# 2016 Self-Monitoring Report
# Baumberg Complex - Hayward, California
# Eden Landing Ecological Reserve

## Order Number: R2-2008-0078

**Prepared for:**

**California Regional Water Quality Control Board**
**San Francisco Bay Region**
**1515 Clay Street, Suite 1400**
**Oakland, California 94612**

**Prepared by:**

**John Krause, Environmental Scientist**
**California Department of Fish and Wildlife**
**Bay-Delta Region**
**7329 Silverado Trail**
**Napa, CA 94558**

**April 2017**

## Table of Contents

# Introduction

This annual self-monitoring report summarizes the pond operations, management and monitoring conducted by the California Department of Fish and Wildlife (CDFW) from May through October 2016 at the Eden Landing Ecological Reserve (ELER), also formerly known as the Baumberg Complex salt ponds, in Hayward, California. Monitoring is conducted for pond operations as required by the Regional Water Quality Control Board (RWQCB) Final Order R2-2008-0078 (Final Order). 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. The U.S. Fish and Wildlife Service (USFWS) separately submit reports for the Alviso and Ravenswood Complexes.

ELER pond systems operated by CDFW in 2016 are fully described in the attached Operations Plans and based on the Initial Stewardship Plan (ISP). Current management reflects implementation of the adaptive management strategies from the South Bay Salt Pond Restoration Project (SBSPRP) in Ponds E10, E12, E13 and E14 (reconfigured, managed ponds), multi-season and multi-species modified pond operations in System E6A (Ponds E8, E6B and E6A) and full tidal restoration in Ponds E9, E8A and E8X.

Data was collected by CDFW staff in accordance with the Final Order requirements. Water quality monitoring was performed in 2016 primarily using pond grab samples, and continuous monitoring devices were not used nor required. Receiving water monitoring was not conducted. Observed water levels and salinity from grab samples had values within ranges specified in Water Quality Objectives (WQO's) and adequately protected receiving waters. Pond operations and management activities were conducted to meet objectives described in the Final Order and CDFW's Operations Plans for each system.

Data was collected at the locations described in the Self-Monitoring Program outlined in the Final Order. The initial "B" for the Baumberg Complex ponds has been changed to "E" for Eden Landing, in accordance with the nomenclature used for the larger SBSPRP.

The ponds are generally being operated as "muted tidal" systems with intake and discharge at the same location, augmenting flow-through systems described in the ISP. Pond operations are fully described in the updated 2017 Operations Plans. In general, bay water enters ponds directly from San Francisco Bay (Bay) or sloughs on high tides via Water Control Structures (WCS's), with flow to one or more ponds, then discharging at low tide. The ponds discharge at tide stages lower than pond water elevations, typically averaging 3.5-feet (NGVD). Discharge is presumed to occur for approximately 13 to16 hours per day (based on predicted tides and spring or neap tide cycle variation). Pond intake of Bay/slough water is presumed to occur at elevations of approximately 1.5-feet or more above pond water levels due to required head (pressure) for in-flow. This head requirement is assumed from continuous in-pond data values from previous years.

The Final Order established maximum salinity levels below 44 parts per thousand (ppt) for discharge from the ponds. In 2016, operation of all systems was monitored and discharge was generally below 44ppt, except as noted below. Other water quality

parameters were not regularly sampled. Ponds were not affected by construction and operated as open water or seasonal (dry) habitat and no adverse conditions were observed in ponds or receiving waters. Water quality monitoring activities were conducted as described in subsequent sections of this report.

As in previous years, the Self Monitoring Report (SMR) includes summary information of pond operations and management, including Best Management Practice (BMP) implementation. Pond operations were similar to previous years, except in System E12 ponds where reconfigured ponds were intensively managed, as discussed later. Low dissolved oxygen (DO) levels at the point of discharge have previously been observed to fall below a $10^{th}$ percentile value of 3.3 mg/L (calculated on a calendar weekly basis). Low DO conditions may be expected during extended periods of high air and water temperature and appear to represent natural DO variations in sloughs or lagoon systems. It has been documented that DO levels below the Basin Plan standard of 5.0 mg/L are observed in sloughs not affected by any pond discharge and are within the natural range of variation in functional slough and lagoon environments of the South San Francisco Bay. Correspondingly, low DO water (of Bay origin) has been observed at pond intake locations. Continuous discharge monitoring was not required in 2016 for Dissolved Oxygen, pH, temperature and salinity. A summary of grab sample data and discharge events are included in this report. Full data sets were provided to RWQCB staff. Additional analysis and interpretation of monitoring data is not expected to be completed nor submitted for 2016.

# 2016 Annual Summary

The calendar year 2016 was the fifth consecutive drought year, following one of the driest, warmest years in recorded history for many areas of California, including Hayward and the SF Bay Area. Drought conditions have persisted since 2011, but beginning in late 2016 and into early 2017, rainfall totals significantly increased and drought conditions are expected to be minor in 2017. The effect of prolonged low, episodic rainfall on pond operations was notable, with higher salinity values year-round, particularly during the summer months. The result of low rainfall is apparent in terms of less direct input into ponds, thereby maintaining higher salinity than expected. Similarly, low rainfall results in higher salinity in San Francisco Bay and sloughs, with higher sustained intake salinity during the summer operation period. In-pond salinity averages continued to be elevated and sustained in summer 2016, and periodically spiked, particularly during neap tide periods.

Construction activities were completed in 2015 for habitat restoration and enhancement of Phase One of the South Bay Salt Ponds Restoration Project (SBSPRP) and managed ponds were successfully operated. In 2016, continuous circulation occurred during the summer monitoring season as described in Operations Plans. Pond operations included intake to, and discharge from, Pond E10, E12, E14, E8X, E6A, E6B, E2C and E2. Pond management and water quality monitoring in 2016 was conducted using grab samples.

In 2016, capital improvement activities were relatively minor, and included completion of the final actions to open new public access improvements, such as the year round Bay Trail spur and seasonal loop trails, a boardwalk into the historic Oliver Salt Works and a kayak launch into Mt. Eden Creek. Only minor operation of the 10,000 Gallon Per Minute (GPM) intake pump at Pond E12 occurred. The Pond E13Mixing Basin WCS (five 36-inch culverts with gates and weirs) was fully operational in 2016.

Pond management in 2016 included successful operations in reconfigured Ponds E12 and E13 and modified seasonal operations for Ponds E6A, E6B and E8. Ponds E12 and E13 were fully reconfigured and intensive management was implemented in 2016. Ponds E12 and E13 are operated year round as a series of pond "cells" to provide salinity gradients in shallow, shorebird habitat. Information regarding the management of reconfigured ponds is being provided by an on-going study by USGS that will characterize water quality, depth and habitat use that will be applied to future SBSPRP actions. This was the second full year of reconfigured operations in Ponds E12 and E13.

The 2016 monitoring results indicate that while Ponds E12 and E13 were reconfigured and intensively managed, water quality was not significantly improved overall, as compared to typical pond management and water quality in other systems. However, there was a notable difference in water quality parameters such as Dissolved Oxygen (DO), pH and salinity between the Pond E12 Reservoir (Intake location) and the Pond E13 Mixing Basin (Discharge location). The Pond E12 Reservoir had lower average DO values and lower $10^{th}$ percentile DO values, as well as higher pH and salinity values during the monitoring season. The Pond E13 Mixing Basin had higher average DO and higher $10^{th}$ percentile DO values, as well as lower pH and salinity values in 2016. The lower water quality values in the E12 Reservoir may be explained by higher, more constant water levels and correspondingly less circulation, which was limited to higher tide intake periods. Conversely, in the Pond E13 Mixing Basin, water levels were more varied on a daily and weekly basis, and there was correspondingly more circulation in the Pond E13 Mixing Basin because of regular intake and discharge operations. It appears that use of a mixing basin for discharge may help meet water quality objectives, but still may not meet all Basin Plan objectives. Such features of managed ponds will continue to be evaluated as an element of adaptive management studies for future pond reconfiguration and enhancement activities.

Habitat enhancements were also monitored in Pond E14, which included approximately 50-acres of oyster shells within two plots, as a nesting and fledging habitat improvement. In order to minimize sedimentation within the shell plots, E14 is operated with shallow water in winter and summer operations maintain water mainly within the borrow ditches.

In 2015, CDFW completed construction activities to repair a sinkhole that occurred at the Pond E2-10 WCS. No problems were encountered in 2016. Pond operations were normal.

A missing flap gate was discovered at the Pond E10 WCS in June, 2015, which has not yet been repaired and has affected normal operations, such that discharge was increased

and the pond operated at a lower water level. Pond E10 water levels were continuously lower throughout the year. The missing flap gate is expected to be repaired in 2017.

For the 2016 monitoring season, periodic (weekly) collection of monitoring data was sufficient to inform pond management (summer and winter). Pond management and operations are discussed in greater detail in the Operations Plans and briefly described herein as related to compliance with the RWQCB Final Order.

Water quality monitoring at the ELER ponds conformed to the Final Order. Salinity, water levels and waterbird use were the primary basis for determining pond management activities for the 2016 season. Typical pond operations and monitoring of salinity and water levels indicated that the ponds were operating within parameters that met biological and water quality objectives. No abnormal conditions, such as fish kills, were observed. It is expected that there may have been brief periods of low DO within ponds in 2016. In previous years with continuous monitoring data collected by Datasondes in ponds (2004-09), low DO levels were observed throughout the South Bay Salt Ponds (SBSP), including ELER, notably in the late-summer/early-fall when temperatures, winds and evaporation were highest. High wind and ambient temperature result in greater evaporation and is of greatest concern during neap tide cycles, when circulation is reduced. Review and analysis of data from previous years indicated there appears to be some correlation with abiotic factors, such as spring and neap tide periods, weather conditions, and seasonal variation. It is likely that biotic factors affect DO levels, such as consumption of DO by pond invertebrates or larger animals, including fish, and algal growth, respiration and decomposition. Observations made in 2016 included typical amounts of macroalgae found in the water column and living and necrotic algal mats that may be observed within the ponds.

Pond operations were similar in 2016 to previous years in systems that were operated "normally" (as compared to modified operations associated with major construction activities), or operated for multi-season, multi-species objectives, as described in the subsequent paragraph. In System E2, pond discharge from one-48-inch gate in Pond E2 to the Bay was set at approximately 25% open during the May-October monitoring season. System E2C intake was 100% and discharge to the Bay via Alameda Creek Flood Control Channel was set at approximately 25% open during the May-October monitoring season. Pond discharge was periodically minimized to maintain water levels during neap tide periods and/or during high ambient temperatures. Temporary suspension of discharge operations was only occasionally conducted in 2016, in cases where brief periods of elevated salinity were observed at the discharge.

