Pond A18
2017 Annual Self Monitoring Report

Reporting Period:
June 1- October 31, 2017

San José-Santa Clara Regional Wastewater Facility
2017 Pond A18 Annual Report

Order No. R2-2005-0003

San José-Santa Clara Regional Wastewater Facility reports are posted online at:

https://www.sanjoseca.gov/your-government/environment/regulatory-reports

Prepared for:

California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94560

Prepared by:

City of San Jose, Environmental Services Department
San José-Santa Clara Regional Wastewater Facility
700 Los Esteros Road
San Jose, CA 95134

Table of Contents

List of Tables

List of Figures

I. Introduction

This report summarizes 2017 water quality monitoring for Pond A18. Monitoring began June 1st and ended October 31st as required by the Waste Discharge Requirement (WDR) Order No. R2-2005-0003 (Order) and subsequent modifications to the Order as approved by the Executive Officer of the San Francisco Bay Regional Water Quality Control Board (Water Board).

This was the thirteenth year of continuous discharge monitoring for Pond A18. Figure 1 indicates the location of Pond A18 hydraulic control structures and sampling sites in the receiving water (Artesian Slough and Coyote Creek).

A. Waste Discharge Requirements

Pond A18 circulates San Francisco Bay (Bay) water by means of two hydraulic control structures located at the northern and southern ends of the levee bounding the western edge of the pond. Discharge of pond water back into the Bay via Artesian Slough is regulated by the WDR and the water quality of the pond must meet specific general water quality limits (Table 1).

Table 1. Pond A18 discharge requirements for Salinity, Dissolved Oxygen (DO) and pH

Constituent	Instantaneous Maximum	Instantaneous Minimum	Units
Salinity	44		ppt
Dissolved Oxygen		5.0	mg/L
pH	8.5	6.5	

Pond A18 must meet the following water quality requirements:

1. Discharge temperature into Artesian Slough shall not exceed the receiving water temperature by 20°F.
2. If pond dissolved oxygen (DO) levels at station A-A18-D fall below 1.0 mg/L, the discharger shall monitor, report, and take corrective actions required by Provision D.2.

B. Monitoring Requirements

Monitoring in 2017 was conducted in compliance with the A18 WDR monitoring requirements on page 9, Table 2 of the Self-Monitoring Program of the Order, and subsequent revisions to the WDR. The City continuously monitored (15-min intervals) Pond A18 discharge from 1 June to 31 October, 2017 for DO, pH, temperature, and salinity. Additionally, chlorophyll-*a*, DO, pH, temperature, and salinity were measured between 0800 and 1000 once per month in the pond. Further, City staff recorded both surface and bottom DO, pH, temperature, salinity, and turbidity measurements by discrete grab sampling on a monthly interval at four monitoring stations in the receiving water. Following the 2012 annual report, the continuous monitoring requirement for receiving water was modified with approval from the Water Board Executive Officer via a letter dated 9 April, 2013. In 2017, the receiving water was monitored with weekly discrete water column measurements in response to the pond's weekly 10th percentile DO concentration falling below the 3.3 mg/L trigger threshold. Per a modification to the WDR in 2010, the previous requirement for annual sampling of pond sediment mercury and methyl mercury was modified to require sediment mercury and methyl mercury monitoring of receiving water sediments in August or September every other year. This monitoring was last conducted in September 2015, and was therefore conducted in 2017.

C. Pond Operations in 2017

Pond operations in 2017 focused on minimizing further deterioration of the southern hydraulic control structure and its levee. In 2015, the pond's northern gate structure was reconstructed due to deterioration and imminent failure. The southern structure was used to pulse slough water into and out of the pond to maintain pond elevation and water quality during the months of dewatering and construction of the northern structure. This pulsing of water accelerated bank erosion and active scouring/slumping on the outboard levee proximal to the southern structure. The extent of the slumping and erosion was substantial, leading City engineering staff and consultant geotechnical engineers to recommend an alternate flow regime to reduce risk of levee failure and breach. A more detailed description of the condition and ongoing monitoring of the southern structure and levee can be found later in this report (IV. Discussion and Interpretation of 2017 Results).

Throughout Pond A18's dry season monitoring, continuous circulation of Pond A18 was oriented for inflow at the southern structure and discharge from the northern gate. Pond discharge water quality was monitored at the northern structure, and 10th percentile weekly DO values calculated on discharge water. Monitoring stations in the receiving water for monthly discrete sampling, along with trigger monitoring sites, were adopted in accordance with the north release scenario detailed in the WDR and Operations Plan (Figure 1). Station 1 was located in Artesian Slough directly upstream of the northern structure, and Station 2 was in Coyote Creek, directly upstream of the confluence with Artesian Slough. Station 3 was located in Coyote Creek directly downstream of the confluence with Artesian Slough, and Station 4 was farther downstream Coyote Creek.

II. Monitoring Methods and Results

San José-Santa Clara Regional Wastewater Facility (Facility) staff used water quality monitoring sondes manufactured by YSI, Inc. for general water quality monitoring (DO, pH, temperature, salinity). The 6600 model sonde was deployed for continuous monitoring and took water quality measurements every 15 minutes. The 600 XLM sonde was used for discrete monitoring of surface and bottom measurements. All sondes were outfitted with an optical DO probe, a conductivity/temperature probe, and a pH probe.

A. Quality Assurance/Quality Control

Facility staff calibrated and maintained sondes to ensure accuracy before deploying. After each use, staff checked sondes for their accuracy against known standards for conductivity, pH and DO. An unattended 6600 sonde was deployed for 1 or 2 weeks and then replaced with another cleaned and calibrated sonde.

Data Validation

Staff followed established acceptance criteria for sonde data with post-deployment readings within 5% of the theoretical level accepted. Data between 5 - 10% were accepted or rejected based on best professional judgment. Staff rejected data with post deployment measurements exceeding 10% of theoretical and investigated the cause of such failures.

Calibration standards used for post-deployment accuracy checks to validate sonde data were:

- DO – percent saturation in water-saturated air (theoretical of 100% saturation).
- pH - a 2-point calibration (pH 7 and pH 10) to establish a pH slope.
- Conductivity - 50,000 microSiemens standard.

One post-deployment QA/QC failure for pH occurred in 2017. This failure, for the week of June 1 through 6, was due to water intrusion resulting in sonde malfunction. Based on best professional evaluation of the corresponding data, only the pH data was subsequently invalidated and rejected, while the other water quality monitoring data for this period was accepted.

Figure 1. Pond A18 monitoring stations and hydraulic control structures

Arrows indicate the current directional flow of water through the water control structures.

B. Continuous Monitoring

Staff monitored Pond A18 discharge (Station A18-D) for temperature, salinity, pH, and DO from June 1, 2017 to October 31, 2017 (Figure 1).

Sondes recorded water quality data every 15 minutes. Following deployment, staff uploaded these data to a computer where they were checked for accuracy and completeness, summarized, and evaluated with respect to discharge requirements and action triggers. Weekly 10th percentile DO readings for pond discharge indicated the need for any adaptive management responses during the upcoming week. Possible examples of such responses included additional receiving water monitoring, aeration, reversing direction of flow, or strategic timing of pond discharges to limit low DO discharge.

Temperature

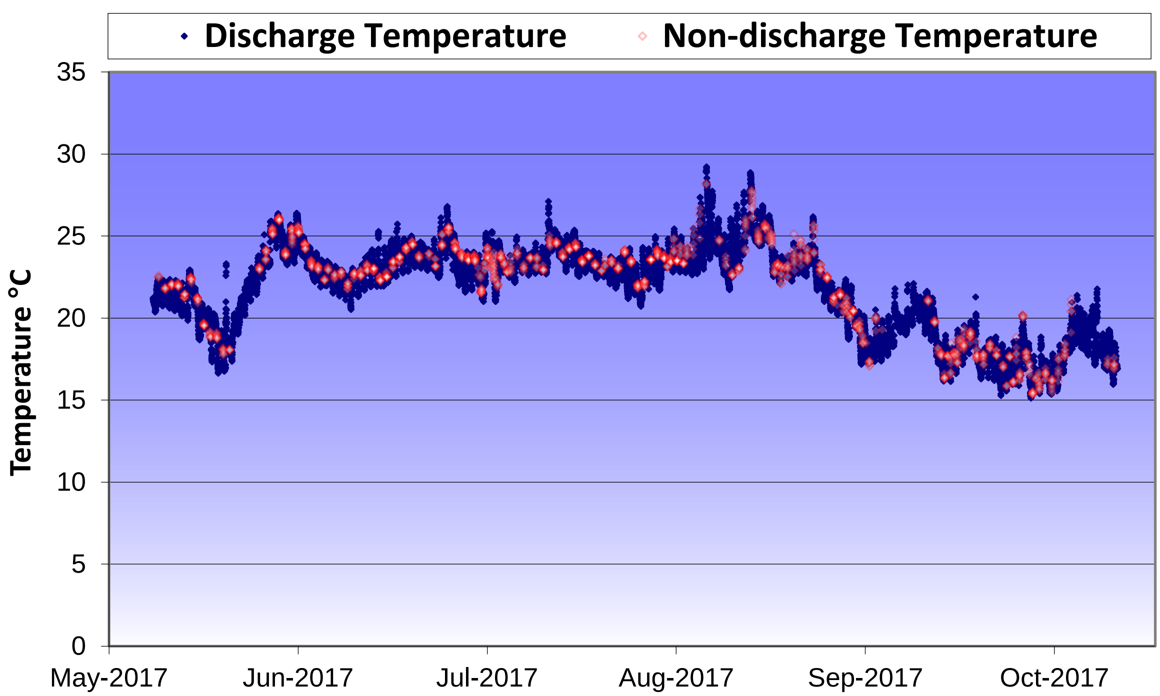
Water temperature for Pond A18 discharge is presented in Table 2.

