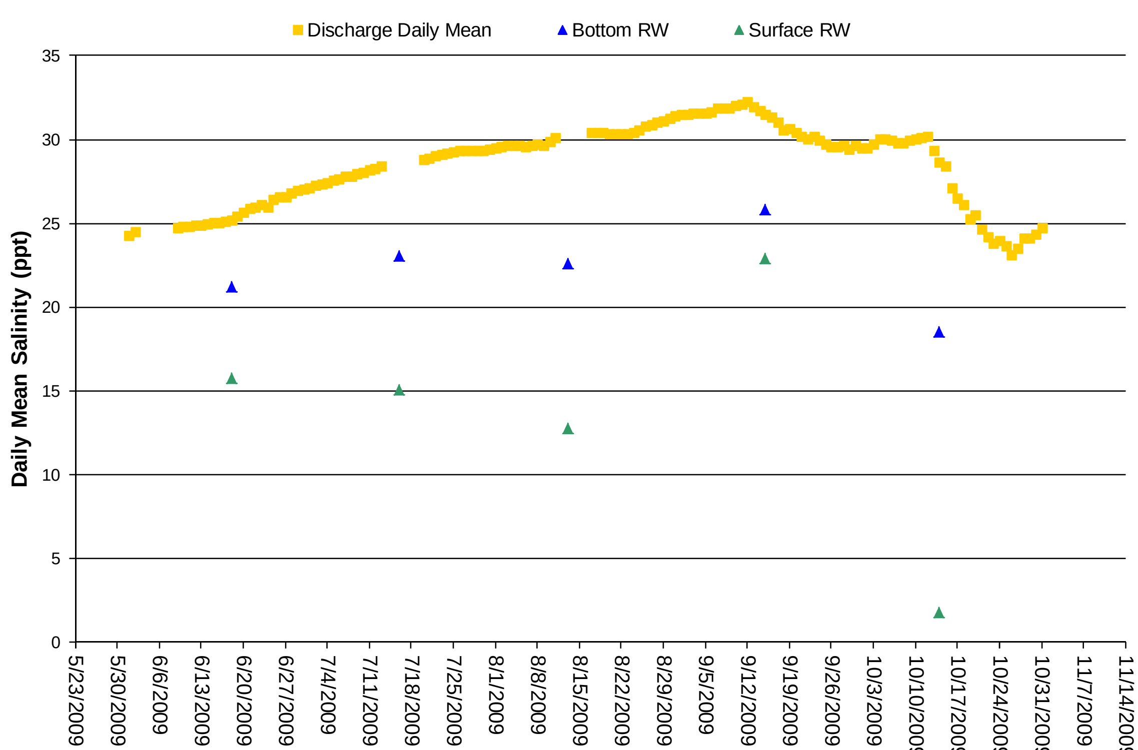


Figure 4.3-28: Salinity from Pond A7 Discharge 2008

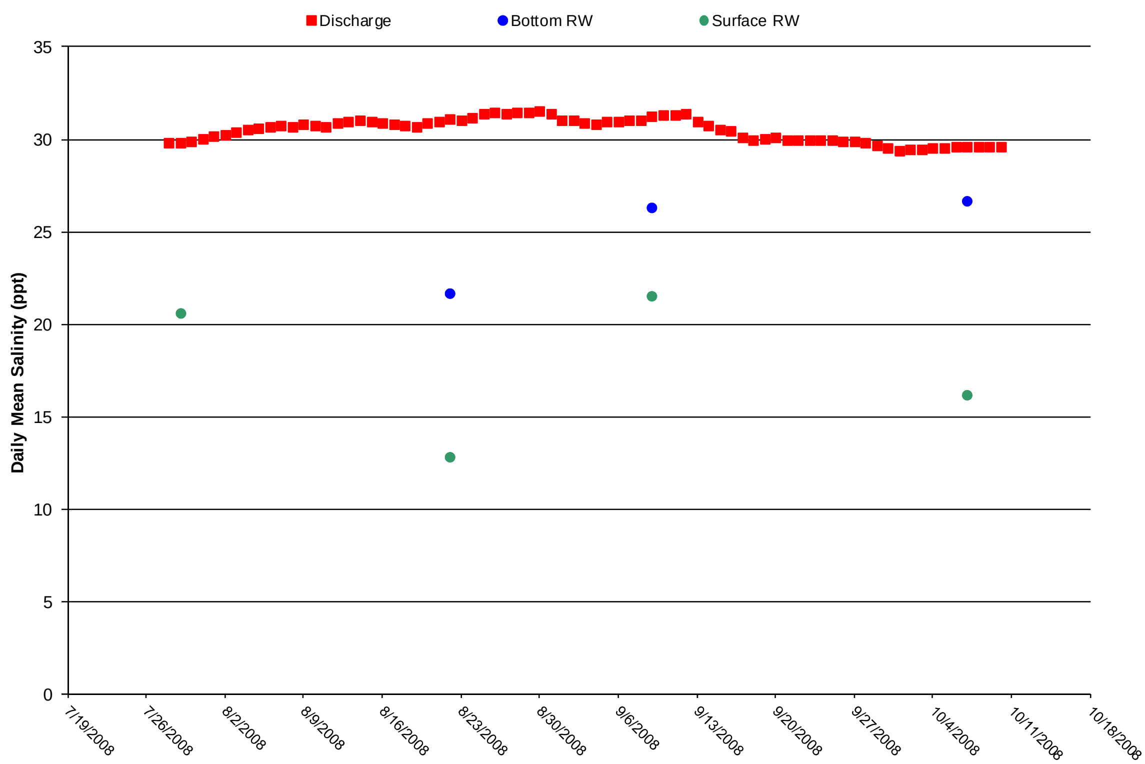


Figure 4.3-29: Salinity from Pond A7/A8 Discharge 2005-2011

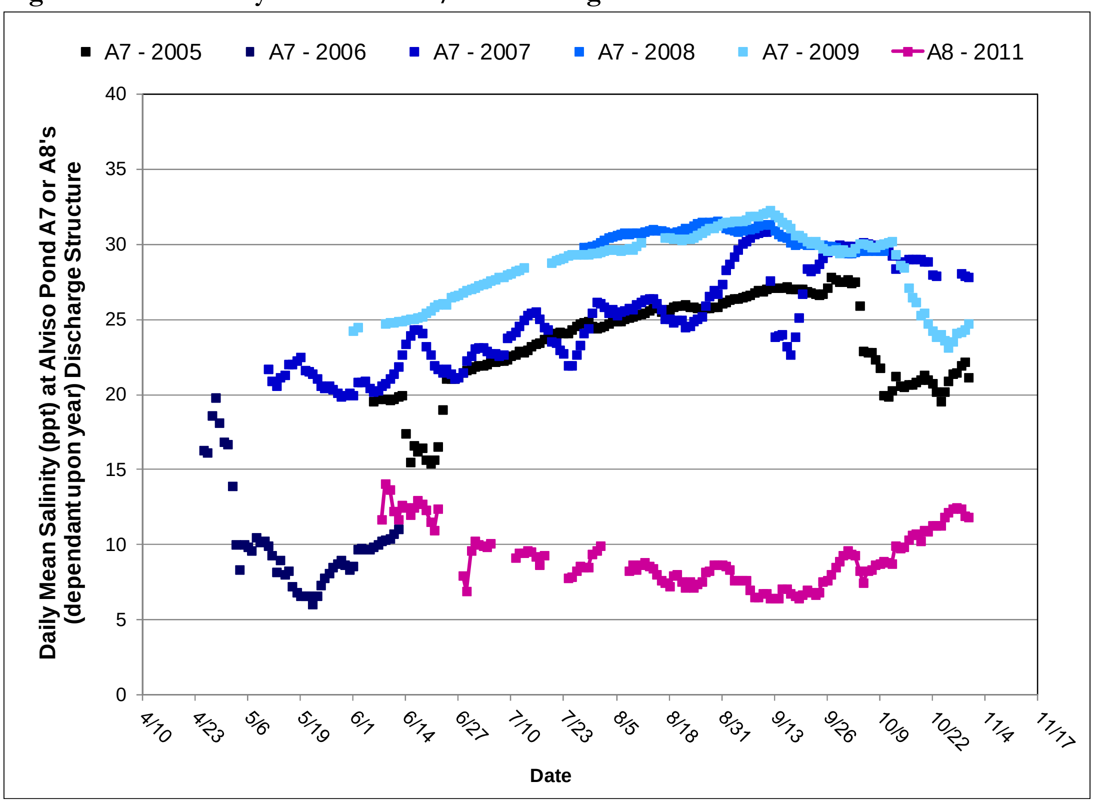
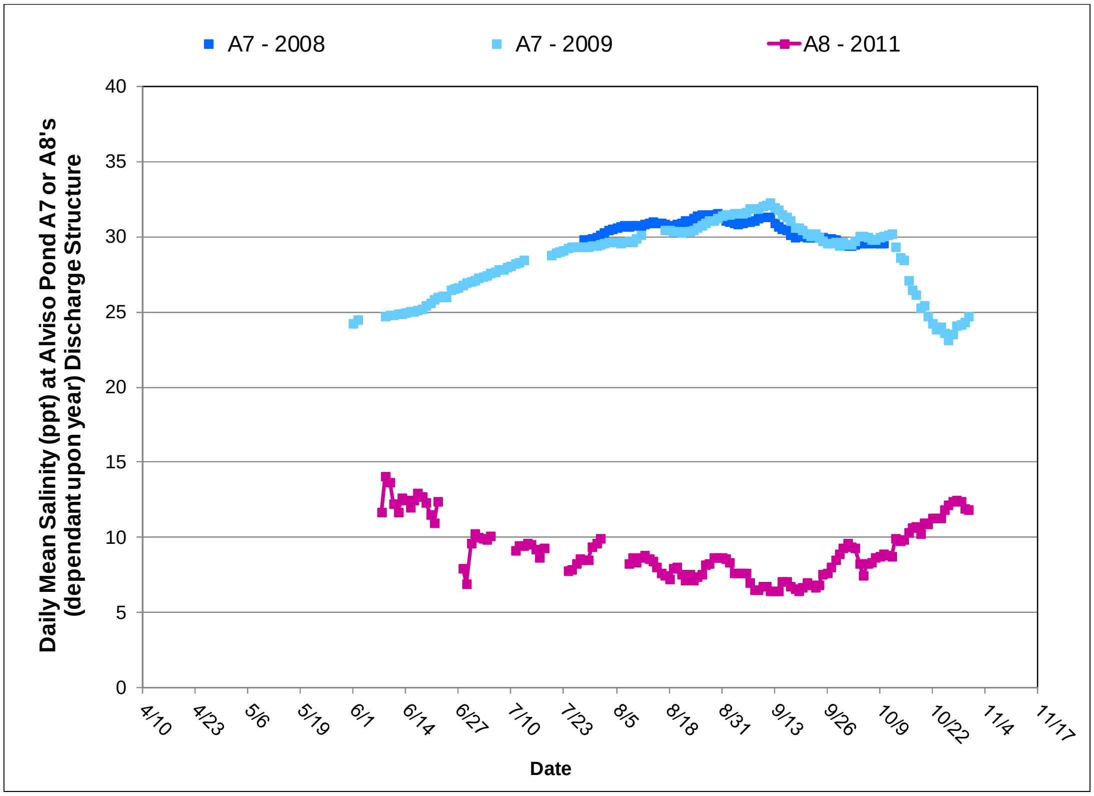


Figure 4.3-30: Salinity from Pond A7/A8 Discharge 2008, 2009, and 2011



At Pond A8 this year, pH levels fluctuated throughout the monitoring season. As with salinity concentrations at Pond A8, pH levels recorded during the 2011 season were almost always higher within the pond than within Alviso Slough. There was one exception to this trend; September receiving water sampling reported higher pH concentrations near the bottom of the water column of Alviso Slough than recorded at the discharge notch for Pond A8. Excluding the 2007 monitoring season, when pH levels within Alviso Slough were higher than levels recorded at Pond A7 on several occasions, pH levels within the slough are usually lower than those recorded near either pond's discharge structure. Comparing data collected this year at Pond A8, pH concentrations were most similar to data collected at Pond A7 during 2008 and 2009 (Figures 4.3-31 through 4.3-36). Although pH levels recorded at Pond A8 this year were more variable than those recorded at Pond A7 during 2008 and 2009, pH levels generally decrease until early-October and then increase slightly throughout the last month of monitoring. Vertical stratification of pH levels within Alviso Slough was apparent this year as with every other year of monitoring (2005-2010). Most often, pH levels were greater near the bottom of the water column than near the surface; the same was true for the 2011 monitoring season.

Figure 4.3-31: pH from Pond A8 Discharge 2011

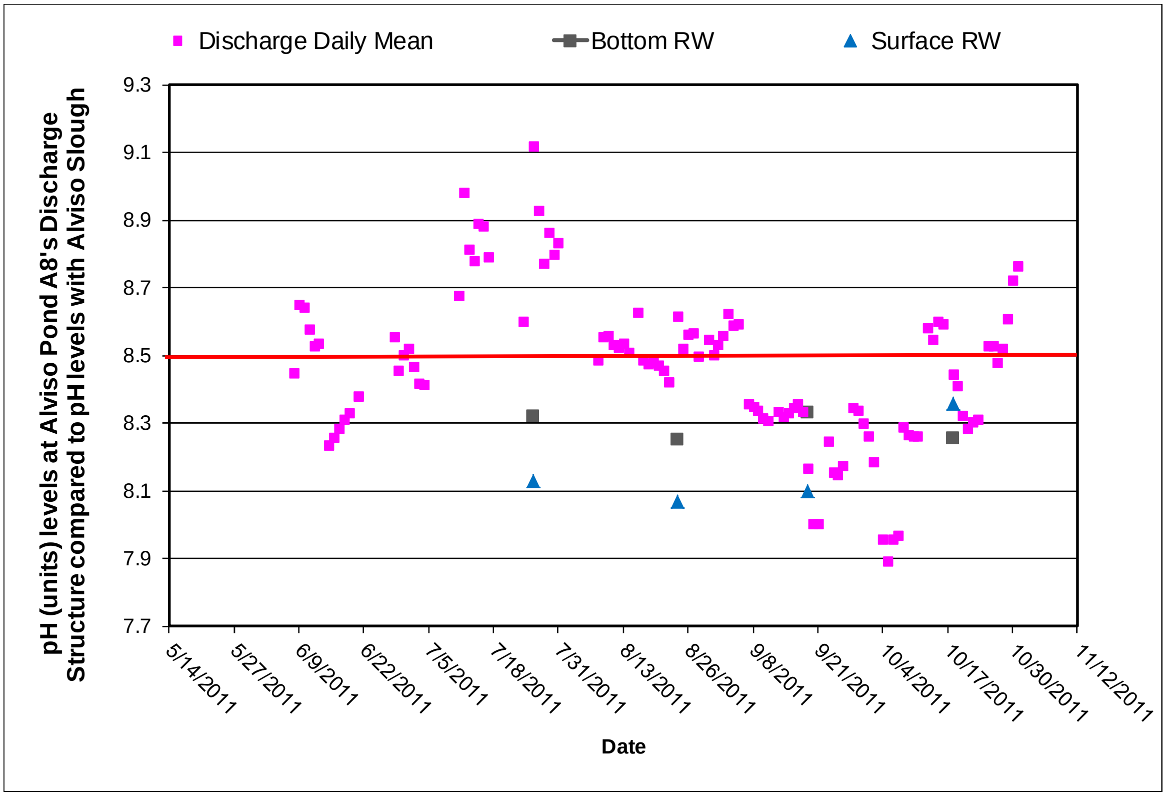


Figure 4.3-32: pH from Pond A7 Discharge 2009

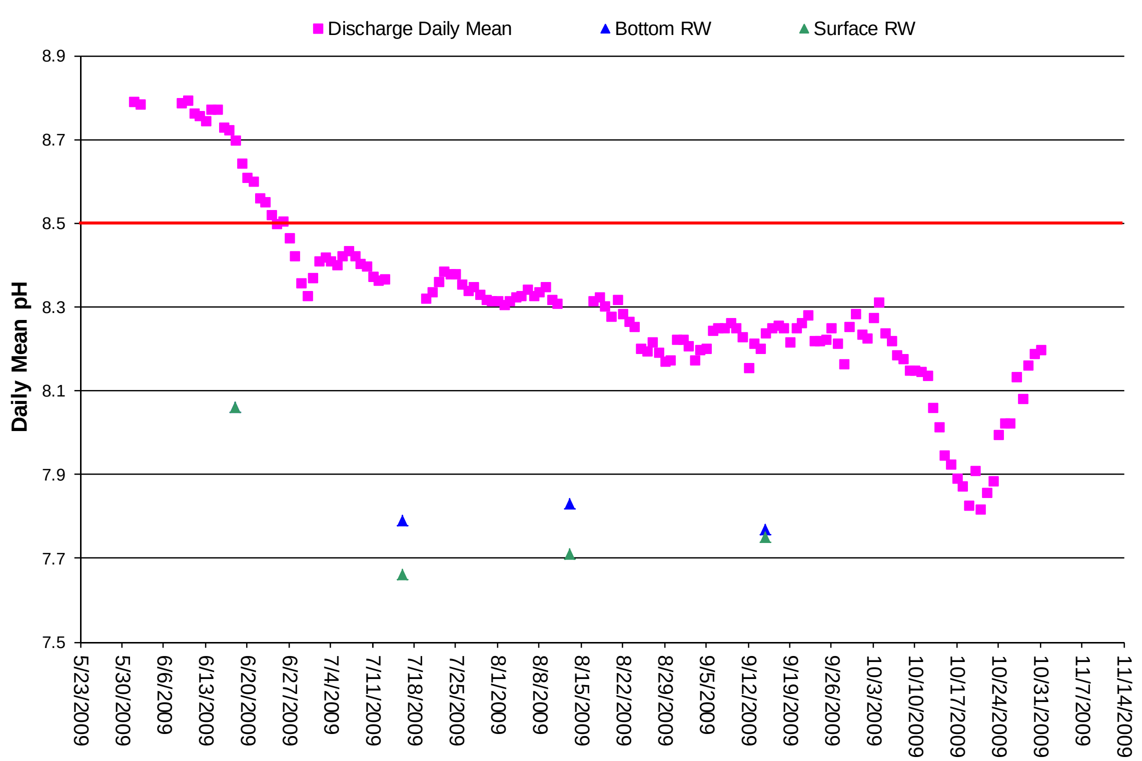


Figure 4.3-33: pH from Pond A7 Discharge 2008

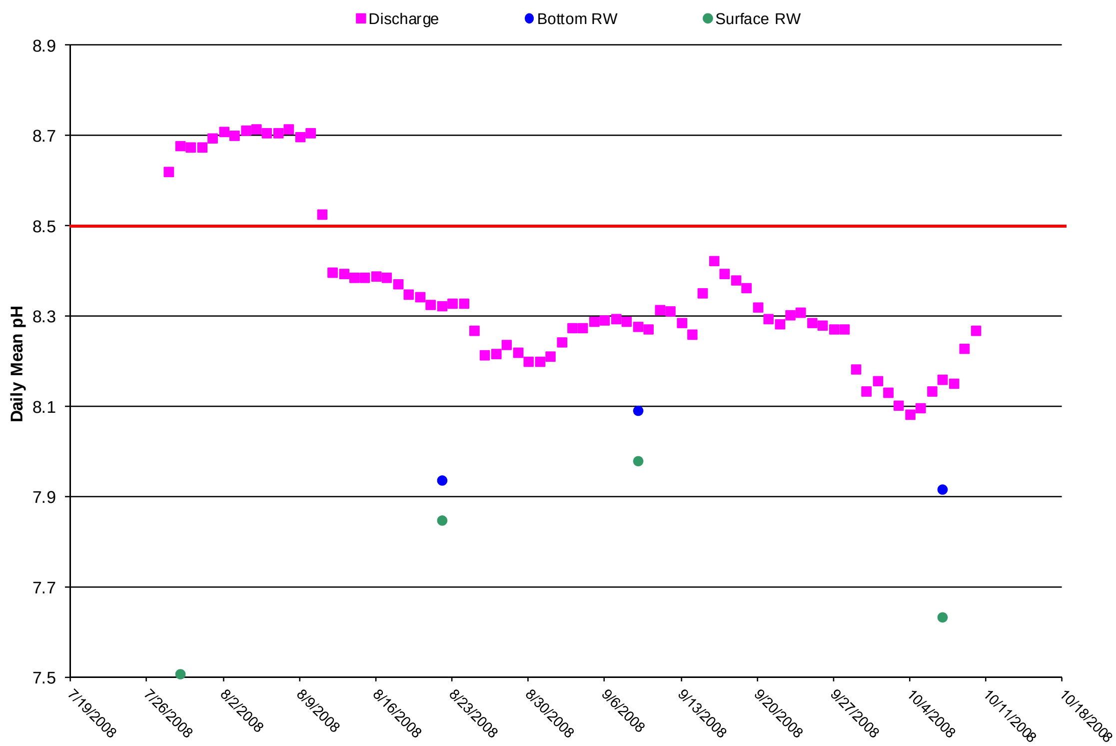


Figure 4.3-34: pH from Pond A7 Discharge 2007

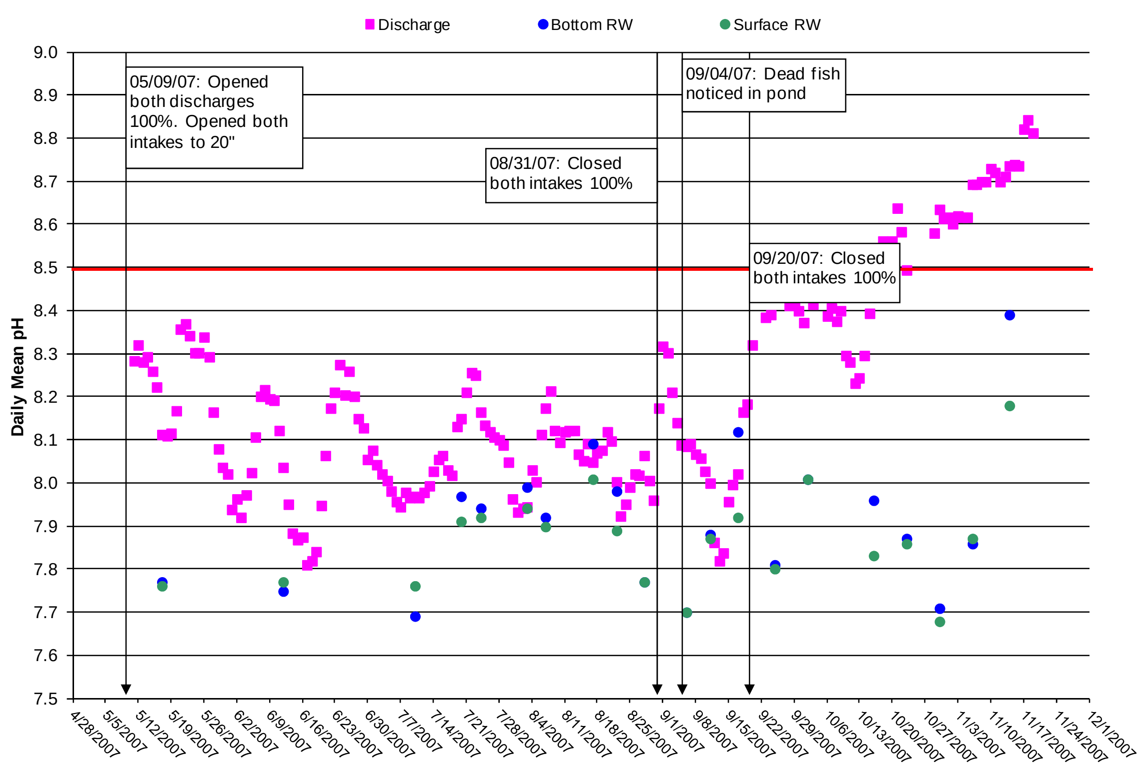


Figure 4.3-35: pH from Pond A7/A8 Discharge 2005-2011

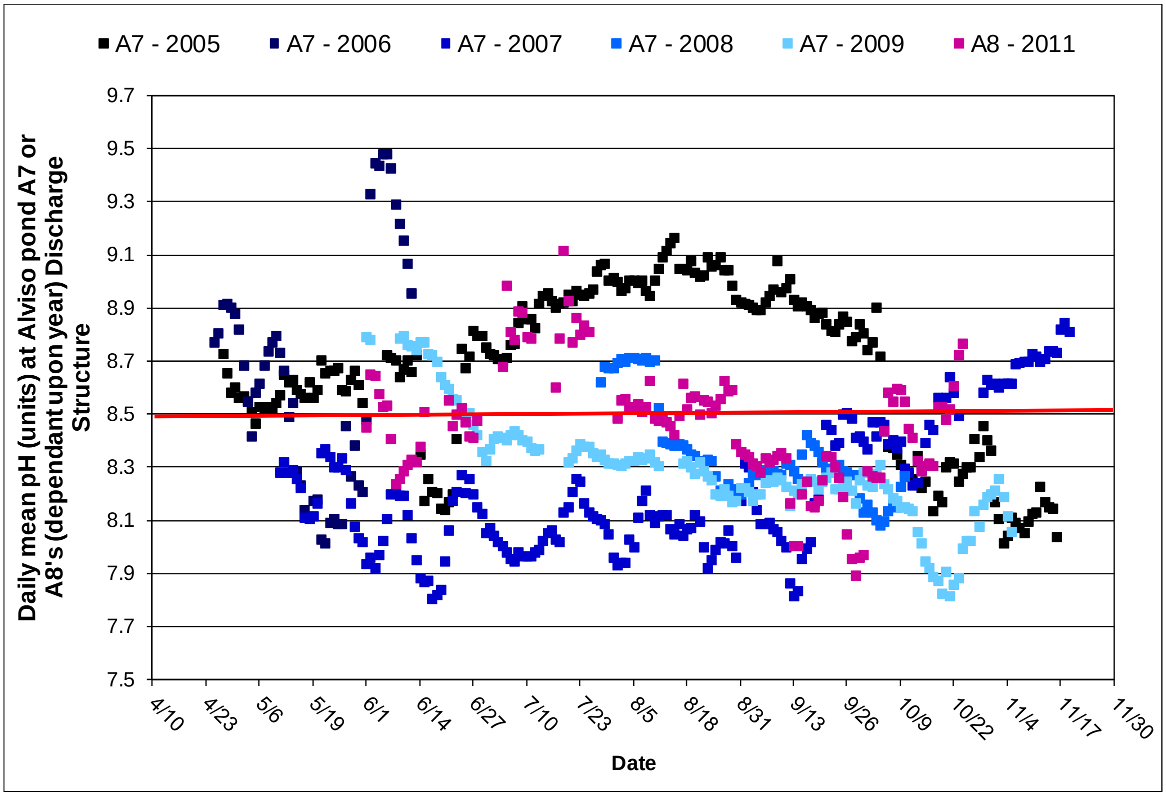
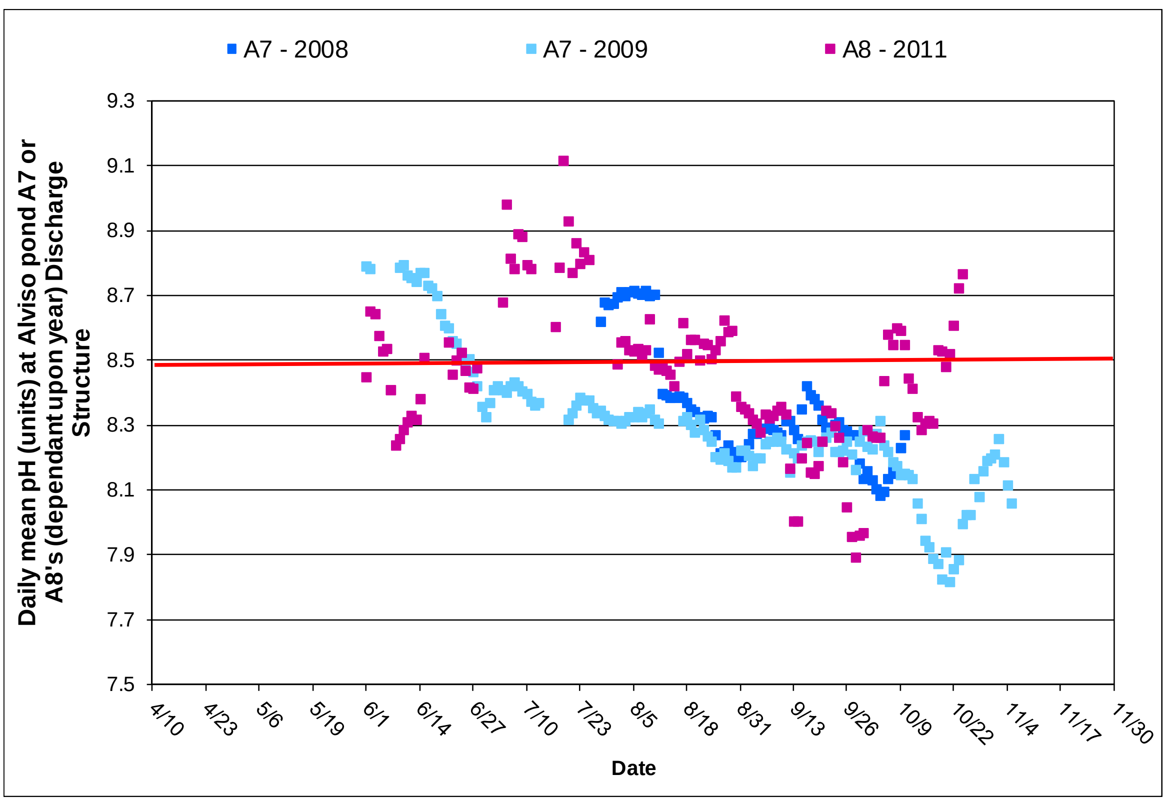


Figure 4.3-36: pH from Pond A7/A8 Discharge 2008, 2009, and 2011



Water temperatures logged at Pond A8's discharge notch this year were similar to those recorded at Pond A7 during monitoring years 2005-2009 (Figures 4.3-37 through 4.3-39). As seen throughout these monitoring years, water temperatures within Alviso Slough were very similar to those recorded at both Pond A7 and Pond A8. True for all monitoring years, vertical stratification of water temperatures within Alviso Slough was obvious. The degree of this stratification has differed throughout the years and is very minimal during the 2011 season (Figures 4.3-40 through 4.3-42).