In 2016, System E6A ponds (E8, E6B, E6A) were managed for multi-season, multi-species objectives. In winter, the System was operated primarily for waterfowl foraging and roosting, with some available habitat for shorebird roosting. In summer, the System is operated more like seasonal ponds, albeit with higher intake and discharge volumes. In the winter, System 6A ponds were managed specifically for diving ducks. In the summer, System 6A ponds were managed for western snowy plover (WSP), black-necked stilt and American avocet breeding, with draw down water levels and subsequent

exposure and drying of much of the pond bottoms. Spring and fall season conditions supported shorebird foraging and roosting during migration periods. During the 2016 monitoring season, discharge operations were conducted. Prior to 2012, the ponds in System E6A were primarily seasonal (dry) ponds, with minimal intake to maintain foraging habitat. Beginning in 2012, modified operations in System 6A ponds increased intake and discharge volumes via Old Alameda Creek (Pond E6A) and North Creek (Pond E6B and E8). Pond management was primarily focused on providing WSP nesting and foraging habitat as well as shorebird foraging and roosting areas, while maintaining low salinities within the primary circulation areas within borrow ditches. During 2016, this system provided good habitat conditions for waterbirds, including WSP.

The ELER site location is shown on Figure 1; sampling and water control structure (WCS) locations are shown on Figure 2.

**For all pond systems:**

Grab samples were collected at pond-to-pond, intake and/or discharge locations to monitor pond conditions and meet habitat management and water quality objectives. Salinity, water level and circulation patterns such as flow direction at a culvert location, as well as bird guild/species and abundance were monitored throughout the pond systems. Seasonal (dry) ponds were managed to facilitate nesting substrate and foraging habitat, in particular for WSP. Since 2009, CDFW has managed pond operations such that discharge settings were less frequently adjusted resulting in sustained discharge operations. Frequent adjustment of intake and discharge gates does not appear warranted as part of regular operations. We observed conditions which indicated improved water quality, particularly for salinity. Current or anticipated weather and predicted tidal conditions are also considered, since those factors affect intrinsic pond dynamics. Reduced pond discharge volumes are infrequently, temporarily used during neap tide cycles to meet water quality objectives (WQO's) for salinity management; however, this increases water residence time. More consistent, moderate volume discharges were observed to improve (lower) recorded salinity and may improve overall water quality based on observed in-pond conditions. During summer operations, water levels in the ponds are maintained throughout the season primarily by adjusting discharge gates, rather than intake gates, with consideration of neap tide cycles, weather conditions, habitat objectives and targeted species use.

In 2016, pond management for continuous circulation was typical for summer operations. For all ponds, adjustment to intake, discharge and pond-to-pond culvert gates were similar in 2016 to recent years. A summary of discharge events is shown on Table 1.

**System E2C:**

Pond E2C was operated in 2016 similar to previous years. A continuous monitoring device was not utilized or required. Management of this system was performed as described in the Operations Plan and was informed by grab samples collected on an approximately weekly basis to monitor salinity, and water levels from staff gauges. Waterbird use was recorded to inform operations and meet habitat objectives. This

system presumably had periods of low DO levels, as observed during continuous discharge monitoring in 2005-09, but continued to provide good habitat conditions for numerous waterbirds. Discharge was at or below 25% of capacity; therefore, no receiving water monitoring was required, as reflected in the Final Order. For 2016, System E2C operations continued use of BMP's, such as weekly discharge timing and flow and transfer of concentrated water (brines) into adjacent ponds (E5C, E4C E1C and Cargill Pond 3C, via E2C).

**System E2:**

Pond E2 operations in 2016 were similar to previous years. In the summer, intake to E1 is circulated to discharge from E2. There is also limited flow from E1 to E7 to E6, and to E5 from E4. Refer to Table 1: Summary of Intake/Discharge Activities for pond operations information during this period. A continuous water quality monitoring device was not used, and management of System E2 was informed by grab samples collected on approximately a weekly basis as noted previously for System E2C and as described in the Operations Plan. It is assumed that during 2016 this system also had periods of low DO levels, as observed in 2005-09, however habitat conditions continued to be good and supported substantial waterbird use. No abnormal conditions were observed and no receiving water monitoring was required. Discharge directly to the Bay from Pond E2 was maintained at 25% of capacity of one 48-inch gate for much of the year. The system was operated with primary flow entering the system through Pond E1 from Old Alameda Creek. Muted tidal intake from the Bay into E2 also provided supplemental intake to this system. Managed "batch" ponds, which entails maintaining water levels by providing "make up" water (for water lost to evaporation) from adjacent ponds and allowed salinity to increase to approximately 120-parts per thousand (ppt) in these "batch" ponds (E6, E5). Batch ponds are recirculated in winter to maintain low salinity in the spring and subsequent summer monitoring season. E6C was managed as a seasonal pond and allowed to mostly dry. System E2 discharge operations during the winter successfully recirculated higher salinity conditions in "batch" and seasonal ponds (E5, E6 and E6C).

**System E10**:

Typical operations were conducted in 2016 in System E10 ponds. Pond E10 was operated as a circulation pond during the monitoring season. Pond E10 is operated as a continuous circulation, low salinity pond, and pond E11 is operated as a seasonal pond. Pond E10 has intake from and discharge into the Bay at the mouth of Mount Eden Creek (MEC). Pond E10 provides year round open water as suitable habitat for waterfowl in winter and in summer for waterbirds such as terns, cormorants, and egrets, as well as wading birds, including avocets and stilts. A flap gate missing at the E10 WCS since 2015 was not repaired, which affected normal operations, such that discharge was increased and the pond operated at a lower water level throughout the year. The missing flap gate is expected to be repaired in 2017. Pond E11 was operated as a seasonal pond, as described in the Operations Plan. E11 is shallowly flooded to provide foraging and roosting habitat for migratory waterbirds during the spring and fall. E11 has intake and discharge from MEC and periodic flow from Pond E10. Continuous monitoring devices (Datasondes) were not utilized nor did they appear necessary based on monitoring in Pond E10 during May-October and receiving water sampling was not required.

**System E6A:**

In 2016, System E6A ponds (E8, E6B, E6A) were managed as deep water with continuous circulation in winter for diving waterfowl roosting and foraging. During spring migration the ponds were drawn down while maintaining continuous circulation and shorebird roosting and foraging habitat. In summer the ponds were further drawn down for shorebird nesting as partially dry/exposed bottom and maintained continuous circulation. In summer, System E6A management targets western snowy plover (WSP) nesting. In the winter, System 6A ponds were managed with deeper water levels to target foraging and roosting habitat for diving ducks. Prior to 2011, System E6A was operated as a seasonal pond, with no intake and discharge in summer, and allowed to dry by evaporation. Dry pond bottoms were used by WSP for nesting and salinities were typically high in shallow water and borrow ditches. The dry summer conditions resulted in the loss of most, if not all, invertebrates that tolerate only low salinity conditions, although a suite of invertebrates with a tolerance for high salinity conditions was able to persist. Therefore, seasonal ponds have a complete turnover of invertebrate communities between seasons. While low salinity conditions were restored in winter with rainfall and resumed intake and discharge operations, invertebrate communities were distinctly different than in year-round, open water, low salinity ponds where continuous circulation operations occur.

To maintain more suitable habitat with low salinity to support diving waterfowl in winter, while maintaining sufficient suitable nesting habitat for WSP in summer, pond management objectives were modified. Under this modified pond operation regime, continuous circulation intake/discharge operations were conducted, whereby low salinity conditions were maintained throughout the year in most of the borrow ditch and ponded areas throughout the system.

In summer 2016, intake/discharge operations and monitoring were conducted in System E6A ponds to promote WSP nesting objectives. Monitoring showed consistent use by WSP and successful nesting by WSP as well as continued breeding, foraging and roosting by other shorebirds. System E6A ponds were drawn down and maintained as partly flooded, low salinity circulation ponds with intake and discharge operations via Old Alameda Creek (Pond E6A) and North Creek (Ponds E6B and E8). Modified pond operations successfully provided target conditions for multi-season, multi-species management, including WSP nesting, and maintained low salinity conditions in the ponds subsequently benefiting migratory shorebirds and overwintering waterfowl in 2016.

**System E9:**

Ponds E9, E8A and E8X in System E9 were restored to full tidal action in 2011 as part of Phase One of the SBSPRP. Managed ponds previously linked are in System E12, below.

**System E12**:

Seasonal ponds previously operated via pond E9, including E14, E13 and E12, were operated with intake from and discharge to Mt. Eden Creek via pond E12 and former pond E9 (tidally restored). Pond E8X was operated with intake from and discharge to North Creek via the portion of pond E8X restored to full tidal action in 2011.

Construction was completed in 2015 on water control structures and public access features around Ponds E12 and E13 as part of the SBSPRP Phase 1. The reconfigured ponds E12 and E13 were fully operational for the second year in 2016, and included intensive pond management activity. In the winter of 2015-16, System E12 ponds were managed to promote foraging and roosting habitat for shorebirds and dabbling ducks. Diving ducks also use the deeper portions of these ponds, such as borrow ditches, but to a lesser extent than dabbling ducks and shorebirds which utilize the majority of the pond, depending on water levels and conditions. Reconfigured Ponds E12 and E13 provide conditions for a "salinity experiment" providing a series of shallow, open water cells of progressively increasing salinity with similar water levels. Significant use of the cells by small and medium shorebirds was observed as part of on-going, regular surveys and use occurred as expected. WSP continued to use System E12 ponds, including dry bottom areas of E14, and dry berms, levees and islands in the reconfigured Ponds E12 and E13. E12, E13 and E14 operations maintained low (40 ppt) salinity discharge, as well as moderate to high salinity conditions (80 to 120ppt) within cells in the ponds.

In 2016, intake/discharge operations and monitoring were conducted in System E12 ponds. Pond E8X was operated as a forebay for intake and discharge operations in ponds E12 and E14. E14 and E8X were generally operated as shallow, muted tidal basins and periodically used as mixing basins during brief periods to help Ponds E12 and E13 meet water quality objectives for continuous circulation. Pond E14 was operated similarly to other seasonal ponds in ELER, with limited intake from tidal areas as needed under continuous circulation to support sufficient dry areas for WSP nesting. Ponds E12 and E13 discharged primarily to Mt. Eden Creek via the "mixing basin" area within E13. Periodically, E14 received low-volume flow from E13 to maintain more constant water surface elevations in E14. This system provided good habitat conditions for shorebirds, particularly WSP, as well as waterfowl throughout 2016.

## *Table 1: Summary of Intake/Discharge Activities*

Complete data and field notes for pond operations/conditions and management activities were provided electronically to RWQCB and are otherwise available upon request.

NOTE: Table 1 salinity values obtained from a hand-held refractometer (Parts Per Thousand, or ppt). In some figures, nomenclature for ponds "B" & "E" are interchangeable (Baumberg aka Eden Landing). Staff gauge readings are specific to each pond (or pond system), and vary between NGVD 29, NAVD 88 or relative to pond bottom.

