D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2017

CITY OF CAPITOLA, 420 Capitola Avenue, Capitola, California 95010

February 2018 **Project # 106-27**

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ACKNOWLEDGMENTS

Ed Morrison and the Capitola Public Works Department did well in creating and maintaining the lagoon in 2017. Extending the plywood above the flashboards on the flume inlet succeeded in maintaining the deepest lagoon possible. We appreciate that Matt Kotila, as heavy equipment operator, and Ed Morrison, as Contracting Supervisor, teamed to daily observe the lagoon and adjust to its needs. Every year is different, and we are grateful for their attentiveness, along with that of other Public Works staff. Longtime Public Works staff, Lance Elliott, passed away during sandbar construction after his battle with cancer. He assisted us for many years in preparing the sandbar and beach for summer, and will be sorely missed. In later years, I would see him working the street sweeper during my early morning lagoon monitoring. He always greeted me with a smile and a wave. I looked forward to it. Lance was a gentle soul and will not be forgotten by this biologist or the Public Works staff.

Regarding the Begonia Festival, the organizers and volunteers effectively dismantled the floats and removed flowers by boat after the parade. We thank Nels and Susan Westman again for the loan of their vintage Sears-Roebuck rowboat for fish censusing and placement/ retrieval of temperature probes.

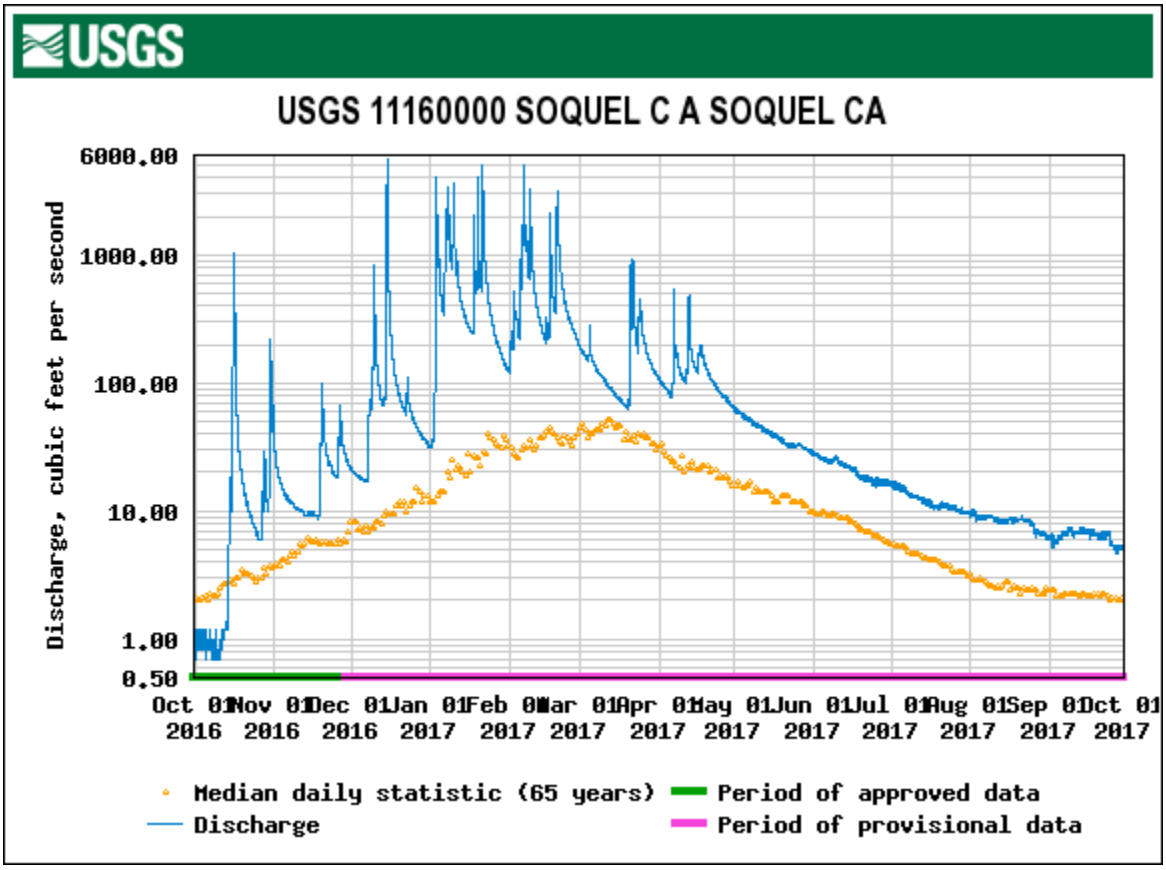
We were grateful to the volunteers who assisted in annual fish censusing at the lagoon. There were local residents and Coastal Watershed Council Education Coordinator, Mollie Behn, and other volunteers. Ben Harris from the Monterey Bay Salmon and Trout Project helped on the first weekend. Robin Aston, math teacher at Soquel High, brought her students. They were very important in providing enough help. The fish data were sent to her afterwards for use in her classes. A local middle school science teacher also assisted. Nigel, a high school biology student from Woodside High, assisted us on both weekends, with his parents providing transportation. Nancy Scarborough (former Coastal Watershed staff member) assisted in seining and data collection on the second weekend. A UCSC student and his parents also assisted. Biologists, Josie Moss, Inger Marie Laursen and Debie Chirco-Macdonald provided their positive energy in working the seine and recording data. Chad Steiner was key to setting the seine, capturing fish and processing them. One of Chad's daughters helped with the seining. Volunteers are greatly appreciated and always welcome on typically the first two Sunday mornings in October. Seining usually ends by 1:00 pm, in time for other afternoon activities.

Lance Elliott

REPORT SUMMARY

Sandbar Construction. No negative impacts to steelhead were detected during sandbar construction in 2017. Sandbar construction and creation of a freshwater lagoon of maximal depth represented habitat enhancement. Sandbar construction was started prior to Memorial Day weekend in May 2017 and was finalized on 1 June. Sandbar construction has been permitted by the California Department of Fish and Wildlife (1600-2003-0357-3), the Army Corps of Engineers (25714-0S), the Regional Water Quality Control Board (Certification No. 34417WQ01) and under the National Marine Sanctuary Permit MBNMS-2004-033-A1. The entire estuary reach was surveyed for steelhead spawning redds, including the glide above estuary influence. No steelhead redds were found. Two lamprey nests were found in the glide above estuary influence. As required in the permit, a fisheries biologist was present during all sandbar construction activities that could affect fish habitat in the lagoon/estuary. This was year 27 of our monitoring and activities associated with sandbar construction. Annual monitoring reports for the first 26 years are available at the City (**Alley 1991-2017**).

Previous winter storms created numerous stormflows greater than 1000 cfs at the Soquel Village gage from October through February and 3 more in the 400−900 cfs range in March and April. The 4 largest stormflows were in the 4,000 to 6,000 cfs range, with bankfull discharge likely around 1,500 cfs. It was the wettest winter since 2006. Stream inflow during sandbar construction was high at 33.4 cfs (Soquel Village USGS gage) when sandbar construction began.



In 2017, no tidewater gobies (*Eucyclogobius newberryi*) or salmonids (*Oncorhynchus spp*.) were observed in the lateral channel or the estuary/ lagoon during sandbar construction activities. **On 22 May 2017,** the typical lateral channel across the beach to the jetty was observed with deep scour. Several pieces of large wood were lining the channel. The cottonwood trunk that had been across from Noble Gulch confluence for more than a decade was now at the mouth of the lateral channel along the outer jetty. Sand was deposited far out on the beach shoulder, 40-50 feet beyond the flume exit, which was buried. The lateral channel was manually blocked with sand at its beginning and fish rescues began. Three staghorn sculpins (*Leptocottus armatus*) were captured and relocated to the lagoon area after 8 total seine hauls throughout the lateral channel. The flume was unplugged, and a sandbar berm was created around the lagoon periphery. Water passed out through the flume. **On 23 May,** the sandbar berm had held the previous night and smolt passage was provided through the flume. Because the lateral channel was not covered over yet and high tide overnight had rewatered it, 6 more seine hauls were made in the full extent of the lateral channel. Three staghorn sculpins, 3 smelt (*Atherinops spp.*) and 1 threespine stickleback (*Gasterosteus aculeatus*) were rescued in the lower fourth of the lateral channel that was tidally influenced. The fish were relocated to permanent water at the end of the jetty. **On 24 May,** the sandbar had opened on its own the previous night. The outlet channel was 25-30 feet wide on the east side of the flume. Alley and Morrison walked upstream to Nob Hill, searching for sidepools and stranded fish. None were found. Only one small side puddle was observed adjacent to Shadowbrook Restaurant, and no fish were observed in it. Two submerged lamprey nests were observed just above the riffle that entered the Sister's Pool adjacent to the Rispin Mansion. They were just upstream of the upper extent of the estuary bathtub ring. No kelp or seagrass was observed in the estuary. Kotila continued to stockpile sand closer to the esplanade wall and Venetian Court through the day. The outlet channel was left open. **On 25 May,** the outlet channel remained open overnight with 32 cfs flow at Soquel Village. Smolt passage was provided. Kotila created a compacted pad of sand around the flume inlet to reduce water seepage under flume. The fishery biologist surveyed the outlet channel and observed no fish. The flume outlet had plugged with sand overnight, which was removed by hand with shovels. The outlet channel was closed off to form a sandbar and allow the lagoon to fill. The flume was passing water by noon to insure fish passage overnight. **On 26 May,** the sandbar had remained in place overnight and water flowed through the flume to an exposed outlet that provided smolt passage. Kotila continued to stockpile sand on the inner beach in preparation for Memorial Day weekend. **On 30 May** after Memorial Day weekend, the sandbar was intact and the lagoon was full. The flume was open, as it was over the Memorial Day weekend to provide smolt passage. Sand continued to be stockpiled from the outer beach to the inner beach. **On 31 May**, the sandbar was intact overnight. Streamflow exited through the flume for smolt passage. Kotila graded sand near the jetty and up to the inner beach from near the surf line. **On 1 June,** the sandbar remained in place the previous night, and water flowed through the flume to insure smolt passage. Kotila opened the sandbar slightly in the morning near the flume inlet, and the estuary drained slowly but not completely. At its lowest point, the estuary extended from bank to bank without exposed streambed or isolated pools formed. The flume inlet was prepared. The weir inside the flume was confirmed to be in place. The sandbar was closed for the season at 1335 hr.

Sandbar Breaching. A tractor is used in the fall to cut a notch approximately 30 feet wide in the sandbar adjacent to the flume, but slightly deflected to the east. A berm was left along the lagoon

margin between the notch and the lagoon. An additional berm was constructed across the notch near the surf to prevent wave action from entering the notch. The intent is to prepare the sandbar so that it would breach at the proper time to prevent flooding. The City cut the sandbar notch below the elevation of the lowest piling bolt, about 0.5 feet below flood stage. The facilitated breach plan was for the tractor to re-cut the sandbar notch, if necessary, and breach the inner berm across the notch first and the outer berm last after the notch filled with waters so that the entire sandbar would breach and allow the lagoon to drain slowly prior to flooding. Flume capacity was approximately 30 cfs. On 16 November, an emergency sandbar breach was facilitated by Kotila at 1410 hr with a 48 cfs reading at the Soquel Village gage. Alley (biologist) and Morrison were present. The City Manager Goldstein observed. Continued steady rain was in the forecast. This was the appropriate time to facilitate the sandbar breach to avoid flooding that would predicatively have occurred otherwise within the next hour or so. The lagoon water surface at breaching was approximately 8 inches below the bent piling bolt and 1 foot below flood stage and rising quickly. Streamflow registered at Soquel Village gage through the day supported our prediction, with the maximum measurement of 295 cfs was reached by 1800 hr.

Stream Inflow and Influence on Lagoon Water Temperature. Baseflow into the 2017 lagoon was relatively high. 2017 streamflow on June 1 at Soquel Village was 26.7 cfs compared to 7.3 cfs in 2016 and 2.6 cfs in 2015. By October 1, the respective streamflows were 5.5, 0.7 and 0.25 cfs. Lagoon water temperature heats up more during the day with less inflow, as indicated by average lagoon water temperature at the 4 monitoring stations at dawn and in the afternoon in 2015 (low stream inflow), 2016 (intermediate stream inflow) and 2017 (high stream inflow) (**Figures 3k-3l**). 2015 had relatively warm air temperature (**Figure 3f**), warm inflow (**Figure 3e**) and very high lagoon water temperatures at dawn and the afternoon (**Figures 3k-3l**). The 2016 dry season had relatively cool air and inflow stream temperatures. The 2016 lagoon had intermediate average water temperature through early August, while the 2017 lagoon was the coolest of the 3 years through early August, despite its warmer inflow throughout most of the summer and fall. However, from early August through mid-September, air temperature (**Figure 3f**) and stream inflow temperature (**Figure 3e**) were much warmer in 2017 than 2016, and average lagoon water temperature was similar for 2016 and 2017 (**Figures 3k and 3l**). The 2015 lagoon, with its very low inflow rate, was much warmer than the 2017 lagoon, even though inflow water temperature was similar or warmer in 2017 compared to 2015 from early August to mid-September. The annual trend in 7-day rolling temperature averages with respect to the seasonal maximum, average and minimum for the dry season indicates an inverse relation between stream inflow rate and average lagoon temperatures in most years (**Figure 4i**). As inflow declines, lagoon water temperature increases. However, in 2017 the pattern did not hold because of warm air temperatures in September and corresponding warm stream temperatures that may have been enhanced by reduced stream shading after a high flow winter that removed some riparian vegetation.

Water Temperature. Lagoon water temperature was well within the tolerance range of steelhead in 2017 and was not likely stressful except for 4 days in early September when water temperature exceeded 22°C at 0.5 ft above the bottom and the 7-day rolling average exceeded 21°C (**Figure 4a**). Daily maximum lagoon water temperatures through June and July were about 1°C cooler in 2017 (daily range mostly 19.5−20.5°C) compared to 2016 and about 1°C warmer in August and September (daily range of 19.5−22°C).

In 2017 at 2-week monitoring sites, *water temperatures near the lagoon bottom just after dawn* were rated "good" (<=20°C) at all sites except rated "fair" (<= 21.5°C) at 3 of 4 sites in early August (**Tables 2 and 3**).

As in past years, no temperature stratification or lagoon thermocline was detected in 2017. As in past years, lagoon water temperatures near the bottom in 2017 somewhat reflected those of stream inflow (**Figures 4a-j; 5a-b**). The seasonal maximum and minimum water temperature was warmer in the lagoon near the bottom than in the stream inflow, as were the minimum, maximum and average 7-day rolling averages (**Table 4**). However, unlike in other years, the stream inflow water temperature in the afternoon was within the range of afternoon lagoon water temperatures near the lagoon bottom through August instead of cooler. Lagoon inflow was more than 1°C warmer than all lagoon stations in early September, which had not occurred in previous years when inflow remained cooler than the lagoon (**Figure 3h**). Stream inflow temperature in 2017, as in other years, had greater daily fluctuation than near the lagoon bottom.

In 2017, the lagoon steelhead management goal was met for maintaining morning temperature near dawn below 20°C near the bottom (**Figure 4a; Table 5**). The lagoon management goal to maintain maximum daily water temperature below 22ºC near the bottom was met except for 4 successive days in early September. The management goal to maintain the 7-day rolling temperature average at 21°C or less near the bottom was met except for the same 4 days.

Aquatic Vegetation. In 2017 at the time of sandbar construction, no decomposing kelp or seagrass were observed in the lower lagoon, downstream of Stockton Bridge. The lagoon bottom was firm. In 2017, the thickness of algae and the coverage and thickness of pondweed was less than in 2014−2016 (**Tables 6−8**). The pondweed came on late in the season in 2017 and had coverage restricted to Reach 1 below Stockton Bridge and under the railroad trestle. The only lagoon-wide planktonic algae bloom was observed on 1 October. Station 4 at the mouth of Noble Gulch had a chronic planktonic algal bloom. However, average algae thickness was not greater there than at other stations except in early September, and pondweed was absent at the mouth of Noble Gulch in 2017. Surface algae was greater at Station 4 than elsewhere in 2017, averaging 3.6% with a maximum of 20% in early September.

Surface algae with floating pondweed fragments were similarly relatively uncommon in 2015−2017. Regarding season averages for surface algae (and pondweed fragments), in Reaches 1–3 for 2017, they were 0.4, 1.1 and 0.8 % of the surface covered.

Oxygen Concentration. Oxygen concentration was lowest at dawn, or soon after, because oxygen was depleted by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is when oxygen concentrations are most importantly measured and rated. In 2017, the oxygen concentration at each of the 4 stations near dawn and in the afternoon remained "good" (greater than 7 mg/l) for steelhead *near the bottom* during 11 of 12 two-week monitoring to November 11 (**Table 2; Figures 6a-1; 6a-2; 6b−6e**). The one exception was a "fair" rating at Station 3 near the Railroad trestle on 29 October. Morning oxygen concentration near the bottom ranged from 6.3 to 11.0 mg/L at the 4 lagoon stations during the 12 monitorings. Afternoon oxygen concentrations near the bottom ranged

from 7.6 (76% saturation) to 15.7 mg/L (153% full saturation) at the 4 lagoon stations.

Salinity. In 2017, no saline conditions were detected in the lagoon. A freshwater lagoon was maintained throughout the period of sandbar closure until sandbar breaching on 16 November. No tidal overwash was allowed to occur through the dry season in 2017, with the elevated berm around the lagoon.

Begonia Festival Observations and Water Quality Findings. No negative impacts to fish were detected during or after the parade in 2017. The City's fishery biologist (Donald Alley) was present before, during and after the nautical procession of floats on 3 September. The parade occurred during the 4-day period in 2017 when the lagoon temperature management goals of maintaining maximum daily water temperature below 22°C and the 7-day rolling average below 21°C were not met (**Table 5**). The gage height that day was excellent at 2.65. The warm water temperatures were the result of warm air temperatures throughout the day and not due to activities of the parade. Oxygen concentrations were very good and supersaturated in the afternoon at measured stations ranging between 135 and 165% full saturation. The procession included 11 floats (all powered by electric motor, 1 assisted by boat paddlers.) One paddle boarder was observed wading after procession ended and was asked to stay on his board. It was the largest crowd the biologist could recall, it being the last, 65th Begonia Festival.

Floats were dismantled the week following the parade, and flowers were gathered from the lagoon, using a boat. More than 90% of the petals were retrieved. Water quality measurements on 17 September detected no oxygen depletion resulting from decomposing begonias (**Figure 6a-1; Appendix A**).

Fish Sampling Results. Fall sampling for steelhead occurred on 8 and 15 October 2017, from upstream of the Stockton Avenue Bridge to the beach. The lagoon population estimate was 259 steelhead (**Table 15**). Juveniles were relatively large (**Table 14; Figure 7a**), but the population size was relatively small compared to the 23-year average of 1,482 (**Figure 24**). This small lagoon population was consistent with low densities of juvenile steelhead detected at most stream sampling sites (**Alley 2018**) and did not indicate poor lagoon nursery habitat. The high growth rate of juveniles indicated very adequate food supply. Fish scale analysis indicated a year class overlap between young-of-the-year and yearling (1+) steelhead occurred in the 150−160 mm SL range. There was no bimodal shape to the size frequency histogram in 2017, unlike in 2016. This indicated that a major portion of the juveniles in the lagoon were likely yearlings and older. Other species captured with the large seine for both sampling days combined were threespine stickleback, starry flounders, staghorn sculpins and YOY Sacramento suckers.

On 15 October 2017, tidewater gobies were sampled for in lower Soquel Lagoon near the beach. No tidewater gobies were captured in 2017, after 4 previous years of occurrence (**Table 17**). The apparent absence has occurred in the past after wet winters. Overwintering cover is scarce at Soquel Lagoon. Tules were planted in summer 2017 in the cove beneath the railroad trestle to improve cover. Threespine stickleback (100+), juvenile Sacramento suckers and staghorn sculpins were captured with the goby seine.

Recreational Use, Pollution and Solutions. The lagoon near the beach was posted as

hazardous to human contact due to bacterial levels above the maximum acceptable level. However, increased human use of the lagoon was observed in 2016 and 2017compared to past years, coincident with the opening of a paddleboard concession. Paddle-boarders were common (observed on 10 of 12 afternoon weekend monitorings in 2017), along with more occasional kayakers, canoers and barge users (3 occasions that included bird feeding) throughout the lagoon. The most paddle-boarders counted in a reach were 5. Waders were commonly observed in the lagoon (usually near the beach in Reach 1; 4 of 12 afternoon weekend monitorings in 2017; 7 of 9 afternoon weekend monitorings in 2016). The most waders seen at one time were 8. Human contact with the lagoon occurred despite warning signs being posted in close proximity.

Instances of observed fish angling increased in 2017 to four. One group at a lagoon-side rental reported catching an adult steelhead, 22 inches long, and releasing it. Another group at a lagoon-side rental was fishing near the railroad trestle. Another group fished from the Venetian Court wall. Fishing rods were seen leaning against the Golino cabin. CDFW posted a fishing regulation sign at the beginning of the path along the east side of the lagoon. Two instances of heavy bird feeding were observed, with 32 ducks attracted at one time. Ducks were more attracted to the monitoring biologist along the periphery in 2017 compared to past years, perhaps due to increased bird feeding. In 2017, algae production was much reduced, and pondweed was scarce except in Reach 1. Thus, the ducks had less aquatic vegetation to process to obtain invertebrate food from. Humans feeding the birds attracted gulls further up the lagoon where they usually did not go. Gulls are a threat to duckling survival.

The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. The parallel wires strung across the roof of the Paradise Grill and other restaurants have been effective in discouraging roosting. All of the refuse cans on the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, pers. comm.**). City building permit conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, Public Works Director, pers. comm.**). Gulls bathing in Reach 1 were interrupted by paddle-boarders and other traffic on the lagoon. The impact of human interference with gull bathing and defecation rate into the lagoon is unknown.

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included in these are urban storm drains leading to Noble Gulch. This would prevent pollutants from anthropogenic sources of street and sidewalk runoff from reaching the lagoon. Surface algae was thicker at the mouth of Noble Gulch than other stations on occasion in 2017, and the highest estimates of 10% and 20% surface coverage occurred there (**Table 6**). Surface algae was as high as 20% there on occasion. Gray plumes were commonly observed emanating from the Gulch (6 of 12 monitoring days). A chronic planktonic algae bloom existed there much of the summer. These are all indications of nutrient pollution and increased eutrophication at the mouth of Noble Gulch in 2017. Water samples were taken from Noble Gulch at several locations during the dry season in an effort to detect pollution sources. The results are yet to be analyzed. By minimizing the summer stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced.

Regarding pollution from urban runoff once the rains start in fall, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff. There has been a pollution problem and high flashiness in streamflow in the past during the first small storms of the fall. Early storms turn the lagoon water turbid (cloudy), requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2016, the lagoon required breaching prematurely because the flume could not accept all of the stormflow with flooding imminent. Retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the sources of this problem.

The storm drain along the Esplanade was connected to the sewer line in 2006 for summer diversion of water in the drain to the sewer system. An automatic pump switch is connected to a float to activate the pump.

The historical lagoon had large tule beds prior to construction of the bulkheads in response to the 1955 flood. Tules are commonly used in managed wetlands to remove nutrients and other pollutants from wastewater effluent. Re-establishment of tule marsh in Soquel Lagoon would reduce nutrient pollution and may reduce bacterial counts while providing fish habitat. Tules were planted in the cove under the railroad trestle in 2017.

Permits required monitoring of enterococcus bacteria in the Bay prior to sandbar breaching and afterwards. The pre-sandbar breaching count near the flume was 331 MPN/100 ml. The immediately post-sandbar breaching count was 1,770 MPN/100 ml. Santa Cruz County data indicated that the enterococcus count declined to 10 MPN/100 ml (41cfu/100 ml Total Coliform count) by 20 November at 1155 hr.

Bird Counts. Piscivorous birds observed at Soquel Lagoon in 2017 included mergansers, pied-billed grebes, kingfishers and a common goldeneye duck. Mergansers were similarly observed in 2017 and 2016 but less than in 2013−2015. The most observed at a time was two in 2017. Mergansers were observed on 4 of 12 monitorings (33%) (**Appendix A**). In 2017, a cormorant was observed on one occasion. A common goldeneye was observed diving in Reach 1 on 16 November, the day the sandbar was breached.

In 2017, a pied-billed grebe was not observed until 20 August. None were seen on 2 September with heavy afternoon traffic from paddle boards, canoes, pedal boats, rowboats and a barge. After that, 1 or 2 were observed on each of the 5 remaining monitorings, totaling 6 of 12 monitoring days (50%) of the dry season. No brown pelicans were observed in the established lagoon in 2017, though 2 were observed in Reach 1 during sandbar construction in late May 2017. No black-crowned night herons or greenback herons were observed in 2017. Two snowy egrets were observed roosting on the railing at the dock at Station 4 (Noble Gulch) on 11 November.

Mallards and gulls were common in 2017. However, gull counts were lower in August−October than in past years (**Figure 46**), with the largest raft consisting of 85 gulls in October. Increased human traffic on the lagoon may have discouraged their afternoon use during weekend monitoring. Their numbers increased in October after recreational use declined. Mallard numbers tend to be lowest in the early lagoon season and decline in October as the coots become common (**Figure 47**). Mallard counts were less in the 2017 lagoon than the previous 3 years and were similar to 2013 levels. Mallard numbers have been higher in 2014-2016 than in 2012-2013 and 2017. In 2017, the mallard population remained mostly in the 15-30 bird range from early June to late September compared to the 30−40 mallards detected in 2016. In 2017, fewer ducklings were observed, and mallards no longer roosted on, or congregated around, the cottonwood log across from Noble Gulch because it was gone. In 2017, mallards were observed roosting at the west side Stockton Bridge park on 3 occasions, which was unusual, along with them roosting on the logs placed under the Stockton Bridge and on the concrete railroad trestle abutments, west side. In mid-September 2017, coots appeared at the lagoon, as annually occurs. As many as 34 coots were observed during a fall monitoring (29 October).

New and Continuing Recommendations

1. If the tules planted in the cove under the railroad trestle withstand winter stormflow, pursue planting them in other locations. Seek volunteers to re-establish tules near the Golino property. When this becomes successful, approach the restaurants to allow tule plantings in Margaritaville Cove. This will provide additional cover for steelhead and tidewater gobies against predators and may reduce dissolved nutrients and bacteria in the lagoon.

2. Continue to maintain and repair the flume as necessary. Repair the flume at a time that does not obstruct fish passage or require lowering of the lagoon water level.

3. Take special care to pack sand under the flume, between the pilings, during final sandbar closure in order to prevent seepage under the flume after closure. Continue to add plywood cutoff sheets between the pilings and perpendicular to underflow to maintain sand under the flume and to reduce water seepage and sink holes from forming.

4. Re-install the wooden baffle inside the flume during sandbar construction, if necessary.

5. Continue to maximize lagoon depth through the dry season, while maintaining passage through the flume for adult steelhead until June 15 and for steelhead smolts until July 1. If the lagoon level begins to drop below the notched upper flashboard for steelhead smolts because of the adult portal after June 15, close the portal. If inflow is sufficient to maintain depth with the adult portal open, leave it open through the dry season. If adult steelhead are seen in the lagoon after June 15 with the portal closed, then open it for a week to allow out-migration.

6. After July 1, leave the flume exit closed if it closes, unless flooding is eminent. Continue to install visquine or plywood on the outside of the flashboards to prevent leakage into the flume and maximize lagoon depth. Maximize the number of boards in the flume entrance to maximize lagoon depth.

7. Continue to secure the flume boards at all times to prevent their lifting by vandals to drain the lagoon. This will also discourage bay back-flushing of saltwater into the freshwater lagoon.

8. Closing the sandbar in late May is better than mid-June or later because streamflow is sufficient to rapidly fill the lagoon in most years, and the juvenile steelhead most likely to be present in the lagoon in May are out-migrating smolts. Late May is prior to down-migration of most YOY steelhead from spawning sites above the lagoon. Small steelhead fry remain in the vicinity of spawning sites before moving down into the lagoon.

9. The management solution for minimizing the time required for sandbar construction is for the City to remain flexible on timing of the work. If rain is in the forecast within two days after the intended starting date for sandbar construction, Public Works should postpone construction until clear weather is forecasted. If 4-5 working days are set aside to construct the sandbar, the sandbar construction may be delayed as late as 4-5 days before the Memorial Day weekend and may still satisfy the tradition of lagoon formation before then.

10. Continue to rake as much kelp and sea grass out of the lagoon as possible before final closure, from the Stockton Avenue Bridge downstream, including plant material trapped under the restaurants and in depressions around the bridge piers. Discontinue raking if juvenile steelhead are observed near the water surface. It is best to minimize time required to stockpile sand, rake out the decomposing organic material and prepare the flume inlet for fish passage. This will minimize the instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to be ready to enter the estuary at the earliest opportunity each day and quickly rake out decomposing kelp and to clear the sand-filled flume.

11. Continue to dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the Fish and Wildlife permit for sandbar construction. County Environmental Health approved of this method so long as kelp is spread over a wide area (**J. Ricker, personal communication cited in the original 1990 Soquel Creek Lagoon Management and Enhancement Plan**).

12. During sandbar construction, continue to close the lagoon each day before the incoming tide can wash salt water and kelp into the lagoon. Re-open the sandbar and unplug the flume, if necessary, each morning to facilitate kelp and sea grass removal.

13. During daily artificial breaching during sandbar construction, continue to maintain water depth in the estuary such that no isolated pools and backwaters form at the margins to strand fish. Blocking of the sandbar may be required to maintain sufficient depth. Check the estuary margins to prevent stranding of fish.

14. Continue to search under the Stockton Avenue Bridge and in Reaches 2 and 3 for stranded fish to rescue as the lagoon drains each day during sandbar construction and raking. It is best to minimize the number of days to construct the sandbar and rake out the decomposing organic material. This will minimize the artificial fluctuation of lagoon water level. Having a

maximum number of personnel to rake decomposing organic material into the bay and to clear the flume of sand will minimize the days needed to prepare the lagoon for the summer.

15. Continue to place a 4-inch by 4-inch plank in the base of the flume outlet to maintain adequate flume depth, if necessary.

16. Continue to maintain an underwater portal in the flume intake for out-migration of adult steelhead until June 15, while maintaining a notched top plank for out-migrating smolts until 1 July. However, in dry years such as 2007−2009 and 2013−2015, when stream inflow is insufficient to both fill an underwater portal and allow lagoon filling, opt for a larger notch in the top plank to accommodate adult kelts and smolts in place of the underwater portal for kelts.

17. Continue to maintain the 1-foot high baffle inside the flume until July 1 for safe entrance of out-migrating steelhead smolts into the flume inlet.

18. During sandbar construction, continue to lash floating logs together under the bridge to create fish cover if they are present and time allows.

19. As stated in previous reports, if the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing all surface flow, notify Tiedemann Nursery and the Fish and Wildlife Department so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

20. Check the gage height at the lagoon once a week (preferably the same day each week) and log the measurements so that the biologist may contact the City to obtain a weekly update.

21. A previous recommendation in the original Management Plan (**1990**) should be emphasized to prevent fish mortality; parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

22. To provide cover for juvenile fishes and to scour deeper habitat, continue to secure large woody material to the lagoon bottom with anchor boulders in appropriate locations. Continue to retain large woody material that naturally reaches the lagoon.

23. Continue to allow a clear path from under the Stockton Bridge to the beach at Venetian Court to enable seining for juvenile steelhead during fall censusing.

24. Continue to require that Margaritaville staff not wash their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

25. As stated in the Management Plan (**1990**), make sure that parking lots and streets draining into the lagoon are cleaned before the rainy season. This will reduce the pollutants entering the lagoon during the first storm of the season that are lethal to fish. Street sweepers with water and suction may be necessary. In addition, roadwork such as repaving and application of fresh petrochemicals should be done in the early summer to allow sufficient time for penetration and drying before the rainy season.

26. Prior to sandbar breaching in the fall, continue to notch the sandbar across the beach at an elevation just below the piling bolt for flooding, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize beach erosion. The purpose is to maximize the residual estuary depth after the emergency breach. The notch in the sandbar should be cut slightly lower than the piling bolt. *Continue to orient the notch laterally (diagonally) across the beach to the southeast of the flume. Continue to* m*ake the notch at least 30 feet wide across the beach to also maximize the possibility of maintaining an estuary with some depth after the breach.* The City may have to periodically re-establish the notch if it does not rain or high tides obliterate it. If a storm is predicted, the sandbar needs a notch as preparation. Continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with the wide notch in between. *When breaching must be facilitated, notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to the east to finish the sandbar breach.*

27. Remove three 4x4-inch flashboards from the flume inlet on one side immediately after the first stormflow of the season which does not require sandbar breaching. This will insure light penetration to the lagoon bottom. If turbidity still prevents light penetration to the bottom, remove enough boards to achieve complete light penetration. As water clarity improves, add boards back into the flume inlet. This will prevent death of aquatic vegetation and increased biological oxygen demand, with the associated loss of oxygen production that would have occurred from photosynthesis. Thus, low oxygen concentration or anoxic conditions will be prevented. This will insure light penetration to the lagoon bottom. If turbidity still prevents light penetration to the bottom, remove enough boards to achieve complete light penetration. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. As water clarity improves, add boards back to the flume inlet.

28. Just as the first storm of the fall season begins, remove boards from each side of the flume if a small storm is anticipated. The number of boards removed will be dictated by the anticipated size of the storm. Remove two boards from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit. After the stormflow subsides, replace the cover until the next storm.

29. If the lagoon bottom becomes invisible due to turbidity after the rains that do not breach the sandbar, continue to immediately lower the lagoon level to the point where the bottom is visible. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. A previous recommendation in the original Management Plan (**1990**) should be emphasized to prevent fish mortality**;** parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

30. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is eventually breached during later, larger storms usually occurring after Thanksgiving. There is now a grated opening on top of the flume inlet.

31. If the sandbar is in place after November 15, continue to maintain an opening in the flume inlet during early, small stormflows to allow early spawning salmonid adults to pass through the flume from the Bay.

32. After a small stormflow in the fall that has made the lagoon turbid, if the flume exit closes after boards have been removed from the flume inlet to reduce the lagoon water level, excavate the flume exit daily, if necessary, to maintain lagoon outflow and a shallower lagoon for effective light penetration.

33. In preparation for sandbar breaching in the fall, continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with a wide notch in between. The notch in the sandbar should be cut slightly lower than the piling bolt. Continue to make the notch at least 30 feet wide across the beach. The City may have to periodically re-establish the notch if it does not rain or high tides obliterate it.

34. When breaching must be facilitated to prevent flooding, continue to notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to finish the sandbar breach, if necessary. If possible, allow the streamflow and tidal action to "naturally" breach the outer berm.

35. Continue to notify the California Department of Fish and Wildlife 12 hours before the possibility of a sandbar breach and immediately after the breach occurs.

36. If the sandbar breaches early in the rainy season, followed by a period of 2−4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

37. If a stagnant, kelp-filled lagoon forms in fall after an early breach and a dry period, do not empty the lagoon by breaching the sandbar. Instead, use the flume and shrouds to pull saltwater out. Breaching of the lagoon will increase the opportunity for more kelp to enter and probably will not empty the entire lagoon anyway. Fish passage need not be maintained through the flume because it should be discouraged until sufficient stormflows develop to provide passage up the Creek. If adult salmonids enter too early, they will become stranded and unable to migrate upstream because of insufficient streamflow.

38. Continue to maximize the lagoon level for any future lagoon nautical parade.

39. Regarding the nautical parade, we continue to recommend that float propulsion by surfboard paddling or rowboat or electric outboard motor be required by the City rather than allowing pulling and pushing by waders. The latest CDFW permit prohibits wading. Allow float passage in one direction only, presumably downstream, before dismantling near the Stockton Avenue Bridge. In the past, floats were taken down the lagoon and then back up before dismantling back at the bridge.

40. Restrict the number/weight of float participants allowed to ride on the floats to a safe level.

41. Enforce the ban on waders during future nautical parades.

42. Continue to recommend to the lagoon parade organizers that floats be safely maneuvered downstream of Stockton Avenue, with a water marshal present to direct floats in a circular direction along the periphery of the lagoon after they clear the bridge.

43. Continue to recommend to the lagoon parade organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

44. Continue to use gull-proof lids on refuse cans at and around the lagoon and beach. Use enough refuse containers to satisfy the demand for refuse disposal.

45. Consider screening the railroad trestle to discourage roosting and nesting by rock doves.

46. The City should encourage and influence planners, architects and property owners through the permit process to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing development in the City and upstream.

47. The City should request from the flood control district that sediment and grease traps be installed, inspected and cleaned on drains leading into lower Soquel Creek.

48. Seek funding to secure large woody material to the lagoon bottom with anchor boulders and cabling to bedrock in appropriate locations on the east bank under the railroad trestle or upstream adjacent to the Golino property. This large woody material will provide additional cover and scour deeper habitat to protect juvenile steelhead from predators. Continue to retain large woody material that naturally enters the lagoon.

49. Road repaving and application of petrochemicals should be done early in the summer. This will allow chemical penetration into the pavement and drying before fall rains.

50. "Gull Sweeps" sold by West Marine Products should be installed on Esplanade roofs to test their effectiveness in deterring gulls. According to the catalogue, "Powered by the slightest breeze, the Gull Sweep's motion will deter the most determined bird." These were successfully used on San Diego restaurants (**Y. Sherman, pers. communication**).

51. The City should influence planners, architects and property owners through the permit review to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing land development within the City and upstream.

52. The City should request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned.

53. The City should continue to fund activities to permanently remove invasive Arundo (Giant Reed) from residences along the lagoon and other non-native plants in the riparian corridor

between Highway 1 and the lagoon in order to maximize stream shading, minimize water temperature of inflow water and protect aquatic and wildlife habitat.

54. Continue to census the juvenile steelhead in the fall to monitor the use of the lagoon as an important nursery area under varying management scenarios and restoration efforts.

LAGOON AND ESTUARY FORMATION

Fishery Rescue Actions Required Prior to Construction Activities

22 May 2017. The estuary margin was surveyed up to the mouth of Noble Gulch for coho salmon juveniles at 0630−0645 hr. No salmonids were observed. A lateral channel went across the beach from Zelda's Restaurant to the jetty, with 33.4 cfs measured at the Soquel Village gage. The lateral channel was blocked with sand and fish rescues began at approximately 1000 hr. The side channel remained inundated with water due to its low streambed elevation and tidal influence. Seining began at the upstream end of the lateral channel and progressed downstream. Ed Morrison assisted Don Alley. No fish were captured in the first 5 seine hauls with a 30-foot, 1/8-inch mesh beach seine. Three staghorn sculpins (*Leptocottus armatus*) were captured and relocated to the lagoon area after 8 total seine hauls ending at 1135 hr. The entire lateral channel down to the jetty was seined.

23 May 2017. The estuary margin was surveyed up to the mouth of Noble Gulch for coho salmon juveniles at 0640−0655 hr. No salmonids were observed. A lateral channel went across the beach from Zelda's Restaurant to the jetty. From 0930 hr to 1110 hr, 6 seine hauls were made in the full extent of the lateral channel down to the jetty. Cooper Sanden of Public Works assisted Alley in the seining. Three staghorn sculpins, 3 smelt (*Atherinops spp.*) and 1 threespine stickleback (*Gasterosteus aculeatus*) were rescued in the lower fourth of the lateral channel that was tidally influenced and relocated to permanent water at the end of the jetty. No tidewater gobies (*Eucyclogobius newberryi*) or salmonids (*Oncorhynchus spp*.) were observed or were observed to have suffered mortality in the lateral channel or the estuary/ lagoon upstream during sandbar construction activities.

As required in the permit, a fishery biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our twenty-seventh year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 26 years are available at the City (**Alley 1991-2017**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**) and 2004 Soquel Creek Lagoon Management and Enhancement Plan Update (**2004**), all instream removal of kelp, sea grass and other organic debris was to be done without heavy equipment in the stream channel except within 25 feet of the flume. The bulldozer/tractor could work adjacent to the flume.

Monitoring of Flume Maintenance and Sandbar Construction

22 May 2017. The fishery biologist, Alley, arrived at 0625 hr. The gauged discharge at Soquel Village was 32.5 cfs at 0600 hr. Delivery of the bull-dozer was delayed such that the operator, Matt Kotila, was not on the beach until 0937 hr to begin moving sand. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. The typical lateral channel across the beach to the jetty developed in 2017 with deep scour. Several pieces of large wood were lining the channel. The cottonwood trunk that had been across from Noble Gulch confluence for more than a decade was now at the mouth of the lateral channel along the outer jetty. Sand was deposited far out on the beach shoulder, 40-50 feet beyond the flume exit, which

was buried. The lateral channel was blocked with sand at its beginning and fish rescues began at approximately 1000 hr. The side channel remained inundated with water due to its low streambed elevation and tidal influence. The flume exit was excavated to ready it for water passage. Sand had plugged the flume despite it being open the previous week. The flume was unplugged with water flowing through by 1130 hr. The sandbar around the lagoon margin was built up to withstand high tides and a large swell overnight. There was not time to cover over the lateral channel after fish rescues. Two pelicans were observed in the estuary in early morning along with gulls. As many as 7 pelicans roosted on the flume later on. Sheet metal covers were placed over the sidewalk storm openings along the Esplanade to prevent cigarette butts from entering the summer lagoon. The biologist left at 1845 hr. A peregrine falcon zoomed past our heads on Zelda's Restaurant walkway toward a group of pigeons. However, none were hit.

Exposed flume prior to sandbar construction. (Add 1 hour to time stamp.)
22 May 2017

Lateral channel flowing toward jetty prior to sandbar construction.
(Add 1 hour to time stamp.) 22 May 2017

Lateral channel after fish relocation was completed. (Add 1 hour to time stamp.) 22 May 2017

23 May 2017. The biologist arrived at 0635 hr. The gauged discharge at Soquel Village was 31.7 cfs at 0600 hr. The sand berm around the lagoon margin held, and the lagoon was full. Fish passage through the flume was maintained through the night. However, water outfall from the flume exit went laterally through the out shoulder of the beach and reconnected with the lateral channel, apparently at high tide. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. The flume outfall was redirected by Kotila toward the bay first thing and disconnected from the lateral channel. The lateral channel was walked by the fishery biologist, and no fish were observed. Later in the morning, the lateral channel was seined for fish. The lateral channel was covered over after the fish rescue. The fishery biologist left at 1615 hr.

Sandbar around lagoon intact overnight. Lagoon full. (Add 1 hour to time stamp.)
23 May 2017

Streamflow from flume exit had meandered over to lateral channel overnight. Pathway was re-directed to Bay. (Add 1 hour to time stamp.) 23 May 2017

Flume exit maintained fish passage overnight. (Add 1 hour to time stamp.)
23 May 2017

24 May 2017. The fishery biologist arrived at 0633 hr. The gauged discharge at Soquel Village was 31.9 cfs at 0600 hr. The sandbar had opened on its own the previous night, sometime after 2100 hr. This was due to high tide and a large swell, combined with the flume outlet possibly becoming plugged with sand. The outlet channel was 25-30 feet wide on the east side of the flume. Alley and Morrison walked upstream to Nob Hill from 0720 hr to 0835 hr, searching for any sidepools and stranded fish. None were found. Only one small side puddle was found adjacent to Shadowbrook Restaurant, and no fish were observed in it. Two submerged lamprey nests were observed just above the riffle that entered the Sister's pool adjacent to the Rispin Mansion. They were just upstream of the upper extent of the estuary bathtub ring. One decomposing adult lamprey was seen in a pool downstream of the nests. On the survey, no fish were observed. Other wildlife included 22 mallards, 1 cormorant and 4 crows. No kelp or seagrass was observed in the estuary. Later in the day, a very tame pelican was walking on the wooden walkway next to Zelda's Restaurant. It later flew into the estuary and then off toward the bay. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. Kotila continued to stockpile sand closer to the esplanade wall and Venetian Court through the day. The outlet channel was to be left open overnight. The biologist left at 1530 hr.

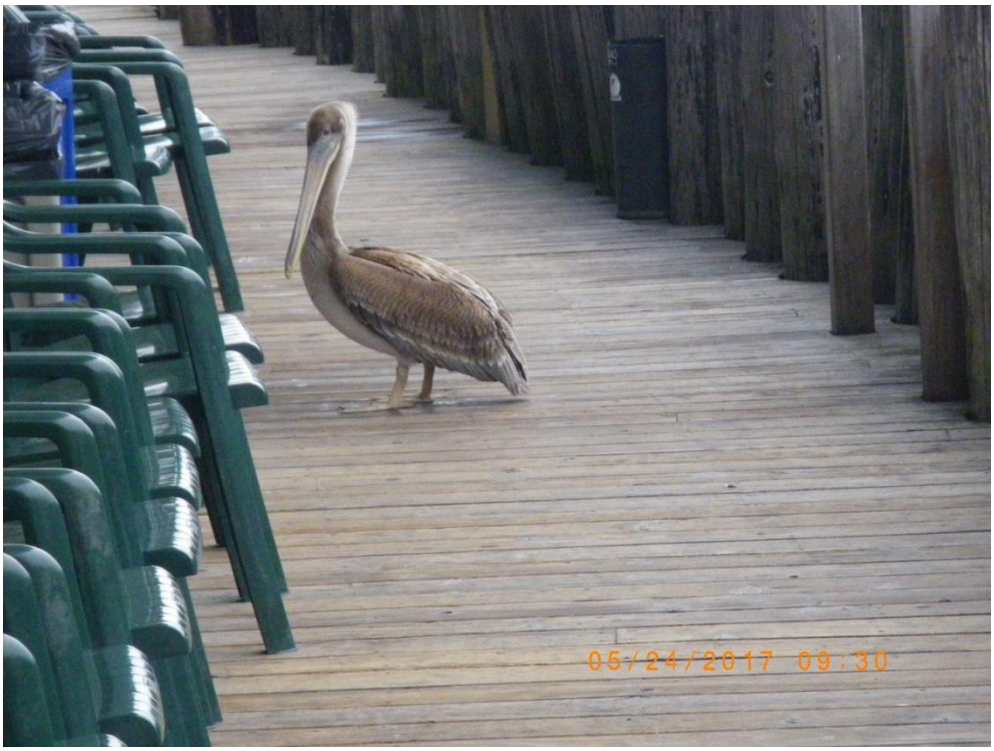
Sandbar had breached overnight with outlet channel east of flume, recreating an open estuary. (Add 1 hour to time stamp.) 24 May 2017

Estuary upstream of Stockton Bridge resulting from unplanned sandbar breach. (Add 1 hour to time stamp.) 24 May 2017

Only isolated puddle found after the unplanned sandbar breach. Located near Shadowbrook Restaurant with Ed Morrison. (Add 1 hour to time stamp.) 24 May 2017

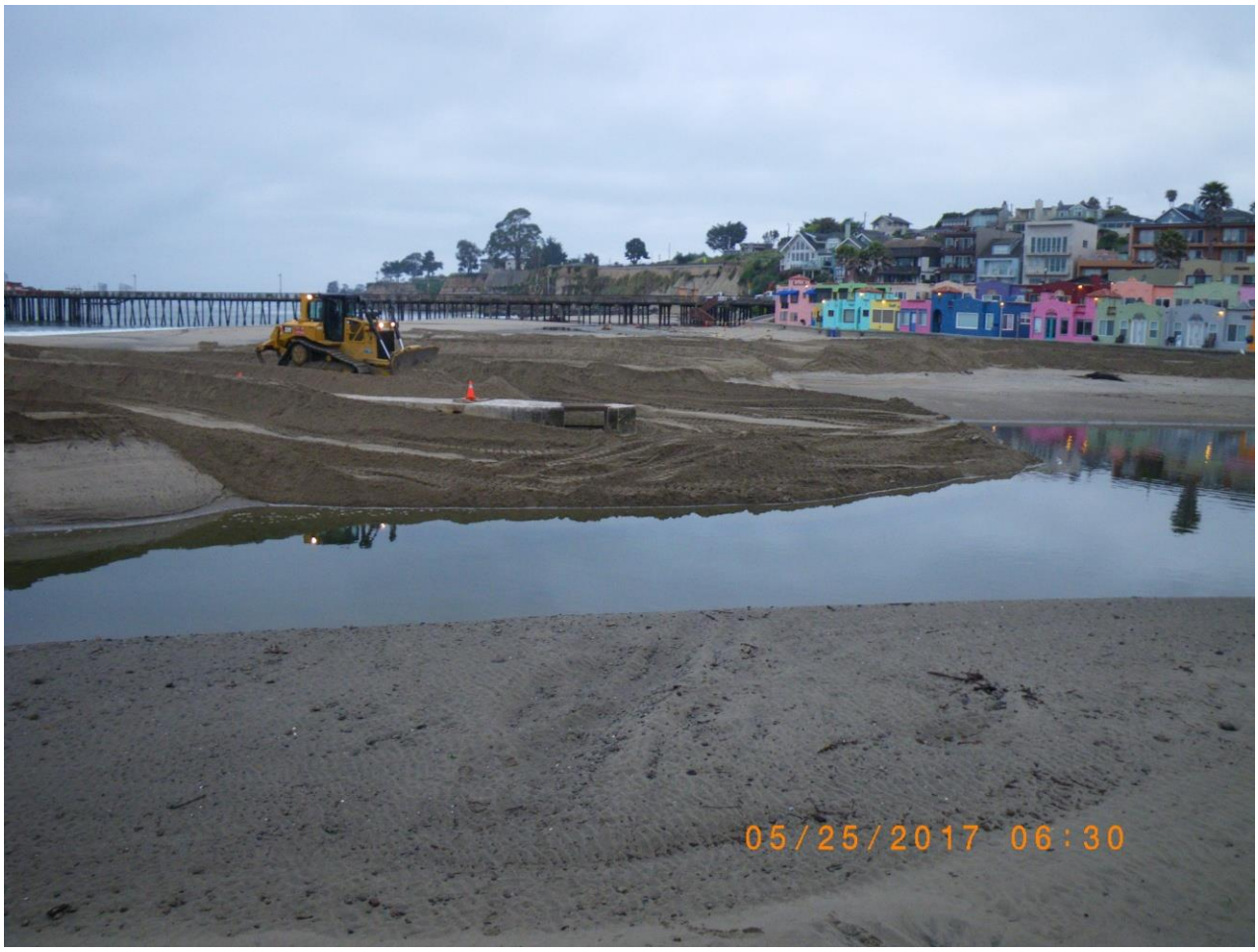
Upper end of estuary, downstream of Rispin Mansion.
(Add 1 hour to time stamp.) 24 May 2017

Two Pacific lamprey (*Lampetra tridentata*) nests just upstream of estuary.
(Add 1 hour to time stamp.) 24 May 2017



Friendly pelican on Zelda's Restaurant walkway. Later flew into the estuary.
24 May 2017

25 May 2017. The fishery biologist arrived at 0550 hr. The outlet channel remained open overnight with 32 cfs gauged at the Soquel Village gage at 0600 hr. Smolt passage was provided. The outlet channel was flowing alongside the flume on the east side. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. Kotila created a compacted pad of sand around the flume inlet to reduce water seepage under flume. The fishery biologist surveyed the outlet channel at 0730 hr and observed no fish. The outlet channel was flowing fast without fish resting places or cover. The flume outlet had plugged with sand overnight, which was removed by hand with shovels. The outlet channel was closed off at 0845 hr to form a sandbar and allow the lagoon to fill. Kotila built up the sandbar around the lagoon margin. The flume was passing water by noon to insure fish passage overnight. The biologist left at 1215 hr with no further grading being done near the lagoon margin.



Compacted pad of sand constructed around flume inlet. Outlet channel in foreground.
25 May 2017

Outlet channel providing smolt passage overnight. 25 May 2017

Outlet channel closed off to create the temporary lagoon prior to Memorial Day weekend. 25 May 2017

26 May 2017. The biologist arrived at 0613 hr. The sandbar remained in place and water flowed through the flume to an exposed outlet. The gauged streamflow at Soquel Village was 33.9 cfs at 0600 hr. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. Kotila continued to stockpile sand on the inner beach in preparation for Memorial Day weekend. The biologist left at 1215 hr.

30 May 2017. The biologist arrived at 0626 hr after the Memorial Day weekend. The sandbar was intact and the lagoon was full. The flume was open to the Bay, as it had been throughout the Memorial Day weekend. Low spots existed on the beach with a high outer beach shoulder. A cormorant floated in the lower lagoon near Venetian Court. The continuing activity was to stockpile sand from the outer beach to the inner beach, eliminating the low points in the middle beach. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. The biologist left at 0730 hr.

Sandbar intact with full lagoon after Memorial Day weekend.
30 May 2017

Flume outlet open throughout the Memorial Day weekend.
30 May 2017

Capitola Beach, east of the Esplanade restaurants, looking toward jetty after Memorial Day weekend. 30 May 2017

31 May 2017. The biologist arrived at 1100 hr. The lagoon was full and emptying through the flume to the Bay. The gauged streamflow at Soquel Village was 29.4 cfs at 0600 hr. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. Kotila graded sand near the jetty and up to the inner beach. The biologist left at 1145 hr.

Sandbar intact with full lagoon and functioning flume. 31 May 2017

Sand being stockpiled at a low point along the jetty. 31 May 2017

1 June 2017. The biologist arrived at 0600 hr. The sandbar remained in place and water flowed through the flume. Alley walked the periphery of the lagoon up to Noble Gulch prior to sandbar opening, looking for any coho salmon juveniles. No salmonids were observed. A female mallard with 7 ducklings were observed near the Stockton Bridge and one cormorant was seen floating below the bridge. The bull dozer was checked for fluid leaks before it was operated this day, and none were found. Kotila opened the sandbar slightly at 0747 hr near the flume inlet, and the estuary drained slowly but not completely. At its lowest point, the estuary extended from bank to bank without exposed streambed or isolated pools formed. The flume inlet was prepared (1120 hr −1320 hr). The pad around the flume inlet was covered with visquine. Sandbags were stacked around the flume inlet and on the visquine to secure it. Sand was hand-broadcasted over the visquine. The weir inside the flume was confirmed to be in place. The sandbar was closed for the season at 1335 hr. The biologist left at 1345 hr. Lance Elliot, long-time Public Works staff member, passed this evening and will not be forgotten…….

Soquel Lagoon prior to sandbar opening for flume inlet preparation. 1 June 2017

Outlet channel along east side of flume after manual breaching of sandbar.
1 June 2017

Work to firm up sand and prevent seepage began around flume inlet.
1 June 2017

Weir intact inside the flume to maintain water depth at flume inlet.
(Date stamp lost when flash was activated.) 1 June 2017

Preparation of pad around flume inlet to prevent seepage. Outlet channel in foreground.
1 June 2017

Completion of flume inlet preparation prior to final sandbar closure.
1 June 2017

Final closure of sandbar outlet channel for summer season. 1 June 2017; 1335 hr.

Underwater portal provided for adult salmonid passage through flume.
1 June 2017

Public Works staff relaxing with pizza provided by Ed Morrison after completion of sandbar construction. 1 June 2017

4 June 2017. The biologist visited the lagoon to detect any remaining salinity in the lagoon. None was found. At 1345 hr, water temperature ranged from 18.5 C to 17.0 C at the bottom at 2 meters, adjacent to the Venetian Court wall. Dissolved oxygen ranged from 11.09 mg/L at the top to 9.61 mg/L at the bottom. Without saltwater present, there was no stratification of water temperature or. We recommended that the shroud need not be installed on the flume inlet because no saline layer was detected on the lagoon bottom.

7 June 2017. Temperature probes were installed in the lagoon and upstream.

Effect of Sandbar Construction on Tidewater Gobies and Steelhead in 2017

No tidewater gobies or salmonids were observed during sandbar construction in 2017. One unplanned sandbar opening occurred overnight on 23-24 May that created an estuary with only one small isolated puddle near Shadowbrook Restaurant. It offered no habitat, and no fish were observed in it on the early morning of 24 May. During the one planned sandbar breaching on 1 June, the lagoon drained very slowly, mimicking normal tidal fluctuations of an estuary and allowed easy fish retreat from the estuary margin. The lowest lagoon level during the planned breach maintained the lagoon width at near a maximum, without any isolated pools. This was perhaps due partially to the streambed scour that had occurred during the winter that had lowered the streambed elevation. The base of the bulkhead margin of the lagoon was exposed an estimated 0.5 to 1 foot lower than heretofore observed. This was due to winter streambed scour.

Minimum Estuary width after planned sandbar breaching, with no sidepools 1 June 2017

With each lowering of the water in the estuary during sandbar construction, tidewater gobies and salmonids would have to retreat to deeper slackwater in the upper estuary as water surface receded. A well defined, bathtub-like margin existed in the estuary in 2017 after heavy winter stormflows, allowing easy retreat of fish into deeper water. We detected no tidewater mortalities during sandbar preparation, though habitat disturbance occurred during the one unplanned sandbar breach. We judged impact to any tidewater gobies that survived the heavy winter stormflows and any salmonids moving through to be minimal during sandbar construction.

The unplanned, unobserved opening overnight on May 23-24 likely caused a slow evacuation of the lagoon because it presumably occurred at high tide when the flume would have plugged with sand. Only 1 small puddle along the estuary margin adjacent to the Shadowbrook Restaurant became isolated from the opening, and no fish were observed in it. The planned opening on June 1 mimicked normal tidal fluctuations of the estuary because the outlet channel did not downcut completely, and water drained slowly with a sizeable estuary present after drawdown and no danger of isolating tidewater gobies. Once the lagoon fills after final sandbar closure and water exits through the flume, water velocities at the lagoon bottom in close proximity to the flume inlet are likely less than expected at a natural creekmouth, open to the Bay. Once summer baseflows decline, water velocity in close proximity to the flume inlet would be negligible at the lagoon bottom and not unlike a closed sandbar because the only outlet flow would be from the surface of the lagoon.

The channel in lower Soquel Creek lacks sheltered backwaters for tidewater gobies to escape high water velocities during high stormflows, except possibly under the restaurants. Tidewater goby populations that have re-occurred during the dry years of 2008, 2009, 2013−2016 may be transitory.

No salmonids were observed along the margin of the lower lagoon prior to the planned sandbar opening. The unplanned breach occurred during the night without anyone present. Raking of decomposing kelp and seagrass was unnecessary in 2017, thus avoiding any potential impact from that activity. Salmonid smolts move downstream at night. During the sandbar construction period, smolts had access to the Bay at night either through the outlet channel or through the flume. A cormorant was observed on 3 of the 8 days in the estuary or lagoon during sandbar construction. No salmonid mortalities were observed in 2017. Most smolt migration had likely occurred before late May, based on data collected on smolt outmigration in the San Lorenzo River in the late 1980's (**Alley, personal observation**).