Figure 4.3-37: Temperature from A8 Discharge 2011

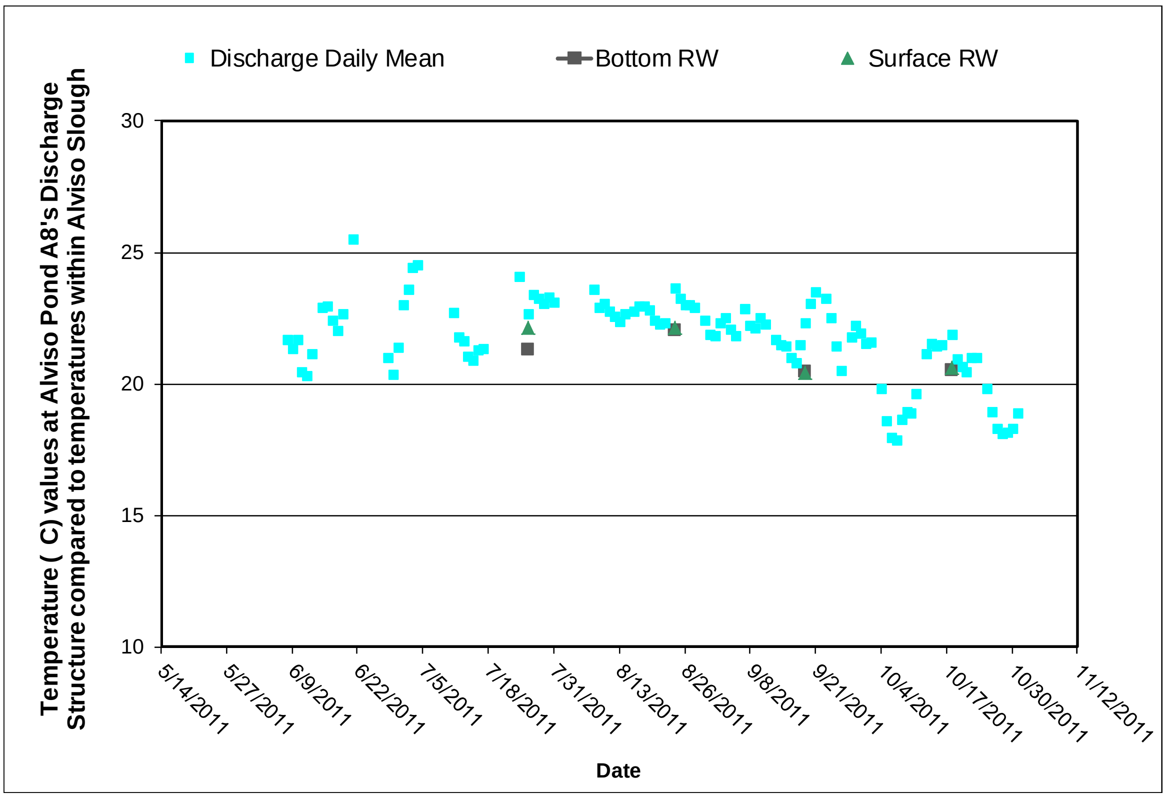


Figure 4.3-38: Temperature from A7 Discharge 2009

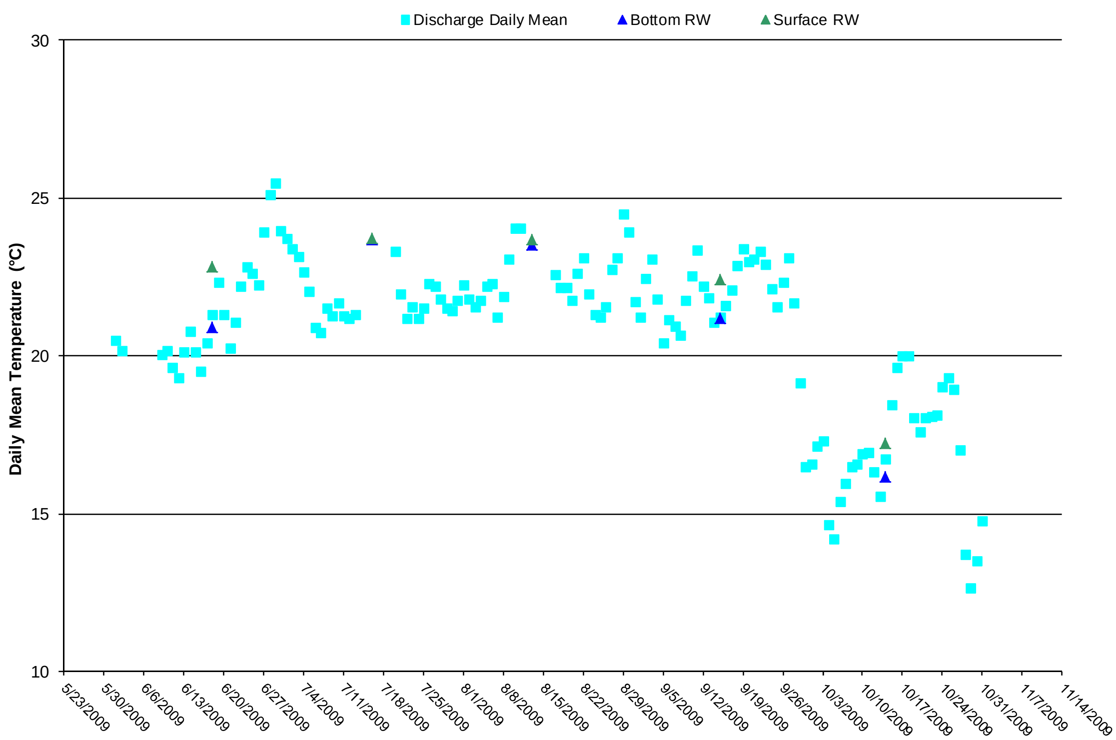


Figure 4.3-39: Temperature from A7 Discharge 2008

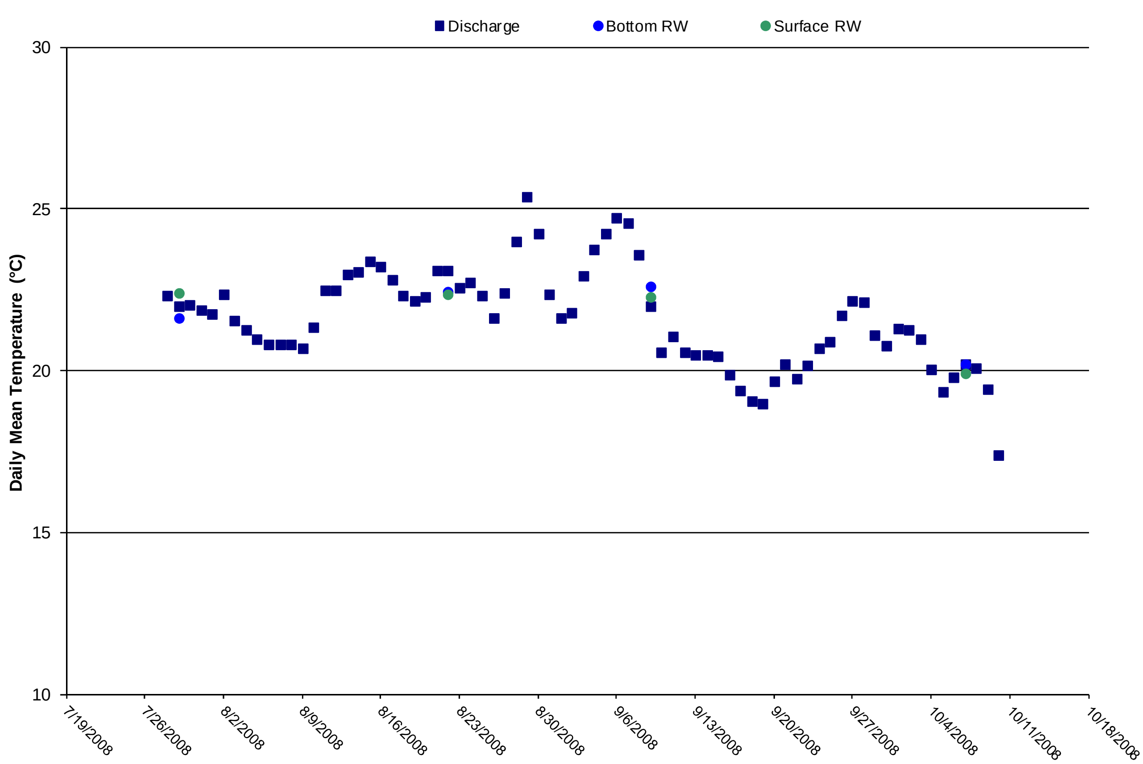


Figure 4.3-40: Temperature graph from A7 Discharge 2007

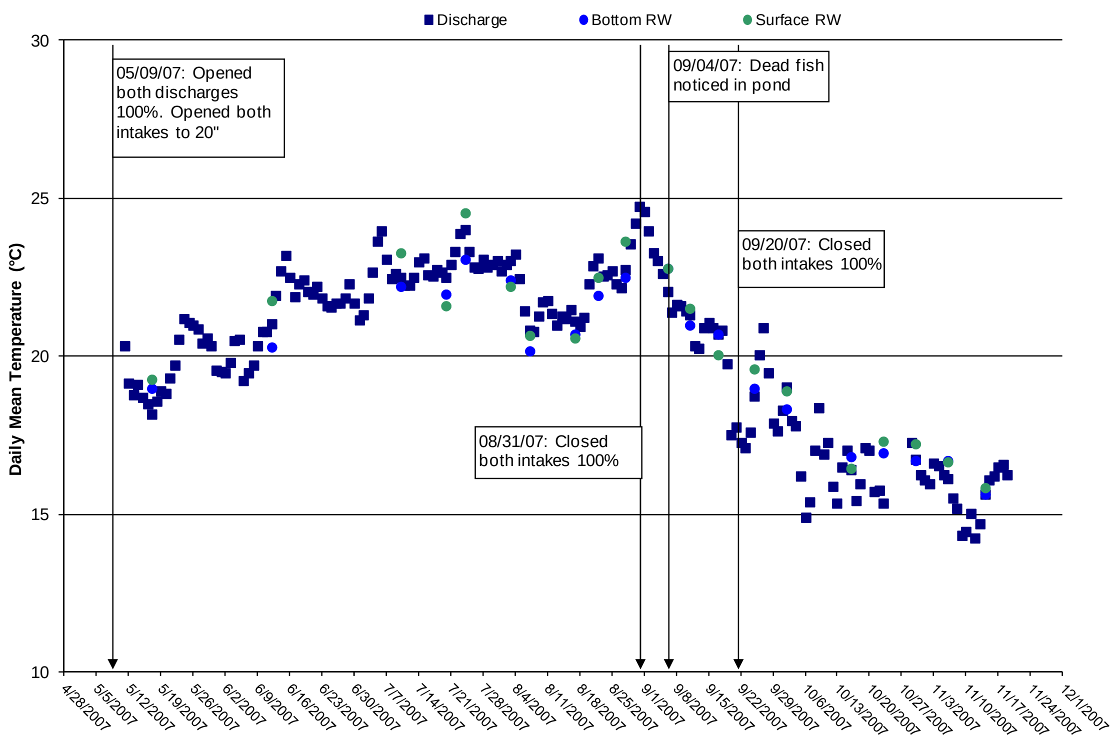


Figure 4.3-41: Temperature from A7.A8 Discharge 2005-2011

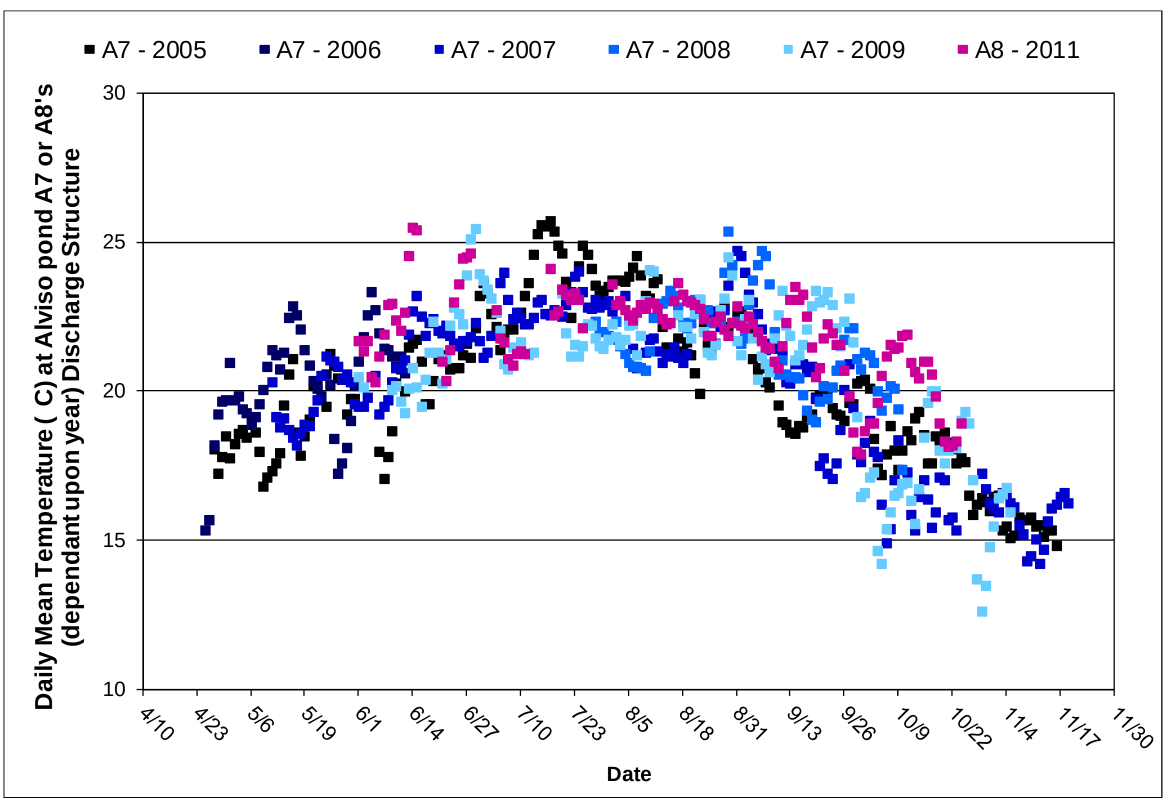
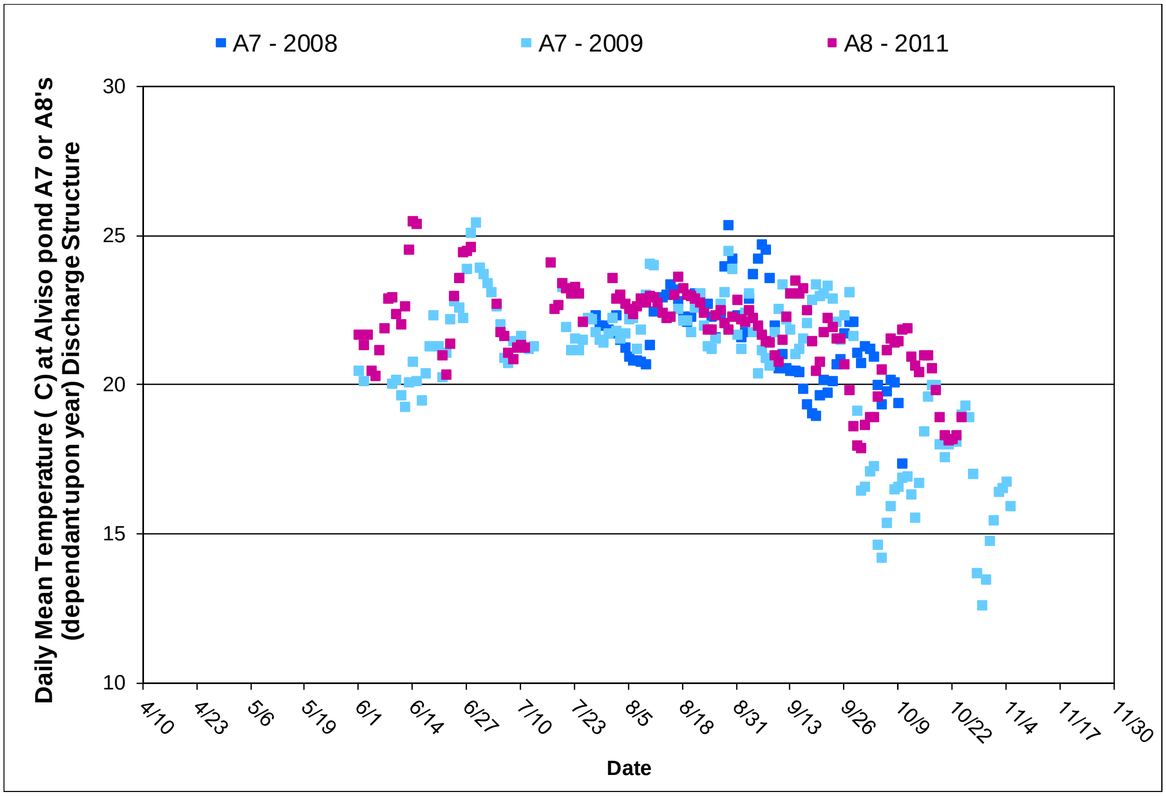


Figure 4.3-42: Temperature from A7.A8 Discharge 2008, 2009, and 2011



Daily mean DO concentrations at Pond A8's discharge notch rarely fell below the 3.33 mg/L threshold during the 2011 monitoring season. In fact, there were only three days during the 2011 season in which the daily average for DO concentration fell below this threshold. One of these instances occurred during late-September when DO concentrations fell to 3.32 mg/L, narrowly missing the threshold cut-off. In late-October there were two consecutive days where the daily DO average fell to around 2.50 mg/L. From June through mid-October, DO averages range from 4.0 mg/L to 10.0 mg/L. After mid-October, daily averages for DO concentrations at Pond A8's discharge notch begin to increase, ultimately to a high of 14.0 mg/L which was logged on the 30th of October. The majority of weekly tenth-percentile values logged at Pond A8 this year remain above the 3.33 mg/L threshold. However, there were several weeks late in the season when the weekly tenth-percentile value for DO concentrations fell below the threshold. Generally speaking, DO concentrations recorded at Pond A8 this year were higher than those recorded at Pond A7 during the monitoring seasons 2005-2009. When making a comparison, DO concentrations logged this year at Pond A8 were most similar to DO levels recorded at Pond A7's discharge structure during the 2005 and 2006 monitoring seasons. Although the majority of average daily DO concentrations logged at Pond A7 during these two years remain above the 3.33 mg/L threshold, the range in DO concentrations and weekly tenth-percentile values were unquestionably higher at Pond A8 for the 2011 season.

Throughout the entire 2011 monitoring season DO concentrations were higher within discharge waters of Pond A8 than within Alviso Slough. A steady decrease in DO concentrations within Alviso Slough can be seen over the course of the 2011 monitoring season. Despite this decrease, DO concentrations within the slough never fell below the 3.33 mg/L threshold for the 2011 season. Vertical stratification of DO concentrations within the slough was most apparent during sampling conducted in August and September. At most, surface waters within Alviso Slough were 1.30 mg/L higher in concentration for DO than water sampled from the bottom of the water column. Vertical stratification of DO levels within Alviso Slough has been much more pronounced outside of Pond A7's discharge structure than for Pond A8's discharge notch (Figures 4.3-43 through 4.3-50).