Table 2. Temperature results – 2017 continuous monitoring (°C)

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
A18 Discharge	15.1	29.2	21.7	22.6	13,363
A18 Non-Discharge	15.3	28.2	22.1	23.1	1,301

Although pond mean temperature increased slightly in 2017 compared to the previous year, it varied little between discharge and non-discharge periods (Table 2; Figure 2).

Figure 2. Temperature profile – Pond A18 2017 dry season



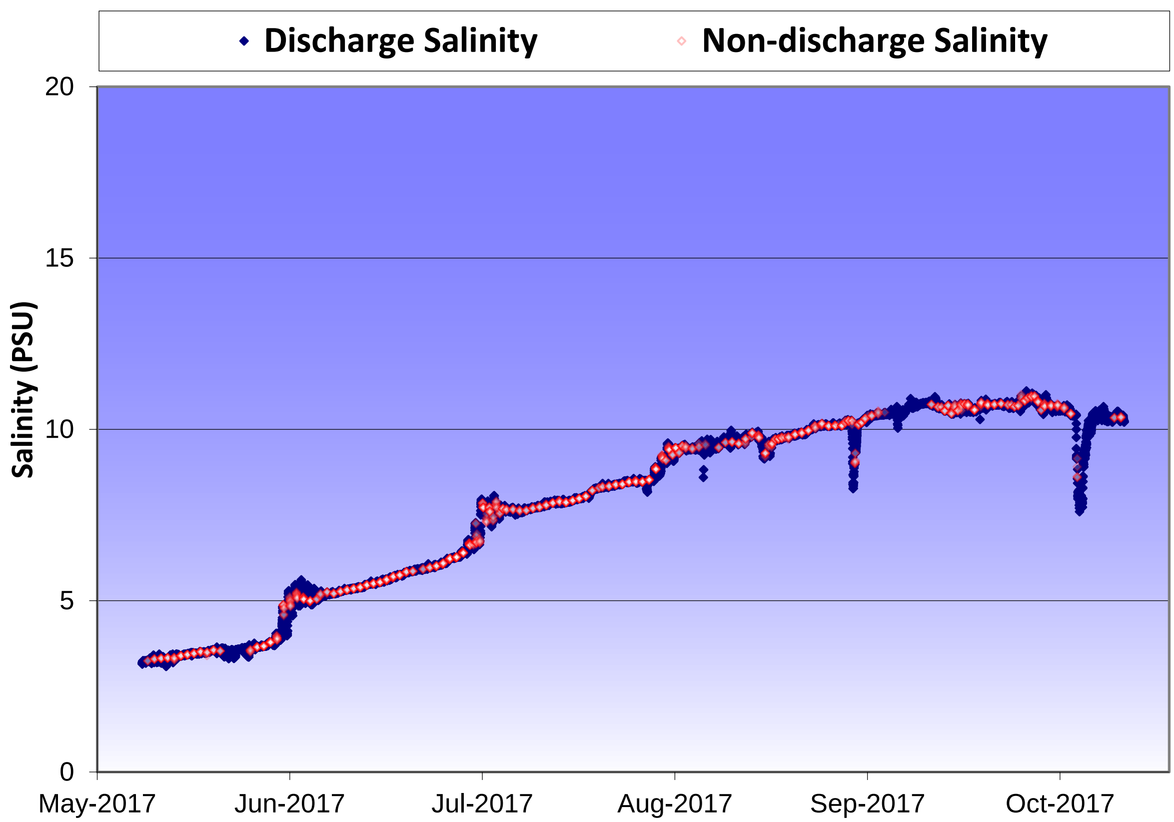
Salinity
Pond salinity, under both discharge and non-discharge conditions, is detailed in Table 3.

Table 3. Salinity results - 2017 continuous monitoring (PSU[1])

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
A18 Discharge	3.1	11.1	7.9	8.5	13,364
A18 Non-Discharge	3.2	11.0	7.9	8.3	1,301

Discharge salinity remained below 44 PSU at all times during the 2017 monitoring period. Pond salinity was markedly lower than prior years throughout the entire monitoring season, reflective of the reverse flow regime in which the southern hydraulic structure was used to intake Facility effluent rich slough water into the pond. Similar to the pattern observed over the past years, salinity climbed steadily through the dry season monitoring to a peak in late September - October (Figure 3).

Figure 3. Salinity profile - Pond A18 2017 dry season



[1] Practical Salinity Units (PSU) are a measurement of salinity from the specific conductance measured in water. An algorithm based on the ion composition of natural sea water converts specific conductance into PSU. One PSU is approximately equivalent to one part-per-thousand salinity.

pH

The pH of the pond discharge, under discharge and non-discharge conditions, is shown in Table 4.

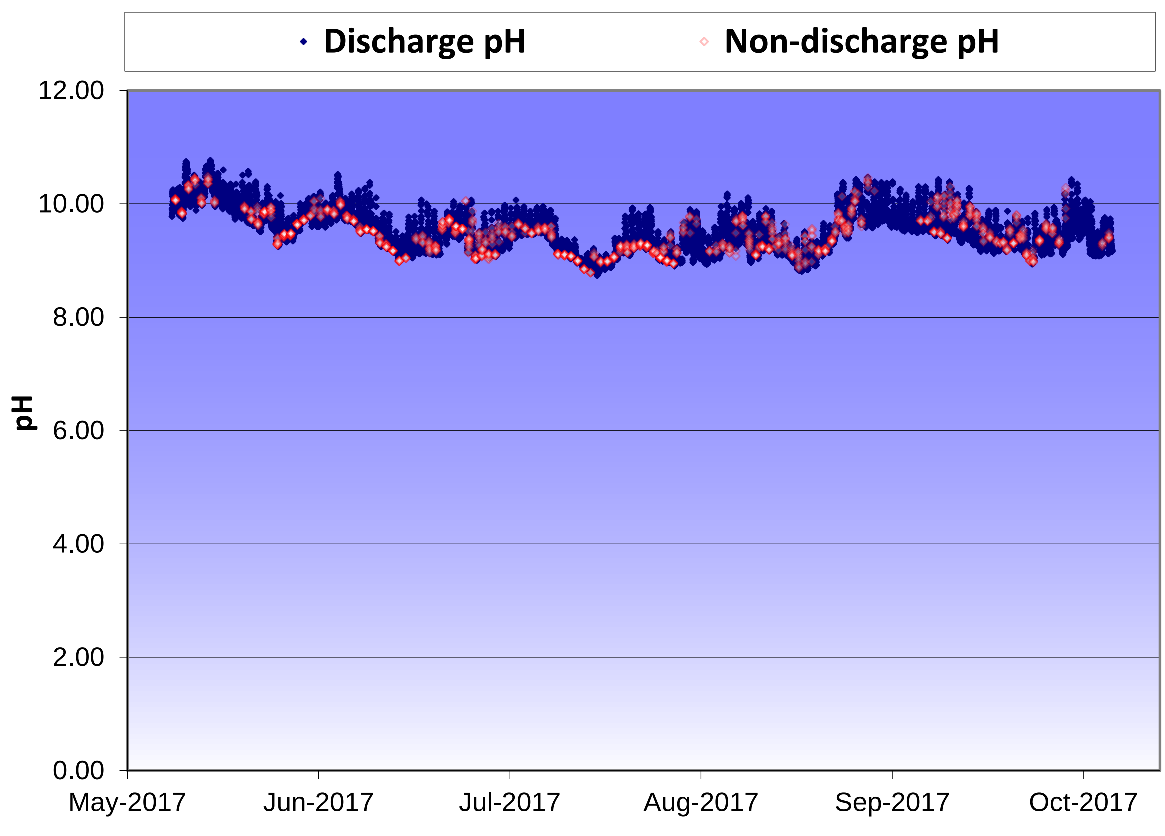
Table 4. pH results - 2017 continuous monitoring

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
A18 Discharge	8.7	10.8	9.5	9.5	12,875
A18 Non-Discharge	8.8	10.5	9.5	9.5	1,265

The Basin Plan Objective requires that receiving water pH remain between 6.5 and 8.5. However, receiving water data was not recorded during 2017 dry season continuous monitoring.