The seasonal effect of removing organic material and constructing the sandbar is to create good summer rearing habitat for salmonids and tidewater goby. Compared to allowing natural lagoon formation, a lagoon is created with cooler, deeper, freshwater conditions, with reduced potential for eutrophication and associated increased biological oxygen demand from plant decomposition and nighttime respiration by live algae. Kelp and sea grass removal, when necessary, and sandbar closure create better fish habitat for tidewater goby and salmonids than if the sandbar was allowed to close naturally. Natural sandbar formation would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Under natural sandbar conditions, a much shallower lagoon would have formed with much more saltwater trapped to create an

unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon water temperature. The naturally formed sandbar would be lower in stature, allowing more tidal overwash of saltwater during especially high tides and large swells. Increased tidal overwash would further elevate water temperature, making the lagoon less hospitable for salmonids.

Standard Recommendations for Lagoon Preparation and Sandbar Construction

1. During the relocation of fishes from the lateral channel (when it is present), provide limited water in-flow to the lateral channel, if necessary, to keep it wetted until fish relocation is completed. In this way, water quality in the lateral channel will be maintained for fish in the event that considerable vegetative material is present and decomposition is occurring in the lateral channel.

2. Insure that the flume is completely open for out-flow to the Bay before the work-day has ended during all sandbar construction activities. This includes during any required sandbar re-construction activities late in the smolt out-migration period. Do not use manhole cover spacers to flush sand out of the flume through the manholes during darkness when the entire outflow from the lagoon must exit through the flume and there is a chance that smolts are still exiting.

3. If stranded fish are detected as a result of sandbar closure or flume clearing, alert the monitoring biologist to discuss the appropriate relocation method for fish, and have the biologist capture and relocate the fish with assistance from Public Works staff. The biologist should be present during all sandbar closure and flume clearing activities when fish may be present (not when the flume is being cleared the week prior to sandbar construction and streamflow is still flowing through the beach). However, if fish become stranded due to unforeseen circumstances unassociated with sandbar closure/ flume clearing and insufficient time is available for the biologist to reach the site, as occurred on 21 June 2011, Public works staff should consult with the biologist prior to any response. Then Morrison (now a private contractor) and Public Works staff should capture and relocate the fish with available dip nets or seine and buckets filled with fresh estuary/ lagoon water, after consultation with the biologist. (Other public works staff should be given experience in relocating fish from the lateral channel in the future or during fall sampling so that they may fill in if Morrison is unavailable.) If the biologist is unavailable during emergency cases, relocate fish to the main body of the estuary or lagoon near the pilings and boulders adjacent to the restaurants, where cover and good water depth are available.

4. If salmonids are detected in the raking area while the biologist is upstream, searching for stranded fish in isolated pools, then stop raking, leave the water and contact him via cell phone. The biologist will return to the lower lagoon as soon as isolated pools upstream are cleared. Do not resume raking until water turbidity in the raked area has dissipated and salmonids have left the immediate area.

5. Closing the sandbar in late May is better than mid-June or later because streamflow is usually sufficient to rapidly fill the lagoon in most years (not 2013−2015), and the

juvenile salmonids most likely to be present in the lagoon are out-migrating smolts. Late May is prior to down-migration of most YOY steelhead from spawning sites above the lagoon. Small steelhead fry remain in the vicinity of spawning sites before moving down into the lagoon. Down-migrant trapping on the nearby San Lorenzo River in 1987 and 1988 by Donald Alley and Stafford Lehr (now with CDFW) indicated that a few YOY steelhead were down-migrating into the lagoon in May, but the number greatly increased in June.

6. The management solution for minimizing the time required for sandbar construction is for the City to remain flexible on timing of the work. If rain is in the forecast within two days after the intended starting date for sandbar construction, Public Works should postpone construction until clear weather is forecasted. If 4-5 working days are set aside to construct the sandbar, the sandbar construction may be delayed as late as 4-5 days before the Memorial Day weekend and may still satisfy the tradition of lagoon formation before then.

7. Continue to rake as much kelp and sea grass out of the lagoon as possible before final closure, from the Stockton Avenue Bridge downstream, including plant material trapped under the restaurants and in depressions around the bridge piers. Discontinue raking if juvenile salmonids are observed near the water surface. It is best to minimize time required to stockpile sand, rake out the decomposing organic material and prepare the flume inlet for fish passage. This will minimize the number of instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to be ready to enter the estuary at the earliest opportunity each day and quickly rake out decomposing kelp and to clear the sand-filled flume.

8. Dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the state Fish and Wildlife permit for sandbar construction. County Environmental Health approved of this method so long as kelp is spread over a wide area (**J. Ricker, personal communication cited in the original 1990 Soquel Creek Lagoon Management and Enhancement Plan**).

9. To provide cover for juvenile fishes, continue to leave any large woody material deposited in the lagoon from winter storms. Allow a clear path from under the bridge to the beach at Venetian Courts to enable seining for juvenile steelhead during fall censusing.

10. Annually evaluate the structural integrity of the flume and its supports. Continue to repair cracks and supports as necessary. This will prevent sinkholes from forming and reduce water leaking from the lagoon along the flume.

11. Repair the flume at a time that does not obstruct fish passage or require lowering of the lagoon water level.

12. During sandbar construction, continue to close the lagoon each day before the incoming tide can wash in salt water and kelp. Re-open the sandbar and unplug the flume, if necessary, each morning to facilitate kelp and sea grass removal.

13. Search under the Stockton Avenue Bridge and in upstream Reaches 2 and 3 past the Rispin Mansion for stranded fish to rescue as the lagoon drains each day during raking. It is best to minimize the number of days required to construct the sandbar and rake out the decomposing organic material. This will minimize the artificial fluctuation of lagoon water level. Having a maximum number of personnel to rake decomposing organic material into the bay and to clear the flume of sand will minimize the days needed to prepare the lagoon for the summer.

14. Maintain an underwater portal in the flume intake for out-migration of adult steelhead until June 15, while maintaining a notched top plank for out-migration of smolts until 1 July. However, in dry years such as 2007−2009 and 2014−2015, when stream inflow is insufficient to fill an underwater portal and allow lagoon filling, opt for a large notch in the upper boards/screen to accommodate smolts and kelts, if possible, instead of a deeper underwater portal for kelts. If kelts are observed in the lagoon in these dry years without the underwater portal or large notch at the top, provide a larger opening in the top of the flume inlet temporarily to allow kelts the opportunity to exit the lagoon.

15. Maintain the 1-foot high weir/ baffle inside the flume until at least July 1 for safe flume entrance of out-migrating salmonid smolts migrating to the Monterey Bay.

16. Continue to cover the visquine around the flume inlet with manually shoveled sand instead of tractor shoveled sand. This will prevent the tractor from displacing the visquine. Clear or white visquine is preferable to black. Key the visquine into the lagoon margin to encourage its retention when the sandbar opens in the fall.

17. Retrieve visquine from around the flume inlet before or immediately after the fall sandbar opening, if possible.

18. In very dry years, such as 2013−2015, when stream inflow is low and no stream outflow occurs through the flume for one or more days after final sandbar closure, partially close the flume outlet to prevent tidal influx of saltwater through the flume into the lagoon at high tide. This will reduce the saltwater volume collected in the lagoon prior to the lagoon filling and provide freshwater outflow to prevent tidal influx. The partial closure of the flume outlet worked well in 2015.

Procedure for Emergency Sandbar Breaching at Soquel Lagoon by the City of Capitola

In 1990, a bolt was set into a wooden piling adjacent to the restaurants at the lagoon. The bolt's elevation was surveyed to coincide with the water surface elevation at which flooding was imminent. That bolt is now bent. The bolt is 1.77 feet above the elevation of the top of the flume inlet. It allowed 1 foot of freeboard at the residence where flooding was identified as a problem.

Since then, another low point has been located near the railroad trestle, which will have flooding problems at approximately 0.5 feet above the bolt. A red line is present on a piling to indicate this elevation. The management goal is to pass stormflow through the flume from the first small storm events in the fall while keeping the lagoon surface below the original bolt. This is done by the City removing boards from the flume inlet prior to and during increased stormflow. Water also flows through the top grate that was constructed in the flume inlet in 2003.

A tractor is used in the fall to cut a notch approximately 30 feet wide in the sandbar adjacent to the flume, but slightly deflected to the east. A berm is left along the lagoon margin between the notch and the lagoon. An additional berm is constructed across the notch near the surf to prevent wave action at the beach from entering the notch. The intent is to prepare the sandbar so that it will breach at the proper time to prevent flooding. The City cuts the sandbar notch at the elevation of the piling bolt. However, the notch fills in from foot-traffic on the beach as time goes on. If, despite efforts to pass all of the stormflow through the flume, the water surface reaches the elevation of the piling bolt, then the City is to facilitate sandbar breaching. A tractor is used to re-cut the sandbar notch and breach the two berms across the notch so that the entire sandbar breaches prior to flooding. If the flume is able to receive all of the stormflow and flooding does not become a threat, boards are replaced in the flume inlet after the stormflow has passed, maintaining light penetration to the bottom of the lagoon.

Sandbar Breaching During the 2017-2018 Rainy Season.

The biologist (Alley) arrived at the lagoon at 0900 hr, 16 November, after a previous call from Ed Morrison, Consultant to Public Works. He predicted a potential breaching within an hour or so. The lagoon was rising slowly at the time of Alley's arrival. But it rain had become very intermittent along the coastline. Alley encountered rain on the way out of the Santa Cruz Mountains towards the lagoon. But it was not raining in Capitola upon arrival. Lagoon water surface elevation stabilized at a height just above the flume inlet at 20 cfs at the Soquel Village gage. Alley left the lagoon at 1156 hr with absence of rain. He returned a second time at 1330 hr with bar after a call from Morrison, reporting heavy rain in Capitola and streamflow reading at the Soquel Village gage in excess of the flume capacity. Alley assisted Morrison in taking a water sample in surf at 1346 hr for purposes of analysis for enterococcus bacteria. An emergency sandbar breach was facilitated by Kotila at 1410 hr with a 48 cfs reading at the Soquel Village gage. Flume capacity was approximately 30 cfs. The lagoon water surface at breaching was approximately 6 inches below the bent bolt and 1.0 foot below flood stage and rising quickly. We decided that this was the appropriate time to facilitate the sandbar breach to avoid flooding that would predicatively have occurred otherwise within the next hour or so with the continued steady rain in the forecast and rapid rise in water surface. Permits required monitoring of enterococcus bacteria in the Bay prior to sandbar breaching and afterwards. Alley left for the Monterey Analytical Services Lab at 1430 hr to deliver the water sample for same-day analysis of enterococcus bacteria. Provisional streamflow at Soquel Village gage supported our prediction-

105 cfs at 1530 hr;
146 cfs at 1545 hr;
193 cfs at 1645 hr;
256 cfs at 1730 hr
295 cfs at 1800 hr;
200 cfs at 2215 hr.

Morrison collected another water sample within 12 hours after sandbar breaching and delivered it to the Monterey Analytical Services Lab for bacterial content. The pre-sandbar breaching count near the flume was 331 MPN/100 ml. The immediately post-sandbar breaching count was 1,770 MPN/100 ml. Santa Cruz County data indicated that the enterococcus count declined to 10 MPN/100 ml (41cfu/100 ml Total Coliform count) by 20 November at 1155 hr.

Lagoon Water Surface in Relation to lower piling ring with bent bolt, 40 minutes after facilitated emergency breach. (Subtract 1 hour from time stamp.)

Facilitated sandbar breach. (Subtract 1 hour from time stamp.)

Soaked City Manager, Jamie Goldstein, Observing Sandbar Breach. (Subtract 1 hour from time stamp.

Standard Recommendations Regarding Sandbar Breaching

1. As stated in the Management Plan (**1990**), make sure that parking lots and streets draining into the lagoon are cleaned before the rainy season. This will reduce the pollutants entering the lagoon during the first storm of the season that are lethal to fish. Street sweepers with water and suction may be necessary. In addition, roadwork such as repaving and application of fresh petrochemicals should be done in the early summer to allow sufficient time for penetration and drying before the rainy season.

2. Prior to sandbar breaching in the fall, notch the sandbar across the beach just below the elevation of the piling bolt indicating flooding, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize beach erosion. The purpose is to maximize the residual estuary depth after the emergency breach.

3. Continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with a wide notch in between. The notch in the sandbar should be cut slightly lower than the piling bolt. Continue to make the notch at least 30 feet wide across the beach. The City may have to periodically re-establish the notch if it does not rain or if high tides obliterate it. If a storm is predicted, the sandbar may require a fresh notch.

4. When breaching must be facilitated to prevent flooding, notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to finish the sandbar breaching, if necessary. If possible, allow the streamflow and tidal action to "naturally" breach the outer berm.

5. Just as the first storm of the fall season begins, remove boards from each side of the flume if a small storm is anticipated. The number of boards removed will be dictated by the anticipated size of the storm. Remove two boards or more from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit.

6. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is breached during later, larger storms usually occurring after Thanksgiving.

7. After the first small storms of the season with the sandbar still intact, lower the water level to a point where light penetrates to the lagoon bottom. Thus, aquatic vegetation in the lagoon may continue to photosynthesize and remain viable. Thus, vegetation mortality and stressfully low oxygen levels for steelhead are prevented until water clarity is re-established. Re-install boards to increase lagoon depth after the lagoon clears up.

8. Notify the California Department of Fish and Wildlife 12 hours before the possibility of a sandbar breach and immediately after the breach occurs.

9. If the sandbar breaches early in the rainy season, followed by a period of 2-4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

10. If a stagnant, kelp-filled lagoon forms in fall after an early breach and a dry period, do not empty the lagoon by breaching the sandbar. Instead, use the flume and shrouds to pull salt water out. Breaching of the lagoon will increase the opportunity for more kelp to enter and probably will not empty the entire lagoon anyway. Fish passage need not be maintained through the flume because it should be discouraged until sufficient stormflows develop to provide passage up the Creek. If adult salmonids enter too early, they will become stranded and unable to migrate upstream because of insufficient streamflow.

WATER QUALITY MONITORING IN 2017

Rating Criteria

Water quality parameters were rated according to the tolerances of steelhead. This was because they are least tolerant of low oxygen, higher salinity and higher temperatures of the resident lagoon fishes. Stress to freshwater acclimatized steelhead would probably not occur until conductivity levels reach 12,000 to 15,000 umhos, associated with sudden increases in salinity to 10 − 12 parts per thousand (**J. Cech, personal communication**). Water temperatures above 22º C (72º F) (**Table 1**) and oxygen levels below 5 parts per million (mg/L) are thought to stress steelhead. Regarding temperature optima, Moyle (**2002**) stated, "*The optimal temperatures for growth of rainbow trout are around 15−18ºC, a range that corresponds to temperatures selected in the field when possible. Thus, in a section of the Pit River containing a thermal plume from an inflowing cold tributary, rainbow trout selected temperatures of 16−18ºC. However, many factors affect choice of temperatures by trout (if they have a choice), including the availability of food.*" Rainbow trout are the same species as steelhead but with a freshwater life history pattern. Optimal temperature for rainbow trout in higher elevation mountain streams of the Sierra Nevada or Cascades may be lower than what is optimal for juvenile steelhead along the Central Coast. Coastal lagoons are very food-rich environments where steelhead growth rates are very high, despite warmer water temperatures. A study completed by **Farrel et al. (2015)** indicated that the thermal range over which a Tuolumne River *O. mykiss* population could maintain 95% of peak aerobic capacity was 17.8°C to 24.6°C. Furthermore, up to a temperature of 23°C, all individual fish could maintain a factorial aerobic scope (FAS) value >2.0 (FAS = Maximum metabolic rate (MMR)/ Routine metabolic rate (RMR)), one that is predicted to provide sufficient aerobic capacity for the fish to properly digest a meal. An added benefit of higher water temperature is that it increases digestive rate, allowing faster food processing and faster growth potential when food is more abundant. Under controlled laboratory conditions, food consumption, growth, and temperature tolerance were compared for Nimbus-strain steelhead (an introgressed breeding stock in the American River) acclimated to and held at 11, 15, and 19˚C in replicated laboratory experiments. Although food consumption rate showed no statistical difference between temperatures, the growth rate was higher at 19˚C than at 11˚C or 15˚C, providing evidence that food conversion efficiency in juvenile steelhead is higher at the warmer temperature (**Myrick and Cech 2005**).

The Santa Ynez River Technical Advisory Committee (SYRTAC) proposed guidelines with upper limits of 20 ˚C average daily temperature and 25 ˚C daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River, south of the Santa Maria River (**SYRTAC 2000**). The SYRTAC (**2000**) decided that a mean daily temperature of 22 ˚C in the River may be the threshold between acceptable and unsuitable from a long-term perspective. This was based on studies by Hokanson et al. (**1977**) who concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23 ˚C. Bjornn and Reiser (**1991**) state that growth, food conversion efficiency, and swimming performance are adversely affected when dissolved oxygen concentrations are <5 mg/L. However, steelhead were found surviving in pools in the Carmel River at 1-2 mg/L for 1-2 hours at dawn (**David Dettman, personal observation**) and in San Simeon Lagoon near Cambria at oxygen concentrations less than 2 mg/l on repeated occasions (**Alley 1995b; 2006b**). Based on 1988

monitoring, steelhead survived in Soquel Lagoon at water temperatures of 23-25º C for 1-2 hours in late afternoon or early evening (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-4º C from a morning minimum, after a sunny, fog-less day.

Oxygen levels critical to steelhead survival were classified as those measured in the lower 0.25 meters from the bottom, where steelhead would inhabit. Early morning oxygen levels below 2 mg/l were rated "critical" (**Table 2**). Those levels between 2 and 5 mg/l were rated "poor." Early morning oxygen levels of 5 to 7 mg/l were rated "fair" with above 7 mg/l rated as "good." Early morning water temperatures in the lower 0.25 meters of the water column of less than 20º C were rated "good" while those 20 − 21.5º C were rated "fair." Temperatures between 21.5 and 23º C were rated "poor," while those greater than 23º C at dawn were rated "critical." If salinity was less than 10 ppt, the rating was "good." If the salinity was more than 10 ppt due to tidal overwash, it was rated "poor." High levels of dissolved carbon dioxide in water will inhibit absorption of oxygen by fish. However, in the alkaline conditions of Soquel Creek Lagoon, carbon dioxide is poorly dissolved and is not a problem (**J. Smith, personal comm**.). Therefore, its monitoring was unnecessary.

Lagoon water level was monitored with the staff gage on the eastern bulkhead, upstream of the Stockton Avenue Bridge (**Figure 1**). Readings below 1.5 feet were rated "critical" while readings between 1.5 and 1.85 were rated poor (**Table 2**). Readings between 1.85 and 2.2 were rated "fair." Readings above 2.2 were rated "good." These criteria were somewhat arbitrary, based on an as yet poorly defined relationship between lagoon depth and associated fish cover, water temperature and algal growth. If the upper lagoon becomes too shallow, steelhead habitat is eliminated and algae growth may be stimulated. An important factor not directly under control by the City is change in streambed elevation resulting from winter scour or fill in the estuary.

Locations and Timing of Water Quality Monitoring

As required under the CDFW permit for 2017, water quality was monitored in late afternoon, as well as in the early morning near first light. Water quality was monitored at four lagoon stations and one stream station. Station 1 was at the flume inlet (**Figure 1**). Station 2 was just downstream of the Stockton Avenue Bridge in the deepest thalweg area. Station 3 was just downstream of the railroad trestle on the east side. Station 4 was at the mouth of Noble Gulch. Station 5 was monitored in the morning and afternoon in Soquel Creek near the Nob Hill shopping center, just upstream of the lagoon. Stream data were compared to lagoon conditions of water temperature and oxygen levels in early morning.

As required by the CDFW permit for 2017, 6 HOBO temperature loggers were launched on 7 June 2017, just downstream of the railroad trestle in Reach 2 (as in 2008−2016) at 1-foot intervals through the water column, beginning at 0.5 feet above the bottom and ending 5.5 feet from the bottom. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. The 6 lagoon loggers and one stream logger were removed on 14 October 2017 prior to any forecasted rain.

Water quality in terms of oxygen concentration, temperature, conductivity and salinity was measured at each lagoon station at two-week intervals after the sandbar was constructed until the sandbar breached in the fall. Prior to the first full monitoring, salinity was measured in deeper

portions of the lagoon to determine if saltwater had been trapped during sandbar construction. No saltwater was detected in 2017 in the lagoon 4 days after the sandbar closure. The biologist judged that the inlet shroud was unneeded to pull saltwater off of the bottom.

Table 1. Temperature Equivalents for Degrees Celsius and Degrees Fahrenheit.

Degrees Celsius	Degrees Fahrenheit
10	50.0
11	51.8
12	53.6
13	55.4
14	57.2
15	59.0
16	60.8
17	62.6
18	64.4
19	66.2
20	68.0
21	69.8
22	71.6
23	73.4
24	75.2
25	77.0
26	78.8
27	80.6
28	82.4
29	84.2
30	86.0

Table 2. Criteria for Rating Water Quality Measurements within 0.25 Meters of the Bottom after Sunrise and for Rating Gage Height Readings.

MORNING RATING	MORNING TEMPERATURE (Celsius)	MORNING OXYGEN (mg/L)	GAGE HEIGHT (ft)
Good	< 20	> 7	> 2.20
Fair	20-21.5	5-7	1.85-2.20
Poor	21.5-23	2-5	1.50-1.85
Critical	> 23	< 2	< 1.50

Water Temperature Goals for Soquel Creek and Lagoon

Regarding Soquel Creek Lagoon in summer, where food is more abundant than upstream, the temperature management goal for steelhead should be to maintain water temperature below 20ºC at dawn within 0.25 m of the bottom and below 22ºC) near the bottom in the afternoon, with the

7-day rolling average near the bottom equal to 21°C or less. This early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). This lagoon management goal is somewhat higher than the enhancement goal we established for Soquel Creek upstream, where the goal was to maintain the 7-day rolling average at 20ºC or less. Maximum daily water temperature in the lagoon should not reach 26.5ºC. Coche (**1967, cited in Kubicek and Price 1976**) determined that temperatures between 20 and 24ºC were responsible for high maintenance requirements and low conversion efficiency of food into growth for his stock of juvenile steelhead. However, measurement of juvenile steelhead from Soquel Lagoon indicates that growth rate has been greater than in upstream stream reaches (**Alley 2008a; 2008b**), with nearly all young-of-the-year juveniles rearing in the lagoon reaching soon-to-smolt size the first summer each year. This indicates that despite higher water temperature in the lagoon, growth rate of juveniles is rapid because food is abundant. The Farrel et al. (**2015**) work indicated that near peak activity (at least 95%) can be maintained up to 24.6˚C in warm-water acclimated steelhead in the Toulumne River, and the Myrick and Cech **(2005**) work with steelhead indicated that growth rate increased with temperature provided that food was abundant.

Water temperatures above 20ºC (68ºF) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and lagoon temperatures below 16ºC (60.8ºF) are preferred (**J. Smith, personal communication**). Therefore, the management target for making Soquel Creek Lagoon habitable for coho should be to maintain summer water temperature below 20ºC (68ºF). The 2010 lagoon was the coolest in the last 20 years, with its relatively high baseflow and deeper lagoon. In 2010, water temperature near the bottom exceeding 20° C for only a 3-day period in early June and a 4-day period in mid-July. However, we do not believe that Soquel Creek Lagoon may be cooled sufficiently to support juvenile coho salmon in most years.

The management goal for water temperature in stream habitat upstream of the lagoon should be maintenance below 20ºC (68ºF) in April and May, when baseflow still exceeds summer baseflow, and juvenile salmonids are feeding and growing rapidly. From June 1 to September 1, the water temperature should not rise above 20ºC (68ºF) more than 4 hours a day (15% of the month) and preferably the maximum daily temperature, averaged weekly (MWAT), should not rise above 20ºC (68ºF) and the maximum daily temperature should be less than 26 ºC (78.8 ˚F). The MWAT and maximum temperature goals are based on 1) conclusions drawn by Kubicek and Price **(1976),** 2) guidelines by SYRTAC **(2000)**, 3) laboratory findings on steelhead temperature lethality by Charlon (**1970**), Alabaster (**1962**) and McAfee (**1966**) , 4) findings Farrel et al. (2015) and 5) our data on steelhead growth rates and water temperatures in Central Coast steelhead streams. These goals are based on literature review of physiological relationships between fish metabolic rate and water temperature (**Kubicek and Price (1976); Brett (1959), cited in Kubicek and Price 1976); and Snyder and Blahm (1971, cited in Kubicek and Price 1976**)).

The temperature optimum is a moving target, increasing and decreasing with food supply. As stated earlier, according to Moyle (**2002**), Baltz et al. (**1987**) reported that optimal temperatures for growth of rainbow trout (not steelhead) to be around 15-18ºC, a range that corresponded to temperatures selected in Sierran streams when possible. As stated earlier, according to Moyle (**2002**), regarding temperature optima, "*many factors affect choice of temperatures by trout (if*

they have a choice), including the availability of food." As stated earlier, the Santa Ynez River Technical Advisory Committee (SYRTAC) proposed guidelines with upper limits of 20ºC average daily temperature and 25ºC daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River, south of the Santa Maria River (**SYRTAC 2000**), much further south of Soquel Creek and the Santa Maria River and in the southern ESU for steelhead. The SYRTAC (**2000**) decided that a mean daily temperature of 22ºC may be the threshold between acceptable and unsuitable from a long-term perspective. This was based on studies by Hokanson et al. (**1977;** Cited in Santa Ynez River Technical Advisory Committee 2000), who concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23ºC.

Until systematic water temperature monitoring occurs near sites where coho salmon are found in Soquel Creek, the management goal regarding water temperature prior to re-introduction of coho salmon to Soquel Creek should be that water temperature in specified reaches meet the Mattole River criteria that average daily water temperature (averaged weekly) during summer/fall months (June 1 to October 1) be 16.7ºC (62ºF) or less in the warmest week and that the weekly maximum temperature be 18.0ºC (64ºF) or less during the warmest week (**Welsh et al. 2001**). The targeted stream segments include 1) the mainstem Reaches 7−9 (Moores Gulch confluence to Hinckley Creek confluence on the East Branch), 2) Reaches 11 and 12a (Soquel Demonstration State Forest between the Soquel Creek Water District Weir at the lower end of the canyon and the gradient increase below the Fern Gulch confluence) and 3) Reaches 13 and 14a on the West Branch (downstream of the lowermost Girl Scout Falls I). Coho salmon juveniles were detected in Fall 2008 by NOAA Fisheries biologists and D.W. ALLEY & Associates (DWA) in Reach 9 of the East Branch, supporting the potential for coho recovery in Soquel Creek. These two groups also detected them in the lower East Branch Soquel Creek in 2015. DWA also detected them at the upper mainstem Soquel Creek site (Reach 8) near the Soquel Creek Road Bridge in 2015.

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Level

Appendix A provides detailed water quality and lagoon height data. The lagoon level was monitored 4 days after sandbar closure (4 June) and 12 times in 2-week intervals from 11 June 2017 to 11 November 2017, as well as the day of the Begonia Festival parade. **Table 3** rates habitat conditions according to the rating scale (**Table 2**). The lagoon level was rated "good" throughout the monitoring period until after early rains in which the lagoon level was lowered to maintain aquatic plant photosynthesis with turbid water. Thus, lagoon level was rated "poor" on 11 November after early rains. But light penetrated to the bottom to allow photosynthesis and adequate oxygen levels for fish. The sandbar breach was facilitated on 16 November due to stormflow that exceeded the capacity of the flume.

Gage height in 2017 was consistently near the highest recorded through the dry period of the last 4 years until late August (**Figure 2**). Baseflow was much greater than most years, allowing good lagoon depth even with the underwater adult portal being open through the dry period. Lagoon depth was maintained as high as possible in 2017 through good management, even early on and as baseflow declined through the summer/fall. Typically, it is more difficult for the City to maintain the highest water surface elevation after wetter winters that bring higher stream inflow

during the following summer. But maximum depth was maintained well throughout 2017.

With the high baseflow, no saltwater was detected in the lagoon on 4 June, just 4 days after final sandbar closure for the season. Therefore, shroud installation was judged unnecessary by the biologist. No vandalism of the flume inlet was detected in 2017

Flume Passability

According to the Management Plans (**Alley et al. 1990; 2004**), steelhead adult passage is to be maintained with an underwater portal through 15 June and smolt passage is to be maintained with a notch in the uppermost flashboard until July 1 with an open flume to the Bay. A flume depth of 12 inches or deeper is desired at the entrance until July 1. The flume was cleared of sand prior to sandbar construction in 2017. But sand had returned to the lower flume by the time of sandbar construction, requiring additional clearing on 22 May. The flume outlet was open for fish passage by 1730 hr and maintained open throughout the sandbar construction period. Nocturnal smolt passage was not delayed during sandbar construction.

Once sandbar construction was complete, the Venetian side of the flume inlet was left completely boarded up. The underwater portal was provided for adults through 15 June as required by the permit, but remained through the dry season with the high baseflow. The flume outlet remained open throughout the summer/fall. Prior to the rainy season, a notch was constructed across the beach, approximately 30 feet wide and oriented slightly away from the flume. Inner and outer berms were constructed in the notch. The inner berm across the beach was notched to initiate a facilitated sandbar breach on 16 October during the first stormy period of the season. The streamflow at the Soquel Village USGS gage was 48 cfs at the time of the breach, with stormflow reaching an estimated 295 cfs that day. The flume capacity is 25-30 cfs at best. No storms followed during the next month. But the sandbar remained open as of 15 December when the flow at the Soquel Village gage was an estimated 6 cfs.

Water Temperature Results from Two-Week Monitoring

In 2017, early morning water temperature of stream inflow was an estimated 0.5 to 3.5 °C warmer than in 2016 after a 2°C cooler reading in mid-June (**Figure 3e**). This was despite the much higher baseflow. This warmer water temperature may have occurred due to loss of riparian vegetation during the sustained high flow winter and resulting reduced stream shading. It may also been warmer because of warmer air temperature in August and September 2017 than occurred in 2016 (**Figure 3f**). The 2016 morning temperature was also cooler than in the two previous drought years of 2013 and 2014, which had warmer inflow temperatures than in 2016. It was similar to temperatures in 2012. During the last 27 years of monitoring, the 1992, 1994 and 2013−2015 lagoons were the warmest and most similar in early morning water temperatures, though the lagoons of 2007−2009 (other dry years) were nearly as warm. However, despite inflow water was warm in 2017, the lagoon remained much cooler than during drought years due to the high inflow rate in 2017.

In comparing 2017 to 2016 for lagoon water temperature near the bottom, both early morning and afternoon temperatures were cooler in 2017 at 6 of 8 monitoring times at all lagoon sites

through late September (**Figures 3a–3d**). Only 1 monitoring time in 2017 (6 August) had morning and afternoon water temperatures higher than in 2016. 2017 afternoon water temperatures were cooler than in 2016 at all sites throughout the monitoring period except on 6 August. Thus, although inflow water temperatures were warmer in 2017, lagoon water temperatures were cooler than in 2016, presumably due to the much higher 2017 baseflow. Also, the daily fluctuation in water temperature from morning to afternoon was much reduced in 2017 compared to past recent years. The daily fluctuation between morning and afternoon near the bottom was 1°C increase or less throughout the summer/fall. On 26 June, the morning water temperature was surprisingly 0.1°C warmer (19.4°C) than in the afternoon at the deepest monitoring Site 2 below Stockton Bridge. Daily fluctuations were greater in years with lower inflow rate. During the drought year of 2015, daily fluctuation was generally a 1–2°C increase at the various lagoon sites.

The warmest MORNING water temperature measured during 2-week monitoring in 2017 near the bottom was 20.2°C (68.4°F) on 6 August near Stockton Bridge and the flume (**Figures 3g**) compared to 20.7°C in 2016 (**Figure 3i**). As was typical, lagoon inflow temperature at Nob Hill in 2017 was cooler than lagoon temperatures near dawn. Surprisingly, 2017 morning lagoon water temperature was much cooler (1.5°C) 2 weeks prior to 6 August and 2 weeks afterwards. In contrast, the warmest morning water temperature measured in 2015 near the bottom was at the Stockton Bridge (22.8˚C (73˚F) on 15 August (**Alley 2017**). The warmest early morning temperature near the bottom in 27 years was 24˚C (75.2˚F) in 1992 during drought at Stockton Bridge.

The warmest AFTERNOON water temperature measured during 2-week monitoring in 2017 near the bottom was 21.2°C (70.2°F) on 23 July at the flume inlet (**Figure 3h**) compared to 21.6°C in 2016 on the same day (**Figure 3j**). By contrast, the warmest afternoon water temperature recorded during drought year 2015 near the bottom was 24.6°C twice in August at the flume (**Alley 2017**) compared to 24.4˚C in 2014 compared to 23.5°C in 2013, 21.2°C in 2012, 19.4°C in 2011, 19.6°C in 2010, 21.9° C in 2009 and 24.6° C after tidal overwash that had created a stagnant saline layer under the Stockton Bridge in early July 2008.

2017 was the first year in which the afternoon water temperature of the lagoon inflow at Nob Hill was warmer than at most of the afternoon lagoon sites until mid-September. A more typical pattern of cooler inflow water occurred in 2016 (**Figure 3j**).

The warmest SURFACE water temperature in 2017 was 23.8°C (74.8°F) on 2 September at the mouth of Noble Gulch during a heat wave (**Figure 3f**) in which the inflow afternoon temperature was warmer than any of the lagoon sites near the bottom (**Figure 3h**), compared to 22.4°C in 2016. The warmest surface water temperature recorded in 26 years was in 2014 at the flume on 20 July (27.7˚C; 81.9˚F). The temperature there in the morning had been 22.8˚C. In 2015, the warmest surface temperature was 25.1˚ C (77.2˚ F) at the flume on 15 August. In 1992 and 1994, the warmest surface temperatures were at the flume; 26˚C (78.8˚F) and 24.8°C (76.6°F), respectively. There were cooler spots for steelhead near the bottom under the Stockton Bridge and upstream in these instances.

In 2017, *water temperatures near the lagoon bottom in the early morning* were rated "good"

(<=20°C) at all stations during 2-week monitorings except on 6 August when 3 of 4 sites were rated "fair" (<= 21.5°C) and at Noble Gulch rated "good" (**Tables 2 and 3**). By comparison, in the drought year 2015, ratings of "poor" (21.5−23°C) were most common with some "fair" (20−21.5°C) ratings. From 5 July to 29 August 2015 (5 consecutive monitorings) the ratings were "poor" at all stations in the morning. In 2014 there were 4 such consecutive "poor" monitorings that started later in July. 2014 was also a drought year. So, when inflow rate is diminished during drought, lagoon water quality is poor regarding water temperature.

At the mouth of Noble Gulch in 2017, as in most years, the water temperature near the bottom in the afternoon was typically cooler than other lagoon monitoring sites by 1−1.5°C from June through September (except on 20 August when it was the warmest) (**Figure 3h; Appendix A**). The higher conductivity typically measured at the bottom at this site in previous years was not detected in 2017, though it was slightly higher than other sites at the surface and higher at the surface than the bottom in August and September 2017. The bottom conductivity is most influenced by the cooler inflow from Noble Gulch, which had relatively lower conductivity in 2017..

As in most years (except 2016), lagoon water temperatures at dawn and in the afternoon in 2017 closely reflect those of the stream inflow from June through early November (**Figures 3g−3h**). The differences were less in 2017 than other years, with inflow 1−1.5°C cooler in the morning and atypically warmer in the afternoon than most of the lagoon sites through early September.

In most years, morning lagoon water temperatures near the bottom are coolest at the upper Station 4 (mouth of Noble Gulch) and warmer progressively downstream. This was the case in 2017 with the flume (Site 1) being the warmest, except on 23 July when Site 2 was warmer than Site 1 and 20 August when Station 4 was the warmer than Site 2 (**Figure 3g**). By afternoon monitorings in 2017, we saw the typical pattern of warming at downstream monitoring stations, the difference usually being approximately 1° C cooler at Station 4 than Station 1 (**Figure 3h**). The exception was on 20 August when Station 4 was the warmest in the lagoon near the bottom.

Table 3. 2017 Morning Water Quality Ratings at Monitoring Stations in Soquel Creek Lagoon, Within 0.25 m of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow Estimated @ 0.5 cfs less than Soquel Village Gage Readings (cfs)
4June17 (Station 2 only)	open	2.67 good	good		good	25.6 cfs
11June17	open	2.77 good	good*	good	good	23.7 cfs
25June17	open	2.42 good	good	good	good	16.3 cfs
09July17	open	2.59 good	good	good	good	12.7 cfs
23July17	open	2.59 good	good	good	good	10.8 cfs
06Aug17	open	2.63 good	fair fair fair good	good good good good	good good good good	8.7 cfs
20Aug17	open	2.67 good	good	good	good	8.1 cfs
2 Sep17	open	2.65 good	good	good	good	5.8 cfs
17Sep17	open	2.50 good	good	good	good	6.6 cfs
01Oct17	open	2.55 good	good	good	good	5.0 cfs
14Oct17	open	2.60 good	good	good	good	4.5 cfs
29Oct17	part. open	2.30 good	good good good good	good good fair good	good good good good	5.0 cfs
11Nov17	open	1.57 poor	good	good	good	8.5 cfs

* Four ratings refer to Monitoring Sites 1-4. If one rating is given per column, it represents all sites.

Water Temperature Results from Continuous Data Loggers

In analyzing water temperature data from the 6 data loggers down the water column in the deepest portion of the lagoon, just downstream of the railroad trestle, results were consistent with temperature data collected at 2-week intervals through the water column at monitoring stations over the past 27 years. The following analysis pertains to the vicinity of these continuous data loggers only. Keep in mind that our 2-week monitoring at Station 3 near the trestle was closest to these data loggers (**Figures 3g and 3h**).

Juvenile steelhead likely spend most of their time near the bottom if oxygen and temperature levels are tolerable, except when feeding on emerging aquatic insects at dusk and dawn. This assumption is based on many years of underwater observations of salmonids. Therefore, the water temperature recorded near the lagoon bottom (0.5 feet from the bottom) has greatest relevance to assessing habitat quality.

As in past years, lagoon water temperatures near the bottom in 2017 somewhat reflected those of the stream inflow (**Figures 4a-j; 5a-b**). Daily temperature *maxima* and *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2017 (**Tables 4 and 5**).

Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead. Therefore, the lagoon management goal is to maintain a daily water temperature MAXIMUM below 22ºC near the bottom. Another temperature related lagoon management goal is to maintain early morning MINIMUM temperature below 20°C near the bottom. A third lagoon management goal is to maintain the 7-day rolling average at 20°C or less near the bottom.

We see from **Table 5** that in wetter years (2006, 2010-2012 and 2017) the lagoon temperature management goals near the bottom for steelhead were mostly met (20°C daily minimum at dawn; 22°C daily maximum in early evening; 7-day rolling average <= 21°C). But air temperature also contributed to stream inflow temperature as when summer air temperature was cooler in 2016, allowing management goals to be met, and when warmer in August and September 2017, causing management goals not to be met some of time. The stream inflow maintains a cooler lagoon during higher baseflow years in terms of 7-day rolling averages, with the difference between inflow average temperature and lagoon average temperature near the bottom being more similar during higher baseflow years (2010-2012 and 2017) (**Table 5**).

As in past years, no lagoon thermocline (*a thermocline has a warm, well-mixed, oxygen-rich epilimnion above it and a cool, non-circulated, oxygen-poor hypolimnion below*) or temperature stratification was detected in 2017 by the data loggers in the deep area near the railroad trestle. The completely freshwater lagoon was likely 7−8 feet deep, at most, and subject to daily inland breezes that circulated the water, surface to bottom. There was complete, diurnal (daily) mixing of the water column.

In 2017, the warmest part of the water column was 3.5 feet from the bottom, based on 7-daily

rolling averages (**Figure 4d**). Interestingly, the upper layers of the lagoon (4.5 feet and 5.5 feet above the bottom) had cooler water temperatures than greater depths in 2017 and less daily fluctuation (**Figures 4e and 4f**). This was inconsistent with temperature measurements through the water column at 2-week monitoring stations (**Appendix A**). During 2-week monitorings, water temperature was typically the same within 0.1°C throughout the column in the morning and cooler near the bottom than near the top in the afternoon. In most other years, water temperature was cooler nearer the bottom and warmer near the surface, based on the continuous data loggers. However, in another relatively high baseflow year, 2006, water temperatures at 4.5 feet from the bottom were cooler than 0.5 feet from the bottom (**Alley 2006a**). Water temperatures at 0.5 and 5.5 feet from the bottom were similar in 2006.

Table 4. Water Temperature Statistics from Continuous Water Temperature Probes at 30-Minute Intervals in Soquel Lagoon and Immediately Upstream.
(Late May to 15 September in 2010−2017.)

Year	Statistic	Stream Inflow Temperature °C	Near-Surface Lagoon Temperature @ 5.5 ft from Bottom °C	Near-Bottom Lagoon Temperature @ 0.5 ft from Bottom °C
2017	Maximum Water Temperature °C	**21.3 (2 and 5 Sep)**	**21.7 (4 Sep)**	**22.9 (5 Sep)**
2017	Minimum Water Temperature °C	**12.9 (13 June)**	**14.5 (12 June)**	**14.5 (13 June)**
2017	Maximum 7-Day Rolling Average*	**19.6 (1 Sep)**	**20.5 (1 Sep)**	**21.3 (1 Sep)**
2017	Minimum 7-Day Rolling Average	**15.0 (8 June)**	**15.6 (7 June)**	**15.9 (7 June)**
2017	**Average 7-Day Rolling Average**	**17.7**	**18.8**	**19.3**
2016	Maximum Water Temperature °C	**21.0 (19 June)**	**21.7 (20-23 June, 25 June, 9-13 July, 20-24 July, 31 Aug)**	**21.3 (24 and 29 July, 2 Aug)**
2016	Minimum Water Temperature °C	**13.7 (15-16 June)**	**17.1 (14 Sep)**	**16.8 (16 June)**
2016	Maximum 7-Day Rolling Average*	**17.7 (18 June)**	**20.8 (19 July)**	**20.2 (18-20 July)**
2016	Minimum 7-Day Rolling Average	**15.4 (11 Sep)**	**18.4 (10 Sep)**	**17.9 (11 Sep)**
2016	**Average 7-Day Rolling Average**	**16.7**	**19.9**	**19.3**
2015	Maximum Water Temperature °C	**20.6 (15 August)**	**24.8 (15-16 August)**	**24.0 (16-17 and 19 Aug)**
2015	Minimum Water Temperature °C	**14.5 (1, 5-6 June)**	**17.9 (30 May, 1 and 5-6 June)**	**19.0 (6-7 June)**
2015	Maximum 7-Day Rolling Average	**18.3 (16 July)**	**23.7 (13-14 August)**	**23.3 (13-15 August)**
2015	Minimum 7-Day Rolling Average	**15.7 (31 May)**	**19.2 (4 June)**	**19.6 (4-6 June)**
2015	**Average 7-Day Rolling Average**	**17.4**	**21.9**	**21.7**

2014	Maximum Water Temperature °C	**20.2 (18-20 July)**	**24.8 (23,24,30 July)**	**24.0 (2 June; 30 July)**
2014	Minimum Water Temperature °C	**14.5 (1-4, 17-18,22-25 June; 9 Sep)**	**18.3 (6 June)**	**19.4 (9-10 Sep)**
2014	Maximum 7-Day Rolling Average	**18.2 (15 July)**	**23.7 (19-20, 23-26 July)**	**23.4 (25-27 July)**
2014	Minimum 7-Day Rolling Average	**15.5 (1 June)**	**19.3 (1 June)**	**20.3 (5-7 Sep)**
2014	**Average 7-Day Rolling Average**	**16.8**	**21.9**	**22.0**
2013	Maximum Water Temperature °C	21.0 (26 Jun)	23.2 (5 July; 31Aug–5 Sep)	25.2 (1 June due to saline layer)
2013	Minimum Water Temperature °C	14.1 (31 May; 4-5June)	17.1 (5 June)	17.1 (26 June)
2013	Maximum 7-Day Rolling Average	18.7 (26 June–2 July)	22.5 (30 Aug–5 Sep)	23.4 (30 May–5 June)
2013	Minimum 7-Day Rolling Average	15.7 (3-9 June)	18.4 (4-10 Jun)	18.9 (20 June–26 June
2013	**Average 7-Day Rolling Average**	**17.0**	**20.8**	**20.7**
2012	Maximum Water Temperature °C	20.2	23.2	21.0
2012	Minimum Water Temperature °C	12.6	11.0	14.5
2012	Maximum 7-Day Rolling Average	17.7	19.9	19.3
2012	Minimum 7-Day Rolling Average	15.5	15.6	16.2
2012	**Average 7-Day Rolling Average**	**16.2**	**17.9**	**18.1**
2011	Maximum Water Temperature °C	20.3	21.0	19.8
2011	Minimum Water Temperature °C	14.1	16.0	15.6
2011	Maximum 7-Day Rolling Average	17.3	19.0	18.2
2011	Minimum 7-Day Rolling Average	15.4	16.8	16.2
2011	**Average 7-Day Rolling Average**	**16.4**	**18.0**	**17.2**
2010	Maximum Water Temperature °C	19.8	21.0	20.6
2010	Minimum Water Temperature °C	13.7	15.2	15.2
2010	Maximum 7-Day Rolling Average	17.5	19.5	18.8
2010	Minimum 7-Day Rolling Average	14.8	16.7	16.3
2010	**Average 7-Day Rolling Average**	**16.0**	**17.9**	**17.4**

*Rolling averages were averaged for the 7 days forward **from the date they were recorded on graphs.**

Table 5. Water Temperature Comparisons between Stream Inflow and the Lagoon Near the Bottom, Diurnal Fluctuations and Differences between Years, Generated from Continuous Water Temperature Probes.
(Late May to 15 September in 2010−2017.)

Year/ Baseflow July1; Sept 1	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Max. 7-day Rolling Avg.	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Min. 7-day Rolling Avg.	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Daily 7-day Rolling Avg.	Temp. Diff. (°C) between Given Year and the Previous Year near lagoon bottom- Daily 7-day Rolling Avg.	Daily Temp. Fluctuat-ion (°C) near lagoon bottom	# of Days Temp. (°C) Min. near Lagoon Bottom above 20°C (STH goal unmet)	# of Days Temp. (°C) Max. near Lagoon Bottom above 22°C (STH goal unmet)	# of Days 7-day Rolling Avg > 21°C near Lagoon Bottom (STH goal unmet)	# of Days Temp. (°C) Max. near Lagoon Bottom above 20°C (Coho goal unmet)	# of Days Temp. (°C) above 20°C for 4 hours at Nob Hill (STH stream goal unmet)
2017/ 16.4; 6.2	cooler 0.7	cooler 0.9	cooler 1.5	cooler 1.0 to late Aug; warmer by 1.0 late Aug−mid Sep	1.0−1.5	3	4	4	55	5
2016/ 3.1; 1.4	cooler 2.5	cooler 3.5	cooler 2.0−3.0	cooler 2.0−3.0	1.5−2.5	0	0	0	50	1
2015/ 1.2; 0.4	cooler 5.4	cooler 3.5	cooler 3.5−5.0	warmer 1−2	1−2	96	64	75	111	2
2014/ 0.7; 0.35	cooler 5.2	cooler 4.8	cooler 3.0−5.5	warmer 1−3	0.5−1.5	113	81	94	119	0
2013/ 1.7; 0.4	cooler 4.7	cooler 3.2	cooler 3−4	warmer 2	0.5−1.5	63	25	40	99	1
2012/ 5.6; 1.8	cooler 1.5	cooler 0.7	cooler 2	warmer 1	1−2.5	0	0	0	7	0
2011/ 15; 5.8	cooler 0.8	cooler 0.9	cooler 1.3−1.5	Similar until cooler by 1 in late Aug – Sep	1.5−2.5	0	0	0	0	0
2010/ 7.3; 3.4	cooler 1.3	cooler 1.5	cooler 1.3−1.5	cooler 1−4	1−2.5	0	0	0	7	0
2009/ 3.3; 1.2	cooler 2	cooler 1.2	cooler 1−3.5	cooler 0−2 to mid July and cooler by 0−1 after	1.5−2.5	16	8	9	75	0
2008/ 2.0; 0.7	cooler 4.1	cooler 2.6	cooler 2	similar except cooler by 1 in early Sep	1.5−2	54	13	20	90	1
2007/ 2.3; 1.4	cooler 3.2	cooler 1.5	cooler 2	–	0.5−3	35	20	23	82	5
2006/ 17.0; 6.6	– Rolling Avg not available	– Rolling Avg not available	– Rolling Avg not available	– Rolling Avg not available	1−2.5	0	4	0	19	14

In 2017, the coho management goal of keeping MAXIMUM lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was NOT met for 55 of 129 days (43%) that were monitored (**Table 5**). The pattern has been that more days exceed the management goal as baseflow is reduced. Water temperature met the coho goal for the entire dry period only in 2011, a year with higher baseflow. The coho goal was mostly met in 2010 and 2012 with moderate baseflow. The high baseflow year, 2006 also met the coho goal much of the time. However, the high baseflow year of 2017 did not fit the pattern, partially due to relatively high air temperatures from early August to early September (**Figure 3f**) and generally warm inflow temperatures through the summer/fall (**Figures 3g and 3h**), despite higher baseflow.

At the creek site near Nob Hill, the stream management goal for steelhead to have *no more than 4 hours a day at greater than 20ºC (68ºF)* was met in 2017 (except 5 days; 11 days reaching 20°C) (**Table 5**). The goal was mostly met in all of the last 12 year, even during drought. No pattern is apparent between number of days of failure and baseflow. In fact, 2 of the 3 years when failure was more evident were wetter years, 2006 and 2017. The stream management goals for steelhead to have the maximum 7-day rolling average at 20°C or less and maximum daily temperature below 26°C were met in 2017, as it had in 2006−2016.

The Soquel Creek water temperature goal for coho salmon in stream habitat just upstream of the lagoon is to have an average weekly temperature (7-day rolling average) of 16.7º C (62º F) or cooler, based on the Mattole River study (**Welsh et al. 2001**). In 2017, the management goal was NOT met on 95 of 122 monitored days (78%; reaching a maximum of 19.6°C) compared to 52 of 121 monitored days (43%; reaching a maximum of 17.6°C) in 2016, compared to 114 of 122 days (93%; reaching a maximum of 18.3˚C) in 2015; 71 of 134 days (53%) in 2014; 83 of 128 days (65%) in 2013 (**Figures 5a-c; Alley 2015a**). In 2012, the coho management goal was not met on 9 days (7%) (**Alley 2014**). In 2011, the management goal was not met 23 of 93 days (25%; reaching a maximum of 17.3°C) (**Alley 2014**). In 2010 the goal was met except for 7 days (6% of the days) consisting of 3 days in early June and 4 days in mid-July (**Alley 2014**). Coho salmon may have survived in the 2010−2012 stream habitat near the lagoon if present. However, in all other past monitoring years, more stream shading and/or streamflow would likely be required to make lower Soquel Creek habitable for coho salmon. This was the case especially in low flow years such as 2013−2015 and the higher flow years of 2006 and 2017 when shading may have been lost after high stormflows. The shading would need to come from larger trees of tall stature along the lower mainstem, such as redwood and Douglas fir.

The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2017, which was typical for previous years except 2010. The maximum daily lagoon water temperature typically occurred between 1600 and 2100 hr each day.

Aquatic Vegetation Monitoring

In 2017 at the time of sandbar construction on 1 June, there was no decomposing seagrass or kelp observed in the lower lagoon, downstream of Stockton Bridge. The lagoon bottom was firm without a layer of detritus. In 2016, approximately 90% of the decomposing kelp and seagrass had been raked out of the lower lagoon, downstream of Stockton Bridge (70% in 2015). In 2015

and 2016, the lagoon bottom was also firm without a thick layer of detritus. It was soft with a thick layer of detritus in 2014, when only 30% of the kelp and seagrass had been raked out. This was compared to 20–25% removal in 2013, 90% removal in 2012, 60% removal in 2011, 90% in 2010 and 70% in 2009. There were more nutrients available for plant growth in 2013 and 2014 than in 2015−2017 and previous years. In 2017, the thickness of algae and the coverage was similarly low compared to 2016, with average thickness slightly more in Reach 1 and slightly less in Reaches 2 and 3 (**Tables 6 and 7**). Algae coverage of the lagoon bottom was greater in 2017. Pondweed was similarly sparse in 2016 and 2017 in Reaches 2 and 3. Reach 1 had more pondweed in 2016 than 2017. Thickness of algae and pondweed and pondweed distribution were greater during the drought years of 2013−2015 (**Tables 8−10**). 2017 algae thickness was more similar to 2010−2012 levels, though pondweed was more prevalent in 2010 and 2012 (**Tables 11−13**). Pondweed was especially sparse in 2011 as in 2017, both lagoons coming after wet winters. The planktonic algae bloom that made the bottom vegetation indistinguishable in 2015 at times was absent in 2017 except at the mouth of Noble Gulch. There was less surface algae in 2017 and 2016 compared to 2015 and much less than in 2014 (**Tables 6−9**). Evidence of nutrient inputs from Noble Gulch in 2013−2015 and 2017 was expressed by recurrent thick planktonic algae blooms and sporadically high levels of surface algae nearby, though bottom algae was not observed thicker than at other sites in 2017 (except on 2 September) or 2016 as had been the case in past years. However, in 2017 the bottom was unobservable during the last 5 monitorings due to planktonic algae soupiness, gray murkiness and dark conditions. Pondweed was again absent at the mouth of Noble Gulch in 2017 as in 2016.

