2009 Self-Monitoring Report
Baumberg Complex - Hayward, California
Eden Landing Ecological Reserve

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Prepared for:

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Introduction

This annual self-monitoring report (ASMR) summarizes the results of the water quality monitoring and pond management sampling conducted at the Baumberg Complex, also known as the Eden Landing Ecological Reserve (ELER), in Hayward, California, from May through October 2009. Data was collected by Department of Fish and Game (Department) staff in accordance with the waste discharge requirements. Water quality monitoring was performed using continuous data recorders at the locations described in the Self-Monitoring Program outlined in the Final Order. Previous nomenclature used the initial “B” for Baumberg Complex ponds, which has been subsequently changed to “E” for Eden Landing, as part of the South Bay Salt Ponds (SBSP) restoration project. For consistency with the SBSP nomenclature now commonly used, this report uses the “E” nomenclature, except where noted and older figures or references provided by others are not easily modified.

The Final Order for the South San Francisco Bay Low Salinity Salt Ponds covered 15,100 acres of ponds in Alameda, Santa Clara and San Mateo counties. This report covers ELER (Baumberg Complex) pond systems operated by the Department in 2009 and described in the Initial Stewardship Plan (ISP), including Systems E10 (B11 in ISP), E2, E2C and E9 (B8A in ISP). Continuous discharge monitoring for the season was conducted in System E10 only, from July-October, with additional data collection and interpretation as part of an Applied Study in E10 as requested by the Regional Water Quality Control Board (RWQCB) in June, 2009. All other pond systems were operated and managed with information gathered typically on a weekly basis, rather than with continuous monitoring devices. System E6A was not managed with discharge operations in 2009 to provide for western snowy plover management activities necessary to provide suitable nesting and foraging habitat. The U.S. Fish and Wildlife Service (USFWS) submitted a report for the Alviso Ponds under separate cover.

The ponds are generally being operated as muted tidal systems, as described in the 2009 operations plans, augmenting flow-through systems described in the ISP. Bay water entered ponds via San Francisco Bay (SF Bay) and associated sloughs at high tides, flowed to one or more ponds, and discharged to sloughs and SF Bay at low tides. The ponds presumably discharge at tide stages lower than pond water elevations, generally 3.5’ (NGVD), a duration ranging approximately 13 to16 hours per day based on predicted tides and spring or neap tide cycle variation. Pond intake is presumed to occur at predicted tide stages which are at elevations assumed to be approximately 1 ½ feet or more above pond water levels due to required head (pressure) to allow in-flows. It is not known from interpreting the data whether discharge has a similar head requirement and discharge begins after a similar time-lag or when tide stages are just below pond water elevations. In 2009, intake and discharge in Ponds E10, E2, E2C and E9 occurred at the same water control structure (WCS), as in previous years. Pond systems E9 and E2 also have additional intake WCSs, as described in the ISP and operations plans.

The Final Order recognized two periods of discharges from the ponds: the Initial Release Period (IRP) when salinity levels in ponds were above 44 parts per thousand (ppt) and would decrease from the initial levels in the ponds, to a Continuous Circulation Period (CCP) thereafter, with salinities at or below the 44 ppt, which is the continuous discharge limit described in the Final Order. In 2009, operation of all systems was within parameters for CCP and water quality monitoring was conducted as described below.

As described in previous years, this ASMR describes required reporting and best management practice (BMP) implementation for periods when the dissolved oxygen (DO) levels at the point of discharge falls below a 10th percentile of 3.3 mg/L (calculated on a calendar weekly basis). Low DO conditions are expected during extended periods of high air and water temperature. The 3.3 mg/L DO "trigger" was determined based on levels found in Artesian Slough in July 1997, during an extended period of high air temperatures, and appeared to be the most relevant representation of natural DO variations in sloughs or lagoon systems currently available. It has been documented that DO concentrations are observed in sloughs not affected by any discharge to contain DO levels below the Basin Plan standard of 5.0 mg/L, as well as periods below the 3.3 mg/L reporting trigger. Similarly, naturally occurring low DO waters have been observed during periods of intake into pond systems. These low DO discharges are within the natural range of variation in functional slough and lagoon environments of the South San Francisco Bay. Therefore, the low DO conditions observed in sloughs do not necessarily indicate a water quality signature of pond waters and discharges.

The RWQCB requested that additional information be provided in this ASMR, as described in their May, 2009 letter describing their review of the previous year's ASMR. This ASMR also incorporates those suggested changes and requests for additional information, except as noted and as discussed below (i.e. unable to complete Applied Study in E10, no discharge volumes, etc.). The Department has prepared this report as the Draft 2009 Self-Monitoring Report for the Eden Landing Ecological Reserve (Baumberg Complex). Additional analysis and interpretation of monitoring data may be completed to complement information presented in this report, and may be submitted for review by the RWQCB before being finalized.

2009 Annual Summary

The 2009 monitoring season evaluation for the ELER ponds (Baumberg Complex) indicates that a greater understanding of pond dynamics continues to inform pond management, and continued, targeted monitoring efforts should continue to address areas of uncertainty. Refer to the discussion below to relate pond management operations and intrinsic pond dynamics to compliance with the RWQCB Final Order in greater detail.

The water quality monitoring performed according to the Final Order for operation of the pond systems revealed periods of low DO again in 2009. In previous years (2004-08), low DO levels were observed in a number of the SBSP, including ELER ponds, notably in the late-summer/early-fall when seasonal temperatures, winds and evaporation were expected to be highest. However, low DO levels are observed throughout the monitoring period, not just during the latter part of the season as was anticipated. Low DO levels were similarly pronounced in 2009 in Pond E10 as in previous years. Preliminary evaluation of 2009 monitoring information suggests such differences may be attributed to modified operations throughout the season. There appears to be some correlation with abiotic factors, such as spring and neap tide periods, weather conditions, and seasonal variations. It is likely that, biotic factors affect DO levels such as algal growth and growth and/or usage by pond invertebrates or larger animals, including fish. While only small localized areas of E10 had large, green algal mats, substantial macroalgae was observed in the water column and living and necrotic mats were observed on the pond bottom.

The Department completed additional analysis of 2007 data sets to attempt to determine correlations and provided a summary in 2007. However, this additional analysis did not provide any conclusive results. In 2005, RWQCB required that the time-period each day that ponds discharge, and an estimate of the quantity discharged, be included in the ASMR. It was understood that this information would be provided for particular periods of interest, rather than be provided in the form of a summary table for each actual discharge day. Estimates of discharge volume could provide useful information, which would be used for activities such as modifications to operations, and for evaluation and analysis, particularly for determining what effects, if any, discharges had on receiving waters, and determination of effectiveness of BMPs. RWQCB modified ASMR requirements similarly for the ponds operated by USFWS, whose staff is working collaboratively with the Department on the ISP and long-term restoration project for the SBSP. USFWS requested assistance from U.S. Geological Survey (USGS) in developing a methodology to estimate discharge volumes. USGS developed a “calculator” to estimate discharge from five Alviso Complex ponds for USFWS. Inputs to the calculator include the pond water surface elevation, the number of discharge culverts (48"), and the range of dates for discharge. Output would be the estimated volume of discharge over the data range. Tidal height is predicted in the calculator. Generalized use of this calculator for other ponds, including those managed by the Department, could be provided once site-specific calibration is performed. However, no funding for such a collaborative study has not been available from the Department or USGS. The Department may pursue the use of this tool if funding can be secured in the future.

Pond management activities and the observed water quality conditions in 2009 may have been affected by continued drought conditions from the previous winter, which recorded below average rainfall. Larger volume discharges were sustained and were targeted during strong tide and rainfall events to maximize circulation and operation of ponds at elevations below normal winter water levels were attempts to circumvent elevated salinity during the 2009 monitoring season. Discharge salinity values were similarly improved in 2009 compared to 2004-2008 by altering management operations, such that discharge was set at a consistently higher volume. Using BMP’s described in this report and more fully in 2009 Operations Plans, discharges were periodically minimized to maintain water levels during neap tide periods with high air temperatures. Temporary suspension of discharge operations as was not performed in 2009, as was previously done in 2004-07, since review of 2008 data showed no adverse affect from continuous discharge. The Increased Discharge BMP were implemented previously only for short periods during spring tide cycles and did not appreciably improve mixing and turnover.

In reviewing 2009 data, the Increased Discharge BMP appears to be successful in managing salinity, especially when used more consistently over longer periods, depending on the size of the system.

The ELER site location is shown on Figure 1; sampling locations are shown on Figure 2.

For all pond systems:
To address water quality and to maintain summer operation water levels in the ponds, Systems B2, B2C, B11 and B8A WCS's were adjusted throughout the season. Management activity for the systems was relatively lower than in previous years, as adjustments were made less frequently based on having determined optimum pond discharge settings based on review of previous years data, and considering current or anticipated weather and predicted tidal conditions. While in previous years it was attempted to minimize discharge of pond waters not meeting water quality objectives (WQO's), including salinity and DO, a preliminary review of data indicates that more consistent, moderate volume discharges improved salinity conditions (lower salinity). A summary of discharge events is shown on Table 1.

System E2C:
Pond E2C was operated under Continuous Circulation protocol in 2009, similar to previous years, but was not monitored using a continuous monitoring device, as noted previously, based on the revisions to the Final Order made by RWQCB in May, 2008. Management of this system was performed as described in the Operations Plan and was informed by grab samples collected on an approximately weekly basis. Grab samples were collected with the same devices as were used to collect continuous data in previous years, and included temperature, pH, salinity and DO. This system presumably performed with continued low DO levels, as observed in 2005-8, but continued to provide good habitat conditions for waterbirds. The previous winter's low rainfall totals were successfully mitigated by allowing more consistent, higher volume discharges than were allowed in previous years; however, discharge was never greater than 25% of capacity. Therefore, no receiving water monitoring was required, as noted in RWQCB's May, 2008 letter and reflected in the revised Final Order. The operational practice (BMP) of periodically draining Pond E2C water into the adjacent seasonal ponds (E5C, E4C and E1C) to improve turnover of pond system water as a result of greater intake volumes was continued in 2009, which continued to help successfully manage salinity, and may have also improved DO conditions.

System E2:
Pond E2 was operated under Continuous Circulation protocol in 2009, similar to previous years, but was not monitored using a continuous monitoring device, as noted previously, based on the revisions to the Final Order made by RWQCB in May, 2008. Management of this system was performed as described in the Operations Plan and was informed by grab samples collected on an approximately weekly basis. Grab samples were collected with the same devices as were used to collect continuous data in previous years, and included temperature, pH, salinity and DO. This system presumably performed with continued low DO levels, as observed in 2005-8, but continued to provide good habitat

conditions for waterbirds. The previous winter's low rainfall totals were successfully mitigated by allowing more consistent, higher volume discharges than were allowed in previous years; however, discharge was never greater than 25% of capacity. The system was operated as muted tidal, with supplemental intake and system discharge to the Bay via Pond 2, while Pond 1 continued to operate as the primary intake pond with inflows during higher tides from Old Alameda Creek. As a Bay discharge, receiving water monitoring was not required. System E2 management included typical discharge operations via E2 for the winter season, including successful recirculation of the higher salinity "batch" ponds (E5 and E6).

System E6A:

This system was operated similarly to 2008 operations, which were different than previous years. This system was managed as seasonal ponds, with ponds maintaining higher salinities, and was allowed to draw down with summer evaporation to provide for use by western snowy plovers (WSP), a federally threatened species. Movement of water between ponds was periodically conducted. This system provided good habitat conditions for waterbirds, including WSP during the latter half of the year.