Despite the pond's northern release configuration in 2017, its pH pattern throughout the monitoring season was consistent with years past. pH increased due to episodes of intense photosynthesis when solar irradiance and water temperature was high, followed by declines when algae experienced periodic decomposition later in the season. These conditions generally coincide with shifts in the phytoplankton species composition.

Figure 4. pH profile - Pond A18 2017 dry season



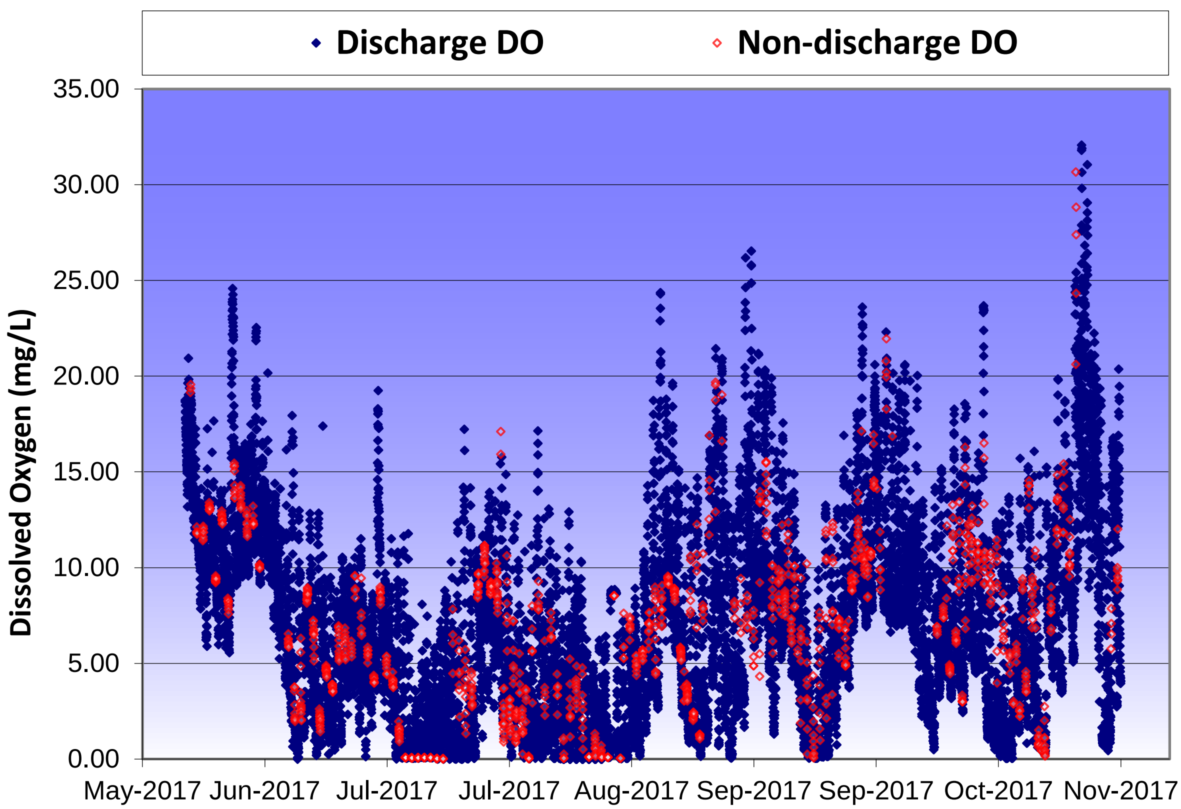
Dissolved Oxygen
DO concentrations in the pond discharge, under both discharge and non-discharge conditions, are summarized in Table 5.

Table 5. DO results - 2017 continuous monitoring (mg/L)

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
A18 Discharge	0.0	32.1	7.1	6.4	13,362
A18 Non-Discharge	0.0	30.7	6.7	6.8	1,301

Pond DO is primarily influenced by a photosynthesis driven diurnal pattern (Figure 5) of high primary productivity by algae during the day and high net ecosystem respiration at night. Other factors influencing pond DO to lesser degrees include strength and level of tides, intensity and duration of sunlight/cloud cover, temperature, time of day, and algal community composition.

Figure 5. Dissolved Oxygen profile - Pond A18 2017 dry season



A letter from the Water Board's Executive Officer Bruce Wolfe dated 9 April, 2013 eliminated the requirement of continuous receiving water monitoring. The City's trigger response in 2017 consisted of weekly discrete water column measurements at three discrete monitoring stations whenever the pond's weekly 10th percentile DO concentration fell below the 3.3 mg/L threshold. Trigger monitoring consisted of surface and bottom sonde measurements collected at three receiving water stations (Figure 1). Due to Pond A18's northern release configuration, Station 1 trigger monitoring data was collected in Artesian Slough directly upstream of the pond's discharge from its northern hydraulic structure. Station 2 was located in Coyote Creek, directly upstream of the confluence with Artesian Slough, and Station 3 was positioned in Coyote Creek directly downstream of the confluence with Artesian Slough.

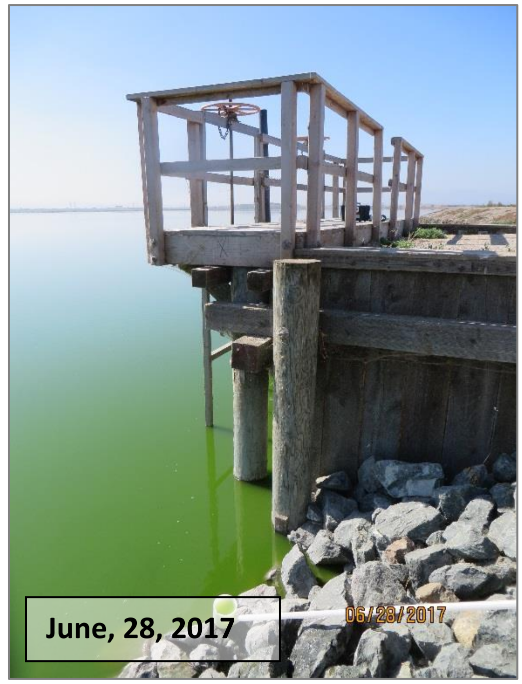
Trigger monitoring was conducted fifteen times in 2017 (Table 6). Trigger data was evaluated by Facility staff and revealed no negative effects from episodic low DO pond discharges, therefore, no additional adaptive management or monitoring actions were implemented.

Table 6. Weekly 10th percentile DO values for Pond A18 discharge and response in 2017

Week and Date Range	10th Percentile Value (mg/L)	Response
1: 6/1/17 – 6/6/17	9.1	None Required
2: 6/6/17 – 6/13/17	8.6	None Required
Week and Date Range	**10th Percentile Value (mg/L)**	**Response**
3: 6/13/17 – 6/20/17	1.8	Trigger monitoring initiated 6/23- No impacts
4: 6/20/17 – 6/27/17	1.5	Trigger monitoring continued 6/29 - No impacts
5: 6/27/17 – 7/4/17	3.7	None Required
6: 7/4/17 – 7/11/17	0.9	Trigger monitoring performed 7/1- No impacts
7: 7/11/17 – 7/18/17	0.0	Trigger monitoring continued 7/19- No impacts
8: 7/18/17 – 7/25/17	2.0	Trigger monitoring continued 7/25- No impacts
9: 7/25/17 – 8/1/17	0.1	Trigger monitoring continued 8/4- No impacts
10: 8/1/17 – 8/8/17	0.1	Trigger monitoring continued 8/8- No impacts
11: 8/8/17 – 8/15/17	0.1	Trigger monitoring continued 8/15- No impacts
12: 8/15/17 – 8/22/17	3.4	None Required
13: 8/22/17 – 8/29/17	0.1	Trigger monitoring initiated 9/01- No impacts
14: 8/29/17 – 9/5/17	3.1	Trigger monitoring continued 9/08- No impacts
15: 9/5/17 – 9/12/17	0.3	Trigger monitoring continued 9/14- No impacts
16: 9/12/17 – 9/19/17	0.3	Trigger monitoring continued 9/14- No impacts
17: 9/19/17 – 9/26/17	7.7	None Required
18: 9/26/17 – 10/3/17	2.8	Trigger monitoring performed 10/04- No impacts
19: 10/3/17 – 10/10/17	3.6	None Required
20: 10/10/17 - 10/17/17	0.5	Trigger monitoring initiated 10/20- No impacts
21: 10/17/17 - 10/24/17	1.2	Trigger monitoring continued 10/27- No impacts
22: 10/24/17 - 10/31/17	1.6	None Required

General Observations

Pond water color and clarity at the onset of the 2017 monitoring season differed from prior years, presumably due to the southern intake flow configuration. This resulted in higher nitrogen concentrations in the water entering the pond due to the southern structure's proximity to the Facility final effluent discharge point. Instead of beginning the monitoring season with generally clear water associated with low phytoplankton concentrations, pond water in early June 2017 was an opaque dark-green associated with high concentrations of phytoplankton not usually seen until late July. Secchi measurements were recorded opportunistically to document shifts in water clarity. Filamentous algae had already accumulated along the pond's margins. Amphipods of the Family Corophiidae were observed in the sondes during retrievals, and mayfly molts were noted on the pilings of the hydraulic control structures. Pond water color shifted to a brighter shade of opaque green in mid- to late June as secchi values dropped.