Figure 4.3-43: DO from A8 Discharge 2011

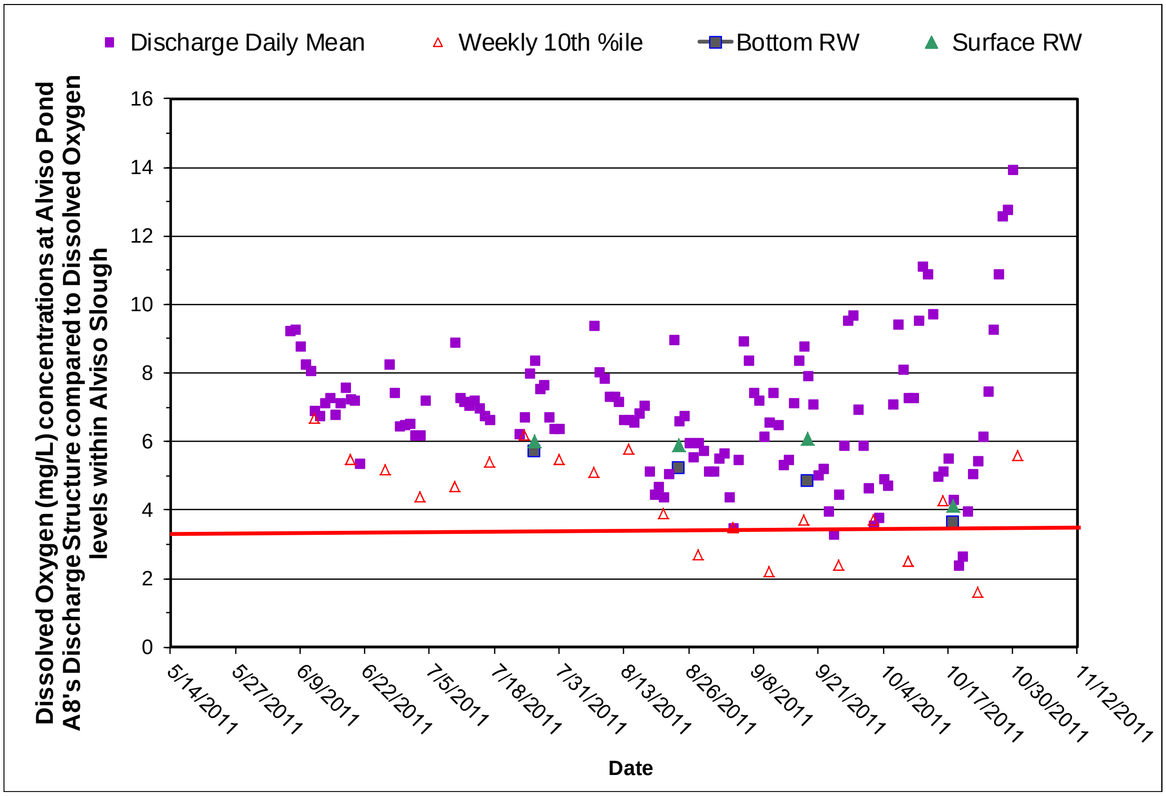


Figure 4.3-44: DO from A7 Discharge 2009

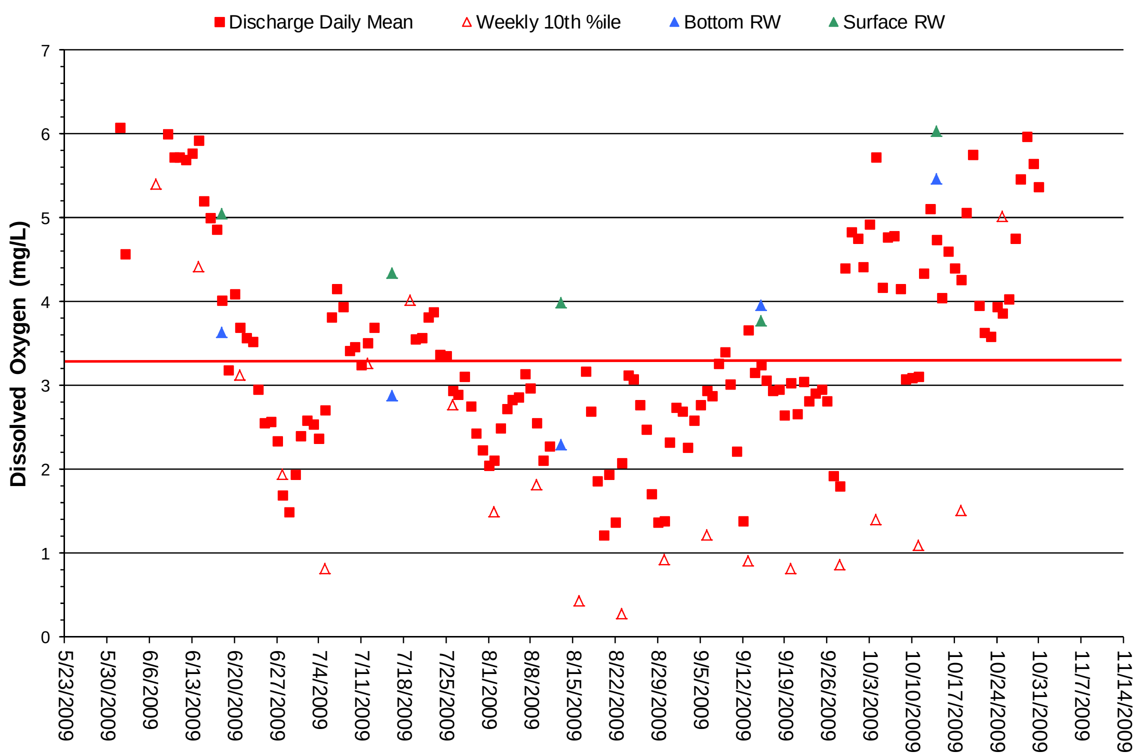


Figure 4.3-45: DO from A7 Discharge 2008

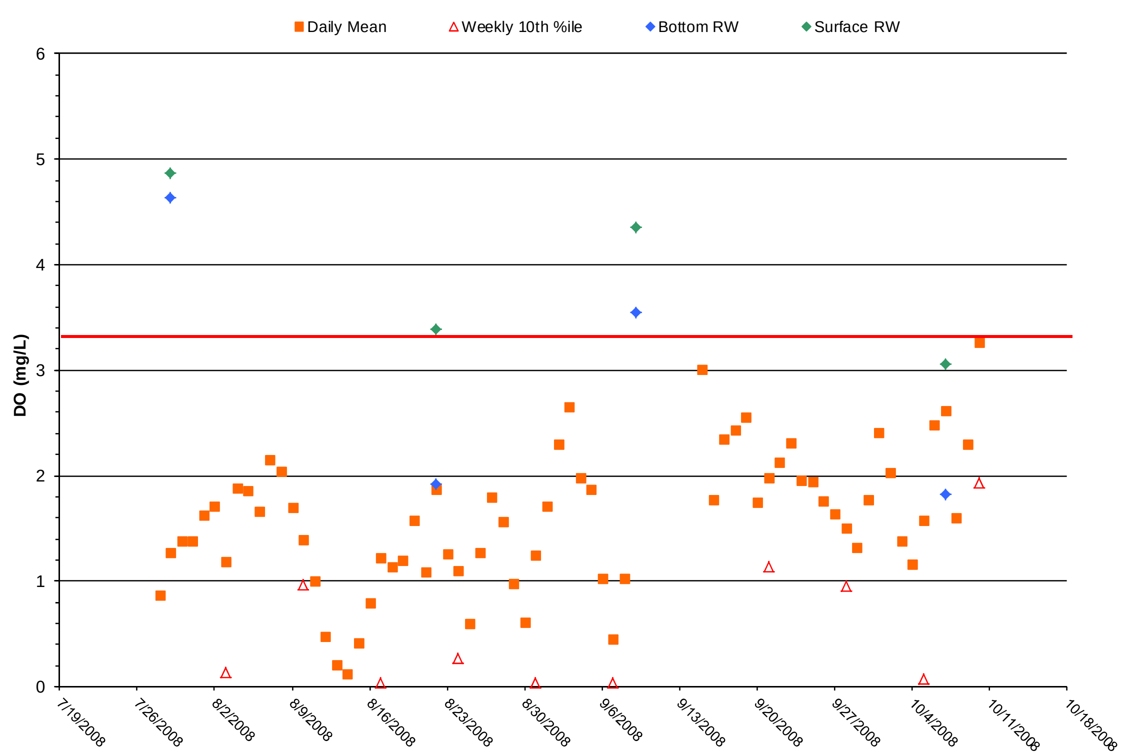


Figure 4.3-46: DO from A7 Discharge 2007

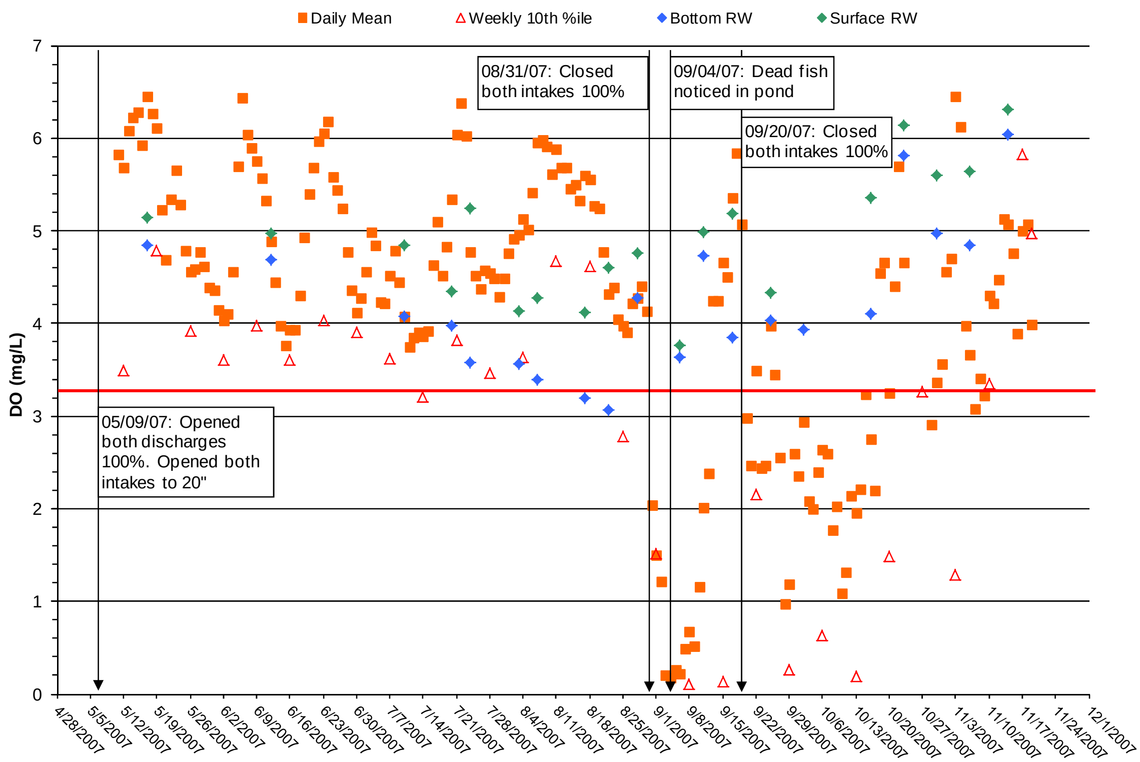


Figure 4.3-47: DO from A7.A8 Discharge 2005- 2011

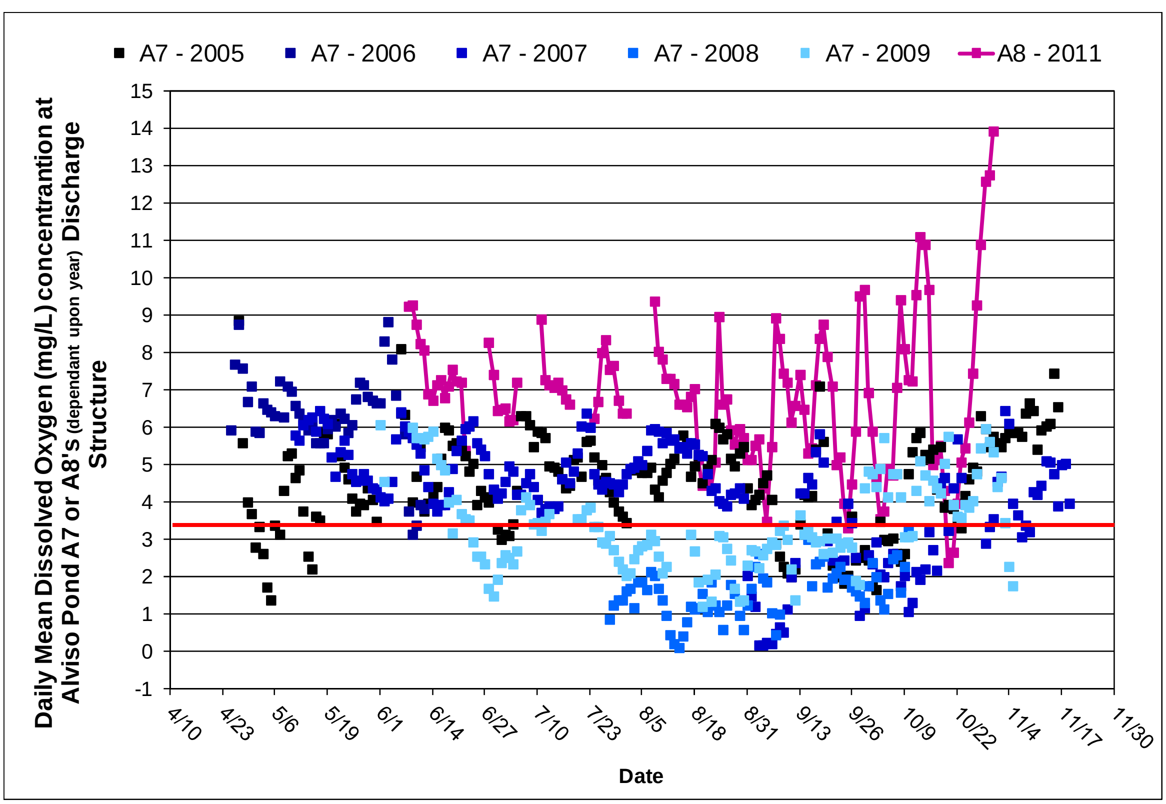


Figure 4.3-48: DO from A7.A8 Discharge 2008-09, 2011

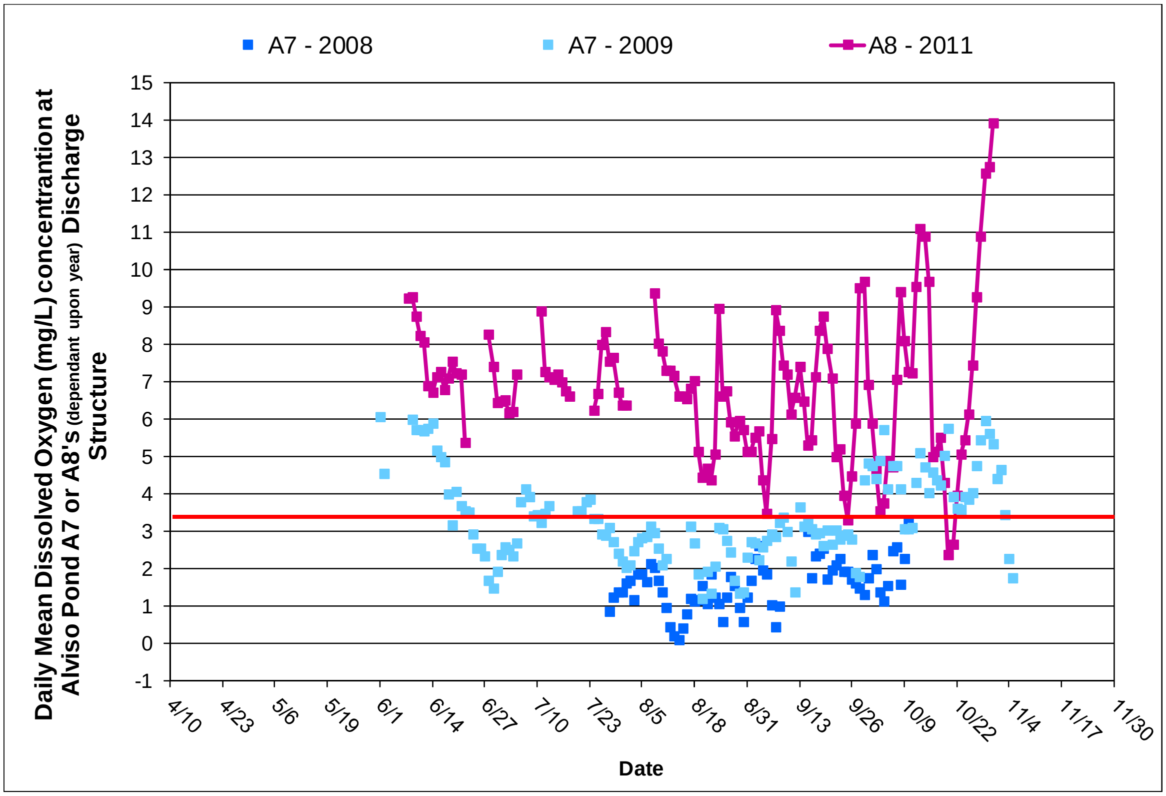


Figure 4.3-49: Weekly 10th Percentile Values for A7/A8 DO 2005-2011

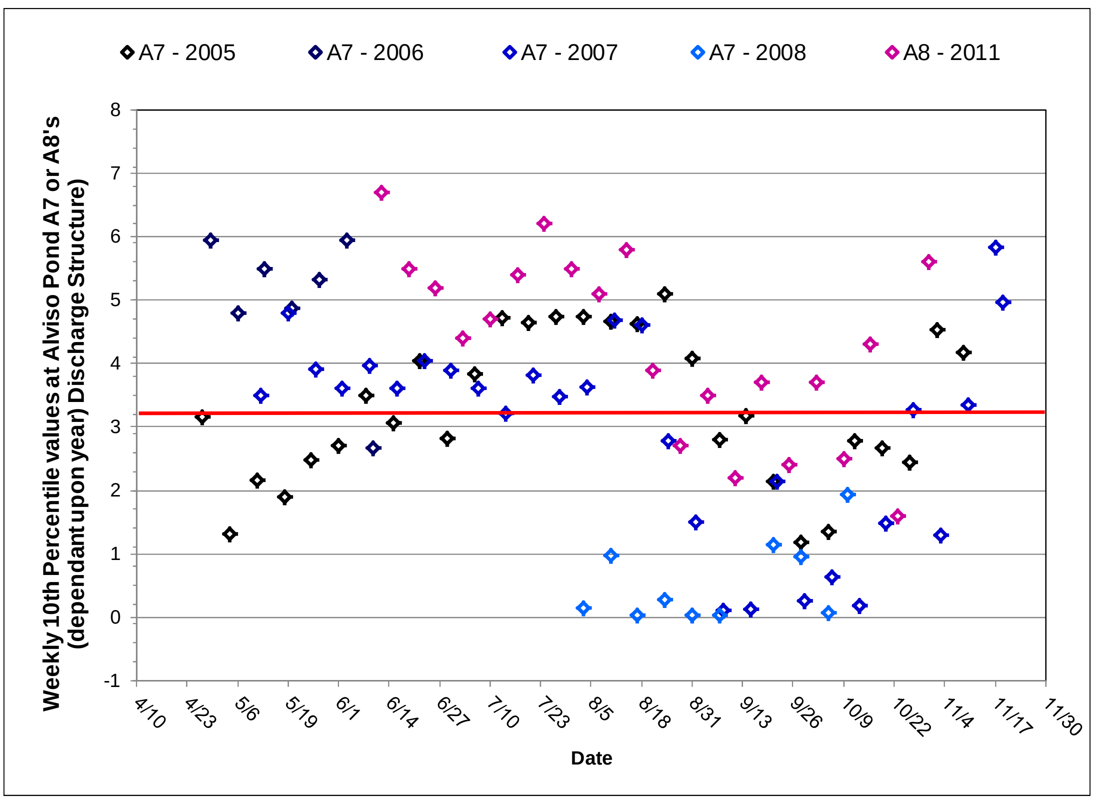


Figure 4.3-50: Weekly 10th Percentile Values for A7/A8 DO 2008-09, 2011)

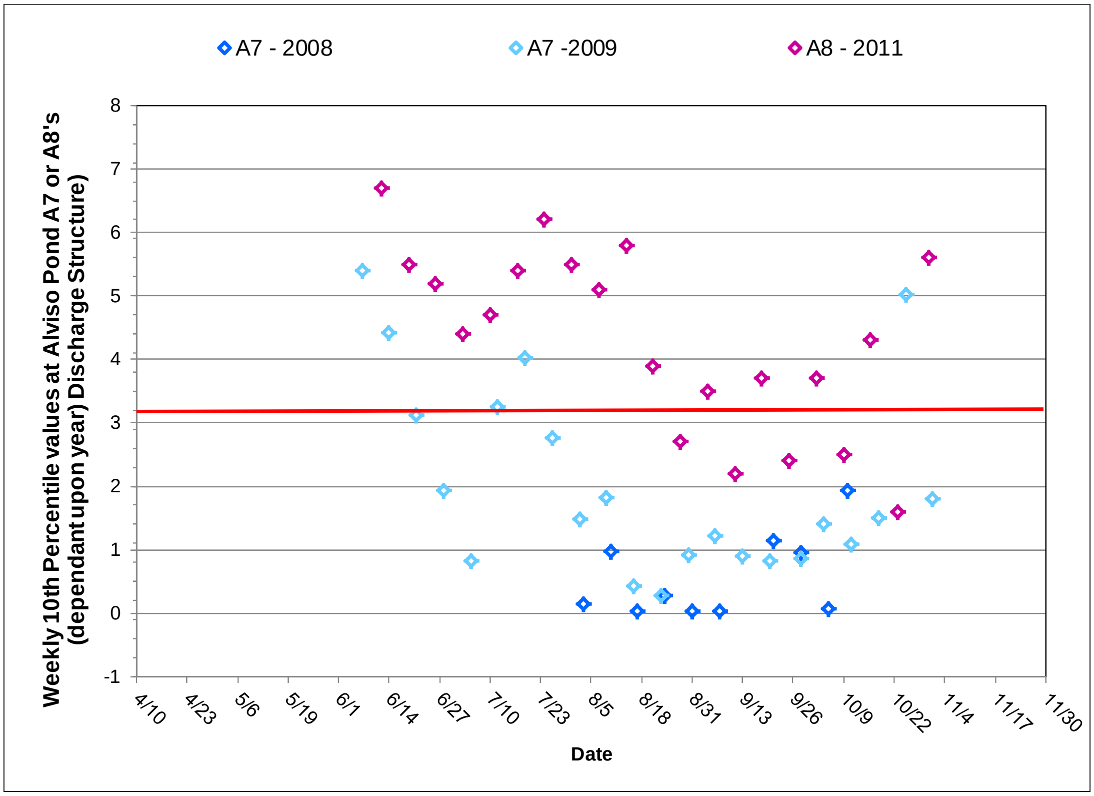


Table 4.3-2: Receiving Water Quality Values (Mean ± Standard Deviation) For Ponds A7 and A8

Pond	Date	Depth	Salinity (ppt)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH (Units)
A7	7/26/2011	**Bottom**	17.50 ± 3.3	5.70 ± 0.7	22.10 ± 0.3	8.00 ± 0.2
		Surface	15.70 ± 3.0	5.70 ± 0.7	23.20 ± 0.5	8.10 ± 0.2
	8/24/2011	**Bottom**	18.00 ± 3.3	5.10 ± 0.8	23.20 ± 0.3	7.90 ± 0.2
		Surface	15.60 ± 3.6	5.50 ± 0.6	24.20 ± 0.2	8.00 ± 0.2
	9/19/2011	**Bottom**	15.80 ± 3.1	4.60 ± 0.9	21.30 ± 0.4	8.20 ± 0.3
		Surface	7.80 ± 3.9	5.40 ± 0.3	22.00 ± 0.7	8.20 ± 0.1
	10/18/2011	**Bottom**	11.50 ± 5.5	4.10 ± 1.8	23.40 ± 3.6	8.10 ± 0.1
		Surface	15.70 ± 3.8	**3.00** ± 2.6	21.00 ± 0.3	8.10 ± 0.1
A8	7/26/2011	**Bottom**	8.20 ± 4.1	5.70 ± 0.5	21.40 ± 0.3	8.30 ± 0.2
		Surface	4.20 ± 1.0	6.00 ± 0.2	22.10 ± 1.0	8.10 ± 0.1
	8/24/2011	**Bottom**	6.50 ± 4.3	5.20 ± 0.8	22.00 ± 0.5	8.30 ± 0.2
		Surface	3.10 ± 0.5	5.80 ± 0.3	22.10 ± 0.6	8.10 ± 0.03
	9/19/2011	**Bottom**	7.60 ± 5.1	4.90 ± 2.0	20.50 ± 0.5	8.30 ± 0.2
		Surface	3.40 ± 2.1	6.10 ± 0.2	20.40 ± 0.6	8.10 ± 0.1
	10/18/2011	**Bottom**	5.80 ± 4.3	3.60 ± 1.5	20.50 ± 1.0	8.30 ± 0.2
		Surface	7.00 ± 3.8	4.10 ± 1.8	20.60 ± 0.8	8.40 ± 0.2

4.3.4 Pond A14 and A16 Receiving Water Samples

Salinity levels outside of Pond A14's discharge structure during the 2011 sampling season were slightly elevated from salinity levels recorded during the 2010 season (Tables 4.3-3 and 4.3-4). As expected, there was an obvious stratification of salinity values between bottom and surface waters. Vertical stratification of pH levels within Coyote Creek was minimal this year, as well as during past monitoring seasons the 2010 season. Throughout these same monitoring years, pH levels outside of Pond A14 have been fairly consistent within Coyote Creek. Temperatures recorded within Coyote Creek during the 2011 were similar to those recording over the past several monitoring years. Vertical stratification was apparent with surface waters maintaining higher water temperatures than those recorded near the bottom of Coyote Creek. Dissolved oxygen concentrations recorded within the creek this season were also vertically stratified. This stratification, as well as DO concentrations throughout monitoring years 2009 and 2010, does not follow an obvious trend (Tables 4.3-4 and 4.3-5). Sampling occurring during July and August of 2011 found DO concentrations with Coyote Creek were lower than those recorded during the 2010 season. On the other hand, DO concentrations logged in September and October of 2011 show a slight increase from those recorded during the 2010 season. DO concentrations within Coyote Creek, just outside of Pond A14's discharge structure, remained above the 3.33 mg/L threshold limit for the entire 2011 monitoring season.

The same is true for DO concentrations just outside of Pond A16's discharge structure; DO concentrations within Artesian Slough remain above the 3.33 mg/L threshold for the length of the 2011 season. Data collected within Artesian Slough this season shows DO concentrations decreased slightly from the 2010 season during July and August and then increase from 2010 levels during September. Sampling conducted in October of 2011 shows a DO increase from 2010 levels within water collected from the bottom of Artesian Slough, yet a decrease in DO concentrations from 2010 levels of surface waters. Vertical stratification of DO levels within the slough was evident during the 2011 season. Water sampled from the surface of the slough was almost always higher in DO concentration than water sampled from the bottom of the water column. The one exception to this trend occurred during sampling conducted in October; at this time DO concentrations were higher near the bottom of Artesian slough. Salinity levels within the slough have decreased from concentrations recorded during the 2010 season and were generally higher near the bottom of the water column. During both years, salinity levels logged in October outside of Pond A16 show higher salinity concentrations within surface waters. Perhaps this is due to the large influx of fresh water discharged from the Santa Clara County Water Treatment Plant located just yards away from several sampling points near Pond A16's discharge. Sampling conducted during 2010 and 2011 show generally consistent pH levels within Artesian Slough with no obvious trend in the location of the sample within the water column (Tables 4.3-1-4.3-3).

Although slight, water temperatures recorded within the slough during 2011 have increased from levels recorded in 2010.

Table 4.3-3: 2011 Receiving Water Quality Values (mean ± standard deviation) for Ponds A14 and A16

Pond	Date	Depth	Salinity (ppt)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH (Units)
A14	7/26/2011	**Bottom**	18.00 ± 0.2	5.80 ± 0.1	21.60 ± 0.01	7.90 ± 0.01
		Surface	14.50 ± 0.4	5.60 ± 0.2	22.80 ± 0.5	8.00 ± 0.01
	8/24/2011	**Bottom**	16.60 ± 0.2	4.90 ± 0.04	23.00 ± 0.04	7.90 ± 0.01
		Surface	14.80 ± 0.3	5.20 ± 0.1	23.80 ± 0.2	7.90 ± 0.01
	9/19/2011	**Bottom**	20.50 ± 2.5	5.60 ± 0.6	21.80 ± 0.1	7.90 ± 0.02
		Surface	10.20 ± 0.9	5.20 ± 0.1	24.10 ± 0.5	7.90 ± 0.01
	10/18/2011	**Bottom**	12.30 ± 0.02	5.00 ± 0.1	22.60 ± 0.03	7.80 ± 0.0
		Surface	20.20 ± 1.8	5.40 ± 0.4	21.60 ± 0.1	7.80 ± 0.02
A16	7/26/2011	**Bottom**	7.40 ± 3.7	5.00 ± 3.0	23.90 ± 1.5	8.20 ± 0.6
		Surface	3.90 ± 3.2	6.40 ± 1.4	25.60 ± 0.9	7.50 ± 0.3
	8/24/2011	**Bottom**	7.20 ± 4.1	5.00 ± 3.2	24.80 ± 1.5	7.80 ± 0.3
		Surface	2.20 ± 1.6	6.80 ± 1.0	26.50 ± 0.5	7.40 ± 0.1
	9/19/2011	**Bottom**	10.20 ± 3.2	6.20 ± 2.6	24.10 ± 1.2	8.40 ± 0.5
		Surface	1.70 ± 0.7	6.70 ± 1.1	26.50 ± 0.3	7.40 ± 0.04
	10/18/2011	**Bottom**	2.90 ± 2.8	6.10 ± 1.4	20.30 ± 0.4	7.30 ± 0.1
		Surface	11.50 ± 2.4	3.50 ± 0.7	25.00 ± 1.0	8.10 ± 0.5

Table 4.3-4: 2010 Receiving Water Quality Values (mean ± standard deviation) for Ponds A14 and A16

Pond	Date	Depth	Salinity	Dissolved Oxygen (mg/L)	Temperature (°C)	pH (Units)
A14	6/4/2010	Bottom	16.88 ± 0.8	4.81 ± 0.2	22.23 ± 0.1	7.90 ± 0.2
		Surface	7.36 ± 1.2	4.89 ± 0.3	22.87 ± 0.5	7.75 ± 0.1
	7/7/2010	Bottom	15.55 ± 1.1	6.00 ± 0.8	23.84 ± 1.2	8.03 ± 0.1
		Surface	14.64 ± 0.6	6.19 ± 0.4	24.23 ± 0.4	8.04 ± 0.3 x 10^{-1}
	8/3/2010	Bottom	15.50 ± 4.0	4.89 ± 0.8	23.34 ± 1.1	7.90 ± 0.1 x 10^{-1}
		Surface	11.98 ± 0.5	5.52 ± 0.3	23.88 ± 0.7	7.91 ± 0.1
	9/1/2010	Bottom	20.14 ± 3.7	5.02 ± 0.7	21.94 ± 0.3	7.69 ± 0.4 x 10^{-1}
		Surface	15.32 ± 1.1	4.65 ± 0.2	22.35 ± 0.1	7.60 ± 0.4 x 10^{-1}
	10/1/2010	Bottom	20.45 ± 0.6	4.34 ± 0.1	22.36 ± 0.1 X 10^{-1}	7.82 ± 0.1 x 10^{-1}
		Surface	18.26 ± 1.2	4.31 ± 0.1	22.49 ± 0.1	7.84 ± 0
A16	6/4/2010	Bottom	7.39 ± 2.1	5.42 ± 1.9	23.68 ± 0.2	8.38 ± 0.5
		Surface	1.81 ± 1.1	5.99 ± 0.8	23.81 ± 0.2	7.19 ± 0.2
	7/7/2010	Bottom	10.03 ± 3.6	5.17 ± 2.3	24.13 ± 1.1	8.36 ± 0.6
		Surface	2.65 ± 1.6	6.92 ± 1.0	25.92 ± 0.5	7.51 ± 0.1
	8/3/2010	Bottom	15.50 ± 1.9	6.36 ± 2.5	24.48 ± 0.4	8.83 ± 0.5
		Surface	5.63 ± 2.0	7.49 ± 0.7	26.04 ± 0.5	7.88 ± 0.3
	9/1/2010	Bottom	16.40 ± 2.8	3.56 ± 1.8	23.91 ± 0.4	8.01 ± 0.2
		Surface	4.53 ± 2.0	6.58 ± 1.2	25.90 ± 0.5	7.25 ± 0.2
	10/1/2010	Bottom	23.74 ± 0.5	2.52 ± 0.6	23.74 ± 0.5	8.29 ± 0.4
		Surface	24.86 ± 1.1	5.40 ± 0.7	24.86 ± 1.1	7.73 ± 0.2

Table 4.3-5: 2009 Receiving Water Quality Values (mean ± standard deviation) for Ponds A14 and A16

Pond	Date	Depth	Salinity (ppt)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH (Units)
A14	6/18/2009	Bottom	19.37 ± 3.0	3.96 ± 0.6	20.92 ± 0.9	7.86 ± 0.1
		Surface	16.33 ± 0.8	4.12 ± 0.1	22.23 ± 0.1	7.96 ± 0.0
	7/16/2009	Bottom	21.28 ± 2.2	3.49 ± 0.5	23.54 ± 0.3	7.63 ± 0.1
		Surface	16.03 ± 1.8	4.16 ± 0.1	24.84 ± 0.3	7.61 ± 0.0
	8/13/2009	Bottom	25.66 ± 1.0	3.71 ± 0.6	23.91 ± 0.7	7.92 ± 0.3
		Surface	14.53 ± 2.0	3.63 ± 0.2	25.53 ± 0.4	7.62 ± 0.0
	9/15/2009	Bottom	28.12 ± 2.8	4.55 ± 1.2	22.25 ± 1.5	7.91 ± 0.2
		Surface	27.14 ± 1.1	5.19 ± 0.1	22.79 ± 0.1	7.79 ± 0.0
	10/14/2009	Bottom	18.33 ± 6.1	5.81 ± 0.5	16.52 ± 0.4	7.62 ± 0.2
		Surface	14.77 ± 4.4	6.06 ± 0.4	17.23 ± 0.4	7.95 ± 0.4
A16	6/18/2009	Bottom	12.94 ± 1.8	5.35 ± 2.3	23.43 ± 1.0	8.54 ± 0.5
		Surface	3.21± 2.4	6.79 ± 1.2	25.41 ± 0.5	7.66 ± 0.1
	7/16/2009	Bottom	15.57 ± 2.4	3.04 ± 1.1	25.23 ± 0.2	8.21 ± 0.4
		Surface	3.32 ± 1.4	6.72 ± 1.0	26.69 ± 0.4	7.47 ± 0.2
	8/13/2009	Bottom	19.13 ± 2.1	2.69 ± 1.8	25.79 ± 0.7	8.31 ± 0.2
		Surface	4.40 ± 3.0	6.18 ± 1.7	27.27 ± 0.6	7.49 ± 0.2
	9/15/2009	Bottom	17.41 ± 2.8	2.48 ± 1.1	22.68 ± 0.8	7.92 ± 0.3
		Surface	6.96 ± 5.9	4.77 ± 1.9	25.24 ± 1.8	7.41 ± 0.1
	10/14/2009	Bottom	8.03 ± 4.9	4.60 ± 1.2	20.09 ± 2.0	6.27 ± 0.8
		Surface	2.79 ± 1.8	5.67 ± 1.2	21.54 ± 2.1	6.64 ± 1.0

4.4 POND SF2 IN-POND SAMPLING

This section summarizes the 2011 data collected for the continuous monitoring program conducted within Pond SF2. This monitoring was conducted to monitor DO concentrations within the newly-restored Pond SF2 during times when increased ambient temperatures have the most effect on DO levels within shallow waters. A brief description of our monitoring data is presented below:

4.4.1 CONTINUOUS WATER QUALITY MONITORING

During the 2011 monitoring period, from June – October, 2011 one datasonde was deployed at the discharge structure of Pond SF2 and one datasonde each was deployed within Unit 1 and Unit 2 (Figure 4.4-1). Over the course of the 2011 monitoring program, DO concentrations decreased pond-wide. However, no overall-monthly average (the overall-monthly average was calculated by averaging all data at all locations by month) fell below the 3.33 mg/L threshold (Table 4.4-1).

Figure 4.4-1: Pond RSF2 Datasonde Locations during the 2011 Monitoring Season

Table 4.4-1: Pond SF2 Summarized Water Quality Values (Mean ± Standard Deviation) By Month

Pond	Month	Dissolved Oxygen (mg/L)	pH (Units)	Temperature (°C)	Salinity (ppt)
RSF2	**June**				
	Discharge	5.00 ± 1.5	8.00 ± 0.2	20.80 ± 3.3	22.00 ± 1.0
	Unit 1	5.00 ± 3.5	8.10 ± 0.3	19.60 ± 3.1	21.30 ± 1.5
	Unit 2	5.60 ± 2.0	8.10 ± 0.2	20.40 ± 3.0	22.00 ± 1.0
	Overall	5.20 ± 2.4	8.00 ± 0.3	20.30 ± 3.1	21.80 ± 1.2
	July				
	Discharge	**3.30 ± 1.2**	7.70 ± 0.2	22.50 ± 2.7	23.80 ± 0.8
	Unit 1	3.60 ± 2.7	7.80 ± 0.3	21.80 ± 2.6	23.30 ± 1.4
	Unit 2	5.80 ± 3.3	8.00 ± 0.3	22.10 ± 2.4	23.50 ± 0.8
	Overall	4.10 ± 2.7	7.80 ± 0.3	22.11 ± 2.6	23.50 ± 1.1
	August				
	Discharge	**3.30 ± 1.5**	7.70 ± 0.2	21.80 ± 2.2	25.50 ± 0.8
	Unit 1	4.20 ± 1.2	7.70 ± 0.1	21.20 ± 2.3	25.00 ± 0.6
	Unit 2	4.00 ± 3.6	7.90 ± 0.3	21.50 ± 1.8	25.60 ± 0.7
	Overall	3.80 ± 2.4	7.70 ± 0.2	21.50 ± 2.1	25.40 ± 0.7
	September				
	Discharge	**3.00 ± 1.7**	7.50 ± 0.2	21.20 ± 2.1	27.00 ± 0.5
	Unit 1	4.30 ± 1.2	7.70 ± 0.1	20.60 ± 2.4	26.30 ± 0.4
	Unit 2	3.50 ± 3.2	7.80 ± 0.2	21.00 ± 2.0	27.20 ± 0.4
	Overall	3.60 ± 2.1	7.60 ± 0.2	21.00 ± 2.2	26.70 ± 0.6
	October				
	Discharge	**2.70 ± 1.6**	7.50 ± 0.2	18.80 ± 2.5	26.70 ± 0.5
	Unit 1	5.10 ± 2.0	7.70 ± 0.2	18.20 ± 2.4	26.00 ± 0.5
	Unit 2	**2.80 ± 2.7**	7.60 ± 0.2	18.80 ± 2.2	26.40 ± 0.6
	Overall	3.50 ± 2.4	7.60 ± 0.2	18.60 ± 2.4	26.40 ± 0.6
	Overall				
	Discharge	3.40 ± 1.7	7.60 ± 0.3	21.00 ± 2.8	25.10 ± 2.0
	Unit 1	4.40 ± 2.3	7.80 ± 0.3	20.30 ± 2.9	24.50 ± 2.0
	Unit 2	4.30 ± 3.2	7.90 ± 0.3	20.60 ± 2.6	25.00 ± 2.0
	Overall	4.00 ± 2.5	7.80 ± 0.3	20.70 ± 2.8	24.80 ± 2.0

4.4.2 Dissolved Oxygen

Over the course of the 2011 monitoring program, DO concentrations decreased pond-wide. However, no overall-monthly average (the overall-monthly average was calculated by averaging all data at all locations by month) fell below the 3.33 mg/L threshold. At 5.20 mg/L, the highest overall-monthly average was recorded during June. After this point, DO concentrations decreased steadily to an overall-monthly low of 3.50 mg/L, recorded in October.

From July to October, monthly averages of DO concentrations at the discharge location fell below the 3.33 mg/L threshold and continued to decrease until the end of the monitoring season in late-October. During this time frame, monthly DO averages at this location ranged from 2.70 mg/L – 3.30 mg/L. Dissolved oxygen values recorded at the discharge location were consistently lower than those recorded within Unit 1 or Unit 2 of Pond SF2. Outside of the discharge channel, the datasonde located within Unit 2 also recorded a monthly DO average, at 2.80 mg/L occurring in October, which fell below the threshold. Monthly averages for DO were highest at Unit 2 for June and July then decreased from August until October, when monthly averages were highest within Unit 1. Averaging data over all locations and all months produced a DO level of 4.00 mg/L. In comparison, the overall-average for Unit 1 was calculated at 4.40 mg/L, Unit 2 at 4.30 mg/L, and the overall-average, at 3.40 mg/L, was lowest at the discharge.

Throughout the 2011 season, DO concentrations at the discharge structure decreased continuously. Interestingly, DO concentrations within Unit 1 and Unit 2 experienced opposite trends over the course of the season. At Unit 1, DO concentrations decreased from June to July then increased from July onward. At Unit 2, DO concentrations increased from June to July then decreased from July through October.

Daily DO averages show concentrations recorded during the 2011 monitoring season ranged from 0.70 mg/L to almost 8.00 mg/L (Figure 4.4-2). These daily averages for DO levels, for all locations within Pond SF2, began to fall below the 3.33 mg/L threshold after the first two weeks in June. After this point, daily averages for DO concentrations at the discharge location primarily fell below the threshold for the remainder of the 2011 monitoring season. DO averages at Unit 2 also fell below 3.33 mg/L frequently, yet this location also recorded a few of the highest average daily DO concentrations over the entire season. Within Unit 1, DO concentrations temporarily fell below the threshold early in the season yet few daily averages fell below the 3.33 mg/L threshold after mid-July. DO concentrations at this location were oftentimes higher in value than those recorded at Unit 2 or within the discharge channel. Moreover, DO concentrations within Unit 1 increased late in the season whereas the other two locations within Pond SF2 generally decreased after early-August.

Weekly tenth-percentile data collected at Pond SF2 during the 2011 monitoring program fell, and continued to remain, below the 3.33 mg/L threshold at all locations after mid-June (Figure 4.4-3). After this point, only the Unit 1 location, at 4.23 mg/L on the 24th of October, logged a weekly tenth-percentile value above the threshold. From June through August, weekly tenth-percentiles values were higher in concentration during times of discharge than any individual location; from August onward, weekly tenth-percentile values were highest at the Unit 1 location. At the Unit 2 location, weekly tenth-percentile values were generally lower than at any other location within Pond SF2. After the first week in June, when the weekly tenth-percentile at this location equaled 3.49 mg/L, weekly tenth-percentiles at this location all fell below the 3.33 mg/L threshold for the remainder of the season.