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| E2C | E2c-14 | 4/26/16 | 22 | 2.85 | 1x48" Discharge at 10%, summer ops. |
| **E2C** | **E2c-14** | **5/4/16** | **25** | **3.4** | **Increased 1x48" Disch. to 25%,** maintain depth, spring tide |
| **E2C** | **E2c-14** | **5/10/16** | **33** | **3.3** | **Reduced 1x48" Disch. to 10%**, neap tide |
| **E2C** | **E2c-14** | **6/1/16** | **31** | **3.0** | **Increased 1x48" Disch. to 20%**, spring tide |
| **E2C** | **E2C-14** | **6/6/16** | **31** | **3.4** | **Increased 1x48" Disch. to 25%**, max circ. for salinity mgmt. into neap tide |
| **E2C** | **E2c-14** | **6/10/16** | **36** | **3.0** | **Reduced 1x48" Disch.to 10%**, neap tides |
| **E2C** | **E2c-14** | **6/17/16** | **35** | **3.2** | **Increased 1x48" Disch. to 25%**, spring tide |
| **E2C** | **E2c-14** | **6/20/16** | **40** | **below** | **Reduced 1x48" Disch. to 10%**, neap tide. Disch.basin/WCS WSE lower than pond bottom, shallow ponding inboard. |
| **E2C** | **E2c-14** | **6/30/16** | **33** | **3.3** | **Increased 1x48" Disch. to 25%**, spring tide |
| **E2C** | **E2c-14** | **7/8/16** | **41** | **below** | **Reduced 1x48" Disch. to 10%**, neap tide. Disch.basin/WCS WSE lower than pond bottom, shallow ponding inboard. |
| **E2C** | **E2c-14** | **7/12/16** | **47** | **below** | **Reduced 1x48" Disch. to 5%,** salinity mgmt, neap tides |
| **E2C** | **E2c-14** | **7/14/16** | **32** | **3.25** | **Increased 1x48" Disch. to 25%**. Cont. salinity mgmt, spring tides |
| **E2C** | **E2c-14** | **7/19/16** | **44** | **below** | **Reduced 1x48" Disch. to 20%**, salinity mgmt. spring tide |
| **E2C** | **E2c-14** | **7/26/16** | **44** | **below** | **Reduced 1x48" Disch. to 10%**. Cont. salinity mgmt, spring tide |
| E2C | E2c-14 | 7/28/16 | 37 | 3.0 | 1x48" Disch. 10% Cont. Salinity mgmt, spring tide |
| **E2C** | **E2c-14** | **8/8/16** | **40** | **3.4** | **Increased 1x48" Disch. to 15%**. Cont. salinity mgmt. neap tide |
| **E2C** | **E2c-14** | **8/16/16** | **34** | **3.2** | **Increased 1x48" Disch. to 25%**, salinity mgmt. spring tide |

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| **E2C** | **E2c-14** | **8/24/16** | **50** | **below** | **Reduced 1x48" Disch. to 10%**, cont salinity mgmt. spring tide. |
| E2C | E2c-14 | 8/26/16 | 37 | 2.8 | 1x48" Disch. 10% cont. Salinity mgmt. spring tide. |
| **E2C** | **E2c-14** | **8/31/16** | **33** | **3.55** | **Increased 1x48" Disch. to 20%**, spring tide. |
| **E2C** | **E2c-14** | **9/7/16** | **44** | **below** | **Reduced 1x48" Disch. to 5%**. Neap tide. |
| **E2C** | **E2c-14** | **9/15/16** | **35** | **3.3** | **Increased 1x48" Disch. to 10%**. Salinity mgmt. spring tide |
| **E2C** | **E2c-14** | **9/19/16** | **32** | **3.55** | **Increased 1x48" Disch. to 15%**. Cont. salinity mgmt. spring -> neap tide |
| **E2C** | **E2c-14** | **9/30/16** | **41** | **3.3** | **Reduced 1x48" Disch. to 10%**, cont salinity mgmt. spring -> neap tide. |
| | | | | | |
| E2 | E2-10 | 4/25/16 | 31 | 3.25 | 1x48" Discharge 25%. 2x48" Intake 100% cont. |
| E2 | E2-10 | 5/4/16 | 26 | 3.3 | 1x48" Disch. 25%, 2x48" Intake 100% continued, summer ops |
| E2 | E2-10 | 6/17/16 | 40 | 3.45 | 1x48" Disch. 25%, 2x48" Intake 100% continued, summer ops. |
| E2 | E2-10 | 6/30/16 | 41 | 3.25 | 1x48" Disch. 25%, 2x48" Intake 100% continued, summer ops |
| E2 | E2-10 | 7/19/16 | 41 | 3.35 | 1x48" Disch. 25%, 2x48" Intake 100% continued, summer ops |
| **E2** | **E2-10** | **7/28/16** | **43** | **3.35** | **Increased to 2x48" Disch. 25%**, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 8/8/16 | 42 | 3.35 | 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 8/18/16 | 35 | 3.3 | Intaking. 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 8/24/16 | 40 | 3.3 | Discharging. 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 9/2/16 | 44 | 3.3 | 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 9/15/16 | 35 | 3.2 | 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| E2 | E2-10 | 9/30/16 | 42 | 3.25 | 2x48" Disch. 25%, 2x48" Intake 100% continued, summer ops, salinity mgmt. |
| | | | | | |
| E10 | E11-1 | 4/25/16 | 24 | 2.9 | Middle 1x48" intake flap gate missing. Discharging. Low tide |
| E10 | E11-1 | 6/10/16 | 30 | 3.1 | Middle 1x48" intake flap gate missing. Discharging. Summer ops. |

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| E10 | E11-1 | 7/8/16 | 31 | 3.3 | Middle 1x48" intake flap gate missing. Discharging. Summer ops. |
| E10 | E11-1 | 8/22/16 | 31 | 3.3 | Middle 1x48" intake flap gate missing. Discharging. Summer ops. |
| E10 | E11-1 | 9/30/16 | 35 | 3.25 | Middle 1x48" intake flap gate missing. Discharging. Summer ops. |
| | | | | | |
| E8X | E8X- Tidal Discharge | 4/12/16 | 25 | *4.85 | 1x48" Disch. 25%, 1x48" Intake 75% cont. Discharging. Maint. WSE for E8X->E14->E9 Ops |
| **E8X** | **E8X- Tidal Discharge** | **10/5/16** | **35** | ***4.3** | **Closed 1x48" Disch., Increased 1x48" Intake to 100%**, Max WSE for E8X->E14 or E12-Res Ops |
| | | | | | |
| E14 | E14-E9 new WCS | 3/14/16 | 15 | *5.4 | Discharging. 1x48" Discharge 50%, 1x48" Intake Closed cont., Salinity Mgmt/SNPL nesting/low water level ops. cont. |
| E14 | E14-E9 new WCS | 8/29/16 | 40 | *5.5 | Discharging. 1x48" Discharge 50%, 1x48" Intake Closed cont., Salinity Mgmt/SNPL nesting/low water level ops. cont. |
| | | | | | |
| **E12** | **E12-1** | **4/29/16** | **30** | ***6.7** | E12-RES-6.7-(30ppt)-**Increased 1x18" gate to 5%**->E12-Lo-6.35-(35ppt)-(E12-DC-6.1')->E12-Med-6.0-(55ppt)->E12Hi-5.85-(65ppt)->E12-DC-5.75->E13MB- 5.6 (32ppt). (MB WSE over weir). (Reconfig. Ops w/MB Intake/Disch). E12-1: 2x48" Intakes 100%, Disch. 0%. |
| **E12** | **E12-E8X** | **4/29/16** | **32** | ***6.8** | E13-RES-6.7-(32ppt)-**Increased 1x18" gate to 5%**->E13-Lo-6.35-(40ppt)->-(E12-DC-6.1)-E13-Med-6.05-(55ppt)->E13Hi-5.75-(74ppt)->E13MB 5.6-(32ppt) E12-DC-(*5.6'). (MB WSE over weirs). Weirs set at 5.5' NAVD (Reconfig. Ops w/MB Intake/Disch). E12-E8X: 1x48" gates closed. |
| E13 | E12-E13 Mixing Basin | 4/29/16 | 32 | (*5.65) | Discharging. 2x36" Discharge 100%, 2x36" Intake Open 100% (Weirs set at 5.5' NAVD). (Reconfig. Ops w/MB Intake/Disch). |
| **E13** | **E12-E13 Mixing Basin** | **5/2/16** | **32** | **(*5.5)** | WSE at weir, Discharge trickle. **Reduced 2x36" Intake to 10%** 2x36" Discharge 100%, (Maint. WSE in Spring Tides (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD). |