June, 28, 2017

August 9, 2017

The pond's water color gradually shifted to darker shades of green in July, and filamentous algae disappeared from the margins. Secchi values climbed considerably in mid- August, and the water color continued to darken to deeper shades of green.

September secchi values dropped precipitously, and filamentous algae returned to the margins, though not to the degree observed earlier in the monitoring season. The water color toggled weekly between varying shades of brighter green and brownish-green, indicating resurgences of phytoplankton concentrations likely due to shifts in species composition.

September 5, 2017

September 12, 2017

September 19, 2017

Water color in October shifted from bright to darker shades of green through the month, as secchi values gradually increased. Starting mid-October, swirling streaks of bright phytoplankton accumulations were observed on the pond’s surface, to the point of obscuring secchi measurements.

October 17, 2017

Table 7. Secchi measurements in 2017

Water quality measurements included for context to illustrate general changes in pond characteristics.

Date and Time	Secchi Depth (cm)	Temp (°C)	Salinity (PSU)	DO (mg/L)	pH
6/06/2017 11:30	16	19.9	3.4	6.4	9.8
6/15/2017 13:00	15	20.6	3.4	7.9	10.0
6/20/2017 16:00	12	25.6	3.7	7.6	10.0
6/28/2017 9:45	14	22.6	5.2	8.1	10.0
7/05/2017 13:45	13	22.3	5.4	2.8	9.8
7/11/2017 10:45	15	23.9	5.8	0.4	9.2
7/18/2017 11:15	20	24.2	6.1	0.9	9.1
8/03/2017 12:30	16	24.9	7.9	5.9	9.7
8/22/2017 13:00	29	23.3	9.4	5.4	9.1
8/29/2017 13:00	23	25.1	9.6	9.8	9.4
9/5/2017 12:45	18	24.4	9.7	3.2	9.1
9/12/2017 12:00	16	24.0	9.9	7.5	9.3
9/19/2017 12:30	16	20.3	10.3	11.3	9.7
9/26/2017 11:30	15	18.5	10.5	10.0	9.9
10/03/2017 11:30	15	17.8	10.7	8.2	9.7
10/17/2017 11:30	18	17.9	10.9	6.9	9.4
10/24/2017 12:15	18	18.8	10.4	15.4	9.5
11/01/2017 12:15	20	15.8	10.2	3.5	9.2

C. Discrete Monitoring

The WDR requires discrete water quality monitoring in both the pond and receiving water at monthly intervals.

Receiving Water Discrete Monitoring

Discrete monthly water quality sampling is required at four receiving water locations (Figure 1) during the monitoring season. These surface and bottom measurements of DO, pH, temperature, salinity and turbidity (Table 8) characterize the mixing of fresh slough water with Bay salt water during tidal exchange, and illustrate the effects (if any) that Pond A18 discharge may have on water quality. The WDR requires these measurements to be recorded while the pond is discharging.

City of San José biologist, Bryan Frueh collects a discrete water sample from Artesian Slough.

Table 8. Receiving water monthly surface and bottom water quality measurements

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)	Turbidity	A18 Flow (cfs)
6/23/2017 8:03	1	Ebb	Top	25.5	4.9	8.8	7.0	203.0	48.9
6/23/2017 8:04	1	Ebb	Bottom	25.5	4.9	8.8	6.8	233.0	48.9
7/19/2017 13:56	1	Flood	Top	26.0	3.6	8.1	8.6	17.4	26.9
7/19/2017 13:58	1	Flood	Bottom	23.0	8.8	8.0	3.9	46.4	26.9
8/23/201712:37	1	Flood	Top	23.7	14.5	7.9	3.7	55.9	40.0
8/23/2017 12:38	1	Flood	Bottom	23.6	14.7	7.8	3.4	87.3	40.0
9/21/2017 10:06	1	Flood	Top	19.5	11.4	8.2	5.9	91.0	50.7
9/21/2017 10:07	1	Flood	Bottom	19.4	11.5	8.2	5.7	101.0	50.7
10/20/2017 11:48	1	Flood	Top	18.2	14.7	7.6	5.4	75.2	27.7
10/20/2017 11:49	1	Flood	Bottom	18.2	14.9	7.7	4.8	65.3	27.7
6/23/2017 8:12	2	Lo Slack	Top	25.2	7.3	8.2	6.9	51.5	48.9
6/23/2017 8:13	2	Lo Slack	Bottom	25.1	9.1	8.0	3.8	53.9	48.9
7/19/2017 14:02	2	Flood	Top	24.3	8.8	8.1	6.3	40.8	28.3
7/19/2017 14:03	2	Flood	Bottom	23.0	11.0	7.9	4.1	189.0	28.3
8/23/2017 12:42	2	Hi Slack	Top	23.4	15.9	7.8	3.3	86.2	40.0
8/23/2017 12:44	2	Hi Slack	Bottom	23.4	15.9	7.8	3.2	85.3	40.0
9/21/2017 10:11	2	Flood	Top	19.9	11.9	8.0	5.8	66.3	50.7
9/21/2017 10:12	2	Flood	Bottom	19.8	11.9	8.0	5.3	108.0	50.7
10/20/2017 11:53	2	Flood	Top	18.1	16.4	7.8	5.0	70.5	27.7
10/20/2017 11:55	2	Flood	Bottom	18.0	17.0	7.8	4.7	93.2	27.7
6/23/2017 8:21	3	Flood	Top	25.2	7.2	8.3	5.1	54.1	48.9
6/23/2017 8:23	3	Flood	Bottom	25.1	8.2	8.2	4.6	59.3	48.9
7/19/2017 14:06	3	Flood	Top	24.4	6.9	8.2	6.7	31.4	28.3
7/19/2017 14:07	3	Flood	Bottom	23.3	10.3	8.0	4.5	65.2	28.3
8/23/2017 12:47	3	Hi Slack	Top	23.3	16.6	7.9	4.1	105.0	37.3
8/23/2017 12:48	3	Hi Slack	Bottom	23.3	16.6	7.9	3.6	112.0	37.3
9/21/2017 10:28	3	Flood	Top	19.9	12.5	8.0	5.6	83.9	49.7
9/21/2017 10:29	3	Flood	Bottom	19.8	12.6	8.0	5.5	65.1	49.7
10/20/2017 11:59	3	Flood	Top	17.9	17.9	7.8	5.2	115.0	27.7
10/20/2017 12:00	3	Flood	Bottom	17.9	18.6	7.8	4.9	108.0	24.3
6/23/2017 8:27	4	Flood	Top	25.2	8.3	8.2	5.2	62.5	48.9
6/23/2017 8:29	4	Flood	Bottom	25.2	8.5	8.2	4.7	81.6	48.9
7/19/2017 14:11	4	Flood	Top	24.3	6.9	8.2	7.0	36.8	28.3
7/19/2017 14:14	4	Flood	Bottom	24.3	11.3	8.0	4.3	99.1	28.3
8/23/2017 12:51	4	Hi Slack	Top	23.5	17.3	7.9	3.8	79.4	37.3
8/23/2017 12:53	4	Hi Slack	Bottom	23.3	17.2	7.9	3.5	109.0	37.3
9/21/2017 10:37	4	Flood	Top	19.7	13.3	8.0	5.8	92.1	48.6
9/21/2017 10:39	4	Flood	Bottom	19.6	13.3	8.0	5.5	107.0	48.6
10/20/2017 12:06	4	Flood	Top	17.8	19.5	7.8	5.2	124.0	24.3
10/20/2017 12:07	4	Flood	Bottom	17.8	19.3	7.8	5.0	121.0	24.3

Trigger Monitoring and Adaptive Management Actions

In 2017, the response to Pond A18's weekly 10th percentile DO concentration falling below the trigger threshold of 3.3 mg/L consisted of recording additional weekly discrete water column measurements at three stations in Artesian Slough and Coyote Creek to determine if lower DO discharges were adversely affecting receiving water DO. Due to Pond A18's northern release configuration, Station 1 trigger monitoring data was collected in Artesian Slough directly upstream of the pond's hydraulic structure. Station 2 was located in Coyote Creek, directly upstream of the confluence with Artesian Slough, and Station 3 was positioned in Coyote Creek directly downstream of the confluence with Artesian Slough (Figure 1).

Ryan Mayfield records water quality measurements using a multi-probe YSI.

Monitoring was performed in response to the trigger events in weeks 3 and 4, weeks 6 through 11, weeks 13 through 16, week 18, and weeks 20 and 21. Results are detailed in Table 9.

Trigger monitoring is designed to detect impacts of pond discharge on receiving water quality. Any confirmed negative impacts trigger additional adaptive management actions (e.g., additional water quality monitoring or valve adjustments). Negative impacts from pond discharges are defined as follows:

- Receiving water DO is < 5.0 mg/L at surface or < 3.3 mg/L at the bottom at Artesian Station 2, and;
- 2-hour average pond DO bracketing the time that receiving water measurements were taken is less than measured receiving water DO.