On a daily a basis, DO concentrations within Pond SF2 fell below the 3.33 mg/L threshold. After early-July, all locations within Pond SF2 recorded DO concentrations below 1.0 mg/L. As seen at other monitored ponds (A3W and A8), the majority of these very low DO concentrations occurred during early morning hours, when PAR levels were very low or non-existent. Dissolved oxygen levels within Pond SF2 appear to be influenced by diurnal and tidal cycling. There were eight occasions, which occurred during September and October only, in which DO concentrations at the discharge location failed to recover from pre-dawn lows and DO concentrations within the discharge channel remained below the threshold for the entire day. The datasonde located within Unit 1 recorded the most variation in DO concentrations during June. On the 21st of June, the daily low recorded at the Unit 1 location was 0.10 mg/L and the daily high recorded was 13.8 mg/L. From July until the end of the 2011 monitoring season in October, the Unit 2 datasonde recorded the largest difference in daily min/max values for DO concentrations. A daily low of 0.10 mg/L and a daily high of 14.70 mg/L were recorded on the 2nd of August, this was the largest difference between high and low DO concentrations recorded within Pond SF2 during the 2011 season. Although DO concentrations recorded at the discharge location were consistently the most stable on a daily basis, the least amount of daily variation in DO concentrations was recorded at the Unit 1 location on the 7th of August. On this date, the daily low recorded was 3.4 mg/L while the daily high logged was 4.7 mg/L, only a 1.3 mg/L difference (Figures 4.4-4 through 4.4-9).

Figure 4.4-2: Average Daily DO for Pond SF2 - 2011

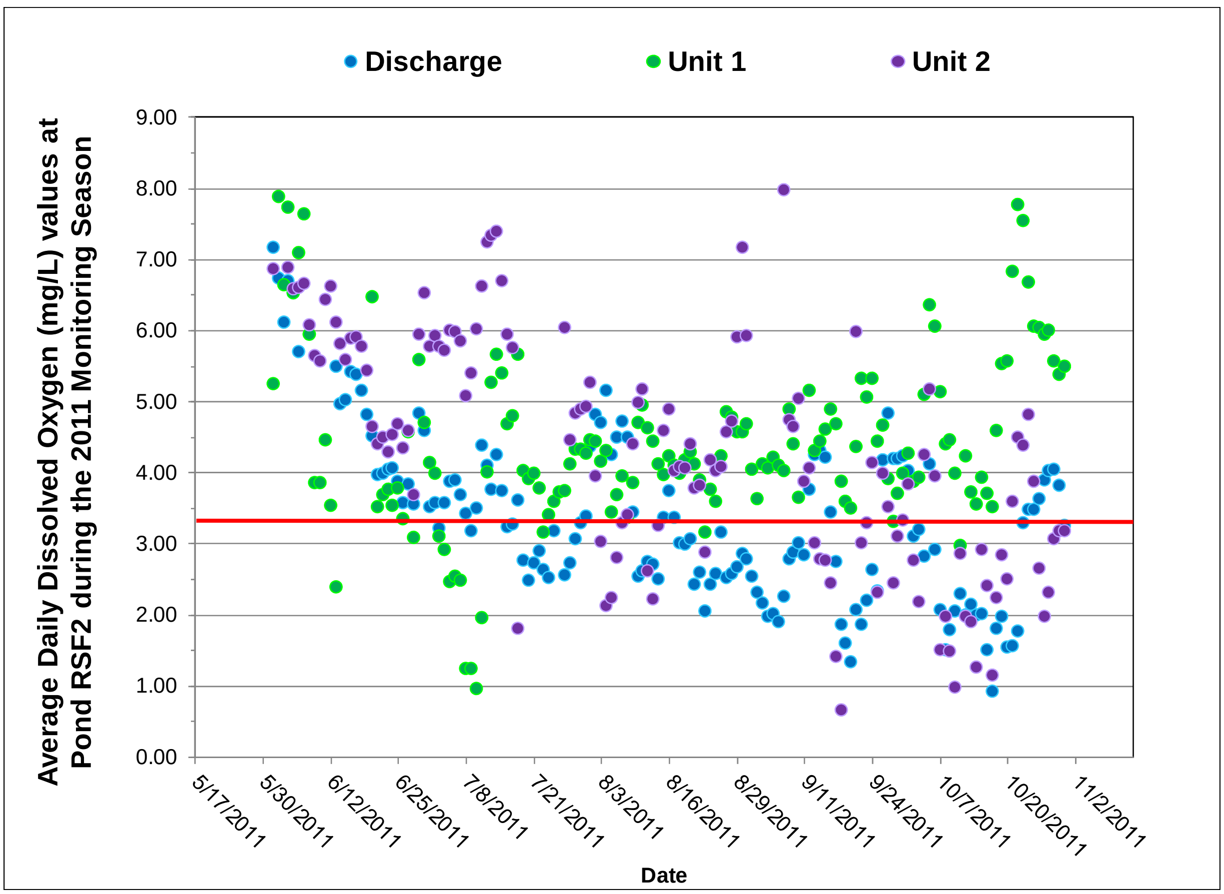


Figure 4.4-3: Weekly 10th Percentiles for DO for Pond SF2

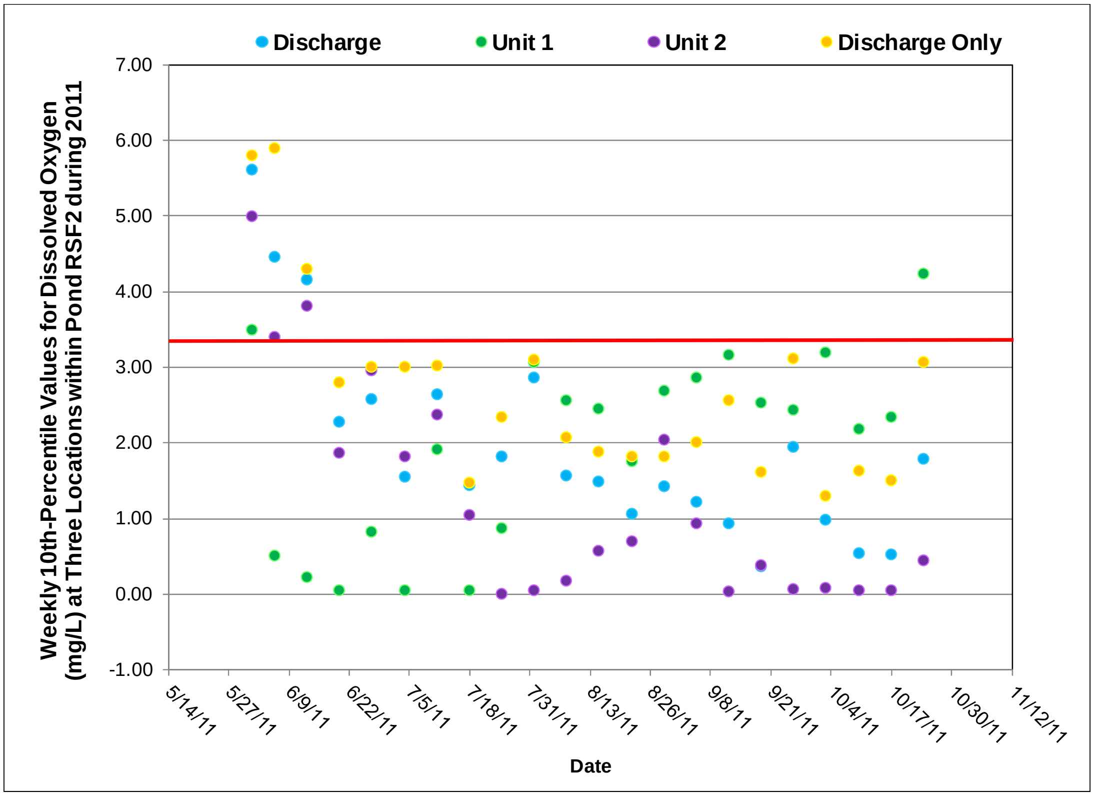
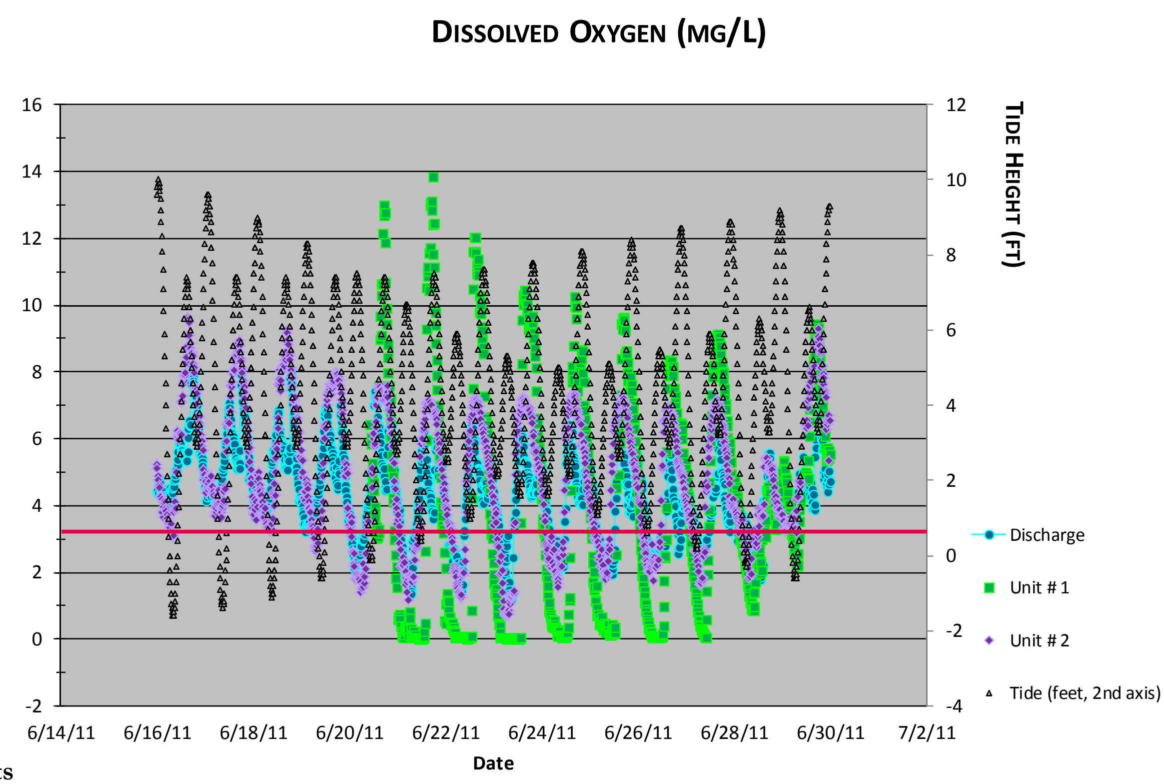


Figure 4.4-4: Pond SF2 DO for 16 June – 30 June 2011



2.charts

Figure 4.4-5: Pond SF2 DO for 1 August – 15 August 2011

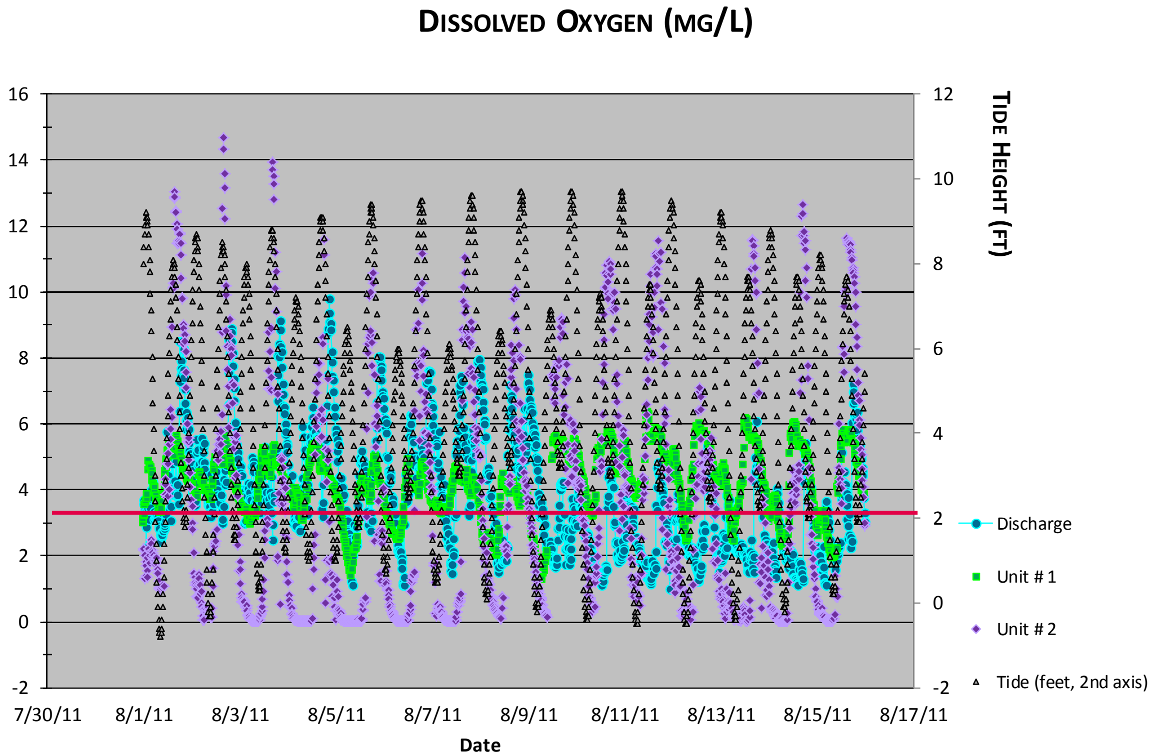


Figure 4.4-6: Pond SF2 DO for 1 Sept – 15 Sept 2011

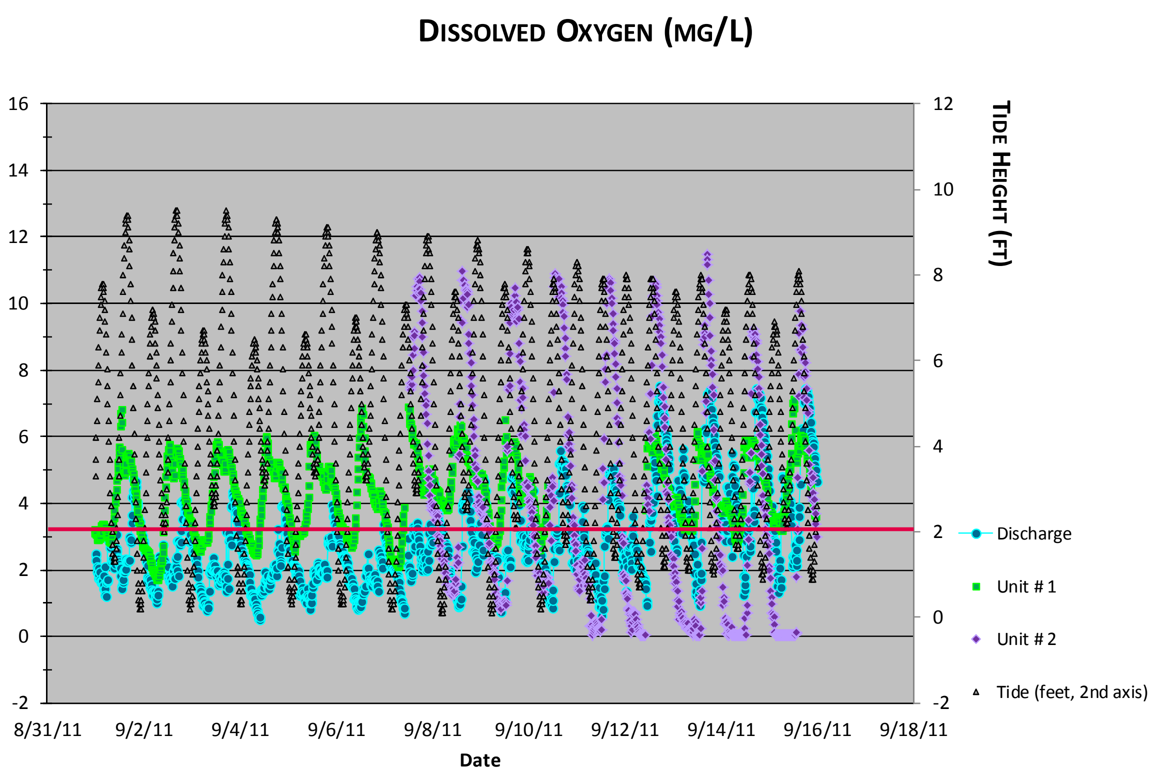


Figure 4.4-7: Pond SF2 DO for 16 Sept – 30 Sept 2011

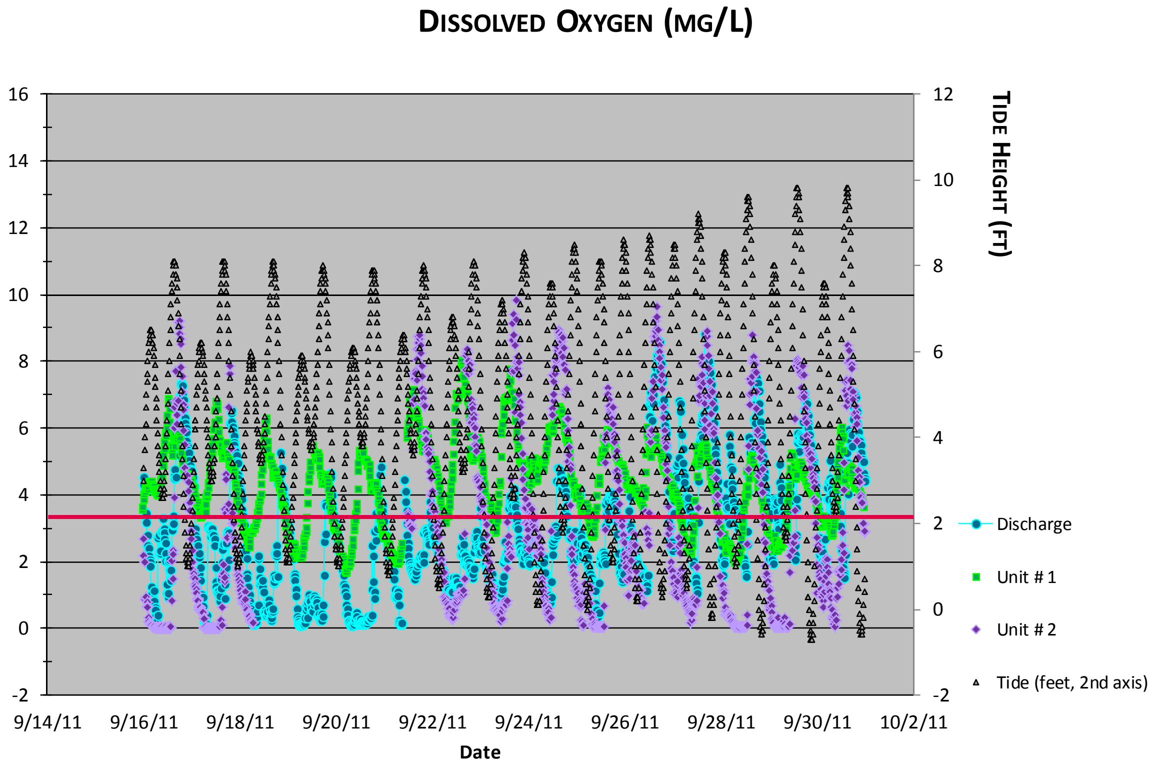


Figure 4.4-8: Pond SF2 DO for 1 Oct – 15 Oct 2011

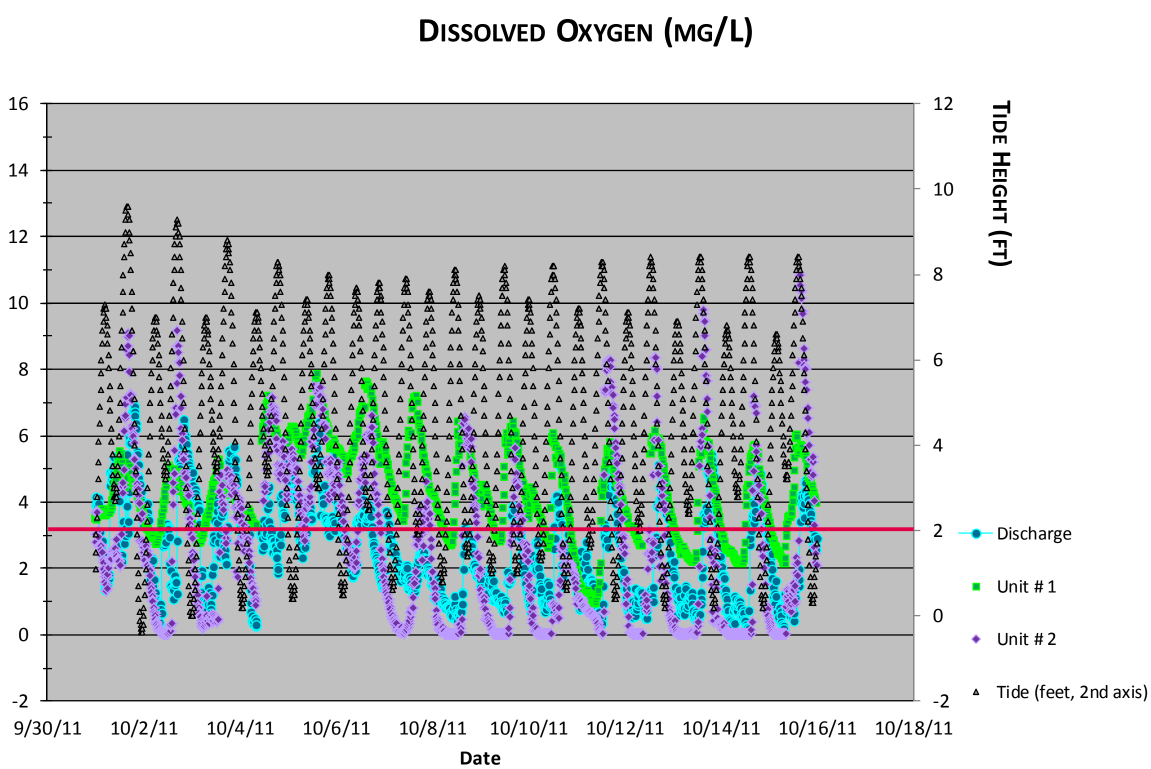
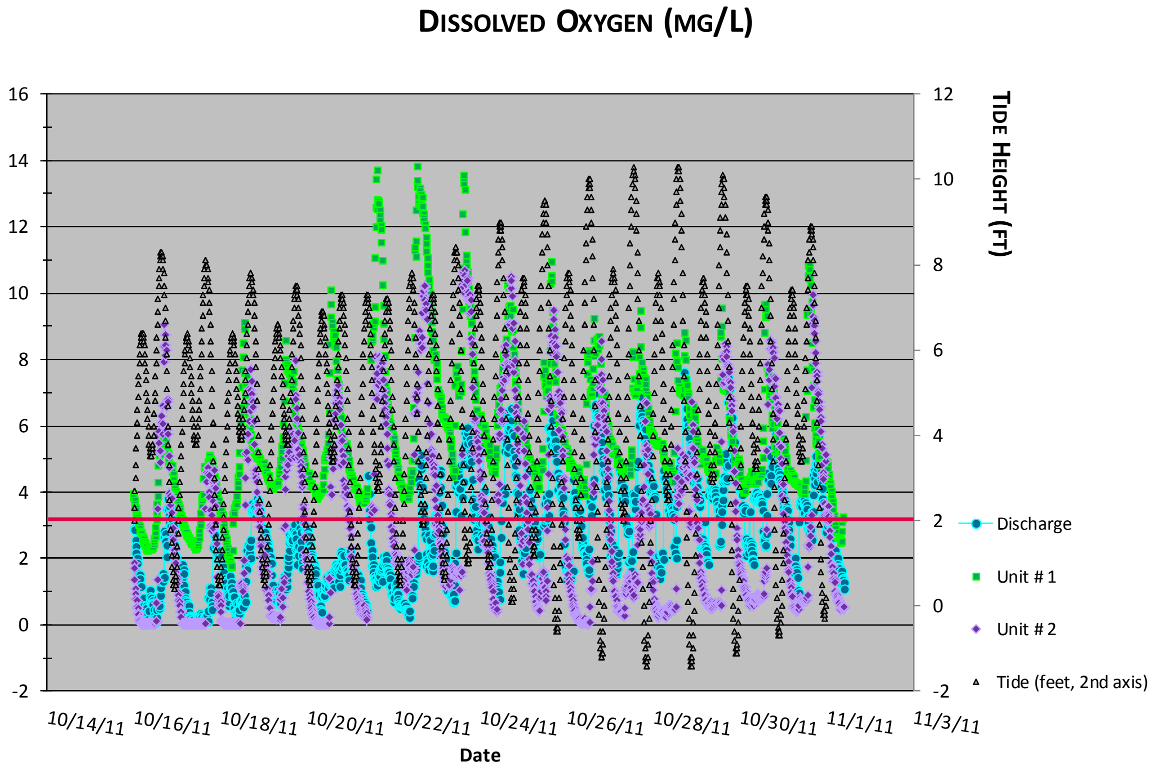


Figure 4.4-9: Pond SF2 DO for 1 6Oct – 31 Oct 2011



4.4.3 SALINITY

As with DO concentrations within Pond SF2, salinity levels during the 2011 season were influenced by tidal cycling. This influence can be seen throughout the monitoring season at all locations within Pond SF2 yet daily variation in salinity levels remained minimal. Generally, salinity levels at these locations only varied by a few parts per thousand over a 24-hour period (Figure 4.4-10).

Interestingly, salinity levels recorded by the Unit 1 datasonde during the 29th of June through the 1st of July show over a 10 ppt decrease from salinity levels recorded at the Unit 2 or discharge locations. A season low of 10.3 ppt was recorded at the Unit 1 location on the 1 July around 0700. Another salinity decrease occurred at the Unit 1 location on 13 October 2011. These are the only two instances of unusual salinity fluctuations within Pond SF2 during the monitoring season and both occurred at the Unit 1 location (Figures 4.4-11 and 4.4-12). Equipment issues due not appear to be related to these salinity decreases. The influx of fresh water from the South San Francisco Bay may, in part, explain reduced salinity levels recorded by the Unit 1 datasonde as this location is closest in proximity to Pond SF2's intake channel.

Excluding these two occasions, overall salinity levels with Pond SF2 ranged from 18.0 – 29.0 ppt. Although a slight decrease in overall salinity levels occurred between September and October, salinity levels within Pond SF2 generally increased throughout the 2011 monitoring season. Monthly salinity averages were similar for all locations yet the discharge and Unit 2 locations were always slightly higher in value than concentrations recorded by the datasonde located within Unit 1.