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| **E13** | **E12-E13 Mixing Basin** | **5/26/16** | **44** | **(*5.6)** | WSE at weir, Discharge (trickle). 2x36" Intakes 10% 2x36" Discharge 100%, **Opened 3x36" Intake 1%**; Salinity Management, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD). |
| **E13** | **E12-E13 Mixing Basin** | **6/24/16** | **47** | **(*5.7)** | WSE over weir, Discharging. 2x36" Discharge 100%, **Opened (+2) 36" Intakes = 5x36" Intakes Open 10%.** Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD). |
| E13 | E12-E13 Mixing Basin | 7/1/16 | 44 | (*5.7) | WSE over weir, Discharging. 2x36" Discharge 100%, 5x36" Intakes Open 10%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| **E13** | **E12-E13 Mixing Basin** | **7/6/16** | **38** | **(*5.8)** | WSE over weir, Discharging. 2x36" Discharge 100%, **Reduced to 2x36" Intakes Open 10%**. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD). |
| E13 | E12-E13 Mixing Basin | 7/12/16 | 50 | (*5.6) | WSE over weir, Discharge trickle. 2x36" Discharge 100%, 2x36" Intakes Open 10%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| **E13** | **E12-E13 Mixing Basin** | **7/14/16** | **50** | **(*5.6)** | WSE over weir, Discharge trickle. **Opened 1x36" gate to 10%**, =3x36" Intakes Open 10%, 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| **E13** | **E12-E13 Mixing Basin** | **7/20/16** | **44** | **(*5.75)** | WSE over weir, Discharging. **Opened 2x36" gates to 100%**, 1x36" Intake Open 10% cont. 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| **E13** | **E12-E13 Mixing Basin** | **7/21/16** | **44** | **(*5.85)** | WSE over weir, Discharging. **Opened 3x36" gates to 100%**. 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD). |
| E13 | E12-E13 Mixing Basin | 7/26/16 | 43 | (*5.8) | WSE over weir, Discharging. 3x36" gates 100%. 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| E13 | E12-E13 Mixing Basin | 7/28/16 | 37 | (*5.85) | WSE over weir, Discharging. 3x36" gates 100%. 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| E13 | E12-E13 Mixing Basin | 8/8/16 | 50 | (*5.85) | WSE over weir, Discharging. 3x36" gates 100%. 2x36" Discharge 100%. Salinity Mgmt, Maint. WSE, (SNPL/AMAV nest protection). (Weirs set at 5.5' NAVD) |
| E13 | E12-E13 Mixing Basin | 8/16/16 | 37 | (*5.95) | WSE over weir, Discharging. 3x36" gates 100% cont. 2x36" Discharge 100%. Salinity Mgmt. cont. (Weirs set at 5.5' NAVD) |
| **E13** | **E12-E13 Mixing Basin** | **8/22/16** | **36** | **(*6.0)** | (Discharging) **Weirs Reset to 5.0' NAVD**. 2x36" Discharge 100%, 3x36" Intakes Open 100%. Salinity Mgmt. Cont. |
| E13 | E12-E13 Mixing Basin | 9/7/16 | 38 | (*5.3) | (Discharging) Weirs at 5.0' NAVD. 2x36" Discharge 100%, 3x36" Intakes Open 100%. Salinity Mgmt. Cont. |
| E13 | E12-E13 Mixing Basin | 9/26/16 | 36 | (*5.75) | (Discharging) Weirs at 5.0' NAVD. 2x36" Discharge 100%, 3x36" Intakes Open 100% cont. |
| | | | | | |
| 6B | E6A-2 | 3/17/16 | 20 | 2.5 | Discharging. 1x48" Disch. 100%, 1x48" Intake 25%**.** Transition to Summer Ops., SNPL nesting. |
| **6B** | **E6A-2** | **5/10/16** | **24** | **1.9** | **Reduced 1x48" Intake to 10%**, 1x48" Disch. 100% cont. Summer Ops., SNPL nesting. |
| **6B** | **E6A-2** | **7/5/16** | **(30)** | **1.9** | **Closed 1x48" Intake**, 1x48" Disch. 100%; Maint. WSE, SNPL nesting |
| **6B** | **E6A-2** | **7/12/16** | **42** | **1.05** | **Opened 1x48" Intake to 10%**, Salinity Management, maint. SNPL nesting, circulation ops |
| **6B** | **E6A-2** | **7/15/16** | **33** | **1.4** | **Reduced 1x48" Intake to 5%**. 1x48" Disch. 100%. Salinity Mgmt. cont. Maint. WSE, SNPL nesting, circulation ops |
| **6B** | **E6A-2** | **8/8/16** | **40** | **1.2** | **Increased 1x48" Intake to 15%**, Disch. 100% cont. Salinity Mgmt. Cont. SNPL ops |
| **6B** | **E6A-2** | **9/28/16** | **35** | **2.1** | **Increased 1x48" Intake to 25%, Reduced 1x48" Disch. to 50%**. Begin Transition to Fall Ops. |
| | | | | | |
| **6A** | **E6A-10** | **4/25/16** | **15** | **(1.95)** | (Staff at E6A-3). **Reduced 1x48" Intake to 50%**, 1x48" Disch. 50%. |

| Pond | Location | Date | Salinity (ppt) | Staff | Activity and notes |
|---|---|---|---|---|---|
| | | | | | Transition to Summer ops. |
| 6A | E6A-10 | 7/28/16 | 33 | (1.9) | (Staff at E6A-3). 1x48" Intake 50%, 1x48" Disch. 50%. Summer ops. cont. |
| 6A | E6A-10 | 8/10/16 | 31 | (2.0) | (Staff at E6A-3). 1x48" Intake 50%, 1x48" Disch. 50%. Summer ops. cont. |
| | | | | | |
| **8** | **E6A-1** | **3/17/16** | **15** | ***5.35** | NAVD Staff at B6A-1a. Discharging. **1x48" Disch. increased to 100%**, **1x48" Intake to 25%**. Transition to Summer Ops, SNPL nesting. |
| 8 | E6A-1 | 7/6/16 | 33 | (2.45) | (old Wood Staff gauge, NAVD staff broken) 1x48" Disch. 75%, 1x48" Intake 25%, Cont. Circ. SNPL ops. |
| **8** | **E6A-1** | **8/8/16** | **40** | **(1.95)** | (old Wood Staff, NAVD staff broken) **Reduced 1x48" Discharge to 25%**, 1x48" Intake 25% cont. Continuous Circ/SNPL ops. |
| **8** | **E6A-1** | **8/10/16** | **40** | **(2.05)** | (old Wood Staff, NAVD staff broken) **Increased 1x48" Intake to 50%**, 1x48" Discharge 25% cont. Continuous Circ. SNPL ops. |
| **8** | **E6A-1** | **8/11/16** | **40** | **(2.05)** | (old Wood Staff, NAVD staff broken) **Reduced 1x48" Intake to 25%**, 1x48" Discharge 25% cont. Continuous Circ. SNPL ops. |
| **8** | **E6A-1** | **8/13/16** | **(37)** | **(2.0)** | (old Wood Staff, NAVD staff broken). **Increased 1x48" Intake to 50%,** 1x48" Disch. 25%. Cont. Circ. Ops |
| 8 | E6A-1 | 9/28/16 | 35 | *5.5 | New Staff gauge (NAVD). Reduced 1x48" Disch. to 5%, 1x48" Intake 50% Cont. Transition to Fall 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 | 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 $\geq$ 5.0 mg/L of dissolved oxygen (DO). When receiving waters do not meet the Basin Plan objective, pond discharges must be $\geq$ DO receiving

water level. Dissolved Oxygen (DO) Trigger: At each pond discharge location when using a continuous data recorder (Datasonde), if the DO concentration 10th Percentile value is < 3.3 mg/L, 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 as needed 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

## Pond Discharge Monitoring/Sampling:

Continuous data were not required in Pond Systems E2, E2C, E6A/B/8, E8X and E14, as previously modified by RWQCB; in 2016, continuous data were not collected in Ponds E12 and E13, in compliance with the Final Order. Pond management targeted waterbird habitat goals and objectives, and operational changes were generally determined based on salinity grab samples, water level monitoring and waterbird use observations on approximately a weekly, monthly and seasonal basis. Pond management conformed to previously submitted operations plans.

## Discharge Time-Period and Volume Estimates:

Estimates of discharge volume may provide context for monitoring of management activities but are not easily obtained. RWQCB previously modified ASMR requirements such that volume estimates are not required. We use discharge time period information as a proxy for discharge volume, as interpreted from monitoring data and predicted tides. Table 1: Summary of Discharge Activities, provides context for management operations. Discharge event information may be used to understand management actions and effectiveness of BMP's implemented and operations. This report complements more detailed information contained in the Operations Plans.

Time-period each day that a pond discharges is not specifically provided in this report. There are no tide stage instruments installed within Eden Landing to record water level (tide stages) to calculate discharge volume and time-periods. Daily discharge should consider assumptions, such as predicted tidal elevations, and atmospheric conditions. Discharge periods in the ISP were assumed to be approximately 8 hours per day. We currently assume that discharge occurs when tide stage is below pond water elevations, estimated to occur for approximately 13-16 hours daily. This may over-estimate actual discharge time periods (and volumes) because it disregards affects of head (pressure) that may alter discharge flows from culverts with tide gates. Lower pond water elevation would be expected to discharge for a reduced period of a daily lower tides (fewer hours per day). Based on observed data, intake requires tide stages that are approximately 1 ½ feet higher than pond water elevations.

## Receiving Water Sampling:

Receiving water was not monitored in 2016 as previously approved by RWQCB. Ponds E2 and E10 discharge to the Bay, while limited discharge occurs into sloughs via Ponds E2C, E6A, E6B, E8, E8X, E14 and the mixing basin for reconfigured Ponds E12/E13.

Sampling requirements under the Final Order were modified by RWQCB in 2008, such that receiving water sampling needed only be conducted for Pond System E2C when water quality objectives were not met. Receiving water sampling was required only when adverse conditions are observed, concurrent with Pond E2C discharge volumes greater than 25% of capacity of the 2x48" water control structure. Discharges were maintained at greater than 25% capacity in System E6A and in Pond E8X in order to maintain nesting habitat for WSP in ponds E6B, E6B, E8 and E14, as well as in reconfigured ponds E12 & E13, and did not require receiving water monitoring, as previously approved by RWQCB and described in Table 3 below.

**Table 3 –Water Quality 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-ACFCC | C | C | C | C | Receiving Water |
| E6A-10 | A | A | A | A | Discharge |
| E6A-2 | A | A | A | A | Discharge |
| E6A-1 | A | A | A | A | Discharge |
| E8X-Tidal | A | A | A | A | Discharge |
| E12-E13 | A/B | A/B | A/B | A/B | Discharge |
| E14-E9 | A* | A* | A* | A* | 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. 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 determine pond operations and management.

B = From July 7 to October 10, the Discharger may monitor discharge ponds at the point of discharge using a continuous monitoring device if adverse conditions are expected or observed within ponds 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. No pond water quality monitoring was conducted during period when pond was dry (seasonal/construction ops).

## Calibration and Maintenance:

The refractometer instrument used for salinity sampling as part of the Self-Monitoring Program was calibrated by using pure water to reset the instrument to zero.

## Pond Management Sampling:

CDFW regularly conducted pond management sampling in 2016 in all ponds in each system. This data was used to adjust pond management and discharge operations. Data include pond water elevation (staff gages), salinity (hand-held refractometer), wildlife use (observations), meteorological/tidal conditions and physical pond conditions.

## 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:

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

## Sediment Monitoring:

CDFW did not conduct sediment sampling because previous analysis showed metals concentrations were within WQO's. In 2006, RWQCB supported redirection of SBSPRP monitoring efforts to address specific issues rather than generalized pond monitoring; accordingly, mercury studies were focused on areas of concern, such as the USFWS Alviso Pond Complex, in Pond A8 and Alviso Slough, reported by USFWS separately.

## Invertebrate Monitoring:

Previous collections for background and ambient conditions (2005-06) proved to be of limited use for analysis and had little applicability to current goals and objectives for pond operations and is no longer required under the Final Order. Invertebrate monitoring was completed in 2015, and continue to be processed in 2016 as part of a separate study underway by USGS for Systems E12 and E6A. Invertebrate information will be provided in future Self-Monitoring Reports once final reports are received from USGS. Ponds in System 6A were operated as modified seasonal ponds with continuous circulation as part of efforts to inform multi-species, multi-season pond operations. The System E6A operations provide modified seasonal pond habitat to promote WSP nesting in summer and diving duck habitat in winter. The reconfigured System E12 operations provide modified open water pond habitat with an increasing salinity gradient for shorebirds year-round, with WSP nesting on berms and levees in summer and shorebird roosting and foraging in spring, fall and winter. Invertebrate and other physical data will be presented in subsequent years' reports, once data collection, analysis and interpretation is completed.