System E9:

Pond System E9 was operated under Continuous Circulation protocol in 2009, similar to previous years, but was not monitored using a continuous monitoring device, as noted previously, based on the revisions to the Final Order made by RWQCB in May, 2008. Management of this system was performed as described in the Operations Plan and was informed by grab samples collected on an approximately weekly basis. Grab samples were collected with the same devices as were used to collect continuous data in previous years, and included temperature, pH, salinity and DO. This system presumably performed with continued low DO levels, as observed in 2005-8, but continued to provide good habitat conditions for waterbirds. The previous winter's low rainfall totals were successfully mitigated by allowing more consistent, higher volume discharges than were allowed in years 2005-7; however, discharge was never greater than 25% of capacity. The system was operated as muted tidal with primary intake/discharge via Pond E9 near the mouth of Mt. Eden Creek, with supplemental intake and system discharge via Pond E8A and North Creek. Pond E9 is considered a Bay discharge, therefore receiving water monitoring was not required. Furthermore, the ponds in System E9 will be part of the Phase 1 Actions undertaken by the Department as part of the SBSP project, and construction is scheduled to begin in August, 2010. These actions will require multiple years of construction and will alter operations, and will be more fully described later.

System E10:

Pond E10 operated as a managed pond in the 2009 monitoring season and was the subject of an Applied Study, as required by RWQCB in their June, 2009 letter. Pond E11 was operated as a seasonal pond in 2009, as described in the ISP and 2009 Operations Plan Continuous monitoring devices (Datasondes) were utilized in Pond E10, as per Continuous Circulation protocol; receiving water sampling was not required for this Bay-discharge system, as previously approved by RWQCB.

As requested by RWQCB, an Applied Study (AS) that provided more spatial and temporal information, particularly with respect to Dissolved Oxygen (DO) was proposed by the Department in addition to the continuous monitoring described above. The Department proposed to examine spatial variability across the ponds by conducting DO transects approximately once per month. A sampling events were to include early morning and mid- to late- afternoon. Due to mandatory furloughs and other staff and budget constraints, data for an in-pond DO investigation in Pond E10 was conducted only in one month. August 4-5, 2009 were the dates the AS actions were actually completed at ELER. These dates may correspond to a similar AS conducted by USGS for USFWS in the Alviso Ponds, and may provide a comparison for interpretation.

Table 1 Summary of Intake/Discharge Activities

Complete datasets and field notes for pond operations/conditions and management activities are available for review upon request. Continuous meter data (Datasondes) in Pond E10 are summarized herein, but not provided in this report due to their large size. Datasets are provided to RWQCB staff electronically via their File Transfer Protocol (FTP) site; Datasonde files are available to others upon request.
NOTE: Table 1 salinity values displayed are generally from field deployed and maintained Datasondes, except occasionally when a hand-held refractometer was utilized; Datasonde values differ slightly from refractometer values collected simultaneously. Datasonde values should be considered more accurate and are generally used for all graphs listed as Figures in this SMR. In some figures, previous nomenclature for ponds are used, as has been the convention. “B” & “E” are interchangeable (Baumberg aka Eden Landing)

Pond	Location	Date	Salinity	Staff	Activity and notes
2C	E2c-14	3/22/2009	39	3.30	1x48" discharge set to 10%, cont. transition to summer operations.
2C	*B2c-15*	*3/22/2009*			*Closed 1x36" gate for transition to summer ops. 5C-/->2C*
2C	E2c-14	4/2/2009	34	3.15	Reduced 1x48" disch. to 5% to maintain water levels, neap tide.
2C	E2C-14	5/5/2009	29	3.60	Increased 1x48" Disch.to 20% for spring tides
2C	E2c-14	5/7/2009	35	3.1	Red.1x48" Disch.to 10% during neap tides.
2C	E2c-14	5/26/2009	29.74	3.55	Increased 1x48" disch. to 20% to max. circulation during spring tides.
2C	E2c-14	6/9/2009	35.01	3.15	Red.1x48" disch. to 10% for neap; maintain water levels
2C	E2c-14	6/24/2009	31.1	3.75	Increased 1x48" disch. to 20% to max. circulation during spring tides.
2C	E2c-14	7/8/2009	36.61	2.85	Red.1x48"disch.to 10% for neap; Water level, salinity mgmt.
2C	E2c-14	7/14/2009	36.34	3.05	Increased 1x48” disch. to 20% for spring tides
2C	E2c-14	8/5/2009	37.98	3.00	Red.1x48"disch..to 5% for neap
2C	E2c-14; *E2C-15*	8/13/2009	34.18	3.4	Increased 1x48” disch. to 20% for spring tides; *Opened 1x36" gate 100%, flood "C"sys.2c-->5C*
2C	E2c-14	8/18/2009	36.91	3.05	Red.1x48" disch. to 15% for neap tide, water level maint/mgmt.

Pond	Location	Date	Salinity	Staff	Activity and notes
2C	*B2c-15*	*8/18/2009*	*40*		*Red.1x36" gate to 25%.2c-->5c cont.*
2C	E2c-14	9/3/2009	37	3.00	Red.1x48" Disch. to 10% for neap tide, water level maint/mgmt.
2C	*E2c-15*	*9/30/2009*			*Closed 1x36" gate, salinity mgmt*
2C	E2c-14	10/15/2009	23.25	4.10	Increased 1x48" Disch. to 25% for spring tides, water level/mgmt. transition to winter ops
9	E8a-1	3/2/2009	23	3.95	Increased 1x48" Disch. to 25% for spring tides, water level/mgmt. transition to summer ops
9	E8a-1	5/19/2009	39	3.00	Red.1x48" Disch. to 5% for neap tide, water level maint/mgmt.
9	E8a-1	5/28/2009	32.8	4.00	Increased 1x48" Disch. to 25% to reduce water levels for spring tides, protect SNPL nests in E8A.
9	E8a-1	6/10/2009	31.07	3.20	Reduced 1x48" Disch. to 10% for neap tides.
9	E8a-1	6/17/2009	31.44	3.20	Increased **1x48" Disch. to 25%** for spring tides.
9	E8a-1	7/8/2009	34.2	3.60	Reduced 1x48" Disch to 10% for neap tides/DO mgmt.
9	E8a-1	7/14/2009	34.71	3.40	Increased 1x48" Disch. to 20% for springs, water level mgmt.
9	E8a-1	7/21/2009	34.16	3.80	Increased 1x48" Disch. to 35% for spring tides
9	E8a-1	7/30/2009	36.19	3.50	Reduced 1x48" Disch. to 20% for neap tides
9	E8a-1	9/1/2009	41	3.40	Reduced 1x48" Disch. to 10% for neap tides
9	E8a-1	9/15/2009	37.51	3.60	Increased 1x48" Disch. to 20% for springs, water level mgmt.
9	E8a-1	9/22/2009	36.43	3.80	Reduced 1x48" Disch. to 10% for neap tides.
9	E8a-1	10/15/2009	38	4.05	Increased 1x48" Disch. to 25% for spring tides, lower pond water elev. for SNPL nest protection in E8A.
9	E8a-1	10/26/2009	30.26	3.45	Reduced 1x48" Disch. to 10% for neap tides
8A	*E8A-NC*	*Winter ‘09* 4/28/2009	29	0.10	Set 1x48" Disch. to 5%
8A	*E8A-NC*	5/24/2009		0.3	Reduced 1x48" intake to 30% open (protect SNPL nests)
8A	*E8A-NC*	5/28/2009	35.36	0.50	Increased 1x48" Disch. to 25% to reduce water levels for springs, protect SNPL nests.
8A	*E8A-NC*	6/10/2009	36	below	Opened 1x48" Intake 100%, reduced 1x48" Disch. To 5% for neap tides

Pond	Location	Date	Salinity	Staff	Activity and notes
8A	*E8A-NC*	6/25/2009		0.60	Reduced 1x48" Intake to 25%, protect SNPL nests
8A	*E8A-NC*	6/30/2009	39	0.30	Closed 1x48" Intake during spring tides, protect SNPL nests.
8A	*E8A-NC*	7/8/2009	46	0.15	Opened 1x48" intake gate 50%, salinity mgmt.
8A	*E8A-NC*	7/14/2009	49	below	Closed 1x48"Disch. (salinity BMP)
8A	*E8A-NC*	7/22/2009	30	0.45	Opened 1x48" Disch. to 10% for spring tides, increased circ. season remainder
2	E2-10	4/14/2009	41	3.25	**1x48"Disch. at 25%**, continue draw down/circ. in neap, ready for springs.
2	E2-10	5/11/2009	42	2.90	Reduced 1x48" Disch. to 10%
2	E2-10	6/2/2009	41	3.30	Increased 1x48" Disch. to 25% for remainder of season (salinity, water level mgmt).
10	E11-1	4/28/2009	34	3.80	Increased 1x48" Disch. to 15% (from 10% winter ops)
10	E11-1	5/28/2009	31.1	4.00	Increased 1x48" Disch. to 25% for spring tides
10	E11-1	6/2/2009	32	3.55	Increased 1x48" Disch. to 35% for spring tides, water level mgmt.
10	E11-1	6/10/2009	33.11	3.30	Reduced 1x48" Disch. to 10% for neap tides.
10	E11-1	6/17/2009	35.86	3.40	Increased 1x48" Disch. to 25% for spring tides
10	*E11-2*	*6/30/2009*	*41*		*Drained milky white, green algal mat in NE corner E10 to E11 (5 hrs)*
10	E11-1	7/27/2009	36.98	4.05	Increased 1x48" Disch. to 25% for spring tides.
10	E11-1	8/4/2009	36	3.55	Reduced 1x48" Disch. to 10% for neap tides.
10	E11-1	8/12/2009	38.58	3.75	Increased 1x48" Disch. to 20% for spring tides.
10	E11-1	9/1/2009	39	3.40	Reduced 1x48" Disch. to 10%.
10	E11-1	9/15/2009	38.54	3.90	Increased 1x48" Disch. to 20%.
10	E11-1	9/22/2009	36.04	3.95	Reduced 1x48" Disch.. to 5% for neap tides
10	E11-1	9/30/2009	40.52	3.70	Increased 1x48" Disch. to 20%.
10	E11-1	10/26/2009	32.06	3.60	Reduced 1x48" Disch. to 10%.
10	E11-2	11/2/2009			Opened 1x Wood gate, 10-->11. reflood, transition to winter ops

Water Quality Monitoring Requirements

Water quality monitoring was performed at the sampling stations shown in Figure 2. The water quality parameters are provided in the Final Order and are summarized below for reference:

Table 2 Continuous Circulation Period Discharge Limits

All pond waters discharging to the Bay or Sloughs shall meet the following limits:

Constituent	Instantaneous Maximum	Instantaneous Minimum	Units
Salinity (Continuous Circulation Period)	44	n/a	ppt
Dissolved Oxygen[1]	n/a	5.0	mg/L
pH[2]	8.5	6.5	

[1 =] Limitation applies when receiving waters contain ≥ 5.0 mg/L of dissolved oxygen (DO). When receiving waters don't meet the Basin Plan objective, pond discharges must be ≥ DO receiving water level.

Dissolved Oxygen (DO) Trigger. At each pond discharge location, if the DO concentration is < 3.3 mg/L, calculated on a calendar weekly basis, values below the trigger shall be reported promptly to RWQCB, corrective measures shall be implemented in an attempt to increase DO concentrations, receiving waters shall be monitored and Operation Plans shall be revised, as appropriate, to minimize reoccurrence.

[2 =] The Discharger may determine pH compliance at the discharge or in the receiving water.

Water Quality Monitoring Methodology

Continuous Pond Discharge Sampling:

The Department installed continuous monitoring devices (Hydrolab-Hach Company, Loveland, CO) called Datasondes in pond E10 in July, 2009, for the remainder of the 2009 discharge monitoring season. All pond systems (E2, E2C, E9, E10) were operated under Continuous Circulation Period protocol in 2009. Datasondes were utilized for grab sample monitoring conducted approximately weekly in Ponds E2, E2C and E9 throughout the 2009 season. Continuous data were not required in Ponds E2, E2C and E9 as described in the Final Order, as modified by RWQCB. The Datasonde measured pond water quality at the outflow of the discharge into San Francisco Bay. Intake water quality is interpreted based on values observed, although the device is located within the pond. Pond E10 had one Datasonde deployed to collect continuous data through the majority of the season and into the transition to winter operations, as described below.