Low DO conditions in the receiving water must be linked to Pond A18 discharge to necessitate additional adaptive management measures.

In 2017, there were four instances when trigger monitoring measured receiving water DO less than 5.0 mg/L at the surface and/or less than 3.3 mg/L at the bottom at Station 2. These four instances occurred on 7/25, 8/15, 9/1, and 9/8. Continuous sonde data in the pond was evaluated to determine if pond discharge contributed to these values, and in every case, the 2-hour average pond DO measured higher than the corresponding receiving water DO, with average pond DO values of 6.2, 6.5, 11.2 and 7.1 mg/L for the four dates in chronological sequence. Accordingly, additional management actions were not implemented.

Table 9. Discrete trigger monitoring results in 2017

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)
6/23/2017 8:03	1	Ebb	Top	25.5	4.9	8.8	7.0
6/23/2017 8:04	1	Ebb	Bottom	25.5	4.9	8.8	6.8

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)
6/23/2017 8:12	2	Lo Slack	Top	25.2	7.34	8.2	6.9
6/23/2017 8:13	2	Lo Slack	Bottom	25.1	9.1	8.0	3.8
6/23/2017 8:21	3	Flood	Top	25.2	7.2	8.3	5.1
6/23/2017 8:23	3	Flood	Bottom	25.1	8.2	8.2	4.6
6/29/2017 9:47	1	Ebb	Top	23.8	4.0	8.1	6.8
6/29/2017 9:48	1	Ebb	Bottom	23.6	4.6	8.1	6.2
6/29/2017 9:52	2	Ebb	Top	22.2	9.4	8.2	6.6
6/29/2017 9:53	2	Ebb	Bottom	22.0	9.7	8.1	6.1
6/29/2017 9:57	3	Ebb	Top	22.3	9.1	8.1	6.4
6/29/2017 9:58	3	Ebb	Bottom	22.2	9.4	8.1	6.1
7/14/2017 10:33	1	Ebb	Top	24.9	5.3	8.4	7.8
7/14/2017 10:34	1	Ebb	Bottom	24.8	5.3	8.4	7.6
7/14/2017 10:29	2	Ebb	Top	23.6	7.6	8.2	7.4
7/14/2017 10:30	2	Ebb	Bottom	22.8	8.8	5.8	8.1
7/14/2017 10:26	3	Ebb	Top	23.9	6.8	8.2	6.8
7/14/2017 10:27	3	Ebb	Bottom	23.1	8.4	8.1	6.2
7/19/2017 13:56	1	Ebb	Top	26.0	3.6	8.1	8.6
7/19/2017 13:58	1	Ebb	Bottom	23.0	8.8	8.0	3.9
7/19/2017 14:02	2	Ebb	Top	24.3	8.8	8.1	6.3
7/19/2017 14:03	2	Ebb	Bottom	23.0	11.0	7.9	4.1
7/19/2017 14:06	3	Ebb	Top	24.4	6.9	8.2	6.7
7/19/2017 14:07	3	Ebb	Bottom	23.3	10.3	8.0	4.5
7/25/2017 12:23	1	Flood	Top	24.1	11.0	8.1	6.9
7/25/2017 12:18	1	Flood	Bottom	24.2	11.6	8.0	4.7
7/25/2017 12:31	2	Flood	Top	24.1	12.5	7.9	4.6
7/25/2017 12:32	2	Flood	Bottom	24.0	12.5	7.9	4.3
7/25/2017 12:37	3	Flood	Top	23.9	13.6	7.9	4.3
7/25/2017 12:37	3	Flood	Bottom	23.9	13.6	7.9	4.2
8/04/2017 10:52	1	Flood	Top	24.4	12.1	8.2	5.3
8/04/2017 10:52	1	Flood	Bottom	24.4	12.5	8.2	5.0
8/04/2017 10:55	2	Flood	Top	24.3	13.4	8.2	5.1
8/04/2017 10:56	2	Flood	Bottom	24.3	13.8	8.2	4.8
8/04/2017 10:58	3	Flood	Top	24.2	14.4	8.2	5.2
8/04/2017 10:59	3	Flood	Bottom	24.2	15.2	8.2	4.7
8/08/2017 7:40	1	Ebb	Top	24.5	5.7	8.4	6.3
8/08/2017 7:41	1	Ebb	Bottom	24.5	5.7	8.4	5.9
8/08/2017 7:45	2	Ebb	Top	23.1	9.1	8.2	6.2
8/08/2017 7:46	2	Ebb	Bottom	22.8	10.6	8.1	4.6
8/08/2017 7:49	3	Ebb	Top	23.5	8.5	8.2	5.7
8/08/2017 7:54	3	Ebb	Bottom	23.0	10.5	8.1	5.2
8/15/2017 11:28	1	Ebb	Top	24.7	4.0	8.0	5.9
8/15/2017 11:29	1	Ebb	Bottom	22.5	10.4	7.9	3.1
8/15/2017 11:19	2	Ebb	Top	22.7	10.1	7.9	4.5
8/15/2017 11:20	2	Ebb	Bottom	22.1	13.3	7.9	3.1
8/15/2017 11:11	3	Ebb	Top	23.5	5.9	8.1	4.0
8/15/2017 11:13	3	Ebb	Bottom	22.1	13.5	7.9	3.0
9/01/2017 9:24	1	Flood	Top	23.9	11.9	8.0	5.5
9/01/2017 9:26	1	Flood	Bottom	23.7	12.5	8.0	4.4
9/01/2017 9:29	2	Flood	Top	24.3	13.4	8.0	4.3

Date and Time	Site	Tide	Depth	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)
9/01/2017 9:30	2	Flood	Bottom	23.7	14.0	8.0	4.2
9/01/2017 9:33	3	Flood	Top	23.8	14.3	8.0	4.4
9/01/2017 9:33	3	Flood	Bottom	23.7	15.6	8.0	4.1
9/08/2017 9:49	1	Ebb	Top	24.5	7.5	8.1	5.4
9/08/2017 9:50	1	Ebb	Bottom	24.5	7.5	8.1	5.1
9/08/2017 9:45	2	Ebb	Top	23.3	10.2	7.9	4.7
9/08/2017 9:46	2	Ebb	Bottom	23.0	10.8	7.7	3.6
9/08/2017 9:41	3	Ebb	Top	23.7	9.1	8.0	4.8
9/08/2017 9:42	3	Ebb	Bottom	23.2	11.7	7.9	3.7
9/14/2017 14:49	1	Flood	Top	26.6	4.4	8.1	10.0
9/14/2017 14:50	1	Flood	Bottom	24.3	11.3	8.1	3.5
9/14/2017 14:53	2	Flood	Top	24.8	11.9	8.2	10.5
9/14/2017 14:54	2	Flood	Bottom	24.1	13.7	8.0	5.7
9/14/2017 14:57	3	Flood	Top	25.8	6.7	8.4	8.9
9/14/2017 14:58	3	Flood	Bottom	24.4	12.5	8.1	6.6
9/21/2017 10:06	1	Flood	Top	19.5	11.4	8.2	5.9
9/21/2017 10:07	1	Flood	Bottom	19.4	11.5	8.2	5.7
9/21/2017 10:11	2	Flood	Top	19.9	11.9	8.0	5.8
9/21/2017 10:12	2	Flood	Bottom	19.8	11.9	8.0	5.3
9/21/2017 10:28	3	Flood	Top	19.9	12.5	8.0	5.6
9/21/2017 10:29	3	Flood	Bottom	19.8	12.6	8.0	5.5
10/04/2017 10:31	1	Flood	Top	19.2	13.1	8.1	5.8
10/04/2017 10:33	1	Flood	Bottom	19.2	13.2	8.0	4.1
10/04/2017 10:35	2	Flood	Top	19.2	14.0	8.0	5.8
10/04/2017 10:35	2	Flood	Bottom	19.1	14.4	8.0	3.4
10/04/2017 10:38	3	Flood	Top	19.1	15.0	8.0	5.6
10/04/2017 10:39	3	Flood	Bottom	19.0	16.1	8.0	5.1
10/20/2017 11:48	1	Flood	Top	18.2	14.7	7.6	5.4
10/20/2017 11:49	1	Flood	Bottom	18.2	14.9	7.7	4.8
10/20/2017 10:53	2	Flood	Top	18.1	16.4	7.8	5.0
10/20/2017 10:55	2	Flood	Bottom	18.0	17.0	7.8	4.7
10/20/2017 10:59	3	Flood	Top	17.9	17.9	7.8	5.2
10/20/2017 12:00	3	Flood	Bottom	17.9	18.6	7.8	4.9
10/27/2017 11:20	1	Ebb	Top	23.8	3.8	7.7	8.4
10/27/2017 11:22	1	Ebb	Bottom	20.5	18.5	7.5	3.2
10/27/2017 11:25	2	Ebb	Top	20.9	11.7	7.8	7.2
10/27/2017 11:25	2	Ebb	Bottom	20.5	18.4	7.6	3.9
10/27/2017 11:29	3	Ebb	Top	22.6	6.9	8.2	8.4
10/27/2017 11:31	3	Ebb	Bottom	20.5	17.2	7.7	3.5

Pond Discrete Monitoring

The WDR requires the collection of discrete water quality measurements in Pond A18 once per month. Monthly discrete DO and chlorophyll *a* readings for the pond need to be taken between 0800 and 1000 hours. Staff measured the discrete pond water quality using temperature, salinity, pH, and DO from the continuous discharge monitoring sonde to fulfill these discrete monitoring requirements (Table 10). These measurements were recorded on the same date and time as the required monthly chlorophyll *a* sampling.