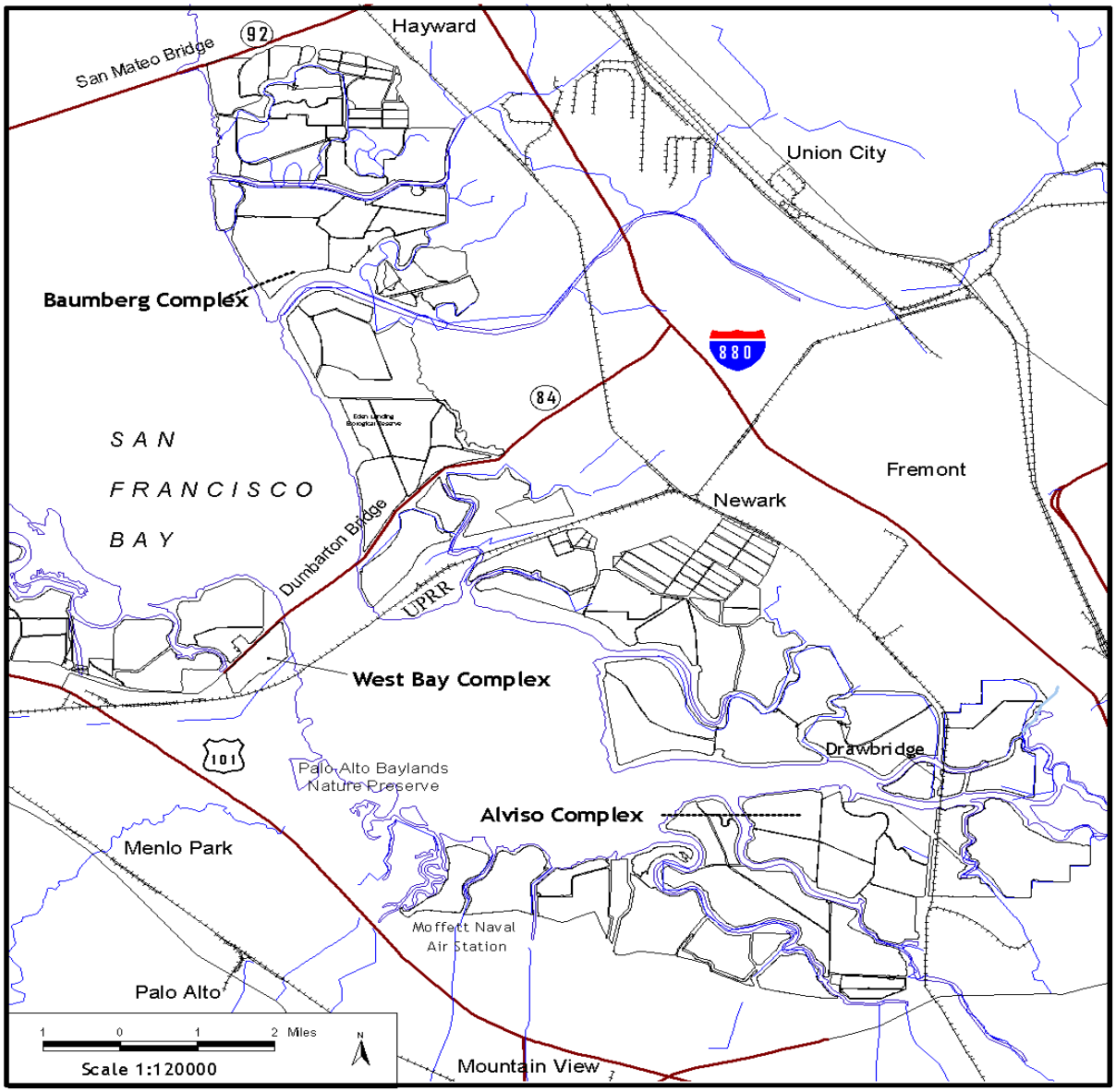
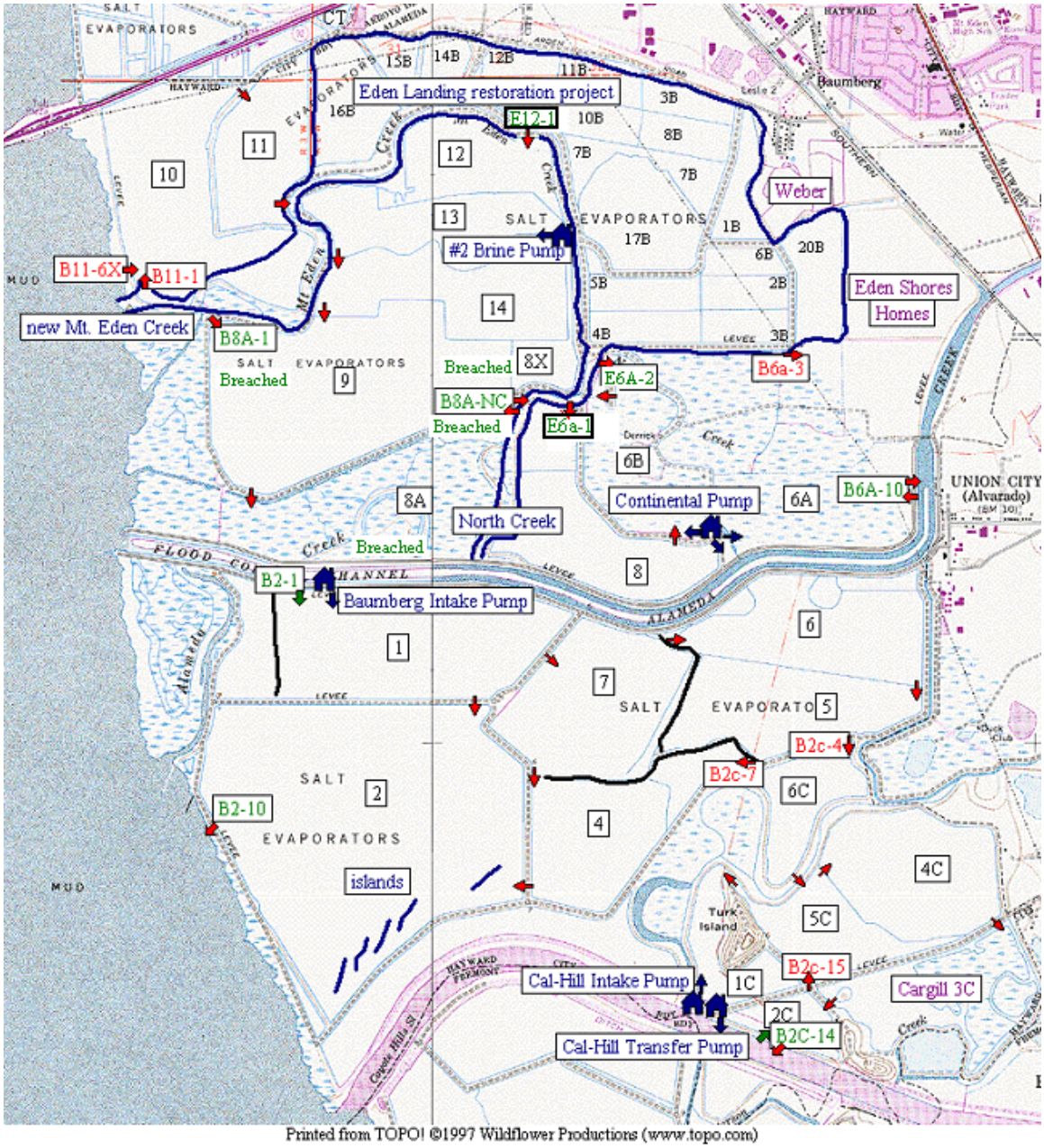



Figure 1. Vicinity Map of the Eden Landing Ecological Reserve (Baumberg Complex) Ponds




## 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 is replaced by "E" in most documents and field notes. SBSP Restoration Project naming convention uses "E" on ponds, WCS)

# Water Quality Monitoring Results

## *Discharge and Receiving Waters*

Results from the monitoring of pond waters at discharge locations are summarized below. Pond discharges do not occur continuously. Pond discharge data should be reviewed with consideration of the variation in tide stage and cycles, and operational activities which resulted in suspending or modifying discharges. During the 2016 water quality monitoring period, salinity appeared to follow the typical patterns and ranges as in previous years. While pH, temperature and DO were not monitored directly, it is assumed that those parameters continued the typical patterns and ranges in 2016 as in previous years, based on visual observed conditions.

Salinity data from 2016 were generally consistent with data collected during previous years on comparative calendar dates in Systems E10, E12/E13, E8X-E14, E6A, E2, E2C, and E10. Salinity values in the past few years under drought conditions have been higher due to below average rainfall and periods of higher temperatures. Modified pond operations sustained more continuous circulation with higher discharge gate settings and associated discharge volumes.

System E6A was successfully managed as a modified seasonal pond system, with salinity and water levels managed for WSP nesting habitat and migratory shorebird foraging in spring through fall, with deeper, low salinity open water habitat in the winter. Modified seasonal operations are typified by large areas of dry pond bottom exposed, with areas of shallowly inundated pond, and deeper water levels in circulation areas, primarily within borrow ditches. Overall pond conditions within this system allowed for continuous circulation discharge operations below 44 ppt.

Reconfigured Ponds E12 & E13 were successfully managed as open water ponds with increasing salinity and nearly constant levels of shallow, open water for migratory shorebird foraging and roosting habitat across both ponds, with islands as nesting habitat and deeper water levels in borrow ditches. Overall pond conditions within this system allowed for continuous circulation discharge operations below 44 ppt.

Water temperature generally has consistent trends across wet and dry years. As determined from previous years' data analysis, dissolved oxygen data is difficult to interpret with respect to actions related to management, and is assumed to be more related to (in-situ) pond conditions and (external) climate trends. Similarly, pH is also variable and difficult to interpret in regards to the effects of management activities on observed levels. Therefore, pH, temperature and DO are not regularly monitored at ELER

The 2016 pond water monitoring results (grab samples) and field observations are large files and are not included in this SMR. Rather, this data is provided in electronic format. Please contact CDFW for requests to cite, distribute or utilize this information for purposes other than in the context of this report.

Table 1 lists the observed (grab sample) values for salinity at the discharge location on dates that changes were made to pond operations. Refer to the electronic pond management and field observations files for data on weekly monitoring and for other monitoring locations**.**

Pond Systems consistently provided good habitat conditions for numerous waterbird species, including migratory shorebirds and waterfowl, as well as resident piscivores and wading birds.

## Salinity

Pond salinities in 2016 were similar to those in preceding years and reflects current management operations which sustain higher volume discharges. Salinities were generally maintained below 44 ppt based on information provided by on-going monitoring. Short term observations of elevated salinity were noted and normalization of salinity typically occurred within one day of pond operations changes. Refer to Table 1 and comprehensive pond management data files for observed salinity values, pond management activities and overall pond conditions.