Table 6. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2017.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-11	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-25	<0.1	100	0	<0.1	100	0	<0.1	100	0	<0.1	100	0
7-9	0.8	5	0	0.3	15	0	0.3	15	0	Soupy plankton	Soupy plankton	0
7-23	1.0	100	0	0.5	100	0	0.4	100	1	0.5	80	1
8-6	1.0	60	0	0.5	100	0	0.5	100	0	0.8	80	<1
8-20	Dark Cloudy (1.5 pond-weed)	Dark	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy plankton	Dark Cloudy plankton	0
9-02	2.0 (3.0 pond-Weed)	90 (1 pond-Weed)	0	1.5 (2.0 Pond-Weed)	99 (1 pond-Weed)	5	1.0 (1.0 pond-weed)	99 (1 pond-weed)	2	3.5 Soupy plankton	80 Soupy plankton	20
9-17	2.0 (3.0 pond-weed)	85 (5 pond-Weed)	0	1.0 (2.0 pond-weed)	99 (1 pond-weed)	1	0.7 (2.0 pond-weed)	99 (1 pond-weed)	2	Murky gray	Murky gray	5
10-01	1.0 (4.0 pond-weed)	90 (5 pond-Weed)	5	Soupy Plankton bloom	Soupy Plankton bloom	5	1.0 (3.0 pond-weed)	99 (1 pond-Weed)	5	Soupy Plankton bloom	Soupy Plankton bloom	7
10-14	0.5 (4.0 pond-weed)	80 (10 pond-Weed)	<1	1.0 (3.0 pond-weed)	98 (2 pond-Weed)	0	1.0 (3.0 pond-weed)	98 (2 pond-Weed)	0	Murky Gray	Murky Gray	10
10-29	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
11-11	Dark	Dark	0	Dark	Dark	2	Dark	Dark	0	Dark	Dark	0
Avg-6-11 – 10-14	**0.9 algae (1.7 pond-Weed)**	**68 Algae (2 Pond-Weed)**	**0.4**	**0.6 algae (0.9 Pond-Weed)**	**76 algae (0.5 Pond-Weed)**	**1.1**	**0.5 algae (1 Pond-Weed)**	**79 algae (0.6 Pond-weed)**	**0.8**	**1.0 Algae (0 Pond weed)**	**68 Algae (0 Pond weed)**	**3.6**

Table 7. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2016.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-12	**0.1**	**10**	**0**	**0.2**	**15**	**0**	**0.1**	**5**	**0**	**0.2**	**10**	**0**
6-25	0.7	15	0	0.7	25	0	0.3	20	0	0.4	25	<1
7-9	0.3	80	0	0.2	60	0	0.1	40	0	0.2	70	5
7-23	0.3	70	0	0.5	50	0	0.3 (1.0 Pond-weed)	30 (<1 pond-weed)	0	0.3	80	0
8-6	1.0	90	0	0.4	100	0	0.3 (1.0 pond-weed)	90 (<1 pond-weed)	0	0.5	90	0
8-21	1.0 (2.0 pond-weed)	45 (15 pond-weed)	0	1.5	100	0	1.0 (2.0 pond-weed)	98 (1 pond-weed)	0	1.0	80	0
9-4	2.0 (2.5 Pond-weed)	50 (20 Pond-weed)	<1	1.5	95	<1	1.5 (2.0 pond-weed)	95 (1 pond-weed)	2	0.8	65	15
9-17	1.0 (3.0 pond-weed)	80 (15 pond-Weed)	2	1.0 (2.5 pond-weed)	80 (15 pond-weed)	2	0.5 (2.0 pond-weed)	80 (15 pond-weed)	<1	1.5	80	<1
10-1	1.0 (3.0 pond-weed)	60 (15 pond-Weed)	4	1.5 (2.0 pond-weed)	60 (15 pond-Weed)	7	1.0 (2.0 pond-weed)	50 (15 pond-Weed)	5	0.6	60	10
Avg-6-12 – 10-1	**0.8 algae (1.2 pond-Weed)**	**56 Algae (6 Pond-Weed)**	**0.7**	**0.8 algae (0.5 Pond-Weed)**	**46 algae (0.3 Pond-Weed)**	**0.8**	**0.6 algae (1.0 Pond-Weed)**	**44 algae (4.0 Pond-weed)**	**0.8**	**0.6 (0 pond-weed)**	**62**	**3.3**

Table 8. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2015.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-7	**0**	**0**	**<1%**	**Film**	**20**	**0**	**Film**	**25**	**0**	**Film**	**50**	**0**
6-21	0.2	100	0	0.3	100	0	0.15	100	0	0.7	100	0
7-5	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0
7-18	Soupy	Soupy	0	2.0	30	0	Soupy	Soupy	0	Soupy	Soupy	0
8-1	Soupy	Soupy	0	2.0 (4.0 pond-weed)	70 (30 pond-weed)	0	2.0 (4.0 pond-weed)	80 (20 pond-weed)	0	1.5	100	0
8-15	Soupy	Soupy	0	2.5 (3.5 pond-weed)	60 (40 pond-weed)	0	2.5 (4.0 pond-Weed)	70 (30 pond-Weed)	0	2.0 (3.0 Pond-Weed)	70 (30 Pond weed)	0
8-29	3.0 (4.5 Pond-weed)	70 (30 Pond-weed)	0	2.0 (4.0 Pond-weed)	60 (40 pond-weed)	0	2.0 (4.0 pond-weed)	50 (50 pond-weed)	0	2.0 (3.5 Pond-Weed)	70 (30 Pond weed)	0
9-13	2.0 (4.5 pond-weed)	70 (30 pond-Weed)	0	1.0 (4.0 pond-weed)	60 (40 pond-weed)	0	1.0 (3.0 pond-weed)	70 (30 pond-weed)	0	0.5 (3.5 Pond-weed)	70 (30 pond-weed)	0
9-26	1.0 (5.0 pond-weed)	70 (30 pond-Weed)	10	0.8 (4.0 pond-weed)	50 (50 pond-Weed)	5	0.5 (3.5 pond-weed)	30 (70 pond-Weed)	5	2.0 (4.0 pond-weed)	50 (50 pond-weed)	5
10-10	2.0 (4.5 pond-weed)	60 (40 pond-Weed)	5	1.0 (4.0 pond-weed)	70 (30 pond-Weed)	1	1.0 (4.0 pond-weed)	60 (40 pond-Weed)	5	Soupy (3.5 pond-weed)	70 (30 pond-Weed)	10
10-24	Dark	Dark	0	Dark	Dark	<1	Dark	Dark	<1	Dark	Dark	0
11-8	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-07 – 10-10	**1.4 algae (4.6 pond-Weed)**	**62 Algae (22 Pond-Weed)**	**1.5**	**1.3 algae (3.9 Pond-Weed)**	**58 algae (26 Pond-Weed)**	**0.6**	**1.1 algae (3.75 Pond-Weed)**	**61 algae (23 Pond-weed)**	**1**	**1.2 Algae (3.5 Pond weed)**	**73 Algae (34 Pond weed)**	**1.5**

Table 9. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2014.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-7	**0.2**	**25**	**0**	**0.2**	**70**	**0**	**0.2**	**15**	**0**	**Soupy**	**Soupy**	**0**
6-21	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0
7-6	1.0	60	0	1.0	100	0	1.0	100	0	0.8	40	0
7-20	3.5	100	50	3.0	99 (1 pond-weed)	30	3.0	100	40	3.0	60	50
8-3	2.5 (5 pond-weed)	95 (3 pond-weed)	15	2.5 (2.5 pond-weed)	70 (30 pond-weed)	2	1.0 (3.0 pond-weed)	70 (30 pond-weed)	7	0.7	70	10
8-16	3.0 (5.0 pond-2eed)	95 (5 pond-weed)	10	3.0 (3.0 pond-weed)	60 (40 pond-weed)	2	1.5 (3.0 pond-Weed)	25 (75 pond-Weed)	3	Soupy	Soupy	0
8-31 Begonia Festival	2.0 (4.0 Pond-weed)	85 (15 Pond-weed)	7	2.0 (3.0 Pond-weed)	70 (30 pond-weed)	10	2.0 (3.5 pond-weed)	30 (70 pond-weed)	15	Soupy	Soupy	5
9-13	soupy (4.0 pond-weed)	80 (20 pond-Weed)	8	1.0 (3.5 pond-weed)	60 (40 pond-weed)	10	1.0 (3.5 pond-weed)	20 (80 pond-weed)	15	soupy (3.0 Pond-weed)	soupy (20 pond-weed)	2
9-28	Turbid	Turbid	10	Turbid	Turbid	10	Turbid	Turbid	20	Turbid	Turbid	10
10-11	Turbid	Turbid	7	Turbid	Turbid	10	Turbid	Turbid	20	Turbid	Turbid	10
10-26	Turbid	Turbid	0	Turbid	Turbid	<1	Turbid	Turbid	<1	Turbid	Turbid	0
11-8	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
11-23	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
Avg-6-07 – 9-28	**2.0 algae (4.5 pond-Weed)**	**77 Algae (6.1 Pond-Weed)**	**11.1**	**1.8 algae (3.0 Pond-Weed)**	**76 algae (20 Pond-Weed)**	**5.9**	**1.4 algae (3.25 Pond-Weed)**	**51 algae (27 Pond-weed)**	**10.9**	**1.5 algae**	**57 algae**	**7.9**

Table 10. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2013.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-22	Soupy	Soupy	0	0.8	20	0	0.8	15	0	0.2	30	0
7-6	Soupy	Soupy	0	0.8	100	0	1.0	100	0	0.5	100	0
7-20	Dark	Dark	0	1.0	100	0	Dark	Dark	0	1.2	100	0
8-3	2.0	100	0	1.5	100	0	0.5 (1.0 Pond-Weed	99 (<1% pond-weed)	0	2.0	60	0
8-17	2.0	100	0	1.0	100	0	0.5 (2.0 pond-Weed)	99 (1 pond-Weed)	0	1.5	100	0
9-1 Begonia Festival	3.0 (4.0 Pond-weed)	85 (15 Pond-weed)	0	1.0 (2.0 Pond-weed)	78 (20 pond-weed)	0	2.0 (2.0 pond-weed)	85 (15 pond-weed)	1	2.0	100	30
9-14	3.0 (4.0 pond-weed)	85 (15 pond-Weed)	5	2.0 (4.0 pond-weed)	85 (15 pond-weed)	2	3.0 (4.0 pond-weed)	85 (15 pond-weed)	10	2.0	100	1
9-28	2.0 (5.0 pond-weed)	80 (20 pond-weed)	3	2.0 (4.0 pond-weed)	80 (20 pond-weed)	0	2.0 (3.0 pond-weed)	75 (25 pond-weed)	10	1.0 (3.5 pond-weed)	75 (25 Pond-Weed)	0
10-12	Dark	Dark	5	1.0 (3.0 pond-weed)	80 (20 pond-weed)	<1	1.0 (3.0 pond-weed)	80 (20% pond-weed)	2	1.0 (2.5 pond-weed)	80 (20 Pond-Weed)	2
10-26	Dark	Dark	7	Dark	Dark	5	Dark	Dark	5	2.0 (3.0 pond-weed)	70 (30 Pond-Weed)	10
11-9	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
11-23	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
12-8	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-08 – 10-26	**2.0 algae**	**50 algae**	**1.8**	**1.1 algae**	**74 algae**	**0.6**	**1.2 algae**	**62 algae**	**2.5**	**1.2 algae**	**74 algae**	**3.9**

Table 11. Visually Estimated Lagoon Algae/Pondweed Coverage and Thickness in 2012.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover
6-5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-19	0.2	10	0	0.2	30	0	0.4	60	0	0.4	60	0
7-3	0.50	90	5	0.7	100	5	0.5	100	25/3 below/above Noble G.	0.4	60	15
7-16	1.0	70	0	0.5	40 (<1% pond-weed)	0	1.0	90	0	Thick plankton bloom- no vis.	Turbid	0
8-1	0.4	90	0	0.4 (1.0 pond-Weed)	99(1% pond-weed)	0	0.2 (1.0 Pond-Weed	99(1% pond-weed)	0	0.2	100	0
8-14	0.2 (1.5 pond-Weed)	80 (10 pond-Weed)	0	0.3 (0.8 pond-Weed)	85 (15 pond-Weed)	0	0.3 (0.8 pond-Weed)	85 (15 pond-Weed)	0	0.5	80	0
8-29	0.4 (2.5 Pond-weed)	70 (25 Pond-weed)	0	0.3 (2.5 Pond-weed)	85 (15 pond-weed)	0	0.4 (2.5 pond-weed)	80 (20 pond-weed)	0	0.5	70	10
9-12	0.2 (3.0 pond-weed)	65 (35 pond-Weed)	<1	0.5 (2.5 pond-weed)	70 (30 pond-weed)	0	0.5 (2.0 pond-weed)	70 (30 pond-weed)	0	0.4	70	0
9-26	2.0 (3.0 pond-weed)	55 (35 pond-weed)	0	0.7 (1.5 pond-weed)	70 (30 pond-weed)	0	0.3 (1.0 pond-weed)	50 (50 pond-weed)	0	1.5 (2.5 pond-weed)	70 (10 pond-weed)	0
10-10	Dark	Dark	0	Film (1.5 pond-weed)	60 (40 pond-weed)	0	Film (1.0 pond-weed)	30 (70% pond-weed)	0	Thick plankton bloom- no vis.	Turbid	0
10-24	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
11-7	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-05 – 9-26	**0.5 algae**	**59 algae**	**0.6**	**0.4 algae**	**64 algae**	**0.6**	**0.4 algae**	**70 algae**	**3 below Noble G.; 0.3 above**	**0.5 algae**	**64 algae**	**3**

Table 12. Visually Estimated Lagoon Algae/Pondweed Coverage and Thickness in 2011.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
7-10	0	0	0	0	0	0	0	0	0	Turbid-Yellow/brown water	Turbid	0
7-26	0.6	60	0	0.5	70	0	0.3	60	0	Thick plankton bloom	Turbid	0
8-10	1.0	60	0	1.0	70	0	Dark	Dark	2% ds Noble; 5% us Noble	1.0 Thick plankton bloom	80	20 after-Noon
8-23	Dark	Dark	<1 morning	0.3	100	25 morning	0.3	80	10% ds Noble; <1% us Noble	Turbid Thick plankton bloom	Turbid	5 morning
9-5	0.5	100	<1	1.0	70 (1 pond-weed)	0	0.3	70 (1 pond-weed)	0	Thick plankton bloom/gray water	Turbid	0
9-18	0.4	100	0	0.6	100 (1 pond-weed)	0	0.4	100	0	0.8 Thick plankton bloom/gray water	100	0
10-01	1.0	90	0	0.5	100 (5 pond-weed)	0	0.5	95	0	1.5 Turbid-gray/brown Water	90	0
Avg-7-10 – 10-01	**0.6**	**68**	**0.1**	**0.6**	**73**	**3.6**	**0.3**	**68**	**1.7 ds Noble/ 0.8 us/ 1.3 total**	**1.1 (limited obs.)**	**90 (limited obs.)**	**1**

Table 13. Visually Estimated Lagoon Algae/Pondweed Coverage and Thickness in 2010.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover
6-19	0.3	10	0	0.3	15	0	0.3	25	0	Turbid	Turbid	0
7-04	0.3	30	0	0.3	60	0	0.3	30	0	Turbid	Turbid	0
7-19	0.8	70	<1	0.8	60	2	0.5	80 (<1 pond-weed)	20 ds Noble/<1 us/8 total	Turbid	Turbid	25
8-02	1.0	80 (1 pond-weed)	0	1.0	65	5	2.0	40 (<1 pond-weed)	15 ds Noble/ 1 us/5 total	0.5	30	5
8-15	1.0(pond-weed 3.0)	85 (15 pond-weed)	0	0.8	40	0	1.0	50 (<1 pond-weed)	0	Turbid	Turbid	0
8-29	2.0(pond-weed 4.0)	60 (10 pond-weed)	0	1.0	30	0	1.0	99	0	Turbid	Turbid	0
9-12	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
9-26	0.5(pond-weed 2.0)	40 (20 pond-weed)	<1	0.5 (pond-weed 2.0)	85 (15 pond-weed)	3	0.5(pond-weed 3.5)	90 (10 pond-weed)	2	3.0	35	30
10-09	0.7(pond-weed 4.0)	60 (20 pond-weed)	1	2.0(pond-weed 3.0)	50 (30 pond-Weed)	1	1.0(pond-weed 3.0)	70 (20 pond-weed)	1	3.0	30	15
10-23	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
Avg-6-19 – 10-23	**0.8**	**53**	**0.1**	**0.8**	**51**	**1.1**	**0.8**	**97**	**3.8 ds Noble/ 0.4 us/ 1.6 total**	**2.2 (limited obs.)**	**32 (limited obs.)**	**7.5**

Dissolved Oxygen Results During the 2-Week Monitorings

Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was depleted by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen concentrations are most importantly measured and rated because they are typically the lowest. In 2017, the average oxygen level and oxygen concentration at each of the 4 stations near dawn and in the afternoon remained "good" (greater than 7 mg/l at dawn) for steelhead *near the bottom* during 11 of 12 two-week monitoring to November 11 (**Table 2; Figures 6a-1; 6a-2; 6b−6e**). The one exception was a "fair" rating at Station 3 near the Railroad trestle on 29 October. Morning oxygen concentration near the bottom ranged from 6.3 to 11.0 mg/L at the 4 lagoon stations during the 12 monitorings. Afternoon oxygen concentrations near the bottom ranged from 7.6 (76% saturation) to 15.7 mg/L (153% full saturation) at the 4 lagoon stations.

With clear water conditions, lower than usual oxygen concentration at dawn is usually associated with more algae present in concert with a previously cloudy/foggy day or a stagnant saline layer along the bottom that prevents the bottom layer from circulating with the surface and other

oxygen-rich water. No stressfully low oxygen concentrations were detected in 2017, and average oxygen levels at dawn (averaging mostly between 8 and 10 mg/L) and in the afternoon (averaging mostly between 9 and 13 mg/L) were within the range of typical measurements over the past 4 years (**Figures 6h and 6i**). Oxygen concentrations varied less at dawn in 2016 and 2017 than in the 2 previous years, but more so in 2017 than 2016 in the afternoon. Stressful oxygen depletion was avoided in 2017 from turbid conditions after early storms that did not breach the sandbar. 2017 oxygen concentrations in the afternoon were lower for most of the dry season than in other recent years, though they were more than adequate. The lower oxygen levels were due to limited algae and pondweed production in 2017. The lowest oxygen concentration registered in the afternoon was on 9 July at 8.1 mg/L at Station 2 near the bottom, when it had been overcast and foggy in the morning, and the cloud layer burned off late in the day. This was a rare case when morning oxygen was higher than in the afternoon at 2 stations and in the lagoon inflow at Nob Hill. At dawn after a previously sunny day with good water clarity, oxygen levels are higher because the water becomes supersaturated with oxygen from high photosynthetic rates of the lagoon algae and pondweed the previous day. When water clarity is reduced after small stormflows, if light does not penetrate to photosynthesizing plant life, oxygen concentrations decline rapidly. This occurred in late September and October in 2014 and November 2015 (**Figure 6h**).

In comparing morning and afternoon oxygen levels in the lagoon, usually oxygen concentration was higher in the afternoon than morning through the years and on all but 2 monitoring days in 2017. In 2017, oxygen concentration was less in the afternoon than morning on 9 July at lower lagoon Stations 1 and 2 and in the stream inflow. On 29 October, oxygen concentration was less in the afternoon at Station 2. The lagoon was very foggy and overcast in the morning on 9 July, and the overcast may have continued most of the day. It was overcast most of the day on 29 October (**Figures 6a-e**). Oxygen concentration typically increases through the day, despite warmer water temperature in the afternoon, which has a lower oxygen saturation point. At or above fully saturated oxygen levels existed near the bottom in afternoon throughout the 2017 lagoon throughout the monitoring period until 29 October and 11 November, when they were mostly in the 70−90% saturation range. Oxygen concentrations at the stream Station 5 at Nob Hill typically measured between 0830 and 0900 hr were usually within the range of oxygen concentrations at lagoon stations in 2017, with them higher at Nob Hill than in the lagoon from mid-October to mid-November (**Figure 6a-1**). Typically, inflow oxygen levels in the afternoon at Station 5 are lower than lagoon levels. However, Station 5 had higher oxygen concentrations in the afternoon than some lagoon stations during 8 of the 12 two-week monitoring in 2017 (**Figure 6a-2**). In stream settings, oxygen is typically at or close to full saturation due to water turbulence in riffles. In 2017, the lowest morning oxygen concentration at Station 5 was 7.3 mg/L (77% of full saturation on 2 September) (**Appendix A**). However, all afternoon oxygen concentrations were between 85% and 125% full saturation (**Appendix A**). Stream oxygen levels were much higher than in 2015, which had lower baseflow during drought.

Salinity Results

In 2017, no saline conditions were detected in the lagoon. A freshwater lagoon was maintained throughout the period of sandbar closure until sandbar breaching on 11 November. No tidal overwash was allowed to occur through the dry season in 2017, with the elevated berm around the lagoon.

Conductivity Results

Measured conductivity remained low throughout 2017 and lower than other recent years. It ranged between 510 and 680 umhos at the various monitoring stations, with the mouth of Noble Gulch being no higher than elsewhere in the lagoon (**Appendix A**). In 2016 after the thin saline layer dissipated, conductivity ranged between 720 and 810 umhos at the various monitoring stations, with a lower range than in 2015 (**Alley 2017; 2016**). Conductivity was not stressful to steelhead in 2017. As in other years, conductivity was usually slightly lower at Station 5 above the lagoon than in the lagoon through the summer.

Stream In-Flow to the Lagoon

The lagoon water quality is generally best with relatively higher summer baseflow. Stream inflow in 2017 started out much higher than the 4 previous years and similar to 1995, 1996 and 2006 but less than 1998 (**Tables 2 and 14; Figures 25−37**). 2017 streamflow on June 1 at Soquel Village was 26.7 cfs compared to 7.3 cfs in 2016 and 2.6 cfs in 2015. By October 1, the respective streamflows were 5.5, 0.7 and 0.25 cfs. Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than low baseflow, thus reducing the heating effects of a stagnant saline layer on the lagoon bottom. Higher summer baseflow can discourage saltwater back-flushes into the lagoon during high tides. The lagoon mixes and cools more quickly overnight when inflow is higher. Lagoon water temperature heats up more during the day with less inflow, as indicated by average lagoon water temperature at dawn and in the afternoon in 2015 (low inflow), 2016 (intermediate inflow) and 2017 (high inflow) (**Figures 3k-3l**). 2015 had relatively warm air temperature (**Figure 3f**), warm inflow (**Figure 3e**) and very high lagoon water temperatures at dawn and the afternoon (**Figures 3k-3l**). The 2016 dry season had relatively cool air and inflow stream temperatures. The 2016 lagoon had intermediate average water temperature through early August, while the 2017 lagoon was the coolest of the 3 years through early August, despite its warmer inflow throughout most of the summer and fall. However, from early August through mid-September, air temperature (**Figure 3f**) and stream inflow temperature (**Figure 3e**) were much warmer in 2017 than 2016, and average lagoon water temperature was similar for 2016 and 2017 (**Figures 3k and 3l**). The 2015 lagoon, with its low inflow rate, was much warmer than the 2017 lagoon, even though inflow water temperature was similar or warmer in 2017 compared to 2015 from early August to mid-September. The annual trend in 7-day rolling temperature averages with respect to the maximum, average and minimum for the dry season indicates the inverse relation between stream inflow rate and average lagoon temperatures (**Figure 4i**). However, the trend is less evident for the relatively high baseflow year of 2017, when the maximum and average 7-day rolling averages are similar or higher than in 2016, despite its lower baseflow. We judge this was because 2016 was a relatively cool summer, while 2017 had relatively high air temperatures in the latter half of the season and possibly less stream shading after a wet winter, resulting in warmer inflow temperatures in 2017.

In 2008, there were repeated problems with apparent saltwater back-flushes through the flume at high tides. This was not a problem in 2009−2017, perhaps resulting from partial boarding of the flume exit in 2014 and 2015 and the use of plywood over the flashboards in 2009−2016. In 2017, the baseflow was so high throughout the dry season that the underwater adult steelhead portal was left in the flume inlet the entire dry season. Since 2008, the sandbar around the periphery of the lagoon has been maintained at a higher elevation to reduce/prevent tidal overwash.

With proper flume management and the grated flume ceiling installed in 2003, it should be easier to maintain lagoon depth and prevent fluctuations in lagoon level when the summer begins with high baseflow. To maximize summer baseflow, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon

The 6 restaurants that were contiguous with Soquel Creek Lagoon were tested for leaks and deficiencies in plumbing connections and repaired as necessary. Confirmation is contained in **Appendix B**.

Begonia Festival Observations and Water Quality Conditions

No negative impacts to fish were detected during the Begonia Festival in 2017. The City's fishery biologist (Donald Alley) was present before, during and after the nautical procession of floats on 3 September. The day of the parade was clear and warm in the morning and afternoon. On 2 September, scheduled water quality measurements were taken throughout the lagoon at dawn and in the afternoon. All water quality parameters were in the "good" range that day. Water temperatures near the bottom had ranged between 20.4 and 20.9°C in the afternoon. On Begonia Festival Day, water temperature near the bottom ranged between 21.6 and 22.1°C at 3 sites (excluding mouth of Noble Gulch), 1.5 hours earlier in the day than measurements on 2 September (**Appendix A**). The maximum water temperature recorded by the continuous temperature probe near the railroad trestle and 0.5 ft from the bottom on 3 September was 22.1°C at 1630 hr (**Figure 4a**). The maximum had been 21.7°C on 2 September at 1530 hr. Air temperatures were identical (23.3°C) at the times of measurement on the 2 days. These afternoon water temperatures near the bottom were the warmest recorded at 2-week intervals for the dry season in 2017. The maximum temperature measured with the continuous temperature probe near the bottom in 2017 was 22.9°C on 5 September. The parade occurred during the 4-day period in 2017 when the lagoon management goal of maintaining maximum daily water temperature below 22°C was not met (**Table 5**). The gage height that day was excellent at 2.65. We judge that the warm water temperatures were the result of warm air temperatures throughout the day and not due to activities of the Parade. Oxygen concentrations were very good and supersaturated in the afternoon at the measured stations ranging between 135 and 165% full saturation. The procession included 11 floats (all powered by electric motor, 1 assisted by boat paddlers.) One wading paddle boarder after procession was asked to stay on his board. It was the largest attendance the biologist could recall, it being the last, 65th Begonia Festival. The railroad trestle was labeled with no trespassing stenciling. Police were present to prevent viewing from the railroad bed on the trestle. About 25 people precariously climbed onto trestle abutments from the west side to view the procession instead. Others viewed from the slope below the trestle, west side. Very few blossoms were left in the water after the procession. The lagoon bottom was undisturbed for the most part. Conductivity increased slightly from disturbance during the procession, based on differences measured between 2 September and 3 September, but was not a problem. Conductivity in the afternoon on 3 September was slightly more than the previous day at the 3 monitored sites, ranging from 675 to 679 umhos in the afternoon near the bottom 659 to 662 umhos the previous afternoon. The secchi depth (water clarity) was to the lagoon bottom

Table 14. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2017.

Year	1 June Streamflow (cfs)	1 July Streamflow (cfs)	1 August Streamflow (cfs)	1 September Streamflow (cfs)	1 October Streamflow (cfs)
1991	4.1	2.6	1.5	0.65	0.37
1992	4.0	4.0	0.6	0.1	0.2
1993	12	5.8	3	1.8	1.6
1994	4.2	1.3	0.7	0.2	0.05
1995	24	17	7.8	4.5	3.7
1996	23	17	8	4.6	3.6
1997	9	7.7	4.2	2.6	2.3
1998	58	22	13	9.7	7.2
1999	16	10	7.4	5.7	4.3
2000	14	9.5	6.2	4.6	7.4
2001	7.2	4.0	3.4	2.6	1.6
2002	9.1	4.9	3.3	2.8	2.2
2003	15	7.2	4	2.2	1.8
2004	5.2	3.3	2.7	1.8	1.4
2005	20	13	7.5	5.1	3.1
2006	28	17	8.7	6.6	7.1
2007	4.7	2.3	2.0	1.4	1.3
2008	3.8	2.0	1.3	0.7	1.4
2009	6.2	3.3	2.5	1.2	0.5
2010	14	7.3	5.3	3.4	2.2
2011	25	15	8.6	5.8	4.5
2012	9.8	5.6	2.9	1.8	1.4
2013	3.3	1.7	1.3	0.4	0.5
2014	1.5	0.7	0.5	0.35	0.5
2015	2.6	1.2	0.6	0.4	0.25
2016	7.3	3.1	1.8	1.4	0.7
2017	26.7	16.4	9.7	6.2	5.5

after the float procession. Begonias were cleaned out of the lagoon in the succeeding days after few were left floating on the lagoon. There was a begonia shortage in 2016 and 2017, bringing an end to the Begonia Festival parade. Floats were dismantled the week following the parade, and flowers were gathered from the lagoon, using a boat. More than 90% of the petals were retrieved. Water quality measurements on 17 September detected no oxygen depletion resulting from decomposing begonias (**Figure 6a-1; Appendix A**).

Casa Fenkel's Float– "Miss BUGonia 'Th, Th, Th, That's All Folks'" 3 September 2017

Nels Westman and the Riverview Rascals with "Now Departing...Begonia Flight #65"

Recreational Use, Pollution Sources and Solutions

The lagoon near the beach was closed to human contact during the summer with warning signs posted. However, increased human use of the lagoon was observed in 2017 as in 2016. A paddle-board concession started in 2016. Paddle-boarders became common in both years (observed on 10 of 12 afternoon weekend monitorings in 2017; 7 of 9 afternoon weekend monitorings in 2016), along with more kayakers, pedal boaters, row boaters, canoers and barge users on the lagoon. The most paddle boarders counted in a reach were 5. Waders and swimmers were commonly observed in the lagoon (usually near the beach in Reach 1; 4 of 12 afternoon weekend monitorings in 2017; 6 of 9 in 2016). The most waders seen at one time were 8. This human contact with the lagoon occurred despite warning signs being posted in close proximity.

On the morning of 9 August, a grandfather and grandson from the central valley were fishing in Reach 2. They had caught a 22-inch adult steelhead the day before and released it. They were told to stop fishing. They had not done so ½-hour later. The game warden was notified. Fishing rods were seen leaning against the Golino cabin at one time. On the afternoon of 14 October, people were fishing from the rental at the lower end of Reach 3 near the trestle. They were asked to stop and they complied. Then a father and son were observed fishing from the Venetian wall in Reach 1 on the same day. They were asked to stop. They were informed of the no-fishing sign

that had been posted at the beginning of the creek path at Stockton bridge and the fishing opportunity on the wharf, and they disappeared. High-volume bird feeding was observed on 2 occasions at Noble Gulch, despite warning signs nearby. One group attracted more than 30 ducks. Ducks were more attracted to the monitoring biologist along the periphery in 2017 compared to past years. In 2017, algae production was much reduced for the second year in a row, and pondweed was scarce except in Reach 1. Thus, the ducks had less aquatic vegetation from which to obtain invertebrate food from. Human bird-feeding attracted gulls further up the lagoon where they usually did not go. Gulls are a threat to ducklings.

Paddle boarders, a barge and waders in Reach 1.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been observed to be successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other restaurants have been effective in discouraging roosting. All of the refuse cans on

the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, pers. comm.**). Refuse containers with gull-proof lids may reduce gull numbers. City building permit conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, Public Works Director, pers. comm.**). The increased presence of paddle boarders and boaters in 2016 and 2017 interfered with gull use in Reach 1. Gulls took wing when visitors appeared on their floatation devices and returned quickly to bathe and raft after they passed. Gulls avoided waders along the periphery near the flume. Human impact from disturbance on the rate of gull defecation is unknown. Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original Management Plan, the trestle could be screened to eliminate pigeon roosting areas.

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included in these would be storm drains emptying into Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch. Though none was detected during 2-week monitorings in 2014−2016, gray water plumes were observed on 6 of 12 monitoring days in 2017, especially in the latter weeks of the monitoring period. Water quality monitoring was conducted along Noble Gulch in summer/fall 2017, including under an accessible manhole cover in the parking lot entrance, to pinpoint potential anthropogenic pollution sources. Noble Gulch was also monitored upstream of urban storm drains to establish a baseline. Results have not yet been analyzed. On one occasion when a thick gray plume emanated from the Noble Gulch culvert into the lagoon, water from a residential hose entered a lateral drain approximately 60 feet from the mouth, with plant material decomposing within. If pollution sources can be identified, source control efforts should be made to control illicit discharges or, where feasible, to direct dry weather flows from storm drains to sanitary sewers. The thick planktonic algal bloom present much of the summer of 2015 at the mouth of Noble Gulch was absent in 2016, but reappeared in 2017. That was the only location where a planktonic bloom was observed in the lagoon in 2017. At times the bloom was so thick that the bottom was invisible (4 of 12 monitorings) (**Table 6**). However, oxygen depletion was not detected at the mouth of Noble Gulch at dawn, as it had been in 2016 near the bottom on 6 and 21 August and 4 September 2016 (2.42 mg/L; 4.24 mg/L and 3.75 mg/L, respectively). In 2017, no elevated conductivity was detected at the bottom at the mouth of Noble Gulch (**Appendix A**). Surface algae was thicker at the mouth of Noble Gulch than other stations on occasion, and the highest estimates of 10% and 20% surface coverage on separate occasions (**Table 6**). The average bottom algae coverage at the Gulch was equal to Reach 1 and less than Reaches 2 and 3. Algae thickness was at a maximum of 3.5 feet at the Gulch mouth and greater than anywhere else in the lagoon on 2 September. But average algae thickness was similar to averages in Reaches 1−3 for the dry season. In conclusion, there were indications of nutrient pollution and increased eutrophication at the mouth of Noble Gulch in 2017.

Another drain into the lagoon exists under the railroad trestle, where slight oxygen depletion has been detected in recent years but not in 2016. This drain could be capped if summer runoff was re-directed into the sewer.

Regarding pollution from urban runoff, once the rains start in fall, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective

traps and percolation basins to encourage winter percolation of storm runoff. There has been a pollution problem and high flashiness in streamflow in the past during the first small storms of the fall. Early storms turn the lagoon water turbid (cloudy), requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2016, the lagoon required breaching prematurely because the flume could not accept all of the stormflow with flooding imminent. Retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the sources of this problem.

The storm drain along the Esplanade was connected to the sewer line in 2006 for summer diversion of water in the drain to the sewer system. However, the pump was in manual mode, requiring Public Works staff to turn it on and off. Now an automatic pump switch has been connected to a float system to improve the operation.

The historical lagoon had large tule beds prior to construction of the bulkheads following the 1955 flood. Tules are commonly used in managed wetlands to remove nutrients and other pollutants from wastewater effluent. Re-establishment of tule marsh in Soquel Lagoon would reduce nutrient pollution and may reduce bacterial counts. Tule re-establishment would also provide fish habitat in Soquel Lagoon. In 2017, tules were planted in the cove under the railroad trestle. They survived well through the summer and fall.

Tules planted in the cove under the Railroad Trestle, east side.

Tule growth 3 months after planting in the cove under the Railroad Trestle. USFWS sign erected.

Recommendations to Maintain Good Water Quality and Fish Habitat in the Lagoon

55. If the tules planted in the cover under the railroad trestle withstand winter stormflow, pursue planting tules in other lagoon locations. Seek volunteers to re-establish tules near the Golino property. When this becomes successful, approach the restaurants to allow tule plantings in Margaritaville Cove. This will provide additional cover for steelhead and tidewater gobies against predators and may reduce dissolved nutrients and bacteria in the lagoon.

56. Prior to sandbar breaching in the fall, continue to notch the sandbar across the beach at an elevation just below the piling bolt for flooding, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize beach erosion. The purpose is to maximize the residual estuary depth after the emergency breach.

57. The notch in the sandbar should be cut slightly lower than the piling bolt. *Continue to* o*rient the notch laterally (diagonally) across the beach to the southeast of the flume. Continue to* m*ake the notch at least 30 feet wide across the beach to also maximize the possibility of maintaining an estuary with some depth after the breach.* The City may have to periodically

re-establish the notch if it does not rain or high tides obliterate it. If a storm is predicted, the sandbar needs a notch as preparation. Continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with the wide notch in between. *When breaching must be facilitated, notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to the east to finish the sandbar breach.*

58. Continue to remove three 4x4-inch boards from the flume inlet on one side as soon as possible after the first stormflow of the season (which does not require sandbar breaching). This will insure light penetration to the lagoon bottom. If turbidity still prevents light penetration to the bottom, remove enough boards to achieve complete light penetration. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. As water clarity improves, add boards back to the flume inlet. A previous recommendation in the original Management Plan (**1990**) should be emphasized to prevent fish mortality; parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

59. If tules planted under the railroad trestle survive winter stormflows, seek volunteers to re-establish tules near the Golino property and in Margaritaville Cove.

60. To provide cover for juvenile fishes and to scour deeper habitat, continue to secure large woody material to the lagoon bottom with anchor boulders in appropriate locations. Continue to retain large woody material that naturally reaches the lagoon.

61. Continue to allow a clear path from under the Stockton bridge to the beach at Venetian Court to enable seining for juvenile steelhead during fall censusing.

62. Continue to require that Margaritaville staff not wash their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

63. Restrict the number/weight of float participants allowed to ride on the floats to a safe level.

64. Enforce the ban on waders during future nautical parades.

65. Continue to recommend to the lagoon parade organizers that floats be safely maneuvered downstream of Stockton Avenue, with a water marshal present to direct floats in a circular direction along the periphery of the lagoon after they clear the bridge.

66. Continue to recommend to the lagoon parade organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

67. Continue to use gull-proof lids on refuse cans at and around the lagoon and beach. Use enough refuse containers to satisfy the demand for refuse disposal.

68. Consider screening the railroad trestle to discourage roosting and nesting by rock doves.

69. Re-install the wooden baffle inside the flume during sandbar construction, if necessary.

70. Continue to maximize lagoon depth through the dry season, while maintaining passage through the flume for adult steelhead until June 15 and for steelhead smolts until July 1. If the lagoon level begins to drop below the notched upper flashboard for steelhead smolts because of the adult portal after June 15, close the portal. If inflow is sufficient to maintain depth with the adult portal open, leave it open through the dry season. If adult steelhead are seen in the lagoon after June 15 with the portal closed, then open it for a week to allow out-migration.

71. After July 1, leave the flume exit closed once it closes, unless flooding is eminent. Continue to install visquine or plywood on the outside of the flashboards to prevent leakage into the flume. Maximize the number of boards in the flume entrance to maximize lagoon depth.

72. Continue to secure the flume boards at all times to prevent their lifting by vandals or bay back-flushing to drain the lagoon.

73. If the lagoon bottom becomes invisible due to turbidity after the rains that do not breach the sandbar, continue to immediately lower the lagoon level to the point where the bottom is visible. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. A previous recommendation in the original Management Plan (**1990**) should be emphasized to prevent fish mortality**;** parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

74. After a small stormflow in the fall that has made the lagoon turbid, if the flume exit closes after boards have been removed from the flume inlet to reduce the lagoon water level, excavate the flume exit daily, if necessary, to maintain lagoon outflow and a shallower lagoon for effective light penetration.

75. Road repaving and application of petrochemicals should be done early in the summer. This will allow chemical penetration into the pavement and drying before fall rains.

76. Continue to maximize the lagoon level for any future lagoon nautical parade.

77. Regarding the nautical parade, we continue to recommend that float propulsion by surfboard paddling or rowboat or electric outboard motor be required by the City rather than allowing pulling and pushing by waders. The latest CDFW permit prohibits wading. Allow float passage in one direction only, presumably downstream, before dismantling near the Stockton Avenue Bridge. In the past, floats were taken down the lagoon and then back up before dismantling back at the bridge.

78. Check the gage height at the lagoon once a week (preferably the same day each week) and log the measurements so that the biologist may contact the City to obtain a weekly update.

79. "Gull Sweeps" sold by West Marine Products should be installed on Esplanade roofs to test their effectiveness in deterring gulls. According to the catalogue, "Powered by the slightest breeze, the Gull Sweep's motion will deter the most determined bird." These were successfully used on San Diego restaurants (**Y. Sherman, pers. communication**).

80. The City should influence planners, architects and property owners through the permit review to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing land development within the City and upstream.

81. The City should request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned.

82. The City should continue to fund activities to permanently remove invasive Arundo (Giant Reed) from residences along the lagoon and other non-native plants in the riparian corridor between Highway 1 and the lagoon in order to maximize stream shading, minimize water temperature of inflow water and protect aquatic and wildlife habitat.

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2017, as was the case in 2003–2016. CDFW has allowed juvenile planting of smolts in spring only in streams where planted juveniles were descendents of captured adult steelhead brood stock from those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured from Soquel Creek for hatchery propagation. Therefore, no juveniles were planted there.

Fish Sampling Results. Fall sampling for steelhead occurred on 8 and 15 October 2017, from upstream of the Stockton Avenue Bridge to the beach. A bag-seine with dimensions 106 feet long by 6 feet tall by 3/8-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and upstream of it. Juvenile steelhead congregate in the shade under the bridge and under the willows on the west side. The seine was pulled to the beach in front of Venetian Court. A total of only 102 steelhead were captured and marked on 8 October after 6 seine hauls. There were no mortalities. A total of 117 steelhead were captured on 15 October in 5 seine hauls. There were 46 recaptures and no mortalities. The lagoon population estimate was 259 steelhead, using the Lincoln index for a closed population (**Table 14;** methods in **Ricker 1971**). Juveniles were relatively large (**Table 14; Figure 7a**), but the population size was relatively small compared to the 23-year average of 1,482 (**Figure 24**). This small lagoon population was consistent with low densities of juvenile steelhead detected at most stream sampling sites (**Alley 2018**) and did not indicate poor lagoon nursery habitat. Size histograms of steelhead captured from the lagoon in 2017 and other years back to 1998 may be found in **Figures 7a−23**. The four larger steelhead captured in 2017 were all likely older than 2+. The 425 mm SL fish was either 3+ or 4+, based on scale analysis. The largest fish of the 4 was likely an adult, though scales were not taken. All of the larger fish were in good condition, indicating adequate food supply. The median size of steelhead captured on 8 Oct 2017 was 160-164 mm SL (**Figure 7a; Table 16**). It was 155-159 mm SL on 15 October. The size histogram indicated excellent growth rate and no clear demarcation between YOY and older steelhead. Scale analysis from fish captured on 15 October indicated that scale samples from the largest YOY came from steelhead 154, 157 and 158 mm Standard Length (SL); 172, 172 and 173 mm Fork Length, respectively. The smallest yearling steelhead was 153 mm SL (163 mm FL). Therefore, there was likely year class overlap in the 150−160 mm SL range, and a major portion of the lagoon population was yearling or older juveniles. Other species captured were hundreds of threespine stickleback, 5 staghorn sculpins, 2 starry flounders and 63 YOY Sacramento suckers.

On 15 October 2017, 6 seine hauls were made to capture tidewater gobies with a 30-foot x 4-foot x 1/8-inch mesh beach seine in lower Soquel Lagoon near the beach. None were captured after being captured the 4 previous years (**Table 17**). Numerous threespine stickleback were captured (100+) along with 6 YOY Sacramento suckers. The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until 2008 and 2009, probably indicated a lack of backwater areas for overwintering refuge during high winter stormflows. This species was plentiful in Soquel Lagoon during the previous drought years of the late 1980's and early 1990's and reappeared during the recent two, less severe droughts (2007-2009 and 2013-2015). It was surprising to find good numbers in the 2016 lagoon despite an 8,000 cfs stormflow the previous winter. Tidewater gobies were also detected upstream of the Stockton Avenue Bridge during sandbar construction in 2016. Perhaps they had migrated from adjacent lagoons after the high stormflow in March 2016. Tidewater gobies have been reported in recent years in adjacent Moran Lake Lagoon by Jerry Smith (**pers. communication**).

Tidewater gobies from up-coastal-current Moran Lake likely re-colonized Soquel Lagoon in 2008, when Soquel Creek had two mild winters in a row. They likely re-colonized Soquel Lagoon again in 2013 after two large stormflows in December 2012. We found them in Aptos Lagoon in 2011−2014 (**Alley 2012; 2013; 2014; 2015**) but have not sampled for them since.

Past calculations indicated that lagoon steelhead production represented nearly 1/3 of the smolt-sized steelhead production in the lower 7.2 miles of mainstem Soquel Creek in both 1999 and 2000. In 1993, the lagoon production estimate of nearly 2,800 fish represented 10% of the estimated smolt production in the 16.6 miles of steelhead habitat in the mainstem, East and West Branches. The 2004 lagoon population estimate of 3,900 fish represented an estimated 47% of the smolt production for the 16.6 miles of stream and lagoon habitat. Though we do not have 2007–2017 population estimates for the entire Soquel Creek watershed, the lagoon population of larger, smolt-sized fish has likely been a significant portion of the total watershed population in most dry years and 2017. The lagoon provides valuable habitat through proper management.

Two factors that may influence growth of juvenile steelhead at the time of fall sampling are population size and the time of lagoon closure prior to sampling. Another factor that will affect the size distribution in the fall is timing of YOY entry into the lagoon. If certain YOY enter the lagoon later in the summer, they will be smaller than if they entered early on. Still another factor is the proportion of yearlings versus YOY in the lagoon population. The higher the proportion of yearlings, the larger the size distribution will be. A summary table was prepared for the years, 1998−2017 (**Table 16**), corresponding to scatter plots of the data presented in previous reports (**Alley 2011**). Scatter plots of median juvenile size versus weeks of sandbar closure and versus population size done for data in 1998−2010, indicated no strong relationship between these factors when considered separately.

One would predict that if the population was large, then competition for food would be high and juvenile size at the time of fall capture would be less. One would expect that since the lagoon is a very food-productive habitat, then juvenile size would be larger with longer lagoon growth periods. The population estimates may not be entirely precise but likely are accurate in reflecting relative annual differences in actual population size. Usually the lagoon population is overwhelmingly dominated by young-of-the-year steelhead, based on past scale analysis. We

suspect from the size distributions of juveniles captured, that steelhead grew faster in 2006, 2009, 2011, 2014 and 2016 than in either 2007 or 2008 because of less competition for food with much smaller populations (**Table 16**). The food-rich lagoon was in place nearly 3 weeks less in 2006 than in 2007 and 2008 before sampling, and the steelhead still grew faster in 2006 with the much smaller population estimate than 2007 or 2008. We see that with similarly low population sizes in 1998, 2001 and 2009, as the growth period increased, the median size also increased, respectively. 2012 also had relatively large juveniles with a long growth period. However, in years like 1999 and 2003 that had similar population size to 2000 and 2006, growth rate remained relatively slower despite longer growth periods. So, other factors influence growth rate.

Capitola's Soquel Lagoon with tule marsh.
(circa 1927; Provided by the Capitola Historical Museum.)

Table 15. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2016.

Year	Steelhead Population Estimate for Soquel Creek Lagoon
1988-	Rough estimate of a few hundred. No mark/recapture activity done. 157 juveniles captured in 5 seine hauls.
1992-	Rough estimate of a few hundred. No mark/recapture activity was done. 60 juveniles captured in 4 seine hauls.
1993-	2,787 +/- 306 (standard error). 1,046 fish marked from two seine hauls.
1994-	1,140 +/- 368 (standard error). 76 fish were marked from two seine hauls.
1995-	360 +/- 60 (standard error). 59 fish were marked from 4 seine hauls.
1996-	255 +/- 20 (standard error). 105 fish were marked from 3 seine hauls.
1997-	560 +/- 182 (standard error). 53 fish were marked from 3 effective seine hauls.
1998-	671 +/- 74 (standard error). 164 fish were marked from 3 effective and one snagged seine haul.
1999-	928 +/- 55 (standard error). 397 fish were marked in 4 effective seine hauls.
2000-	875 +/-156 (standard error).185 fish were marked in 4 effective seine hauls.
2001-	454 +/- 27 (standard error). 186 fish were marked in 4 effective seine hauls.
2002-	1,042 +/-84 (standard error). 363 fish were marked in 4 effective seine hauls.
2003-	849 +/-198 (standard error). 109 fish were marked in 5 effective seine hauls.
2004-	3,869 +/-1,009 (standard error). 281 fish were marked in 4 effective seine hauls.
2005-	1,454 +/-347 (standard error). 212 fish were marked in 5 effective seine hauls.
2006-	992 +/- 125 (standard error). 178 fish were marked in 5 effective seine hauls.
2007-	6,064 +/- 1,671 (standard error). 226 fish were marked in 5 effective seine hauls
2008 -	7,071 +/- 1,574 (standard error). 551 fish were marked in 2 effective seine hauls
2009 -	449 +/- 87 (standard error). 114 fish were marked in 6 effective seine hauls.
2010-	1,174+/- 111 (standard error). 318 fish marked in 2 effective seine hauls.
2011-	678 +/- 107 (standard error). 197 fish marked in 5 effective seine hauls
2012-	220 +/- 94 (standard error). 44 fish marked in 6 seine hauls. 1 hindered by submerged log.
2013-	1,681+/- 265 (standard error). 195 fish marked in 4 effective seine hauls.
2014-	No Estimate Possible. 10 fish marked in 6 seine hauls. 2 unmarked fish caught on day 2.
2015-	No Estimate Possible. 10 fish marked in 6 seine hauls. 5 unmarked fish caught on day 2.
2016-	237 +/- 19 (standard error). 161 fish marked from 4 effective seine hauls.
2017-	259 +/- 23 (standard error). 102 fish marked from 5 effective seine hauls.

Table 16. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2017.

Year	Sandbar Closure Date	Fish Sampling Dates	Weeks of Sandbar Closure Prior to Final Fish Measurements	Days of Sandbar Closure Prior to Final Sampling	Steelhead Population Estimate	Median Size Grouping of Captured Fish (mm SL)- 1st and 2nd Day
1998	9 July	4/11 Oct	13.1	92	671	115-119 First Day
1999	18 May	3/10 Oct	20.6	144	928	120-124 First Day
2000	7 June	1/8 Oct	17.4	122	875	135-139 First Day
2001	14 June	7/14 Oct	17.3	121	454	125-129
2002	23 May	6/13 Oct	20.3	142	1,042	105-109 First Day
2003	22 May	5/12 Oct	20.3	142	849	110-114 First Day
2004	26 May	3/10 Oct	19.4	136	3,869	115-119 First day
2005	9 June	2/9 Oct	18.1	127	1,454	105-109& 110-114
2006	14 June	30Sep/8 Oct	16.4	115	992	150-154 & 145-149
2007	23 May	7/14 Oct	20.4	143	6,064	125-129 Both days
2008	22 May	27Sep/ 11 Oct	18.1	127	7,071	115-119 First day
2009	21 May	4/11 Oct	20.3	142	449	155-159 Both days
2010	2 June	3/10 Oct	18.4	129	1,174	115-119 Both days
2011	20 June	2/16 Oct	15.3+1.6 weeks estuary	106+11 days estuary	678	155-159 & 160-164
2012	24 May	7/14 Oct	20.3	142	220	140-144 Both days
2013	23 May	6/13 Oct	20.3	142	1,681	125-129 & 130-134
2014	22 May	12/19 Oct (2 unmarked fish- 2nd day)	21.3	149	None possible (No recaptures)	155-159 First Day
2015	21 May	4/11 Oct (5 unmarked fish- 2nd day)	20.4	143	None possible (No recaptures)	95-99 First day
2016	27 May	2/9 Oct	19.1	134	237	155-159 & 165-169
2017	1 June	8/15 October	19.4	140	259	160-164 & 155-159
Average/ Median					**1482/ 875**	

Table 17. Number of Tidewater Gobies Captured at Soquel Lagoon in October.

Year	# of Tidewater Gobies Captured in Soquel Lagoon	# of Seine Hauls (30-foot Seine)
1988	102	2
1992	2	?
1993	0	4
1994	35	4
1995	0	8
1996	0	6
1997	1	8
1998	0	4
1999	0	5
2000	0	5
2001	0	5
2002	0	5
2003	0	5
2004	0	5
2005	0	4
2006	0	5
2007	0	5
2008	33	4
2009	8	4
2010	0	6
2011	0	6
2012	0	5
2013	10	7
2014	481	6
2015	309	5
2016	98	4
2017	0	6

Other factors that may strongly influence growth rate are water temperature and food availability. The density of aquatic vegetation, which may be an indirect indication of food availability, may vary considerably between years. Also, pondweed with attached algae may provide more invertebrate food than just filamentous algae alone. So, the density of pondweed is also important. 2012−2015 had good densities of pondweed with attached algae (15-70% of bottom coverage in various reaches) from mid-August onward **(Tables 8−11).** High pondweed production would encourage faster steelhead growth rate. Consideration must be given to potentially diminished water quality (high water temperature or low oxygen levels at the end of the night) and/or poor fish foraging efficiency if aquatic vegetation becomes too dense, making it difficult to maintain food intake. Warmer water increases fish metabolic rate and food demands.

Cooler lagoons reduce fish metabolic rate for maintenance and may allow a higher portion of the food intake to be used for growth. However, cooler lagoons may have less production of aquatic vegetation, and fish digestion rate is slower in cooler lagoons. This slows the processing of food for growth. The 2013−2015 lagoon was relatively warm with very limited stream inflow. The lagoons in 2011−2012 and 2016−2017 were cooler. Aquatic plant production was less in 2011, 2016 and 2017 than in the warmer lagoons of 2008, 2009, 2012 and 2013−2015 (more pondweed) (**Tables 6−12; Alley 2016**), indicating less food available in 2011 and 2016−2017. There may have been a higher proportion of yearlings in the lagoon population in 2011 and 2016−2017 compared to other years due to overall low YOY production in the watershed. In 2016 and 2017, juvenile densities were extremely low in the lower mainstem Soquel Creek. A higher proportion of yearlings would have increased the median size of juveniles.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. The 2017 lagoon was deeper than recent years, with scour at the base of the exposed bulkheads visible. Stations 2 and 3 were 0.25 meters (10 inches) deeper in 2017 than in 2016.

The City must maintain the water level as high as possible throughout the summer until sandbar breaching, without large fluctuations. It is potentially easier to maintain good water quality and water depth when there is higher streamflow into the lagoon in summer (known as summer baseflow). The ceiling grate constructed in 2003 makes it easier to maximize lagoon depth because a portion of the flow can spill over the boards into the ceiling opening with all of the flashboards in place. However, even with the grate, it was difficult to maximize lagoon depth in 2006 because of the seepage of water and sand under the flume (**Figure 2**). Seepage again occurred in 2009 as previously, and sandbags were piled into the hole that developed in front of the flume inlet. Seepage was prevented in 2007, and lagoon depth was maintained. Although a seepage problem existed in 2012, it was largely solved in 2013−2017. Prior to sandbar construction in 2013, plywood sheets were inserted between the flume pilings to slow or divert any water and sand underflow beneath the flume and discourage undermining. These sheets remained in 2017. There were periods during the 2017 summer when no threat of sink holes existed and no areas were flagged on the beach. The lagoon water surface was kept at the top of the flume inlet throughout the summer/ fall until 2 small storms occurred in early November prior to the breach required in mid-November. Usually, in drier years it is easier to maintain a high gage height. However, gage height was managed near or at the maximum even in the high baseflow year of 2017.

If the lagoon water surface drops, steelhead habitat in the upper lagoon is lost. Therefore, the lagoon level should be kept as high as possible during summer. The flume's flashboards must be secured against vandals removing them and against tidal backpressure that may dislodge them.

Maintenance of the lagoon in the fall after the first small storms is important. If the sandbar opens with the first small stormflows and closes again, kelp and seagrass may become trapped to rot and create an anoxic lagoon leading to a fish kill. In 2017, the sandbar has periodically closed and opened since the emergency breach on 16 November because only 1 small storm has occurred to the time of this writing on 22 December. In 2015, the lagoon opened and closed repeatedly after the early breaching on 9 November because streamflow was low. In 2016 the

sandbar was opened even earlier on 16 October. However, the first stormflow of the season reached 1,040 cfs at Soquel Village, and baseflow was sufficient afterwards to prevent sandbar re-closure until more stormflows occurred in November. Minimization of pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

Recommendations Regarding Fish Management

1. Seek volunteers to re-establish tules in the alcoves under the railroad trestle, near the Golino property and beside Margaritaville.

2. Seek funding to secure large wood to the lagoon bottom with anchor boulders as added fish cover and as scour objects to deepen the lagoon and enhance rearing habitat.

3. If the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify nurseries having surface diversions upstream and the Fish and Wildlife Department so that direct surface water diversion may be reduced or discontinued until flow returns. Pumping by the Soquel Creek Water District from the Main Street well may also need to be curtailed. Avoid complete loss of surface flow.

4. Continue to maximize lagoon depth by maximizing flashboards in the flume inlet and by sealing the boards with visquine and/or plywood.

5. Continue to secure the flume boards at all times so that vandals cannot pry them up and drain the lagoon. This will prevent tidal surges through the flume from dislodging boards and doing the same thing. Design and installation of a louver system on one side of the flume inlet would eliminate the need to deal with boards all summer and is recommended.

6. Do not unplug the flume exit after 1 July unless flooding is eminent.

7. Continue not to remove flume boards for the nautical parade.

8. Continue to remove flume boards before the first small storm that does not require sandbar breaching and replace the boards after the stormflow has subsided while maintaining light penetration to the lagoon bottom. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches for the winter. Many forecasts for rain and storm intensities are incorrect in the early fall. It is harmful to steelhead to drop the lagoon level in anticipation of a storm that fails to develop, followed by failure to re-install the flume boards afterwards.

9. Maintain the lagoon in fall until streamflow has increased enough (25-30 cfs) to prevent stranding of spawning adult steelhead or coho salmon and to prevent osmotic stress to lagoon-inhabiting steelhead. If necessary, install a perimeter fence with 2"x 4" mesh and with 6-foot panels around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. Maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar. By this time, the winter storm pattern has usually developed to keep the sandbar open.

10. When the first small storm of the fall season creates turbidity, remove at least three 4x4-inch

flashboards as soon as possible after the storm to insure that light penetrates to the bottom of the intact lagoon. If the bottom is still invisible, remove more boards as necessary to see the bottom with a secchi disc. This will prevent death of aquatic vegetation and increased biological oxygen demand, with the associated loss of oxygen production that would have occurred from photosynthesis. Thus, low oxygen concentrations or anoxic conditions will be prevented. As the lagoon clears up, add boards to eventually re-establish the maximum lagoon depth.

11. If the sandbar is still in place after November 15, maintain an opening in the flume inlet to allow early spawning adult steelhead or coho salmon to pass through the flume Bay.

12. Continue to census the juvenile steelhead in the fall to monitor the use of the lagoon as an important nursery area under varying management scenarios and restoration efforts.

BIRD CENSUSING

Piscivorous Birds and other Waterfowl. Predation may be a factor in population size and body size distribution of juvenile steelhead. If bird predation rate was heavier, smaller steelhead would be most vulnerable because fish swimming speed increases with size. Heavy predation could increase the size distribution of juveniles surviving until fall sampling. Maximizing lagoon depth is important to make feeding more difficult for piscivorous animals.

Mergansers were similarly observed in 2017 and 2016 but less than in 2013−2015. The most we observed at a time was two in 2017 compared to four in 2016, three in 2015 and as many as 6 in earlier years. In 2017, mergansers were observed on 4 of 12 monitorings (33%) (**Appendix A**). In 2016, mergansers were observed on 3 of 9 monitoring days (33%), compared to 6 of 12 monitoring days (50%) in 2015. They were observed on 6 of 13 monitoring days (46%) in 2014 compared to 9 of the 18 two-week monitoring days (50%) in 2013. In 2012, one merganser was observed on only 3 of 12 monitoring days (25% of the time). A common Goldeneye was observed in Reach 1 on 16 November, the day the sandbar was breached. Two snowy egrets were observed roosting on the railing at the dock at Station 4 (Noble Gulch) by resident Dick Arthur on the day prior to our last monitoring on 11 November. None were observed in 2016 and they were uncommon in 2015, being observed on only 1 occasion compared to 4 times in 2014. No egrets were sighted in 2013 (1 observation in 2012). In 2017, a cormorant was observed on one occasion, as was the case in 2016. In 2015, a cormorant made the lagoon its home. It was observed on 7 of 12 two-week monitoring days plus on the day of the Parade. On two occasions there were 2 cormorants. One cormorant was observed on one occasion in 2014 compared 3 times in 2013 and 4 times in 2012.

In 2017, a pied-billed grebe was not observed until 20 August. None were seen on 2 September with heavy afternoon traffic from paddle boards, canoes, pedal boats, rowboats and a barge. After that, 1 or 2 were observed on each of the 5 remaining monitoring days at 2-week intervals, totaling 6 of 12 of the total monitoring days (50%) of the dry season. Pied billed grebes were seen on 4 of 9 monitoring days (44%) in 2016, beginning on 9 July. However, only one was observed the first 3 times, with 2 pied-billed grebes observed on the final monitoring day, 1 October. Pied-billed grebes are commonly seen in pairs. They were less common in 2015, having

been observed on only 4 of 12 monitoring days (33%) and not until 13 September. They were seen on 7 of 13 monitorings in 2014. A pied-billed grebe was observed on 6 July 2014 but not again until 13 September. Similarly in 2013 when rain did not come until well into winter 2014, 1−4 pied-billed grebes were seen in the lagoon not until 14 September but for the 10 monitorings thereafter (56% of the monitorings). In 2012, 1 pied billed grebe was observed on 4 monitoring days early in the season and a pair of pied-billed grebes were observed on 4 monitoring days late in the season (67% of the monitoring days with grebe sightings). No brown pelicans were observed in the lagoon in 2016 or 2017, though 2 were observed in Reach 1 during sandbar construction in late May 2017. No black-crowned night herons were observed in 2017. One was observed on one occasion on 16 September 2016, at which time a greenback heron was observed along with 2 other observed flying toward the beach on 6 August and one on 1 October roosting on an overhanging willow in Reach 2. In 2015, a black crowned night heron was observed on one occasion on 24 October, at which time a greenback heron was observed, along with one greenback heron sighting during sandbar construction. A lagoon-side resident said there was a night heron nest in a redwood near the railroad trestle in 2015.

Common merganser at Soquel Lagoon

Common merganser at Soquel Lagoon

Pied-billed grebe at Soquel Lagoon

Common Goldeneye 16 November 2017

No western pond turtles were observed in 2013−2017, although a paddle-boarder observed a turtle in the upper lagoon in 2015. Previously, they regularly basked on the instream cottonwood log across from the Noble Gulch mouth and on additional logs further downstream adjacent to the Golino Property. The cottonwood was flushed out to the beach during the wet 2016-2017 winter. In 2012, as many as 3 pond turtles were observed at one time on the cottonwood log and another nearby log. The cottonwood that had been previously used had sagged and was mostly underwater in 2013−2015, offering limited basking area. In 2016 the cottonwood had moved upstream a few feet and was still partially submerged.

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge. However, when people were feeding the ducks in upstream reaches, a few gulls were attracted to the food source. 2017 gull densities were the lowest since 2013 until mid-October, their numbers also being relatively low in 2016 (**Figure 46**). Numbers in 2017 ranged between 18 and 85 (20 and 65 in 2016) during afternoon monitorings, when they are most common. The increased human waders and paddle boarders in 2016 and 2017 may have reduced gull bathing numbers on the weekends when monitoring took place. The highest gull counts in 2017 occurred in mid and late October after human traffic on the water lessened.

Mallard numbers tend to be lowest in June before ducklings become common in July – September, with a decline in October at a time when coots become common (**Figure 47**). Mallard counts were less in the 2017 lagoon than the previous 3 years and were similar to 2013 levels. Mallard numbers have been higher in 2014-2016 than in 2012-2013 and 2017. In 2017, the mallard population remained mostly in the 15-30 bird range from early June to late September compared to the 30−40 mallards in 2016. In 2017, fewer ducklings were observed and mallards no longer roosted on and congregated around the cottonwood log across from Noble Gulch because the cottonwood was gone. In 2017, mallards were observed roosting at the west side Stockton Bridge park on 3 occasions, which was unusual, along with them roosting on the logs under the Stockton Bridge and the concrete railroad trestle abutments, west side. In mid-September 2017, coots started to appear at the lagoon, as annually occurs. As many as 34 coots were observed during a fall monitoring (29 October). In fall 2016, the sandbar was breached relatively early in mid-October, and only 13 coots were counted on 1 October, compared to higher numbers in 2015 (as many as 113 on 24 October 2015 and 71 by 7 November 2015).