Table 10. Discrete monthly water quality measurements at Pond A18 discharge

Date and Time	Temperature (C)	Salinity (PSU)	pH	DO (mg/L)
6/28/2017 09:45	22.6	5.2	10.0	8.1
7/18/2017 09:15	24.3	6.1	9.2	3.3
8/28/2017 09:30	24.4	9.5	9.3	6.2
9/27/2017 09:45	19.3	10.5	9.6	7.3
10/26/2017 09:00	18.4	10.0	9.7	18.7

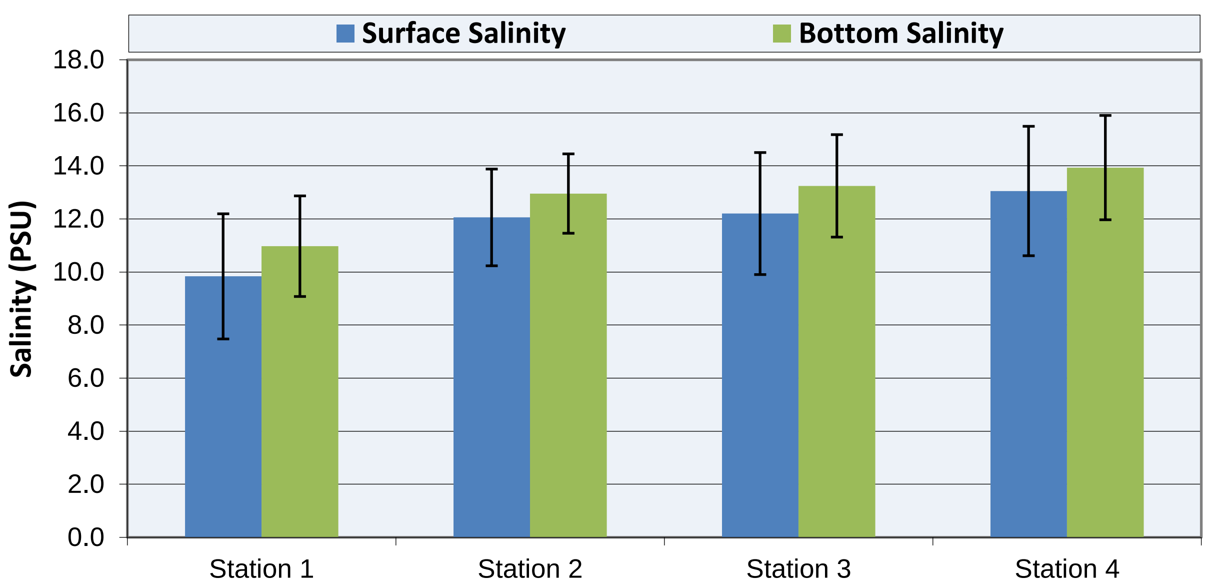
Temperature

Receiving water temperature measured highest at Station 1 in Artesian Slough, and was relatively consistent across the three stations in Coyote Creek (Table 8). Similar to previous years, temperature decreased with depth. The pond is large and shallow with a limited flow so pond water temperature is highly influenced by ambient air temperature.

Salinity

In years prior to the northern release discharge configuration that was initiated in 2016, the salinity profile for receiving water has been dictated by upstream stratification and downstream mixing in Artesian Slough. This pattern, caused by interactions between saltier tidal influence and fresher Facility effluent, was observed regardless of pond discharge or tides. In 2017, surface and bottom salinity across all stations measured less than 2016 salinity values, particularly at the Stations 2, 3 and 4 in Coyote Creek. Compared to previous years configured with a southern discharge scenario, salinity stratification across all stations was less pronounced in 2017, indicative of more mixing since all stations are much further downstream from the Facility freshwater effluent discharge. As expected, bottom salinity measured higher than surface salinity at all stations.

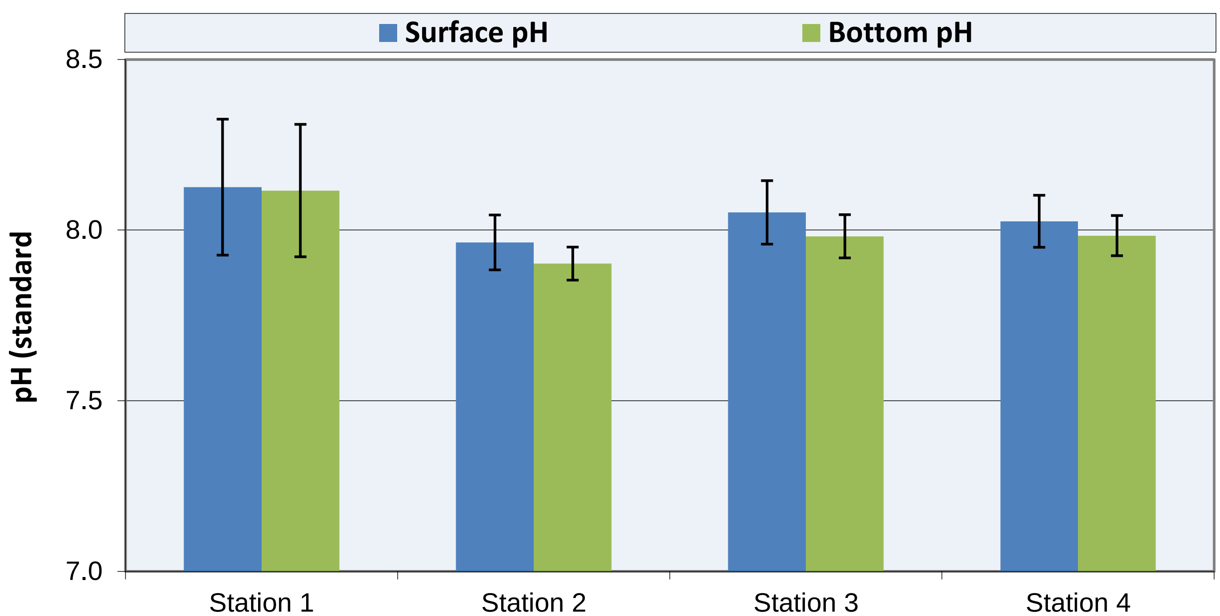
Figure 6. Mean (± SE) monthly Salinity in receiving water for 2017



pH
Surface and bottom pH was markedly higher across all stations in 2017. Consistent with 2016 values, pH was higher at the surface of every station, and Station 1 measured the highest surface and bottom pH values. Unlike 2016, however, stratification of pH in the receiving water was most pronounced at the three stations in Coyote Creek, while pH at Station 1 was the most mixed.

Pond pH was higher (8.7 – 10.8,) than the surface and bottom measurements of the receiving water (7.6 – 8.8). Despite the pond's comparatively elevated pH discharge, pH values in receiving waters remained within the Basin Plan Objective with the exception of a slightly elevated pH value of 8.8 in June, at Station 1, which is upstream of the Pond A18 discharge point. The cause of this slightly elevated pH in the receiving water is unknown, but it is unlikely to be caused by the pond discharge since the station is upstream of the discharge point and the tidal stage at the time of the measurement was ebbing, so tidal flows were pushing all water in the downstream direction.