The salinities for all system ponds were observed to maintain low salinity discharge conditions. Eden Landing continues to function chiefly as low to medium salinity managed ponds. Reconfigured ponds E12 & E13 include a series of cells in each pond, with progressively higher salinities than the intake waters, and a mixing basin to maintain intake from and discharge to the Bay via Mt. Eden Creek. On a larger scale, Pond Systems in Eden Landing include some seasonal ("dry") or managed "batch" ponds. Differences in mean salinity between low salinity ponds and Bay waters are more apparent during neap tide periods and higher salinity is expected during drought years. Review of data collected to date indicates that pond management and operations sufficiently maintain low salinity discharge in all pond systems. Higher salinity pond water is sufficiently mixed at the discharge location to adequately protect receiving water quality objectives.

<u>E2C:</u>
System E2C is operated as a muted tidal pond, characterized by intake and discharge at the same location. Salinity varied depending on duration of intake periods resulting from spring and neap tide cycles and other environmental factors. During 2016, System E2C was managed with typical operations, as described below. Grab samples obtained during routine pond operations in April, 2016 showed values ranging from 18-22 ppt, with one anomaly value of 51ppt (April 1, 2016). In winter through early spring 2016, salinity values ranged from 0-44ppt. In previous years, salinity values in early spring ranged from 30-33ppt (2015), 30 to 35ppt (2014), 20 to 36ppt (2013), and 23 to 28ppt (2012).

Grab sample monitoring values during the monitoring season from May to October 2016 showed pond salinities from 25-50 ppt, (33-52 ppt in 2015; 34-48 ppt in 2014; 29-49 ppt in 2013, 30-47 ppt in 2012), with a few exceptions noted below. Elevated salinity values are typically observed with a brief neap tide between two stronger spring tide periods which may resulted in brief periods where circulation of higher salinity water occurred to

the discharge location. Sufficient tidal mixing resulted in more typical salinity ranges. Observed E2C salinity was below 44 ppt throughout much of the 2016 monitoring season, except on the following dates. Elevated salinity values were observed on July 12, 2016 (47ppt), and August 24 (50ppt). Higher salinity likely occurred briefly as pond E2C drew down and higher salinity water from further back in the pond system could have dominated pond E2C water during a neap tide period. Best Management Practices (BMPs) for pond operations were implemented. The primary BMP was to reduce discharge to a minimum after each observed elevated salinity episode to allow pond E2C to restore typical water levels and salinity (below 44 ppt). During spring tides periods we resumed larger volume continuous discharge operations.

In the summer of 2016, Pond E2C infrequently mixed with Pond E5C (and E4C and E1C) to maximize circulation and increase intake at Pond E2C. Other BMP's such as weekly discharge timing and minimizing discharge volumes adequately protected receiving waters. The system was operated under atypical conditions (low rainfall) but maintained low salinity conditions generally below 44ppt). Average salinity over the May to October monitoring season, including the brief, elevated salinity periods, was 37 ppt (40 ppt in 2015, 41 ppt in 2014; 46ppt in 2013; and 38 ppt in 2012).

E2:

System E2 is operated as a circulating system, rather than a primarily muted tidal system as is operated in all other pond systems except System E12, as described below. However, System E2 is augmented by muted tidal intake at the E2-10 discharge location to the Bay. The system was operated as low salinity, continuous circulation ponds for the season, with muted tidal intake/discharge directly on the Bay, with primary inflow from E1. Discharge was maintained with one to two gates approximately 25% open. Observed salinity at the E2-10 discharge at the end of April, 2016 was approximately 31 ppt (35 ppt in 2015, 38 ppt in 2014, 40 ppt in 2013, 37 ppt in 2012) and ranged from 26 to 44 ppt during the May-October operational season (37 to 53 ppt in 2015, 35 to 55 ppt in 2014, 39 to 50 ppt in 2013, 29 to 46 ppt in 2012). Salinity for the majority of the 2016 season based on grab samples averaged 38 ppt (46 ppt in 2015, 46 ppt in 2014, 40 ppt in 2013, 40 ppt in 2012) and were generally below 44 ppt. In late July 2016, the E2-10 WCS discharge gates (two) were set at approximately 25% each and was sustained at that setting for the remainder of the summer. This operation appears to have resulted in lower overall salinity values in 2016 which were not above 44 ppt (due to greater intake and discharge volumes near the WCS), compared to previous years when only one gate was open 25% (with reduced intake/discharge volumes). In 2016, no adverse effects were observed. The BMP for temporary suspension of discharge was not implemented in 2016. Pond E2 discharge occurs directly in the open bay and is quickly normalized in receiving waters.

E10:

System E10 was operated in 2016 as shallow open water for the summer, with intake and discharge at the same location (muted tidal operations) at the mouth of MEC. Pond E11 is operated as a seasonal pond and allowed to draw down and be mostly dry during the summer. E10 salinity in the May-October 2016 monitoring season averaged 32 ppt (35

ppt in 2015, 40 ppt in 2014; 36 ppt in 2013) and ranged from 30-35 ppt (32-40 ppt in 2015, 38-43 ppt in 2014; 31-43 ppt in 2013; 27-39 ppt in 2012). Prior to the start of the monitoring season, salinity in E10 was approximately 25 ppt (32 ppt in 2015, 33 ppt in 2014, 31 ppt in 2013; 29ppt in 2012). Average salinity did not exceed 44 ppt in 2016 (0 days in 2015, 2014, 2013 and 2012) and the system had typical (low) salinity conditions throughout the season.

A missing flap gate discovered at the E10 WCS in June, 2015, which affected normal operations, has not yet been repaired. Discharge remains increased compared to normal operations, and the pond maintains a lower water level (discharge gate normally set at 5-25% open). The E10 WCS is expected to be replaced in 2017.

E9:

System E9 ponds, including E9, E8A and E8X, were restored to full tidal action in 2011. Seasonal ponds previously operated via pond E9, including E14, E13 and E12 were operated with intake from and discharge to Mt. Eden Creek via pond E12 as well as via the remaining managed pond E8X. Ponds E12 and E13 were reconfigured in 2013-2014 as part of an applied science study and pond management experiment as part of the SBSPRP Phase 1 Actions and were fully operational in 2016. These actions are described briefly below and more fully in the updated Operations Plan and within the environmental compliance documents for the SBSPRP.

E12:

Major construction activities were previously completed in Ponds E12 and E13 as part of Phase One of the SBSPRP. System E12 was operated as shallow, open water in 2016 with intake and discharge via MEC, as part of full, reconfigured operations of Ponds E12 and E13. These ponds are managed with nearly constant water levels across three cells in each pond which provides progressively increasing salinities, terminating in a mixing basin to ensure low salinity discharge. Ponds E12 and E13 were previously operated as seasonal ponds and allowed to dry in the summer. Pond E8X may be operated as a supplemental intake forebay for Ponds E12 and E13. No discharge occurred from Pond E12 in 2016, only intake operations. System E12 met expected salinity conditions throughout pond cells during the summer discharge monitoring season. Ponds E12 and E13 provided seasonal nesting, foraging and fledging habitat for WSP, primarily on graveled levees, berms and islands.

E13:

E13 Mixing Basin salinity during the May-October 2016 monitoring season averaged 41 ppt (40 ppt in 2015) and ranged from 32-53 ppt (32-50 ppt in 2015). Prior to the start of the 2016 monitoring season, salinity in the E13 Mixing Basin was approximately 32 ppt (34 ppt in 2015). Grab sample salinity exceeded 44 ppt in 2016 on eight days (two days in Sept. 2015), 6/17/16, 46 ppt; 6/20/16, 47 ppt; 6/24/16, 47 ppt; 7/12/16, 50 ppt; 7/14/16, 50 ppt; 7/15/16, 53 ppt; 8/8/16, 50 ppt; and 8/10/16, 52 ppt; limited discharge occurred in these conditions because the water level in the E13 Mixing Basin was only slight above or just below the weirs, except during intake. Grab sample salinity in E13 Mixing Basin was higher on more occasions in 2016 than 2015. Higher salinity was likely due to

shallow water levels and reduced WSE fluctuations as a result of reduced intake and discharge operations, which were implemented to protect WSP nests that were established during a neap tide period when the pond water surface elevation was low enough to dry portions of the pond bottom.

E14:

Pond E14 was operated as a seasonal pond in 2016 and was allowed to draw down and be mostly dry during the summer, with shallow water in the borrow ditches to provide circulation to Pond E8X. The mostly dry pond bottom provided nesting, roosting and foraging habitat for the federally threatened species, western snowy plover (WSP), as well as other resident waterbirds. Pond E14 had periodic flow from the Pond E12-E13 mixing basin and discharge to Pond E9. Discharge also occurs from pond E8X, which may act as a mixing basin for E14 if higher salinity conditions occur. E14 was primarily operated as a seasonal pond in prior years. Limited inflow from the Pond E13 Mixing Basin and outflow via Pond E8X occurred throughout most of the year. Supplemental intake/discharge operations were undertaken via former pond E9 as appropriate. Pond E9 was fully restored to full tidal action in 2011 and represents the E14 receiving waters near the mouth of Mt. Eden Creek. Pond E14 provided very good habitat conditions for WSP nesting and fledging habitat, as well as foraging and roosting habitat for other shorebirds in 2016.

In March, 2016, salinity in E14 at the E9 discharge location was approximately 15 ppt (60 ppt in 2015). Low salinity values reflect rainfall and limited intake from the bay in winter. No intake was allowed from E9 in 2016, while discharge was regularly allowed to maintain adequate dry nesting areas and foraging habitat for WSP. E14 salinity at the E9 discharge was not regularly monitored during the 2016 monitoring season because salinity was observed to be consistently below 44 ppt at the E13-E14 WCS where water was sufficiently deep. At the E14-E8X location, salinity ranged from 23-42 ppt (at E9-E14 salinity was 35-62 ppt in 2015, 28-43 ppt in 2014) and averaged 34 ppt (at E9-E14, 45 ppt in 2015, 42 ppt in 2014); E14 was operated primarily as a seasonal pond prior to 2014. Weekly observed salinities were not above 44 ppt in 2016. Higher salinity values were noted in May, June and September 2015 (48-62 ppt) and in July 2014 (80 ppt).

High salinity periods typically coincide with a lower than typical water level, such that shallow water in the borrow ditches is not discharged at the WCS due to water surface elevation, neap tides and warmer weather. During neap tide periods, intake is limited. To ensure water levels remain low to protect nests known to occur on the dry pond bottom areas, intake is reduced during spring tides to minimize temporary increases in wetted pond bottom areas. Little actual discharge occurs under these conditions. Active management of pond water level and salinity was conducted as needed. Observed salinity is quickly normalized to ambient conditions during intake periods. Pond E14 typically had moderately low salinity conditions throughout most of the 2016 season. Pond E14 provided seasonal nesting, foraging and fledging habitat for WSP, and nearly 100 nests were monitored in Pond E14.