Datasondes were installed on the pond side of the WCS that discharged waters to the SF Bay receiving waters using ABS plastic pipes as device holders mounted to the structure to allow for free water circulation around the sensors. The devices were installed at a depth of at least 25cm to ensure that all sensors were submerged, and these depths were monitored and adjusted to maintain constant submersion as the pond water levels fluctuated. Datasondes were calibrated pre-deployment and maintained on a biweekly cleaning and calibration schedule unless they required additional maintenance. Spare data recorders were deployed to replace devices discovered to be malfunctioning during servicing periods. For the Applied Study conducted in Pond E10, a second Datasonde was not deemed necessary nor was staff available to deploy one near the middle of the pond, as done in 2008.

Datasondes collected values for the following parameters: salinity, pH, temperature, and dissolved oxygen which were collected at 15-minute intervals with a sensor and circulator warm-up period of 2 minutes. Data were downloaded approximately weekly from Datasondes and the devices were serviced to check battery voltage and data consistency. The Datasondes were generally serviced biweekly to recalibrate and de-foul the units (service records available upon request). At various times during the season, a recently calibrated Datasonde was placed next to the deployed Datasonde in the pond at the same depth, and readings of the two instruments were compared, to ensure deployed units were collecting valid data. Any problems detected with the Datasonde were corrected through calibration or replacement of parts or instruments.

Device malfunctions that occurred resulted in generally brief gaps in data or questionable data accuracy and were mostly attributed to battery failure, corrosion, exposure, and bio-fouling. These episodes were corrected as soon as possible after being observed in the field or during review of data and occurred less frequently than in previous years. It is likely that malfunctions cannot be completely avoided due to staff and budget limitations and because the Datasondes are deployed in harsh saline environments. The devices periodically suffer significant bio-fouling and the data from the week between cleanings may be affected by the bio-fouling. In 2009, short periods resulted in some data gaps due to equipment malfunctions; however, typical pond operations and monitoring were conducted during those periods and management operations were not adversely affected.

Discharge Time-Period and Volume Estimates:

Estimates of discharge volume could provide useful information, which would be used for activities such as modifications to operations, and for evaluation and analysis, particularly for determining what effects, if any, discharges had on receiving waters, and determination of effectiveness of BMPs. RWQCB modified ASMR requirements similarly for the ponds operated by USFWS. They contracted technical assistance from USGS, which used in-house budget and staff in developing a methodology to estimate discharge volumes using a calculation model (PONDCALC) to estimate discharge from five Alviso Complex ponds.

The Department continues to be unable to secure funding to contract a similar effort with USGS, since there is no dedicated annual budget for ELER. The Department understands the usefulness of such a tool to provide discharge volume estimates and will continue to look for opportunities to acquire and use such tools. At this time, the Department does not anticipate funding will be available due to the State budget constraints.

Discharge time period information may be interpreted from continuous monitoring data and is available in the electronic data files and summarized in discussions herein. Table 1: Summary of Discharge Events provides context for management operations; using discharge percentages, multiplied by discharge capacity described in ISP and Operations Plans, a generalized volume may be obtained. The time-period each day that a pond discharges is not specifically provided in this report. It should be noted that the daily discharge time-period information is based on predicted tidal elevations, not actual tide stages and time periods because there is currently no tide stage and other instrumentation installed to record actual discharge time-periods. Discharge periods in the ISP were assumed to be approximately 8 hours a day.

For the initial evaluation of discharge time periods, it was assumed that discharge would occur once tide stage was below pond water elevations, which occurs for approximately 13-16 hours daily. This assumption may over-estimate discharge time periods (and volumes) because it disregards affects of head (pressure) which may affect discharge flows through culverts. Based on observed data, intake requires tide stages that are approximately 1 ½ to 2 feet higher than pond water elevations; therefore, discharge may have similar head requirements. Nonetheless, discharge event information is useful to contextualize management actions and BMP's implemented during ponds operations and provides information to complement the general information in the Operations Plans. Discharge quantity estimates, as noted above, will also complement this information.

Receiving Water Sampling (Continuous Circulation Period):

Receiving water was not monitored for SF Bay discharges, as approved by RWQCB in the revised Final Order in 2005. SF Bay discharge locations include Ponds E2, E9 and E10. Receiving water sampling to determine water quality measurements are required only for slough discharges, where a pond is discharged into a slough at a substantial distance from the main body of the SF Bay (otherwise, SF Bay discharge receiving water monitoring is not required nor is practicable).

Only one slough discharge occurs for ELER, based on 2009 operations. The slough discharge is from Pond E2C into Alameda Creek Flood Control Channel (ACFCC), also known as Coyote Hills Slough, near the southern boundary of ELER. Sampling requirements under the Final Order were modified by RWQCB in 2008, such that receiving water sampling needed only be conducted when water quality objectives in discharge locations were not met if pond waters are discharged at greater than 25% capacity from the E2C system.

Management operations for System E2C maintained discharge at or below 25% for the 2009 season. Therefore, no receiving water sampling was conducted by the Department along ACFCC.

Table 3 –Continuous Circulation Monitoring For Eden Landing Ponds

Sampling Station:	D.O.	pH	Temp	Salinity	Sample Function
E2-10	A	A	A	A	Discharge
E2C-1 (E2C-14)	A/B	A/B	A/B	A/B	Discharge
E2C-	C	C	C	C	Receiving Water
E2C-	C	C	C	C	Receiving Water
E2C-	C	C	C	C	Receiving Water
E2C-	C	C	C	C	Receiving Water
E2C-	C	C	C	C	Receiving Water
E9-1 (E8A-1)	A	A	A	A	Discharge
E10-1 (E11-1)	A/B	A/B	A/B	A/B	Discharge

LEGEND FOR TABLE 3

A = For time periods between May and October when the Discharger is not monitoring its discharge continuously in accordance with Table 2B and 4A/B, it shall collect weekly grab samples before pond water mixes with receiving water. For days it collects pond water samples or downloads continuous monitoring data, the Discharger shall also report standard observations, as described in Section D of the SMP. Additionally, the Discharger shall report the time of sample collection and alternate the time it collects weekly grab samples between the morning and the afternoon to the maximum extent practicable. Based on weekly grab samples and standard observations, the Discharger shall consider implementing continuous monitoring, as necessary, to help craft management decisions.

B = From July 7 to October 10, the Discharger shall monitor discharge pond E10 before pond water mixes with receiving water using a continuous monitoring device. The Discharger shall also continuously monitor discharges from Pond System E2C, between July 7 and October 10, if pond waters are discharging at greater than 25% of capacity.

C = Receiving water samples shall be collected at discrete locations near the surface and bottom from downstream to upstream of the discharge point. Receiving water slough samples shall be collected monthly from July through October as close to low tide as practicable, if pond waters are discharging at greater than 25% capacity from the E2C system. For days it collects receiving water samples, the Discharger shall also report standard observations, as described in Section D of the SMP, and document if it collect samples at flood tide, ebb tide, or slack tide. Additionally, the Discharger shall record a daily estimate of the quantity and time-period of discharge based on pond water levels and the strength of tides.

Calibration and Maintenance:

All the instruments used for sampling as part of the Self-Monitoring Program were calibrated and maintained according to the standard procedures previously developed and employed by USGS. Datasondes were calibrated pre-deployment and maintained on a generally biweekly cleaning and calibration schedule unless they required additional maintenance or staff availability occasionally required a slightly longer (3 week) cycle. During the cleaning and calibration procedure, simultaneous readings were generally collected with a recently calibrated Datasonde to confirm data consistency throughout the procedure (initial, de-fouled [post cleaning], 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 on the sensors. The problem of biofouling was minimized with the use of nylon stockings and copper mesh covering the Datasonde. This allowed for maximum water flow past the sensors. The Department reviewed data approximately biweekly during servicing, to determine if fouling caused detectable shifts in the data due to the accumulation of biomaterial and sediment on the sensors or if other malfunctions occurred, such as power loss. A calibration and maintenance log was maintained.

Two types of DO sensors were used, Clark Cell and Luminescent DO. There was no particular reason why one type was used over another; rather the devices were deployed as needed/available. When malfunctions occurred and meters required replacements, the available replacement units may have had a different sensor. Regardless of type, the salt pond environment results in corrosion and fouling and will continue to pose challenges to successful deployment of continuous monitoring devices.

Pond Management Sampling:

As approved by RWQCB in 2005, the Department did not regularly conduct pond management sampling in 2009 in all ponds in each system. However, the Department did continue to collect data throughout the season for all ponds where the data would be useful in determining pond management operations and be useful in interpretation and analysis. Data include pond water elevation (staff gages), salinity (hand-held refractometer), wildlife (observations) and any items of note. Datasondes were used periodically to collect grab samples when more water quality data could be useful.

Chlorophyll-a Sampling:

Chlorophyll-a sampling in all ponds was not conducted due to limited analysis and applicability, as approved by RWQCB in 2005.

Metals- Annual Water Column Sampling:

The Department did not collect water column samples in 2009, as approved by RWQCB in 2005, because previous data showed metals concentrations were within WQO's.

Sediment Monitoring

The Department did not conduct sediment sampling because previous analysis showed metals concentrations were within WQO's. In 2006, RWQCB supported redirection of monitoring efforts to address specific issues rather than generalized pond monitoring; accordingly, mercury studies shall be centered on areas of concern, such as the USFWS Alviso Pond Complex, in Pond A8 and Alviso Slough. USFWS will provide a report to the RWQCB when available and any relevant findings may be applicable to the Department's ponds at ELER.

Invertebrate Monitoring

Invertebrate monitoring was not conducted in 2009. Previous collections (2005-06) proved to be of limited use for analysis and had little applicability to pond operations.

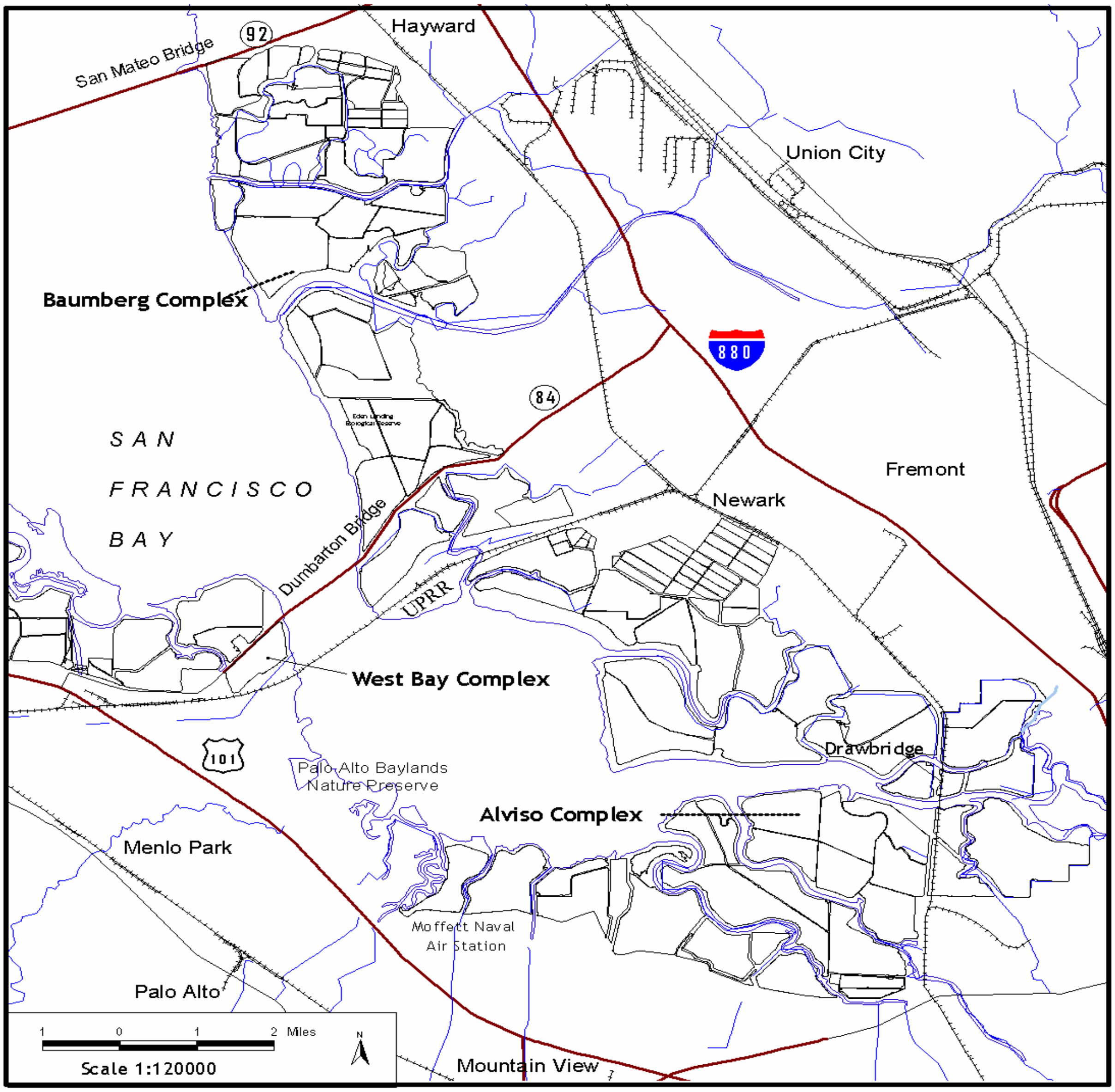

Figure 1. Vicinity Map of the Eden Landing Ecological Reserve (Baumberg Complex) Ponds