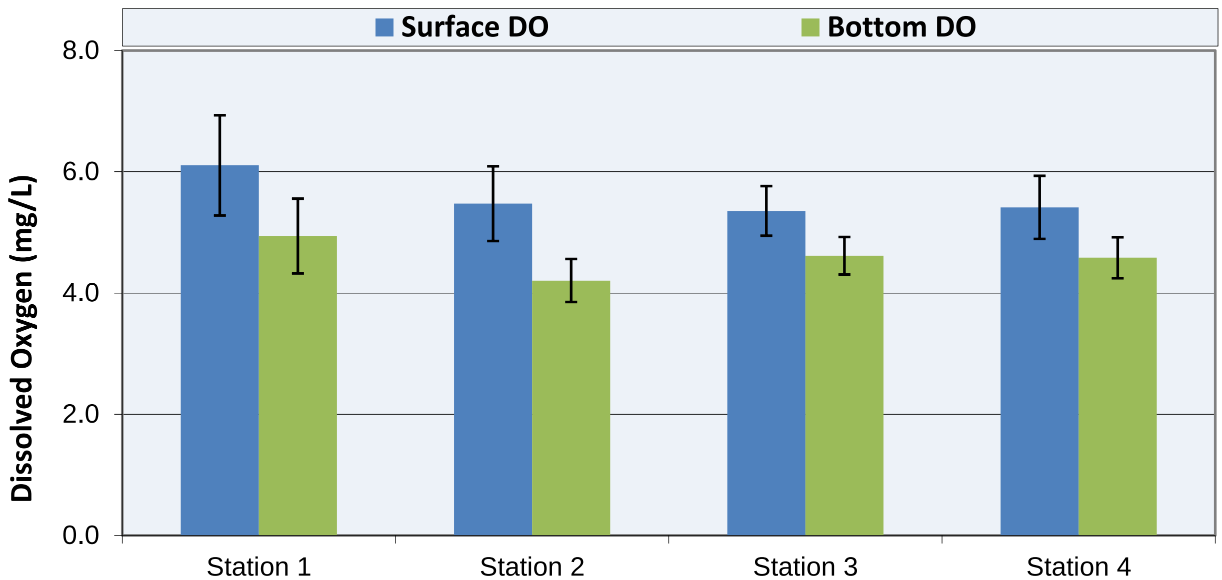
Figure 7. Mean (+ SE) monthly pH in receiving water for 2017



Dissolved Oxygen
Consistent with previous years, monthly DO measurements at the four monitoring stations (Table 8) reveal surface DO was substantially higher than bottom DO across all stations. DO recorded at the surface and bottom was highest at Station 1. Compared to 2016 values, surface and bottom DO increased notably across all stations by 0.5 to 1.0 mg/L.

The WDR requires the Discharger to monitor, report, and take corrective action if monthly discrete DO levels in Pond A18 fall below 1.0 mg/L. This scenario did not occur during the 2017 season (Table 10). Trigger monitoring for temperature, salinity, pH and DO was initiated on June 23 (Table 6) when pond DO levels fell below the 10th percentile weekly trigger of 3.3 mg/l.

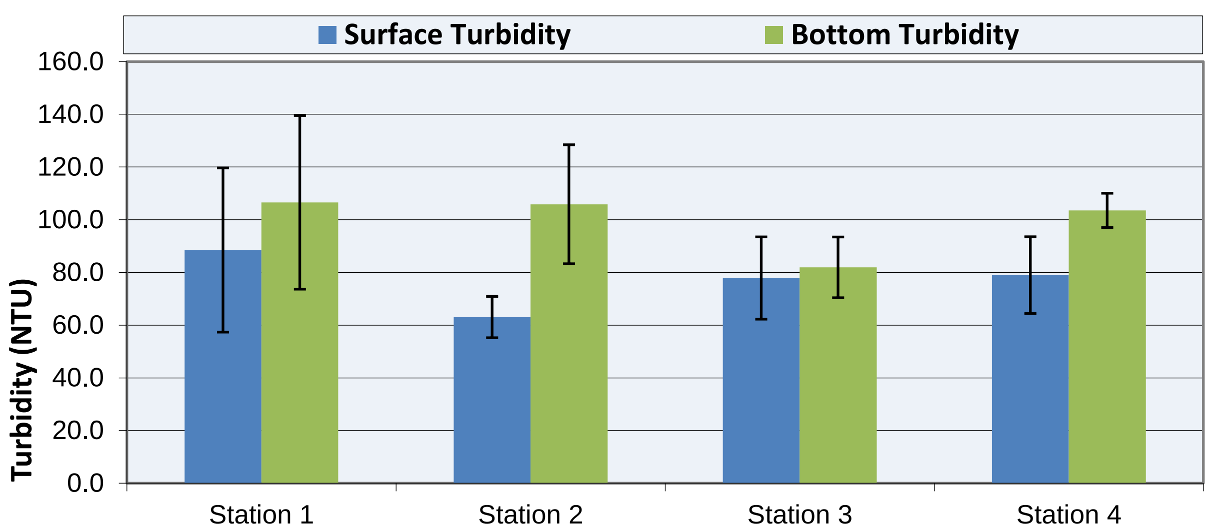
Figure 8. Mean (+ SE) monthly Dissolved Oxygen in receiving water for 2017



Turbidity

Turbidity was measured monthly at the four monitoring stations. Surface and bottom turbidity was considerably higher across all stations in 2017. As expected, bottom turbidity was higher at each station, with stratification evident to varying degrees across all stations.

Figure 9. Mean (+ SE) monthly Turbidity in receiving water for 2017



Chlorophyll-*a* Monitoring

The City measured chlorophyll *a* as an index of phytoplankton biomass in Pond A18 by collecting a monthly grab sample in a 1-liter amber glass jar. This sample, kept cool and out of direct light, was sent by same-day courier to Basic Laboratory services in Redding, CA for analysis.

Chlorophyll *a* concentrations in Pond A18 were significantly higher in 2017 compared to last year (Table 11). At the onset of the 2017 monitoring season, chlorophyll *a* concentration was over three times greater than that of the previous year. Chlorophyll *a* concentrations remained two to three times higher than 2016 throughout the entire 2017 monitoring season, with the exception of the month of August.

Table 11. Monthly chlorophyll *a* measurements at Pond A18 discharge

Salinity measurements are included for context to indicate general changes in pond characteristics.

Month	Date sampled	Chlorophyll *a* (μg/L)	DO (mg/L)	Salinity (PSU)
June	6/28/2017	681	8.1	5.2
July	7/18/2017	280	3.3	6.1
August	8/28/2017	208	6.2	9.5
September	9/27/2017	561	7.3	9.5
October	10/26/2017	513	18.7	10.0

D. Sediment Monitoring

A letter from the Water Board's Executive Officer Bruce Wolfe dated 15 September, 2010 modified the annual mercury sediment monitoring requirement, allowing for a change in location from Pond A18 to the receiving water and adjusting the sampling frequency to every other year during the months of August through September. Consistent with the revised sampling frequency, the City contracted USGS to conduct sediment sampling on September 6, 2017. Sediment sampling was performed in Artesian Slough in 2011, 2012, 2013, and 2015.

Mercury/Methyl Mercury

Artesian Slough sediment was sampled for total mercury and methyl mercury at four locations by the United States Geological Survey (USGS). Total mercury in sediment samples ranged from 160 to 304 ng/g dry weight (Table 12), which is well below USEPA criteria for total mercury in sediment (1000 ng/g dry weight). Methyl mercury concentrations in sediment ranged from 2.8 to 15.4 ng/g. Both total mercury and methyl mercury concentrations in 2017 were consistent with prior years at all four stations.

Table 12. 2011-2017 sediment mercury & methyl mercury results for Artesian Slough.

Analyte	Year	Station 1	Station 2	Station 3	Station 4
Total Hg (ng/g)	2011	131	310	329	232
	2012	198	433	387	253
	2013	242	448	501	368
	2015	222	261	325	144
	2017	298	304	298	160
Me Hg (ng/g)	2011	2.0	13.1	1.6	1.5
	2012	6.7	3.5	19.3	1.7
	2013	9.9	17.9	3.0	2.5
	2015	0.9	10.0	1.8	0.5
	2017	15.4	4.5	3.7	2.8
Percent Fines (%)	2011	33	92	92	68
	2012	36	80	94	50
	2013	63	90	92	69
	2015	71	99	96	38
	2017	87	73	84	36

III. Exceedances and Triggered Actions

A. Summary of Exceedances and Triggers

Table 6 lists the DO trigger events for pond discharges in 2017 and subsequent responses.

B. Summary of Corrective Action

There were fifteen weeks in which the weekly 10^{th} percentile DO level in the pond's discharge dipped below the trigger threshold. The City responded by conducting additional weekly discrete water column measurements at three stations in Artesian Slough and Coyote Creek (Figure 1, Table 9). An evaluation of trigger data revealed no negative effects in the receiving water that could be attributed to Pond A18 discharge, so no additional protective actions were implemented.

IV. Discussion and Interpretation of 2017 Results

Temperature

Although pond mean temperature increased slightly in 2017 in comparison to previous years, it varied little between discharge and non-discharge periods. Pond temperatures generally peak in July/August and exhibit large fluctuations depending on heat waves or cloud cover.

Salinity

Discharge salinity in 2017 was considerably lower compared to years past due to lower salinity water entering the pond from the southern intake point throughout the entire monitoring season. In past years when the intake point was the northern structure, pond salinities averaged significantly greater. The mean pond salinity in 2017 was 7.9 PSU, compared to mean salinities of 30.5 PSU and 29.4 PSU for years 2014 and 2013, respectively, in which the pond was managed in a southern release scenario throughout its entire dry season monitoring. Similar to patterns observed over the previous years, salinity climbed steadily through the season and peaked in late September into early October.

Consistent with prior years, salinity gradients in the receiving water were driven by tidal cycles and fresh water effluent from the Facility. The less dense freshwater tends to float on top of the saltier bay water that is pushed into Coyote Creek and Artesian Slough by the flooding tide.