E8X:

Prior to the monitoring season, salinity in E8X at the discharge location was approximately 25 ppt in 2016 (33 ppt in 2015, 32 ppt in 2014; 34 in 2013; 30 ppt in 2012). E8X salinity during the 2016 monitoring season ranged from 25-35 ppt (33-45 ppt in 2015; 36-44 ppt in 2014; 32-38 ppt in 2013; 30-42 ppt in 2012) and averaged 35 ppt (39 ppt in 2015; 41 in 2014; 36 ppt in 2013; 35 ppt in 2012. E8X was operated as a seasonal pond in 2011 and prior. Weekly observed salinities were not above 44 ppt in 2016. In August 2014, salinity was observed above 44 ppt on two dates (60 ppt and 45 ppt). Observed salinity did not exceed 42ppt in 2013 or 2012. Active salinity management was conducted as part of typical pond operations and implemented BMP's quickly normalized elevated values. Pond E8X had typical low salinity conditions throughout most of the 2016 season. Pond E8X provided good habitat conditions for numerous waterbirds, including piscivores and wading birds in 2016.

E6A:

In 2016, System E6A continued operations as a modified seasonal pond system, with continuous circulation via muted tidal intake and discharge at the same location. Since 2012, System E6A ponds (E8, E6B, E6A) have been managed as modified seasonal ponds with a multi-season, multi-species management objective, providing deep water in winter for waterfowl roosting and foraging, and shallow water to partly dry in summer for shorebird foraging, roosting and nesting. In the winter, System 6A ponds are managed with deep, low salinity water for waterfowl to support benthic invertebrates as the prey base for diving ducks. In spring, the ponds are drawn down and operated such that pond conditions are similar to seasonal ponds, albeit with higher intake and discharge volumes, lower salinity and a slightly higher water surface elevation. Under modified seasonal operations, salinity is generally low in the borrow ditches that act as water conveyance for continuous circulation and discharge, while some interior areas of the ponds are a mosaic of dry bottom and shallow water areas which have moderate salinity conditions. Salinity is generally below 44 ppt near the discharges, and is less varied because the pond is operated at a low water surface elevation with ample mixing and a low residence time. Seasonal ponds typically have little or no discharge, limited intake and are allowed to draw down, resulting in elevated salinity in late summer and mostly dry.

Higher salinity observations can occur in late spring though summer and may be attributed to lower water levels or reduced intake associated with neap tides and on-going operations targeting WSP nesting and fledging habitat. Elevated salinity occurs infrequently and is typically brief, often observed during neap tide periods, resulting from a "pocket" of higher salinity water at the discharge location when intake is more limited. Sufficient tidal mixing during spring tide periods results in more typical salinity ranges. BMP's such as weekly discharge timing adequately protected receiving waters.

Grab samples from System E6A obtained during routine pond operations prior to May 2016 showed values in pond E6A ranging from 15-18 ppt (21-25 ppt in 2015; 24-38 ppt in 2014; 19-24 ppt in 2013; 24-26 ppt in 2012), in pond E6B from 20-29 ppt (25 to 29 ppt in 2015; 26-34 ppt in 2014; 24-32 ppt in 2013; 26-30 ppt in 2012), and in pond E8 from 15-27 ppt (26-32 ppt in 2015; 30-37 ppt in 2014; 24-36 ppt in 2013; 28-38 ppt in 2012).

System E6A ponds maintained continuous circulation and discharge salinity was below 44 ppt in 2016 (above 44 ppt at E6A-10 discharge on one date in August 2015, 47 ppt).

Observed salinity in 2016 in pond E6A at the discharge generally ranged 31-33 ppt (29-47 ppt in 2015; 28-41 ppt in 2014; 28-44 ppt in 2013; 25-43 ppt in 2012). In 2016, average salinity at discharge in pond E6A (E6A-10 ) was 32 ppt (36 ppt in 2015; 41 ppt in 2014; 36 ppt in 2013; 32ppt in 2012). Salinity in previous years was below 44 ppt.

In 2016, observed pond E6B salinity at the E6B-2 discharge was not above 44 ppt (one date in July 2015 (45ppt)). Observed salinity in E6B at the discharge ranged 24-42 ppt (32-45 ppt in 2015; 32-43 ppt in 2014; 32 to 43 ppt in 2013; 25-38 ppt in 2012). Average salinity at the discharge in pond E6B was 35 ppt (38 ppt in 2015; 39 ppt in 2014; 38 ppt in 2013; 37 ppt in 2012).

In 2016, observed pond E8 salinity was not above 44 ppt at the discharge (in May 2015 (57 ppt) and in September 2015 (47 ppt); none in 2014; two days in August and September 2013). Observed salinity in 2016 in pond E8 at the discharge generally ranged 33-40 ppt (32-41 ppt in 2015; 35-39 ppt in 2014; 35 to 37 ppt in 2013; 30 to 44 ppt in 2012). Average salinity in 2016 at the discharge in pond E8 was 37 ppt (41 ppt in 2015; 38 ppt in 2014; 36 ppt in 2013; 37 ppt in 2012).

## pH

For 2016, no Datasondes were utilized to collect instantaneous or continuous pH values. Pond water quality in 2016 was assumed to be similar to previous years, based on observed salinities, pond depth, conditions and waterbird use. The Final Order allows pH levels to be measured in either the pond or receiving waters, as determined by the discharger. The ponds were managed based on biological resource objectives and habitat requirements for various species. Previous years' data showed periodic, brief periods of 2-12 hours where pH values were approximately 9.0 and above. These values do not appear to cause a decline in waterbird use or abundance, nor indicate prolonged water quality impairment. There is no apparent pattern in pH values as related to discharge operations.

For reference, in 2015 the reservoir of Pond 12 (Intake) had continuous monitoring which recorded pH values that ranged from approximately 7.6 to 10.1 during the May-October monitoring season and pH averaged 8.4 throughout the 2015 season. In the Pond 13 Mixing Basin (Discharge), continuous monitoring pH values ranged from approximately 7.6 to 9.2 during the 2015 season and pH averaged 8.3 throughout the season.

As similar background, in 2009 in Pond E10, continuous monitoring data and grab sample data showed pH ranged from approximately 7.9 to 8.5 at the discharge and in-pond transects. Higher values were found in more distant areas of E10 associated with poor circulation (8.2-9.6 pH during August transects).

In other ELER pond systems in 2009, pH similarly ranged approximately one point over the season. In Pond E2C, grab sample pH values ranged from approximately 8.0 to 8.6

and averaged 8.2 throughout the season. In Pond E9, grab sample pH values ranged from approximately 8.1 to 8.6 and averaged 8.1 pH. In Pond E2, grab sample pH values ranged from approximately 8.0 to 8.6 and averaged 8.2 pH. Receiving water sampling in 2007 showed that a discharge "signal" was not discernable except in the immediate vicinity of the discharge.

## Temperature

For 2016, no Datasondes were utilized to collect instantaneous or continuous temperature values. Water temperature data were not collected in other ponds in 2016. CDFW pond operations and management at ELER included continuous monitoring data collection in 2004-2009. Pond water temperatures were generally similar to ambient Bay and slough temperatures, with the exception of in-pond temperatures being approximately 5-degrees warmer during hot weather periods, primarily in shallower ponds. Managed ponds easily met the temperature discharge limits, not exceeding ambient temperatures of the receiving waters by $20^{o}$F in any case.

## Dissolved Oxygen (DO)

Continuous monitoring of dissolved oxygen (DO) was not conducted in 2016. Two years (2014-15) of continuous data were collected per the Final Order in reconfigured Ponds E12 and E13 as part of SBSPRP Phase One actions. Those Applied Studies tested hypotheses regarding reconfigured managed ponds having improved water quality by managing for lower residence time and higher volume continuous circulation discharge. Ponds E12 and E13 were reconfigured as a "salinity experiment" to help determine whether higher salinity ponds may be important to maintain in pond systems throughout Eden Landing and other pond complexes within the SBSPRP. DO and other parameters were not significantly improved. Managed ponds appear to meet water quality objectives (WQO) of the Basin Plan, with periodic, short duration periods below those standards.

DO values are known to be highly variable, with a diurnal pattern observed in all years. Regular DO monitoring is no longer conducted. Pond management operations are mostly informed by weekly or otherwise periodic water level and salinity grab samples. Patterns or periods of low or sustained depressed DO in previous years indicate that achieving compliance with the Final Order continues to be problematic.

In 2016, it is assumed that there were periods when low DO levels occurred, as were previously observed in managed ponds, including reconfigured ponds E12 and E13. All managed ponds generally exhibit strong diurnal patterns, where lower DO is observed near dawn and higher DO is observed at mid-day. Algal growth, respiration and decomposition in the ponds are assumed to be a primary cause of diurnal fluctuations of DO levels in managed ponds during the summer. In 2016, large algal blooms were not generally noted to persist nor perceived as more prevalent than in previous years. Annual variations and other factors are not well understood with respect to correlations with weather patterns, observed pond conditions and pond management operations. Pond management changes require several days to several weeks to result in observable changes in water quality conditions, habitat quality and species use.

In the Pond 12 Reservoir (Intake), no instantaneous DO values were collected in 2016. As reference, 2015 values ranged from approximately 0.2 mg/L to 24.8 mg/L during the May-October 2015 monitoring season and DO averaged 5.5 mg/L throughout the season. Weekly $10^{th}$ percentile values in 2015 in the reservoir of Pond 12 (Intake), based on continuous monitoring DO values, ranged from approximately 0.4 mg/L to 3.9 mg/L during the May-October 2015 monitoring season.

In the Pond 13 Mixing Basin (Discharge), no instantaneous DO values were collected in 2016. For reference, DO ranged from approximately 0.1 mg/L to 17.4 mg/L during the May-October 2015 monitoring season and DO averaged 6.3 mg/L. Weekly $10^{th}$ percentile values in the Mixing Basin at Pond 13 (Discharge), based on continuous monitoring DO values, ranged from approximately 2.2 mg/L to 5.9 mg/L during the May-October 2015 monitoring season. It should be noted that continuous and grab sample values were collected inside the pond at the discharge location; however, discharge of pond water typically did not actually occur when water surface elevations in Pond E13 Mixing Basin were below the weirs which were set at 5.5' NAVD.

The 2014-2015 monitoring results indicate that while Ponds E12 and E13 were reconfigured and intensively managed, overall water quality was not significantly improved, as compared to typical pond management and water quality in other systems. There was a notable difference in water quality between the lower average and $10^{th}$ percentile DO values during the 2014-15 monitoring season in the Pond E12 Reservoir (Intake location) and the E13 Mixing Basin (Discharge location) which had higher average and $10^{th}$ percentile values. This may be explained by the higher, more constant water levels and correspondingly less circulation conditions (limited to intake periods) in the E12 Intake Reservoir. Conversely, water levels were more varied on a daily and weekly basis, and there was correspondingly more circulation in the E13 Mixing Basin due to intake and discharge operations.