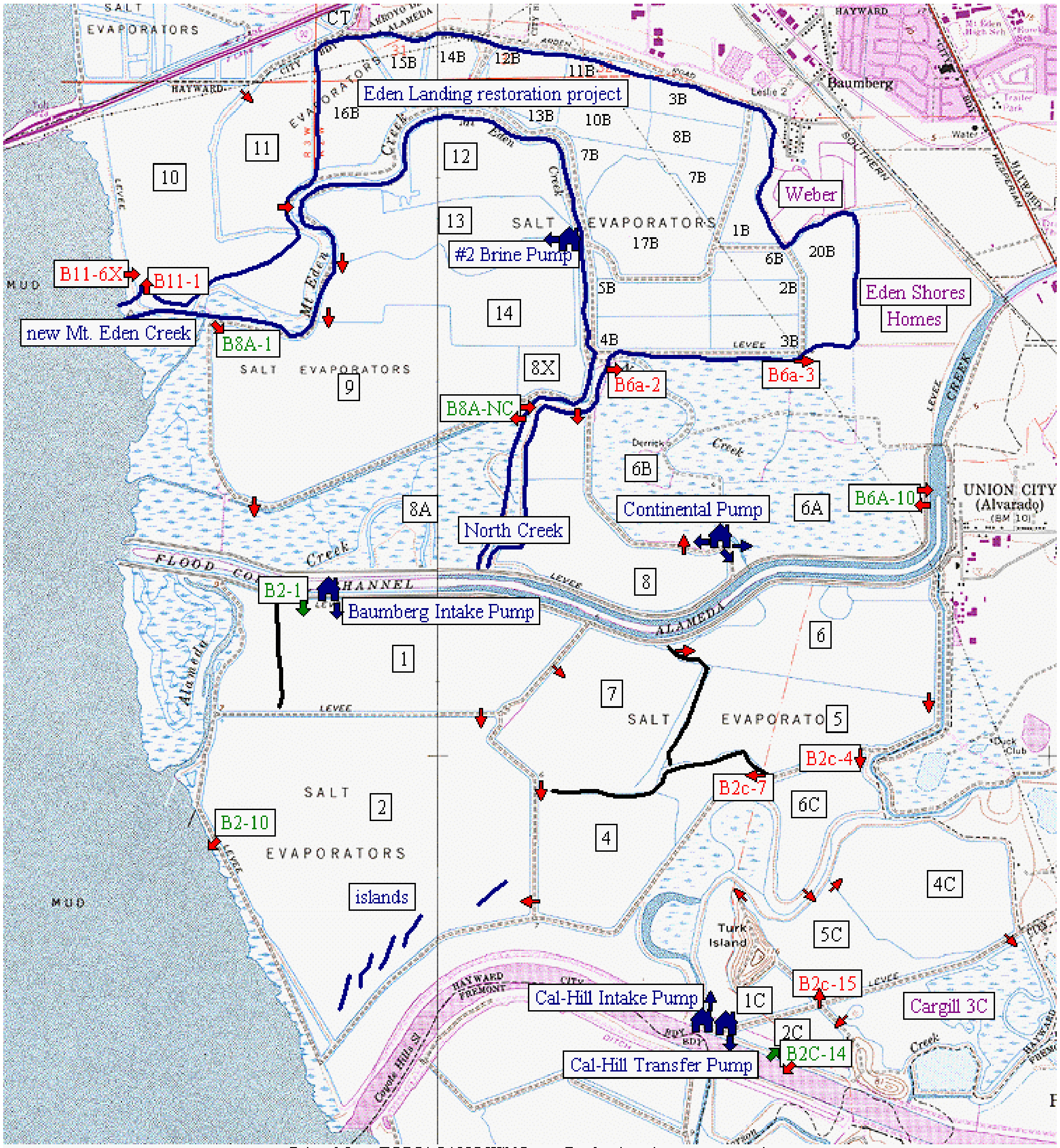

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Figure 2. Eden Landing Ecological Reserve (Baumberg Complex) Ponds: Discharge and Intake Locations

Green text boxes note Intake and Discharge Locations, Red text boxes note other key pond operation and monitoring locations. ("B" nomenclature from water control structure names for ISP and "E" nomenclature from SBSP dropped on pond labels)

Water Quality Monitoring Results

Discharge and Receiving Waters

Results from the monitoring of pond waters at discharge locations are summarized below by parameter. It should be noted that, where the continuous data collection meter files show values below Basin Plan objectives and Final Order requirements, it does not necessarily indicate or reflect actual violations. Pond discharges do not occur continuously. Pond discharge data should be reviewed considering variation in tide stage and cycles, and operational activities which resulted in suspending or modifying discharges. Salinity, pH, temperature and DO appeared to continue within the typical patterns and ranges in 2009 as in previous years.

Data from 2009 were generally consistent with data collected during previous years on similar calendar dates. In Systems E9, E2, E2C, and E10, salinity during 2009 was somewhat lower than in 2008 and during previous years. System E6A salinity continued to be higher, which is attributable to seasonal management operations to provide western snowy plover (WSP) breeding habitat. WSP management efforts resulted in higher salinity in System E6A prior to and during the summer, precluding discharge. Temperature has been generally consistent across years. Dissolved oxygen is more difficult to interpret and has been highly variable across years; however, calendar weekly 10th percentile and median values were lower in E10 than in previous years, and daily mean DO concentrations in E10 were slightly higher than in 2008 and comparable to previous years. Most E10 weekly 10th percentile values and median values were often below the 3.3mg/L trigger value, and all were below the water quality objective of 5.0mg/L as described in Basin Plan. Although pH is also variable, it was somewhat lower in E10 than in previous years.

Figures 4-7 show the daily means for salinity, pH, temperature, and DO for the pond water at the discharge location at E10. See Figures 3 and 8 for the E10 Applied Study data.

The 2009 pond water analytical results (continuous collection) and field observations are large files and are not included in this SMR. Rather, those data are provided in electronic format. Please contact the Department for requests to cite, distribute or utilize this information for purposes other than reviewing this report.

Discharge (flow) volume to measure inflow to the pond and outflow from the pond discharge and stage in the pond was not measured, as noted in previous reports, due to staff and funding constraints at ELER.

Salinity

Pond salinities were generally similar to previous years, although in 2009, management operations appear to be more successful at maintaining salinity below the discharge limit of 44ppt. Similar to the previous two years, the low rainfall total for the winter season affected winter operations and resulted in management operations with reduced circulation. Winter pond discharge was more limited, and input of rainwater to dilute pond water was less than expected. Salinities were generally not above the 44 ppt required for Continuous Circulation Period operations, except for brief periods, especially during neap tide intervals when intake is extremely limited (refer to Instantaneous/daily mean salinity values). These periods show how with limited intake to promote mixing and dilution, combined with overall higher pond salinities, slightly higher salinity will be observed. This is especially true for drought years, exhibiting atypical water circulation patterns in pond operations. An elevated salinity period, for approximately one week, was observed in E8A, which may have been a result of WSP management activities to prevent flooding nests. E8A accommodates WSP nesting because of the high, exposed pond bottom, operating as open water only in the deep borrow ditch, while primary intake and discharge operations occur in pond E9. BMP's were implemented such that during this elevated salinity period, E8A discharge was minimal (5%) or temporarily ceased and values were only a few points above 44 ppt (49 ppt max). Once E8A pond water elevations were no longer likely to risk flooding WSP nests, supplemental intake was resumed, and salinity was reduced to more typical values (approximately 30 ppt). Refer to Figure 4 for daily mean salinity in E10.

The operating salinities for all system ponds are expected to remain under Continuous Circulation Period conditions in future normal rainfall years, and will continue to chiefly function as low-salinity systems, reflecting only relatively higher salinities than the intake waters from the Bay and sloughs. Differences in mean salinity between pond and Bay waters are more apparent during neap tide periods and higher salinity should be expected during drought years. Review of data collected to date indicates that management operations provide sufficient maintenance of salinities in seasonal or batch pond operations, where a limited number of ponds are allowed to reach moderate salinities, and do not prevent continued management of primarily low salinity ponds. Batch ponds are sufficiently mixing with system ponds before discharge.

E2C:

System E2C is operated as a muted tidal system, with intake and discharge at the same location, and salinity therefore varied depending on duration of intake periods resulting from spring and neap tide cycles. Grab samples obtained during routine pond operations prior to May showed values ranging from 27 to 40 ppt (16 to 37 ppt in 2008), and grab sample monitoring values during the monitoring season from May through October showed pond salinities from 30 to 44 ppt (30 to 44 ppt in 2008), except on 7/27/09, which had an observed salinity value of 45ppt. This date coincided with similar observed salinities in Pond 3C (44ppt), and was presumably brief, as salinities observed before and after were approximately 36ppt, within the normal operations range for the season. The 7/27 elevated salinity observation coincided with a brief neap tide between two stronger spring tide periods which may have resulted in circulation of a "pocket" of higher salinity water to the discharge location. It is apparent that sufficient tidal mixing thereafter resulted in more typical salinity ranges. Observed E2C salinity was below 44 ppt throughout the remainder of the season with periodic implementation of the pond water transfer BMP, where Pond 2C water is allowed to drain into Pond 5C to increase intake at Pond 2C. Additional BMP's such as weekly discharge timing and minimizing discharge volumes adequately protected receiving waters. The system was operated assuming

Continuous Circulation Period conditions, and average salinity over the entire monitoring season (May through October) was 36 ppt (39ppt in 2008).

<u>E9:</u>

System E9 is operated as a muted tidal system primarily via Pond 9, with intake and discharge at the same location (E8A-1), adjacent to the historic mouth of MEC. Supplemental intake and secondary discharge occurred in Pond 8A, via North Creek. This arrangement is now considered the normal operational mode, and is the reverse operation of years prior to 2007 (the first year such operation was feasible, after MEC was restored to full tidal action). The primary intake and discharge operational mode at Pond 9 was an effort to improve water quality values, presuming that primary operations via Pond 9 could improve water quality in the system because of greater mixing, assumed because the E8A-1 WCS is comprised of four-48" culverts, all of which can be used for intake, compared to the single-48" culvert in Pond B8A. Primary intake/discharge operation at E8A-1 appears to have improved water quality, based on the review of 2007-9 data; meeting WQO's in all pond systems was complicated by the previous low-rainfall winter. Receiving waters would likely be better protected, since Pond 9 is considered a Bay discharge, while discharge from Pond 8A is into North Creek, which drains into Old Alameda Creek. Secondary discharge via Pond 8A, therefore, would result in system pond water having lesser residence time, though it would slightly greater residence time in sloughs since there is a greater distance in sloughs before mixing with the greater Bay. With minimal discharge settings in Pond 8A (5%), high volumes in sloughs result in rapid mixing and discharge is indiscernible from slough water immediately outside of the discharge location. Pond 9 discharge is assumed to mix with the open Bay in one ebb tide period.