LITERATURE CITED

Alley, D.W. 1992. Soquel Creek Lagoon Monitoring Report, 1990- 91. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1993. Soquel Creek Lagoon Monitoring Report, 1991- 92. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1994. Soquel Creek Lagoon Monitoring Report, 1992- 93. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1995a. Soquel Creek Lagoon Monitoring Report, 1993- 94. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1995b. Monitoring Report, 1993-1994. Lagoon Water Quality for Fish, Streamflow Measurements, Fish Sampling and Passage Conditions in San Simeon and Santa Rosa Creeks, San Luis Obispo County, California. Prepared by D.W. ALLEY & Associates for the Cambria Community Services District.

Alley, D.W. 1996a. Summary Report Regarding Development, Implementation and Monitoring of the Soquel Creek Lagoon Management and Enhancement Plan, 1996. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1996b. Soquel Creek Lagoon Monitoring Report, 1994- 95. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1997. Soquel Creek Lagoon Monitoring Report, 1995- 96. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 1998. Soquel Creek Lagoon Monitoring Report, 1996- 97. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 1999. Soquel Creek Lagoon Monitoring Report, 1997- 98. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1998-1999. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1999-2000. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2001. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2000 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District.

LITERATURE CITED (continued)

Alley, D.W. 2002a. Soquel Creek Lagoon Monitoring Report, 2000-2001. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2002b. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2001 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District.

Alley, D.W. 2003a. Soquel Creek Lagoon Monitoring Report, 2002. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2003b. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2002 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District and Santa Cruz County Environmental Planning.

Alley, D.W. 2003c. Soquel Creek Lagoon Monitoring Report, 2003. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley D.W., K Lyons and S Chartrand. 2004a. Soquel Creek Lagoon Management and Enhancement Plan Update. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2004b. Soquel Creek Lagoon Monitoring Report, 2004. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2005. Soquel Creek Lagoon Monitoring Report, 2005. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2006a. Soquel Creek Lagoon Monitoring Report, 2006. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2006b. Monitoring Results for Lower San Simeon and Santa Rosa Creeks, 2004-2005: Lagoon Water Quality, Fishery Resources and Inflow Near Cambria, San Luis Obispo County, California. Prepared by D.W.ALLEY & Associates for the Cambria Community Services District

Alley, D.W. 2008a. Soquel Creek Lagoon Monitoring Report, 2007. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2008b. 2007 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2007.

Alley, D.W. 2018. Draft 2017 Summary Report– Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds, Santa Cruz County, CA.

LITERATURE CITED (continued)

Alabaster, J.S. 1962. The effect of heated effluents on fish. Int. J. Air Water Poll. 7: 541-563. (Cited by Kubicek and Price 1976).

Alley, D.W. 2009. Soquel Creek Lagoon Monitoring Report, 2008. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2010a. Soquel Creek Lagoon Monitoring Report, 2009. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2010b. Soquel Creek Lagoon Monitoring Report, 2010. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2011. Soquel Creek Lagoon Monitoring Report, 2010. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2012. Soquel Creek Lagoon Monitoring Report, 2011. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2013. Soquel Creek Lagoon Monitoring Report, 2012. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2014. Soquel Creek Lagoon Monitoring Report, 2013. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2015a. Soquel Creek Lagoon Monitoring Report, 2014. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2016. Soquel Creek Lagoon Monitoring Report, 2015. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2015. 2014 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, CA.

Alley, D.W. 2016. Soquel Creek Lagoon Monitoring Report, 2015. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2017. Soquel Creek Lagoon Monitoring Report, 2016. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Baltz, D.M., B. Vondracek, L. R. Brown, and P.B. Moyle. 1987. Influence of temperature on microhabitat choice by fishes in a California stream. Trans. Am. Fish. Soc. 116:12-20. (Cited in Moyle 2002).

LITERATURE CITED (continued)

Bjornn, T. and D. Reiser. 1991. Habitat requirements of salmonids in streams. In Meehan, W. ed., Influences of Forest and Rangeland Management on Salmonids Fishes and Their Habitat. American Fisheries Society Special Publication 19. pp. 83-138.

Brett, J.R. 1959. Thermal requirements of fish – three decades of study, 1940-1970. In: Biological problems in Water Pollution. USPHS Tech. Rept. W60-3, 110 Cincinnati, Ohio. pp. 110-117. (Cited by Kubicek and Price 1976).

Cech, Joseph. 1993. Personal Communication. Fish Physiologist and Professor. University of California, Davis, CA. Phone # (916) 752-3103.

Charlon, N., B. Barbier and L. Bonnet. 1970. Resistance de la truite arc-en-ciel (Salmo gairdneri Richardson) a des variations brusques de temperature. Ann. Hydrobiol. 1: 73-89. (Cited by Kubicek and Price 1976).

Coche, A.G. 1967. Production of juvenile steelhead trout in a freshwater impoundment. Ecol. Monographs 37: 201-228. (Cited by Kubicek and Price 1976).

Dettman, David. 1991. Personal Communication. Senior Fishery Biologist. Monterey Peninsula Water Management District.

Farrel, A.P., N.A. Fangue, C.E. Verhille, D.E. Cocherell, K.K. English. 2015. Thermal Performance of Wild Juvenile *Oncorhynchus mykiss* in the Lower Tuolumne River: A Case for Local Adjustment to High River Temperature. Prepared for Turlock Irrigation District and Modesto Irrigation District.

Hokanson, K.E.F., C.F. Kleiner and T.W. Thorslund. 1977. Effects of constant temperatures and diel temperature fluctuations on specific growth and mortality rates and yield of juvenile rainbow trout, Salmon Gairdneri. J. Fish. Res. Board Can. 34:639-648. (Cited in Santa Ynez River Technical Advisory Committee 2000).

Kubicek, P.F. and D.G. Price. 1976. An evaluation of water temperature and its effect on juvenile steelhead trout in geothermally active areas of Big Sulphur Creek. Pacific Gas and Electric Company Department of Engineering Research.

McAfee, W.R. 1966. Rainbow trout. In: Inland Fisheries Management. A. Calhoun (ed.). Calif. Dept. Fish and Game. 546 pp. (Cited by Kubicek and Price 1976).

Moyle, P.B. 2002. Inland Fishes of California. Revised and Expanded. Univ. of Calif. Press. Berkeley, Los Angeles and London. ISBN: 0-520- 22754-9.

Myrick, C.A. and J.J. Cech. 2005. Effects of Temperature on the Growth, Food Consumption, and Thermal Tolerance of Age-0 Nimbus-Strain Steelhead. N. Am. Journal of Aquaculture 67: 324–330.

LITERATURE CITED (continued)

Ricker, W.E. (ed.) 1971. Methods for Assessment of Fish Production in Fresh Waters. Blackwell Scientific Publications. Oxford and Edinburgh. ISBN: 0-632-08490-1. 2nd edition. 543pp.

Santa Ynez River Technical Advisory Committee (SYRTAC). 2000. Lower Santa Ynez River Fish Management Plan. Volume II Appendices. *Prepared for* Santa Ynez River Consensus Committee. *Prepared by* Santa Ynez River Technical Advisory Committee. October 2, 2000.

Sherman, Y. 2002. Personal Communication. Editorial Services. San Diego, California.

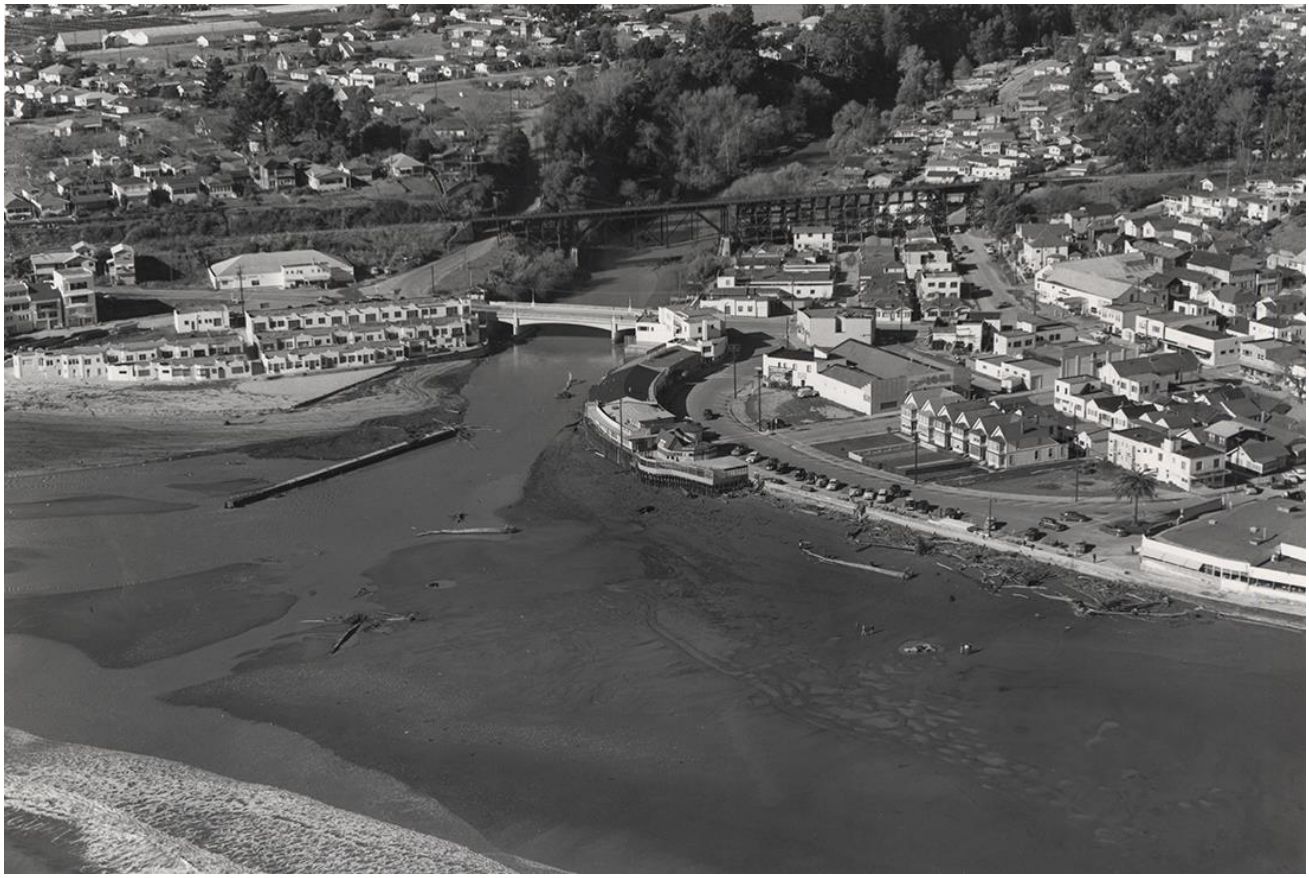
Smith, J.J. 1999 and 2009. Personal Communication. Professor. San Jose State University.

Snyder, G.R. and T.H. Blahm. 1971. Effects of increased temperature on cold water organisms. J. Water Poll. Control Fed. 43: 890-899. (Cited by Kubicek and Price 1976).

Soquel Creek Lagoon Management and Enhancement Plan. 1990. Donald Alley, Project Manager. Prepared by Habitat Restoration Group for City of Capitola and Coastal Conservancy.

Welsh, H.H., G.R. Hodgson, B.C. Harvey and M.F. Roche. 2001. Distribution of juvenile coho in relation to water temperatures in tributaries of the Mattole River, California. N. Am. J. Fisheries Mgmt. 21: 464-470.

Soquel Lagoon Post-Venetian Court Construction- Older Stockton Avenue Bridge visible and prior to expanded development on eastern margin of the Lagoon, upstream and downstream of the Railroad Trestle; circa 1931.
(Courtesy of the Capitola Historical Museum)



Post-World War II Soquel Creek Estuary at very low tide (present-day Stockton Bridge with flume exposed on the beach after the December 1955 flood). Riparian corridor re-established on west side upstream of Stockton Bridge since 1931 photo; circa 1955-56 after the flood.
(Courtesy of the Capitola Historical Museum)

FIGURES

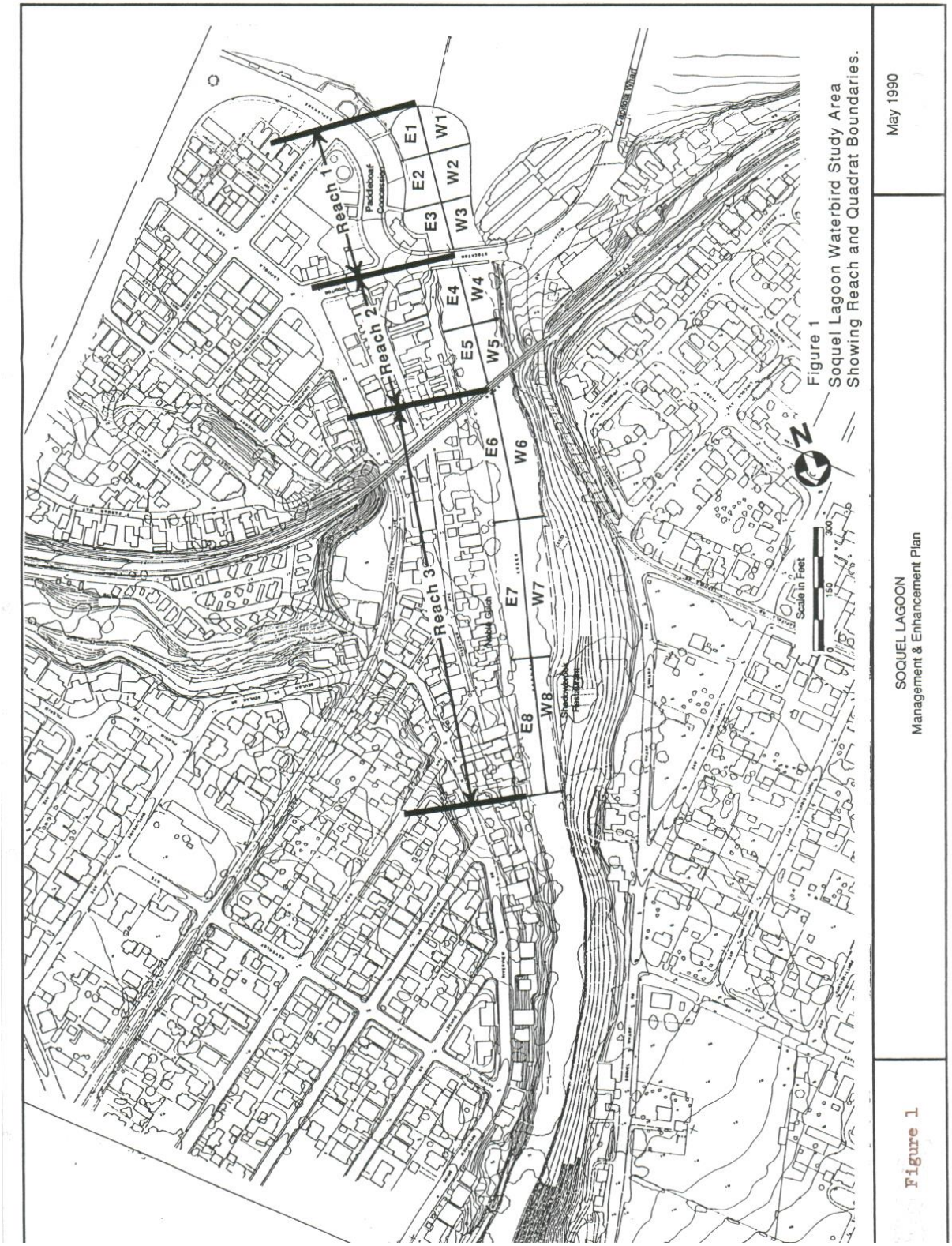


Figure 1. Map of Reaches in Soquel Creek Lagoon

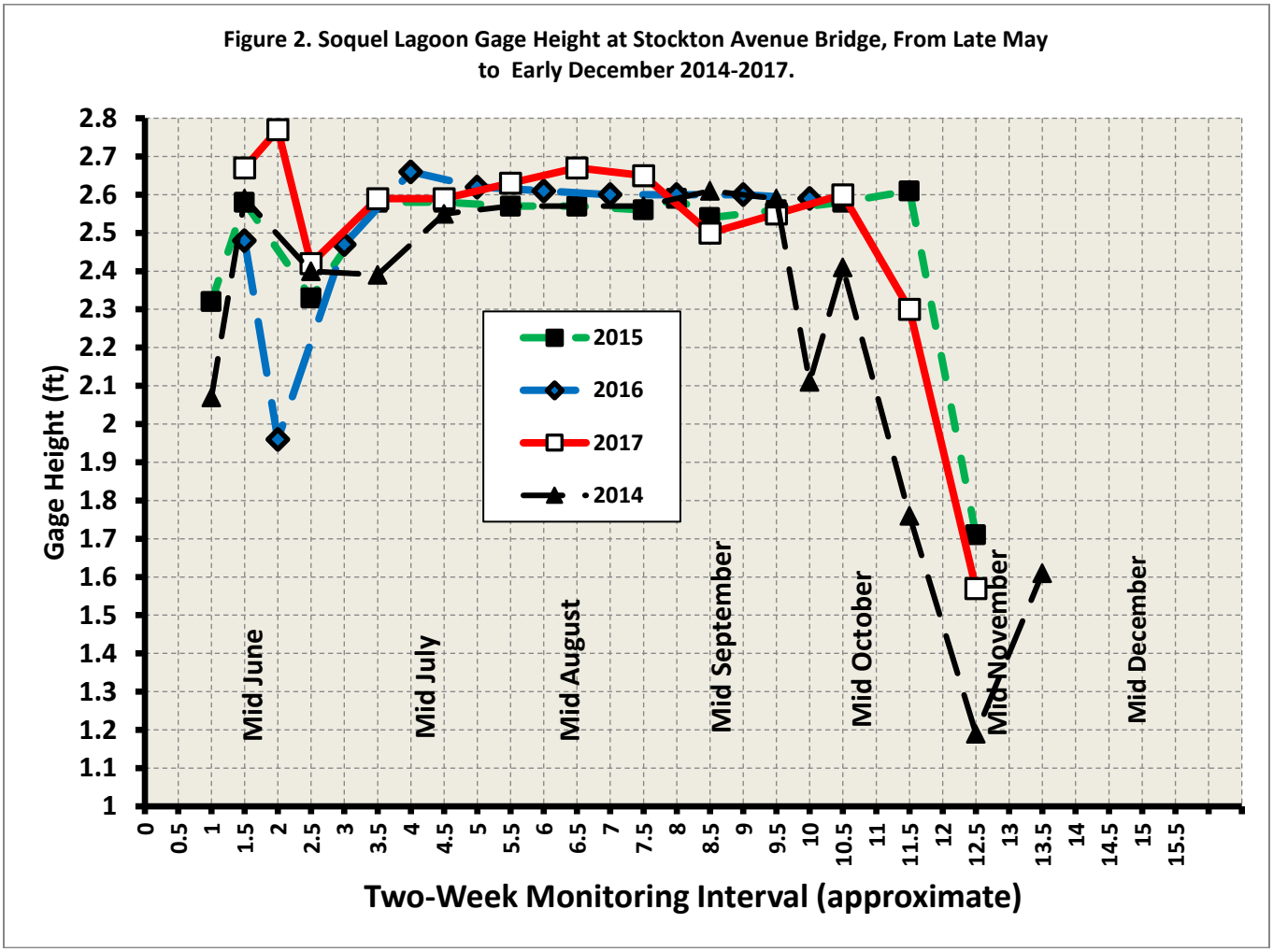


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2014-2017

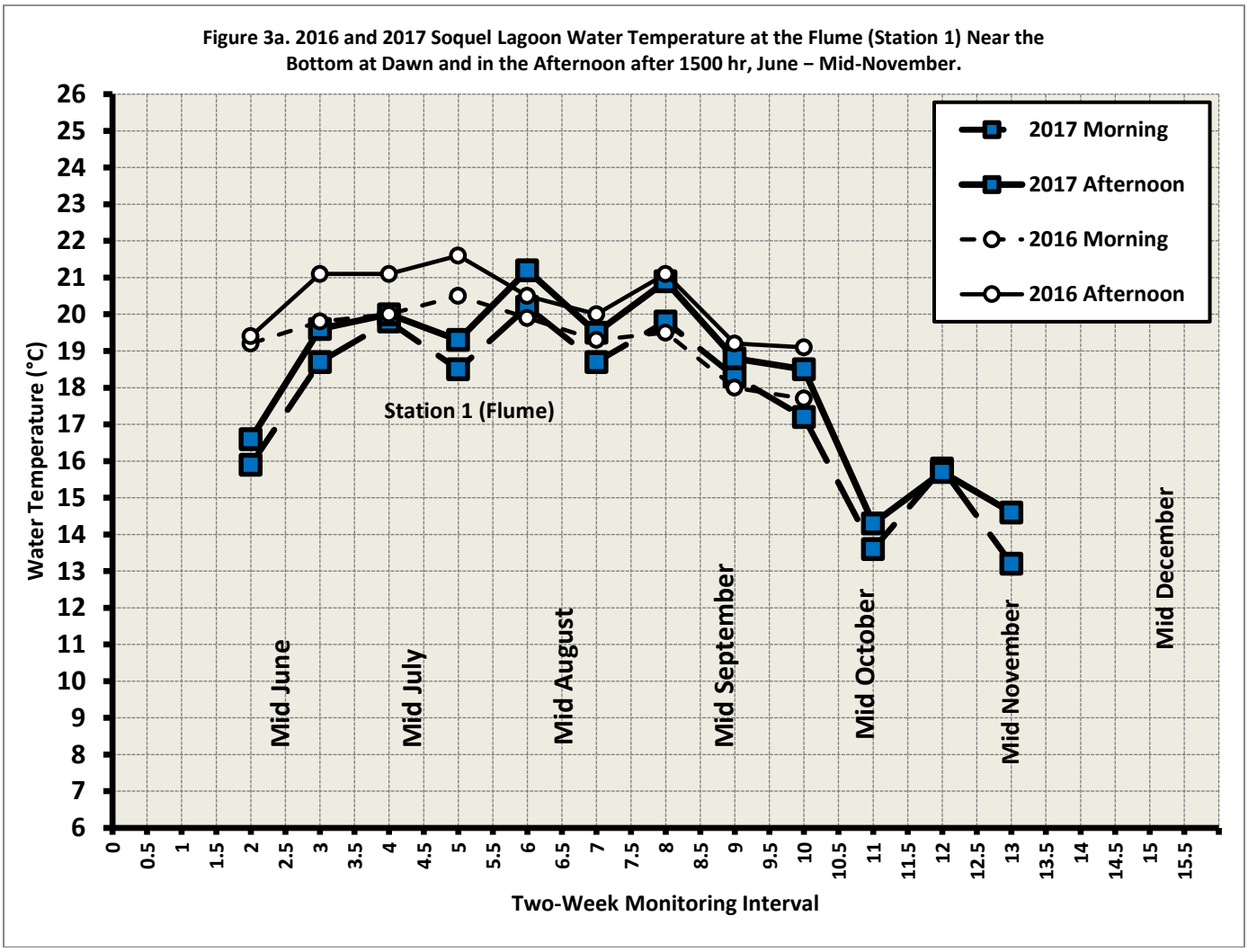


Figure 3a. 2016 and 2017 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr, June – Mid-November.

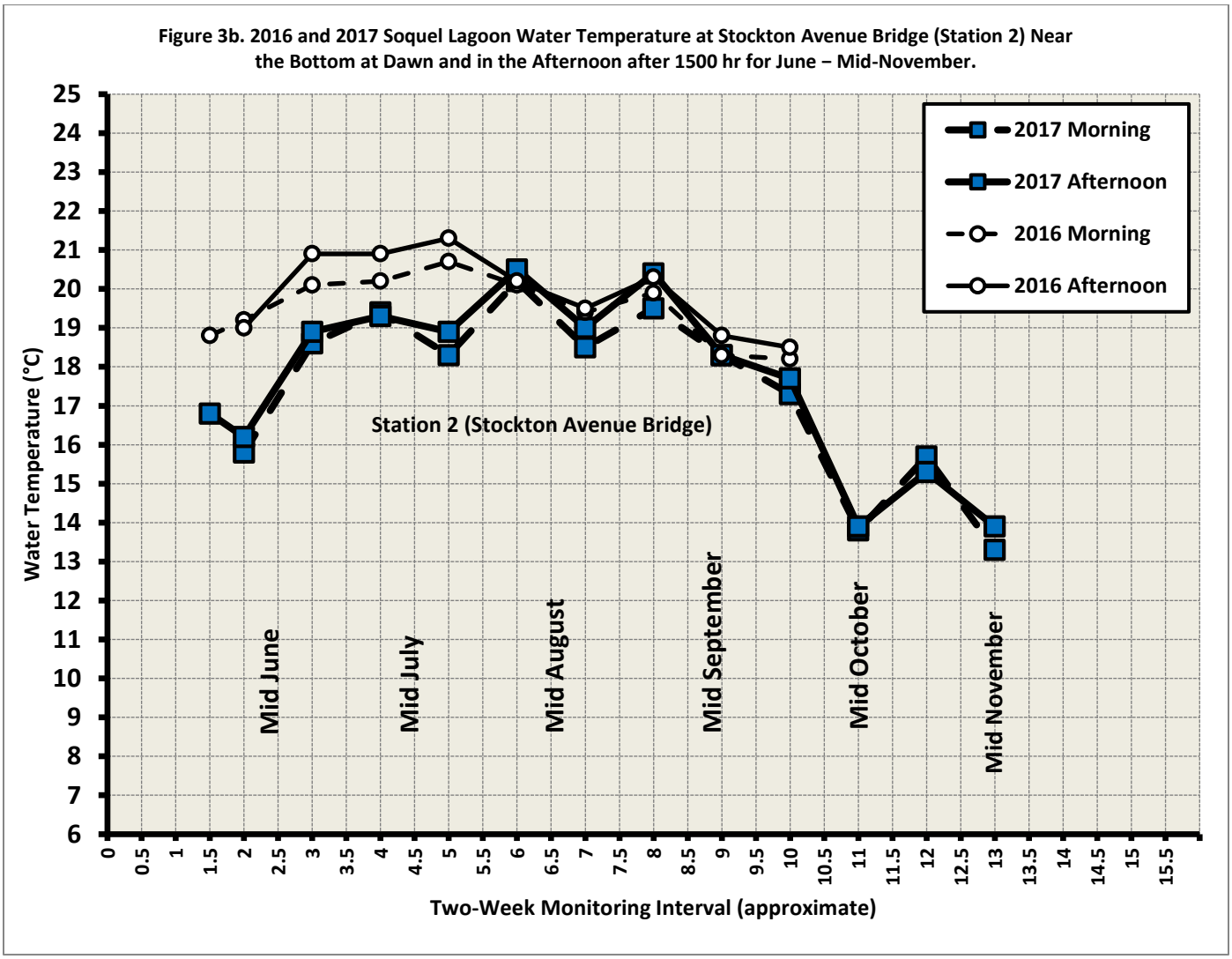


Figure 3b. 2016 and 2017 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr for June – Mid-November.

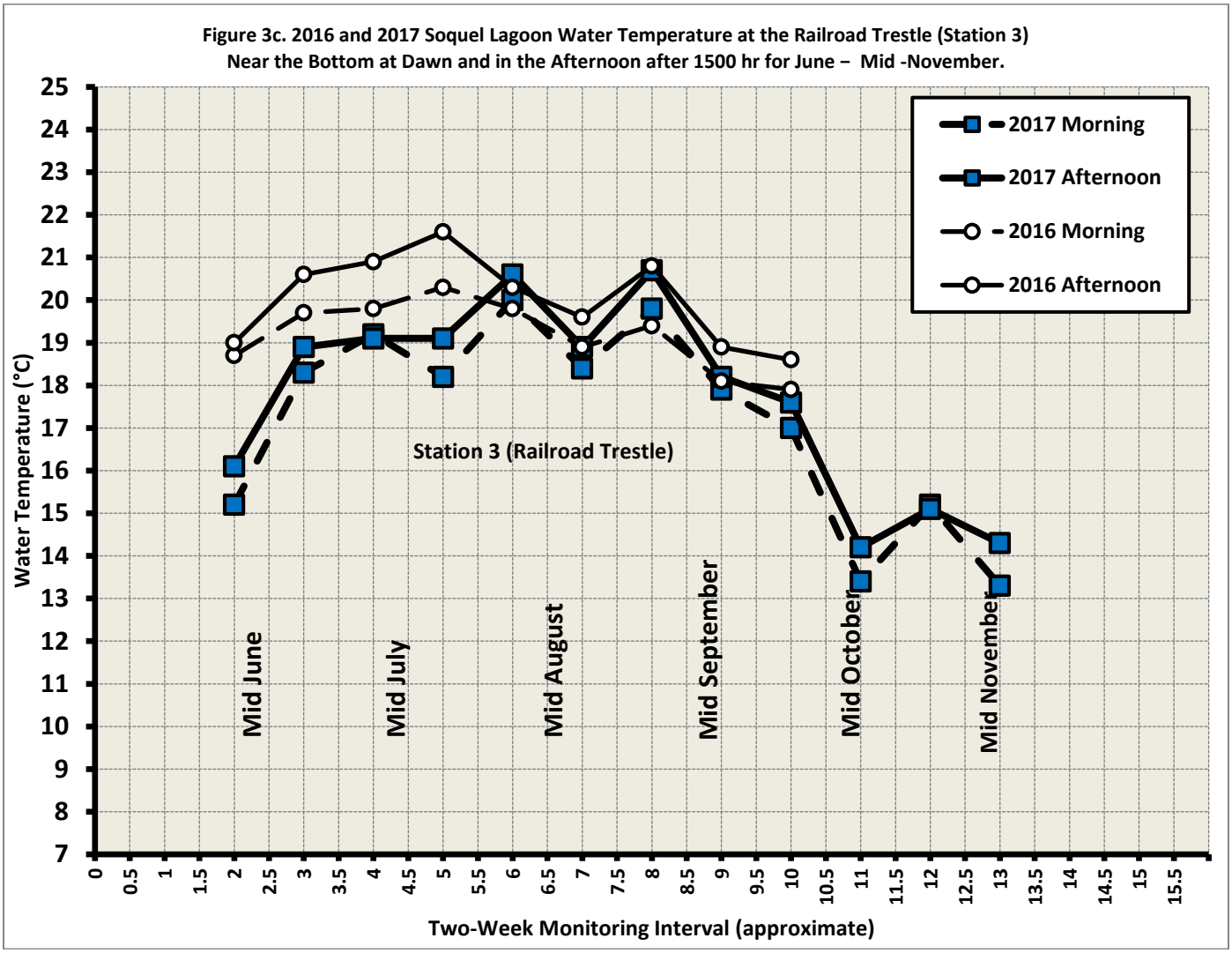


Figure 3c. 2016 and 2017 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr for June– Mid-November.

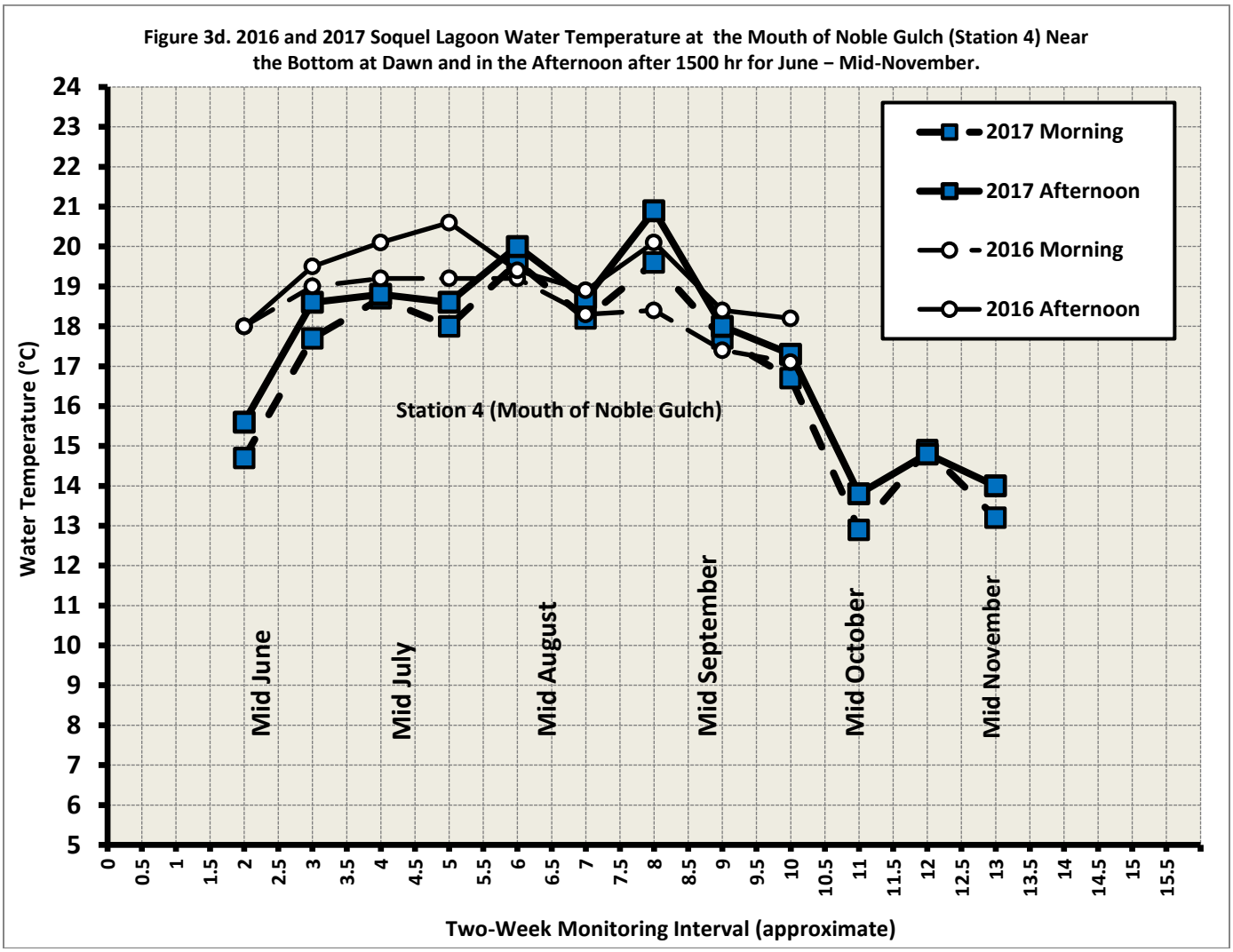


Figure 3d. 2016 and 2017 Soquel Lagoon Water Temperature at Noble Gulch Near the Bottom at Dawn (Station 4) and in the Afternoon after 1500 hr for June – Mid-November.

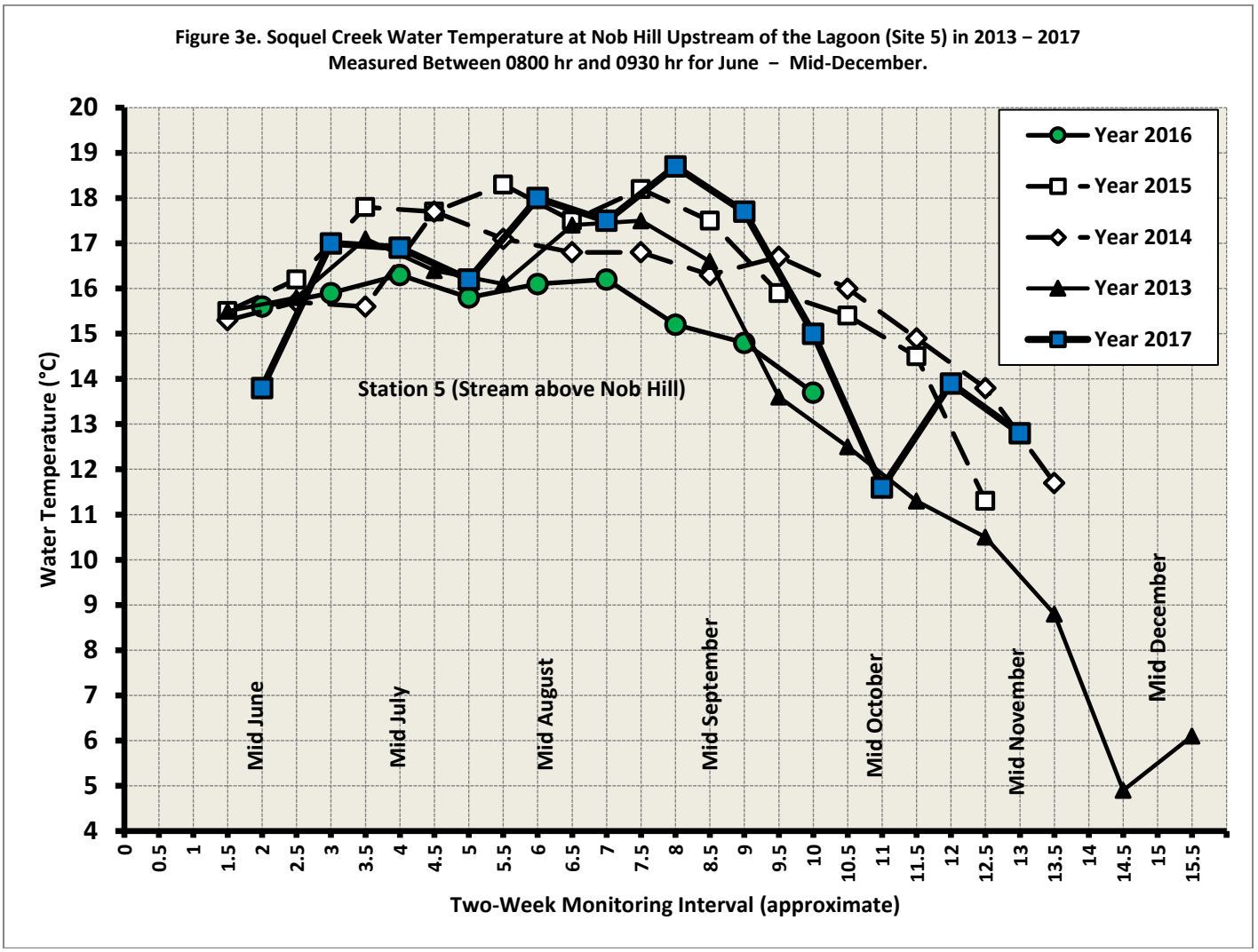


Figure 3e. Soquel Creek Water Temperature at Nob Hill Upstream of the Lagoon, 2013−2017. Measured Between 0800 hr and 0930 hr for June − Mid-December.

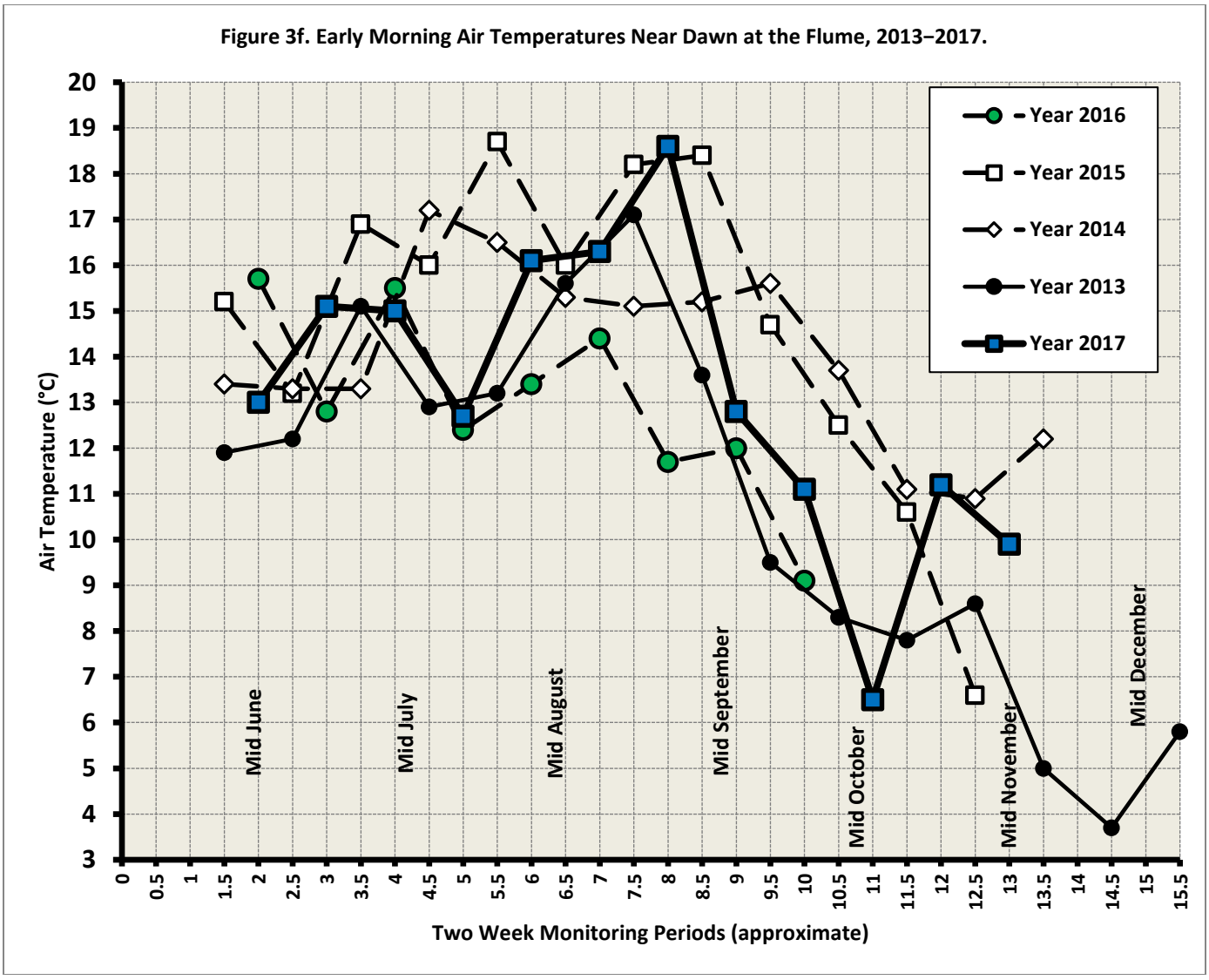


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, 2013−2017.

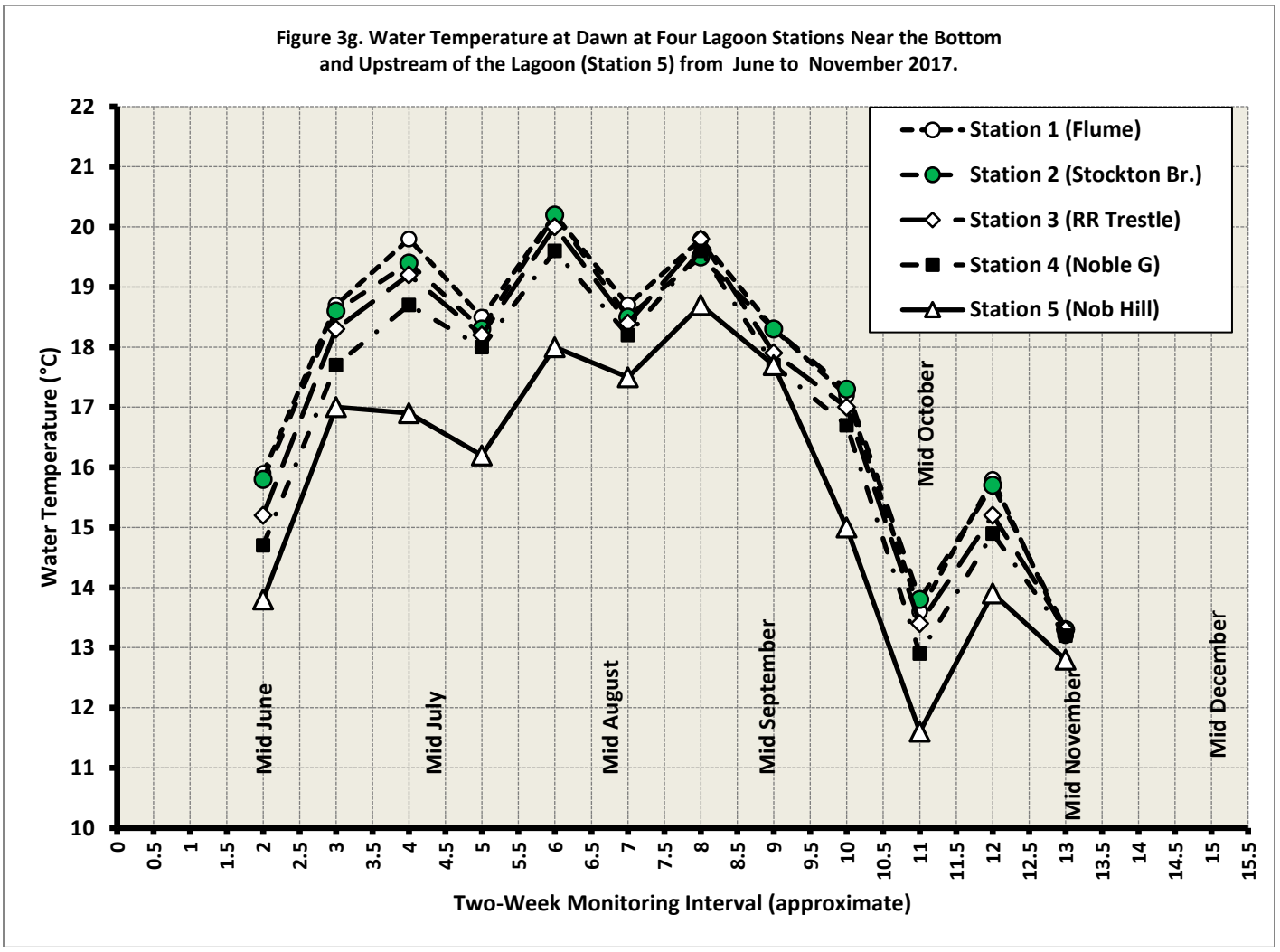


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to November 2017.

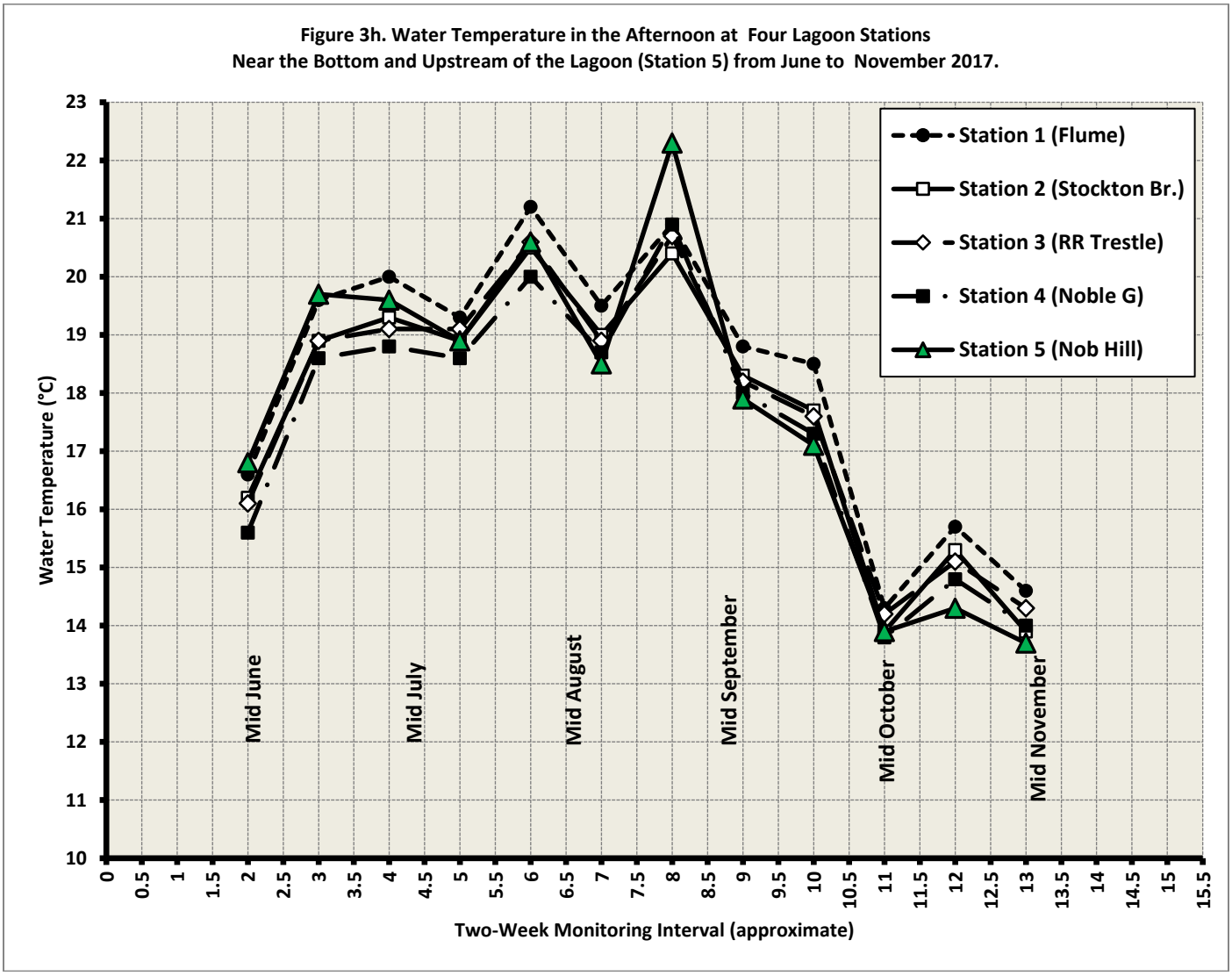


Figure 3h. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to November 2017.

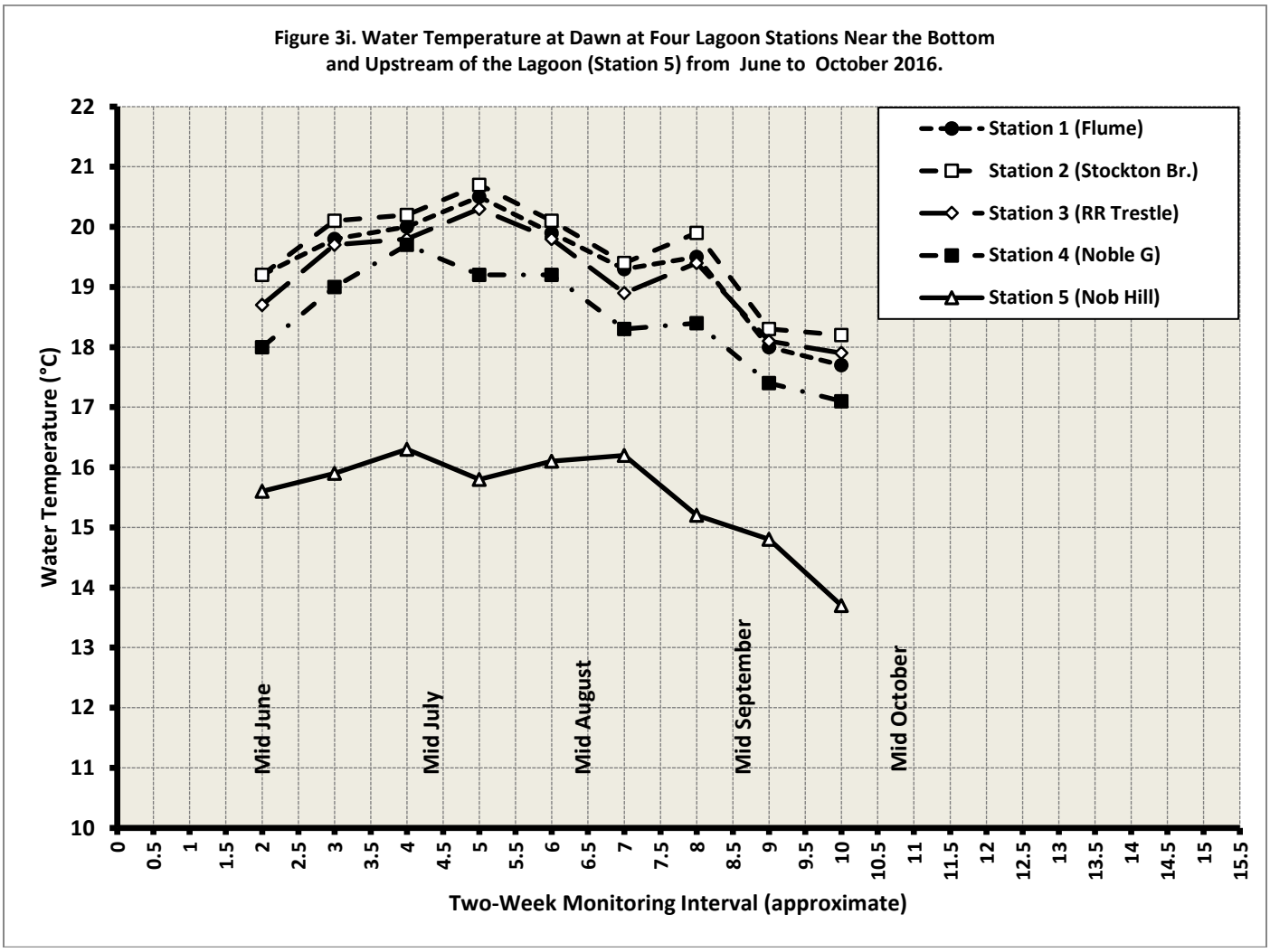


Figure 3i. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to October 2016.

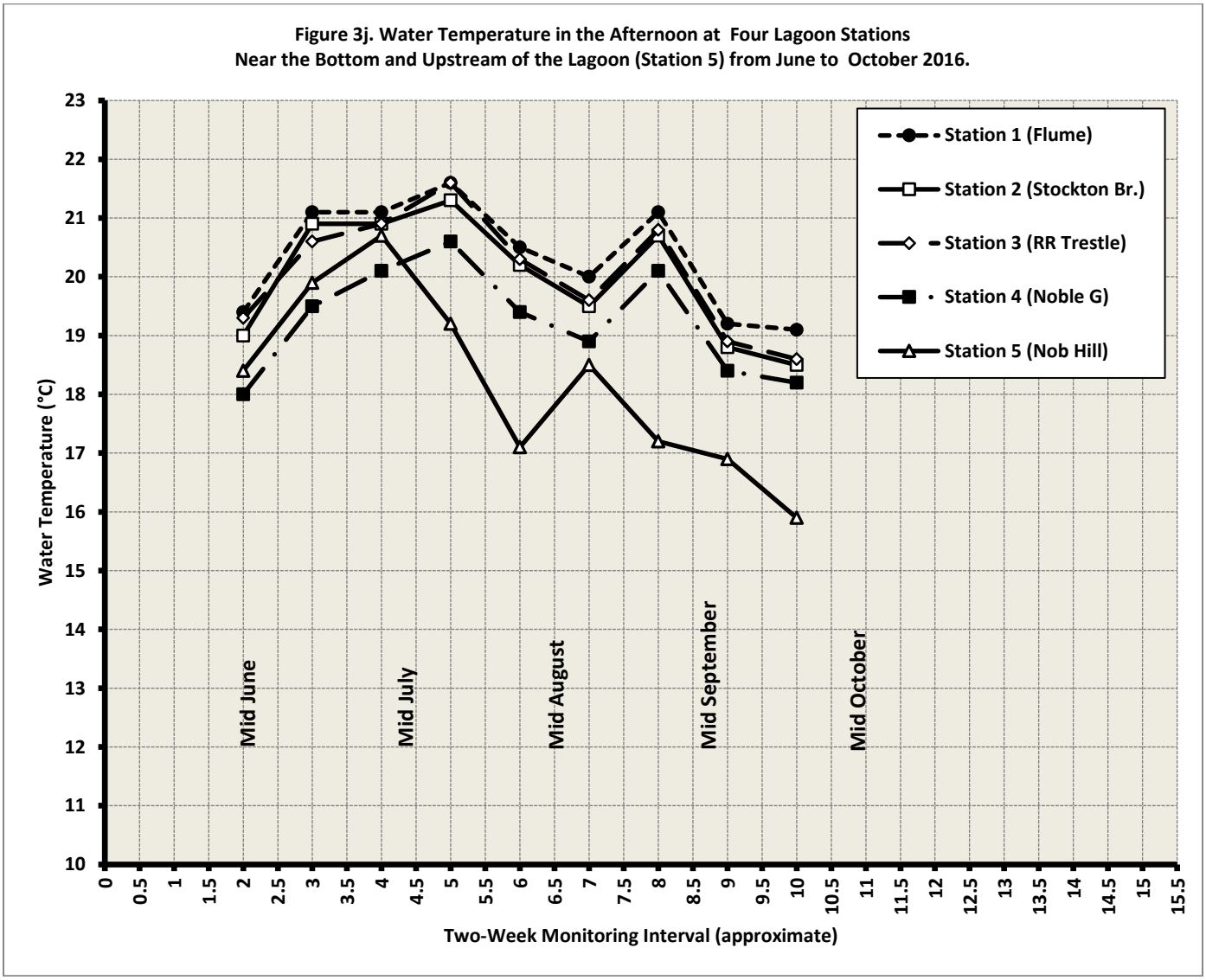


Figure 3j. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to October 2016.