Figure 4.4-10: Pond SF2 Average Daily Salinity 2011

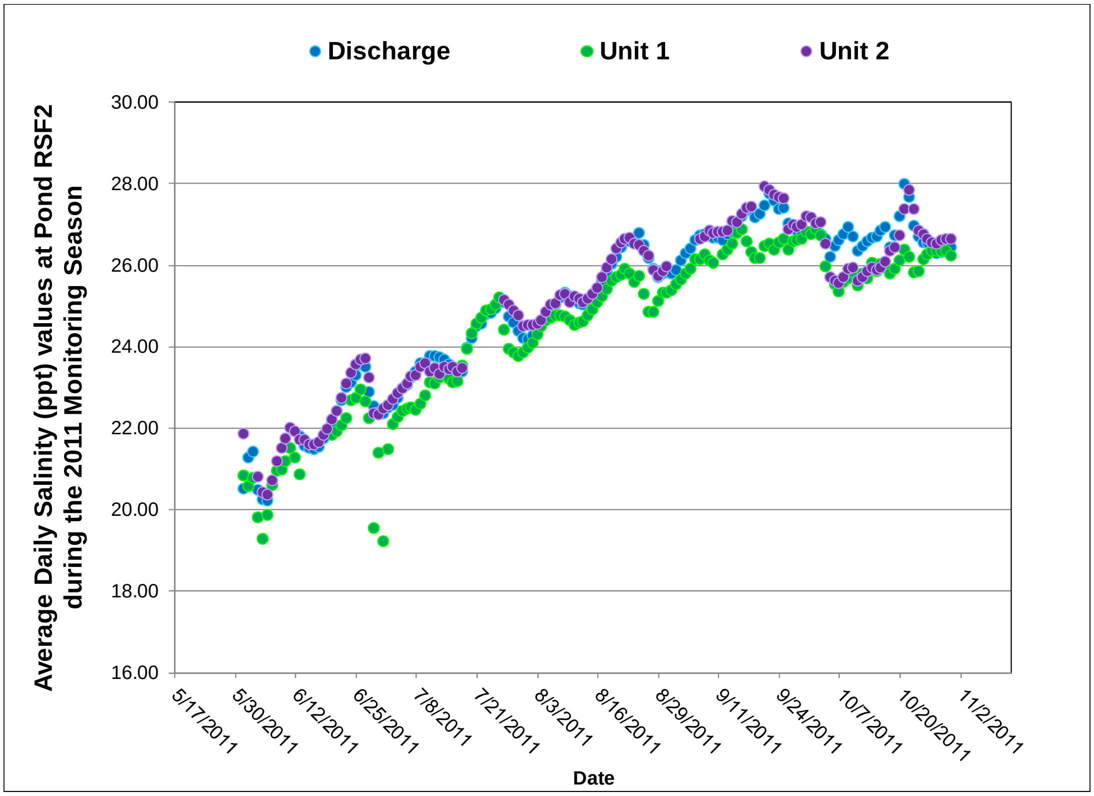


Figure 4.4-11: Pond SF2 Salinity for 25 June – 5 July 2011

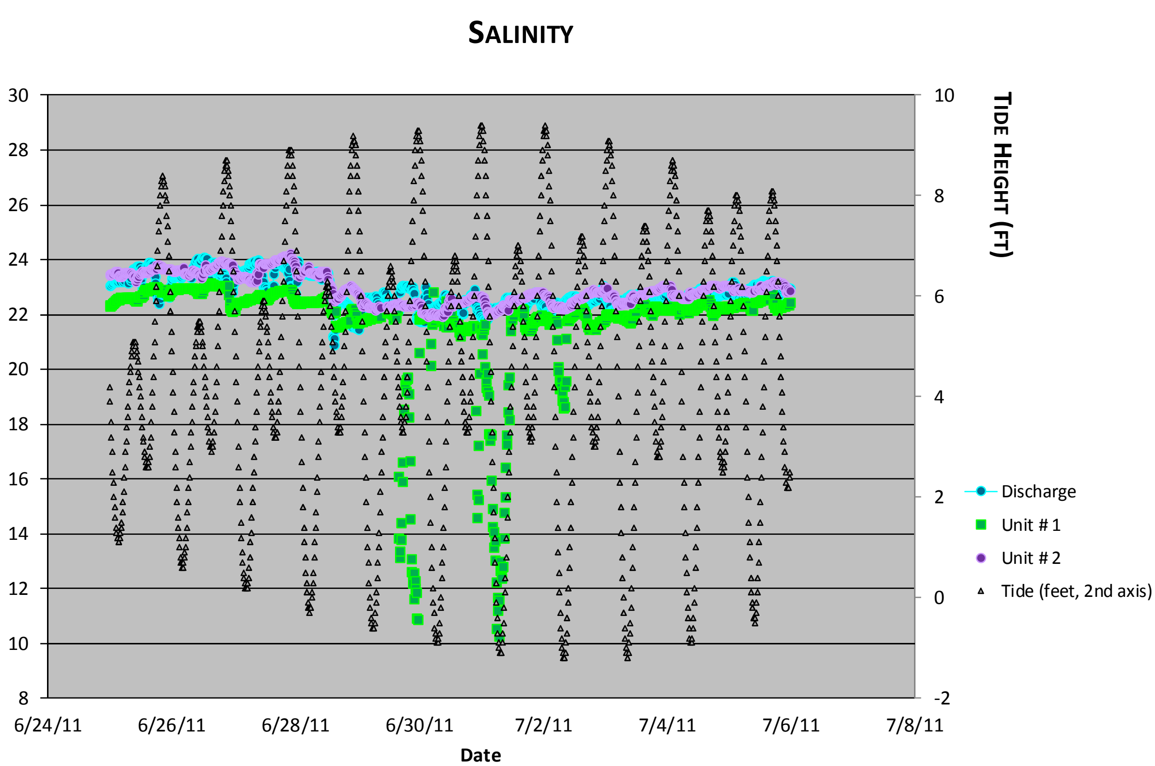
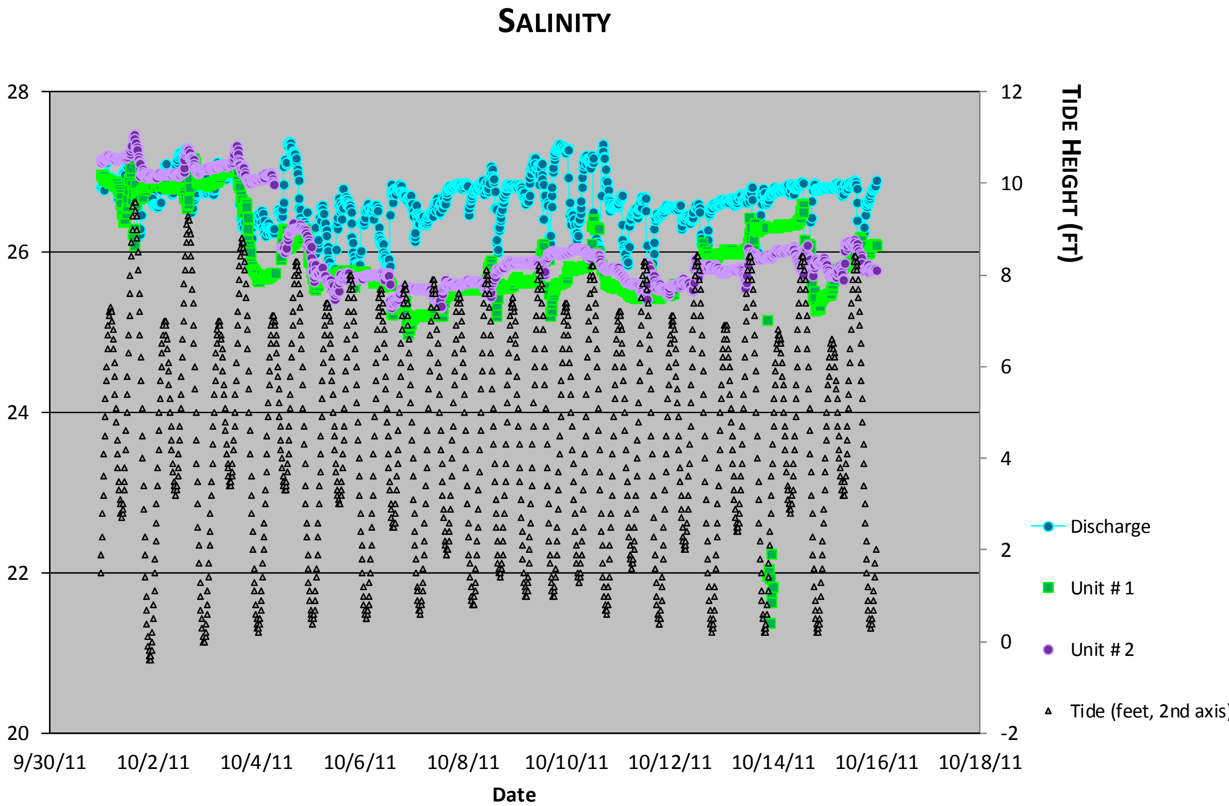


Figure 4.4-12: Pond SF2 Salinity for 1 Oct – 15 Oct 2011



4.4.4 PH

Unlike salinity levels within Pond SF2, pH concentrations recorded during the 2011 monitoring season generally decreased (Figures 4.4-13 and 4.4-14). Monthly averages show pH concentrations recorded at the Unit 2 datasonde were slightly higher than those logged at the Unit 1 or discharge location. Daily and weekly variations in pH concentrations varied by one to two pH units only. Within Pond SF2, pH levels ranged from a low of 6.93, recorded on the 4th of October at the discharge location, to a high of 10.01 units which was recorded at the Unit 1 location on the 8th of June. As with other water quality parameters, pH concentrations within Pond SF2 were influenced by tidal cycling. This cycling seemed to have the most effect on pH concentrations recoded at the Unit 2 datasonde during the month August; still, the daily fluctuation of pH concentrations at this location only resulted in roughly a 1.0 unit difference.

Figure 4.4-13: Pond SF2 Average Daily pH 2011

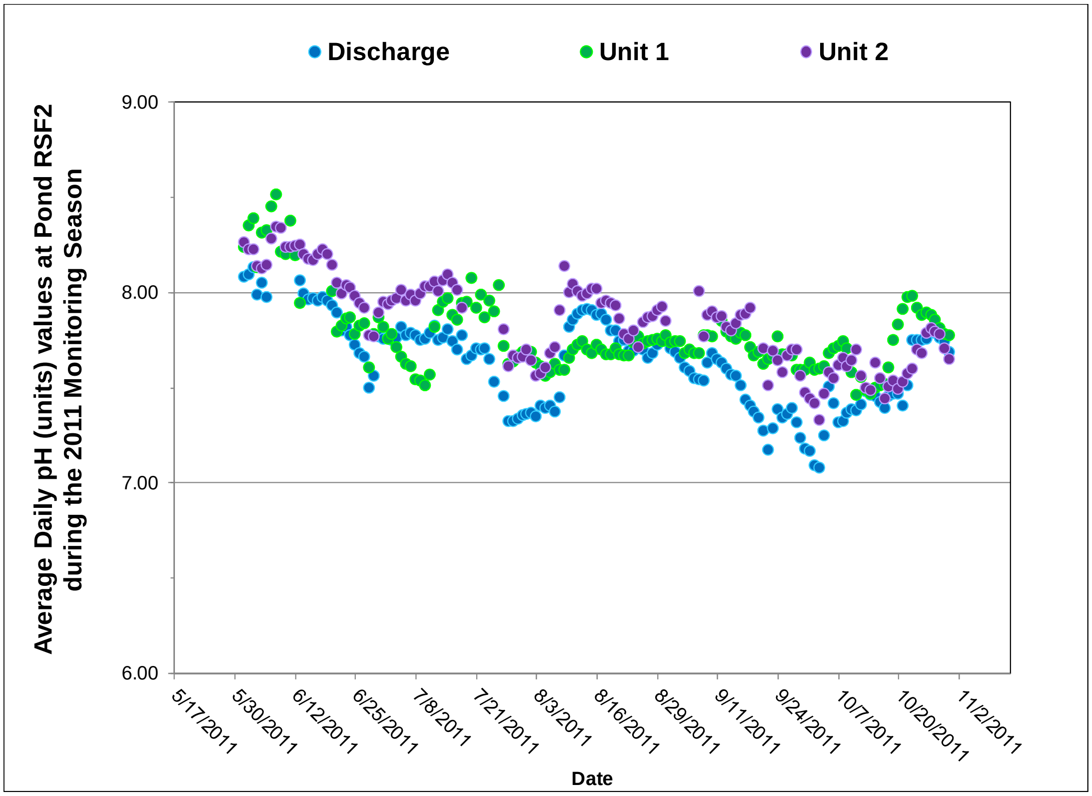
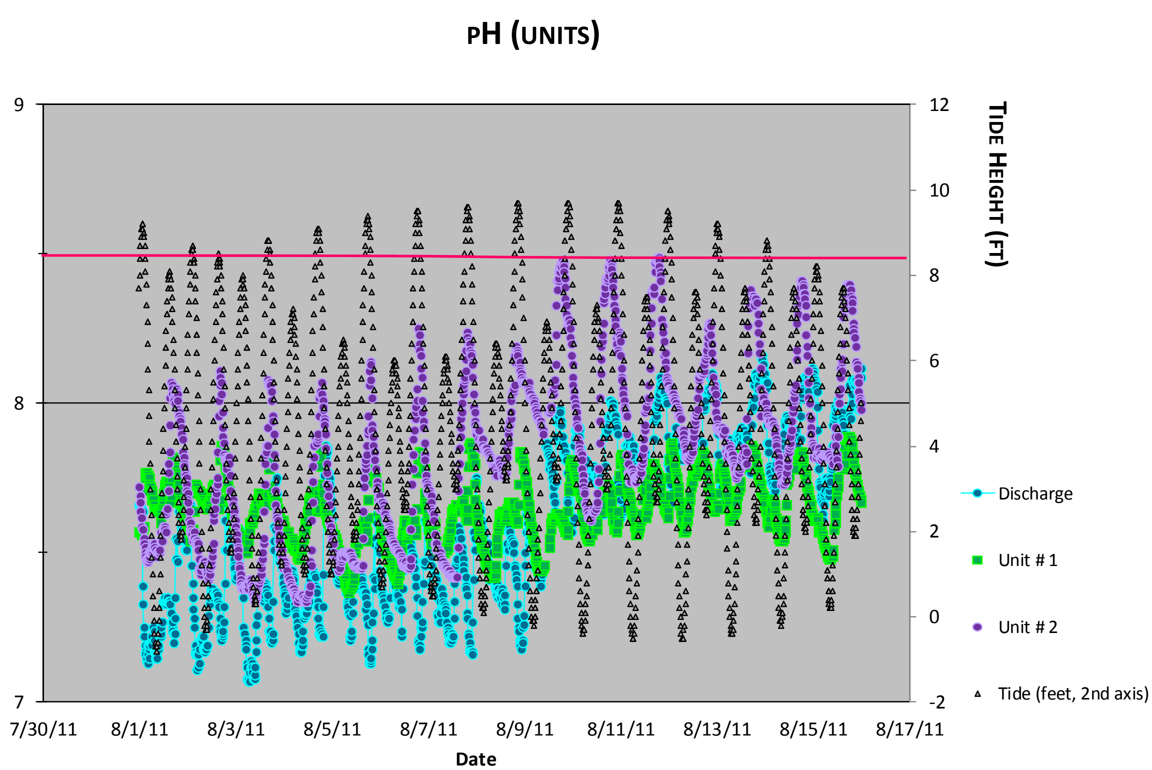


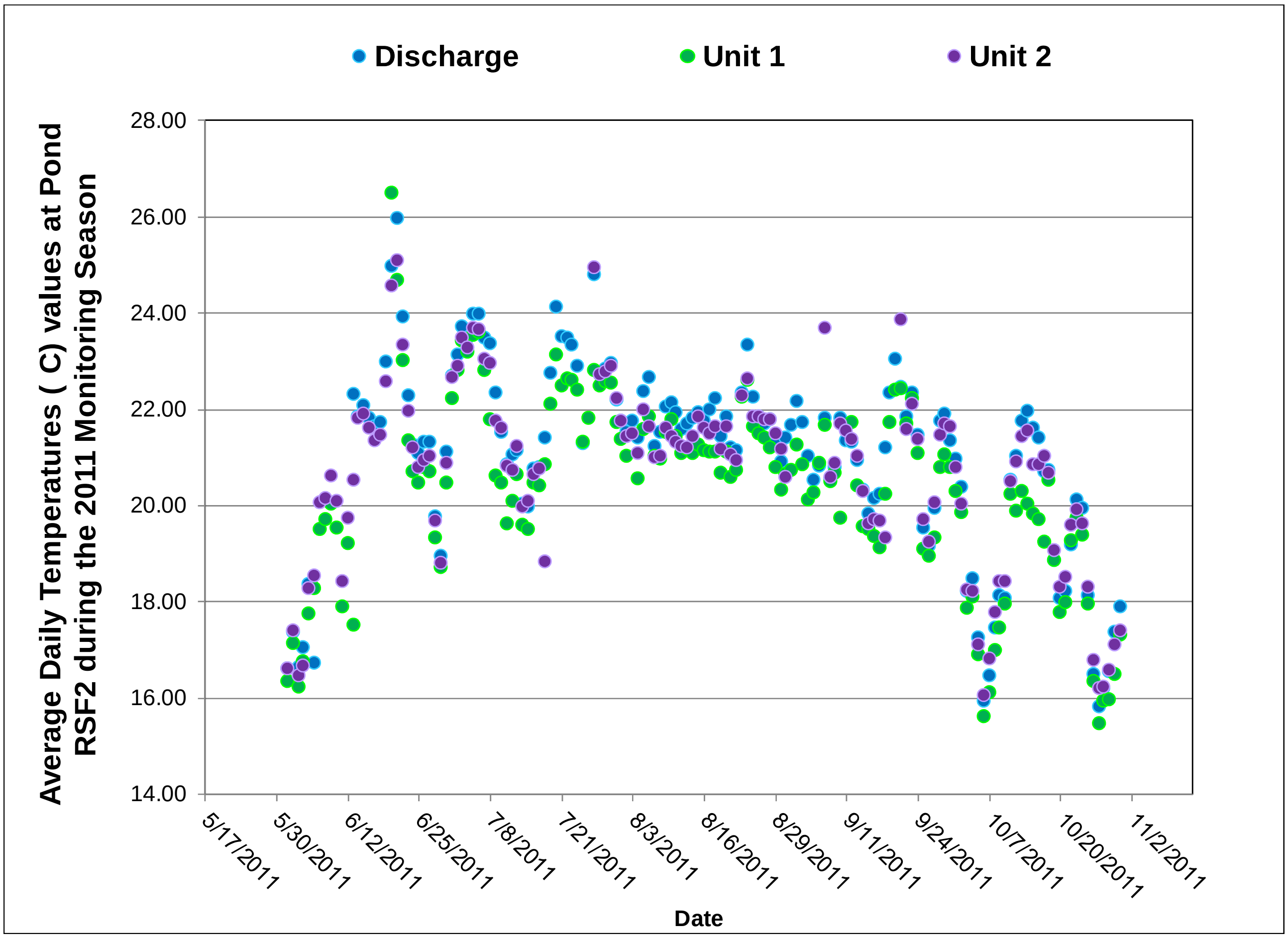
Figure 4.4-14: Pond SF2 pH for 1 August – 15 August 2011



4.4.5 Temperature

Diurnal and tidal cycling both had obvious influences over water temperatures recorded within Pond SF2 during the 2011 monitoring season (Figure 4.4-15). As expected, water temperatures logged at all locations were lowest early in the morning and continued to increase throughout the day. Daily temperature averages ranged from 15.5 to 26.5 degrees Celsius with the low recorded on the 27th of October and the high recorded on the 20th of June, both at the Unit 1 location. Monthly averages show temperatures increased briefly from June to July then decreased steadily until October. Throughout the monitoring season, monthly temperature averages were consistently highest at the discharge location while the lowest monthly averages always occurred at the Unit 1 location.

Figure 4.4-15: Pond SF2 Average Daily Temp 2011



4.4.6 METEOROLOGICAL MEASUREMENTS

Meteorological data were relatively consistent during the study period. Winds were primarily from the north and monthly averages ranged from 4.20 to 9.20 miles per. Dew point averages increased from June through September then decreased slightly from September to October, with no occurrence of precipitation events during the 5-month study. Monthly mean temperatures ranged from 16.3 °C to 18.4 °C with the lowest monthly averages occurring during June and October (Table 4.4-2).

Table 4.4-2: Summarized Weather Values (Mean ± Standard Deviation) For Pond SF2 by Month

Month	Temperature (°C)	Dew Point	Rainfall (cm)	Primary Wind Direction	Wind Speed (mph)
June	16.30 ± 3.0	55.10 ± 3.8	0.00 ± 0.0	North	8.50 ± 6.2
July	17.60 ± 2.5	58.00 ± 3.1	0.00 ± 0.0	North	9.20 ± 5.6
August	17.20 ± 2.0	58.50 ± 2.3	0.00 ± 0.0	North	8.00 ± 6.3
September	18.40 ± 3.0	58.80 ± 3.3	0.00 ± 0.0	North	4.20 ± 4.5
October	16.80 ± 3.3	56.00 ± 5.5	0.00 ± 0.0	North	4.40 ± 4.5

SECTION 5
FISHERIES MONITORING

5.1 FISH ASSEMBLAGES IN RESTORED SOUTH BAY SALT PONDS

One of the key Project uncertainties identified was effects on non-avian species, especially the extent to which restoration and management will affect fish in the South Bay ecosystem. As a result, the Science Team developed a list of the highest priority applied studies, to be researched through hypothesis testing and modeling, in order to reduce key uncertainties.

The proposal titled "Monitoring the Response of Fish Assemblages to Restoration in the South Bay Salt Ponds" by James Hobbs (UC Davis) was accepted by the Project as part of the 2008 Request for Proposal Awards for Phase I Selected Monitoring and Applied Studies. The 2011 Semi-Annual Report (Appendix F) provides an update of sampling efforts conducted to assess the effects of pond restoration on fish species assemblages inside newly breached ponds and adjacent sloughs. In addition, the study is developing indicators of fish health using the longjaw mudsucker (*Gillichthys mirabilis*) as a sentinel species.

The study sites for this project include the Phase I restoration actions of Project. Restoration began in 2006 with several ponds in the Alviso Pond Complex, Eden Landing Pond Complex, Ravenswood Pond SF2 and Bair Island. Fully breached ponds include, Pond A6 (breached Nov 2010) at the end of Alviso Slough, the Island Ponds A19-21 (breached May 2006) on Coyote Creek, Pond E9 and Ponds E8A and E8X at Eden Landing (breached Nov 2011) and the Outer Bair Island Pond (Breached June 2008) along Steinberger Slough. Muted tidal ponds include Pond A8 (breached June 2011) at the upstream end of Alviso Slough, and Ravenswood Pond SF2 (breached September 2010) at the outer end of the Ravenswood Marsh.

Sampling took place within restored ponds and along adjacent sloughs and fringing marsh on a monthly basis. Fish species presence, relative abundance and condition are quantified, as well as water quality parameters (DO, salinity, and temperature). The relative abundance of fish was greatest within the Island Ponds (PondsA19 and A21) and was consistently at least an order of magnitude higher than adjacent sites along Coyote Creek. At the Alviso Pond Complex, a seasonal shift in fish species composition was observed, with several additional species arriving during winter (e.g. American and threadfin shad, longfin smelt and Pacific herring) and species such as northern anchovy declining in winter. Populations within mature pickleweed marshes adjacent to restored ponds (Ponds A6, A8 and

SF2), showed higher catch relative to sites within ponds; however, some months had higher catches within the newly breached ponds, suggesting fish were exploring the new habitats. Condition factors of longjaw mudsuckers (constituting 67% of the catch) were greater at sites within ponds relative to sites outside restored ponds. Overall, the study is showing that salt pond restoration is providing quality habitat for the sentinel species, with no evidence of detrimental effects.

5.2 REPORTED FISH KILLS

No fish kills were observed during 2011 that were associated with pond operations or Phase I restoration actions.

SECTION 6
PROPOSED 2012 APPLIED STUDIES

6.1 WATER QUALITY MONITORING

For 2012, the Service proposes to focus efforts on Applied Studies in support of the Science Program rather than compliance monitoring of standard water quality parameters in the Alviso Ponds, except for newly restored ponds which we will monitor at the discharge under continuous circulation monitoring standards for the first year. Therefore, we propose to discontinue the monitoring requirements described in Tables S2A and S2B of the SMP. Rather than being limited to monitoring periods and parameters in Tables S2A and S2B, the Service proposes to implement the Applied Study work in Pond A3W that was initiated by USGS in 2010. Therefore, in 2012, we will complete a second and final year of study in Pond A3W to provide initial measurements of nutrient benthic flux that complements ongoing investigations and monitoring in the Alviso Pond complex. Extending sediment oxygen demand studies in these salt ponds, we will quantify nutrient sources assimilated at the base of the food web in these ponds and hence the beginnings of trophic transfer for mercury and other particle-reactive contaminants. Both the significant magnitudes and variability of initial flux measurements in 2010, strongly suggest the need to quantify that variability at least over annual time scales, to track transitional benthic processes responding to hydrologic alterations.

Beyond 2012, the Service would like to continue to focus resources on implementing Applied Studies that answer water quality questions through the Science Program. This will allow the Service to seek out studies that assist our management decisions required to maintain a balance between water quality and providing habitat for wildlife in managed pond systems. The Service will continue to coordinate with the RWQCB, NMFS and USGS on an on-going basis to determine the best approach for monitoring and studies that help determine success of Phase I actions and how best to guide the development of Phase II restoration.

6.2 MONITORING FISH ASSEMBLAGES

The study titled "Monitoring the Response of Fish Assemblages to Restoration in the South Bay Salt Ponds" by James Hobbs (UC Davis) has been funded in two phases. Phase one has been funded by NMFS for two years and will end in June 2012. Phase two will be funded by the Resources Legacy Fund for two years and will be conducted from July 2012 to June 2014.

6.3 OTHER APPLIED STUDIES IN 2012

Other Applied Studies being funded in 2012 include the Critical Role of Islands for Waterbird Breeding and Foraging Habitat in Managed Ponds of the South Bay Salt Pond Restoration Project and Impacts of Disturbance on Breeding Waterbirds in Pond SF2. USGS, in cooperation with SFBBO, has initiated a research project to monitor the response of waterbirds to management actions and to evaluate the optimal configuration of salt ponds, island morphometry, and water depth that maximize waterbird foraging, roosting, and nesting success. This study includes a supplement to investigate the impacts of potential disturbance features at SF2 (such as access trails, viewing platforms, internal pond berms, exterior levees, and highways) on nest survival, clutch size, and nest settling patterns of breeding waterbirds. This study will 1) assess how the specific structure (morphometry and vegetation) of islands influence nest site selection, nest densities, and reproductive success of avocets and terns; 2) evaluate factors influencing the variation in numbers of waterbirds roosting and foraging near the newly created islands in Pond SF2; 3) using salt pond complex-wide surveys, evaluate whether waterbird diversity and abundance at a broader scale are influenced by island habitat and water depth within salt ponds; and 4) increase the field effort to monitor nests in Pond SF2 and model the effects of potential disturbance features (viewing platforms, trails, berms, levees, highways, etc.) on nest survival, clutch size and nest settling patterns of breeding waterbirds.

Another study continuing in 2012 is the South Bay Salt Pond Restoration Project Pond A6 Sediment Study. The University of San Francisco and H. T. Harvey & Associates have been contracted by the Resources Legacy Fund to perform studies to measure sedimentation rates and elevations for establishing marsh vegetation in the newly restored Pond A6. This work will help provide a better understanding of the time and conditions that may be necessary for vegetation recruitment in future pond restoration projects. This study was initiated on September 2010. Sediment accumulation is being estimated by measuring the burial of sediment pins that were established at the site prior to the breach. So far the study indicates that there continues to be very rapid sediment accumulation at the site with depths of cumulative sediment erosion and deposition ranging from -1.5 cm (erosion) to 27 cm (deposition) at individual sampling stations. Nine of the ten pins showed deposition over the 6.5 months since the breach, with five of the ten accumulating 15 cm of sediment or more since the breach. These rates of accumulation are greater than the initial rates of sediment accumulation that were measured in Pond A21 (one of the Island Ponds), where on average of approximately 10 and 3.5 cm occurred in the lower and higher elevation areas of the pond respectively, in the first 6 months post-breach. Elevations across the pond were collected before breaching (5 August, 2010). Elevations of exact pin locations (including the elevation at the top of each sediment pin) were collected on 21 June 2011 using RTK GPS equipment. No sampling for vegetation elevations was completed, as no tidal marsh vegetation recruitment has yet been observed at the site. Sediment Samples were collected from all sampling locations in June 2011 and delivered to Mark Marvin-DiPasquale at USGS for his analysis of mercury in the pond.

SECTION 7
PHASE II

7.1 PHASE II PLANNING

The Project Management Team prepared *Phase II: Preliminary Options for Future Actions* in a September 2010 memo (http://www.southbayrestoration.org/planning/phase2/), and then took those ideas to the public for initial feedback and brainstorming. The Project Management Team considered the input received at Stakeholder Forum meetings, as well as at the Alviso and Ravenswood Working Group meetings in making its selection of Phase II actions. Decisions about what construction and restoration activities to pursue in Phase II of the project in part, on the evaluation of adaptive management information collected to date. The overarching guiding principles for the selection of Phase II actions are first, to "do no harm" relative to flood impacts, and second, not to deviate significantly from the goal of creating at least 50% managed ponds and 50% tidal marsh at the restoration site. Until adaptive management results supply us with significant data to the contrary, our plan is to build upon decisions made in previous planning processes.

In September 2011, the State Coastal Conservancy (SCC) sought responses to a Request for Environmental and Engineering Services for a one-plus year contract to conduct restoration, flood management, and public access planning, modeling, environmental analysis/review, design, and cost estimating for Phase II projects of the 15,100-acre Project. In early 2012, a consultant was selected and the SCC is currently negotiating the contract with the selected consultant.

The initial contract period for Phase II work will be approximately 1 year. It is the intent of the SCC to augment the contract as additional tasks are sufficiently defined. The overall scope of work will include development of:

- Preliminary Design Memoranda or Plans for Phase II restoration, public access, and flood protection projects;
- A Plan for beneficial reuse of aquatic and upland materials for habitat and flood protection;
- An Environmental Impact Statement/Environmental Impact Report (EIS/R) tiered off of the Project's programmatic EIS/R; and

- Regulatory agency coordination and permits applications.

The three primary geographic areas for this Request for Services are:

1. The Ravenswood Pond and the Alviso Ponds of the Don Edwards San Francisco Bay National Wildlife Refuge for Phase II habitat, public access, and flood protection projects;

2. The Eden Landing Ponds of the Eden Landing Ecological Reserve (owned and managed by CDFG) for Phase II habitat, public access, and flood protection projects; and

3. Project area-wide (Ravenswood, Alviso, and Eden Landing Pond Complexes) analysis of beneficial reuse of aquatic and upland material for habitat restoration and flood protection.

7.2 PHASE II PROJECT LOCATIONS

For Phase II the Project would like to develop plans, complete 10% design and conduct environmental analysis of and permitting for the following projects:

Alviso Habitat Restoration and Flood Protection Projects

1. Additional breaches of the Island Ponds: Evaluate the potential benefits of levee lowering and additional breaches on the north (Mud Slough) side of Alviso Ponds A19, A20, and A21. Coordination with the Santa Clara Valley Water District will be necessary in order to sustain their mitigation requirements at these ponds.

2. Tidal Restoration of Alviso Ponds A1 and A2W and Charleston Slough: Evaluate the tidal restoration opportunities and potential flood impacts of Ponds A1 and A2W in conjunction with Charleston Slough. Charleston Slough was originally a mitigation project and is currently owned by the City of Mountain View. It is not part of the Project. By incorporating Charleston Slough into tidal restoration of Alviso Ponds A1 and A2W, which are part of Project, it is expected to make a more successful project and reduce the amount of flood protection work necessary between Charleston Slough and Pond A1. However, flood impacts would still need to be assessed and solutions proposed as part of this project. Preliminary conversations with the regulatory agencies and the City of Mountain View indicate support for the project.

Ravenswood Habitat Restoration and Flood Protection Projects

1. Tidal Restoration of Pond R4: Evaluate the feasibility of levee lowering, breaching and other actions to restore tidal flows to Pond R4. Flood protection analysis will be an important component of tidal restoration of this pond. The consultant may also be requested as an optional task to evaluate the incremental cost difference for including Pond R3 in Phase II tidal restoration.

2. Managed Ponds at R5/S5: Develop concepts for habitat creation and management at Ponds R5/S5 to benefit birds and meet other project goals. These two small ponds are slated to become managed ponds under all of the Project's scenarios. However, their size and location are a constraint on habitat enhancement. Coordination with the Project's Lead Scientist and

others involved in the monitoring program will be necessary when developing concepts for these two ponds.

3. Public Access and Recreation: As described in the Project's EIS/R, each pond complex presents opportunities to construct spine or spur segments of the Bay Trail or facilities for the Water Trail and other public recreation features such as interpretation, trailheads, and overlooks. The consultant will be asked to provide an analysis of opportunities to implement public access improvements as outlined in the EIS/R or any newly emerging opportunities not previously considered and incorporate public access into plans for the Alviso and Ravenswood Ponds. Furthermore, if restoration or flood protection features designed in above tasks impact existing public access features, the project will need to mitigate for these impacts.

Eden Landing Ecological Reserve Comprehensive Restoration and Public Access

For the area of ponds between Old Alameda Creek and the Alameda Creek Flood Control Channel (referred to as "Southern Eden Landing"), the Project would like to develop a comprehensive plan for tidal wetland restoration of all the ponds integrated with public access that links with existing and planned Bay Trail and Water Trail segments. The consultant may also be asked to incorporate concepts for fresh/brackish water wetland creation using treated wastewater. In addition to wetland restoration, the plan should address:

- Potential flooding impacts,
- Impacts to existing public access features and appropriate alternatives to mitigate these impacts,
- Historic and cultural identification, evaluation, and interpretation,
- Phased implementation through an adaptive management process; and
- Peer review of Alameda County Flood Control District's analysis and modeling for this area as it pertains to meeting the Project's restoration goals.

This planning effort will need to be closely coordinated with CDFG, San Francisco Bay Trail, the State Coastal Conservancy, Alameda County Flood Control District, Union Sanitary District and East Bay Regional Park District. Once this comprehensive plan is complete, the Project Management Team will select which specific actions in this geographical area will be pursued for further design work and environmental analysis and permitting work.

Project-wide Analysis of Beneficially Using Aquatic and Upland Material

The Project would like to develop a comprehensive plan for securing approval to opportunistically receive material from aquatic and upland sources for habitat creation and flood protection features throughout the Project area. In light of projected sea-level rise, the existing subsided elevation of the ponds, the potential for reduced suspended sediment concentrations in the South Bay, and the desire for broad upland transition zones, the Project can use large amounts of sediment, likely much more than available through natural processes. Yet due to the lack of regulatory approval and appropriate infrastructure, the project has had to turn down unplanned sources of material. The Project would like to complete a planning process that would allow the project to capitalize on sediment as it becomes available, even if the material will not be used until part of future project phases. This analysis should:

- Identify suitable locations and required infrastructure for short- and long-term storage of material delivered to the site by other parties.