At the start of the 2009 monitoring season, average observed discharge salinity from Pond 9 was approximately 32 ppt (32 ppt in 2008), considered a normal value at the start of summer operations. This indicates that the system was minimally affected by low rainfall the previous winter, though this system only briefly reached winter water depth targets, in mid-January, and thereafter operated more shallowly. Shallower water depths resulted from management operations allowing higher than typical discharge in the latter half of the winter, intended to reduce spring salinities by reducing overall salt mass balance by reduced pond volume. The system was operated for the summer monitoring season assuming Continuous Circulation Period conditions, as average salinity over the entire May-October monitoring season (from grab samples) was 36 ppt (37 ppt in 2008, continuous data). Grab sample salinities in 2009 were not above 44 ppt (42 ppt max in 2008).

The highest salinity value (from grab samples) in 2009 was 44ppt on 7/8/09 (42 ppt, 7/15/08). Grab sample salinity ranged from 30-44ppt in 2009 (33-42 ppt in 2008). Discharge salinity was actively managed in 2009 based on grab sample data and operations were implemented to minimize discharge values above 44ppt. Discharge operations were not temporarily suspended in 2009, in an attempt to lower salinity overall, considering salt mass balance. Review of 2007 data did not show an appreciable increase in water quality across all parameters using the temporary suspension of discharge BMP; therefore suspension of discharge was not utilized in 2008 or 2009.

Periodic draining of Pond 9 waters to seasonal ponds (E14, E8X and E12/13), effectively increased intake of Bay water at the mouth of MEC, and presumably improved mixing. After periods of water transfers to E14, especially for periods of more than one day and during spring tide cycles, system salinities generally improved and operated under 44 ppt, within Continuous Circulation standards. When E9 water transfers occurred during neap tide cycles, salinities did not notably improve until intake increased during the following spring tide cycle. Higher salinity waters in Pond E9 appear to have been well mixed at the discharge location during spring tides with intake in E9, presumably because there was greater turnover. The use of the BMP allowing periodic draining to seasonal ponds was again limited in 2009 by use of the seasonal ponds by nesting western snowy plovers (WSP), a threatened species. This BMP was used only once because of WSP nesting activities, in mid-July, which provided shallowly flooded foraging habitat in E14.

E2:

System E2 is operated as a circulating system, rather than a primarily muted tidal system as with all other ponds, but is augmented by muted tidal intake at the E2-10 discharge location on the Bay. Observed salinity at the E2-10 discharge at the beginning of May, 2009 was approximately 42ppt (39ppt in 2008) and ranged from 33-56ppt during the season (38-45ppt in 2008). Salinity for the majority of the 2009 season based on grab samples averaged 40ppt (average 42ppt in 2008) and were generally below 43ppt (below 44ppt in 2008) for the entire season, except on 10/12, when it was observed to be 56.4ppt. The 10/12 elevated salinity observation coincided with a neap tide period which may have resulted in circulation of a "pocket" of higher salinity water to the discharge location. It is apparent that sufficient tidal mixing thereafter resulted in more typical salinity values (33ppt). The system was operated as if under Continuous Circulation Period conditions since the E2-10 discharge is located directly on the Bay and operates as muted tidal intake/discharge.

E10:

System E10 is operated as a muted tidal system in Pond 10, with intake and discharge at the same location at the mouth of MEC. Pond E11 is operated as a seasonal pond and is allowed to drawn down and dry during the summer. Salinity in E10 ranged from 30-41ppt in 2009 (32-44ppt in 2008). At the start of the monitoring season in early-May, 2009 salinity in E10 was approximately 32ppt at the E11-1 discharge location (33ppt in 2008). Daily mean salinities were not above 44 ppt in 2009 (2 days in 2008) and the system operated under Continuous Circulation Period conditions.

Daily mean salinity ranged from 30-41ppt during the 2009 season (32-46ppt in 2008), and the average daily mean salinity was 35ppt (39ppt in 2008). The highest recorded daily mean value in E10 was 41ppt on 10/1/09 (43ppt on 10/10/08). No recorded daily mean salinity values exceeded 44ppt (2 in 2008). Instantaneous salinity values ranged from 22-42ppt (28-47ppt in 2008), and the season average was 36ppt (39ppt in 2008).

Discharge was actively managed, operations were intended to avoid large fluctuations in water levels or resulting habitat values.

2009 pond management operations in E10 resulted in typical water levels. In 2008 deeper water was required to adequately operate a boat in E10 to allow boat access to deploy a Datasonde and to conduct the DO transects. Deeper water was presumed to have potential for improved water quality conditions; however, in 2008, water quality may have been reduced overall, compared to 2007 and previous years. Pond discharge operations in 2009 were less frequently adjusted compared to 2008 and previous years.

System E10 provided good habitat conditions for numerous waterbirds in E10 despite periods of low DO conditions, and E11 provided seasonal habitat for shorebirds. Pond operations did not result in flooding breeding Caspian tern nests on their island in E10.

pH

The pH values in the ponds were similar to previous years, with season averages in E9, E2, E2C and E10 of approximately 8.1, 8.2, 8.2 and 8.0, respectively (8.2, 8.22, 8.23 and 8.46 in 2008, respectively). In 2009, sampled pH values at the discharge ranged from a minimum of pH 7.6 to a maximum of 8.6, though higher values were found in more distant areas of E10 with poor circulation (8.2-9.6 pH during August transects). In 2008, values ranged from 7.74 to 10.02 at all locations, including mid-pond and more distant, poor circulation areas. While in-pond pH values were generally less than 8.5, during discharge periods it is expected that brief periods of elevated pH in-pond waters were readily mixed immediately after discharge and receiving waters were adequately protected, based on previous monitoring (receiving water sampling in 2007 showed that no pond discharge “signal” was discernable except in the immediate vicinity of the discharge). Compliance for pH levels was allowed in the Final Order to be measured in either the pond or receiving waters, as determined by the discharger. There was no apparent pattern in pH values as related to discharge operations. In E10 in 2009, pH varied less extensively at the discharge (pH = 7.5-8.5 at E10-1) than in previous years, with instantaneous values ranging within one pH point over the season, compared to two pH points in 2008. During pond transect sampling in August, 2009, pH values ranged from 8.2 in areas with adequate circulation to 9.7 in areas with poor circulation. In other pond systems, pH similarly ranged approximately one pH point over the season. Refer to Figure 5 for daily mean pH in E10**,** and to electronic files for pond management data for E9, E2 and E2C.

In Pond E2C, grab sample pH values ranged from approximately 8.0 to 8.6 during the 2009 season (7.7 - 8.6 in 2008) and pH averaged 8.2 (8.2 in 2008) through the season.

In Pond E9, grab sample pH values ranged from approximately 8.1 to 8.6 during the 2009 season (7.8 to 8.6 in 2008) and pH averaged 8.1 (8.2 in 2008).

In Pond E2, grab sample pH values ranged from approximately 8.0 to 8.6 during the 2009 season (8.2 to 8.6 in 2007) and averaged 8.2 pH (8.2 in 2008).

In pond E10, daily mean and grab sample pH ranged from approximately 7.9 to 8.5 during the 2009 monitoring season, including in-pond transects (7.9 to 10.0 in 2008). Instantaneous values ranged from 7.4 to 8.7 pH, and averaged 8.0 pH, throughout the season (7.76 to 10.29, average 8.4 in 2008).

Temperature

Pond water temperatures were generally similar to ambient SF Bay and slough temperatures and were only slightly warmer during hot weather periods, especially for shallower ponds. The ponds easily met the discharge limits, not exceeding natural temperatures of the receiving waters by 20^{o}F in any case. For E2C, E9 and E2, season average grab sample temperature was 22^{o} F, 21^{o} F and 20^{o} F ($22.^{o}$ F, 20^{o} F and 21^{o} F in 2008), respectively. For E10, the 2009 season average of daily mean temperature was 20.8^{o} F (19.5 ^{o} F in 2008). Refer to Figure 6 for daily mean in E10 and to electronic files for pond management data for E9, E2 and E2C.

Dissolved Oxygen (DO)

For the 2009 season, pond dissolved oxygen values continued to be highly variable and there were periods of low or sustained depressed DO which showed that achieving compliance with the Final Order is problematic. Monitoring efforts showed that DO levels in the ponds generally continued to exhibit a strong diurnal pattern where lower DO is observed near dawn and higher DO is observed at mid-day. Substantial algal growth and decomposition in the ponds is assumed to be the cause of diurnal fluctuations of DO levels throughout the ELER Ponds during the summer.

Continuous monitoring DO values for 2009, as well as the values observed during the August in-pond study, are discussed below for pond E10. Grab sample monitoring values for ponds E2C, E9 and E2 are also provided, but are less representative of variance over each day, week and the season, since those values are only from samples taken during the day; however, if any periods of sustained, depressed DO conditions had occurred in those ponds, grab samples should have reflected those periods. Management actions were implemented as appropriate. Evaluation of Pond E10 s is based on daily mean values recorded at the discharge location and on calendar-weekly 10^{th} percentiles. Values are referenced with the Basin Plan water quality objectives (compliance limit of 5.0 mg/L) and reporting “trigger” values established by RWQCB (below 3.3 mg/L), as discussed herein. Calendar-weekly tenth percentile “trigger” values were below 3.3 mg/L for most of the season for E10, and notification of these conditions was made to RWQCB staff.

It should be noted that the summary data does not necessarily indicate or reflect actual violations of the Final Order. Pond discharges did not occur continuously nor in all of these periods, and variations in pond operations, including BMPs, were implemented to attempt to increase DO values, or to limit potential adverse affects. Refer to Figure 7 for daily mean DO in E10. For E2C, E9 and E2, mean DO of grab samples was 7.1, 5.0 and 5.7 mg/L (6.3, 5.7 and 6.3 mg/L in 2008), respectively.

Pond System 10: Monitoring data for Pond E10 was evaluated from May 11 through November 5, 2009, representing 188 total days (157 days of recorded data in 2008). For this discussion and for the figures, 61 days within the monitoring season have no data, because data was removed after review showed unreliable values due to device malfunctions or other errors, or because a file set up error resulted in lost data, or no data was recorded due to staff availability and changes to monitoring requirements in the Final Order for 2009.

For E10, daily mean DO was below 5.0 mg/L on 91 days (140 days in 2008), and daily mean DO was below 3.3 mg/L on 30 days (90 days in 2008). 16 of the 18 calendar week periods had tenth percentile "trigger" values below 3.3 mg/L (all weeks in 2008). For System E10, receiving waters were not monitored because it is a Bay discharge location, as discussed previously, and receiving waters were presumably not adversely affected since pond discharge volumes are negligible relative to volumes exchanged in tidal cycles at the mouth of Mt. Eden Creek and the open Bay.

E10 Applied Study

An applied study was conducted in Pond E10 during August, 2009 to examine both spatial and temporal variability of water quality parameters within the pond. Two perpendicular transects were completed on each day, aligned approximately north-south and east-west. The transect areas included sampling areas near the intake/discharge and across the entire width and length of the pond. A Datasonde was used to record pH, temperature, salinity and dissolved oxygen every 2 minutes. Nutrient and chlorophyll "a" sampling was not conducted due to limited applicability and staff availability, as was completed in 2008.

The Applied Study (AS) was conducted by the Department in addition to the continuous monitoring described above, which provided data from early morning (pre-dawn) and late afternoon conditions in Pond E10 from two consecutive days. The Department had proposed to RWQCB to conduct transects monthly, but was unable to do so because of limited staff availability due to mandatory furloughs and budget constraints. The dates the AS were actually completed at ELER were August 4 and 5, 2009. These dates generally corresponded to a similar AS conducted by USGS for USFWS in the Alviso Ponds, in order to provide a comparison for the results.