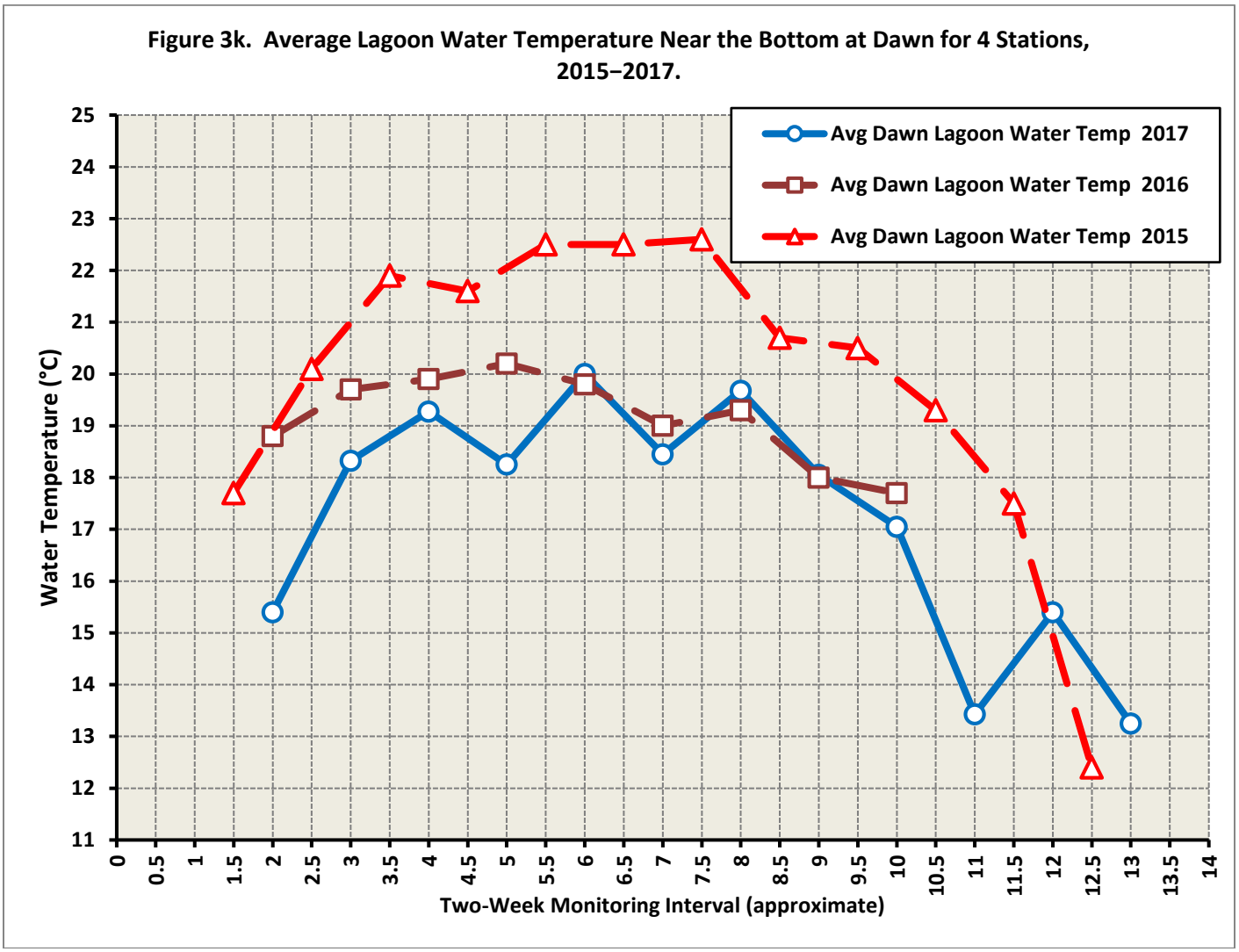


Figure 3k. Average Lagoon Water Temperature Near the Bottom at Dawn for 4 Stations, 2015–2017.

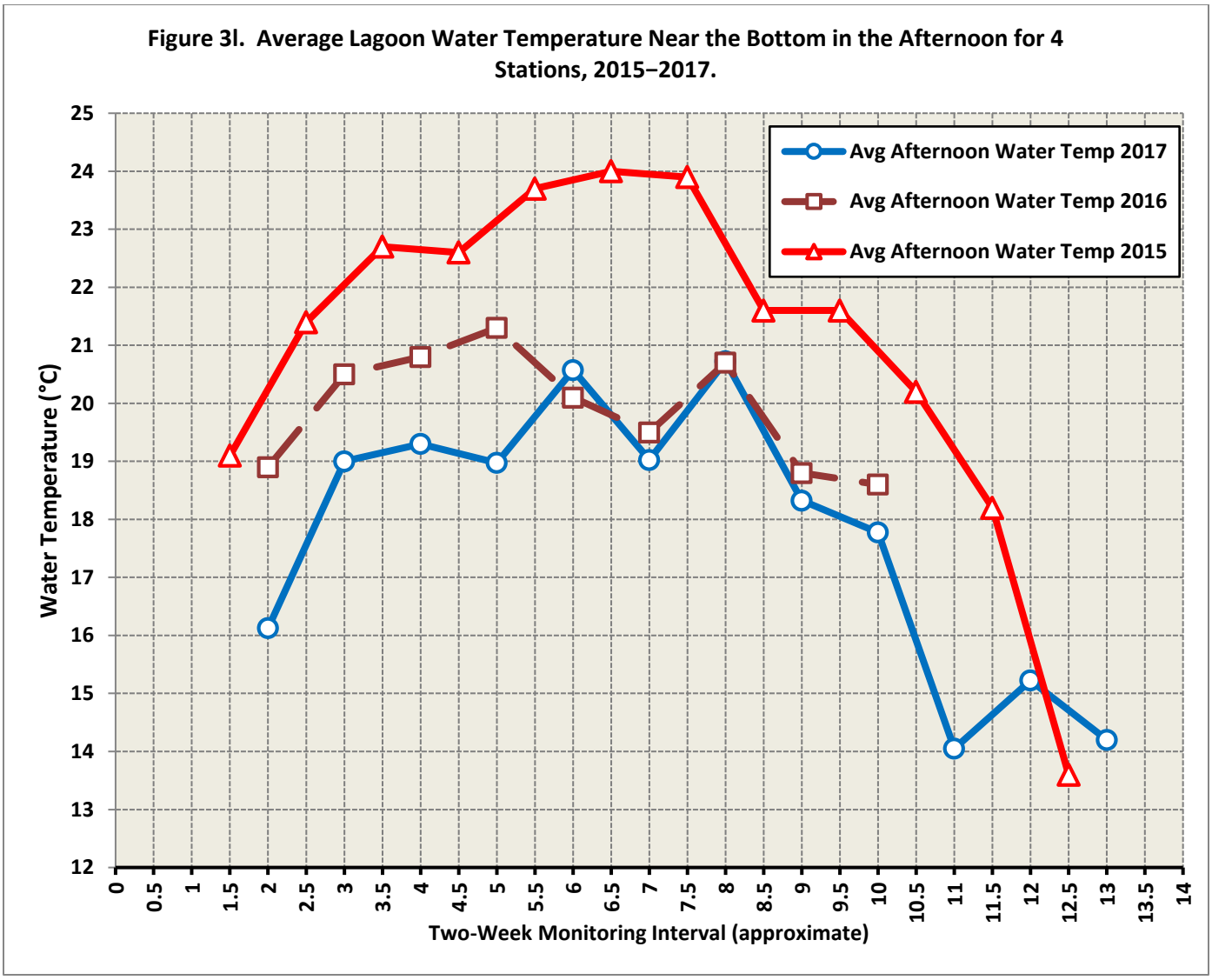


Figure 3l. Average Lagoon Water Temperature Near the Bottom in the Afternoon for 4 Stations, 2015–2017.

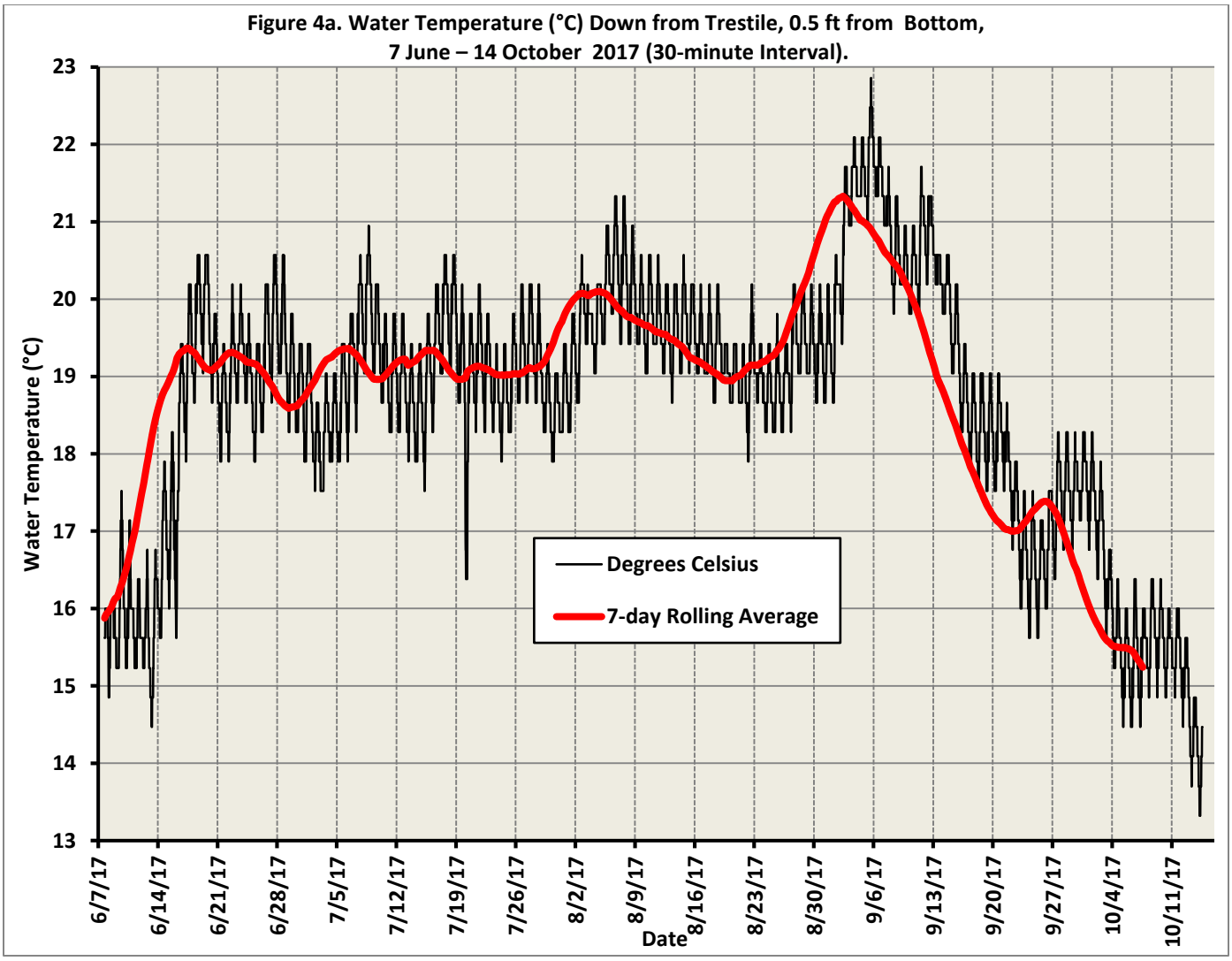


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

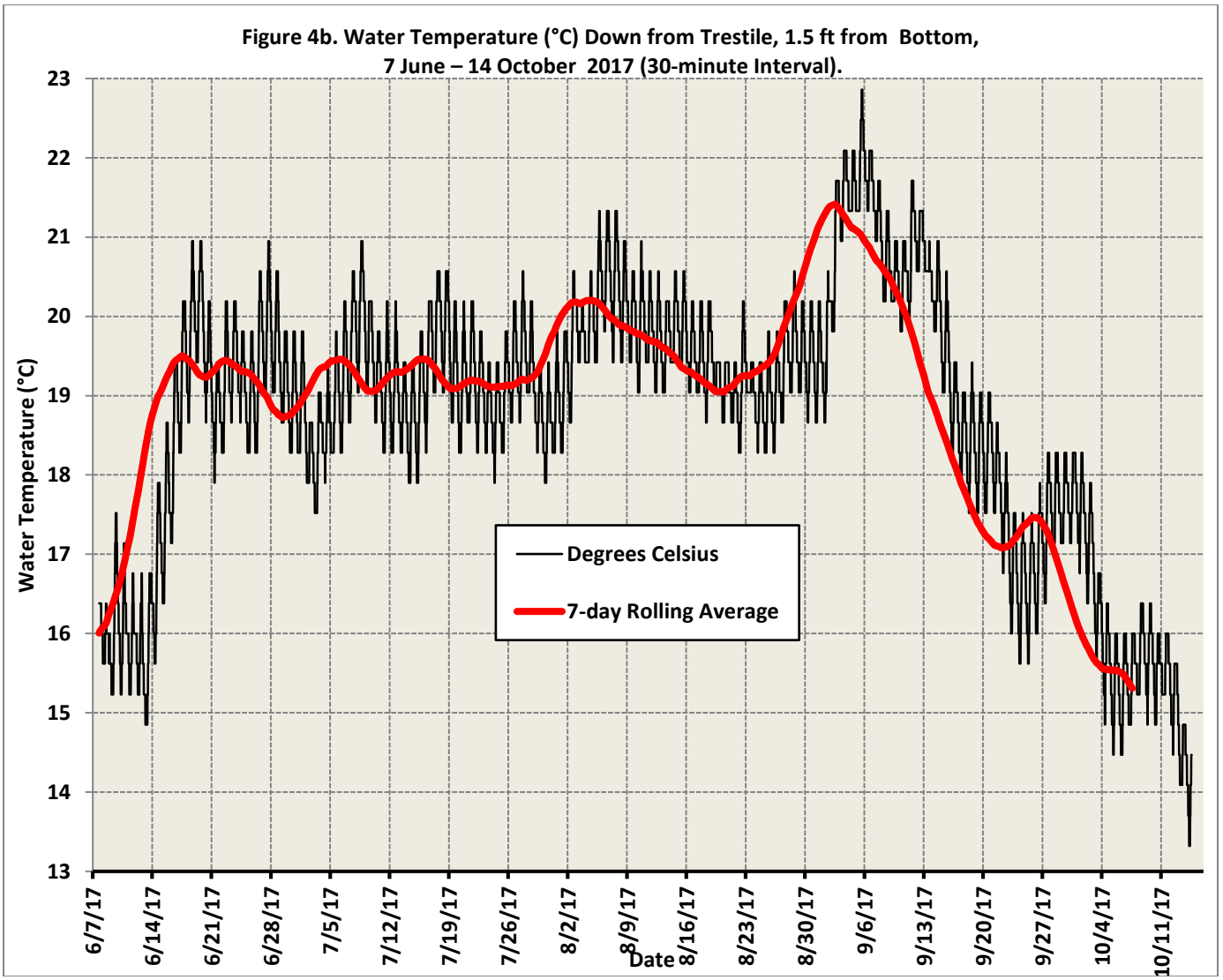


Figure 4b. Water Temperature (°C) Down from Trestle, 1.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

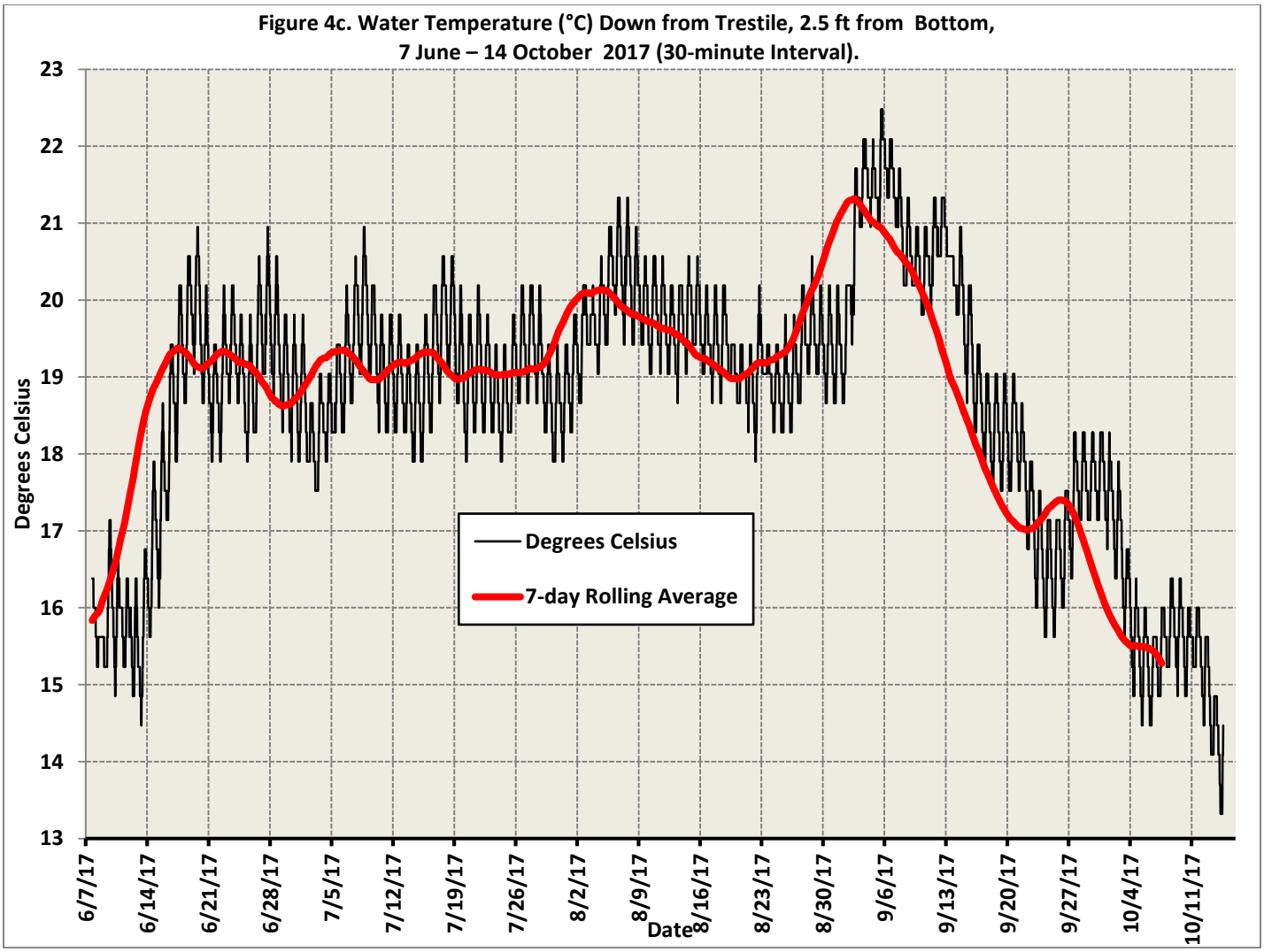


Figure 4c. Water Temperature (°C) Down from Trestle, 2.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

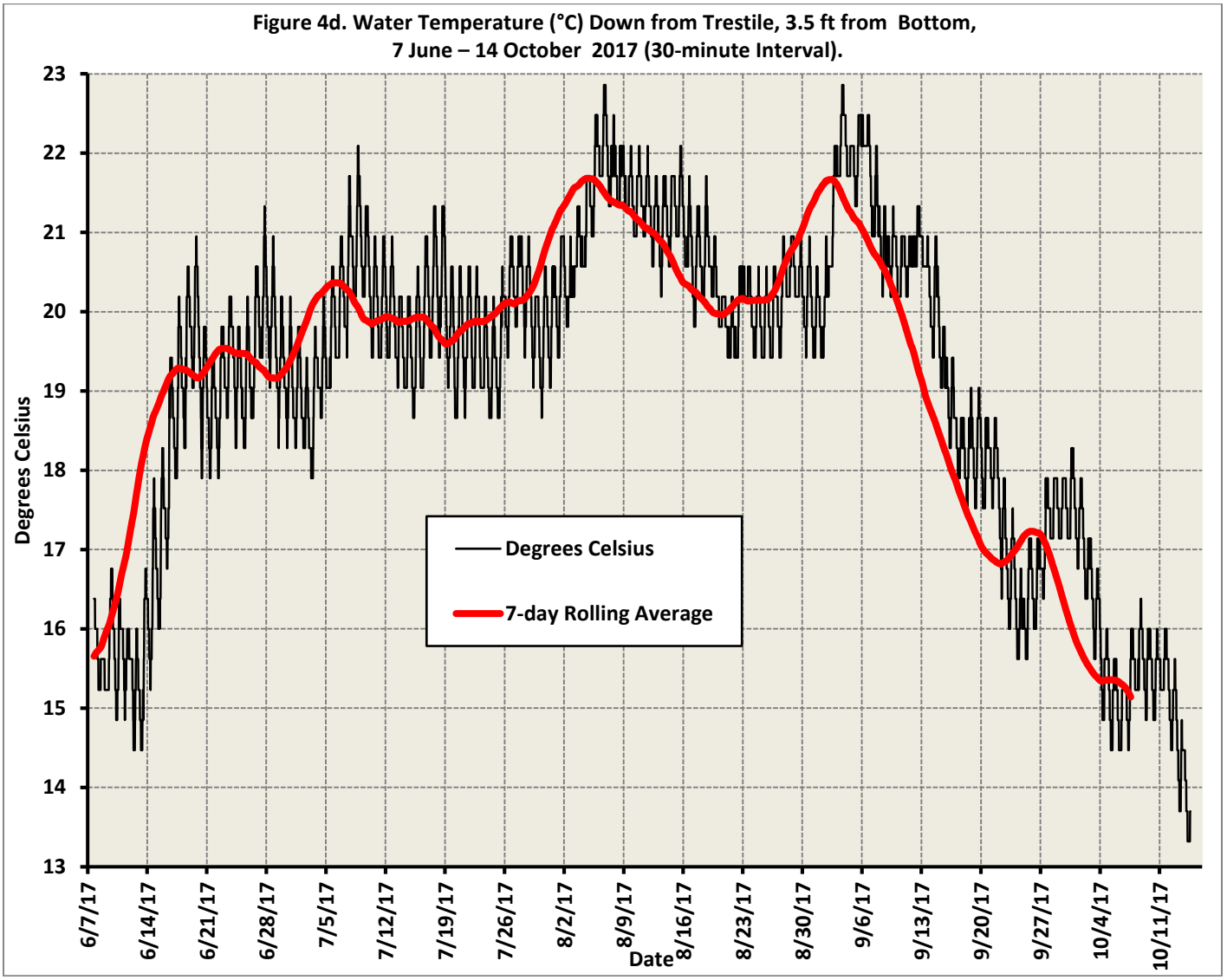


Figure 4d. Water Temperature (°C) Down from Trestle, 3.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

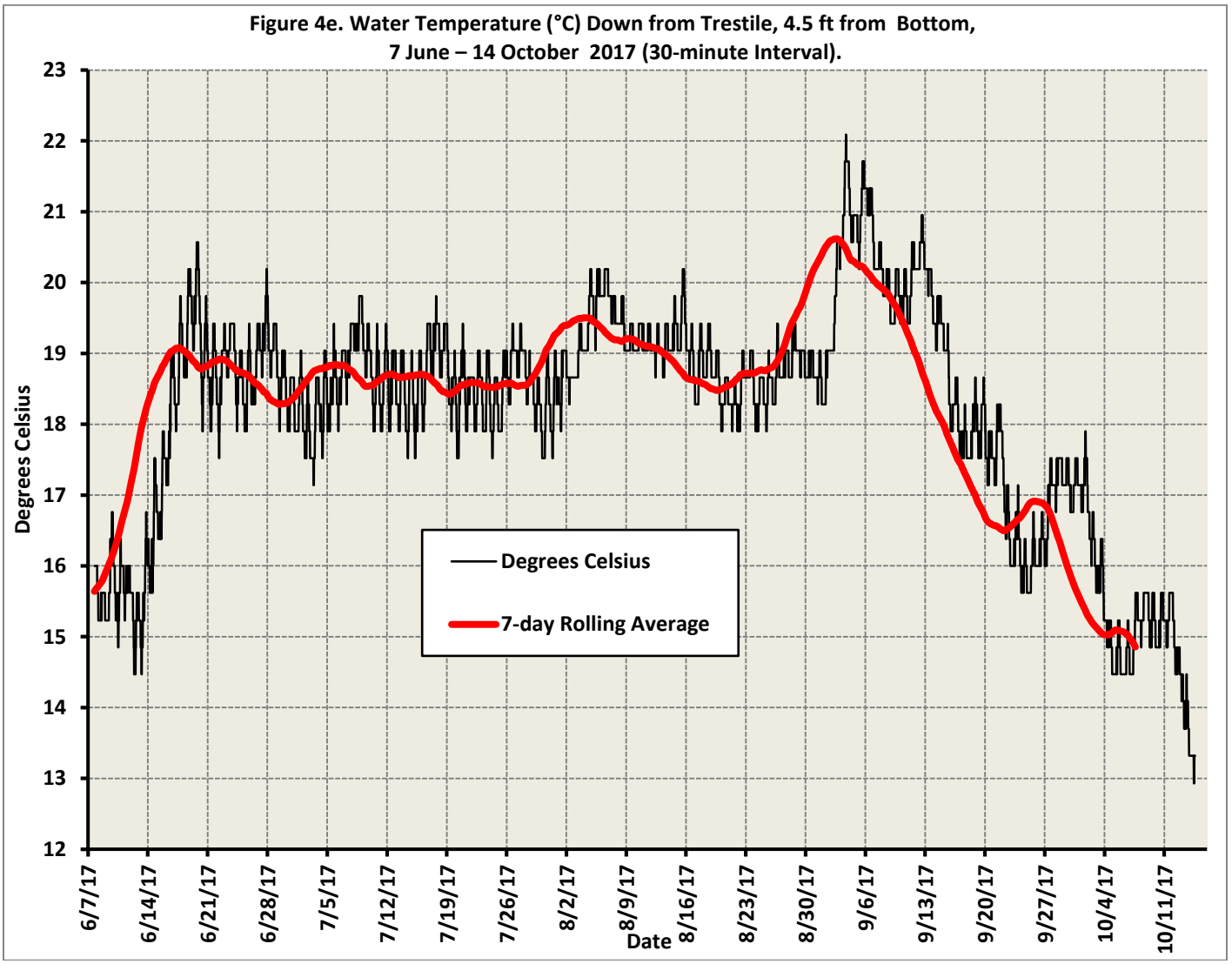


Figure 4e. Water Temperature (°C) Down from Trestle, 4.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

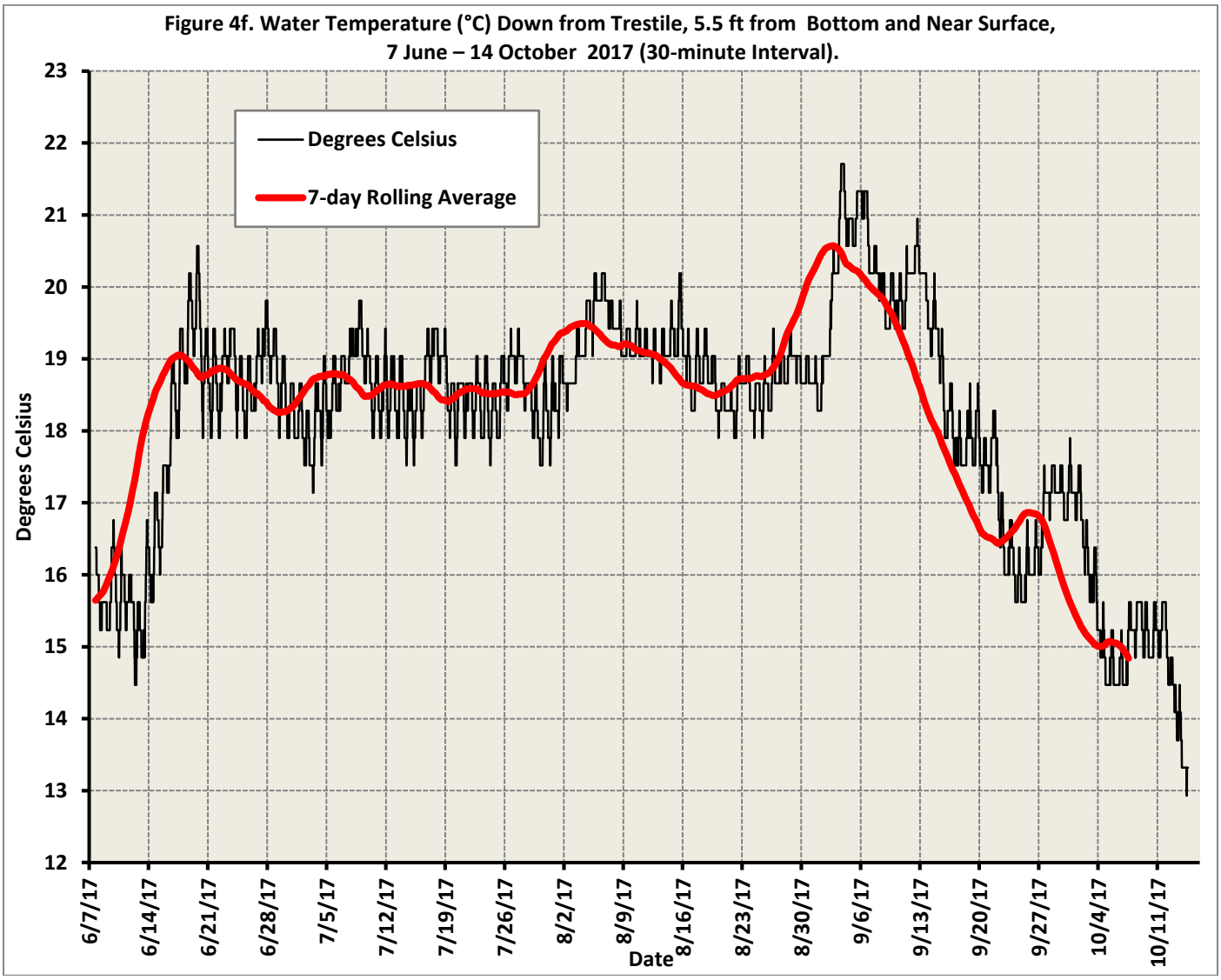


Figure 4f. Water Temperature (°C) Down from Trestle, 5.5 ft from Bottom, 7 June – 14 October 2017 (30-minute Interval).

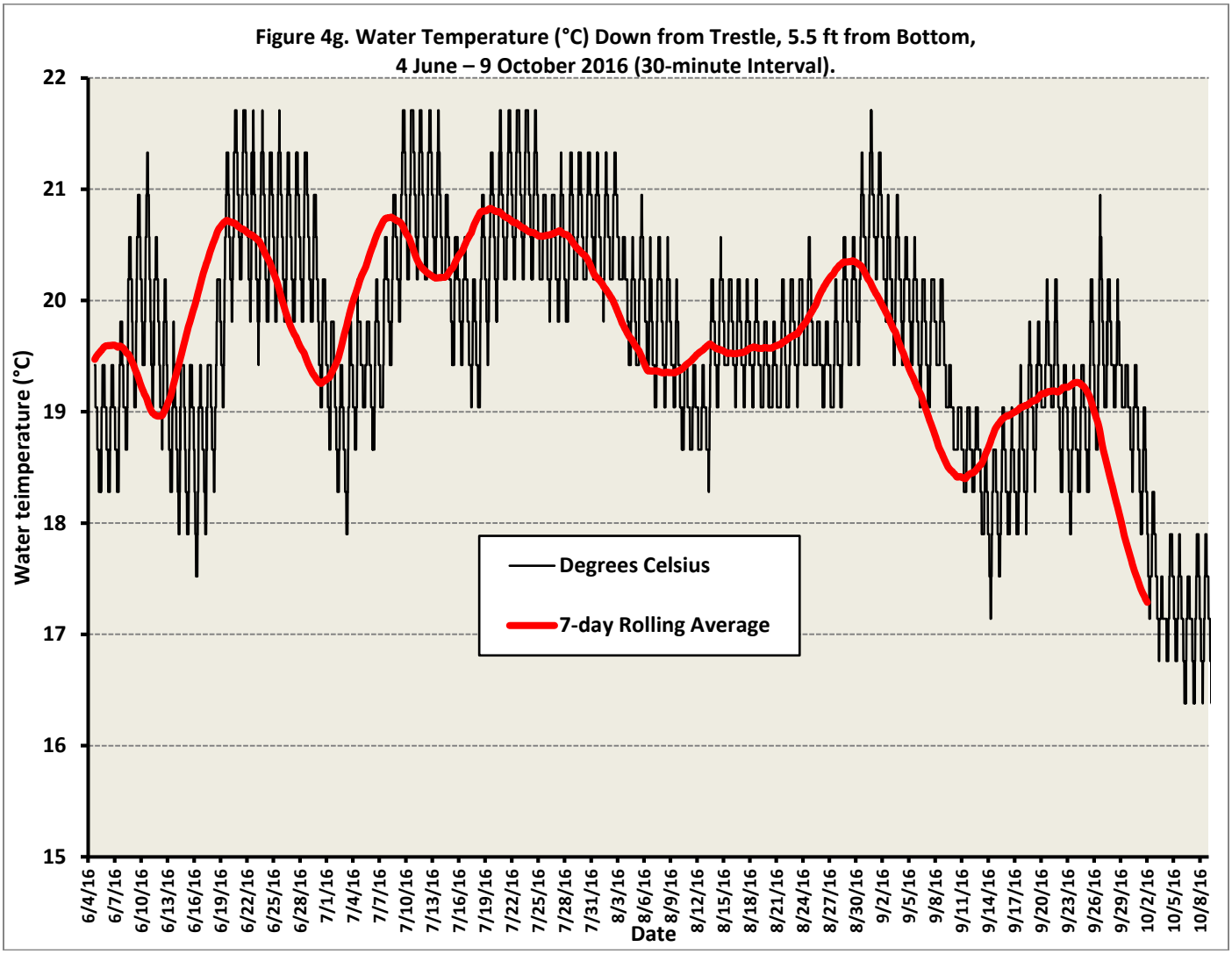


Figure 4g. Water Temperature (°C) Down from Trestle, 5.5 ft from Bottom, 4 June – 9 October 2016 (30-minute Interval).

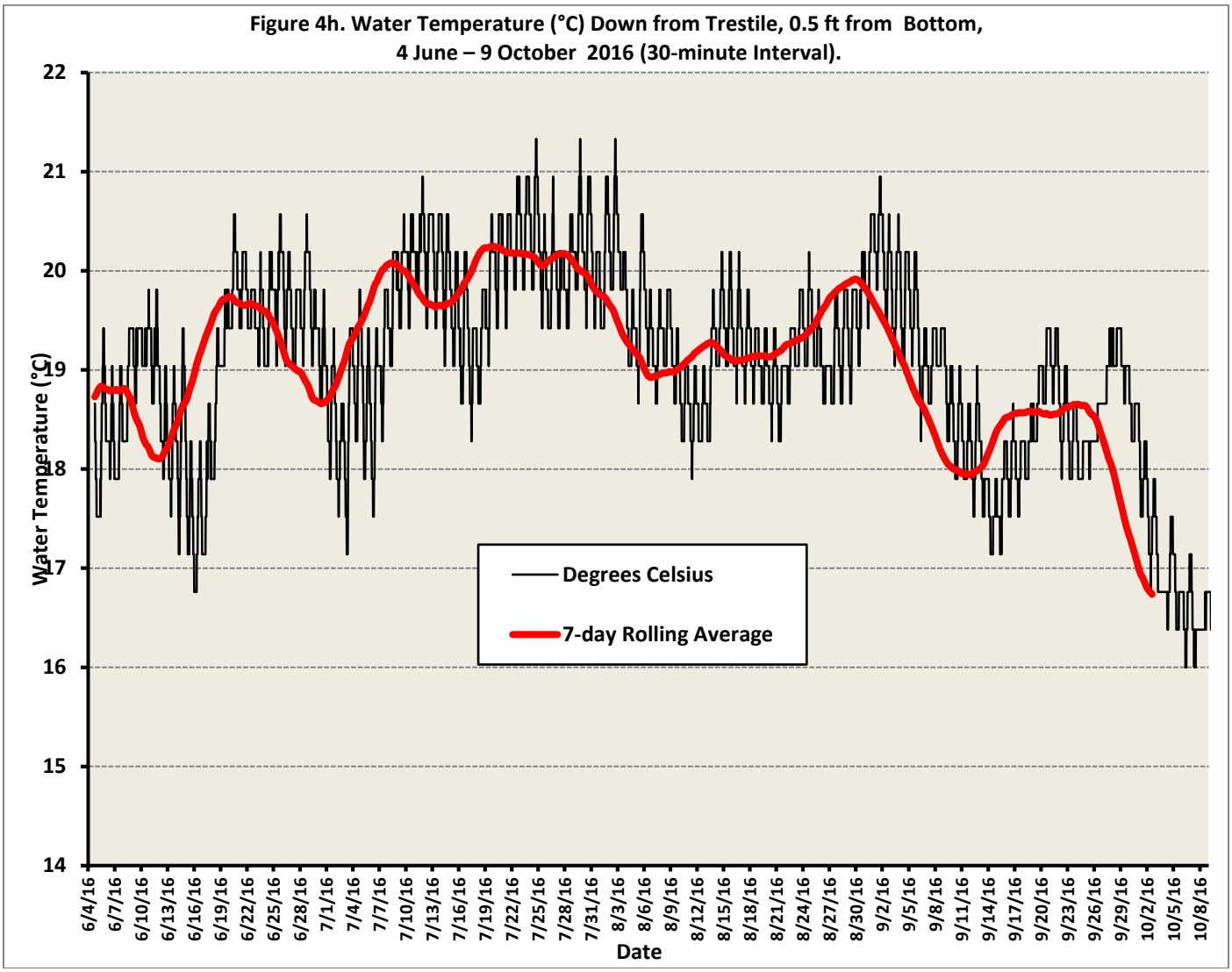


Figure 4h. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom, 4 June – 9 October 2016 (30-minute Interval).

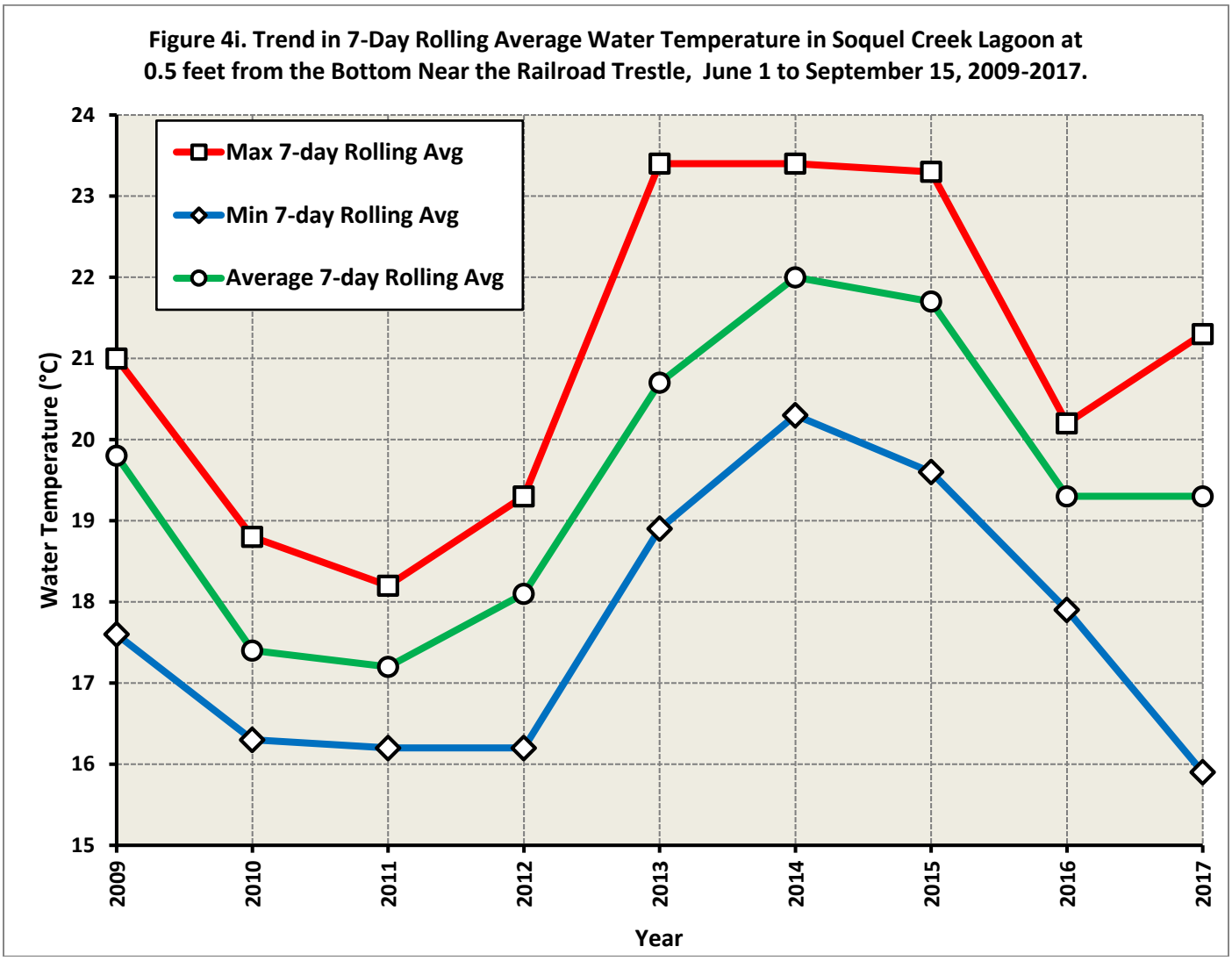


Figure 4i. Trend in 7-day Rolling Average Water Temperature in Soquel Creek Lagoon at 0.5 ft from the Bottom Near the Railroad Trestle, 2009−2017.

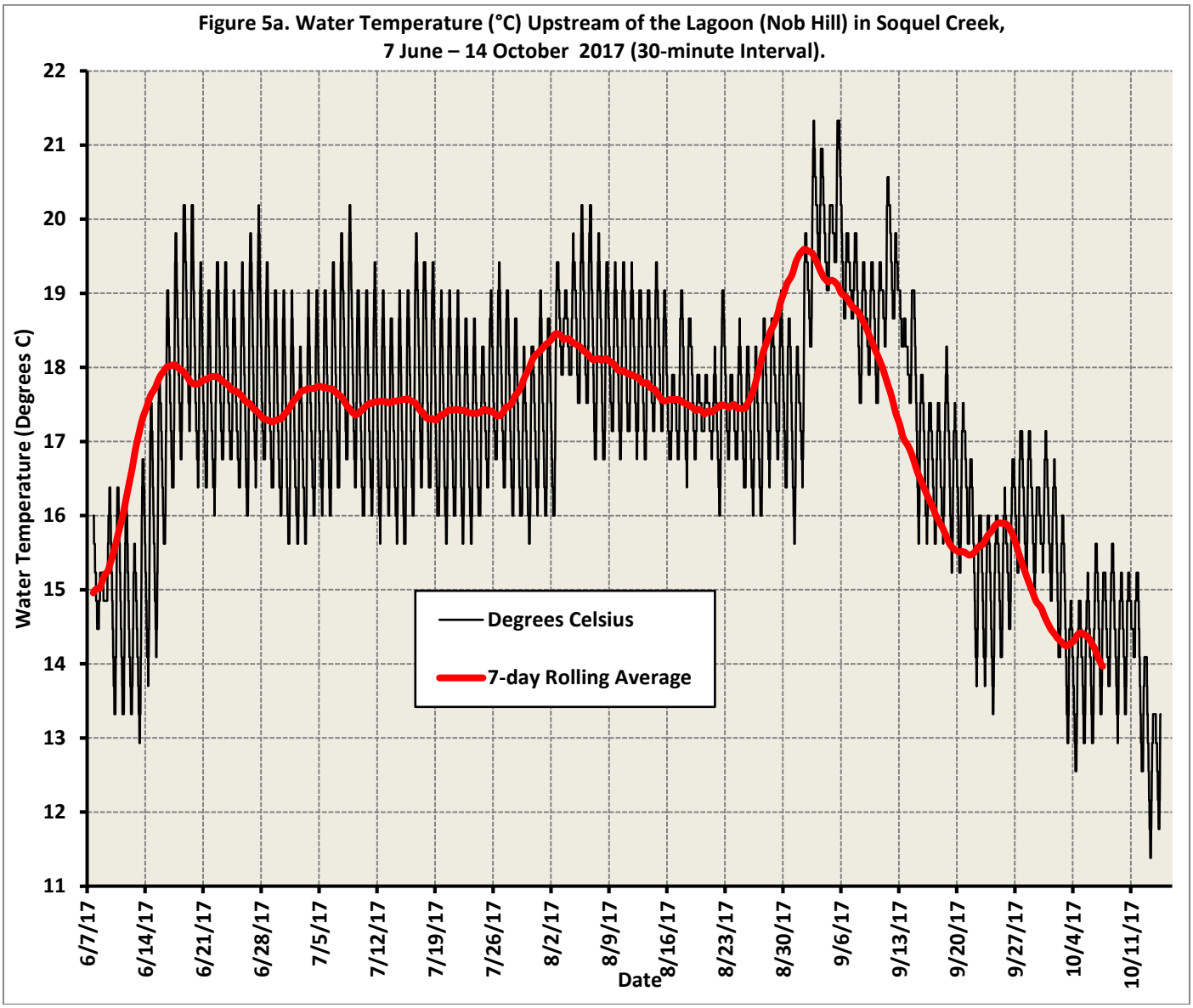


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 7 June – 14 October 2017 (30-minute Interval).

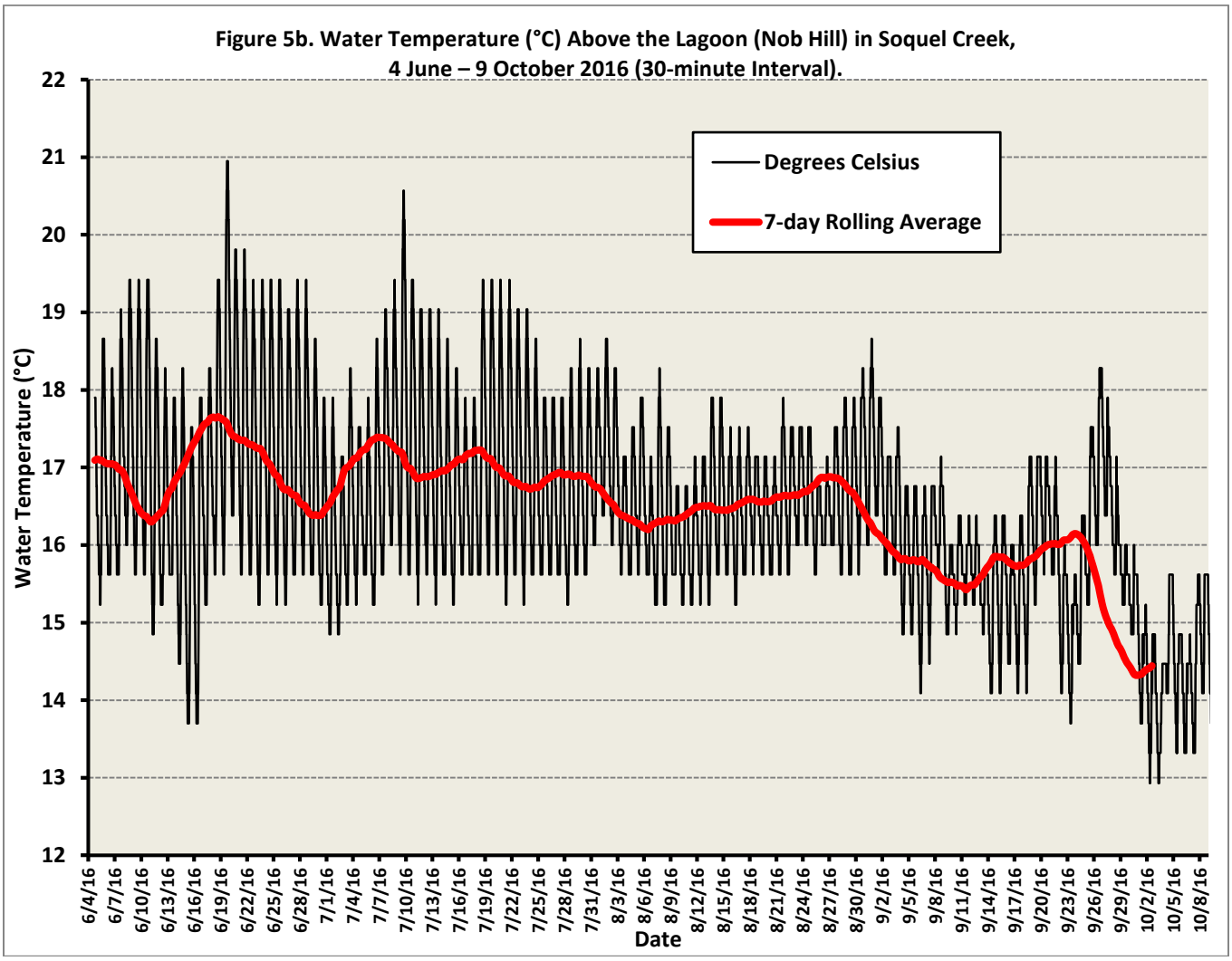


Figure 5b. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 4 June – 9 October 2016 (30-minute Interval).

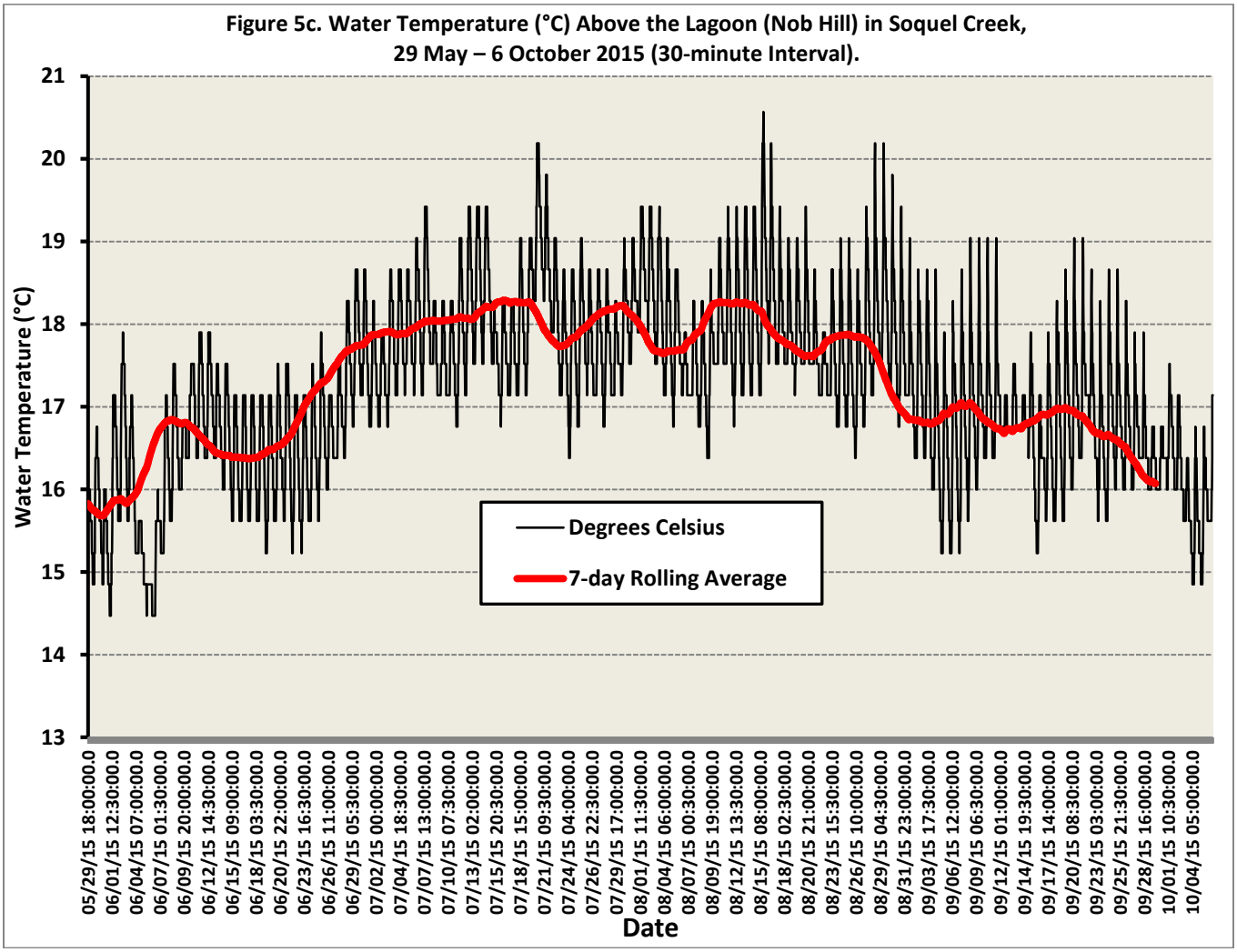


Figure 5c. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 29 May – 4 October 2015 (30-minute Interval).

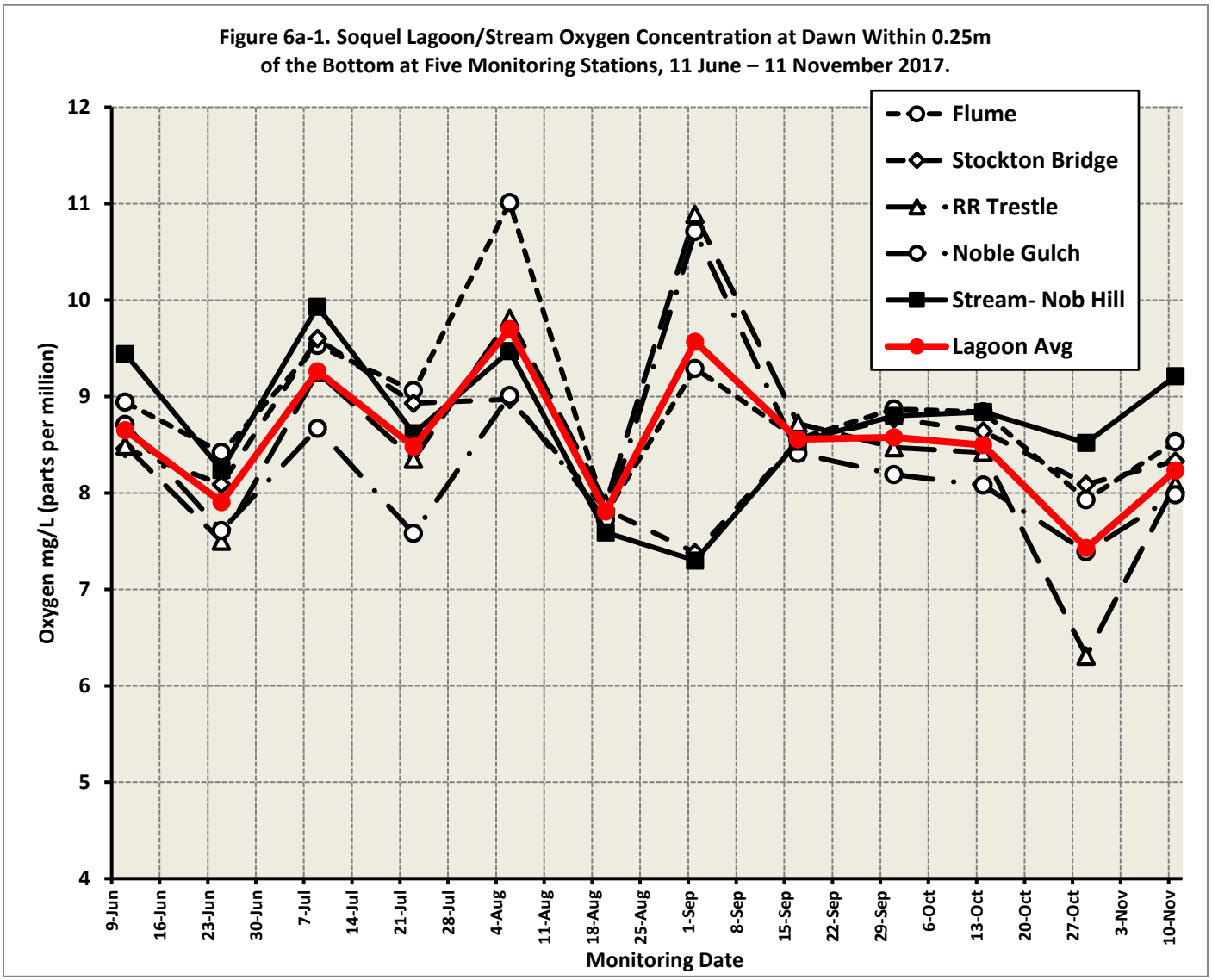


Figure 6a-1. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 11 June – 11 November 2017.

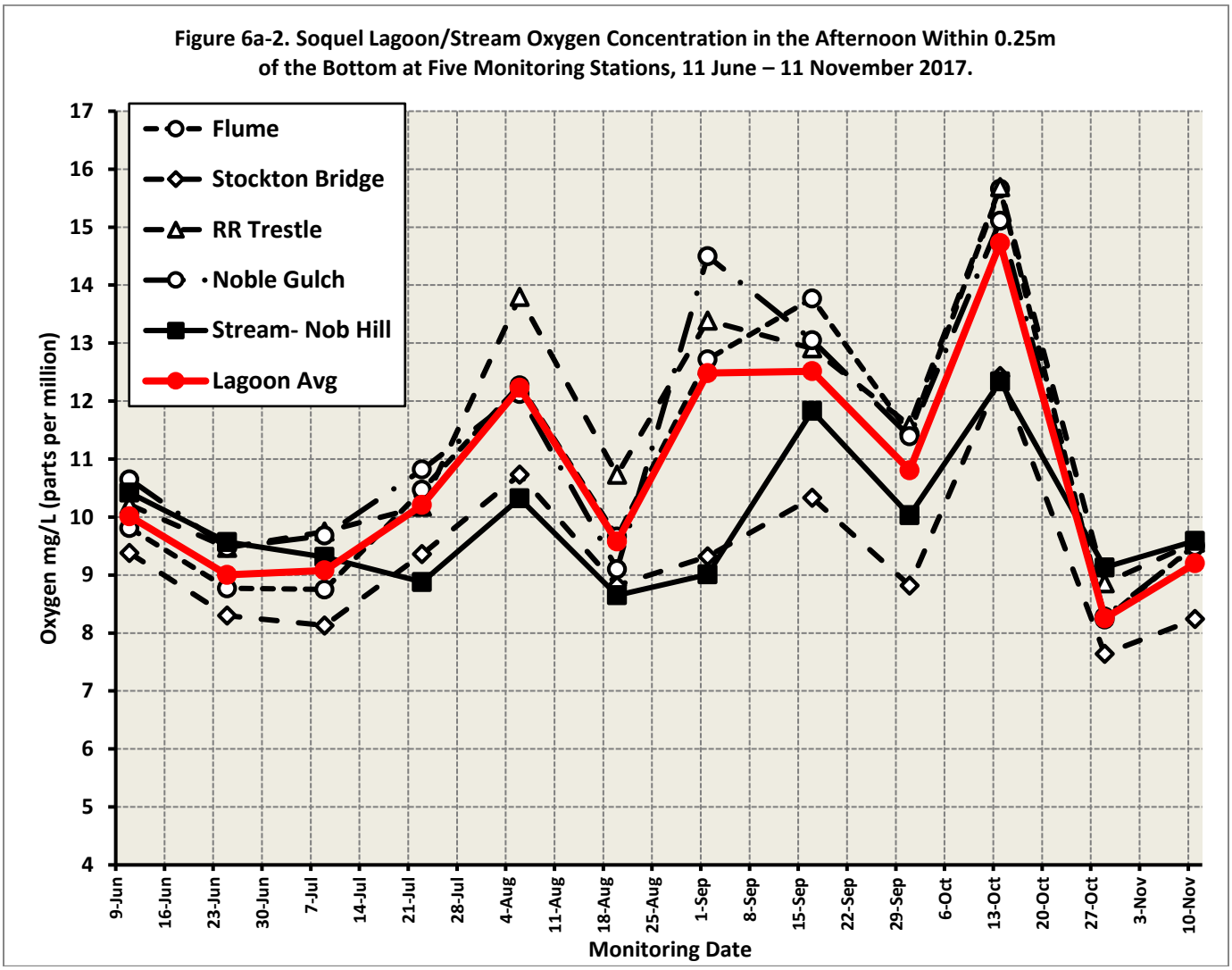


Figure 6a-2. Soquel Lagoon/Stream Oxygen Concentration in the Afternoon Within 0.25m of the Bottom at Five Monitoring Stations, 7 June – 7 November 2015.