- Specifying the types of material needed for the different project features or actions such as expediting marsh development, filling borrow ditches, upland transitions zones, and engineered levees.

- Submit a conceptual plan to the Project Management Team to select which specific actions will be pursued for further design work.

- Complete the required NEPA/CEQA analysis and permits to able to receive material as it becomes available.

- Prepare 10% design documents and permit applications.

- Coordinate with other efforts to facilitate beneficial reuse for dredge material in the San Francisco Bay to ensure the Project is prioritized in regional plans (e.g. the Long-Term Management Strategy for the Placement of Dredge Material in the San Francisco Bay Region (LTMS) Program and the U.S. Army Corps of Engineers' development of a long-term Dredge Material Management Plan (DMMP) for San Francisco Bay.)

APPENDIX A
2012 ALVISO POND A2W OPERATION PLAN

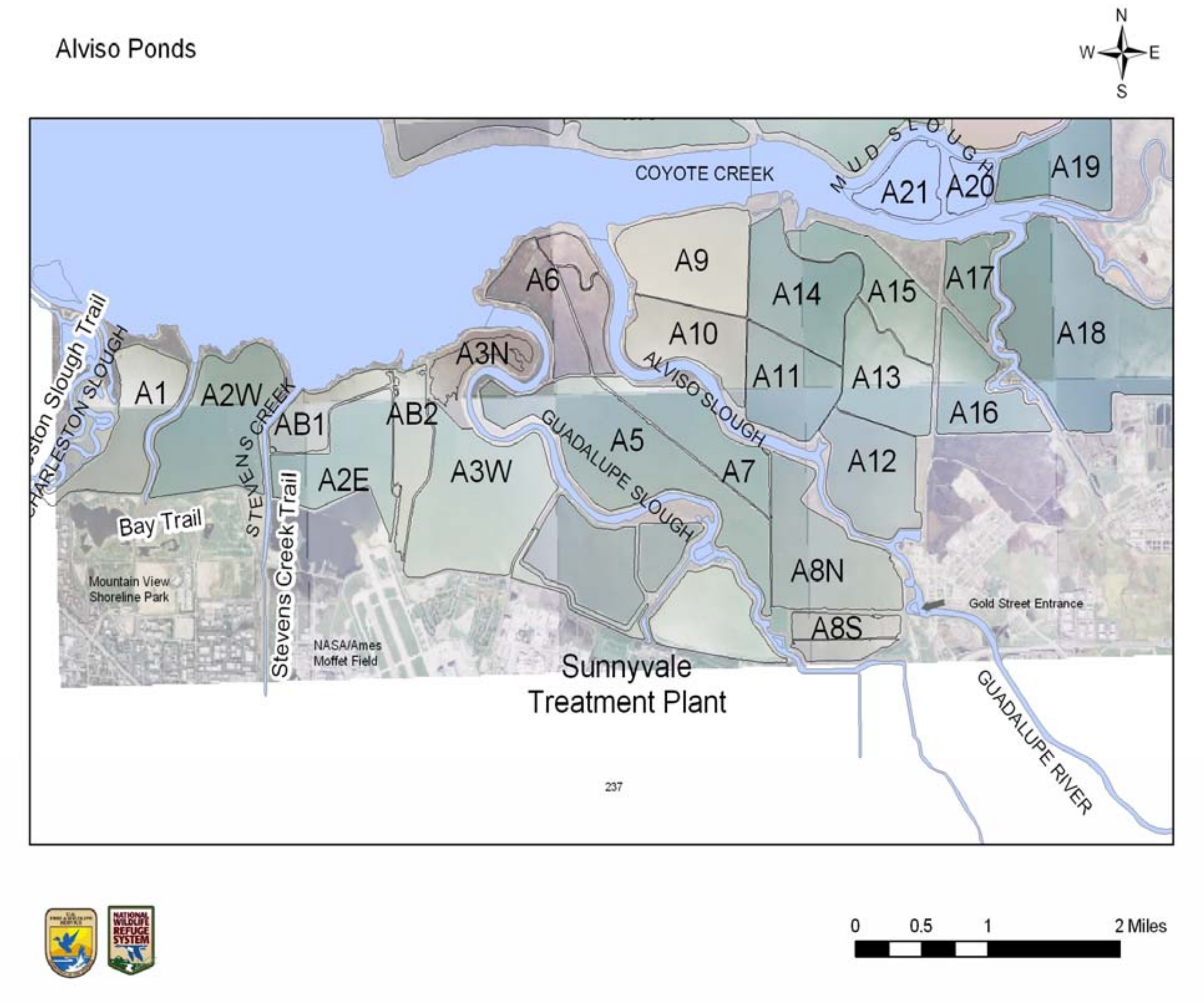
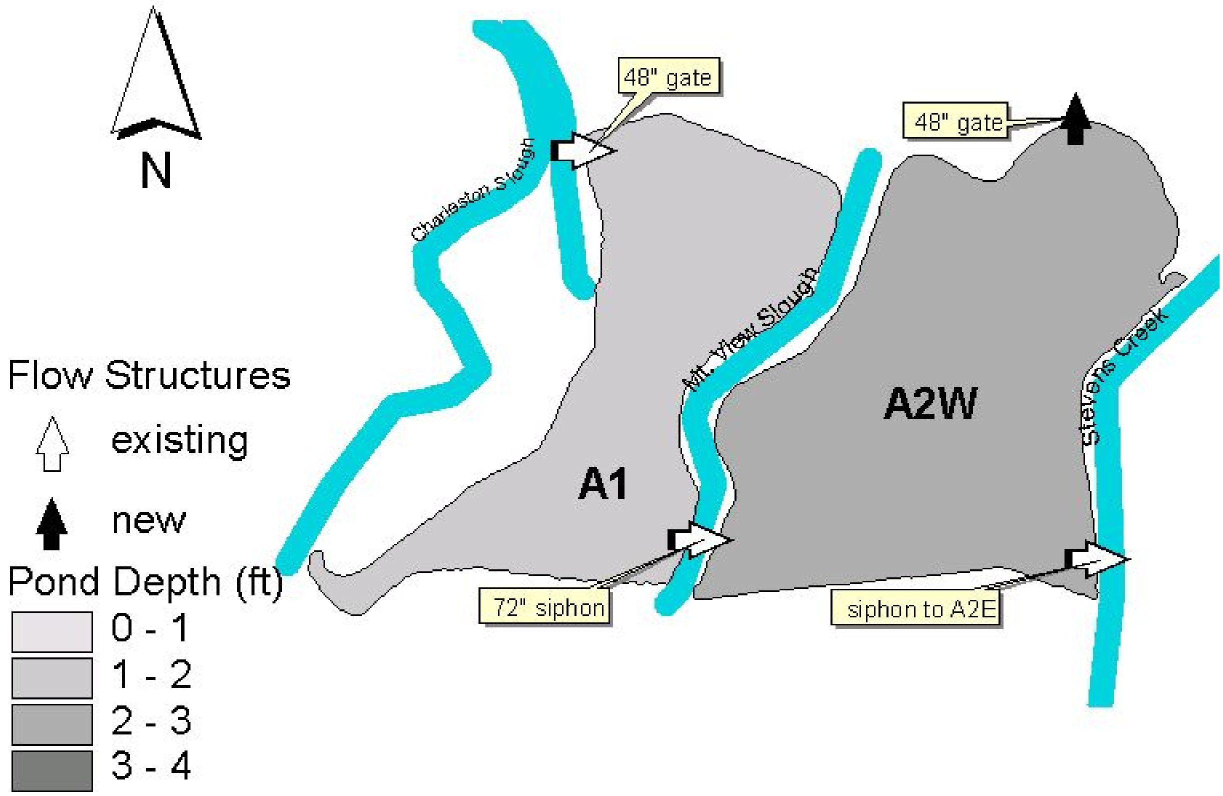


Table of Contents



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 make up 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.

<u>Summer Pond Water Levels</u>

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

<u>Summer Gate Settings</u>

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 10th 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.

<u>Winter Pond Water Levels</u>

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

<u>Winter Gate Settings</u>

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 B
2012 ALVISO POND A3W OPERATION PLAN

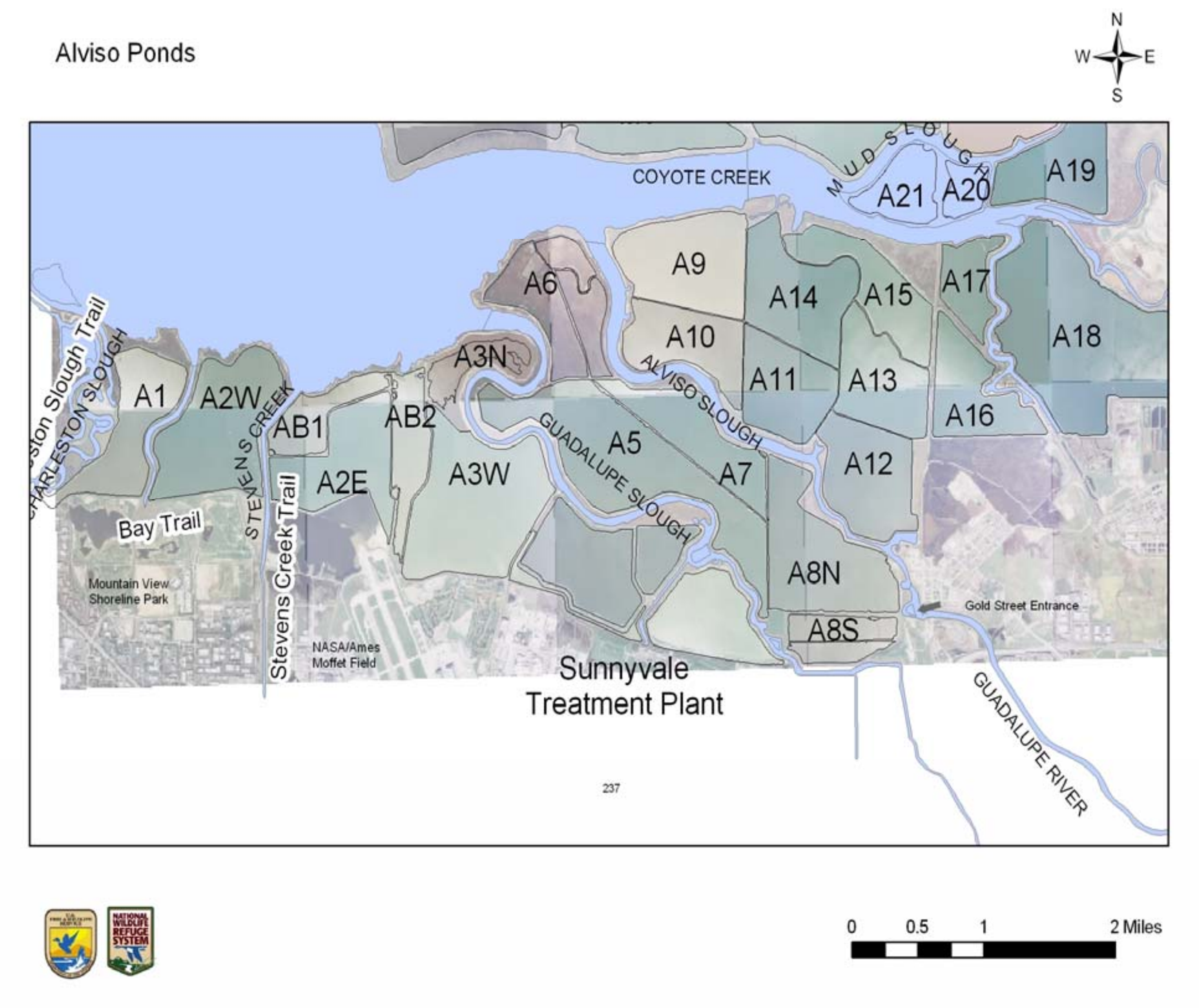
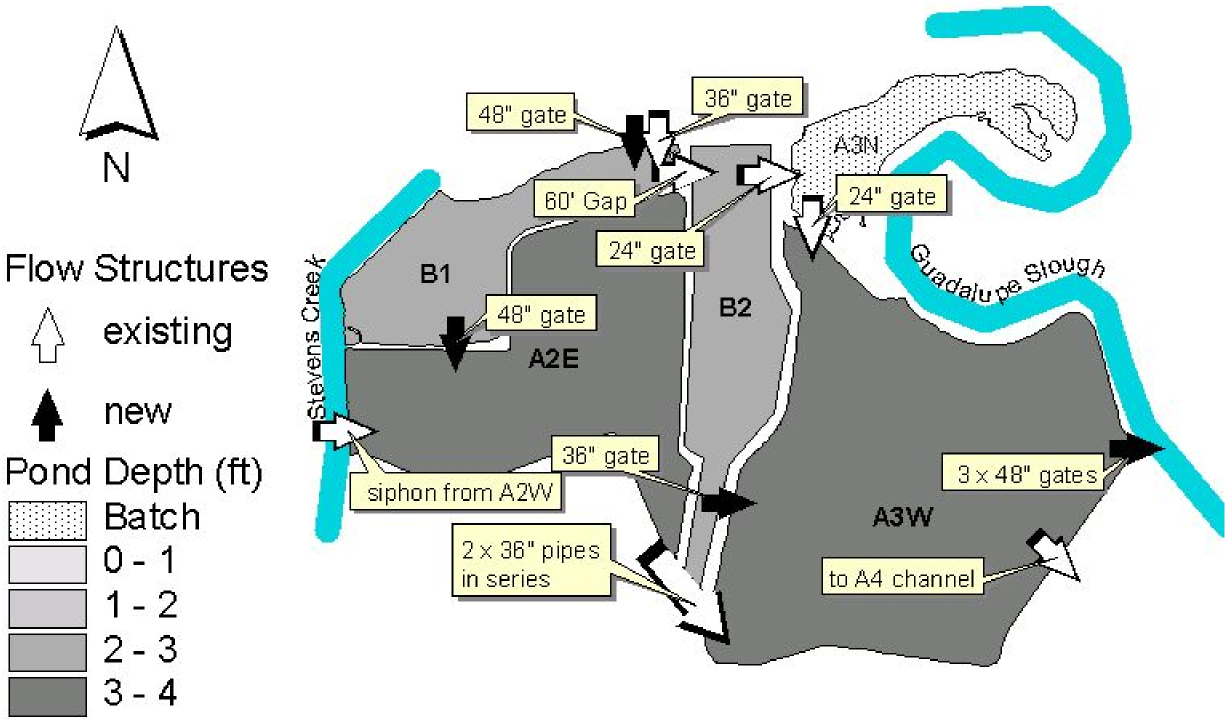


Table of Contents



Objectives

1. Maintain full tidal circulation through ponds B1, B2, A2E, and A3W while maintaining discharge salinities to Guadalupe Slough at less than 40 parts per thousand (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 (DO), temperature, avian botulism, and potential for inorganic mobilization.

2. 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).

3. 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 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 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:

4. Have an extra monitor on hand, in case there is a break down.

5. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.

6. 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 C
2012 ALVISO POND A8 OPERATION PLAN

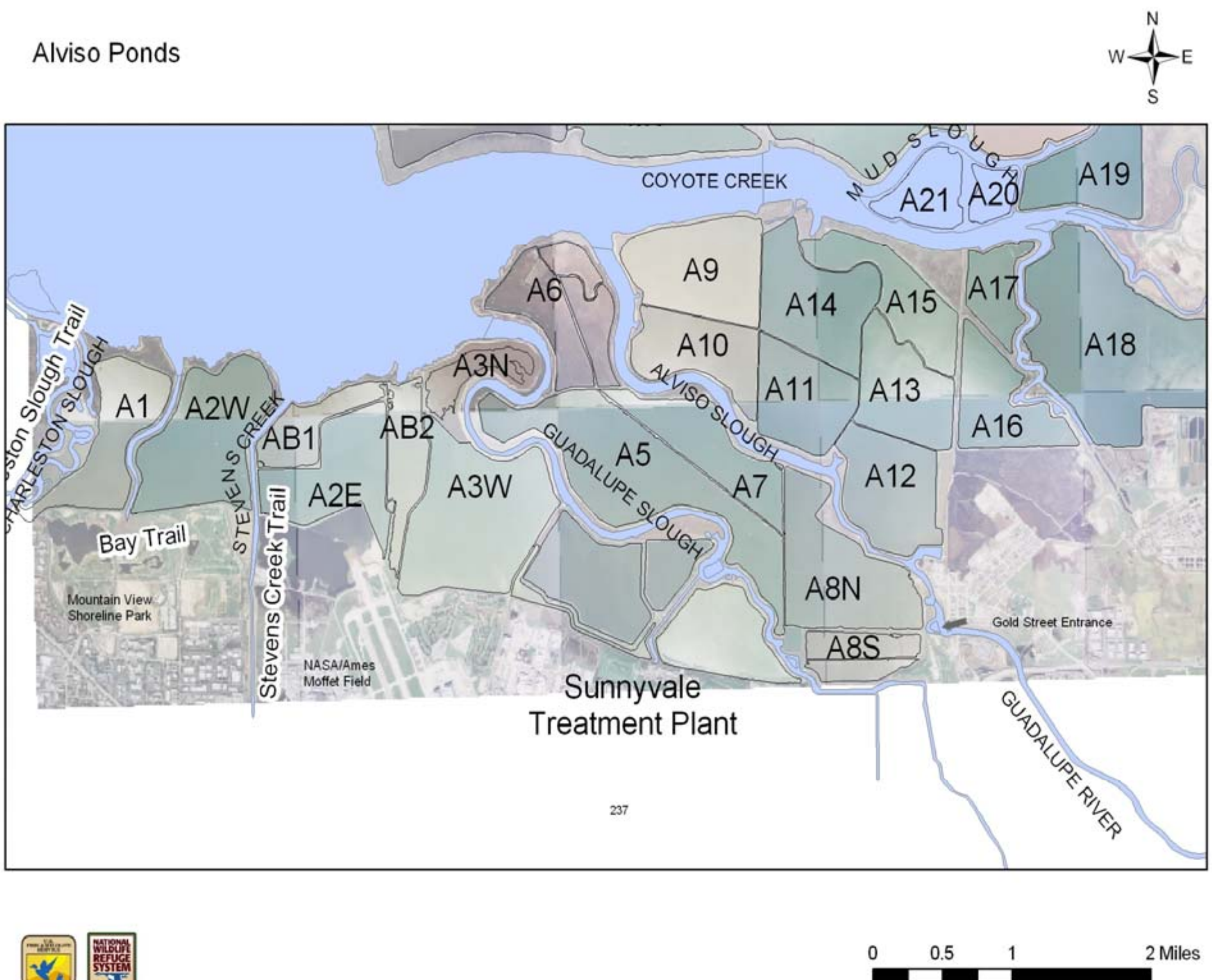
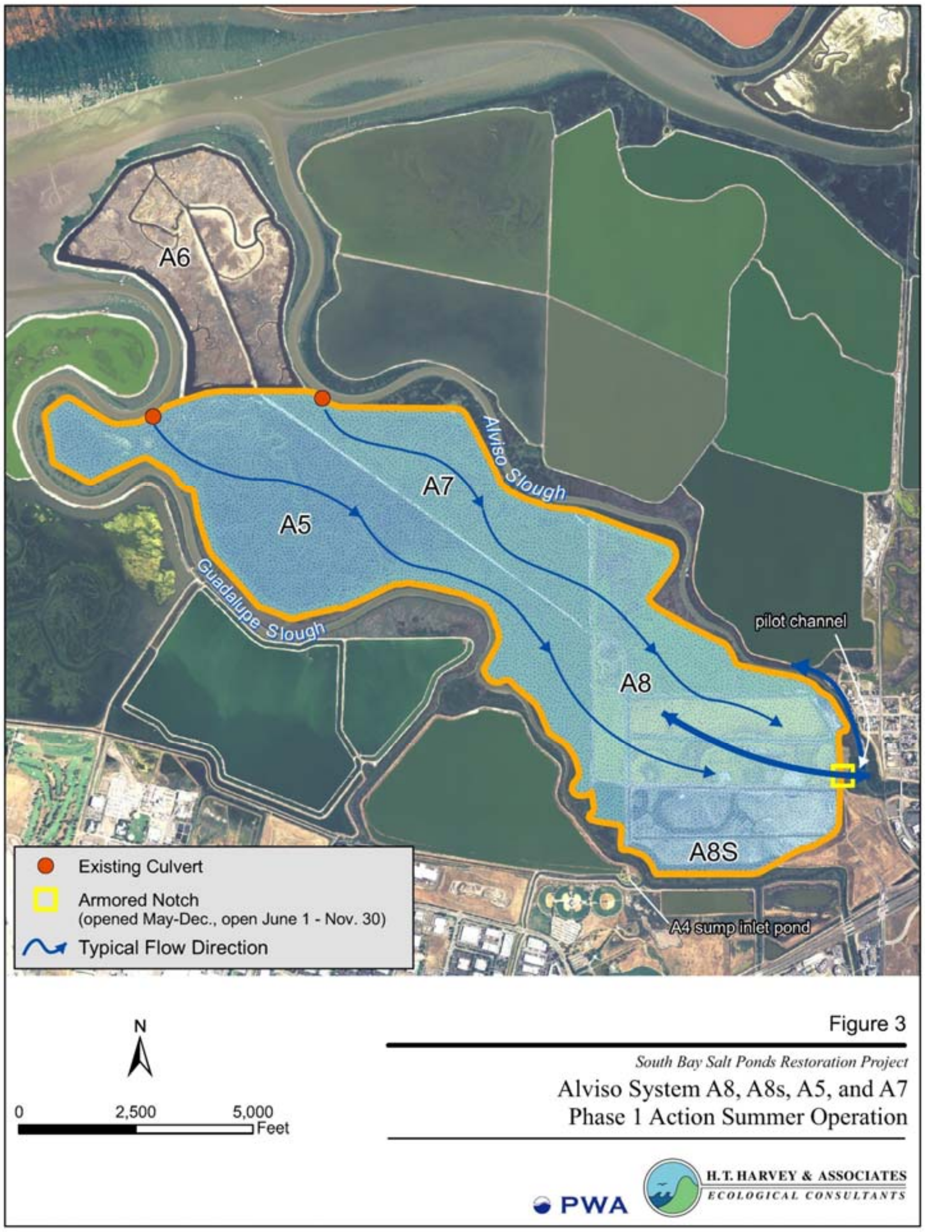


Table of Contents



Map provided by Philip Williams and Associates (PWA)

Goals

The Phase 1 action at Pond A8 is one of the initial actions for implementation under the larger South Bay Salt Pond (SBSP) Restoration Project. Pond A8 is identified as tidal habitat in the long-term programmatic restoration of the SBSP Restoration Project, which would contribute to achieving the overarching project goal of restoring wetland habitat while providing for flood management and wildlife-oriented public access and recreation (U.S. Fish and Wildlife Service et al. 2007). The Pond A8 system will be operated to maintain muted tidal circulation through ponds A5, A7, A8N and A8S while maintaining discharge salinities to the Bay at less than 40 ppt. Other water quality requirements in the Regional Water Quality Control Board's (RWQCB's) Waste Discharge Requirements (Order No. R2-2008-078) include monitoring for pH, dissolved oxygen, temperature, avian botulism, and mercury methylation.

Pond A8 is located within the Alviso pond complex between Alviso and Guadalupe Sloughs in South San Francisco Bay. The pond was historically part of a larger tidal marsh, which was diked in the mid-1900s for salt production. Perimeter levees separate the pond from Alviso Slough to the northeast and Guadalupe Slough to the southwest. Internal levees separate Pond A8 from adjacent Ponds A5 and A7 and divide Pond A8 into Ponds A8N and A8S. Deeper borrow ditches surround the ponds along the inboard side of the levees (PWA et al. 2008).

This Phase 1 action would introduce muted tidal exchange to create approximately 400 acres of muted tidal habitat within Pond A8, and modify water depths in approximately 1,000 additional acres of existing shallow water habitat in Ponds A5 and A7. Restoration of tidal action at Pond A8 is designed to be adaptable and reversible so that in the event that unacceptable environmental impacts begin to occur, tidal exchange to Pond A8 can be modified or eliminated to prevent long-term adverse impacts. If needed, water management at Ponds A5 and A7 can revert to ISP operations. Adaptive management experiments associated with the Phase 1 action will study the effects of increased mercury exposure on the food web of the South Bay. The mercury study will monitor bioaccumulation across a variety of estuarine and managed pond habitats to assess potential impacts of restoration and management actions on wildlife (PWA et al. 2008).

The following goals have been identified to guide the design of the Phase 1 action at Pond A8 (PWA et al. 2008).

- Enlarge the Alviso Slough channel in a way that can be sustained by natural tidal flows. Do not increase peak water levels or erode levees along Alviso Slough, particularly those along the east side of the slough.

- Provide a cost-effective project that reflects the expected 10 -50 year lifecycle expected of notch structure. The goal is that in 10 or 15 years the SBSP Restoration Project would have direction on whether to pursue full tidal restoration of Pond A8 or to maintain ISP or other pond management operations. Both directions entail the permanent removal of Phase 1 structures. Channel enlargement through tidal scour is a central component of the SBSP sustainable flood management approach and will provide public access improvements for small craft navigation along Alviso Slough

- To the extent possible given other goals, encourage conversion of tall-form brackish marsh vegetation to short-form salt marsh vegetation by increasing salinities along Alviso Slough. Vegetation conversion would enhance public access (small craft navigation).

There are three vertical datums mentioned in this plan. The FWS currently uses NGVD29 in the ponds to calculate water levels. To correlate the different data sets, use the following relationships:

NAVD88 = NGVD29 + 2.7 feet
MLLW = NAVD88 + 1.97 feet

Structures

The A8 system includes the following structures needed for water circulation in the ponds:

- Existing 2x48" gate intake at A5 from Guadalupe Slough.
- Existing 2x48" gate inlet with two 24' weir boxes at A7 from Alviso Slough.
- Existing staff gages in ponds; Existing NGVD gages at A5 and A7 structures (see Figure 2).
- Existing 36" gate between A7 and A8N.
- Existing siphon between A4 to A5 will generally be closed, this siphon is pump driven rather than gravity fed.
- New 40 ft. armored notch with multiple bays that can be opened and closed independently.

Figure 2: Water Level Gauge Locations

2.1 Weir Structure

Under existing conditions, the Alviso Slough channel does not have the capacity to convey the 100-yr design storm of 18,300 cfs (at the UPRR Bridge) to the Bay (Santa Clara Valley Water District 2001). Therefore, a portion of the levee adjacent to Pond A8 was reconfigured as part of the Lower Guadalupe River Flood Protection Project (LGRFPP) to act as an overflow weir and take advantage of the off-line storage provided by the Pond A8 system. The LGRFPP was constructed by the Santa Clara Valley Water District (SCVWD) on the Guadalupe River/Alviso Slough between Highway 101 and Alviso Marina County Park. The focus of the LGRFPP was primarily to address the Guadalupe River contribution to flood conditions in the area. In addition to the Pond A8 overflow weir, project work included: construction of floodwalls or raising levees along the river banks; replacement of the Highway 237 eastbound bridge; modification of storm drain outfalls; improvement and construction of maintenance roads and under-crossings; improvement of the west perimeter levee around Alviso and construction of grade-control weirs (gradual drops in the stream elevation) (Santa Clara Valley Water District 2001).

The 1,000-ft long overflow weir at Pond A8 allows high flood flows to exit Alviso Slough when water levels reach approximately 10.5 ft NAVD88. Due to the relatively low elevation of interior pond levees, flood water stored in Pond A8 would spill into Pond A8S (at 2.5 ft NAVD88), Pond A5 (at 3.25 ft NAVD88), Pond A7 (4.0 ft NAVD88), and eventually Pond A6 (at 10.0 ft NAVD88), (PWA et al. 2008).

2.2 A4 Siphon

The SCVWD may request to pump water from Pond A4 into Pond A5. At that time, SCVWD will provide monitoring data from Ponds A3W, A4 and A5 twice weekly, in accordance with the Pond A4 Water Management Operations Plan (December 2005) to assure that A8 discharges will remain below RWQCB permit limits. The Fish and Wildlife Service (USFWS) may also desire to pump water from Pond A4 into Pond A5 and may request SCVWD to do so. Operations of the A4 siphon will be consistent with the A4 MOU agreement between SCVWD and USFWS which was established in 2005.

2.3 Notch / Bridge Structure

The armored notch provides a muted-tidal connection between Pond A8 and upper Alviso Slough. Earth excavated to construct the notch has been placed within Pond A8 and covered by clean sediment. The notch width is adjustable up to approximately 40 ft. The depth of the notch (invert at 0.5 ft NAVD88) is approximately one foot above the average bed elevation (-0.5 ft NAVD88). The size of this structure was to maximize the volume of water exchanged between the slough and the pond while controlling water levels within the pond. The notch consists of multiple ‘bays’ that can be opened and closed independently. This allows for adjustments to the amount of tidal exchange between Pond A8 and Alviso Slough based on monitoring data. Initially, the notch is to be operated with only one bay open. Additional bays may be opened if monitoring data confirm that slough widening does not threaten downstream levees, in particular the levees along the east side of Alviso Slough (perimeter levees to Ponds A11 and A12). Flow through the notch occurs during both flood and ebb tides. Concrete armoring is to prevent unintentional widening and/or deepening of the notch. Vehicle access over the notch for maintenance of the overflow weir and management of flashboards is provided by a bridge that spans the 40-ft notch (PWA et al. 2008). The FWS at its own expense operates and maintains the notch, bridge, and access levees and insures that the notch remains fully functional. As part of the preventive maintenance, the FWS performs weekly monitoring for the notch, bridge, channels, weir boards, and access levees to document areas for repair. FWS staff will be monitoring for erosion, cracks, missing or defective pieces, vandalism, or any normal and/or abnormal wear that was not part of the original construction. Once these repair items have been identified, FWS staff will inform Refuge Manager of repairs needed to keep these improvements in fully functioning condition.

3. System Description

The Pond A8 project consists of a variety of elements that allow for a muted-tidal connection from adjacent slough to Ponds A8, A5 and A7. The notch can be closed if there is evidence of adverse environmental impact. Water exchange through this connection is limited and the tidal range within the ponds is muted. With a fully open notch, water level fluctuations in the ponds over a tidal cycle were predicted to be small (0.5 to 1 ft) compared to the range of tidal change in

Alviso Slough (over 8 ft). Initially, water level fluctuations in the ponds are predicted to be less as the notch is to be only partially open. Water levels in Pond A8 were predicted to exceed elevations of internal levees, spill into adjacent Ponds A8S, A5 and A7 and modify the existing hydrologic regime in these ponds as well. Water levels were predicted to fluctuate over the tidal cycle evenly across the area of all the ponds, and depths vary due to differences in bed elevations. Depths were predicted to exceed those at which the ponds were managed under the ISP (<1 foot). Typical summer water levels are shown in Table 1.