## Effectiveness of Dissolved Oxygen Best Management Practices (BMPs) for Pond Management

It is recognized by RWQCB that a well-operated lagoon/pond system may not necessarily continuously meet an instantaneous DO limitation of 5.0 mg/L as specified in the Basin Plan and Final Order. It is also understood that a stringent interpretation of this limit is not necessary to protect water quality, based on review of previous continuous monitoring data and other studies. These data and studies include site-specific standards and monitoring in the Everglades and Virginian Province (Cape Cod, MA to Cape Hatteras, NC), as well as San Francisco Bay studies and data collected by USGS in Newark Slough in 2005, 2006 and 2007. Monitoring programs have regularly recorded DO levels lower than 5.0 mg/l in estuaries under natural conditions, and is not necessarily indicative of pond discharges.

Operational strategies (BMPs) were implemented similar to previous years, as described below and in the enclosed Pond (system) Operations Plans. CDFW used BMPs such as the temporary closure of discharge gates during periods when salinity values were at or

above 44 ppt, when pond DO was assumed to be below 5.0 mg/L standard and 3.3 mg/L trigger values. For example, we temporarily ceased discharge or reduced discharge volume during periods when low DO could occur within the ponds, based on water levels and salinity values as a proxy for low DO conditions. Thereafter, when intake is sufficient to lower salinity and/or increase water levels, pond discharge resumed. This adequately achieves standards as described in the Final Order. As stated in previous SMR's, daily discharge timing BMP is not practicable due to staffing and budget constraints. CDFW periodically ceased or reduced discharge during predicted neap tides when water levels were low, intake was limited and/or during hotter weather conditions, as a weekly timed discharge BMP. These BMP's adequately protect receiving waters, based on previous monitoring and analysis, to ensure similar conditions minimize discharge of low DO waters during potential "trigger" value periods. Weekly discharge timing entailed setting pond discharges at greater volumes when spring tide periods occur, to maximize intake, discharge and mixing. The result of this BMP is that higher volume pond discharge occurs during the daytime when photosynthesis increases the pond DO levels or when discharge follows periods of sufficient intake.

During neap tide periods, intake is limited and pond water has the least mixing and turnover. Based on previous years' data, it appears that ceasing discharge for prolonged periods may further degrade water quality. Reducing residence time of water in the ponds appears to improve overall DO levels; therefore, maintaining discharge, particularly at higher sustained 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. It is presumed that DO levels in these ponds were similar to ambient conditions in sloughs and the Bay, notably during neap tides, when tidal ranges are more limited.

Refer to Table 1 for a full summary of discharge events and gate settings in 2016.

# Compliance Evaluation Summary

Data collected in 2016 were comparable to values from previous years. Monitoring indicates that reconfigured ponds E12 and E13, which were intensively managed, did not significantly improve water quality overall, as compared to typical pond management and water quality in other systems.

As background, in 2015 during continuous monitoring using Datasondes as part of the evaluation of the E12-E13 "salinity experiment," there was a notable difference in water quality between the lower average and $10^{th}$ percentile values during the monitoring season in the Pond E12 Reservoir (Intake location) and the higher average and $10^{th}$ percentile values calculated during the monitoring season in the E13 Mixing Basin (Discharge location). This may be explained by the higher, more constant water levels and correspondingly less circulation conditions, limited to intake periods in the E12 Intake Reservoir. Conversely, water levels were more varied on a daily and weekly basis, and there was correspondingly more circulation in the E13 Mixing Basin due to intake and discharge operations.

Maintaining dissolved oxygen levels in the ponds within water quality objectives and Final Order requirements is expected to continue to be the most notable management challenge during operation of the ponds. The BMPs developed and implemented as corrective actions as part of the Initial Stewardship Plan and subsequent SBSPRP Phase One actions have maintained, but not improved, water quality parameters including salinity and dissolved oxygen levels in the ponds. It appears that little immediate change within ponds can be affected since the intrinsic nature of open-water managed ponds to have high residence times. Some BMPs are more effective and practicable than others and it is a matter of evaluation and interpretation of data collected whether the BMPs maintained or 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 observations recorded during pond management and operations, CDFW will continue to determine which operations, management and monitoring activities adequately protect water quality and best achieves Final Order compliance.

Some of the BMPs, including installation of baffles to block algal mats and improve flow and DO values are not practicable, as demonstrated by such actions by USFWS at the Alviso Complex of the Refuge managed ponds. Infrastructure improvements, such as major changes in pond management/operations, topography or geometry, do not appear viable as a means of improving compliance with water quality objectives. Intensively managed, reconfigured ponds implemented as part of SBSPRP Phase One actions do not appear to provide the expected improvement in water quality. Pond management is expected to continue to be informed by on-going operations and any future applied studies implemented as part of SBSPRP Phase Two or other directed actions. CDFW expects to receive a report from USGS after completion of their applied studies in Ponds E12 and E13 in 2016 which will include lessons learned from the second year of monitoring bird use and water quality in the reconfigured ponds and information from other studies of reconfigured, managed ponds operated by USFWS (Pond A16, and RSF2).

As discussed above, strong diurnal patterns of DO levels are known to occur at the ELER and other managed pond complexes. A BMP such as ceasing discharge on a daily basis is not practicable to eliminate discharge of low DO waters, nor is such pond management/operation likely to improve overall water quality. Cessation of daily pond discharges may, in fact, decrease water quality because of more limited intake and mixing. Weekly discharge timing, reduced discharge gate settings and other BMPs were implemented by CDFW at ELER to address expected low DO conditions and appear to be sufficiently protective of receiving waters, as noted previously. For Systems E10 and E2, pond water is discharged to the open Bay and quickly disperses in the open water or over extensive mudflats.

In 2016, discharge gates were generally set to allow similar discharge volumes to the four 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 as well.

CDFW routinely manages pond systems with periodic and seasonal outflow and inflow to dry seasonal ponds adjacent to open water circulation ponds to improve water quality in discharge ponds. Muted tidal ponds with modified pond operations that maintain low water surface elevations, such as in System E6A, or ponds which are drained for construction are expected to have water quality values similar to ambient conditions in sloughs and the Bay.

## Data Collection, Evaluation and Communication

In 2016, sufficient data were collected for monitoring purposes using salinity grab samples in managed ponds. When recording salinity values, we also noted pond water levels, as well as waterbird counts and patterns. Continuous data was not collected in 2016 in reconfigured Ponds E12 and E13. CDFW provided detailed operations and monitoring data to the RWQCB staff electronically, and data are summarized within this report. It should be noted that pond operations were monitored as often as possible, given staff limitations. CDFW conducted all of the monitoring considered in this analysis for 2016. One CDFW biologist conducted pond operations, management, monitoring, review, and interpretation of data. Despite staffing and other challenges, CDFW has successfully managed the pond systems and implemented the BMPs discussed herein in such a manner as to both comply with regulatory standards and continued to provide high-quality waterbird habitat conditions on and around ELER.

Final Order requirements regarding communication of compliance to the RWQCB were satisfied by email, telephone and in-person meetings. Additionally, CDFW has provided extensive data to RWQCB for review and interpretation. We expect that continued collaboration and discussion between CDFW and RWQCB staff is useful for on-going pond management and operations.

## Summary, Completion of Phase 1 Actions and Requests for Revisions to SMP:

SBSPRP Phase One actions at ELER included tidal salt marsh habitat restoration, managed pond reconfiguration, recreation/public access features and maintenance of the existing level of "de-facto" flood risk management. Future monitoring activities and applied studies are expected to inform subsequent SBSPRP actions. SBSPRP Phase One actions restored and enhanced a mosaic of habitats, including tidal salt marsh, tidal mudflat, salt panne, subtidal flats and channels, sloughs, ponds, upland transition zones, and open water habitats (managed ponds). ELER continues to support healthy populations of fish and wildlife, special-status species, migratory waterfowl, shorebirds, and anadromous and resident fishes. Full tidal action was restored to 630-acres of former ponds E9, E8A and E8X in 2011. Tidal salt marsh vegetation in ponds E9, E8A and E8X continues to develop at the expected rate. Pond management and operations in all ELER pond systems continued to provide high-quality waterbird habitat.

Ponds E12 and E13 were reconfigured to create 230 acres of high quality shallow water foraging areas at varying salinities and 6 constructed nesting islands. The first full year of operations occurred in 2015. The reconfigured E12-E13 managed ponds represent the most extensive infrastructure improvements undertaken by CDFW at ELER, including a new intake pump, installation of new water control structures for intake and discharge, an elaborate water conveyance system via a series of pond cells composed of berms, ditches and weirs, and construction of new nesting islands. Ponds E12 and E13 provide a series of pond cells with shallow water foraging and roosting habitat for resident and migratory shorebirds with similar water depths, increasing salinity and include six islands for nesting and roosting. Pond operations in E12 and E13 will help future planning to enhance shallow water habitats and maintain migratory shorebird densities as well as adequate primary productivity and prey resources.

Pond E14 has been enhanced for shorebird management, with seasonal operations expected to maintain WSP nesting and fledging, as well as support migratory waterbirds. On-going monitoring and study will inform whether future pond enhancement actions should be undertaken in other ponds or systems.

Operations and Maintenance activities in 2016 were adequately addressed in the Final Order for the SBSPRP. CDFW will continue to review the SBSPRP Final Order with respect to the proposed 2017 operations and monitoring results, and will make any requests for alterations to the Final Order as appropriate in future reports. Planning for SBSPRP Phase Two actions continues. CDFW with SBSPRP partners expect to release the Draft Environmental Impact Report/Study for Phase 2 restoration actions in 2017.

Table 3 “Water Quality Monitoring For Eden Landing Ponds” requires type “A” monitoring activities for CDFW pond operations. Type “B” and “C” monitoring is not conducted because discharge will not be greater than 25% of WCS capacity in pond E2C.

Sustained, higher-volume discharges and corresponding reduced residence time of pond water has been shown to improve overall DO levels; therefore, allowing discharges at greater than 25% of WCS capacity provides for increased circulation and mixing. This is particularly important in System E6A, which requires lower water surface elevations in order to maintain WSP nesting habitat. System E2 pond discharge may be regularly sustained above 25% because pond E2 discharges directly to the Bay (at E2-10). Maintaining low salinity in continuous circulation operations within borrow ditches is also important in order to meet the objective of providing for multi-season, multi-species management of the ponds, including winter operations for diving duck management.

Based on monitoring activities associated with the reconfigured Ponds E12 and E13, it appears that use of a mixing basin for discharge may improve water quality of the discharge of managed ponds. Mixing Basins may be warranted to meet, or at least improve compliance with, water quality objectives. Future SBSPRP actions may consider construction of a mixing basin as an element of future pond reconfigurations and/or operations activities. CDFW does not intend to collect continuous monitoring data in System E12 in 2017.

**ATTACHMENT:**

**2017 Pond Operations Plans**