For the two AS sampling dates, data was collected as described below. A Datasonde was deployed from a boat near the pond surface (approximately 25cm deep) and data was collected every two minutes to provide a continuous recording of pond water quality along the transects to help determine in-pond spatial and temporal variability; one transect was conducted before the sun affected algal photosynthesis and reflects overnight DO conditions. These transects collected a minimum of 20 data points within the two perpendicular transects. Nutrient and Chlorophyll "a" samples were not collected.

Data for meteorological measurements, including parameters such as wind speed and direction, air temperature, relative humidity, solar radiation were not collected at ELER. Rather, this information was collected at a permanent station nearby, in Union City, as part of the California Irrigation Management Information System (CIMIS) program in the Office of Water Use Efficiency, California Department of Water Resources which manages a network of automated weather stations in the state. CIMIS data is provided in this report in lieu of having a portable weather station deployed at ELER.

Table 4: Summarized Weather Values for Pond E10 (CIMAS data)

Sampling Period	**Solar Radiation (Ly/day)**	**Net Rad. (Ly/day)**	**Temp (ºF)**	**Wind Speed (mph)**	**Wind Direction (degrees)**	**Precipitation (in.)**	**Relative Humidity (%)**
August 4	516	298	64.6	4.3	102.7	0.0	71

Datasonde values varied considerably, reflecting adequate to poor circulation within Pond E10, with better water quality (WQ) observed near the intake/discharge location and poorer WQ at more distant locations within the pond. Mean, minimum and maximum values for the WQ parameters varied, generally becoming poorer with greater distance from the intake/discharge location. As expected, dissolved oxygen was generally higher near the intake/discharge location. Minimum DO values differed by location, but were located nearest the periphery and least circulating portions of the pond in shallower water.

Table 5: Summarized Water Quality Values by Sample Type/Location for Pond E10

Date	**Sample Type/ location**	**Temp (ºC)**	**pH (Units)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/L)**	Weekly DO 10th %-ile/median (mg/L)
August 4	Grab Sample Mean/ Transect (PM)	25.92	8.73	37.45	8.44	-
August 5	Grab Sample Mean/ Transect (AM)	23.10	8.69	37.43	7.53	-
August 4-5	Grab Sample Mean/ Transect (AM/PM)	22.90	8.73	37.60	7.75	
August 4	Daily Mean Intake/discharge	21.7	8.3	36.4	3.2	1.49/ 3.2

Dissolved Oxygen Transects

Dissolved oxygen transect data were collected to compare with the primary Datasonde deployed for the season at the E10-1 location to provide context for spatial and temporal variation in pond water quality parameters. Transects were completed on two consecutive days due to staff availability; one on the afternoon of August 4, 2009, and the other in the early morning of August 5, 2009. There were 37 valid readings from those dates, presented below, with some data removed due to collection errors. The information presented in Tables 5 and 6 does nonetheless provide some useful information in terms of spatial variability. In general, the morning transects included values that were less than 5.0 mg/L, while afternoon transect samples showed all values were greater than 5.0 mg/L. For the morning transects, the majority of the pond showed samples were closer to 5.0 mg/L nearest the intake/discharge where the greatest mixing was presumed to occur, and in the northernmost and easternmost portion of the pond, where the least circulation was presumed, values were the lowest.

Table 6: Pond E10 Transect Water Quality Values for 8/4-5/09 AM/PM Sampling Period

Date MMDDYY	Time HHMMSS	Temp ºC	pH Units	Sal ppt	DO mg/l
8/4/2009	16:02:00	25.3	8.18	35.89	6.11
8/4/2009	16:04:00	25.29	8.32	35.91	6.13
8/4/2009	16:06:00	25.31	8.35	35.87	6.23
8/4/2009	16:08:00	25.26	8.35	35.92	6.15
8/4/2009	16:10:00	25.23	8.35	35.91	6.06
8/4/2009	16:12:00	25.29	8.36	35.99	6.29
8/4/2009	16:14:00	25.36	8.36	36	6.26
8/4/2009	16:16:00	25.41	8.37	36	6.14
8/4/2009	16:18:00	25.8	8.41	36.14	6.4
8/4/2009	16:22:00	26.54	8.42	37.01	7.25
8/4/2009	16:24:00	26.9	8.46	37.91	6.97
8/4/2009	16:26:00	26.21	8.42	36.96	7.43
8/4/2009	16:28:00	25.63	8.44	37.78	7.04
8/4/2009	16:30:00	26.12	8.68	39.88	8.46
8/4/2009	16:32:00	26.29	9.4	39.99	16.29
8/4/2009	16:36:00	26.1	9.21	40.77	11.91
8/4/2009	16:38:00	26.21	9.21	40.74	9.98
8/4/2009	16:40:00	26.15	9.26	40.8	14.27
8/4/2009	16:42:00	26.42	9.38	40.85	13.95
8/4/2009	16:58:00	25.93	8.39	36.11	6.4
8/4/2009	17:00:00	25.84	8.38	36.1	6.26
8/4/2009	17:02:00	25.84	8.38	36.12	6.64
8/4/2009	17:04:00	25.69	8.56	36.97	8.13
8/4/2009	17:08:00	25.86	8.81	37.28	13.94
8/5/2009	6:44:00	18.82	8.15	35.87	4.64
8/5/2009	6:46:00	18.87	8.29	35.78	4.04
8/5/2009	6:48:00	18.74	8.22	34.08	4.79
8/5/2009	6:50:00	18.91	8.2	33.47	4.86
8/5/2009	6:52:00	19.05	8.33	36.93	3.66
8/5/2009	6:54:00	18.81	8.46	38.74	4.32
8/5/2009	6:56:00	19.1	8.85	40.8	2.69
8/5/2009	6:58:00	19.43	9.09	41.07	2.9
8/5/2009	7:00:00	19.17	8.7		1.68
8/5/2009	7:02:00	19.13	9.13	41.75	1.8
8/5/2009	7:18:00	18.93	8.33	36.43	3.75
8/5/2009	7:20:00	18.59	8.33	35.01	5
8/5/2009	7:22:00	18.5	8.37	36.86	3.49

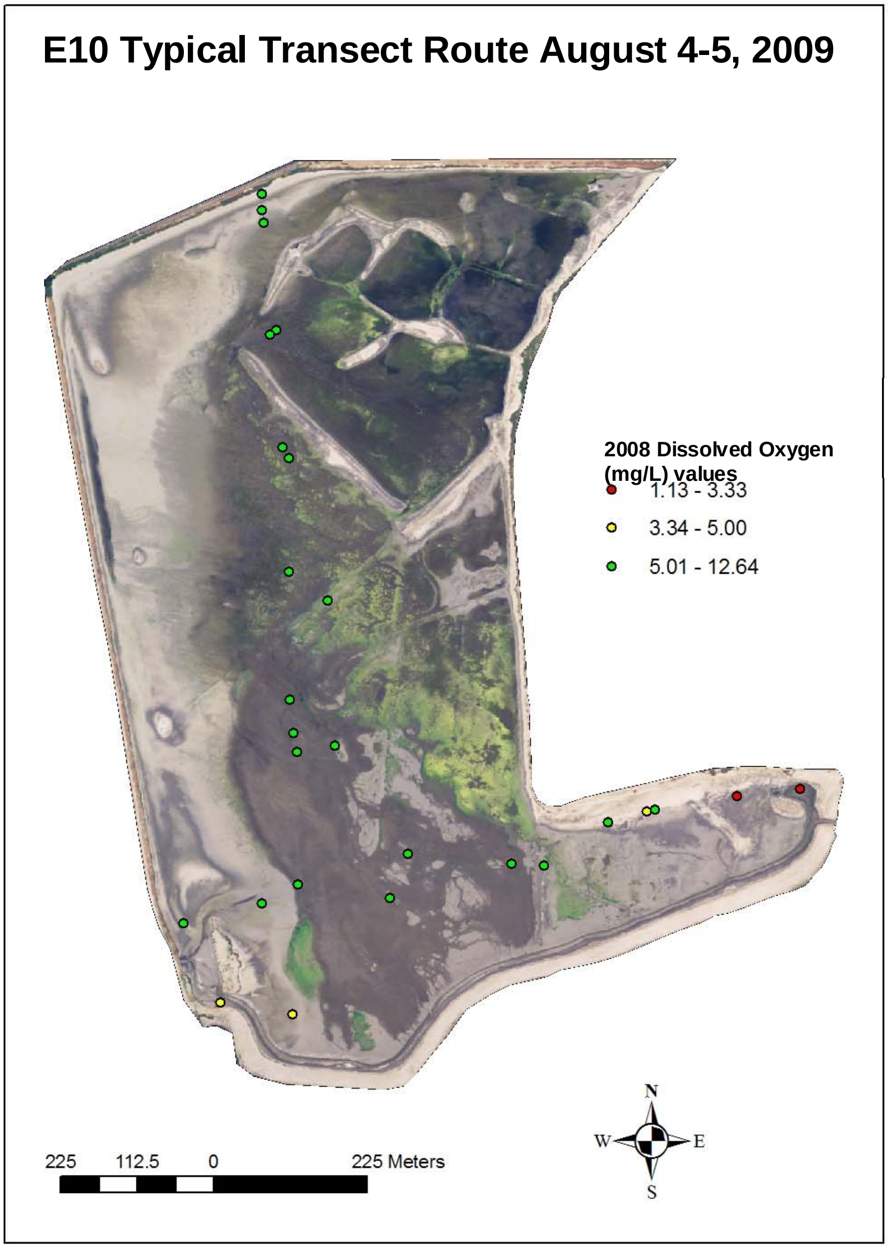

Figure 3: E10 Typical DO Transects August 4-5, 2009 (2008 values)

A map could not be produced for 2009 values because a GPS-enabled Datasonde was not available, and no GPS data was collected by a separate unit due to the hand-held GPS unit failure. The 2008 transect map and values is provided for reference.

Pond E10 Daily Mean and Applied Study Summary (Figures)

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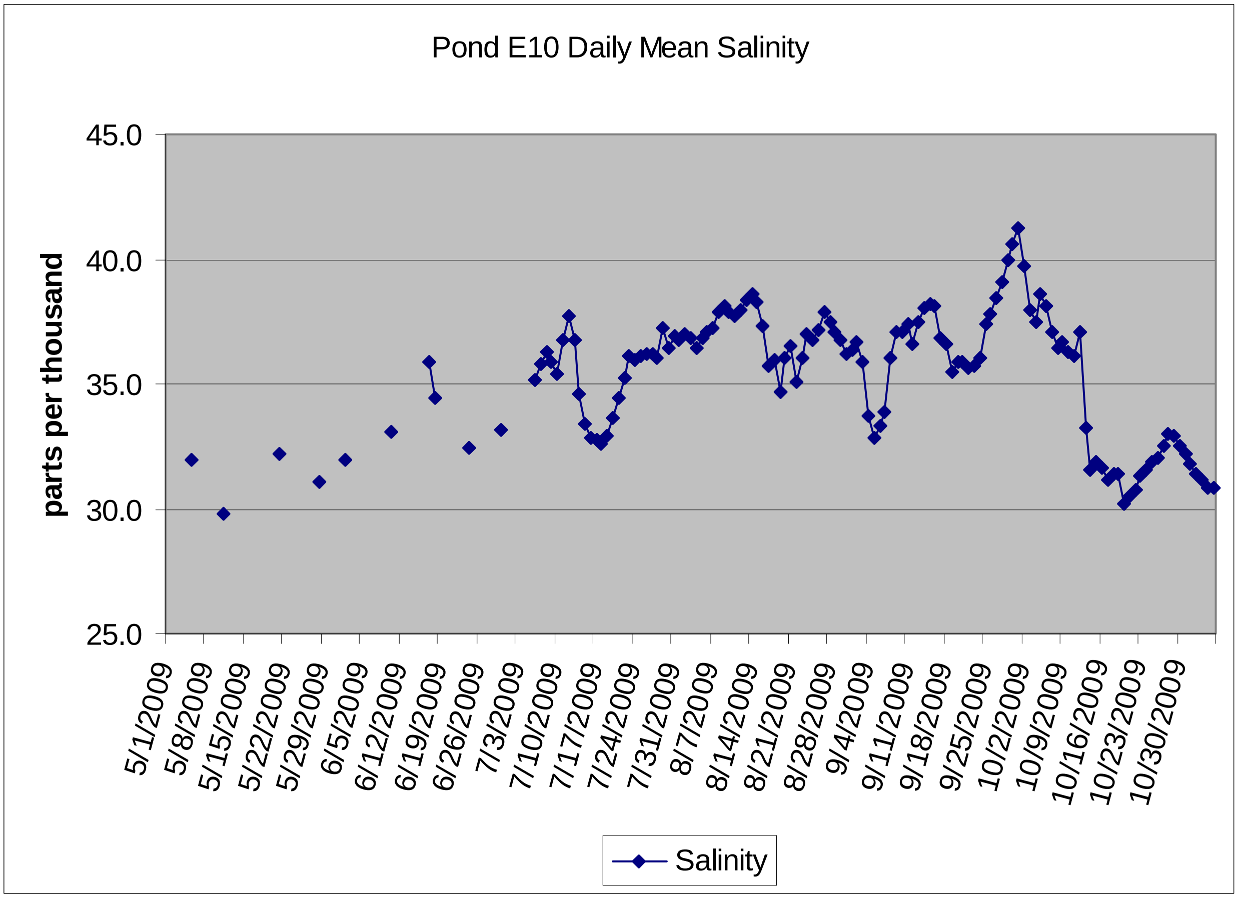