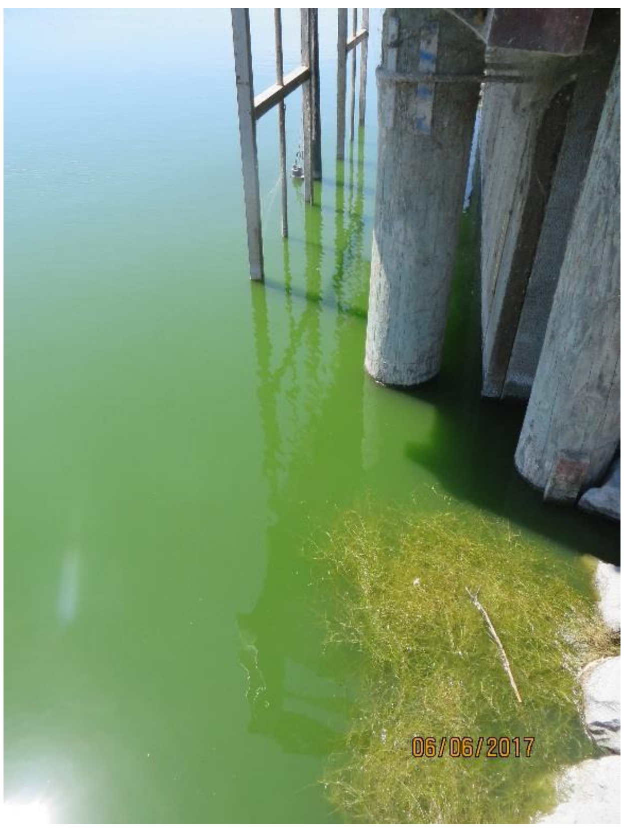
pH

Increases in pond pH are driven by high rates of photosynthesis, accompanied by high irradiance and temperatures. Conversely, high salinity can act as a buffer, limiting pH increases. Despite the reversal of the pond's continuous circulation regime, pH in 2017 was consistent with years past, albeit more varied. pH increased due to episodes of intense photosynthesis, followed by declines when algae experienced periodic decomposition. Pond pH followed the typical pattern of climbing gradually throughout the dry season in 2017, and remained elevated at the close of the monitoring season.

Dissolved Oxygen

Pond dissolved oxygen concentrations in 2017 were slightly lower (mean DO of 7.1 mg/L) compared to the previous year (mean DO of 7.7 mg/L). Similar to the previous year, pond DO was variable at the start of the 2017 season, with the boom and bust cycle of super-saturation to low DO occurring in June and throughout the remainder of the monitoring season. This is likely due to the higher load of nitrogen entering the pond due through a southern intake point proximal to the Facility. Higher nitrogen loads in a shallow, freshwater system can lead to high algal biomass (> 60 ug/L chlorophyll-a), and Pond A18's chlorophyll concentrations never measured below 208 ug/L. As abundant phytoplankton or macro-algae die and decay, the decomposition process consumes dissolved oxygen in the water column and drives DO concentrations down. Consequently, there were a total of fifteen trigger events in 2017.

Nuisance Filamentous Macro-algae



The presence of filamentous macro-algae in Pond A18 varies from year to year. Filamentous algae consist of macroscopic filaments which are of little value to pond productivity since benthic filter feeders and filter-feeding zooplankton (copepods, cladocerans, rotifers, shrimp, aquatic insects) are not able to utilize them effectively. Further, filamentous algal mats impede light penetration through the water column, thereby decreasing phytoplankton production and overall pond productivity.

During the first few months of the 2017 monitoring season, filamentous algae grew in sparse patches along the Pond A18's margins. The expansive surface and benthic accumulations that have been observed in years past never became established at any point in the 2017 season.

Condition Assessments of Southern Hydraulic Structure

In March 2015, the U.S. Army Corps of Engineers authorized the emergency replacement of Pond A18's northern hydraulic structure to prevent critical structural failure and subsequent breach of the levee system. During the reconstruction of this structure in the summer of 2015, the southern structure was used to pulse water into and out of the pond to maintain pond water elevation and water quality. This pulsing of water exacerbated bank erosion and active scouring/slumping on the outboard levee proximal to the southern structure.

Google Earth satellite imagery details the erosion on the outboard side of the southern hydraulic structure.

Construction of the northern structure was completed in August 2015, and the water control structures were configured to return to the pond's normal continuous circulating regime of intake at the northern structure and discharge from the southern structure. The erosion around the southern structure progressed to the extent that Facility engineering staff and consultant geotechnical engineers recommended an alternate flow regime to mitigate risk of levee failure and breach.

The extent of the active scouring rendered the southern structure's trash rack ineffective in preventing fish from entering the pond. Facility staff installed fish screens in early 2016, and continuous circulation of Pond A18 was re-oriented for inflow at the southern structure and discharge from the northern gate.

Steel flap gates were replaced with slotted fish screens to allow for inflow while preventing fish passage.

Throughout the 2017 monitoring season, Staff calculated 10th percentile weekly DO values on north discharge water, and the monitoring stations in the receiving water for monthly discrete sampling, along with trigger monitoring sites, were adopted in accordance with the north release scenario detailed in the WDR and A18 Operations Plan.

Pond Infrastructure

The City contracted HydroScience Engineers, Inc. to prepare a biddable set of plans and specifications to repair/reinforce the levee embankments and channel bottom in the vicinity of Pond A18's southern structure to allow for flow in either direction. Repairs will likely include, but not be limited to:

-Installing sheet piles along the inboard and outboard levee banks on each side of the structure.

-Rebuilding levee banks in the vicinity of the gate with engineered fill and installing articulated concrete block mats to armor these embankments.

- Filling and reinforcing the below-water scouring structure with fill material such as riprap or layered articulated concrete block mats.

- Repairing/replacing the structure's deck framing.

As the City awaits issuance of permitting required for repairs and restoration of the levee embankments, Staff has developed a monitoring protocol to document and track the progress of erosion. In August 2017, monitoring was initiated with the placement of survey lath and the collection of photo documentation in areas of concern. Pertinent weather and tidal information was compiled and included in the monitoring reports. In October 2017, Cal Engineering was asked to provide consultation to further develop the City's monitoring methodology and reporting. Staff placed additional survey lath and whiskers on the levee embankments, and established photo points for ongoing tracking and comparison of conditions. Alert Levels were established to indicate incidents of significance meriting further City review, and Action Levels were identified as conditions requiring immediate corrective actions. Condition assessments have been conducted on a biweekly basis, as well as immediately following storm events delivering greater than .75 inch of precipitation.

The City continues to monitor the mechanical and geotechnical vulnerabilities of the pond's southern structure, and adjust operations to minimize sediment transport, scour and levee erosion.

Avian Habitat Value

The City partners with the Santa Clara Valley Audubon Society to evaluate local Christmas Bird Count (CBC) data to assess avian population trends. The Alviso Complex CBC dataset, encompassing the Facility and surrounding wetlands, most notably Pond A18, extends back to 1975 and provides 40+ years of data which has been instrumental in evaluating bird recovery in the context of Facility treatment advancements and large-scale wetlands restoration efforts.

2017 waterfowl abundance data underscores the habitat value of the Alviso Complex system, with overall counts roughly double the population tallies before Pond A18, along with nearby Ponds A16, A17, A19, and A20 were breached and managed for long-term restoration in 2005-2006. Such positive trending illustrates Pond A18 continues to provide foraging and congregating habitat for many waterfowl species.

V. Lessons Learned and Recommendations

1. Thirteen years of monitoring sediment mercury and methylmercury in the pond and then in Artesian Slough has not resulted in any valuable data or insights into mercury concentrations or methylation rates associated with Pond A18. This requirement serves to divert time, staff resources, and money towards collection of data that is not utilized or valuable.

   Recommendation: Discontinue future mercury and methyl mercury associated with the Pond A18 WDR.

2. Sampling chlorophyll *a* is useful for characterizing the variability of phytoplankton abundance in pond A18.

   Recommendation: Continue monitoring chlorophyll *a.*

3. Pond A18's primary productivity can decrease with cloud cover and rain events, which can decrease photosynthesis and temporarily lower DO. No adverse effects on receiving water DO have been measured during these short-term decreases in the thirteen years of monitoring.

   Recommendation: Continuous pond discharge provides the most stable conditions in the pond. Shutting the discharge valve as a result of temporary low DO due to uncontrollable conditions may exacerbate low DO due to stagnation of pond water.

4. Adoption of a northern discharge regime since 2016 has resulted in higher nitrogen inputs to Pond A18 due to a greater percentage of Facility effluent rich slough water entering the pond. Consequently, phytoplankton biomass was higher throughout the entire 2017 monitoring season than in previous years. Dissolved oxygen concentrations were more variable earlier in the year and low DO occurred more frequently this monitoring season, likely due to the increased algal biomass. As with all previous years, the low DO conditions in 2017 did not affect water quality in either Artesian Slough or Coyote Creek, indicating that the pond discharges have minimal spatial influence on receiving water DO.

   Recommendation: Considering the negligible effect of pond discharges on receiving water DO, the City shall continue to manage the pond's operations to minimize sediment transport, scour and levee erosion by adjusting flow and discharge configuration as ongoing monitoring dictates.