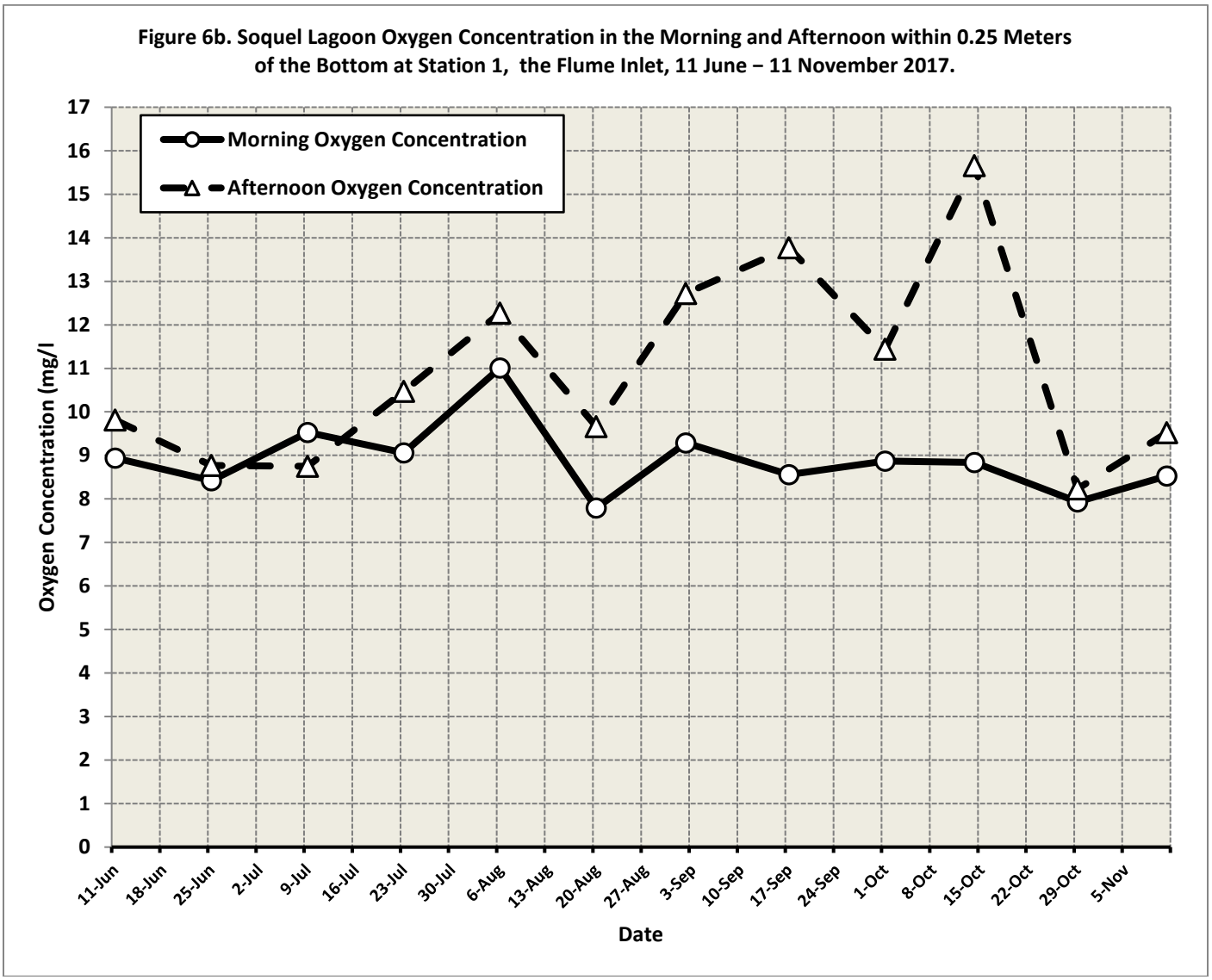


Figure 6b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 1, the Flume Inlet, 11 June – 11 November 2017.

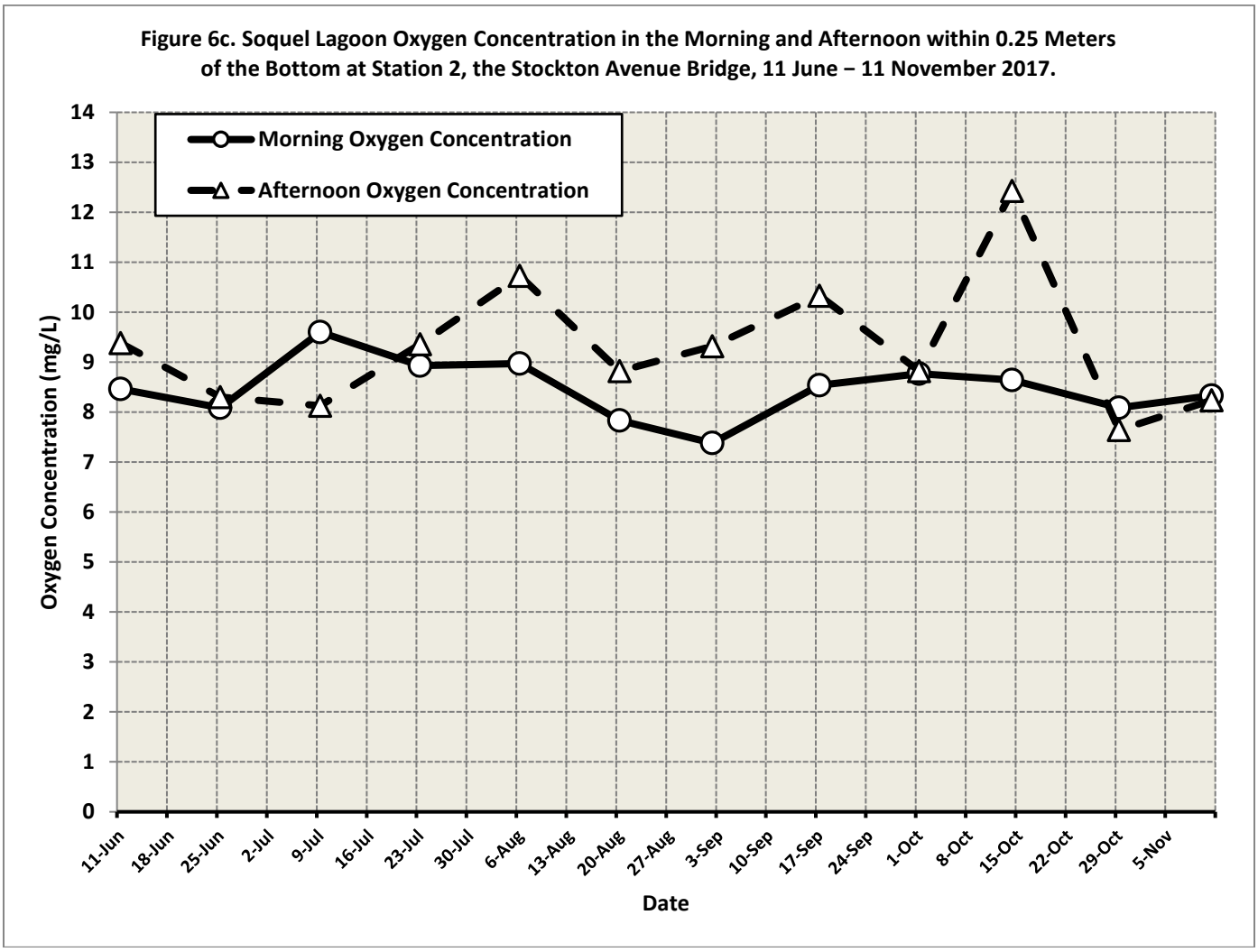


Figure 6c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge, 11 June – 11 November 2017.

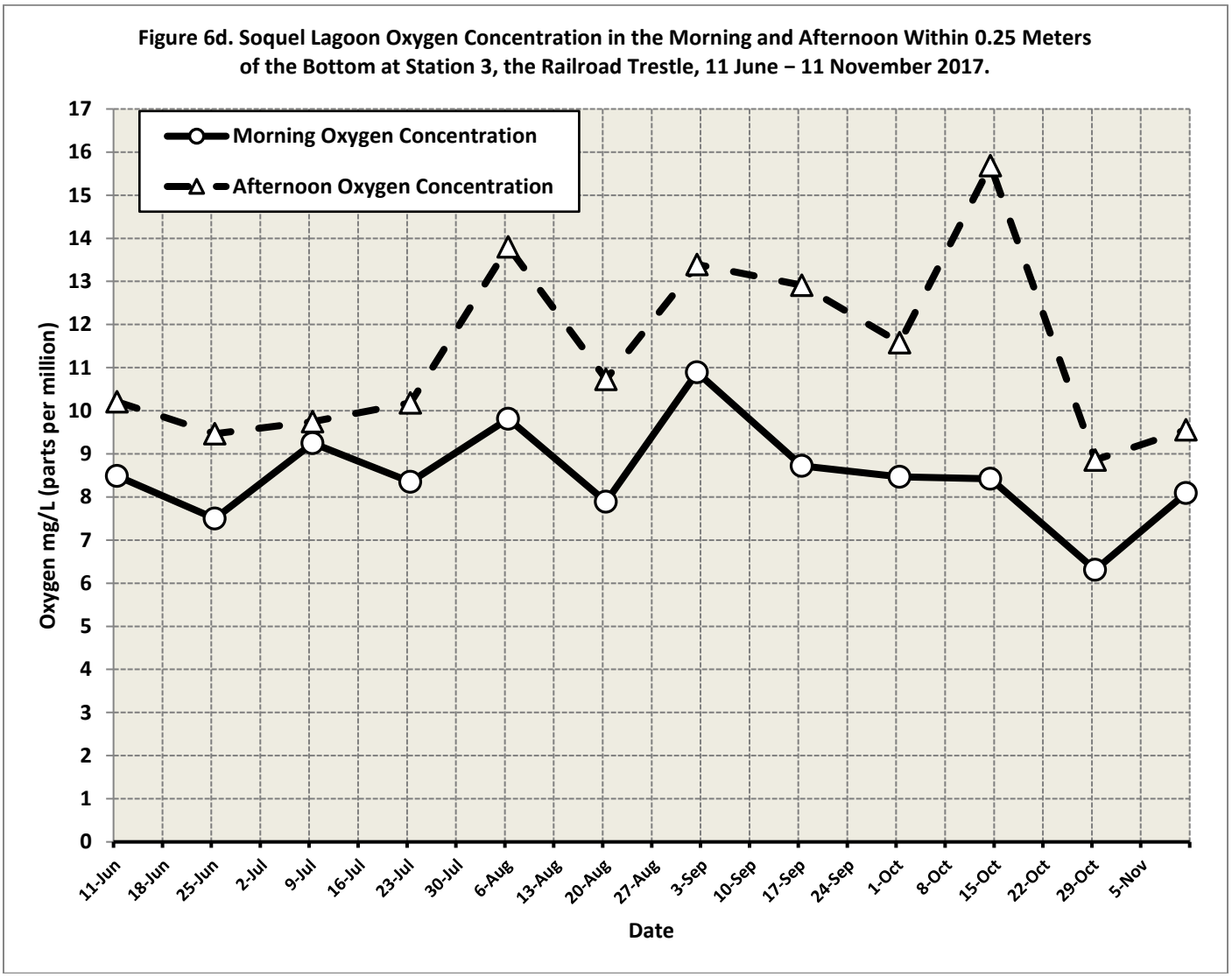


Figure 6d. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 11 June – 11 November 2017.

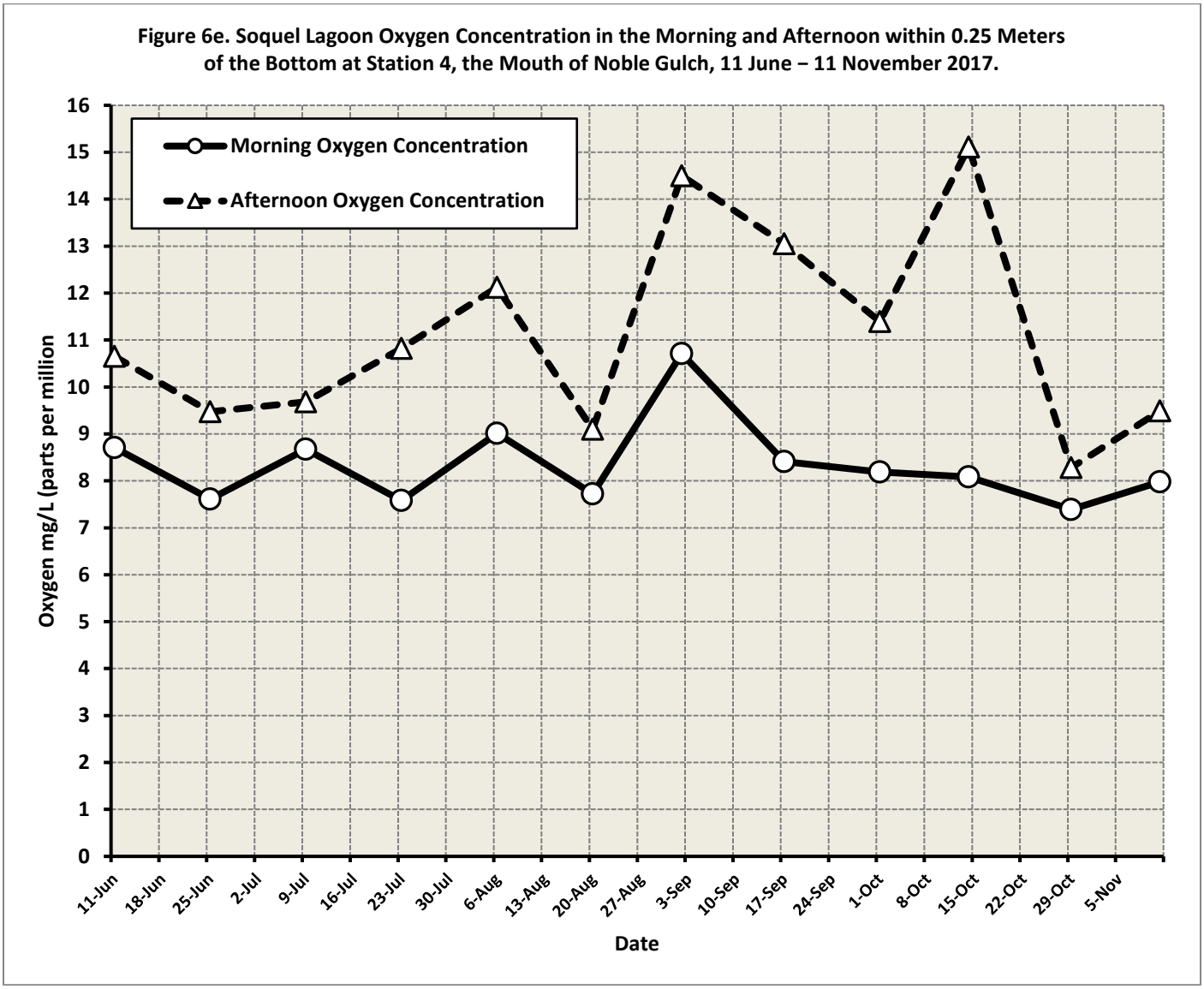


Figure 6e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 4, the Mouth of Noble Gulch, 11 June – 11 November 2017.

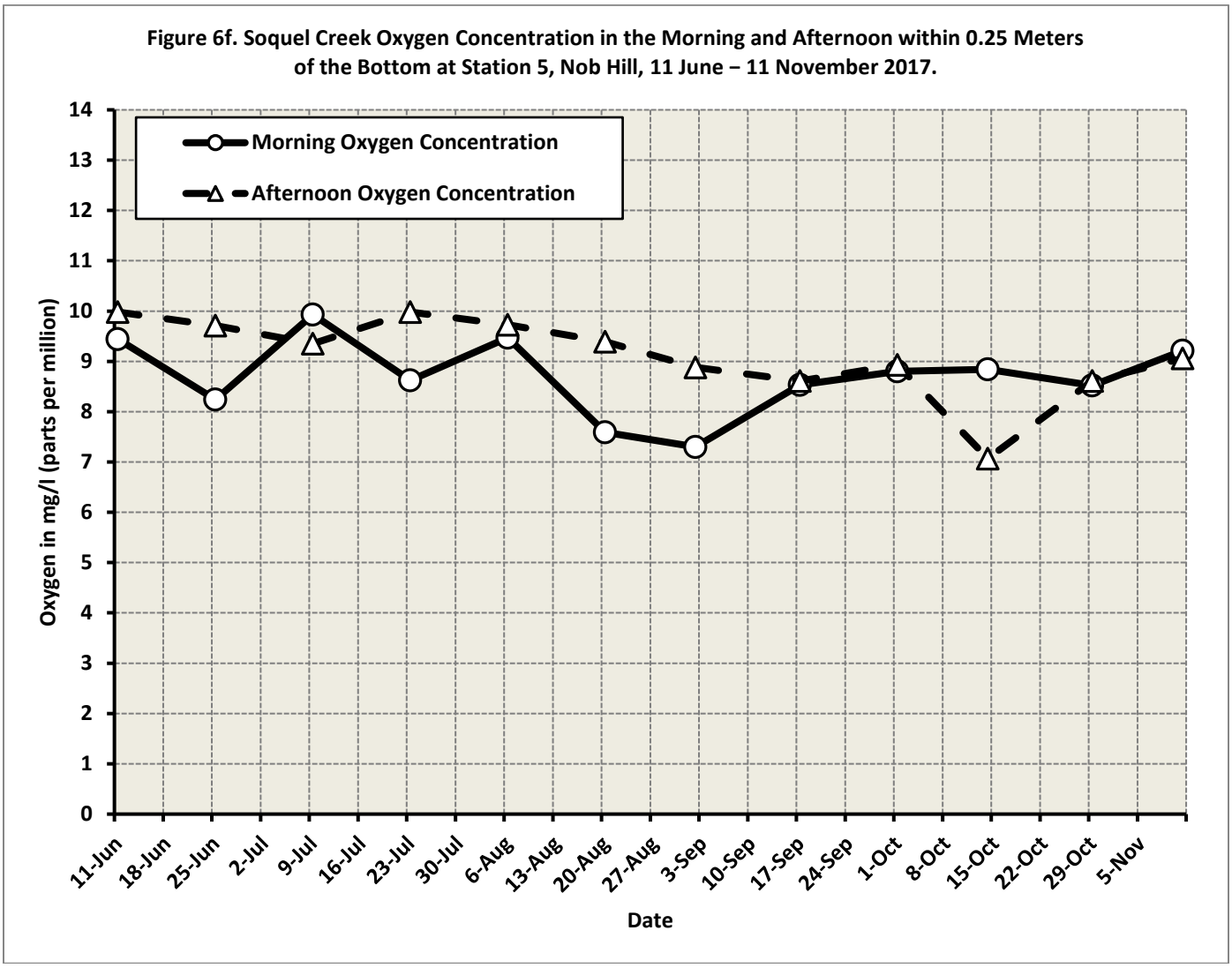


Figure 6f. Soquel Creek Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 5, Nob Hill, 11 June – 11 November 2017.

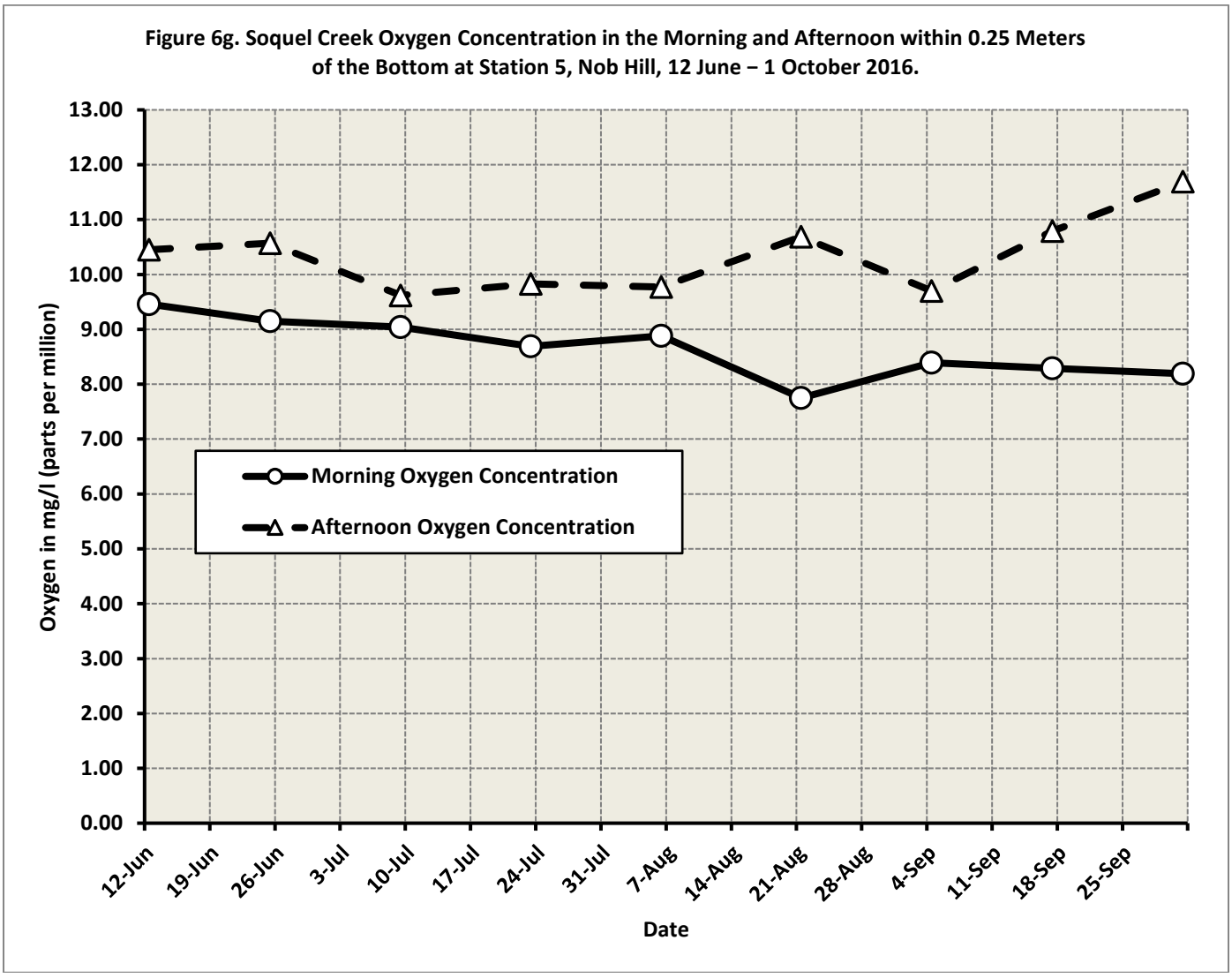


Figure 6g. Soquel Creek Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 5, Nob Hill, 12 June – 1 October 2016.

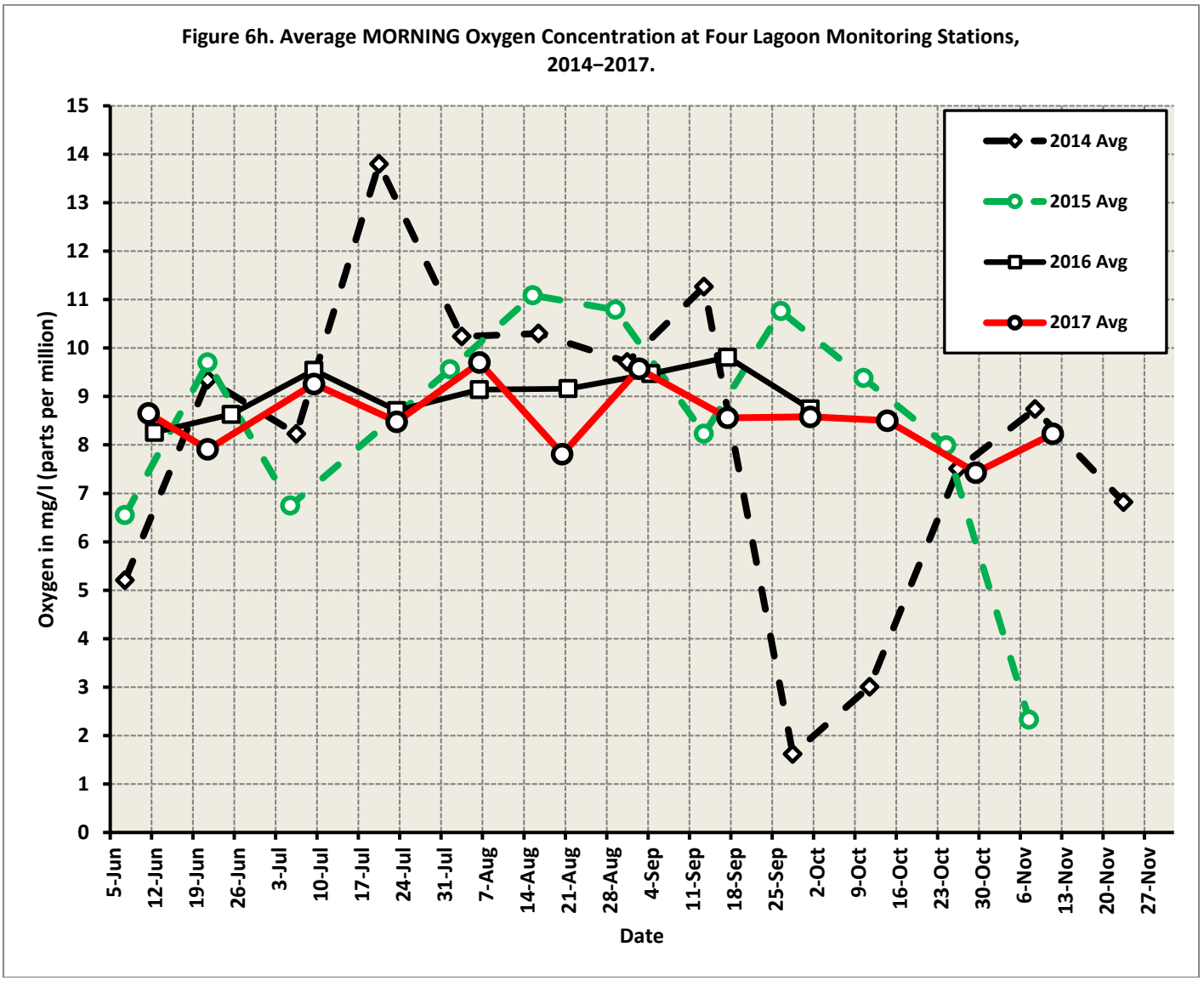


Figure 6h. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2014–2017.

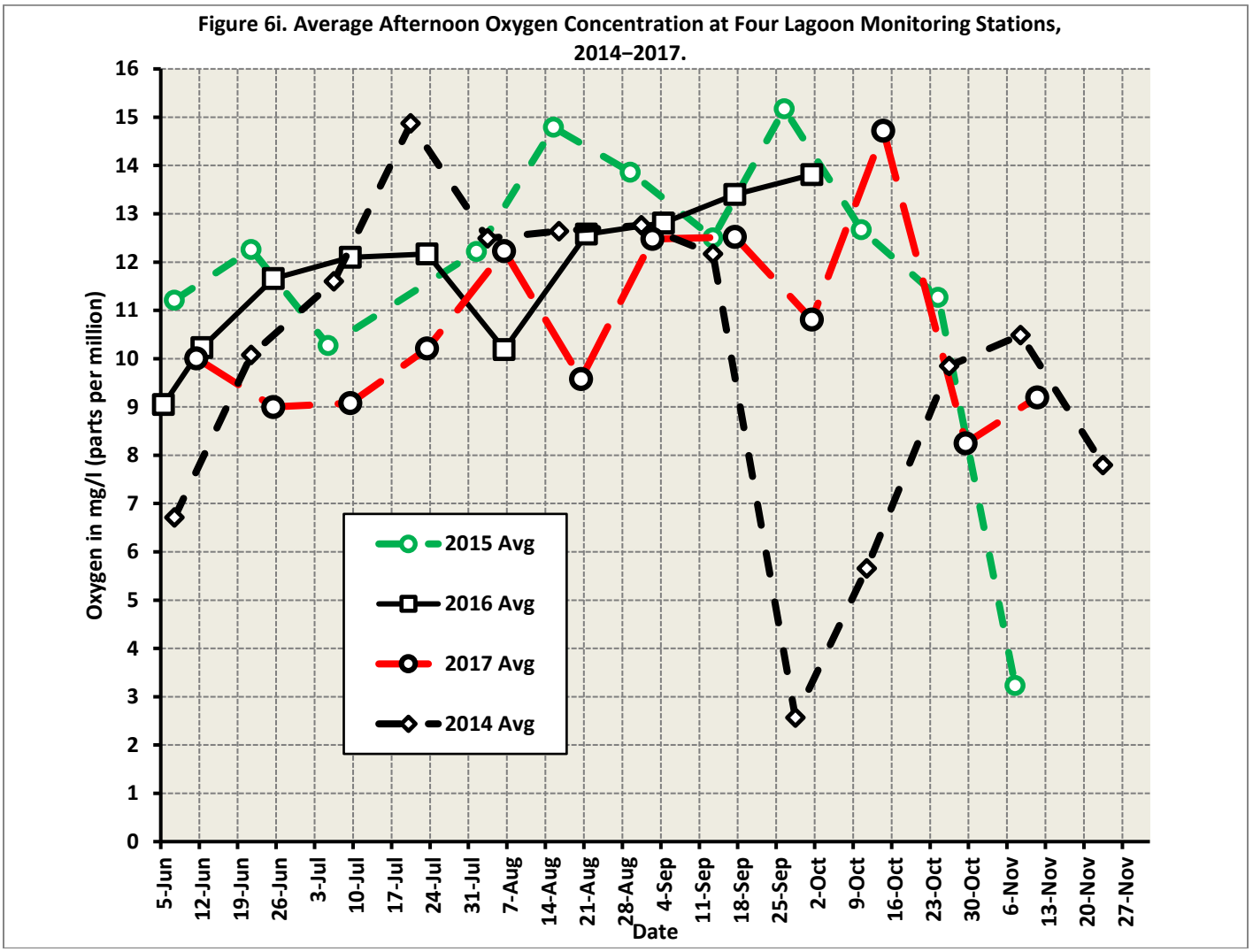


Figure 6i. Average AFTERNOON Oxygen Concentration at Four Lagoon Monitoring Stations, 2014–2017.

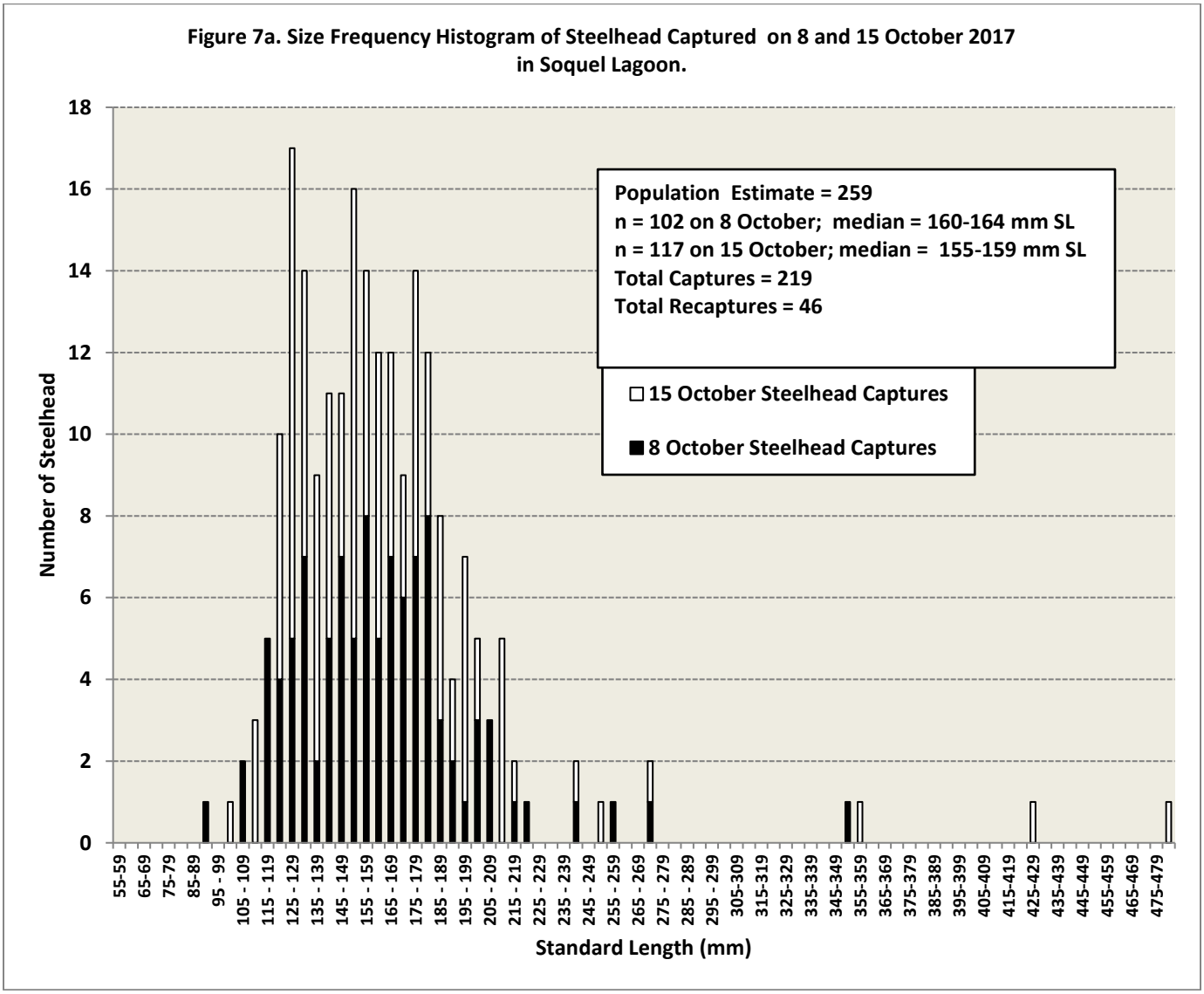


Figure 7a. Size Frequency Histogram of Steelhead Captured on 8 and 15 October 2017 in Soquel Lagoon.

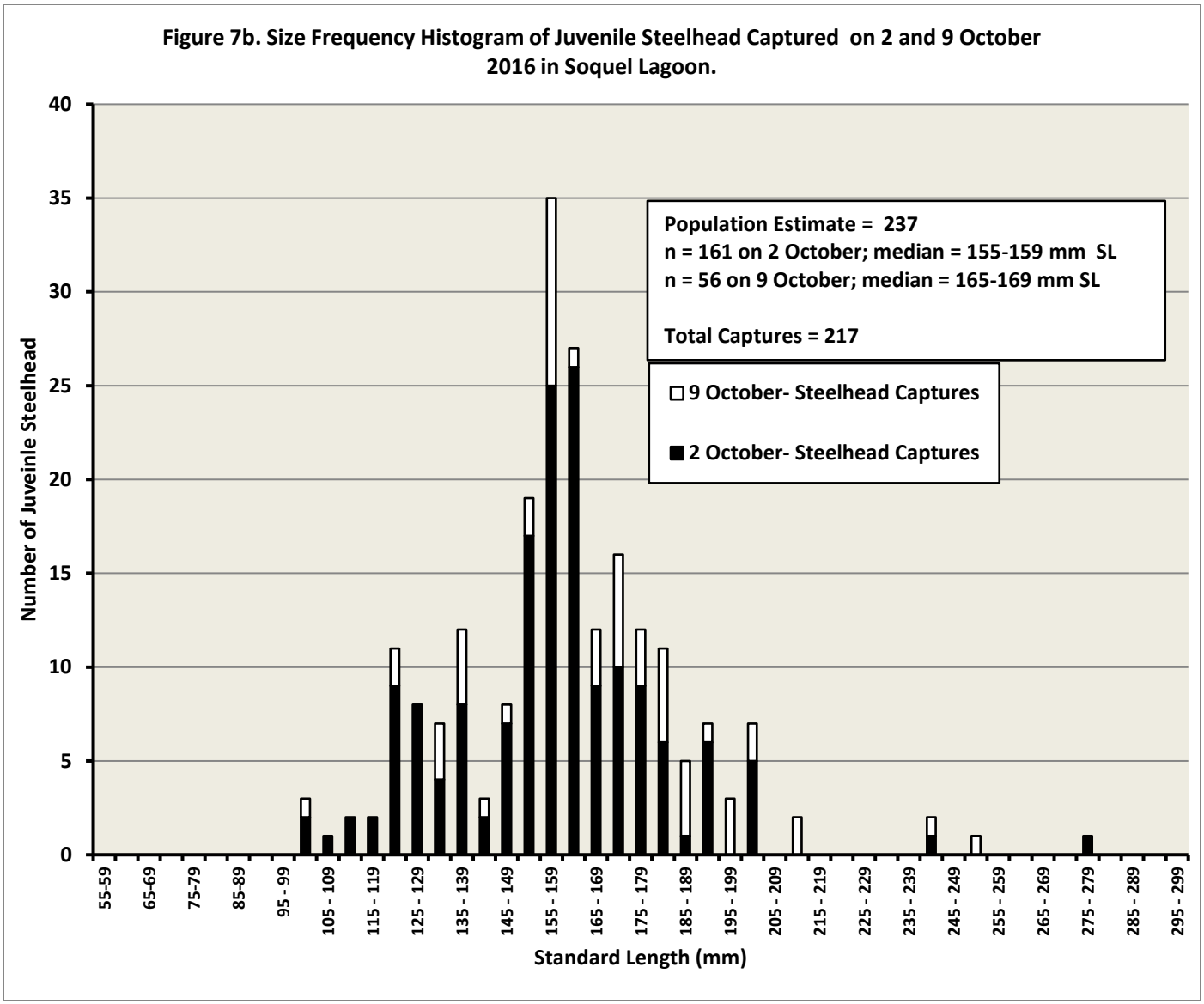


Figure 7b. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 9 October 2016 in Soquel Lagoon.

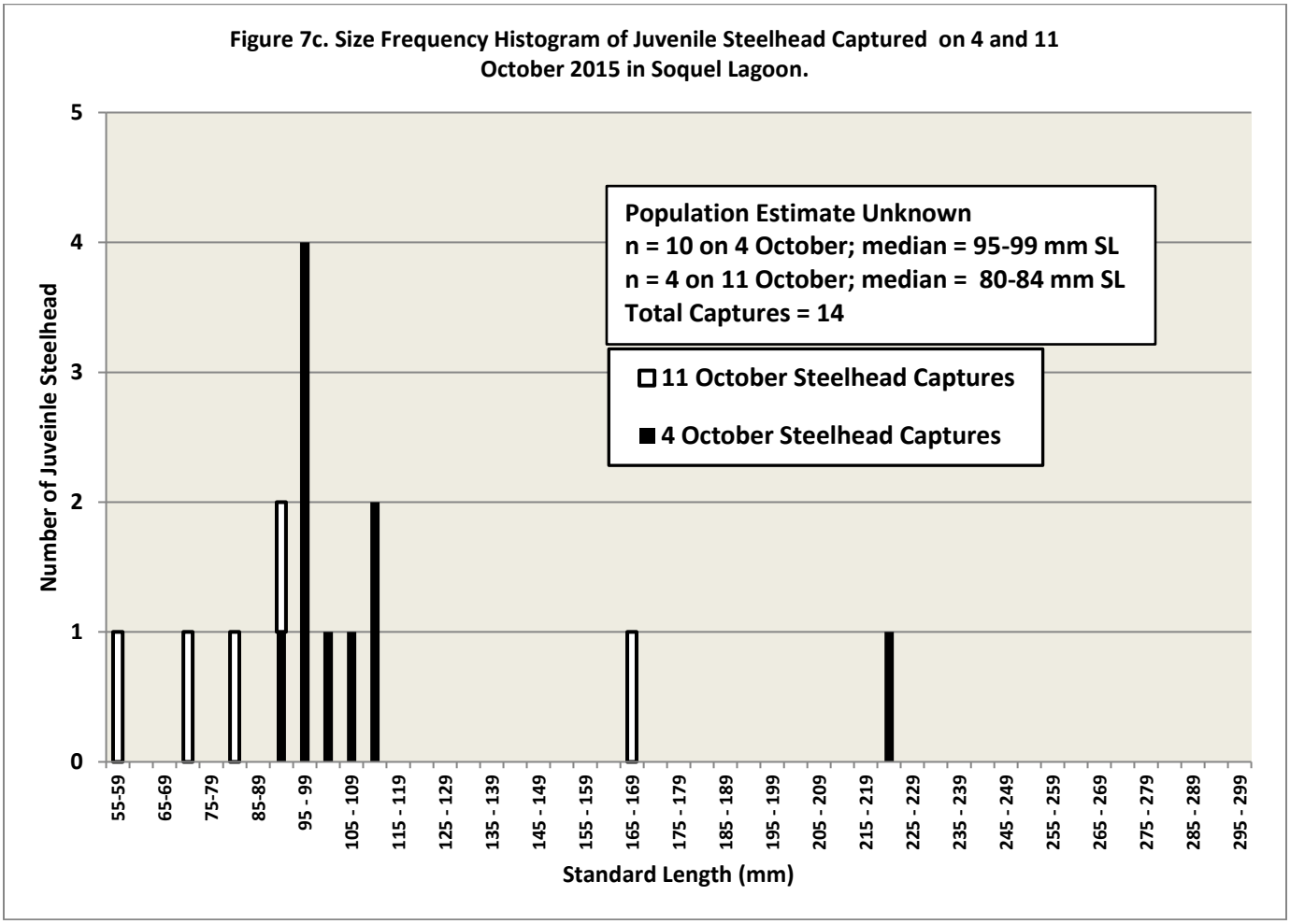


Figure 7c. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2015 in Soquel Lagoon.