A notch with multiple bays adds operational flexibility, and the operation of the notch is informed by on-going monitoring activities. Initially, the notch will be operated with one (5 ft) bay open during the dry season (summer and fall) in order to avoid excessive channel widening and possible erosion of perimeter levees along Alviso Slough and the former salt ponds (e.g., the A12 levee at the A8 'Bulge'). Depending on the actual channel widening observed and the amount of fringing marsh remaining, the notch width may gradually be increased up to its full 40-ft width. If monitoring indicates a substantial risk to the structural integrity of perimeter pond levees, additional channel scour could be halted by reducing the restored tidal prism. Closing one or more of the multiple bays provides this flexibility.

Table 1. Summer Pond Water Levels

Pond	**Bottom Elev. (ft, NGVD)**	**Water Level (ft, NGVD)**	**Water Level (ft, Staff Gage)**
A5	-0.9	1.4	2.9
A7	-0.8	1.4	2.8
A8N	-3.6	1.4	NA
A8S	-3.5	1.4	NA

The intakes for the A8 system are located at the northwest end of pond A5 (two 48-inch gated culverts from lower Guadalupe Slough and at the northeast end of pond A7 (two 48-inch gated culverts from Alviso Slough. The discharge point is located at the east end of Pond A8 with a 40 foot notch which has adjustable independent bays that allows flood and ebb flow. In normal operations, the flow through the system starts at the intakes of A5 and A7, and then muted tidal at the notch in Pond A8. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow occurs at high tide, and all outflows occurs when the tide is below 8.12 ft. MLLW. The standard summer operation gate settings are shown in Table 2.

Table 2. Summer Gate Settings

Gate	**Setting (% open)**	**# of gates and size**
A5 intakes	100	2 X 48"
A7 intakes	100	2 X 48"
Notch	1 bay of boards to begin	1 of 8 bays

3.1 Water Level Control

The water level in A8 is the primary control for the pond system. The 40 foot notch at Pond A8 includes multiple bays that can be adjusted to reach desired pond depth. The intake gate settings or notch may be used to limit flow through the system. The system flow is limited by the outlet capacity. Normal operation is to have the intake gates fully open, and the initial notch setting is to have one bay fully open. The normal water level in A8 will normally be at 1.4 ft NGVD in summer (see Table 3). The level may vary by 0.2 feet due to the influence of weak and strong tides.

The A5 and A7 intake gates can be adjusted to control the overall flow though the system. The maximum water level in A5, A7, and A8 is to be less than 1.6 ft NGVD. This is to maintain freeboard on the external levees, limit wind wave erosion, and to preserve remnant lengths of islands within the system occupied by nesting birds. If future monitoring efforts result in re-evaluating the maximum level, the FWS will verbally consult with the SCVWD to determine appropriate water levels. Additionally, the extent of tidal exchange needs to be adjustable such than corrective actions can be taken if needed to avoid increases in flood hazards to the community of Alviso.

Table 3. 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	1.4	1.6	3.1	0.9	2.2
A7	1.4	1.6	3.0	0.9	2.1
A8	1.4	1.6	NA	0.9	NA

Table 4. 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	1.4	0.2	1.4
A7	1.4	0.2	1.4
A8	1.4	-2.5	NA

Table 4 shows the water elevation needed to cover the pond bottom. 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.

3.2 Channel Erosion along Alviso Slough

Restoration of muted tidal action at Pond A8 is expected to deepen and widen the channel along the upper
(landward) portion of Alviso Slough due to substantial increases in the slough tidal prism. The magnitude of tidal current velocities and associated slough scour would be related to the size of the notch opening, with less deepening and widening occurring with fewer open bays. These potential changes would increase the ability of the slough channel to convey flood flows and lower water levels associated with large rainfall-runoff events on the Guadalupe River. However, restoration of muted tides in Ponds A8, A7 and A5 during the rainy season would also reduce the amount of flood storage provided by these ponds and possibly result in higher maximum water elevations along Guadalupe Slough. The Phase 1 action at Pond A8 would provide an opportunity to assess the changing flood conveyance along Alviso Slough and determine if flood hazards are decreased over both the short- and long-term. Monitoring data of slough scour and tidal regime would provide the necessary information to examine changes to baseline flood hazards. If it is determined that changes in channel conveyance always compensate for losses of flood storage, seasonal management of the Phase 1 notch could be modified (PWA et al. 2008).

3.3 Water Quality Monitoring

Water quality monitoring is conducted as stated in Attachment D of the RWQCB Order No. R2-2008-078. A continuous monitor at the notch location records several water quality parameters. Weekly checks are made to clean and download data from the monitor. Monthly grab samples are conducted in the receiving waters to record if any impacts are occurring. The monitoring season is conducted from May through October each year with an annual report provided to the RWQCB.

3.4 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 botulinum* along water bodies. 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. Historically, Ponds A5 and A7 were susceptible to botulism outbreaks due to a shallow water depth and pond dynamics. At A8, the raised waters levels within the system should reduce potential botulism outbreaks.

3.5 Winter Operation

The notch is closed during winter months (December – May) to prevent entrapment of migrating salmonids. During these winter months, Pond A8 system is operated by closing the inlets at A5 and A7 and allowing them to discharge only until waters levels within Ponds A5 and A7 are at or below 0.6 NGVD. The gate between A7 and A8 is also opened to lower water levels in A8. Once the winter operation target level is reached at Pond A5, both A5 and A7 is operated as muted tidal as part of the FWS permit requirements stated in National Marine Fisheries Service (NMFS) biological opinion (NMFS et al. 2009). Table 5 shows the target water levels for winter operation. During winter operations, if the water levels exceed approximately 0.6 ft NGVD, the A5 intake will be closed to allow the excess water to drain. Note that without pumping, rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds. If water levels exceed the capacity of Pond A8, SCVWD will use pumps to remove excess water at various locations stated in the Pond A8 Floodwater Evacuation Plan (2006). With the pumping described in the 2006 plan, the pond should be returned to the beginning winter operations water level within 40 days.

Winter operation provides less circulation flow than the summer operation. Evaporation is normally minimal during the winter. Winter operation is to limit large inflows during storm tide periods to allow rain water to drain from the system, and maintain flood storage for the Guadalupe River. The Pond A8 system (Ponds A5, A6, A7, and A8) currently provides flood overflow storage and conveyance of Guadalupe River/Alviso Slough flows via the Pond A8 overflow weir along Alviso Slough. The Phase 1 action must maintain or improve current levels of flood protection. This includes avoiding unintentional breaching of downstream perimeter levees due to channel widening. Table 6 shows the winter gate settings which are based on visual observations of water elevations that provide enough water in the ponds to prevent mud flats from occurring, and not yet too high to overtop internal levees.

Table 5. Winter Pond Water Levels

Pond	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A5	-0.9	0.6	1.8
A7	-0.8	0.6	NA
A8N	-3.6	NA	NA
A8S	-3.5		

Table 6. Winter Gate Settings

Gate	Setting (% open)	# of gates and size
A5	100	2 X 48”
A7	100	2 X 48”
A8 Notch	Closed	Closed

4. Monitoring

The system monitoring requires weekly site visits to record pond and intake readings. The monitoring parameters are listed below in Table 7.

Table 7. Weekly Monitoring by Refuge staff

Location	Parameter
A5	Depth, Observations
A7	Depth, Observations
A8	Depth, Salinity, Observations

The weekly monitoring program includes 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 also includes supplementary DO monitoring when problems are identified in the formal monitoring listed below in Table 8.

Table 8. Additional Refuge monitoring required by the RWQCB discharge requirements

Location	Frequency	Parameters
A8 notch (discharge)	Continuous (May-Oct)	DO, pH, Temp., Salinity
Alviso Slough	Monthly (May –Oct)	DO, pH, Temp., Salinity

4.1 Mercury

Sediments in some parts of Pond A8, particularly in and along Alviso Slough, contain elevated levels of mercury contamination. Re-mobilization of mercury-contaminated sediments into the water column, either directly (e.g., during excavation of pilot channels) or indirectly (through increased sediment scour after the pond is opened to tidal action), could result in adverse effects on South Bay biota.

South Baylands Mercury Project started in 2006 to assess the risks associated with restoring pond A8 to tidal action and to collect baseline data prior to breaching. This study established baseline mercury levels in the sediment, water column, and various sentinel species (song sparrows, brine flies, long jawed mud suckers, silver sides, stickleback, killi fish, and yellow fin gobies); bioavailability of inorganic mercury in sediments; mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. These baseline data may be influenced by direction and/or future requirements imposed by regulatory agencies (including the RWQCB), as well as findings from other applied studies or scientific research. These baseline data will be used to inform management decisions to further minimize mercury exposure. Specifically, exceedence beyond the baseline levels will be cause for changing management of the armored notch.

Future mercury monitoring projects will be developed to advance the understanding of uncertainties faced by the project. If the change in operation of the pond by opening the notch results in a negative effect on the local environment, the notch may be operated differently or closed following the process described in the Memorandum of Agreement between FWS and the SCVWD. Alternatively, if there is not a negative effect or the benefits of tidal restoration appear to outweigh any negative effect, the FWS will consider beginning the planning process for full tidal restoration of Pond A8.

4.2 Alviso Slough Channel Scour and Effects on Downstream Levees

The SCVWD will monitor scour effects in Alviso Slough, as specified in the Memorandum of Agreement between FWS and the SCVWD. Monitoring will consist of taking cross-sections at two points in the slough annually to assess potential impacts to the FWS-owned levee bordering Pond A12 and the District-owned levee upstream (see Figure 2). The purpose for these inspections is to determine if operations of the notch have produced undesired scour or other undesired conditions, as described below. The District will provide results of its monitoring in an annual report to the FWS. If undesired scour of either levee occurs or other undesired condition is observed, the FWS will close the notch and promptly notify all the members of the SBSP Restoration Project Management Team (PMT), in writing. A meeting of the PMT will be convened to discuss and determine Adaptive Management actions as soon as possible to determine the appropriate course of action regarding the operation of the Armored Notch (e.g., changing Armored Notch operation).

As part of the regular monitoring conducted by FWS, FWS staff will visually inspect the levees downstream of the armored notch. Any of the following is considered to be an undesired condition:

1. Sloughing, scarps, or bulges in the levee slope
2. Ruts, rills, and erosion on the levee slope.
3. Cracks - transverse, longitudinal, or diagonal crack anywhere on the levee
4. Seepage- water emerging on slope, at toe, or beyond the toe of the levee
5. Sinkholes and/or animal burrows anywhere on the levee

4.3 Fish Entrapment

The notch is closed seasonally from December 1 through May 31 to prevent migrating salmonids from swimming up current into Pond A8 and becoming entrapped. An applied study will be developed to address the potential for fish entrapment. The exact timing and study design will be based on timing of the availability of funding. If future studies performed pursuant to the NMFS biological opinion demonstrate no impact to salmonids, i.e., entrapment of smolts and adults within the pond, the notch may be allowed to remain open during winter months of December 1 through May 31, pending approval from NMFS.

4.4 Flood Storage Capacity

The Pond A8 system (Ponds A5, A6, A7, and A8) currently provides flood overflow storage and conveyance of Guadalupe River/Alviso Slough flows via the Pond A8 overflow weir along Alviso Slough. The Phase 1 action must maintain or improve current levels of flood protection. It is predicted by Phillip Williams and Associates (PWA) that the water surface elevation will decrease with the notch fully open. If future studies such as Mercury, channel scour, and fish entrapment prove to show no unacceptable risks, the notch can be operated fully open year round. Until the notch is fully open year round, winter operations (refer to winter operations 3.5) will be followed to maintain existing flood storage capacity.

Figure 3. Monitoring locations of Alviso Slough for erosion

References

NMFS (National Marine Fisheries Service). 2009. Biological Opinion – 10 year permit for operation and maintenance.

PWA, Brown and Caldwell. 2008. Pond A8 Phase I Action Engineers Report: Prepared for: California State Coastal Conservancy, U.S. Fish and Wildlife Service, Santa Clara Valley Water District.

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APPENDIX D
2012 ALVISO POND A14 OPERATION PLAN

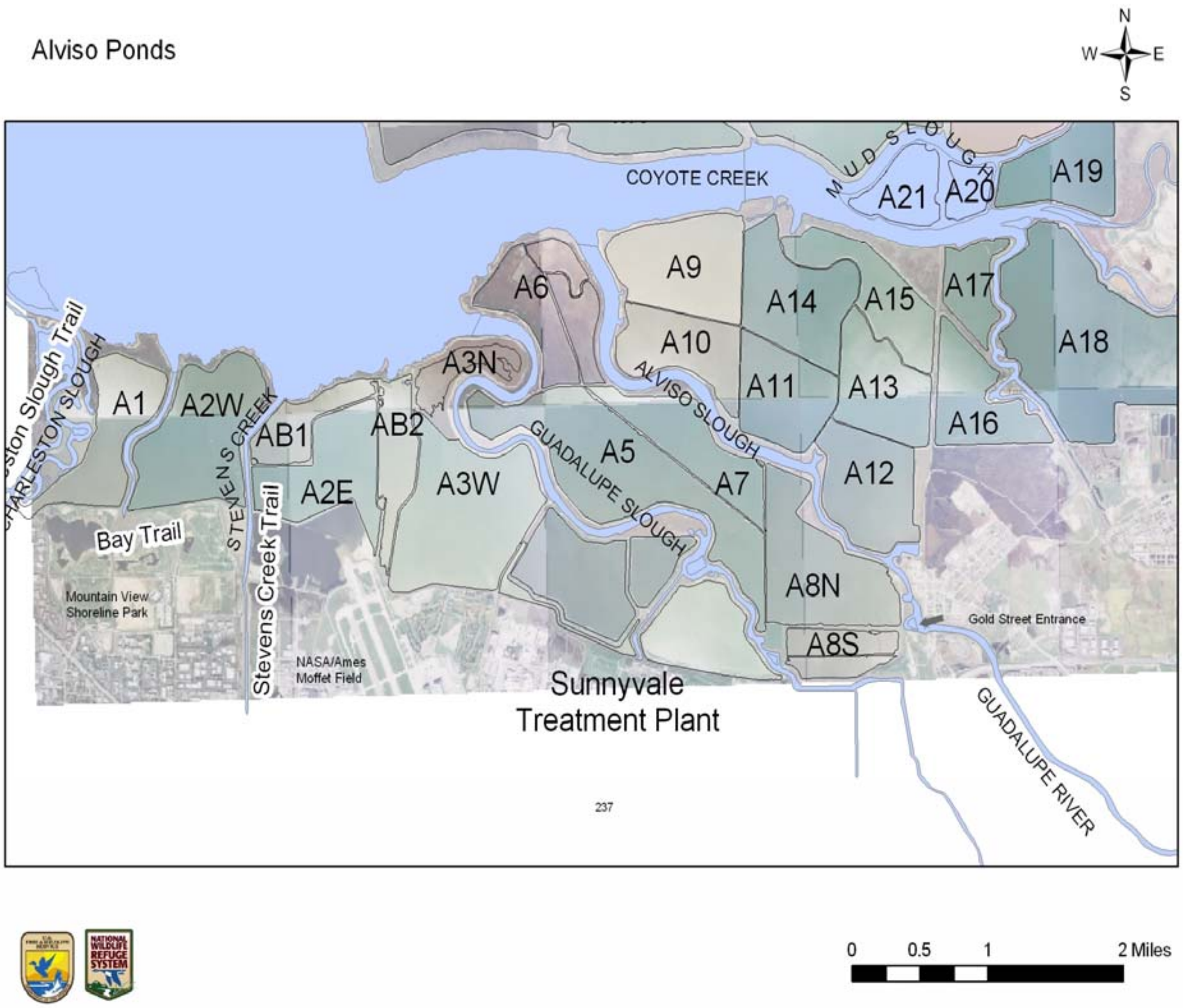
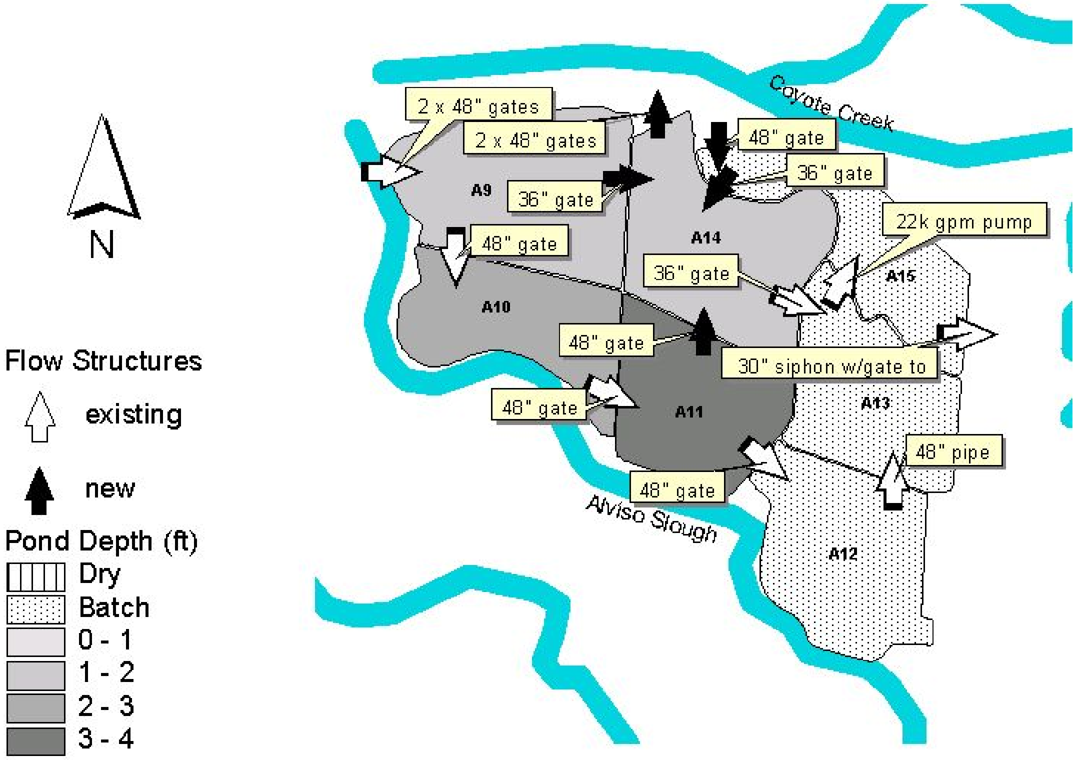


Table of Contents



Goals

1. Maintain full tidal circulation through ponds A9, A10, A11 and A14, while maintaining discharge salinities to Coyote Creek at less than 40 parts per thousand (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 (DO), temperature, avian botulism, and potential for inorganic mobilization.

2. 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.

3. Minimize entrainment of salmonids by limiting inflows during winter.

4. 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.

<u>100 Percent Coverage Water Level</u>

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:

7. Have an extra monitor on hand, in case there is a break down.

8. Get a loaner unit through Hydrolab (within a week), if the extra monitor is being used.

9. 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 Water Pond 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

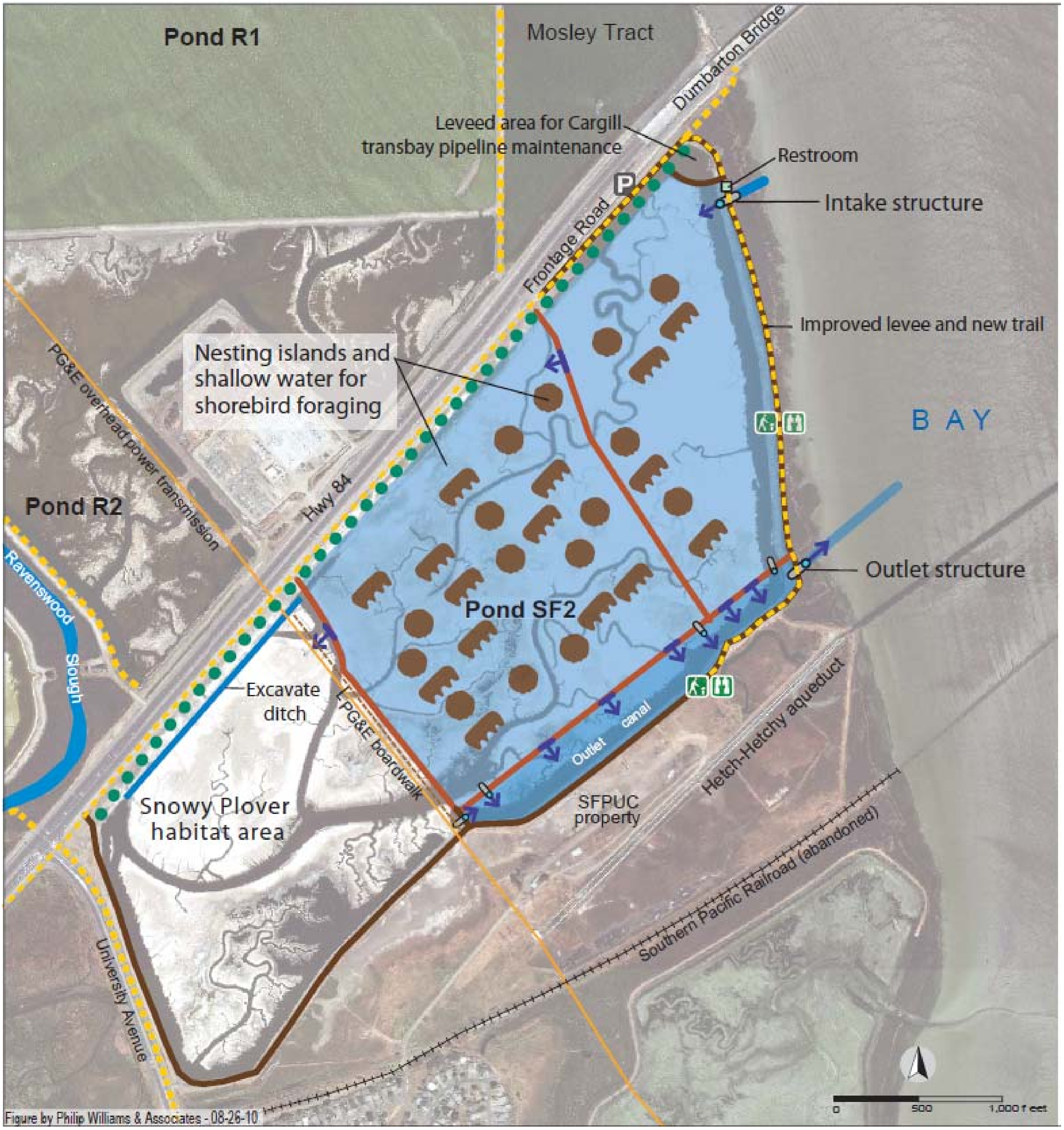
The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees. This program will also include supplementary DO monitoring when problems are identified in the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

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

APPENDIX E
2012 POND SF2 OPERATION PLAN


Project Vicinity
Antioch
Oakland
San Francisco
Tracy
San Francisco Bay
San Jose
Detail
California
Pacific Ocean
Santa Cruz
Monterey
0 10 Miles
Project Vicinity
R1
R2
R3
R4
R5
S5
SF2
Project Site
Alameda
Menlo Park
East Palo Alto
Hamilton
Ivy
Newbridge
Market
Pierce
Bay
Fredrick
Ringwood
Carlton
Saratoga
Bayshore
Willow
Okeefe
Coleman
University
Donohoe
Capitol
Pulgas
Chilco
0 0.5 1 Miles
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
South Bay Salt Pond Restoration Project
Phase 1 Pond SF2: Vicinity Map
Proj No. 2346-04
Date June 2007
Figure 1
ML N:/Projects/2346-04

Table of Contents



Map of SF2 System

Goals

The Phase 1 action at Pond SF2 is one of the initial actions implemented in 2010 as part of the South Bay Salt Pond (SBSP) Restoration Project. Pond SF2 is adjacent to the Dumbarton Bridge (Highway 84) and the Bay. Pond SF2 is bordered by diked marsh to the southwest and the southeast, and a small section of upland habitat borders the pond to the south. The northeast portion of the pond borders a narrow fringe marsh along the Bay. The north portion of the pond is bordered by a paved public access trail, an access road, and the Dumbarton Bridge, while the East Palo Alto section of University Avenue borders the west side.

The goals of Pond SF2 are to enhance 240 acres by creating a 155-acre managed pond with 30 nesting islands for nesting and resting shorebirds, and an 85-acre seasonal wetland for western snowy plovers. Pond SF2 includes three management cells; the eastern and middle cell will be managed pond habitat and the western-most cell will be managed seasonal wetland. Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the Bay, and between cells, for shorebird foraging habitat and to meet water quality objectives.

Structures

The SF2 system includes the following structures needed for water circulation in the ponds:

- New intake structure consisting of 5 new 4-foot intake culverts with combination slide/flap gates on each end of the culvert
- New outlet structure consisting of 6 new 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert
- Approximately 10,000 linear feet of earth berms were constructed to create three cells in Pond SF2
- Pilot channels were excavated to the Bay through the fringe marsh outboard of the new water control structures
- Approximately 400 linear feet of weirs
- Two new viewing platforms and benches
- Bathrooms and interpretive signage
- Exclusion fencing – around water control structures
- Approximately 1.2 miles of trash fence along Highway 84
- 0.7 of miles of ADA trail between Pond SF2 and the Bay

System Description

Water would flow into and out of Pond SF2 through new water control structures at the northern (cell #1) and southern ends (cell #4) of the bayfront levee between Pond SF2 and the Bay. Weirs with adjustable flashboard risers (flashboard weirs) will be used to control flow in and out of cells #2 and #3. Water would flow out of Pond SF2 during low tides through the outlet structure located in the southern portion (cell #4) of the bayfront levee. Within Pond SF2, flashboard riser weirs are installed to convey flow into and out of individual cells. The weirs would be located along the northwest edge of the pond and the southeast edge of the pond in portions of the deep

existing borrow ditch. The seasonal wetland area will have 1 intake and 1 outlet structure. The intake structure will consist of four 4-ft long flashboard weirs while the outlet structure will consist of 1 culvert with a flashboard weir box on the seasonal wetland area side and a tide gate on the outlet canal side (to prevent the outlet canal from flowing into the seasonal wetland area during high tides). In addition to the cell intake and outlet weir structures, 4 cell outlet culvert structures will be located where the berms cross deeper, historic channels and borrow ditches (giving a total of 5 of these structures including the seasonal wetland area outlet structure). These culvert structures are included to drain deeper water from these channels for periodic maintenance and as a water quality management approach. Water would be circulated through the cells in Pond SF2 at rates sufficient to meet water quality objectives. The water quality objectives for Pond SF2 would be to maintain adequate DO levels, salinity, and pH in the cells and at the outlet structure.

Summer Operation

The summer operation is intended to provide maximum circulation flow to compensate for evaporation during the summer season and improve water quality. Average summer inflow will be approximately 35 cfs and maximum summer inflow will be 365 cfs. From June 1 through January 31, the southern water control structure will be operated as a one-way outlet and the northern water control structure will be operated as a one-way intake.

Operational Measures to protect Juvenile Salmon and Steelhead

Water Control Structure	Summer/Fall Operations	Winter/Spring Operations
SF2-1	No restrictions June 1 to Jan 31	Two-way flow or outlet only from Feb 1 to May 31
SF2-2	No restrictions June 1 to Jan 31	Two-way flow or outlet only from Feb 1 to May 31

Water Level Control

The water level in SF2 is designed to maintain shallow water which will provide extensive foraging habitat for the target species of shorebirds and waterfowl. Water levels are controlled by the outlet weirs located on cell 4.

Winter/Spring Operations

During the winter/spring season, both water control structures will be operated as "2-way" flow to create muted tidal conditions. The winter/spring operation period would normally extend from February through May. During the winter, rainfall would tend to increase the water levels in the ponds. Therefore, winter inflows are expected to be lower due to the presence of rainwater in the pond. If alternative management scenarios require either of the water control structures to be operated for one-way flow year-round, fish screens will be installed prior to their year-round use for one-way flow. The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter.

APPENDIX F
MONITORING THE RESPONSE OF FISH ASSEMBLAGES TO RESTORATION IN THE SOUTH BAY SALT PONDS

MONITORING THE RESPONSE OF FISH ASSEMBLAGES TO SALT POND RESTORATION:

Prepared by

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Prepared for

South Bay Salt Pond Restoration Program

&

Resource Legacy Fund

Semi-Annual Report 2 **Grant Number 2009-0215**

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDIX

EXECTIVE SUMMARY

Habitat loss in the form of tidal wetlands in the San Francisco Bay Estuary has been identified as one of the key factors associated with major historical declines of fish and bird populations (Brown 2003). In 2003, several salt pond complexes were purchased by consortium of state and federal agencies, creating the largest tidal marsh restoration project in the country (~15,000 acres) including the creation of the Don Edward San Francisco Bay National Wildlife Refuge (SBSP EIR/EIS 2007). The restoration of the ponds to tidal wetlands should result in benefits to migratory shore birds and native fish population including threatened salmonids. However, concerns over the impact of restoration on redistribution of legacy contaminants deposited in the sediments from gold mining activities such as mercury have resulted in a careful comprehensive approach to conducting pond restoration which is founded upon an adaptive management program. Development of a flexible monitoring program is essential to implementing an adaptive management program for restoration activities in the South Bay Salt Ponds (SBSP EIR/EIS 2007).

The objective of this study is to monitor the spatial and temporal variability of fish species composition and relative abundance in newly restored salt ponds and adjacent slough habitats using boat based trawling (otter trawl), which samples the bottom of slough habitats up to 1-meter of depth. We use beach seines to sample areas that are less than 1-meters depth and sample larger fishes using gill/trammel style netting, and hook and line sampling. The sampling design incorporates newly restored ponds and adjacent slough habitats to compare the species composition and relative abundance inside and outside restored ponds. In addition, we are conducting fish health studies of the sentinel species, longjaw mudsucker, (*Gillichthys mirabilis)* in high intertidal saltmarsh creeklets inside and outside the restored salt ponds.

This report constitutes the second semi-annual report and summarizes data up through October, 2011. Thus far we have capture 13,990 fish representing 34 families; of these 97.4% are native species using the otter trawl method (Table 2). Three-spine stickleback was the most common fish captured with 99.2% being observed in the Alviso/Coyote Marsh complex (Table 3). Pacific staghorn sculpin, Pacific herring and northern anchovy were the next most abundant species in our trawl catches and were relatively common (at least seasonally) at all sites (Table 1). The relative abundance of fish was greatest within the Island Ponds (A19 &A21) and was consistently at least an order of magnitude higher than adjacent sites along Coyote Creek. At the Alviso Complex we've observed a seasonal shift in fish species composition, with several additional species arriving during winter (e.g. American and threadfin shad, longfin smelt and Pacific herring) and species such as northern anchovy declining in winter. We have collected 3,959 fish via baited minnow traps, with the longjaw mudsucker constituting 67% of the catch. Populations within mature pickleweed marshes adjacent to restored ponds, (A6, A8 and SF-2), showed higher catch relative to sites within ponds; however, some months had higher catches within the newly breached ponds, suggesting fish were exploring the new habitats. Condition factors of longjaw mudsuckers were greater at sites within ponds relative to sites outside restored ponds. Overall, pond restoration is providing quality habitat for the sentinel species, with no evidence of detrimental effects.