Figure 4: Pond E10- 2009 Daily Mean Salinity (Grab Samples only 5/5-6/30/09) at Intake/Discharge Location

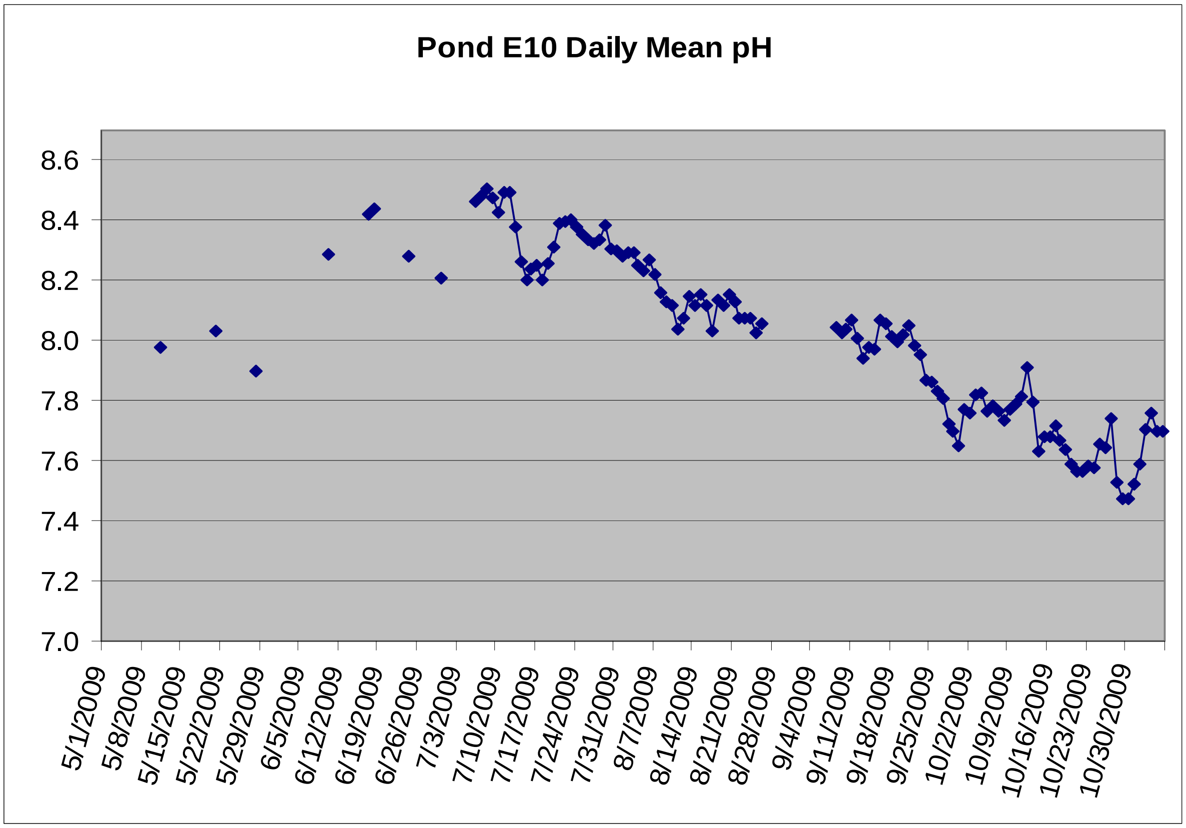

Figure 5: Pond E10- 2009 Daily Mean pH (Grab Samples only 5/5-6/30/09) at Intake/Discharge Location

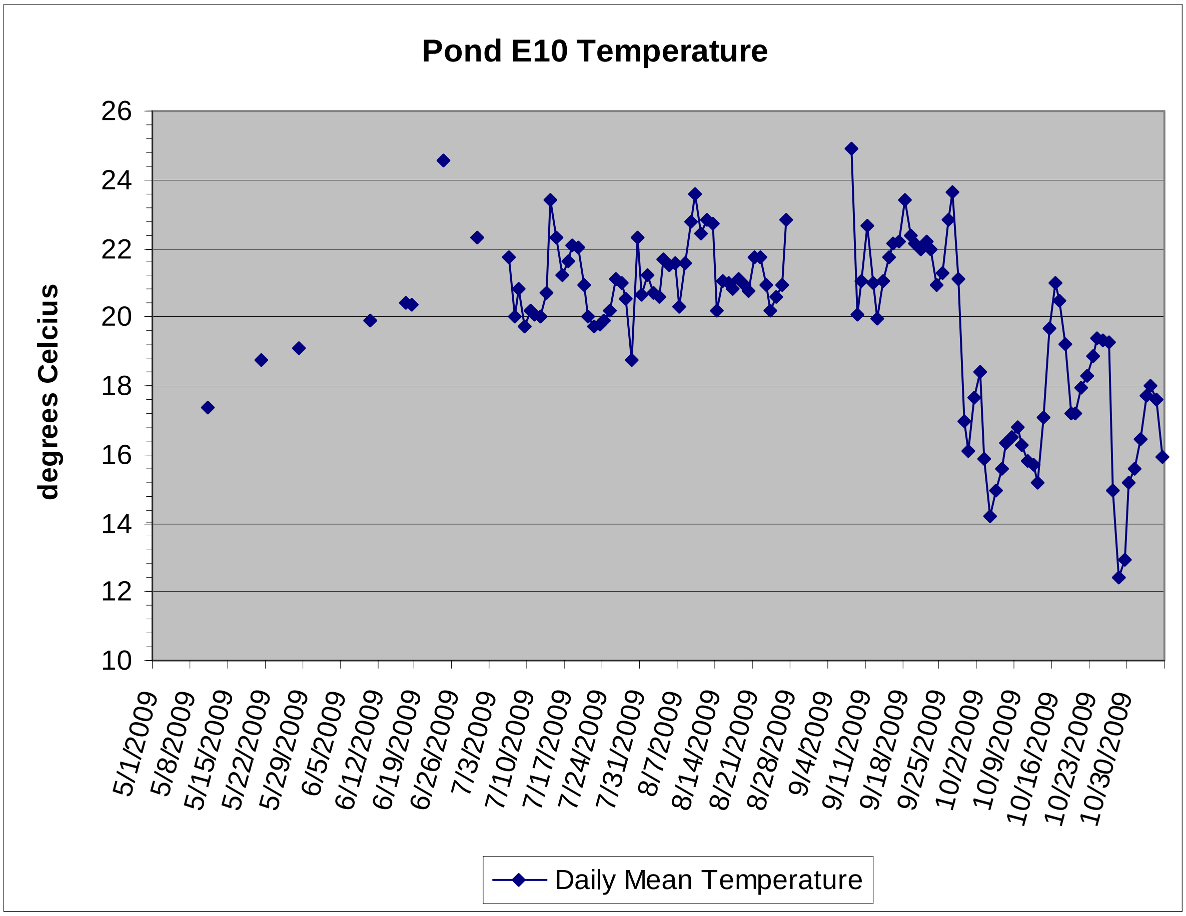

Figure 6: Pond E10- 2009 Daily Mean Temperature (Grab Samples only 5/5-6/30/09) at Intake/Discharge Location

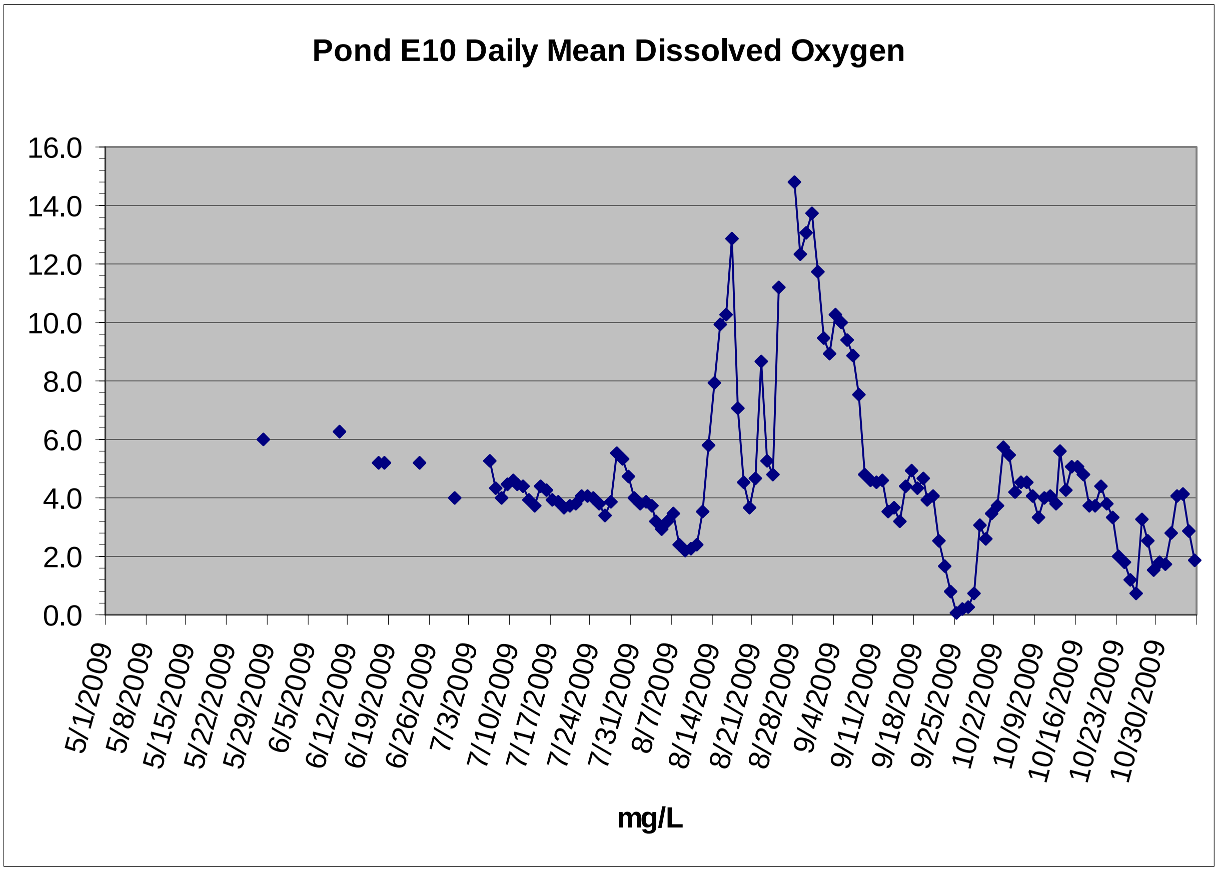

Figure 7: Pond E10- 2009 Daily Mean DO (Grab Samples only 5/5-6/30/09) at Intake/Discharge Location