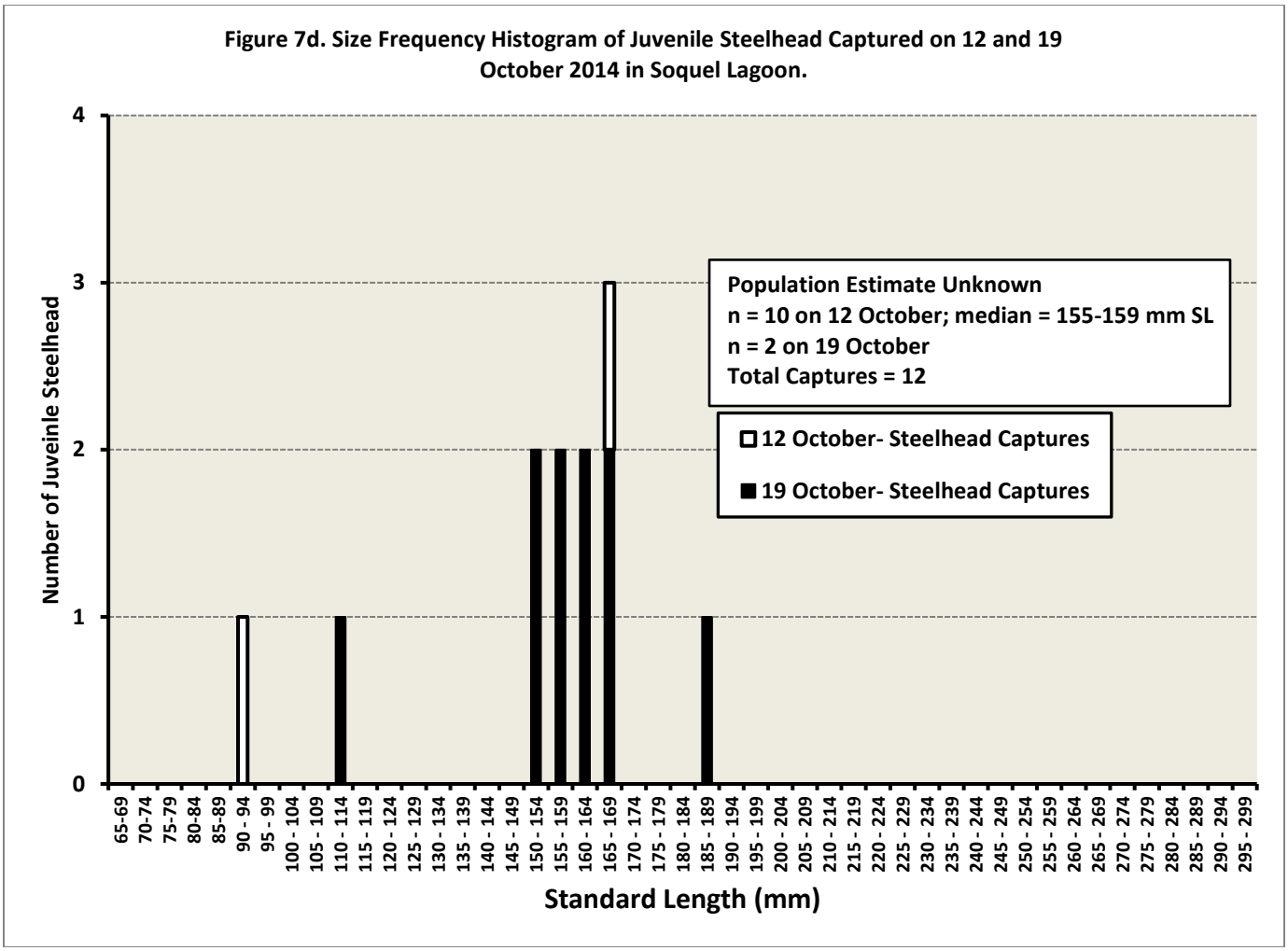


Figure 7d. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

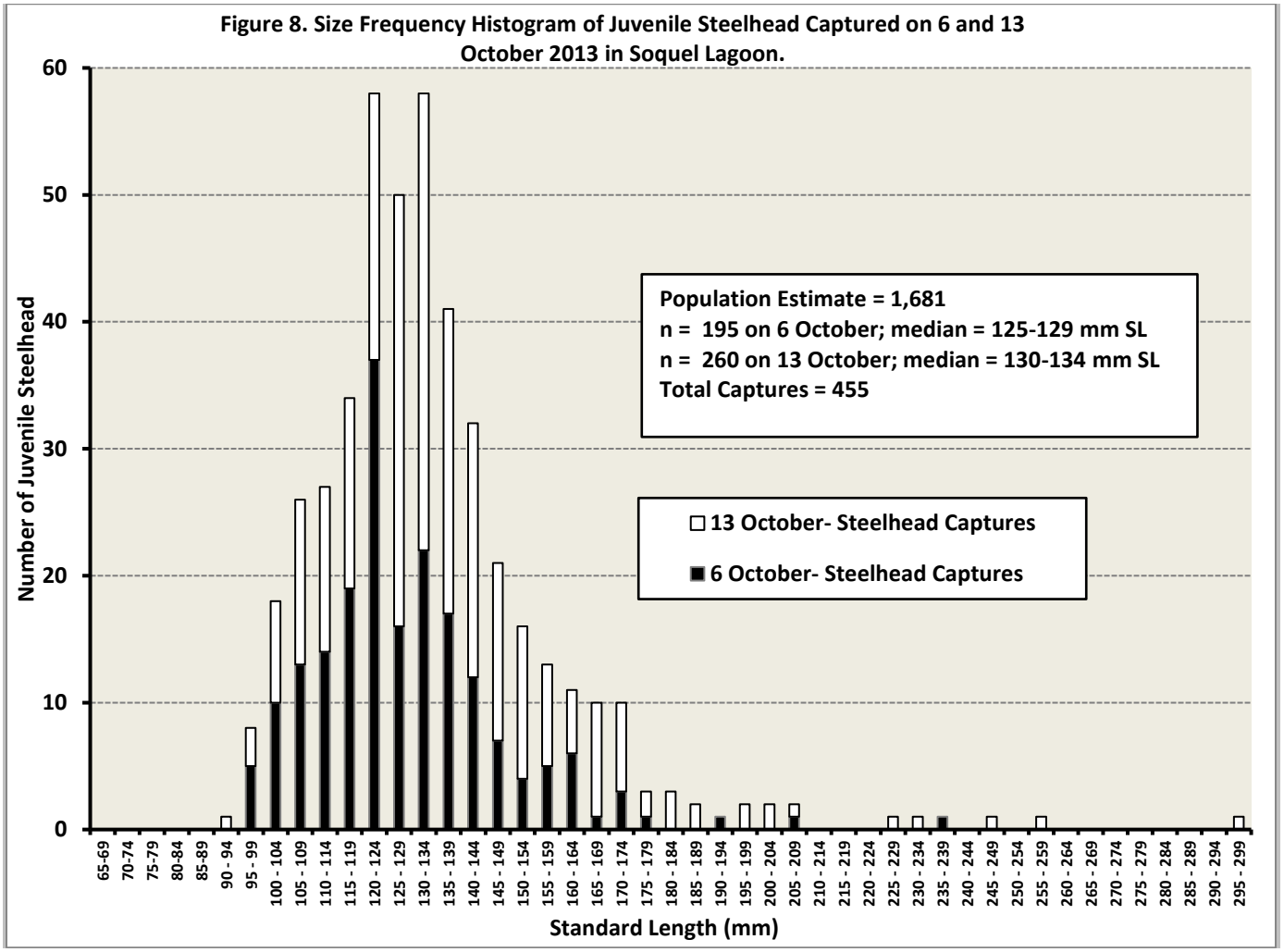


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

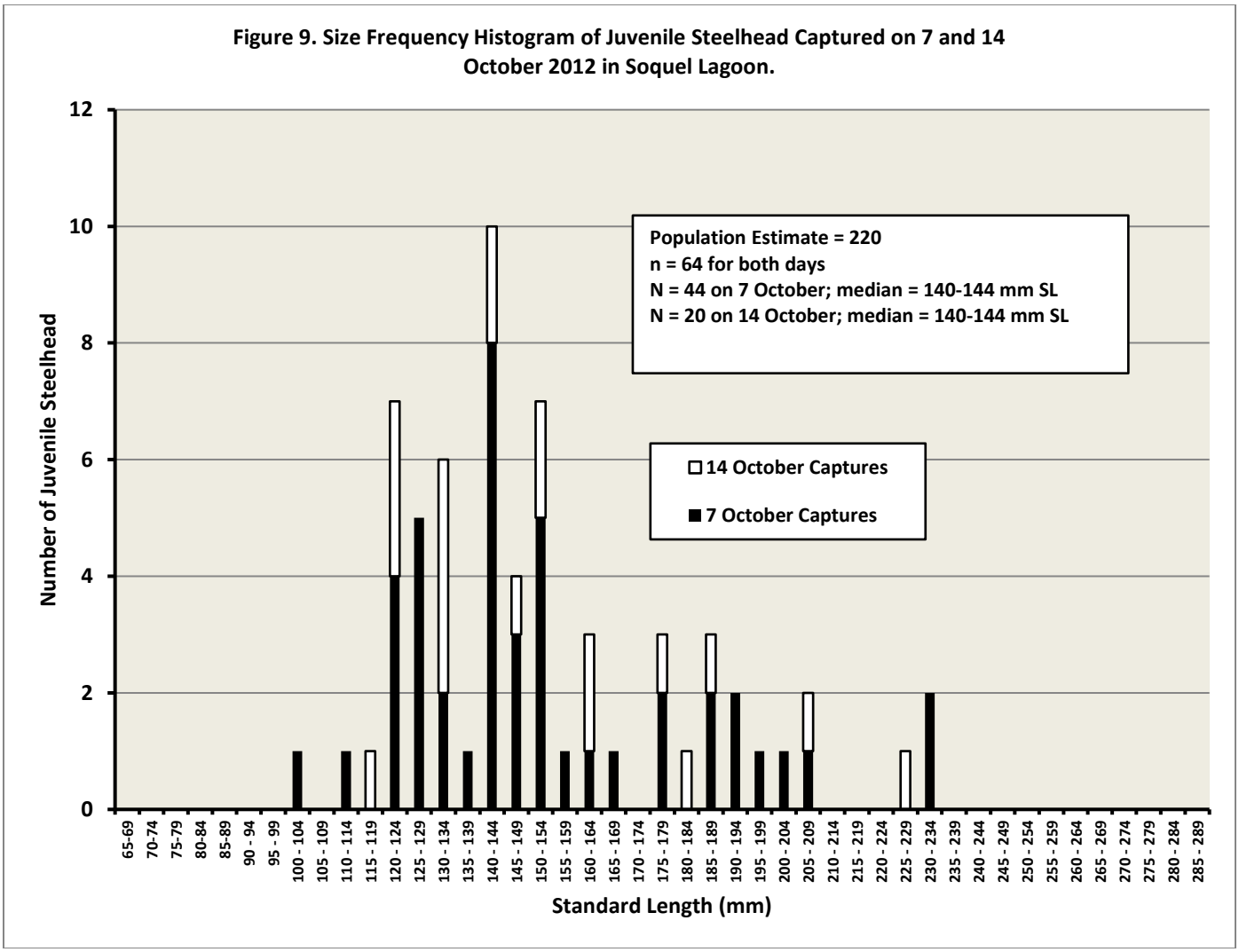


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

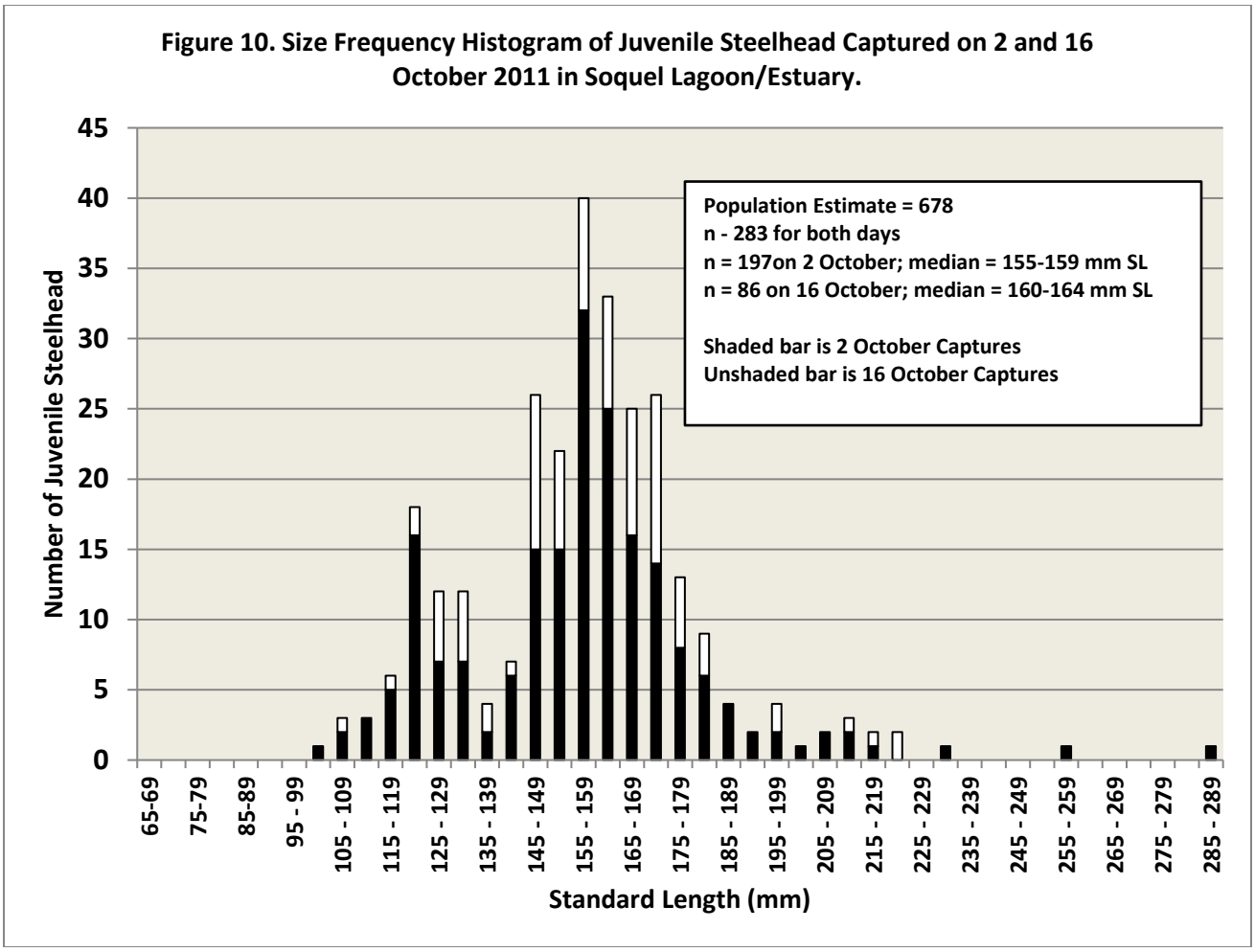


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

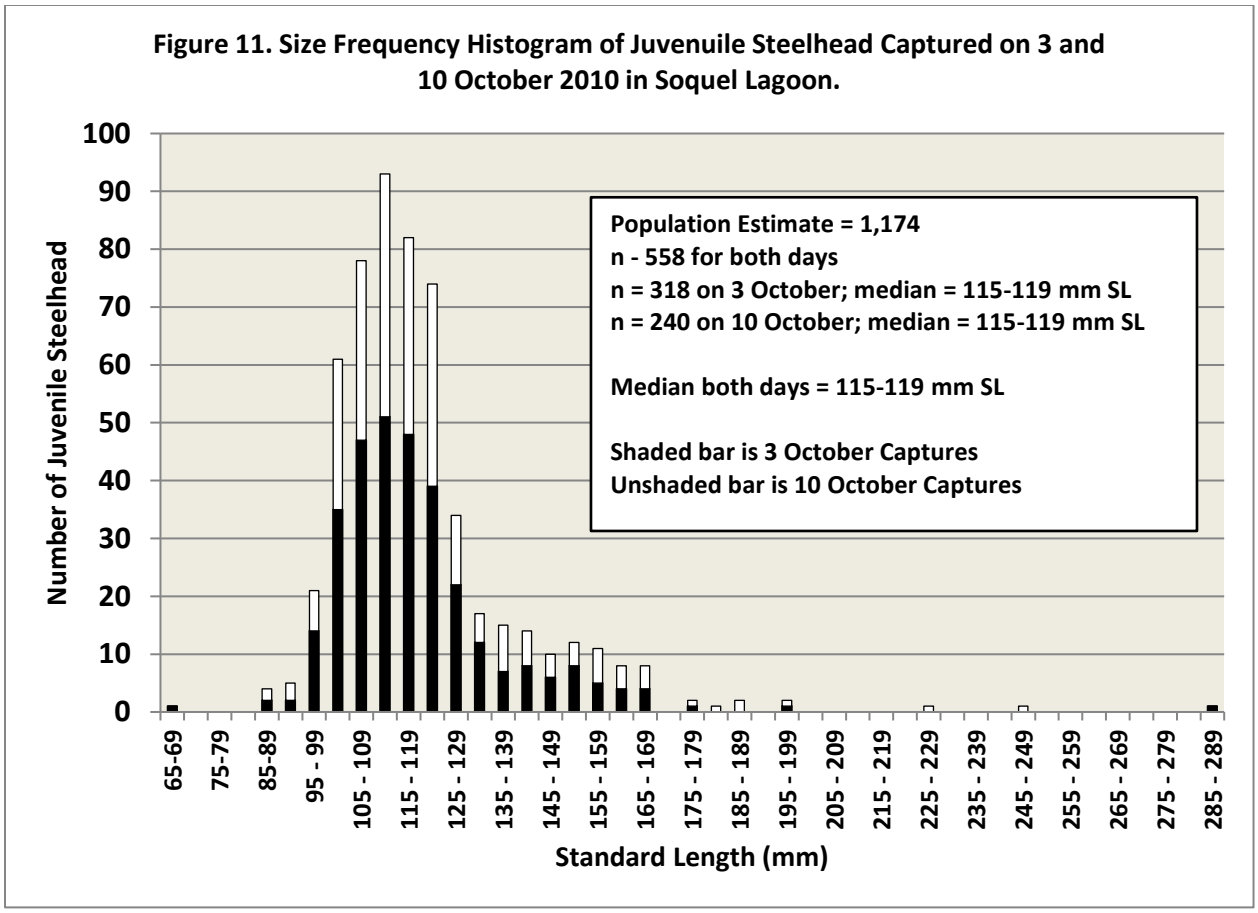


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

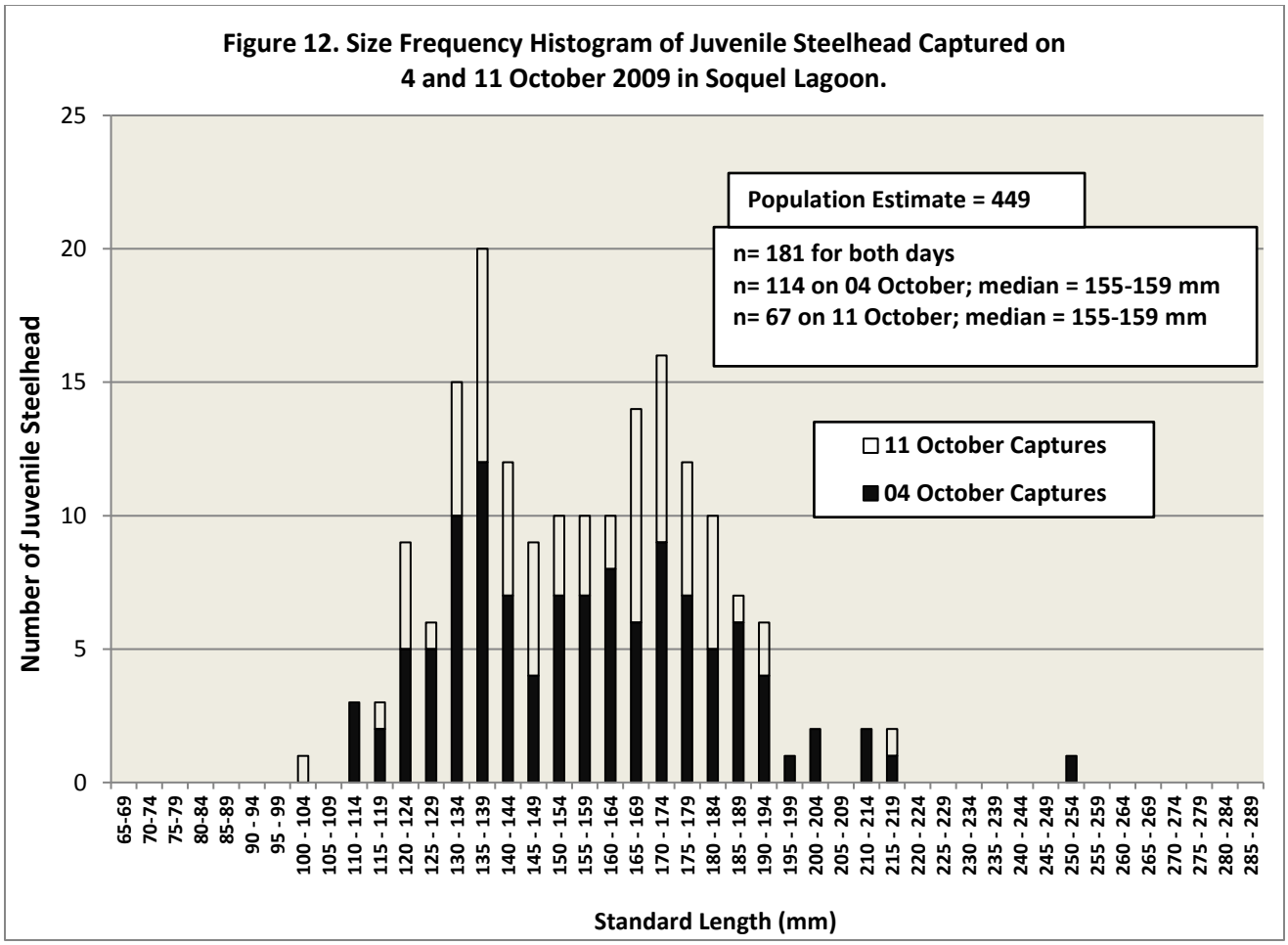


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

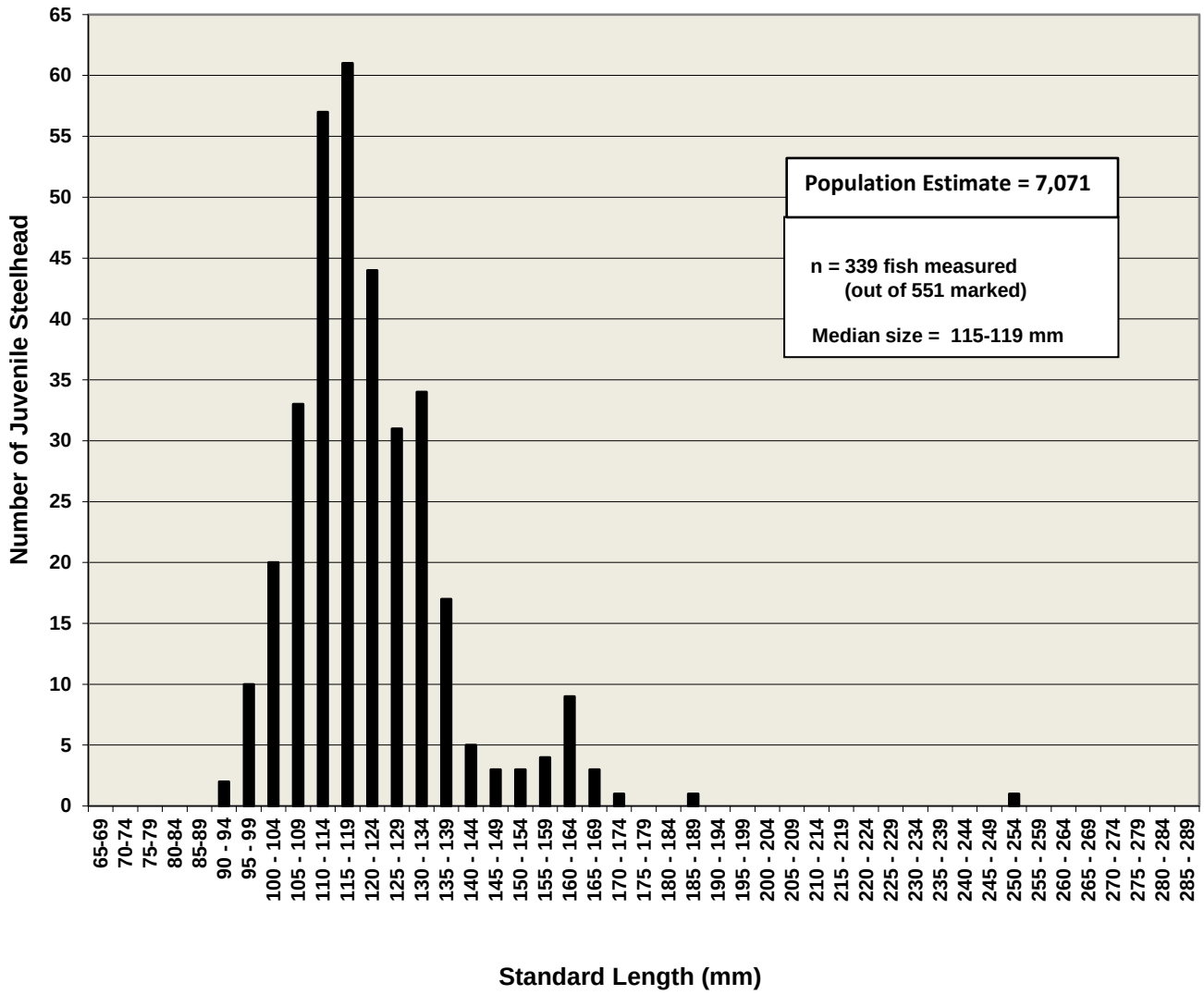


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

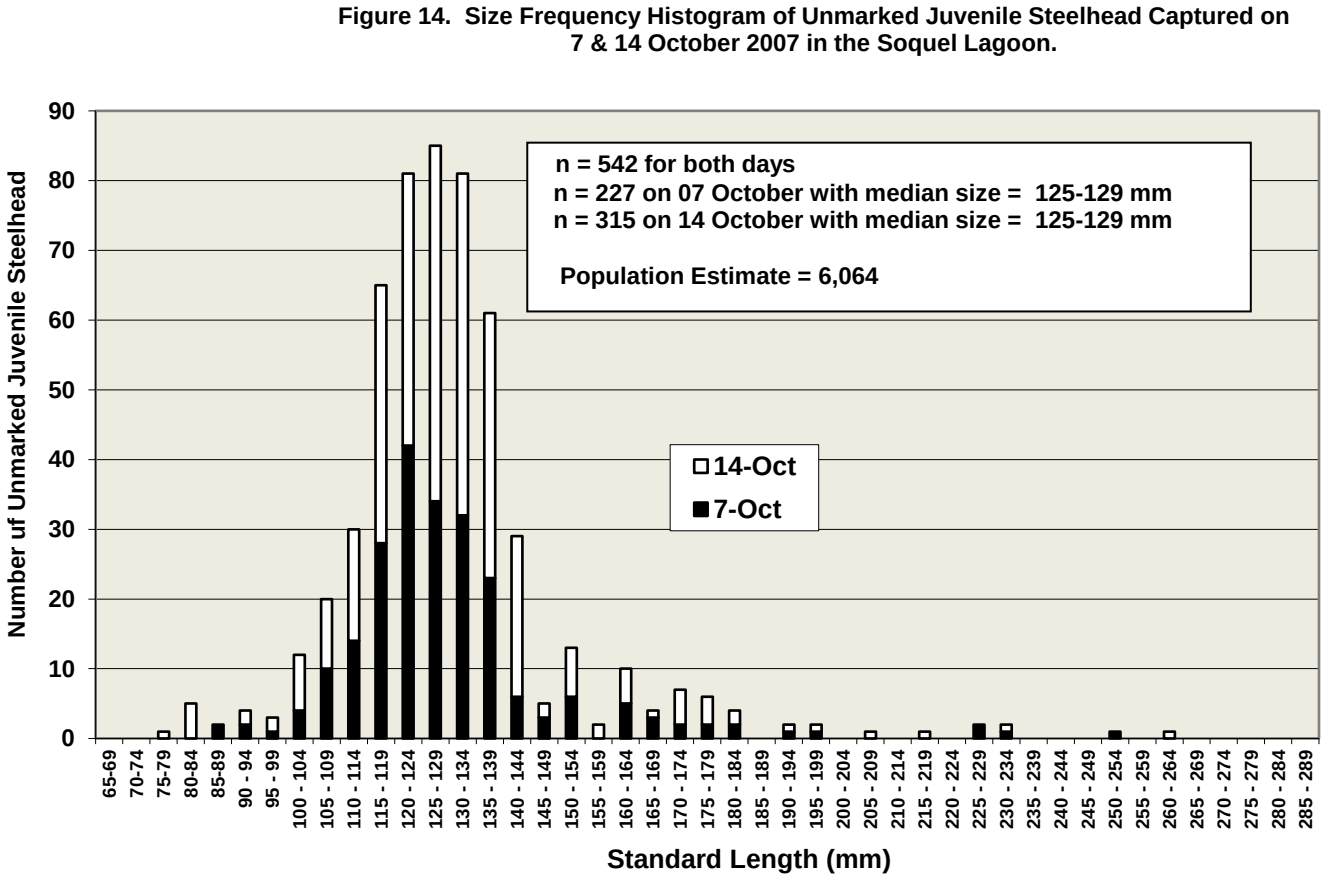


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

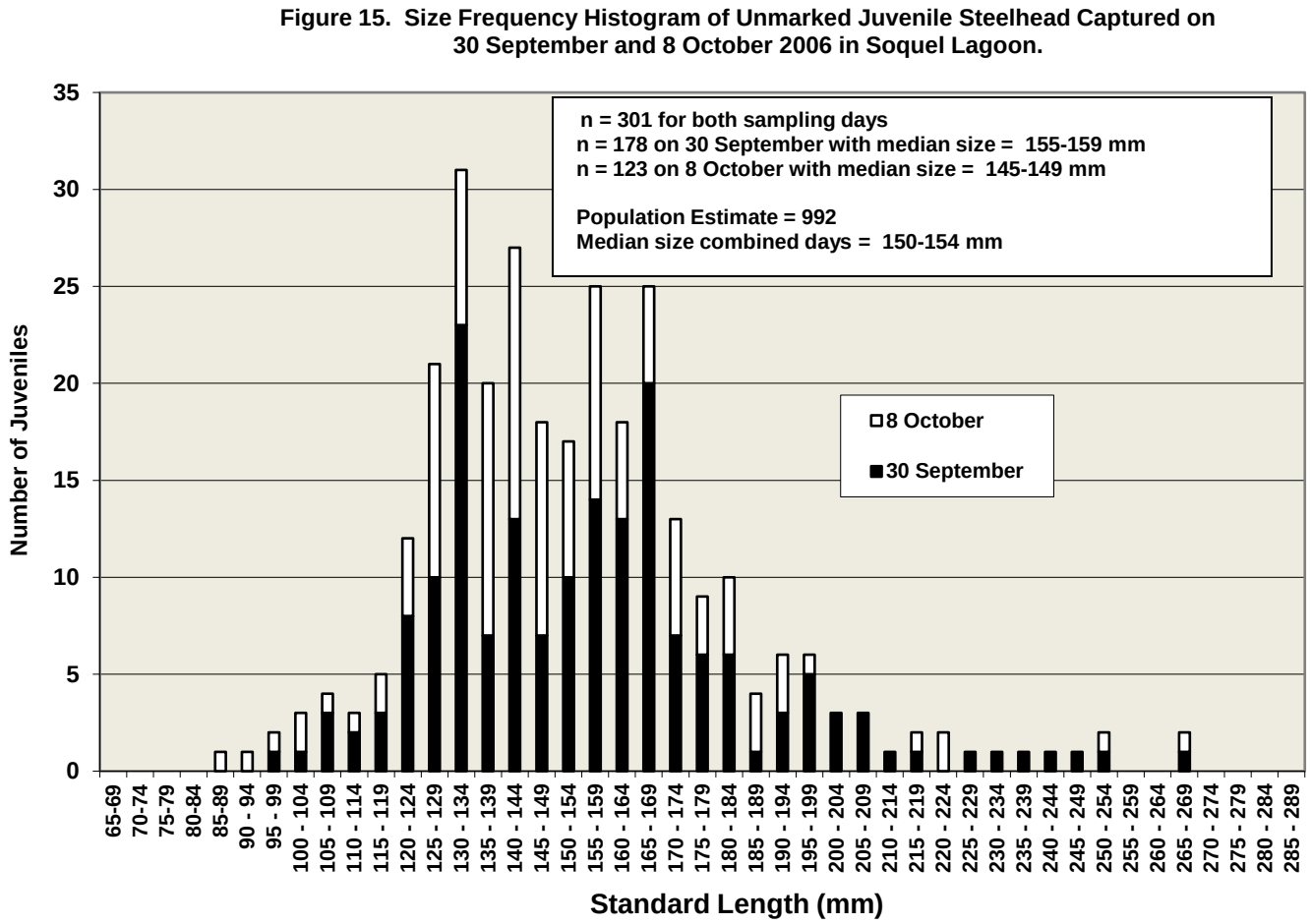


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

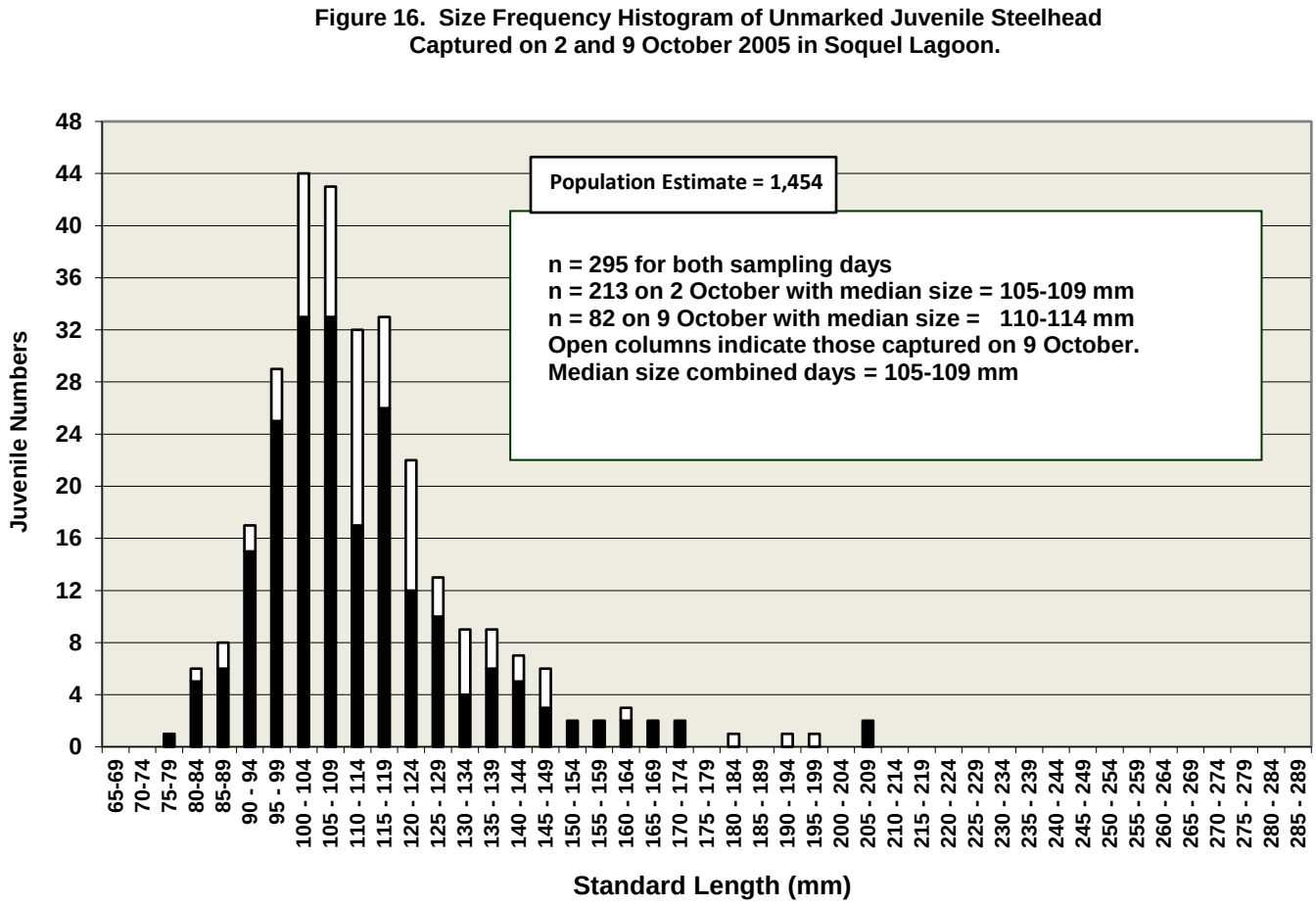


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

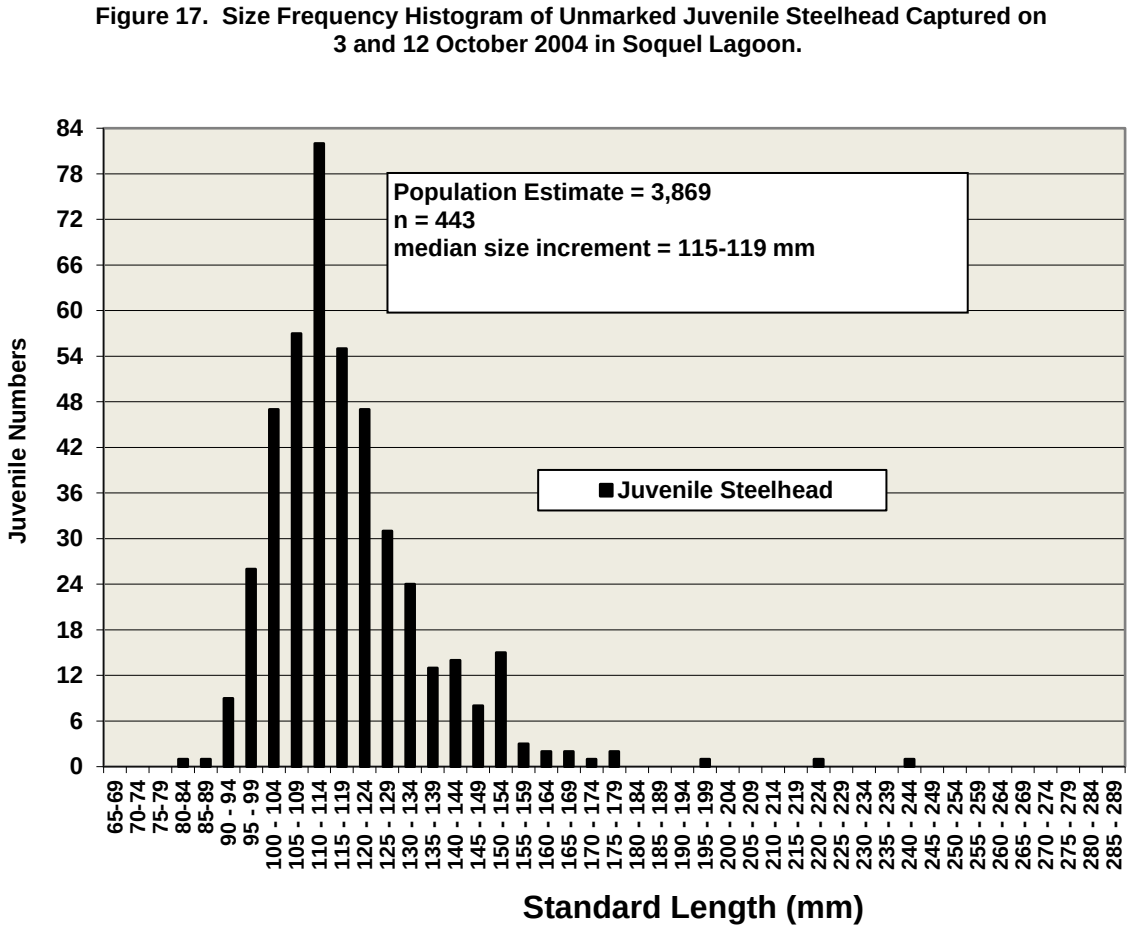


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

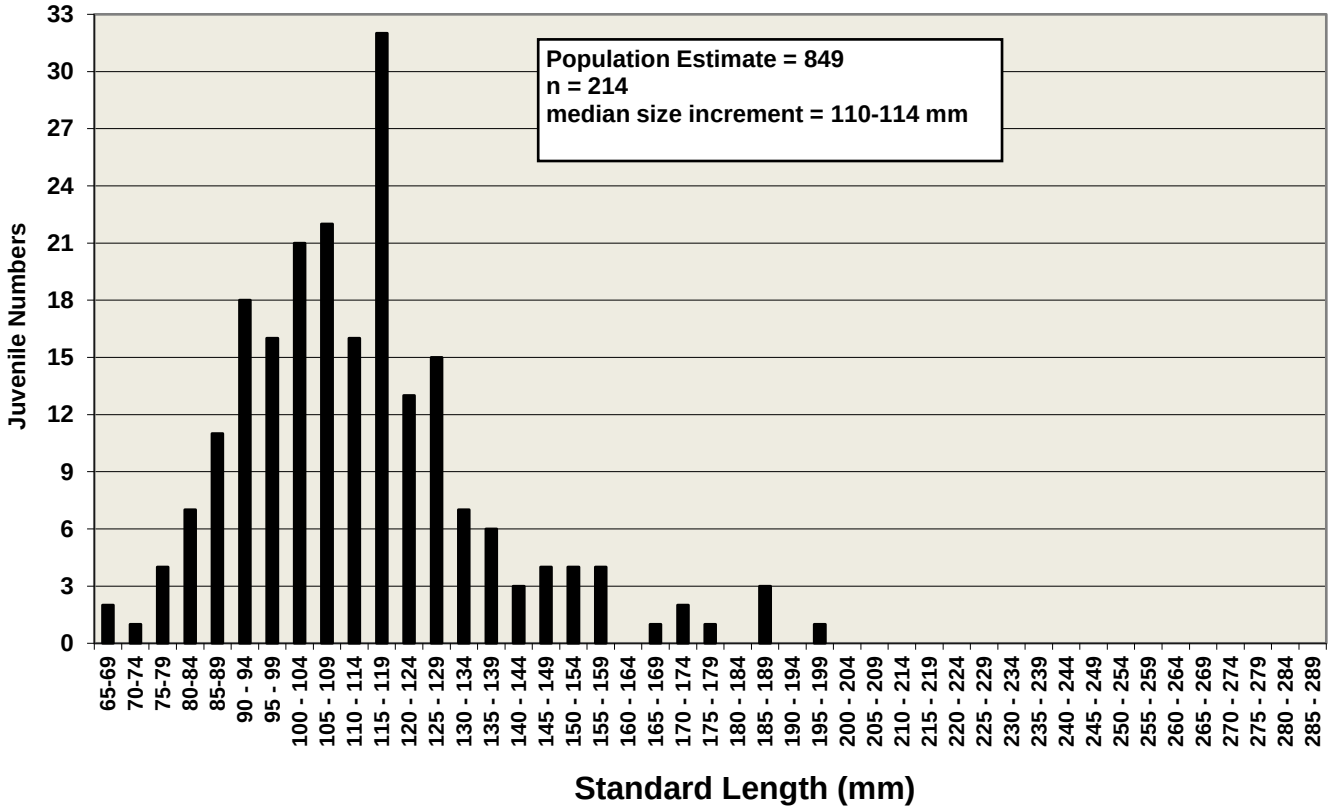


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

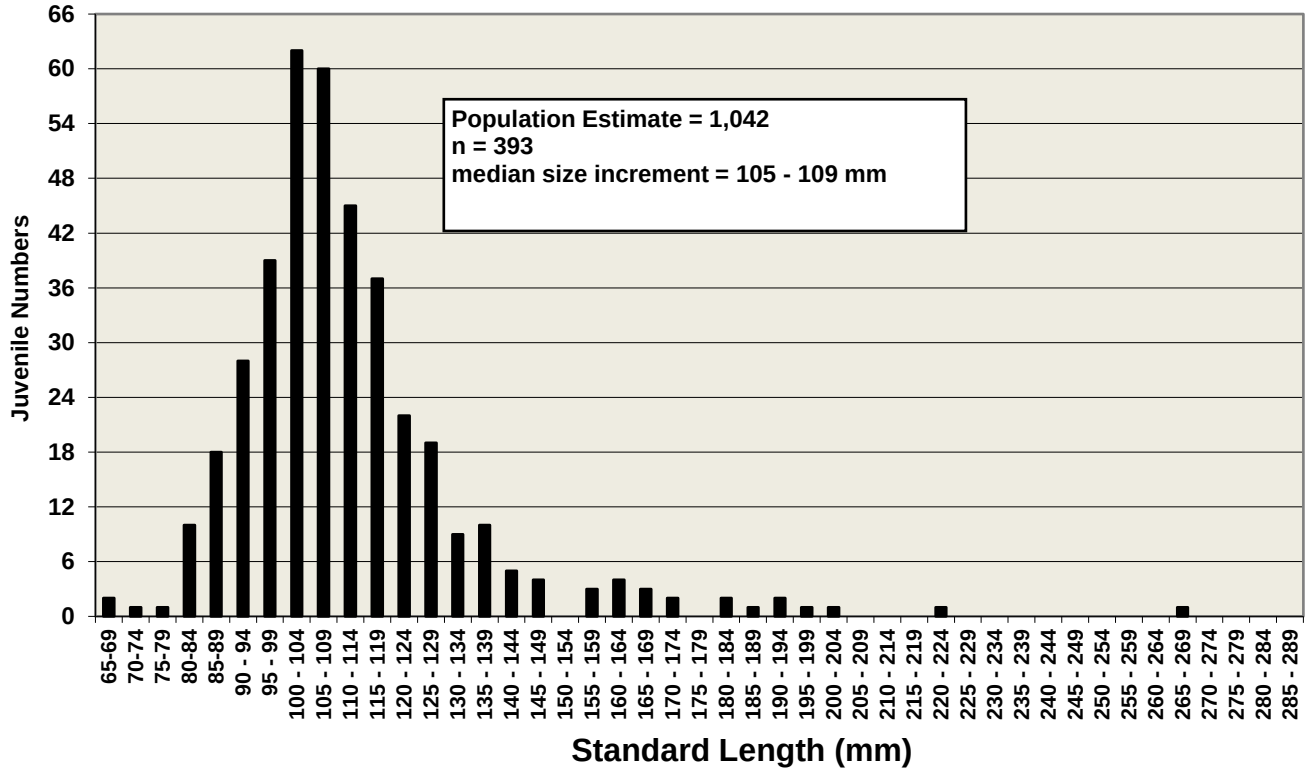


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

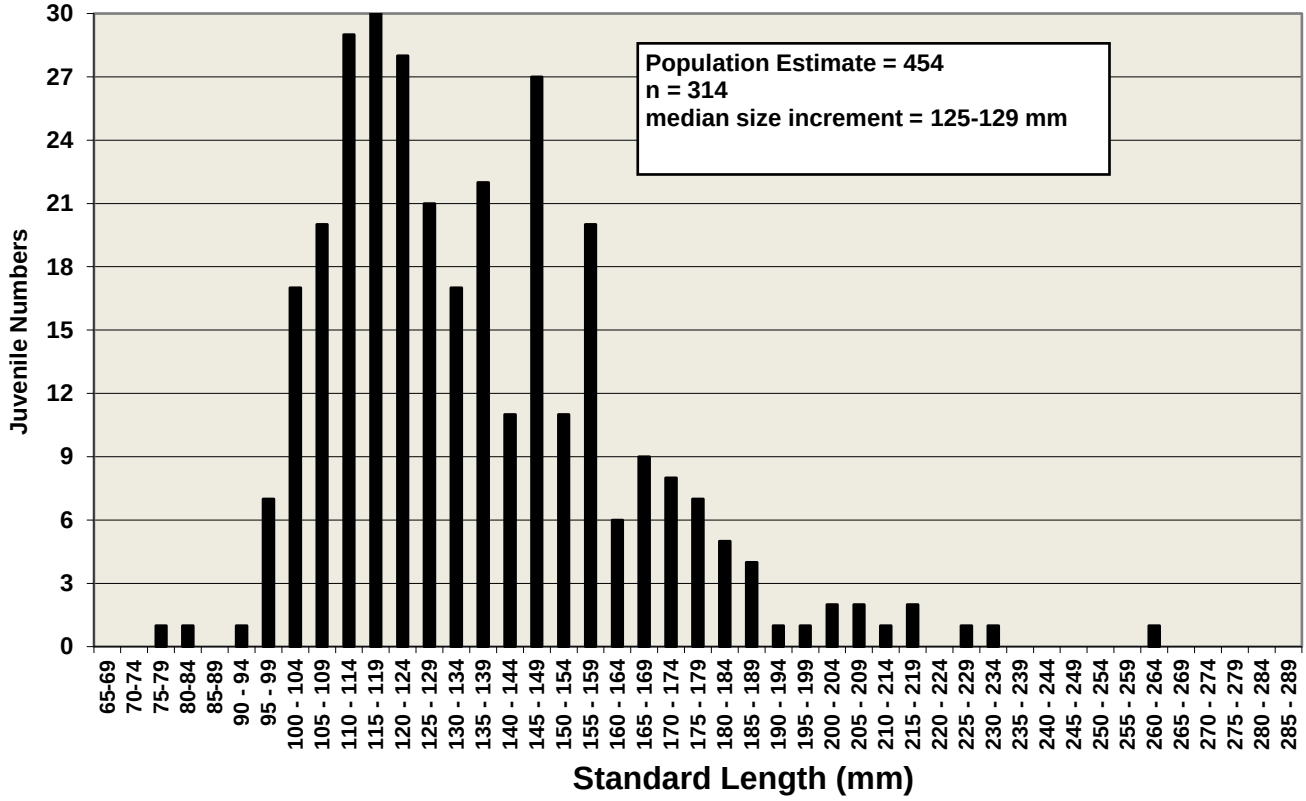


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

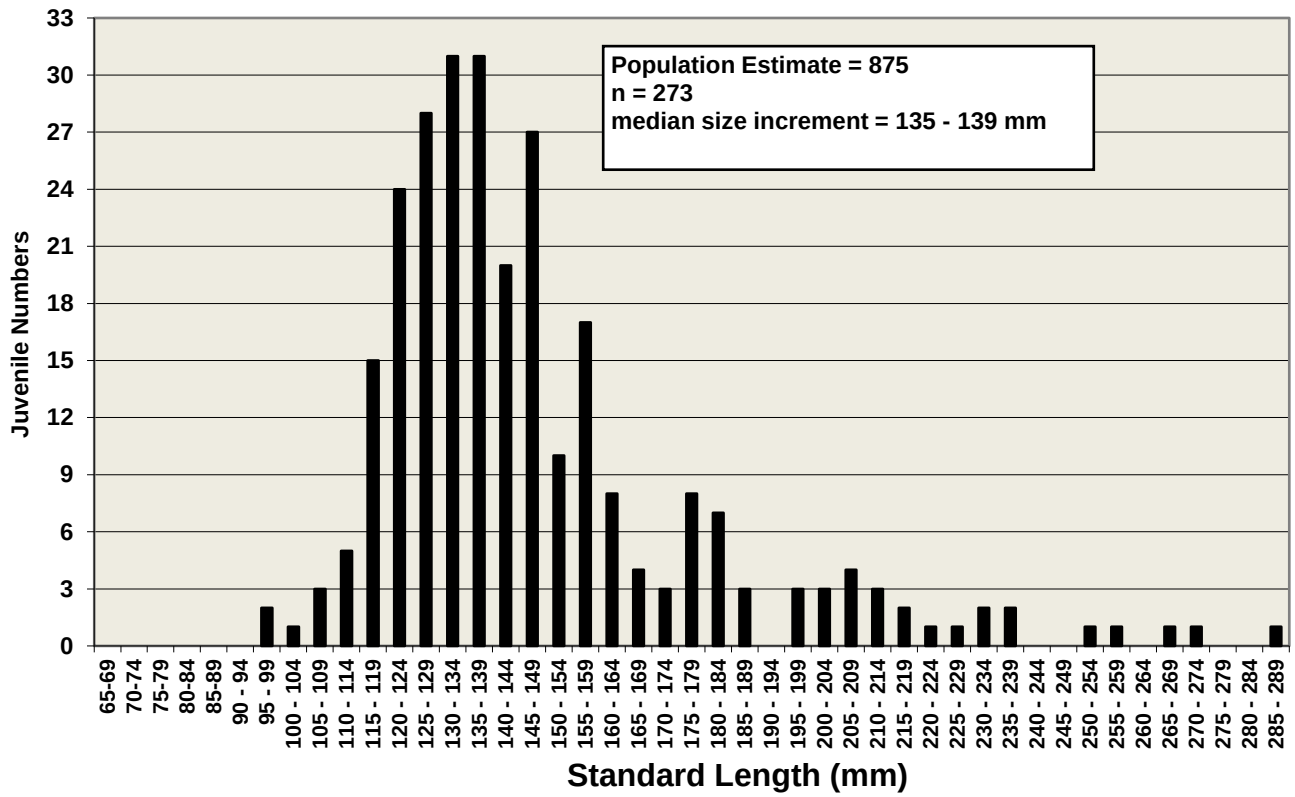


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

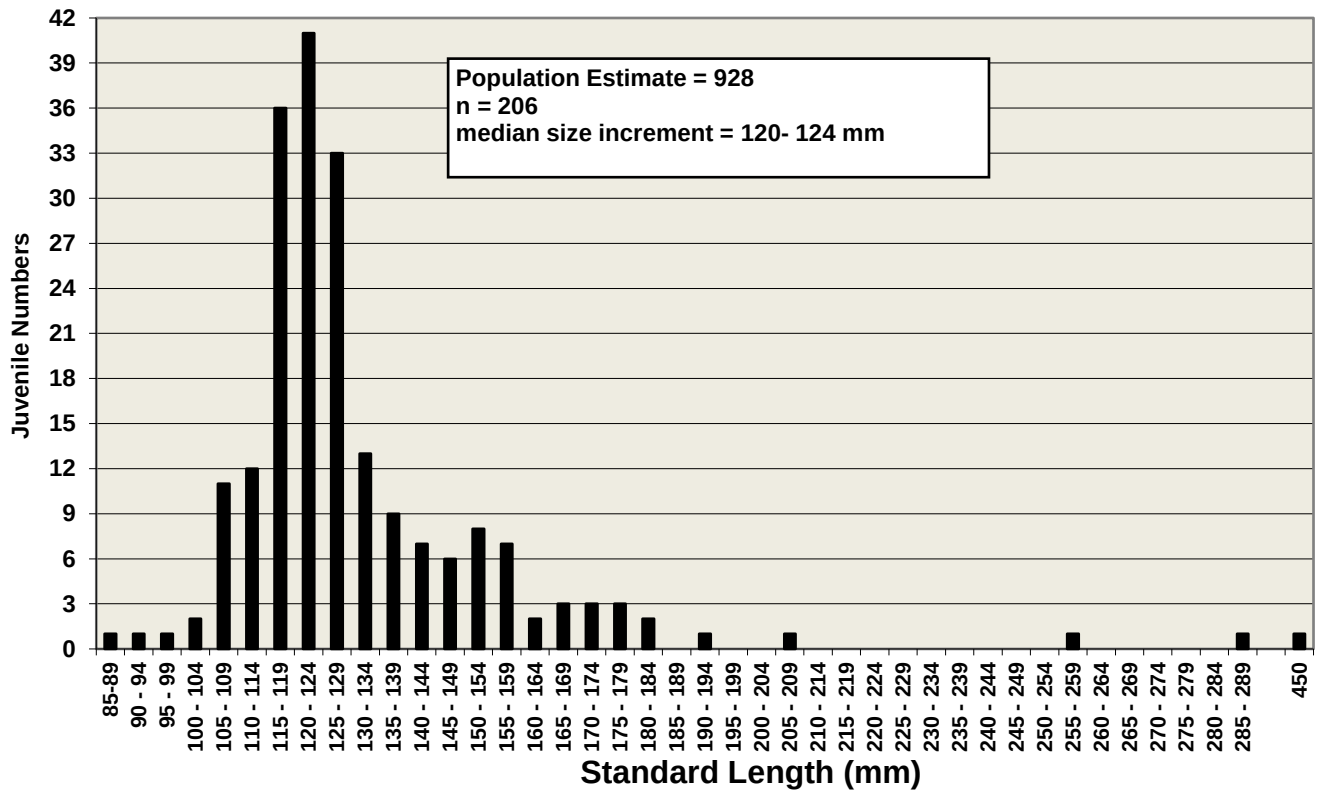


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.

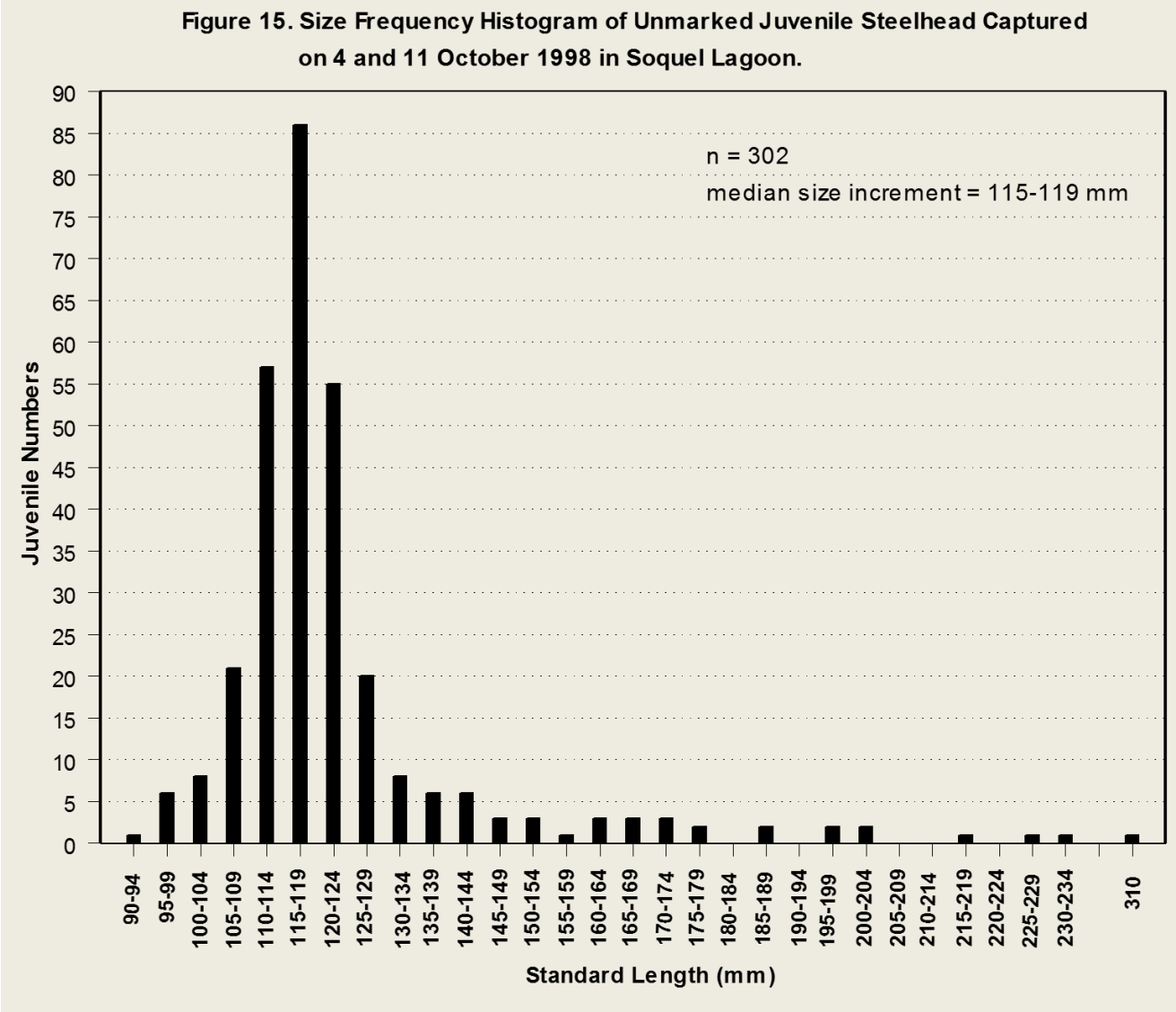


Figure 23. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

Population Estimate = 671.

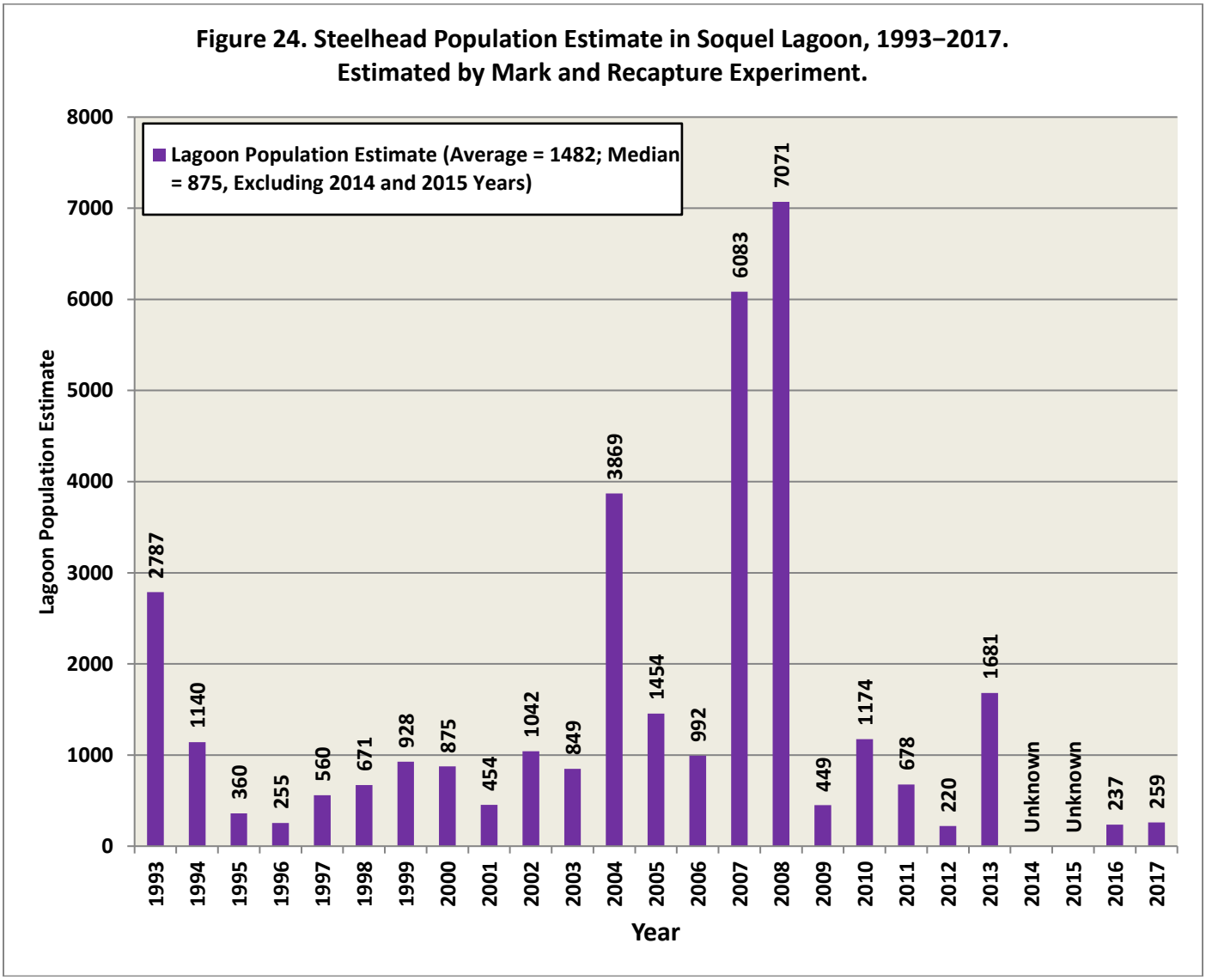


Figure 24. Steelhead Population Estimate in Soquel Lagoon, 1993−2017.

Figure 25. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

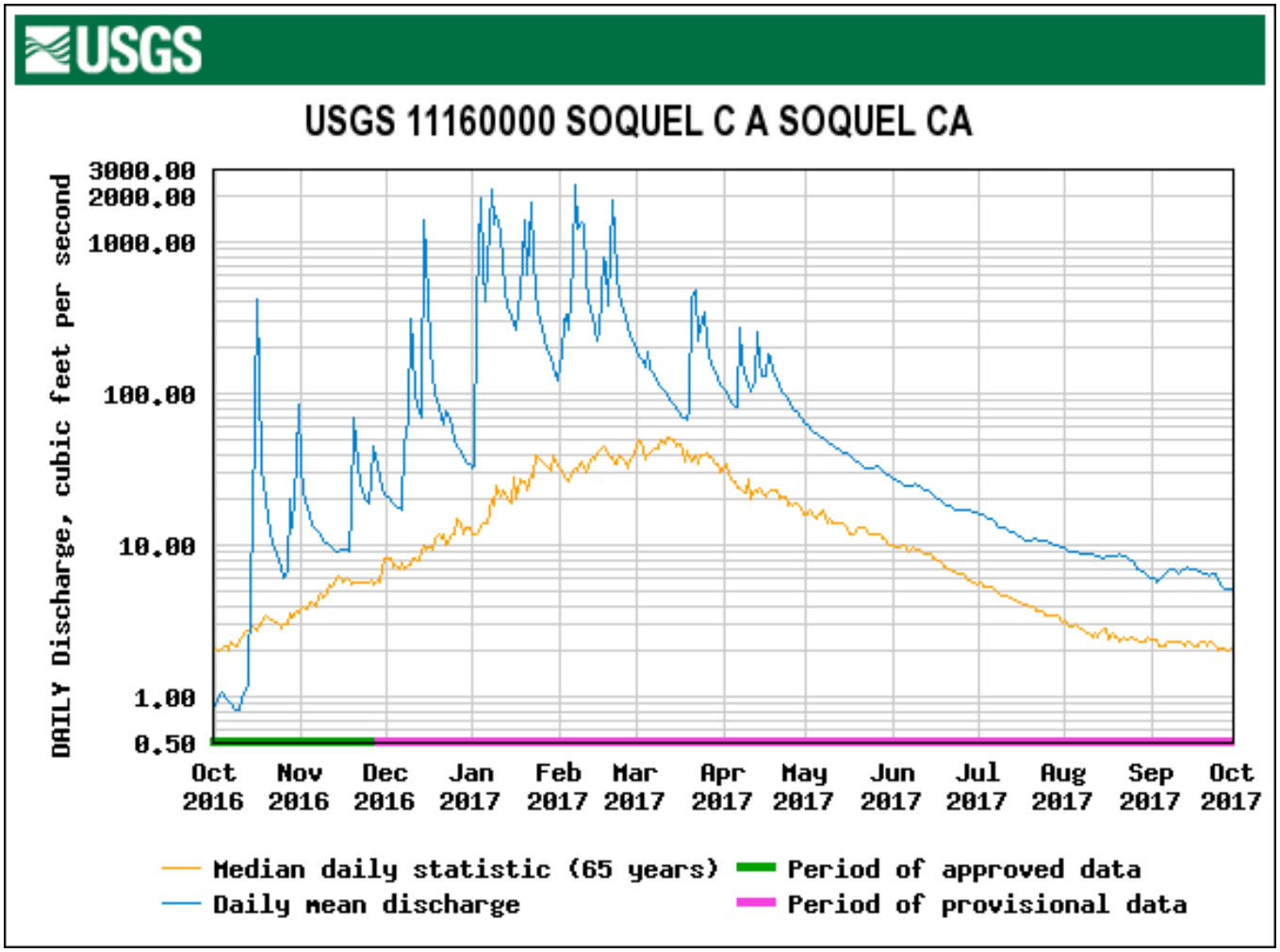


Figure 26. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

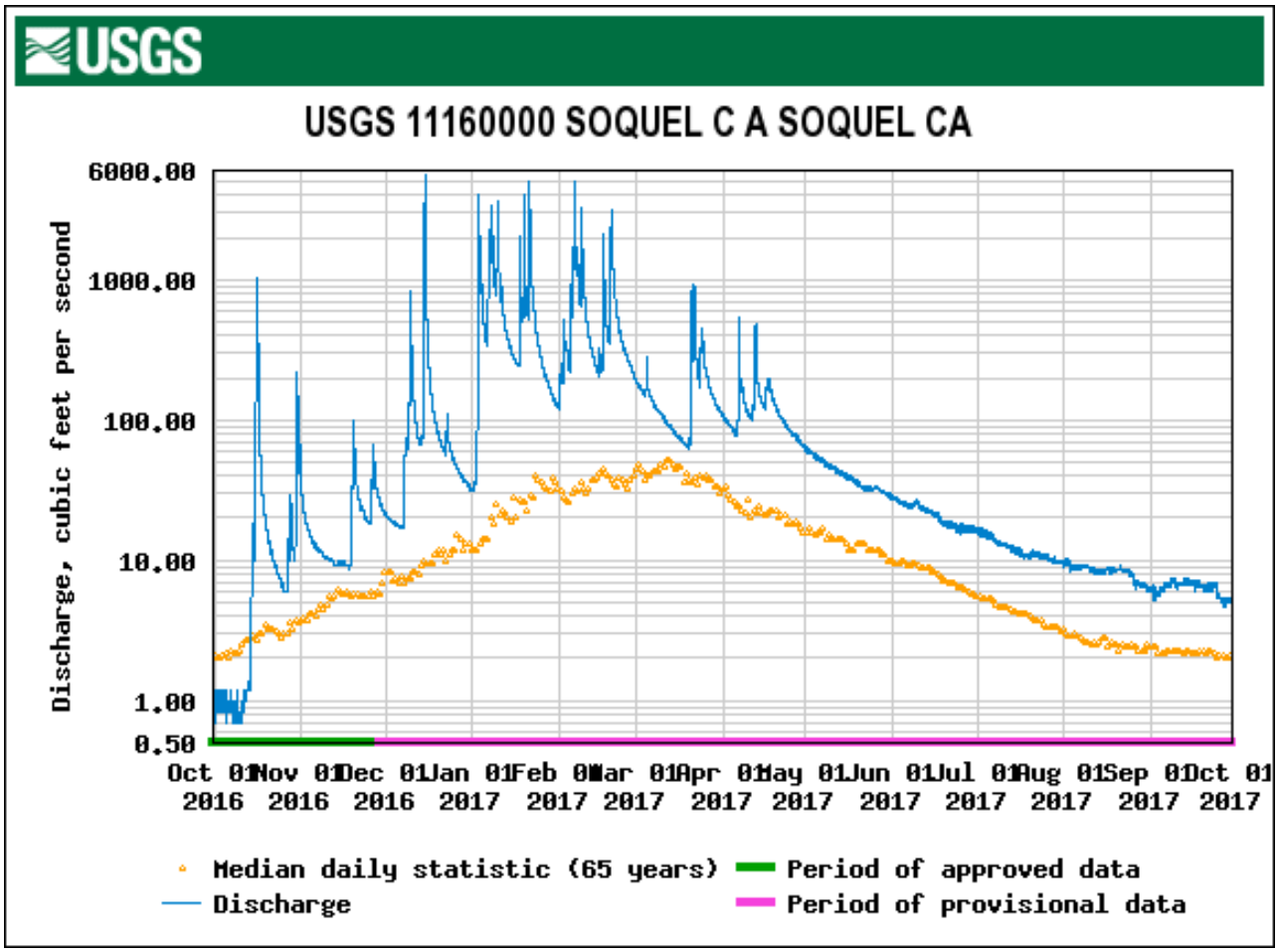


Figure 27. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 20 November 2017.