INTRODUCTION

When the first European explorers arrived in San Francisco Bay during the late sixteenth century, the intertidal margins of the South, Central and much of North Bay were covered in vast tidal marsh providing habitat for migratory waterfowl, shorebirds and fishes. Historically tidal salt marsh plants encompassed approximately 300-square miles of tideline, or an area the size of New York City (REF). Beginning in the late 1800's, much of this habitat was transformed for agriculture and salt production (Nichols et al. 1986, San Francisco Bay Conservation and Development Commission, http://www.bcdc.ca gov/pdf/planning/reports/salt_ponds.pdf). Today, all that remains are small pockets of marsh constituting less than 1/3 of its former expanse (Foxgrover et al. 2004, Goals Project 1999). Salt marshes support vast numbers of shorebirds, and are home to endangered species such as the California Clapper Rail (*Rallus longirostris obsoletus)* and the Salt Marsh Harvest Mouse *(Reithrodontymys raviventris*) (Takekawa et al. 2001, Page et al. 1999). Historically, these marshes also provided feeding grounds for migratory fishes such as salmon, sturgeon, anchovy and herring (REF). Salt marshes are also home to the longjaw mudsucker (*Gillichthys mirabilis*), a small nocturnal fish that makes its home in high intertidal creeks amongst the pickleweed (Moyles book). The mudsucker have adapted to the high marsh lifestyle by developing the ability to breathe air and produce a moist, sticky slime coat for protection against drying out. The longjaw mudsuckers are found primarily in pickleweed marshes, and thus have experienced significant habitat loss, much like the endangered clapper rail and harvest mouse.

In 2003, a consortium of state and federal agencies known as the South Bay Salt Pond Restoration Program began the largest tidal salt marsh restoration project west of the Mississippi River purchasing over 15,000 acres of salt ponds from the Cargill, Inc. The restoration of former salt-producing ponds to tidal wetlands will result in benefits to shorebirds, waterfowl and native fish populations. Restoration of former production salt ponds to tidal habitat is taking several forms with different management objectives, including full breaching of pond levees to tidal action to create tidal wetlands, partial breaching to create ponds with muted tidal stages for shorebirds and migratory waterfowl and ponds that have water levels managed with water control structures to create deeper pond habitats for diving ducks (SBSP EIR/EIS 2007). The creation of a mosaic of habitats takes advantage of existing pond configurations and maximizes the creation of key habitats outlines in the Goals Project (1999). Moreover, restoration actions that provide operational control of water levels afford the application of adaptive management.

Phase one of the South Bay Salt Pond Restoration Program began in 2008 with the restoration of several ponds in the Alviso Marsh Complex (A6, A8,), Eden Landing (E8A, E8X, E9), Ravenswood (SF-2) and Bair Island (Outer Bair pond) which are the study sites of this project (Figure 1). Fully breached ponds include, pond A6 (breached Nov 2010) at the end of Alviso Slough, ponds A19-21 (breached May 2006) on Coyote Creek, pond E9 and ponds E8A and E8X at Eden Landing (breached Nov 2011) and Outer Bair Island Pond (Breached June 2008) along Steinberger Slough. Muted tidal ponds include A8 (breached June 2011) at the upstream end of Alviso Slough, SF-2 (breached September 2010) at the outer end of the Ravenswood Marsh.

The goal of this project is to develop a monitoring program to assess the effect of pond restoration on fish species assemblages inside newly breached ponds and adjacent sloughs. In addition we are developing indicators of fish health using the longjaw mudsucker (*Gillichthys mirabilis*) as our sentinel species. Sampling takes place within restored ponds and along adjacent sloughs and fringing marsh on a monthly basis. Fish species presence, relative abundance and condition are quantified, as well as water quality parameters (D.O. salinity and temperature).

PROJECT MANAGEMENT

The project is divided into 7 tasks:

Task 1 – Alviso Complex Sampling
Task 2 – Eden Landing Complex Sampling
Task 3 – Pond SF2 Sampling
Task 4 – Bair Island Sampling
Task 5 – Data Analysis
Task 6 – Project Management
Task 7 – Reporting

Progress reporting occurs quarterly and semi-annually. This report constitutes the second semi-annual report summarizing findings for quarters 3 and 4 of 2011. We've previously supplied reports to Pacific Legacy Fund and the South Bay Salt Pond Restoration Program for quarters 1 (July –Sept) and 2 (Oct-Dec) of 2010 and quarters 1 (Jan-Mar) and 2 (Apr-June) of 2011. This report will synthesize previous reporting periods and include results up to November.

Project Activities during Quarters 3 and 4:

- Beginning May 2011 we began sampling the Alviso complex monthly, to enhance our ability to detect seasonal differences in fish abundance (Table 1).
- In July we began the mark-recapture study of longjaw mudsuckers inside A8, inside A6 and adjacent marsh along Alviso Slough, inside A21 and adjacent marsh along Mud Slough, and inside SF-2 unit 1 and the adjacent marsh.
- Lastly, in August, 10 longjaw mudsuckers from each mark-recapture study site were sampled for otoliths and archived for other biomarker assays.

Progress Towards Milestones

1. Results of this study were presented at the 2011 "State of the Estuary" Conference in Oakland California,
2. The California-Nevada Chapter of the American Fisheries Society at Lake Natoma, California
3. Interagency Ecological Programs' Estuary Ecology Team meeting at UC Davis in November.
4. We also published an article in the San Francisco Bay Wildlife Refuge "Tideline" newsletter entitled "This place is for the birds – Or is it?", Winter 2011 Volumne 32 Number 4.
5. We also participated in the BioBlitz that took place at the Don Edwards Reserve Education Center in December of 2011. We sampled with beach seine and minnow traps pond A17 and New Chicago Marsh with about 100 local residents.

Environmental Outcomes.

- We sampled water quality during the first significant rain event of the year in October. We observed dissolved oxygen levels in upper Coyote Creek and Alviso Slough to be well within normal range, thus no low D.O. event occurred in 2011.
- In October we began to catch longfin smelt in Coyote Creek and Alviso Slough. In November, we caught a handful of fish at Alviso-1, which is downstream of the Alviso boat launch. We did not see any longfin inside A8, but the presence of longfin smelt in Alviso Slough may need to be taken into consideration for the operation of tide gates on A8, because they are listed as "Threatened" under the California Endangered Species Act and a can

Problems encountered and resolutions.

- Minnow trapping for LJM at Bair Island and Eden Landing have continued to result in very few if any individuals. We will continue to sample with minnow traps on a quarterly basis.
- Access to Eden Landing continues to be a real problem. We have not been able to get across the bay from Bair to sample outside of Eden Landing. Mt Eden Creek has gotten two shallow for the larger boat and we still do not have a safe place to launch the smaller Jon boat. We've been sampling Eden with a 100-ft beach seine and gill nets. We've added more seining and gill netting in the Alviso and Bair island sites so that we can compare. These methods do not result in as many individual fish as otter trawling, but between the two methods the species composition appears to be similar. Once Eden Landing construction is complete and Mt Eden Creek is dredged we will try to get out there and otter trawl again. Hopefully by then we will have enough seine and gillnet data to assess the value of the methods.
- We've also increased our hook and line sampling at all locations to assess the presence of larger predatory fish.
- We are still undergoing the permitting process for longfin smelt, but we have provided DFG all the required information and have been informed that an MOU will be drafted shortly.
- Lastly we have significantly overspent funds from our supplies account. This occurred because I had intended funds to cover truck rentals from the university to come from the travel category; however the university considers this a supply expense. Within this report we provide a budget summery for the 2011 year (Table 3.) and a request to rebudget (Table 4.). The request has been sent to sponsored programs and contact with Aaron O'Callahan at Resource Legacy Fund has been made. We also provided a forecast for the remaining funds (given the rebudget) to June 2012.

Activities planned for next quarter.

We will continue with monthly sampling of the Alviso Slough complex, with bi-monthly sampling of Bair and Eden Landing.

METHODS

Otter Trawl

Since 2010 we have been sampling juvenile and adult fishes at three marsh restoration locations in South San Francisco Bay. Beginning in June, 2011, we excluded one marsh (Eden Landing) from otter trawl surveys because increasing elevation made boat based sampling impossible. Prior to May, 2011, only a single trawl was conducted at each station on a bi-monthly basis. We attempted to improve our ability to document trends in fish abundance by increasing our sampling frequency to once a month and sampling at high and low tides. In total, we have conducted trawl surveys at 35 stations in nine sloughs and seven former salt ponds, however, only 26 stations have been retained (Figure 1). We measured temperature (° C), salinity (PSU), conductivity (µS), dissolved oxygen (mg/L) and water clarity at the conclusion of every trawl. A Yellowstone Springs Instrument (YSI) model 85 was used to measure water quality, though a Secchi disk was used to measure turbidity. Additional water quality surveys were conducted in July, September and November of 2011 using a Hydrolab 5a Sounde equipped with a Turner Designs fluorometer in attempt to investigate general patterns of water column production associated with restored habitats and to monitor storm water runoff from local watersheds. Because these additional water quality surveys were only loosely associated with trawl stations, the data was not used in the monthly average salinity and temperature calculations.

Trawling was conducted using a four-seam otter trawl with a 1.5-m X 4.3-m opening, a length of 5.3-m, and mesh sizes of 35-mm stretch for the body and 6-mm stretch in the cod end. Surveys were conducted in waters deeper the 0.75-m, and the depth of the water was recorded every minute the trawl was towed. The otter trawl was towed at approximately 3 to 4-km/hr for 5 minutes in shallow water, though it was towed for 10 minutes in deep water to compensate for smaller catches. Following the conclusion of a trawl, the trawl contents were emptied into an aerated bucket of water. Fish were identified to species and measured from the snout to the end of the vertebral column (SL), then released. Sensitive native species were processed first and released as quickly as possible. In addition, bay shrimp, *Crangon sp,* oriental shrimp (*Paleomon macrodactylus)*, sea hare (*Philini auriforms*), Oregon mud crabs (*Hemigrapsus oregonensis*)*,* welk snails (*Ilyanassa obsoleta*)*,* Asian clams (*Corbicula fluminea*)*,* soft-shell clams (*Macoma sp*) and overbite clams, (*Corbula amurensis*) were identified and counted. Mysid shrimp (Mysidae), isopods and amphipods can be extremely abundant in trawls and were given nominal rankings (1=1-3, 2=3-10, 3=11-50, 4=51-100, 5=100+), then released.

Seining and Gill Netting

Otter trawling is an effective method for analyzing fish community assemblages and relative abundances; however, otter trawling is ineffective when employed in perennially shallow habitats (such as managed salt ponds) and inefficient for documenting large, coursing fish species (which can out swim the trawl). In order to compensate for this, we have been employing seine nets and gill nets throughout the restored marshes. Seines are used monthly to sample muted tidal ponds (SF2, A8), and are 30-ft x 4-ft with a 3-ft bag, 25-ft "walls" attached to each wing, and a mesh size of 9.5-mm. In total, the seines are 95-ft long and are deployed in a rectangular fashion from a canoe which enables us to avoid the complications encountered by previous researchers when attempting to seine restored ponds. At each station, three replicate seine hauls are pulled and the contents are quantified following the same protocol used for otter trawl catches. Gill net surveys are conducted monthly along the lengths of Alviso Slough (Alviso Marsh), Coyote Creek Slough (Alviso Marsh), Corkscrew

Slough (Bair Island) and Steinberger Slough (Bair Island). The gill nets are experimental gill nets and are 100-ft X 8 ft and have a mesh size ranging from 0.5-in to 2.5-in stretch. In addition, trammel nets (100-ft X 8-ft with a 1.5-in and 2-ft stretch) are now being used in conjunction with gill nets to improve our capture efficiency of sturgeon. Gill nets are deployed for two hours, and checked hourly. Fish are processed and released as quickly as possible, though in some cases the fish is too large to be brought aboard and is cut out of the net, then released.

<u>Notable modifications to our protocol include:</u>

(1) Coyote Creek and Alviso Slough were divided into upper, middle, and lower units, with replicate trawls conducted at high and low tide. This will account for variations in salinity and temperature during tidal cycles that significantly affect fish communities, yet still achieve spatial replication.

(2) Otter trawls at Eden Landing will no longer be conducted due to the high elevation of the ponds and shallow depths to Mt Eden Creek and Alameda Creek which make it impossible to operate a boat-based sampling method on a consistent basis. Instead we are utilizing seine nets and gill nets to sample this location in a consistent and thorough manner.

(3) Gill nets and trammel nets are being deployed in all field areas in an effort to target fish species which are capable of escaping our trawl nets.

Minnow Trapping

Collection of the longjaw mudsucker-LJM (*Gillichthys mirabilis*) was accomplished using baited minnow traps in first order channels (creeklets) of mature marsh and along fringes of ponded water inside newly breached ponds (Figure 19). At each location, a minimum of 3 creeklets were sampled, each creeklet with 5 individual traps spaced ~15-m apart. In locations without mature pickleweed marsh with distinct creeklets, we chose 3 replicate lines of 5 traps spaced ~15-m apart, along barrow ditch levees with fringing marsh, or in or near early forming creeklets. Traps were allowed to soak overnight to insure sampling of the nocturnal high tide. Locations with paired outside and inside breached pond sites were sampled monthly (e.g. outside A6 along Alviso Slough and inside A6 along the north-east edge, outside A21 along Mud Slough and at several sites within A21, and inside and outside SF2). Inside breached ponds, at least 1 line was placed in a new section of the pond to determine the spatial distribution of LJM. All LJM were enumerated, measured for standard length, weighed and sexed. At select pond-marsh sites, LJM were tagged with Northwest Marine Technologies Alpha Tags (A8, A6, A21 and SF2) (Figure 18). In addition, captured fish were inspected for the presence of any morphological deformities (Figure 20) and parasites (microsporidia, and external parasites) (Figure 20). We also enumerated, measured and weighed other fish species collected in the minnow traps and enumerated all invertebrates.

Sentinel Species Health

An index of abundance was created for each location by calculating the mean catch-per-trap for each creeklet or line (N=5) and then averaging for each pond location (N=3). Population abundance was also determined using the Jolly-Seber multiple mark-recapture method. Next we assessed the individual condition using several metrics of condition based on length and weight (C, K_n, W_t). We also scored each fish for presence of parasites and skeletal deformities. A sub-sample of 10 fish were collected bi-annually from each location and sacrificed for otolith growth rate analysis and proximate analysis, which quantifies the percent of water, ash and crude protein of each fish. In addition we took blood samples, which were archived for potential future biomarker analysis.

RESULTS

Trends in Otter Trawls

Summer fish abundance at the Alviso Marsh Complex (July-Aug) in 2011 was similar to 2010; however, total abundance was greater in fall (Sept-Nov) of 2011, driven by large increases in the abundance of three-spined stickleback and Pacific staghorn sculpin. Northern anchovy abundance was lower in 2011 and yellowfin goby and arrow goby abundance were similar. In December we began to collect adult sized Pacific herring and in May we found a large number of young-of-year herring, suggesting spawning occurred somewhere in the Alviso area (Figure 2).

Bair Island fish abundances were similar between 2010 and 2011. The Bair Island species assemblage differs from the Alviso Complex, although the majority of species occurred at both marshes. Interestingly, two species were only found at Bair Island: chameleon goby and white croaker. These two species are typically associated with marine conditions and intolerant of freshwater, so their dearth within the Alviso Marsh is easily explained. Unlike Alviso, all of the species at Bair Island were less abundant in the winter, and many of the species were absent from the marsh entirely (Figure 3). In May and June, trawling surveys documented large numbers of English sole and Pacific herring. Because these species were absent before this and our catch declined rapidly the following month, it is likely that these fish were migrating past Bair Island en route to the Pacific Ocean.

Alviso Marsh Complex

Alviso Marsh extends east from Guadalupe Slough to the mouth of Coyote Creek and north to Mud Slough. The marsh contains the estuaries of two of the three largest drainages in South San Francisco Bay as well as two sewage treatment plants, which discharge tertiary treated sewage into Artesian Slough and Guadalupe Slough. Sloughs fed by freshwater typically exhibit very steep, rapidly fluctuating salinity gradients. Even lower Coyote Creek Slough, at the downstream end of this marsh, will experience salinity fluctuations of 10-ppt or more during the tidal cycle. This creates an incredibly heterogeneous environment, which is maintained by large tidal swings. To date, four former salt ponds have been breached in the Alviso Marsh: Knapp's Tract (A6) along Alviso and Guadalupe Sloughs, the Station Island Salt Ponds (A21, A20, and A19) along Coyote Creek.

Alviso Marsh consistently yields higher species diversity than Bair Island, which lacks freshwater inflow. The most commonly captured fish species in the Alviso Marsh were three-spined stickleback and Pacific staghorn sculpin. From May to November of 2011, the seven most abundant species (three-spined stickleback, Pacific staghorn sculpin, Pacific herring, northern anchovy, arrow goby, yellowfin goby and starry flounder) accounted for 97.5% of the otter trawl catch, while the other 17 species captured in the marsh during these months were "rare". Three-spined stickleback were the most abundant fish in the otter trawls, while Pacific staghorn sculpin were the most ubiquitous. Both three-spined stickleback and Pacific staghorn sculpin had higher catch per unit efforts during the summer and fall of 2011 than in 2010. Additionally, Alviso Marsh is the only marsh where migratory pelagic fish, typically associated with the North Bay occur, a topic that will be addressed in the next report.

Common Resident Fishes of Alviso Marsh

Of the most abundant species of fish in the Alviso marsh, three abundant species are likely resident within the marsh (three-spined stickleback, Pacific staghorn sculpin, yellowfin goby), and can complete their entire lifecycle within the marsh. However, there is some evidence that yellowfin gobies and Pacific staghorn sculpin immigrate into the marsh from adjacent areas in order to use the marsh as a nursery. These species - in addition to abundant, transient species such as Pacific herring and Northern anchovy- will form the basis for our analysis of restored habitats.

Three-spined stickleback typically exhibit peak abundances in the fall months and reach a minima in the late spring, a trend seen in both 2010 and 2011 (Figure 2). Three-spined sticklebacks are most abundant within restored salt ponds, and 85% of the total catch came from the Island Ponds and Upper Coyote Creek Slough, adjacent to Warm Springs Marsh. The three-spined stickleback population within the Alviso marsh displays an abundance pattern consistent with a resident, annual population. Peak recruitment occurs from May to August and the population exhibits rapid declines in late fall to spring, presumably due to temperature related mortality, predation and spawning mortality. In Suisun marsh, stickleback display a spring spawning peak in addition to one in summer-fall (T. O'Rear, personal communication). Because we did not begin monthly sampling until May, 2011, there is very good possibility that there was a second cohort in the spring that we were unable to document. In summary, three-spined sticklebacks are extremely abundant and closely associated restored habitats. Because of their small size and high abundance, it is likely that three-spined stickleback are a prey item for larger fish species, such as gobies, sculpin and young striped bass.

Pacific staghorn sculpin and the introduced yellowfin goby are, like stickleback, present in the marsh year round. Though the species can complete their life cycle within the marsh, there are significant fluctuations in catch and length-frequency distributions. These discontinuities suggest two separate movements of staghorn sculpin into the Alviso Marsh, and at least one such movement of yellowfin goby. Beginning in May, there was a large migration of young-of-year staghorn sculpin into the brackish portions of Alviso and Coyote Creek. Studies elsewhere have shown that juvenile Pacific staghorn sculpin will move into brackish water to exploit higher food densities which appeared to be the case, as their immigration was coincident with a very large bloom of mysid shrimp, an important food source. One month after the staghorn sculpin immigrated into the marsh, yellowfin goby from the 2011 year class also increased in abundance, suggesting a similar migratory event. Yellowfin goby successfully reproduced in the marsh during the 2010-2011 winter season; however, the abrupt increase in young-of-year occurred several months after the fish had recruited to the otter trawl (July), and were most likely from adjacent populations attracted by high food densities in Alviso Marsh. Beginning in September, large, gravid Pacific staghorn sculpin began increasing in otter trawl catches. The adult staghorn were considerably larger than the fish within the marsh larger fish and were likely two year old fish moving into the Alviso Marsh from elsewhere in the bay to reproduce. This trend was not observed in 2010, possibly because of infrequent sampling events or factors within the marsh were not favorable.

Seasonal Assemblages within Alviso

There are several seasonal trends in the species composition within the marshes, with three principle classifications: a summer assemblage, a winter assemblage, and a resident assemblage (Figure 4). The winter assemblage consisted of euryhaline pelagic species, such as longfin smelt, American shad and Pacific herring. The catch of threadfin shad, which is primarily a freshwater species that can be found in a wide range of salinities, is perplexing. It is likely these fish followed the American shad schools, though previous studies in the Alviso marsh found a resident threadfin shad population in Guadalupe slough. It is important to note that the species comprising the "winter" assemblage are increasingly rare in the North Bay, which would suggests that the Alviso Marsh retains some of the ecosystem function historically present in the northern portions of the estuary. The "summer assemblage" tends to be species that occur in high salinities. A third assemblage, which serves more as a "catch-all" grouping was the resident assemblage. This assemblage was characterized by species that are very tolerant of salinity and temperature variability. Species such as the Pacific staghorn sculpin and three-spined stickleback can be found in salinities as low as zero or freshwater up to salinities as high as 80ppt -almost three times that of sea water. These species are also the fish that could utilize low salinity salt ponds production ponds, and are the species that most likely would provide us the opportunity to associate pond restoration with fish production. However resident species tend to show the greatest variability between sampling periods, and thus was the main impetus to increase our sampling efforts to a monthly periodicity.

The Island Ponds

We have observed greater numbers of fish inside the Island Ponds (A19 & A21) (Figure 5) compared to trawl sites adjacent to the ponds along Coyote Creek (Figures 6) in the summer and fall months. This pattern is most evident among four of the most abundant species: Pacific staghorn sculpin, northern anchovy, three-spined stickleback and yellowfin goby (Figure 7). These fish exhibit different life styles, with Pacific staghorn sculpin and yellowfin goby being benthic "bottom dwelling" species, while the northern anchovy is a pelagic "water-column dwelling" species, and three-spined stickleback capable of being both benthic and pelagic. This would suggest that fish are truly selecting the Island Pond habitats over Coyote Creek, and our dramatically higher catches are not due to differences in sampling efficiency. There could be several explanations for the higher catch in the Island Ponds: (1) The Island Ponds provide better foraging habitat, as they are shallower with more edge habitat than adjacent sloughs. The Island Ponds also contain extremely high concentrations of mysid shrimp, a primary food source for small fishes. (2) The islands ponds may function as predation refugia, as angling surveys and otter trawl data show greater numbers of sharks and rays outside the Island Ponds. However, harbor seals have been observed foraging within the ponds, and striped bass have been captured throughout the Island Ponds. Regardless, either hypothesis would result in more fish residing in the Island Pond habitats, or it appears that the Island Ponds provide a benefit for fish species.

Within the Alviso marsh complex, it appears that the addition of shallow water habitats has a positive impact on both benthic and pelagic fish species, though the exact mechanism is unknown. It is pertinent to point out that benefits to lower trophic levels, such as threed-spined stickleback and Pacific staghorn sculpin can ultimately improve foraging opportunities for piscivorous birds, commercially important species such as striped bass, and large charismatic taxa such as leopard sharks and harbor seals.

"Comparing Bair Island to Alviso"

Our total catch per trawl was considerably higher at Bair Island for shiner surfperch and the northern anchovy, two fairly ubiquitous species in San Francisco Bay. However, northern anchovy were considerably more abundant at Bair Island than Alviso in the winter months; whereas, shiner surfperch are actually more abundant in Alviso in the winter and considerably more abundant at Bair Island in the summer. Northern anchovy require higher salinities to spawn, and it is likely that salinities up to 10-ppts lower preclude this species from the Alviso marsh during the winter and spring months. Shiner surfperch, however, readily move into the Alviso marsh in the spring months, presumably to give birth and exploit the high densities of food within the marsh. Shiner surfperch abandon the Alviso marsh in the summer months, possibly because of warm temperatures and low dissolved oxygen levels; however, Bair Island, with lower temperature and higher dissolved oxygen levels, is occupied by shiner surfperch all summer long.

Seine and Gill-netting.

Because muted tidal ponds are a challenging habitat to sample consistently, we have experimented with several different methods over the last year. Employed at Eden Landing, SF2 (Ravenswood) and A8, we are now using a combination of gill netting and beach seining to sample these habitats. However, because of our inconsistent sampling methods we have limited ability to do more than establish the presence/absence of fish from these habitats for the June-October time period. Our surveys do indicate that "sensitive" fish species (striped bass, surfperch) were not present in SF2 beginning in July, 2011, concomitant with extremely low nighttime dissolved oxygen levels caused by inadequate exchange with the bay (Sara Poitter, pers. com). In spite of their low abundance in the pond, these species were present in the adjacent bay habitat (Table 2), suggesting that they were excluded from the ponds by low dissolved oxygen levels.

Seining and gill netting in SF-2 has produced very high catches with numbers of jacksmelt, topsmelt and herring often in the hundreds per seine haul. Gill netting has produced many larger jacksmelt, larger than those collected via beach seine and leopard sharks inside SF-2. Our surveys in A8 have documented the presence of large striped bass (*Morone saxitalis*) within the pond itself (Table 2). Our surveys of Eden Landing have documented extraordinary abundances of fish within the water in pond E9 prior to the breaching; however, we have found very few fish in the adjacent slough habitat, and very low catches after the breach. As with fully tidal ponds, it appears that fish usage of muted tidal ponds is highly seasonal, and that most fish abandon the shallow water habitat in the winter.

Hook and Line Sampling

Generally sampling took place at pond outlets of A6, A8, A21 and SF-2 monthly, using live or dead yellowfin goby or frozen squid, fishing for at least 1-hour during the ebb tide. In addition we sampled inside A21, A8 and SF-2. Bair Island was also sampled in May, July and December. Our catches were highly inconsistent, which was the reason why we began gill netting. We did catch leopard shark and bat rays at Bair Island, Eden Landing, Coyote Creek and Alviso Slough. We did not catch fish inside A21. Our highest catch/rod-hour occurred in December outside the breach site at Outer Bair Island. The largest leopard shark was a 112-cm and 5,443-g female outside A6 in October, a considerably smaller specimen than the ones landed in 2010. In total we caught 16 leopard sharks and 6 bat rays in 2011.

Water Quality

Water quality parameters varied significantly across the survey months. Lows in temperature occurred during December, 2010 and February, 2011, and highs occurred during the summer months (July-Aug) (Figure 8). Dissolved oxygen was lowest in the summer-fall months (July-October) and was chronically depleted in and around the Island Ponds, averaging a full milligram/liter lower within the Alviso Marsh (Figure 9). Salinity was highest in October and lowest in May, however the Alviso/Coyote marsh exhibited the lowest and most variable salinities while Bair Island exhibited the highest and least variable (Figure 10).

Sentinel species population health studies.

From July 2010 to November 2011, we have collected 3,959 fish in minnow traps. The LJM was by far, the most abundant species (2,665), (Table 3). Thus far we have successfully tagged 1,363 LJM from May to November and recaptured 171 individuals resulting in an overall recapture rate of 12% (Tables 4a & b). Tag and recapture data will be used to calculate survival estimates for each pond location, as well as produce growth estimates for individuals in the future. The relative abundance of LJM varied seasonally, with the mean catch declining in the winter months (Figure 10). We found a similar pattern of abundance in marshes located in central San Francisco Bay and Tomales Bay. The decline in catch during winter months may be explained by reduced feeding due to lower water temperatures in winter as the metabolism of this species is determined by water temperature otherwise known as poikilothermy. Since we rely on the fishes feeding behavior, thus the reason for baiting minnow traps, it is likely the decline is due simply to a reduction in feeding behavior. However, seasonal differences in tidal amplitude may also explain the decline of LJM in the winter. Because the LJM is an intertidal fish, the timing of high tides has an important effect on feeding behavior and capture efficiency. Our sampling protocol for LJM requires us to sample during the spring tides, when the mixed semi-diurnal tidal amplitude is greatest. Seasonally the higher-high tide varies, such that during the summer months the higher-high tide occurs at night, thus our protocol has us setting traps during the daylight and collected the next day to allow our traps to sample the higher-high tide. However during the winter the higher-high tide occurs during the daytime. Depending on when traps are set in place we may not sample the higher-high tide with the same "soak-time", and thus have different sampling efficiencies. We tested this in December by setting traps before the higher-high tide during the day, checking the traps and enumerating fish after the higher-high has occurred, replacing the trap and checking the next day after the nocturnal high tide. We have yet to enter the data from December but the results were very clear, most of the LJM captured occurred during the diurnal higher-high tide, thus the seasonal pattern of catch for LJM will need to be re-evaluated after taking the tides and soak-time into consideration.

Longjaw mudsucker were most abundant at the Mud Slough location adjacent to A21 in August 2011 with a mean catch of 10 LJM per trap (Figure 12). This location is a mature pickleweed marsh and considered a reference point for the Island Ponds. The Island Ponds all had populations of LJM, with A21 and A20 having a similar mean catch-per-trap and monthly pattern, while A19 was consistently lower. Error bars are not shown on these figures as we may modify the abundance index calculation in the future. These data are averaged across both fixed locations and locations that vary from month to month, creating signification variance in the data. However this variance would reflect spatial structure and not temporal patterns thus, we will need to address this issue prior to publication of any results for peer review. Pond A19 has the least extent of pickleweed habitat and may explain the lower abundance of LJM, however being the furthest pond upstream along Coyote Creek the lower salinity may be a contributing factor. Outside pond A6 in mature pickleweed marsh we had the longest record of trapping for the study, and consistent catch-per-trap data comparing July and August of 2010 (*4 per trap*) to 2011(*4.5 per trap*) (Figure 13). We observed the second highest mean catch inside A6 in July 2011, however the fish declined precipitously in the fall. High catches in July and August reflect the influx of the 2011 juveniles, thus the decline may reflect mortality, as juveniles compete for space or the spreading out of fish into unsampled areas. This pattern was also apparent at the SF-2 site with the highest catch occurring inside SF-2 in

August 2011, but then quickly declining in October (Figure 14). Overall the abundance of LJM tended to be greater outside restored ponds in mature pickleweed marshes.

LJM condition metrics were greater for populations inside A6 and SF-2 relative to the populations outside these marshes (Figure 14). In addition fish inside A8 averaged above 1 K_n, suggesting fish inhabiting newly restored ponds are experiencing good conditions for feeding and growth. However LJM inside A21 had a lower condition index relative to outside A21 along Mud Slough. Locations with low condition metrics and or highly variable condition had a greater incidence of the parasite Microsporidia (Figure 16). Microsporidia is a protozoan parasite that forms single celled clusters of parasites that are often visible sub-dermally on the fish. Microsporidia is known to be lethal to fish, however the incidence and severity of infections at all sites in South San Francisco Bay were low, and not likely to be a significant mortality factor. Skeletal deformities were greatest in pond A8, however the incidence overall is extremely low among all locations (Figure 15). Microsporidia incidence and skeletal deformities was much lower in locations in this study relative to other marshes in San Francisco Bay (personal observations) thus at this point we feel these data do not warrant alarm.

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