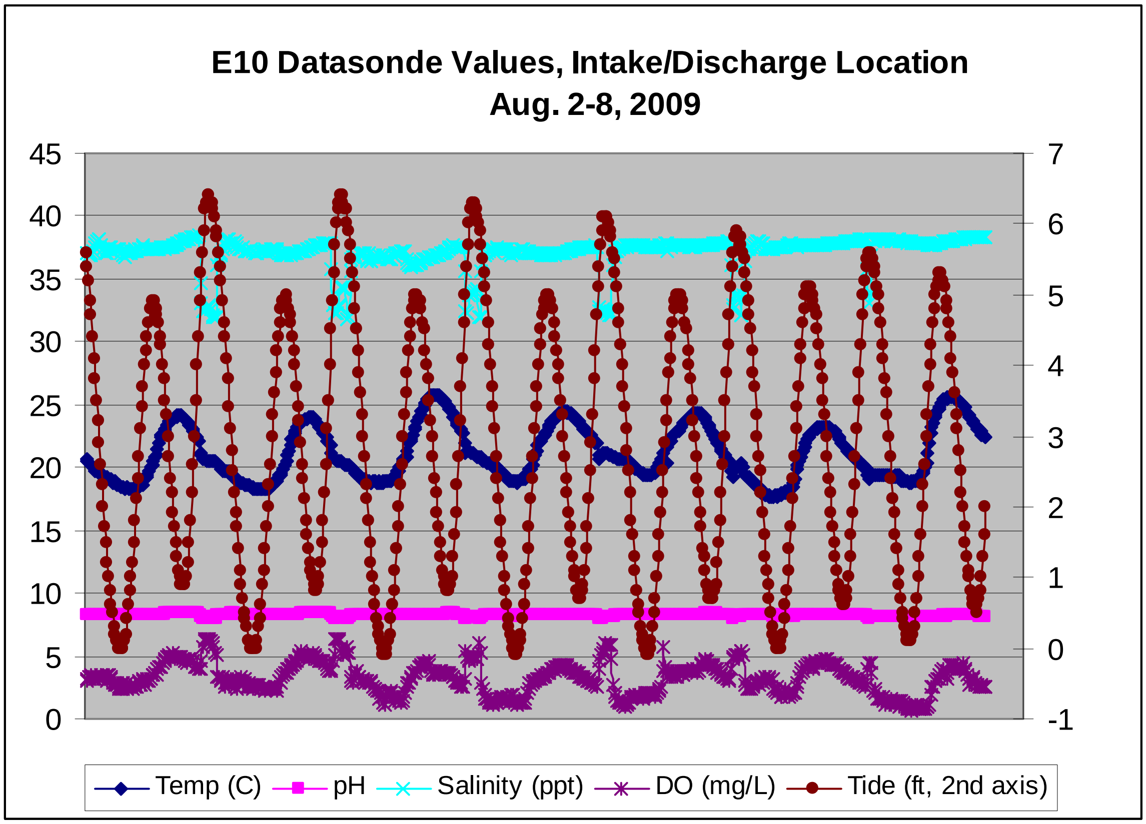

Figure 8: E10 Datasonde Values, Intake/Discharge Location, Aug. 2-8, 2009

E10 Applied Study Discussion

Refer to Figures 3 and 8 and Tables 4, 5 and 6 for this discussion. As expected, during the August 4-5, 2009 applied study sampling, dissolved oxygen was the most variable water quality parameter, and no consistent pattern or trend was apparent. Pond E10 salinity was noticeably affected by tide height, such that neap periods of lower higher-high tides trended toward static to increased salinity, while spring tides with higher-high tides showed trends toward static to decreased salinity (Figure 8). Salinity, pH and temperature during the week transects were performed was overall consistent. One notable trend on August 4th is that of temperature and DO. When pond high temperature increased slightly on that date, DO tended to be depressed for a somewhat longer period than was observed on the days preceding the transects. While DO remained variable, after the minor pond water temperature "spike," DO was observed to be depressed more and for a longer period immediately after the temperature increase. The decrease in DO and increase in temperature may be associated with weather patterns on that date, with decreasing higher-high tide stages, or both.

Temperatures cycled more consistently with sunlight and weather patterns than with tidal cycles. As expected, pond temperature did not change appreciably except with respect to higher tide intake when the Datasonde recorded slightly decreased temperatures as compared to pond water temperature, which reflects more static in-pond conditions**.**

Mean meteorological data showed typical weather parameters for the August study period (Table 4). The meteorological data were relatively consistent on the days prior to, during and immediately after the August study period, with no precipitation and wind primarily from the west, as is typical for this period.

Effectiveness of Dissolved Oxygen BMPs for Pond Management

It is recognized that it will not be feasible for a well-operated lagoon/pond system to continuously meet an instantaneous DO limitation of 5.0 mg/L as specified in the Basin Plan, which is based on the national criteria published by the U.S. Environmental Protection Agency (USEPA). It is also understood that a stringent interpretation of this limit is not necessary to protect water quality, based on review of monitoring data in the Bay, site-specific standards work in recent years in the Everglades and Virginian Province (Cape Cod, MA to Cape Hatteras, NC), and data collected by USGS in Newark Slough in 2005, 2006 and 2007. The Department maintains that DO levels lower than 5.0 mg/l naturally occur in estuaries and lower values therefore do no necessarily implicate pond discharges. In 2005, the Final Order was modified such that RWQCB required a "trigger" for reporting and action if, at the point of discharge, the calendar weekly 10th percentile falls below 3.3 mg/L. RWQCB required that DO corrective measures (BMPs) be implemented, such as minimizing discharges if the 3.3 mg/L trigger values are observed, unless a more effective alternative can be implemented.

To address the excursions from the DO limit, several operational strategies or Best Management Practices (BMPs) were implemented, as described herein and in the individual system operations plans. The Department evaluated BMPs such as closure of the discharges during periods of time when the data indicates that DO would be below the 3.3 mg/L trigger. For example, ceasing discharge from approximately 10 pm to 10 am because there is a strong diurnal pattern to DO levels would avoid most periods of low DO and achieved standards described the Final Order. However, as stated in previous SMR's, a daily discharge timing BMP is not practicable due to staff and budget constraints. The Department did, however, use a weekly discharge timing BMP, which is expected to minimize discharge of low DO waters during trigger value periods. Weekly discharge timing entails setting discharges at greater volumes when DO conditions are low and that period correspond with periods when daytime tides are lowest, resulting in the majority of volume discharged during the day when photosynthesis increases DO.

During particularly weak (neap) tide periods, intake is limited and pond water has the least turnover. Substantially reducing the discharge volume for an extended duration minimizes potential affects on receiving waters but does not improve pond water quality because of lower turnover and higher residence time. In reviewing 2004-7 data, it appears that ceasing discharge for prolong periods of depressed DO levels may even degrade water quality further, because of less circulation and less mixing of in-pond waters. Reducing residence time of water in the ponds appears to improve overall DO levels; therefore, maintaining discharge, even at reduced volumes, provides for increased circulation and mixing. Muted tidal intake/discharge provides for the greatest circulation and mixing and is generally implemented in all ponds.

For most of 2009, the Department set discharge gates to allow increased discharge volumes, even when the ponds are at or below the trigger value, rather than having reduced discharge settings, as done more frequently in previous years. Gates were set at approximately 15-25 percent open on average for extended periods rather than more frequent adjustments (increases and reductions) because of staff limitations. Where possible, the Department continued the BMP developed in 2007, whereby system pond waters were periodically drained into the adjacent seasonal ponds, where applicable, to improve turnover of pond system water as a result of greater intake volumes. This BMP generally moderated salinity successfully, but there was no clear pattern with respect to DO conditions.

Refer to Table 1 for a full summary of discharge events and gate settings in 2009.

Compliance Evaluation Summary

Maintaining dissolved oxygen levels in the ponds within water quality objectives and Final Order requirements has been the most notable management challenge discovered during operation of the ponds as part of the Initial Stewardship Plan. A number of BMPs were developed and evaluated to determine if they are sufficient as corrective actions that can be effectively implemented, beginning in 2005 and continuing through 2009, in an attempt to raise dissolved oxygen levels in the ponds. Some of the BMPs appear to be more effective than others, but it is still uncertain if the BMPs consistently improved DO levels. Improved DO may be the result of a combination of factors, both biotic and abiotic, as well as management actions, that are the driving factors in DO dynamics. Based on the results of monitoring and data evaluation, management operations for 2009 will continue to be modified as appropriate to attempt to determine which methods of operation most improves water quality objective and Final Order compliance.

Previously, RWQCB suggested using some of the BMPs implemented by USFWS which appear to be successful in the Alviso Pond Complex, including installation of baffles, which direct water from portions of ponds expected to have higher DO values and block off lower DO waters with substantial algal mats, to help improve DO values at the discharge. The Department considered the use of baffles again in ELER pond systems in 2009, but installation of baffles was not implemented because they were not expected to improve DO levels at E10 or other discharge ponds. As discussed previously, deep borrow ditches do not generally surround ELER ponds, and the ponds are more consistently shallow than the Alviso Ponds due to operations and maintenance and land-use practices. Improvements that would be more appropriate than baffles may be implemented as part of future actions, such as changes in pond topography or geometry that could address deficiencies in achieving water quality objectives.

Strong diurnal patterns to DO levels are known to occur, however, ceasing discharge on a daily basis is not a practicable means to avoid discharge of low DO waters, nor is such management operation likely to improve water quality; conversely, it may decrease water quality. BMPs such as weekly discharge timing, reduced discharge gate settings and draining system waters to seasonal ponds to increase intake were implemented to address low DO values and appear to be sufficiently protective of receiving waters. For all systems operated in 2009, except B2C, pond water is discharged to the open SF Bay and quickly dispersed and at lower tides the discharge is spread over extensive mudflats. In 2009, discharge gates were generally set to allow increased discharge volumes compared to previous years, to decrease residence time and improve mixing. More continuous operational periods, rather than intermittent operations, appear to help raise water quality values, at least with respect to salinity, and may be affective for other parameters.

The BMP in which large volumes of system pond waters are drained into adjacent seasonal ponds (for systems which have dry ponds to efficiently receive system water) appears to have successfully lowered salinity in systems which were near or above 44 ppt, by improving turnover of pond system water as a result of greater intake volumes.

Data, Collection, Evaluation, and Communication

In 2009, only few gaps in the data sets were caused by malfunctioning meters. Some instances of data gaps were caused by battery failure. While malfunctioning meters resulted in a few days of data gaps, there were no days when low water conditions resulted in full day data gaps, as occurred in previous years. It should be noted that pond operations were monitored as often as possible, given staff limitations, and efforts were made to retrieve data and service devices whenever possible to prevent down-time of the continuous data recorders. In the future the Department will seek to continue to minimize data gaps that result from management operations. Spare Datasondes are available to replace the operating units to address data continuity.

In 2009, the Department continued to make data available to the RWQCB staff on an as needed basis. The Department conducted its own monitoring in 2009. With the same Department staff conducting monitoring and reviewing and interpreting data, the Department has generally been able to effectively consider and implement operational and management decisions. Raw data was evaluated by Department staff for accuracy and erroneous readings, and was provided to the RWQCB.

Final Order requirements regarding communication of compliance to the RWQCB continued to be satisfactory in 2009. The Department reviewed data and contacted RWQCB to discuss DO “trigger” conditions. Communications were typically made via telephone and/or email. Additionally, the Department provided the data to RWQCB by posting files to its ftp site. This continued dialogue is helpful in addressing concerns and conversations and other written communications between the Department and RWQCB staff are useful in determining appropriate pond management operations.

Requests for Revisions to SMP:

Operations and Maintenance activities in 2009 are more appropriately covered under the Final Order for the SBSPRP. The Department will continue to review the SBSPRP Final Order with respect to the 2009 monitoring results and proposed 2010 operations, and will make requests for alterations to the new Final Order as appropriate in future reports.