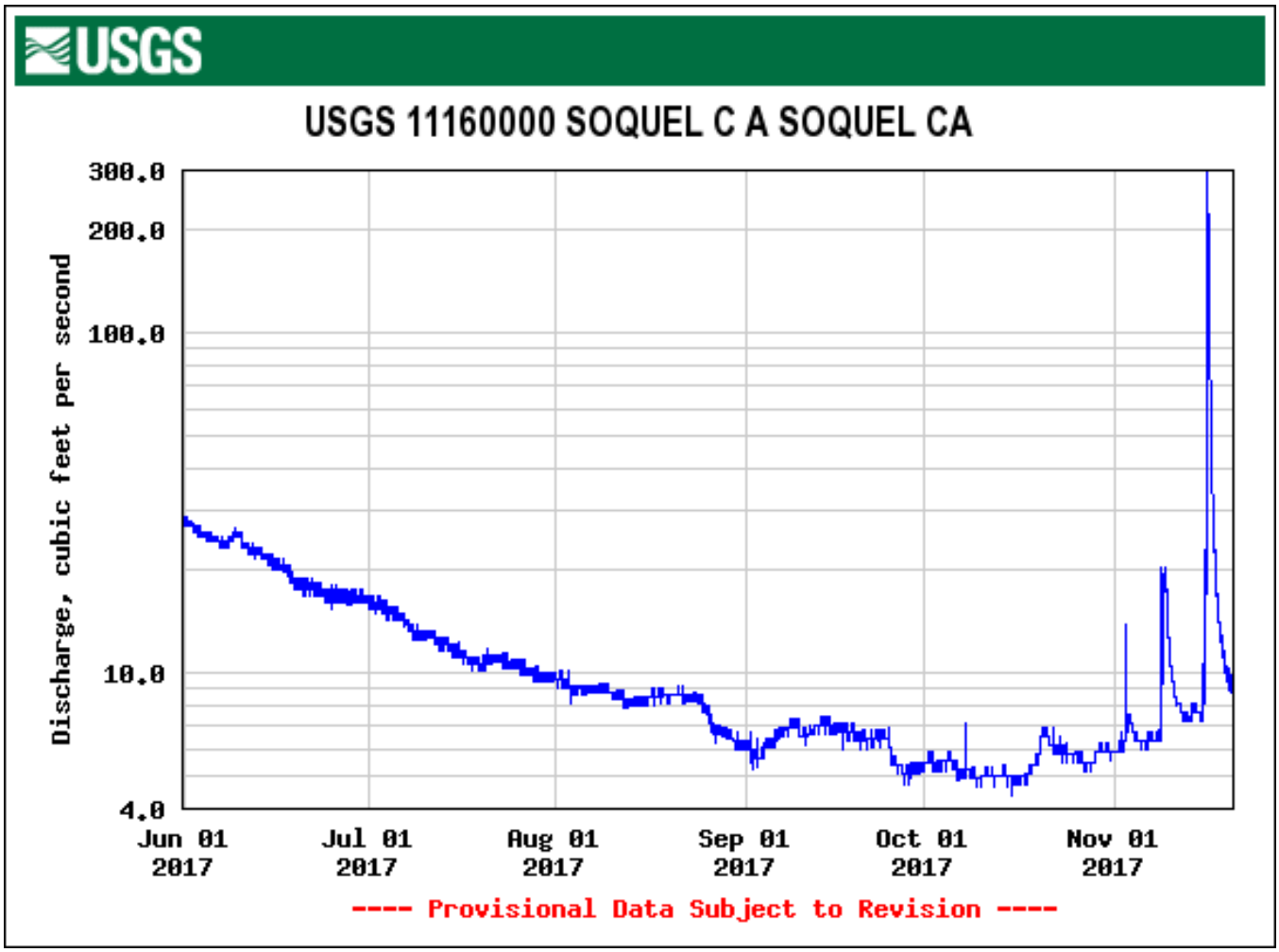


Figure 28. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016

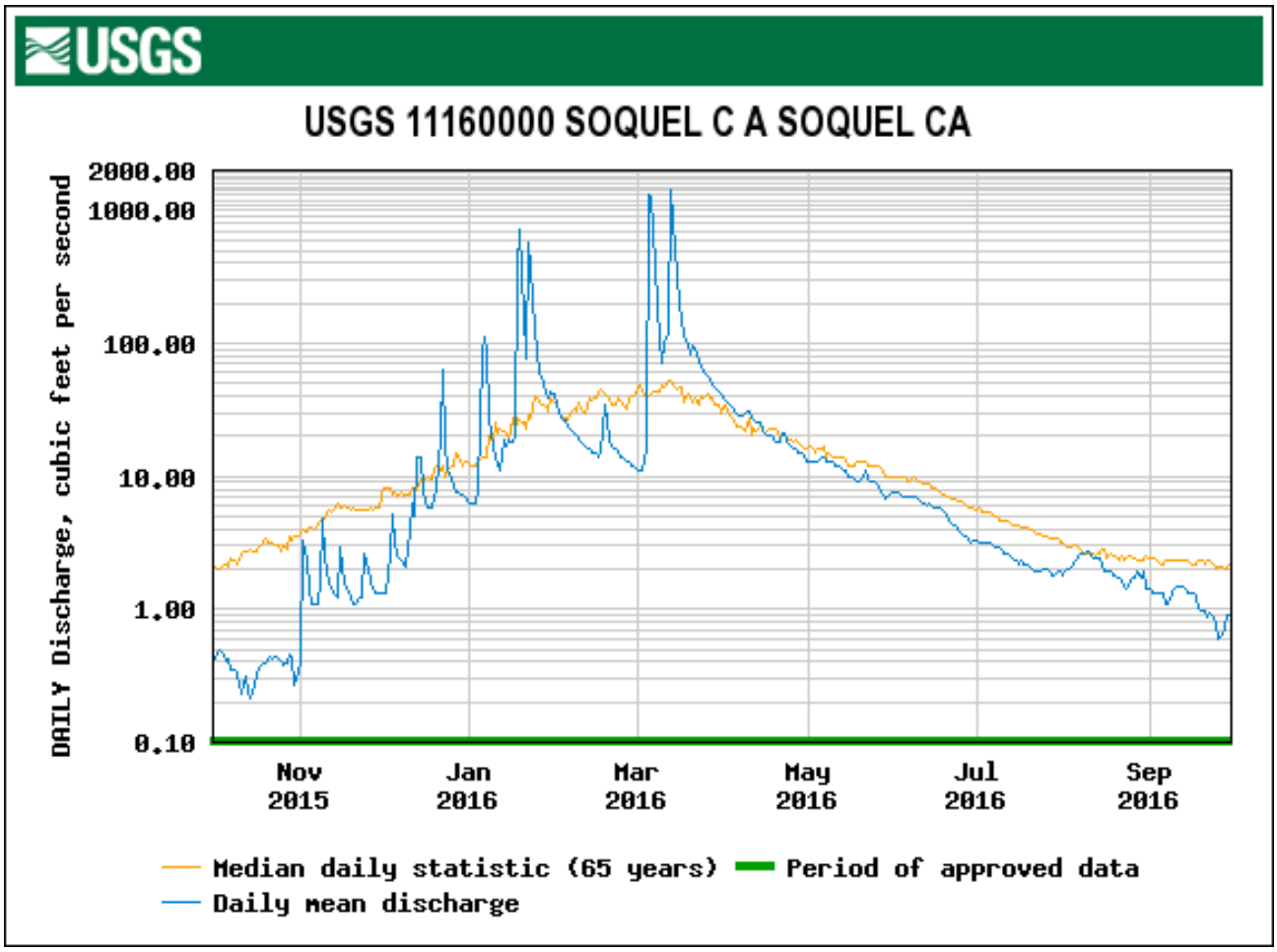


Figure 29. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016.

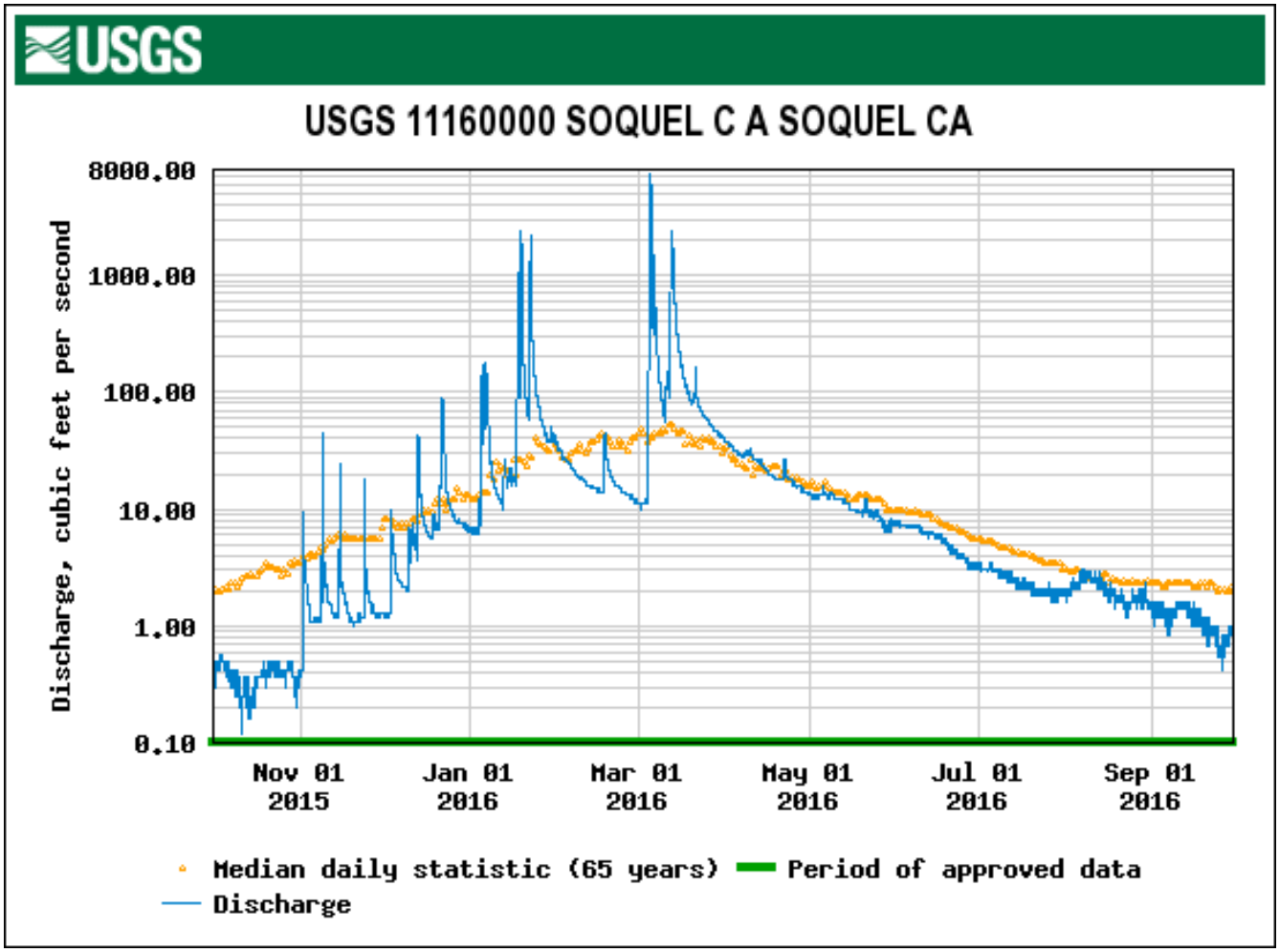


Figure 30. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2016 – 11 October 2016.

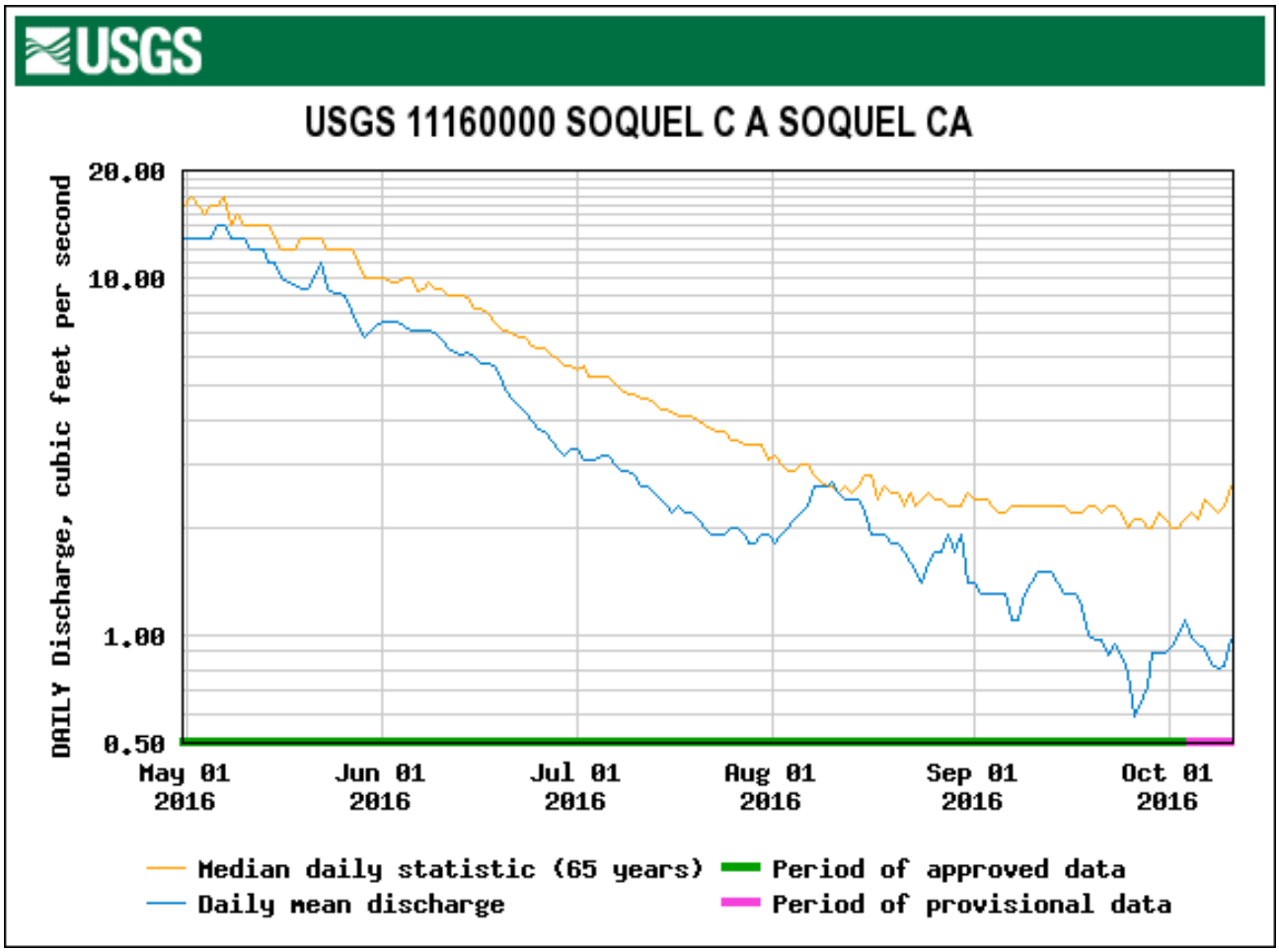


Figure 31. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

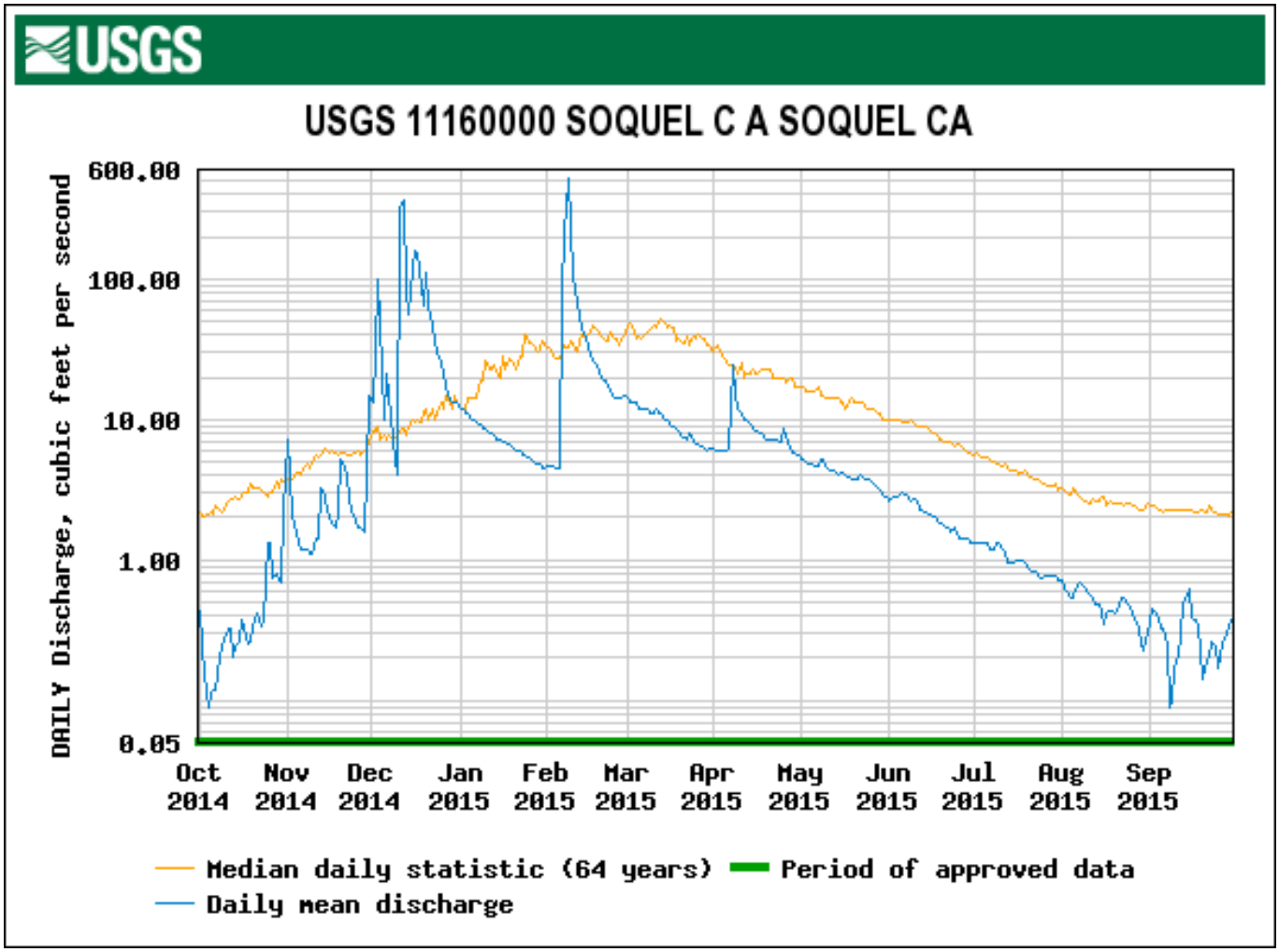


Figure 32. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

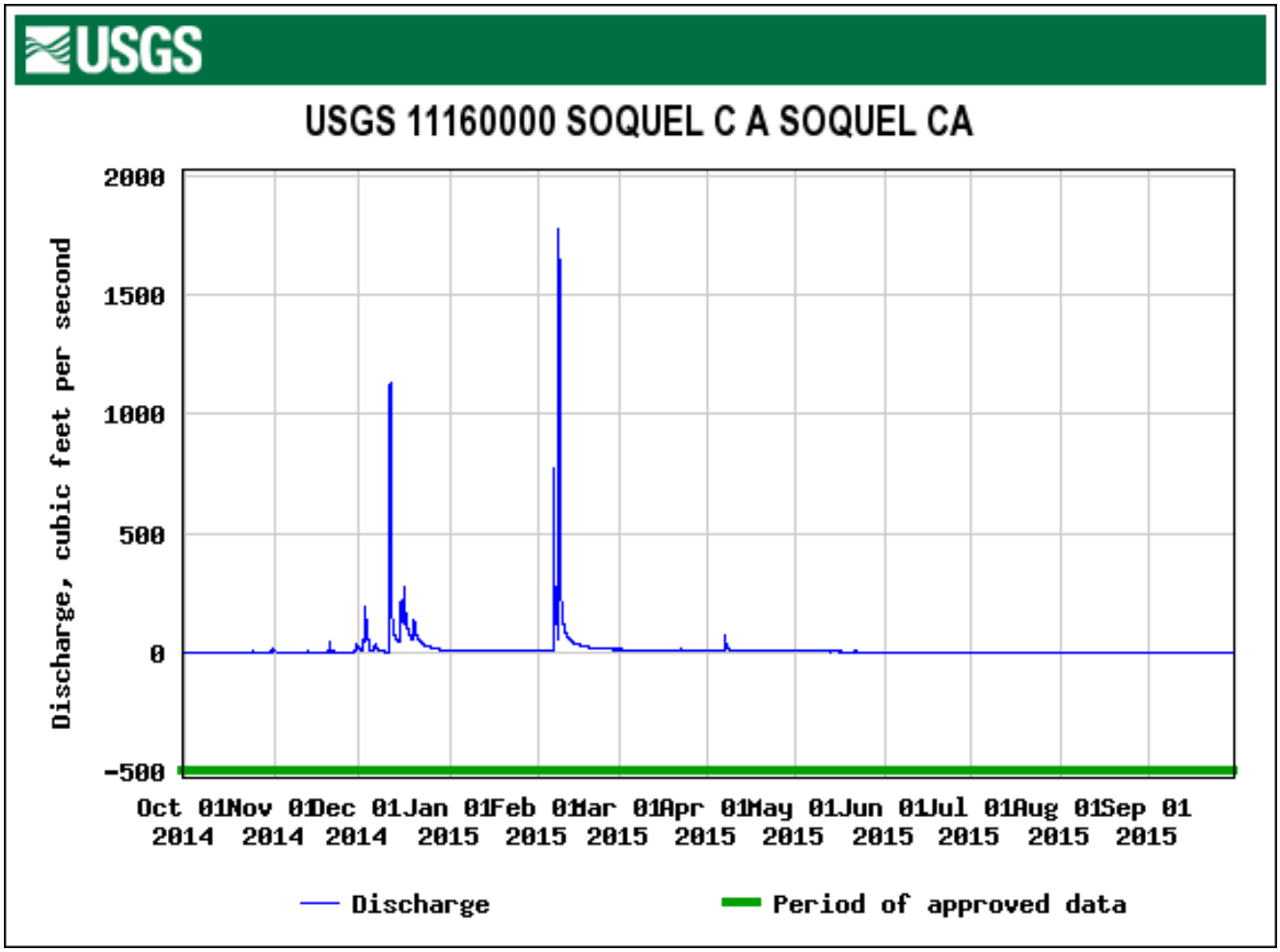


Figure 33. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2015 – 15 November 2015.

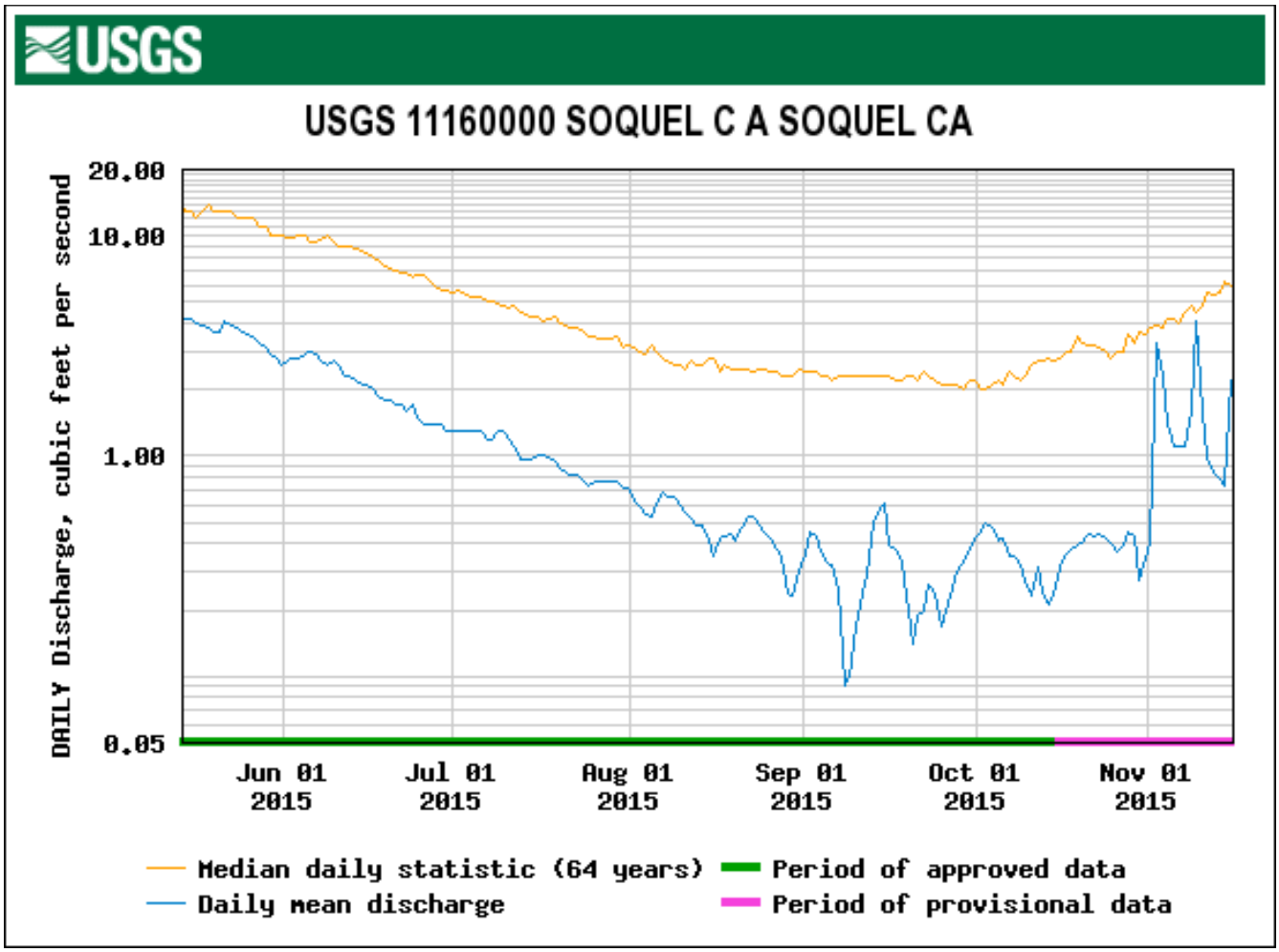


Figure 34. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

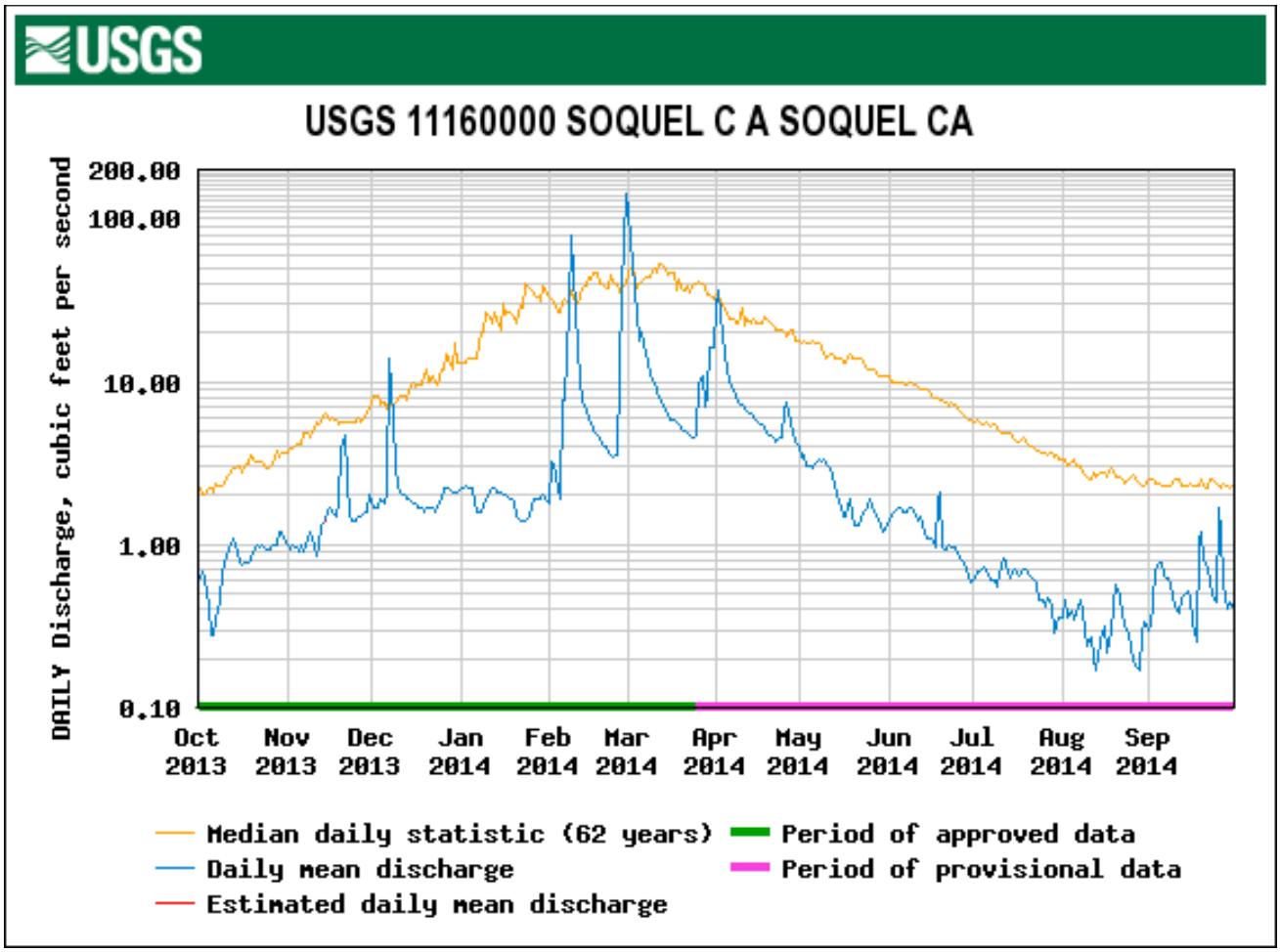


Figure 35. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

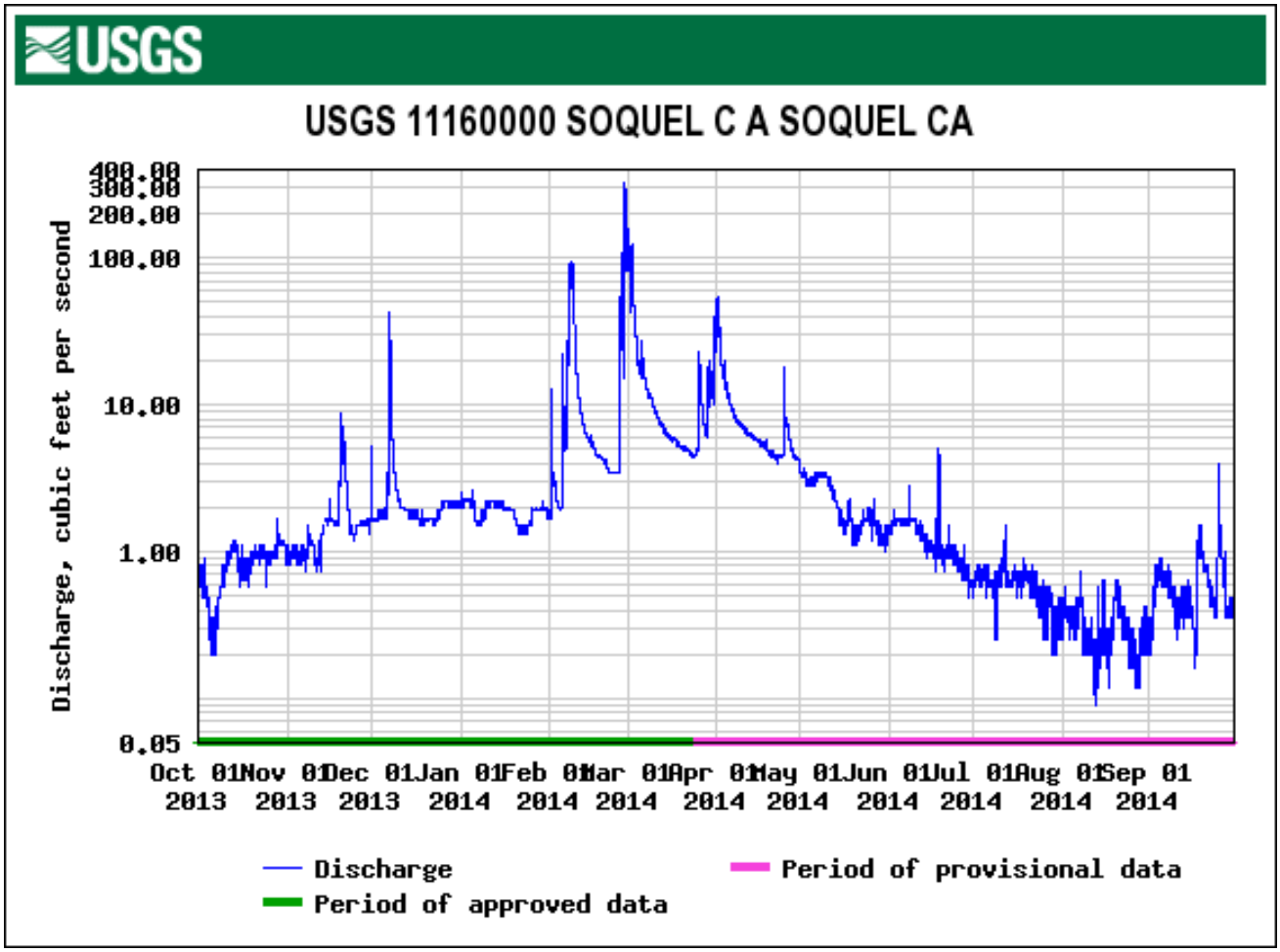


Figure 36. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

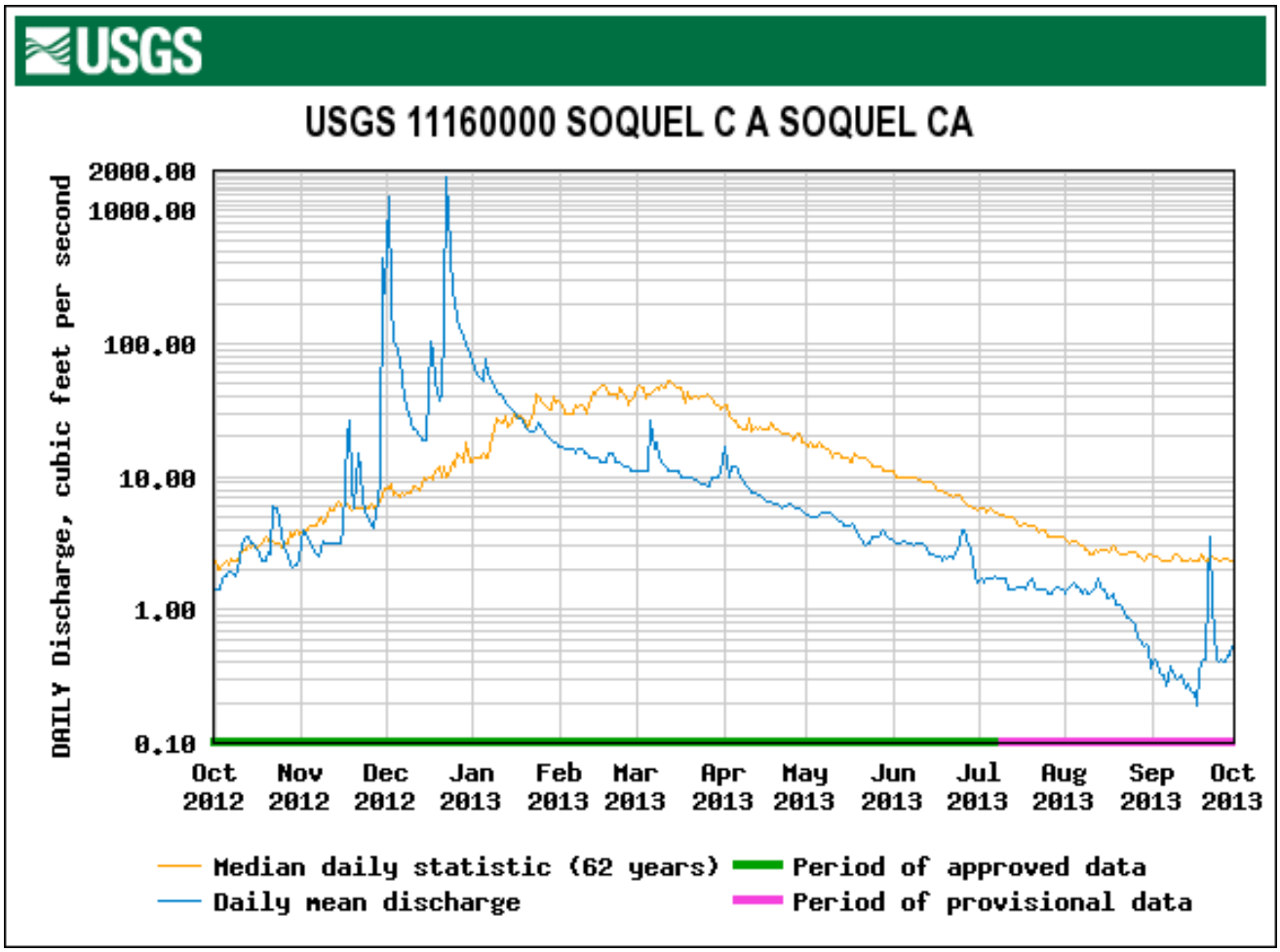


Figure 37. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

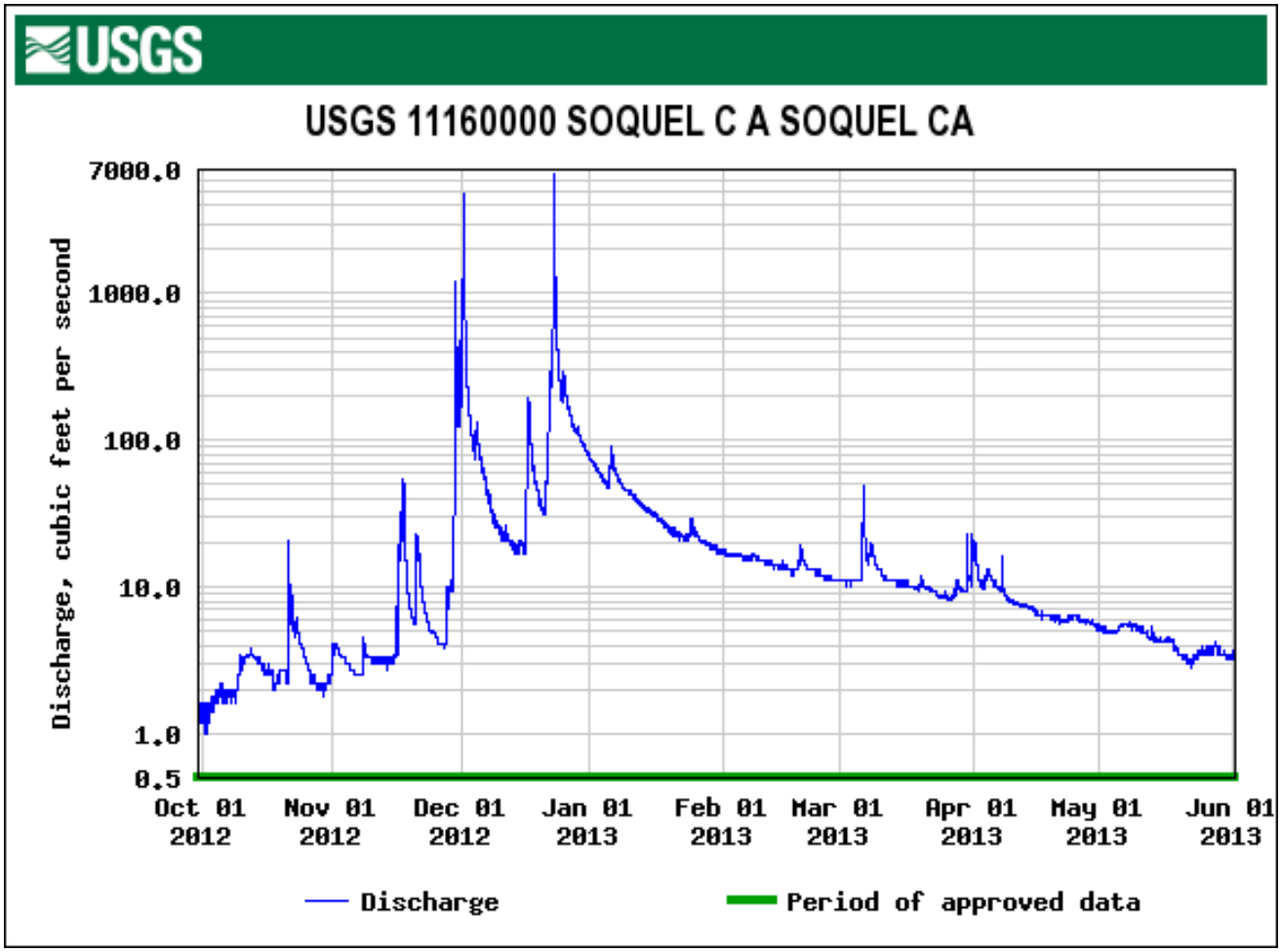


Figure 38. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

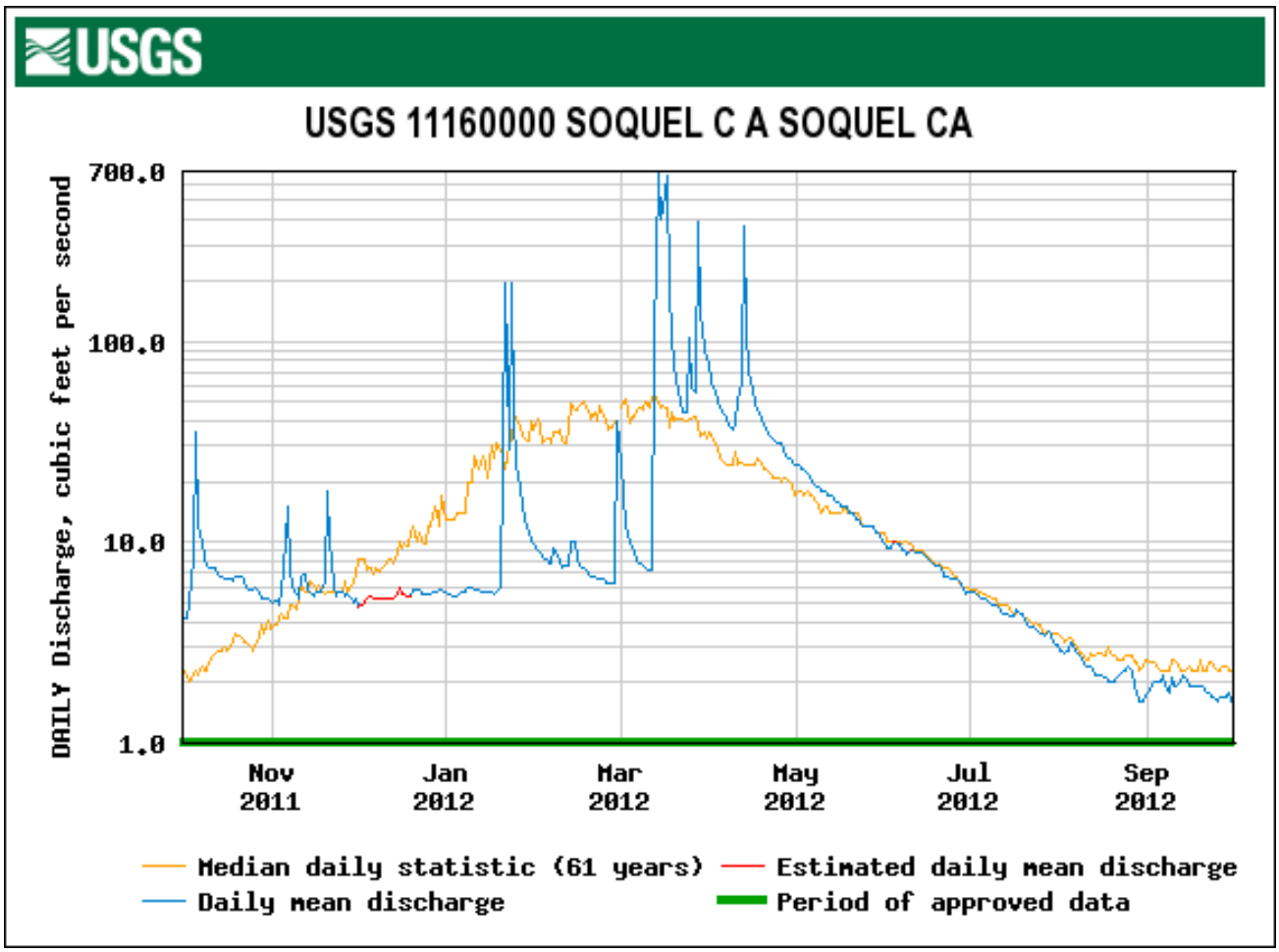


Figure 39. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

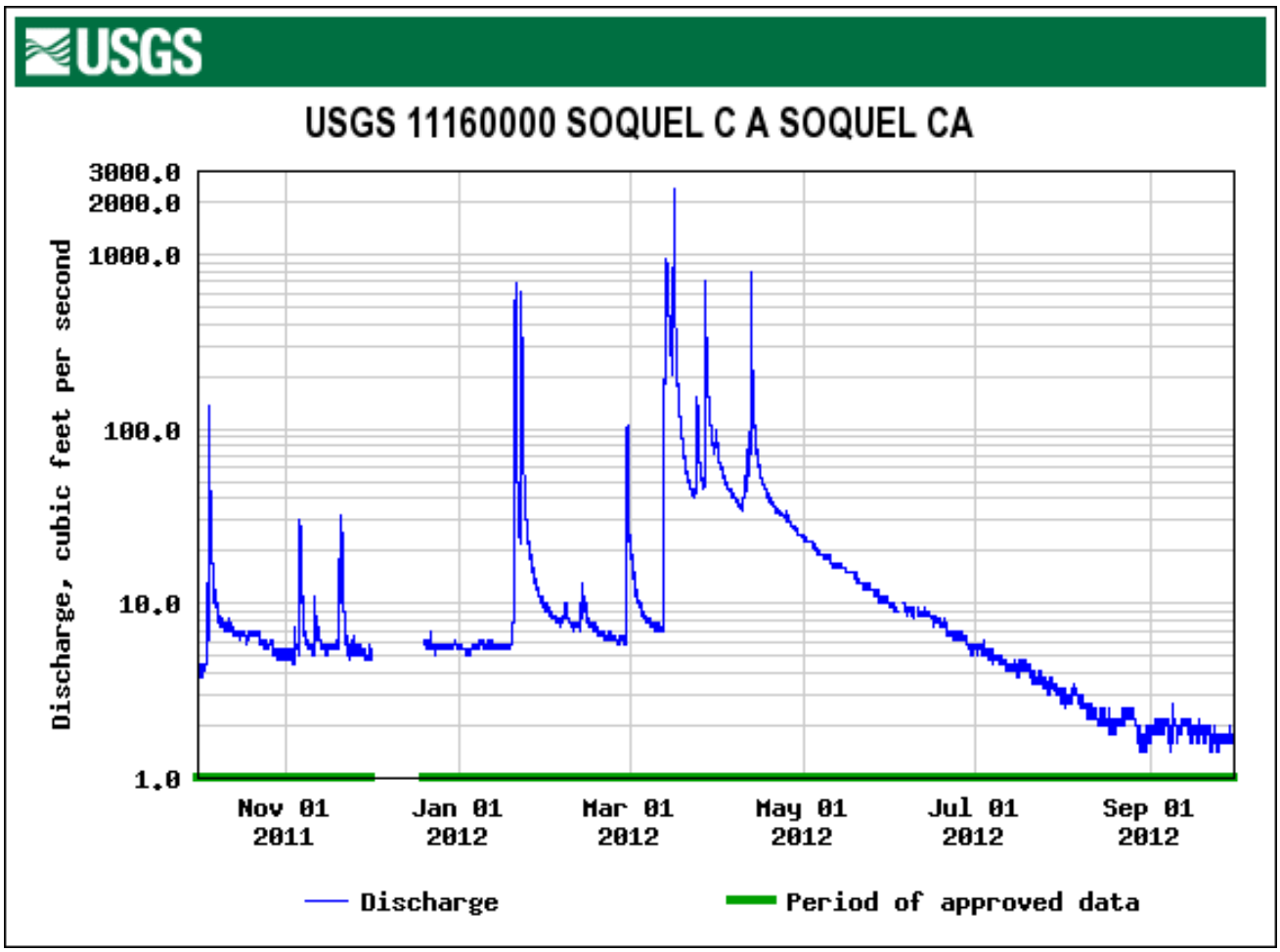


Figure 40. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

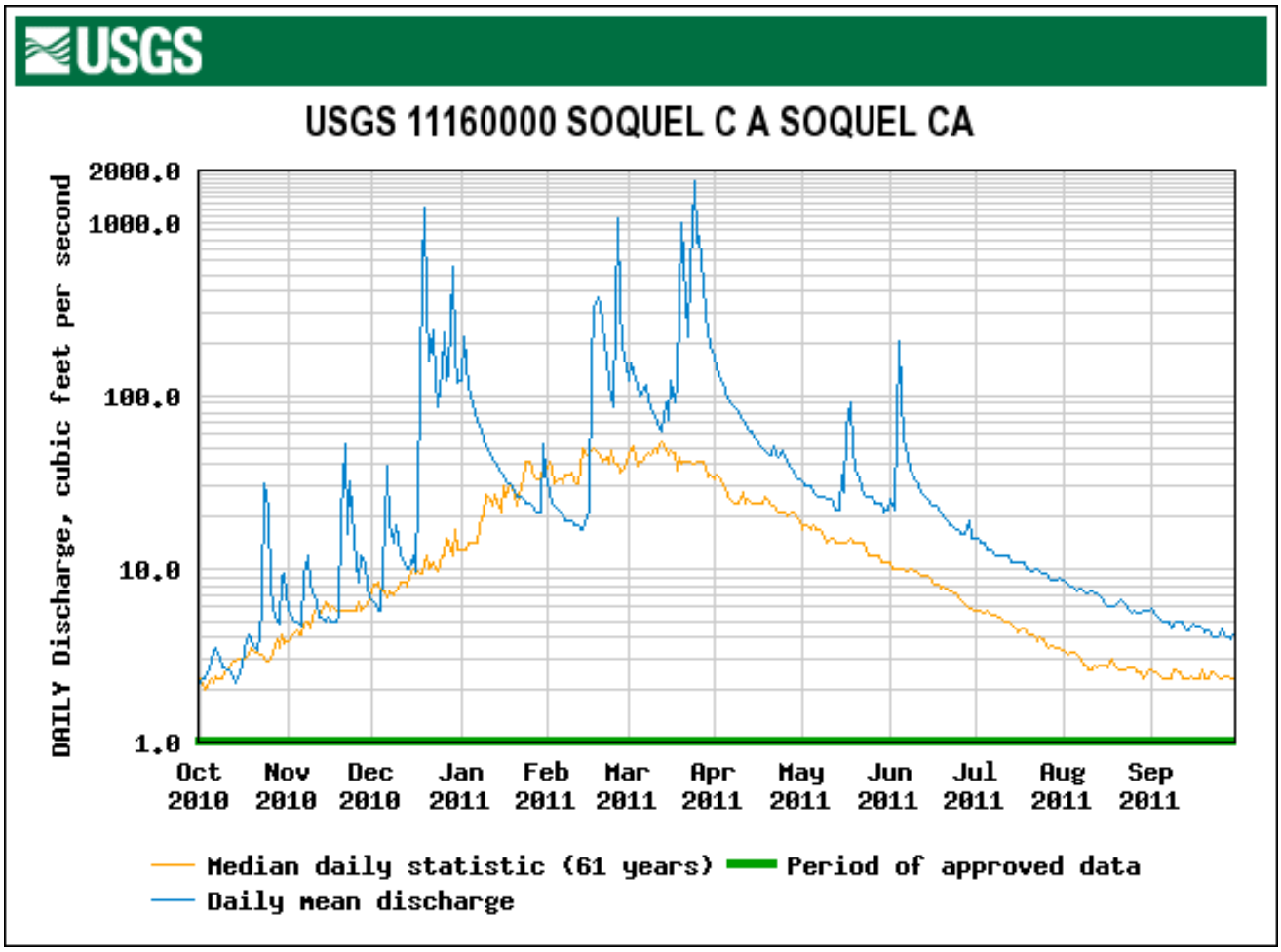


Figure 41. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

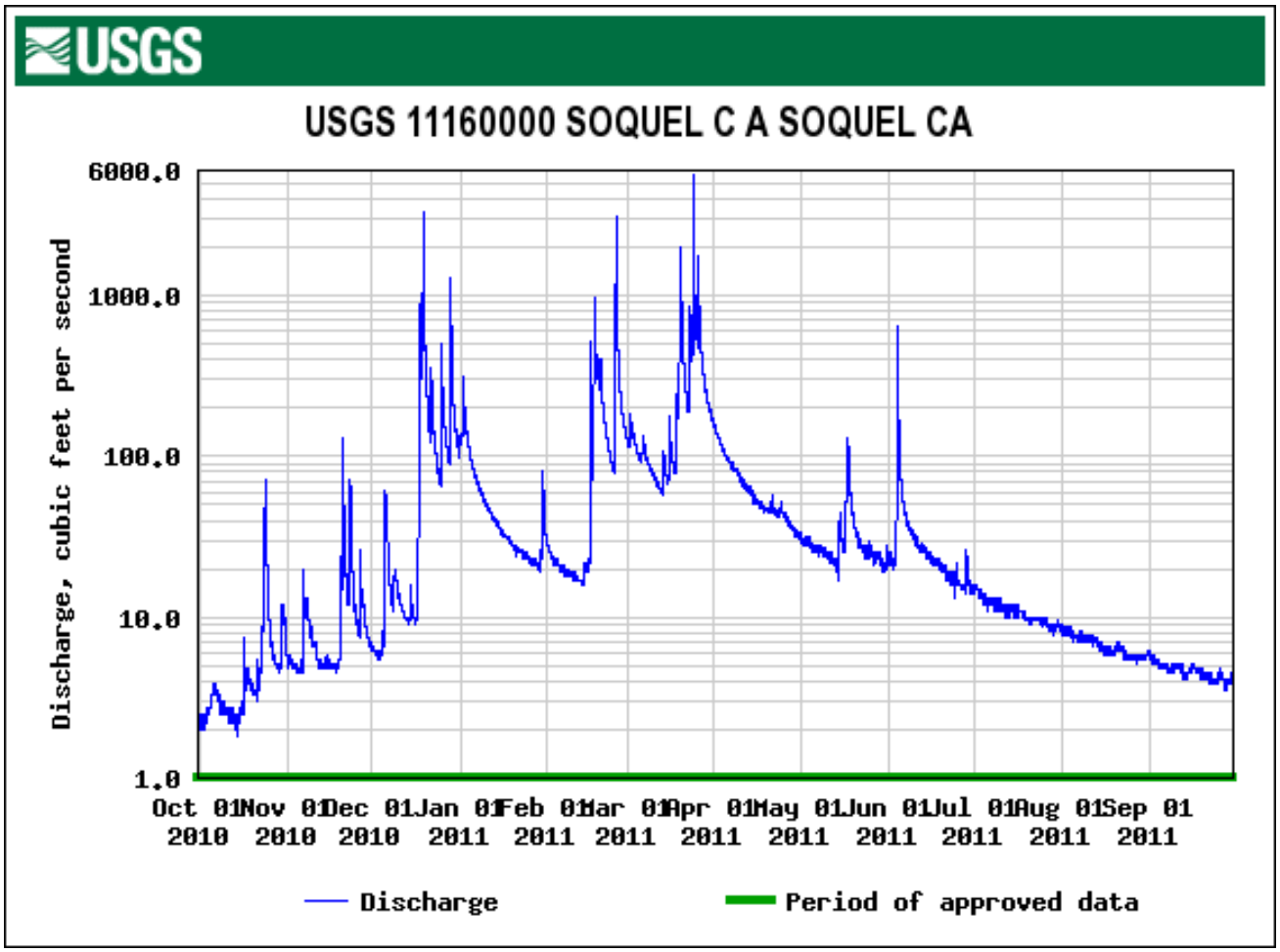


Figure 42. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

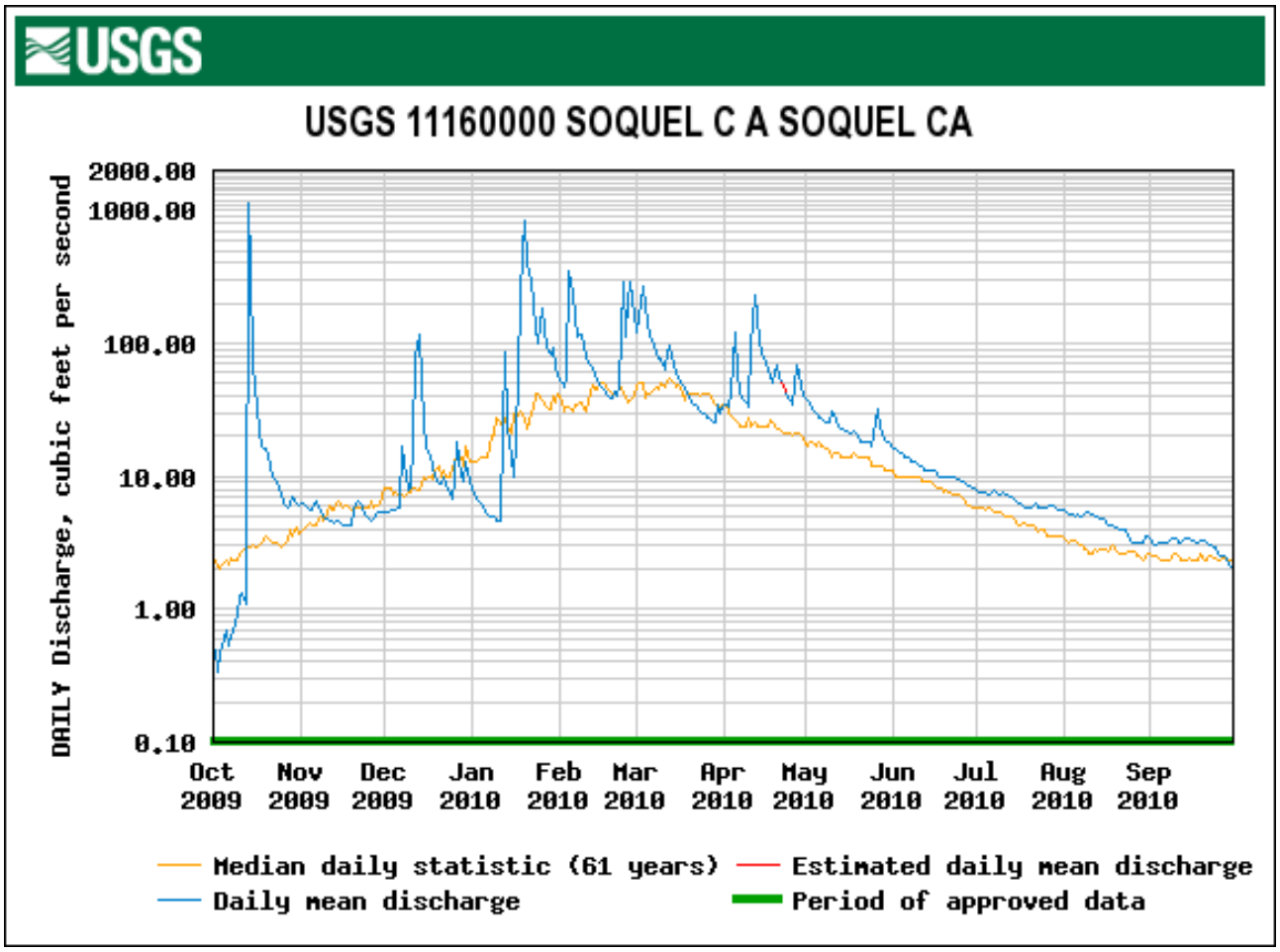


Figure 43. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

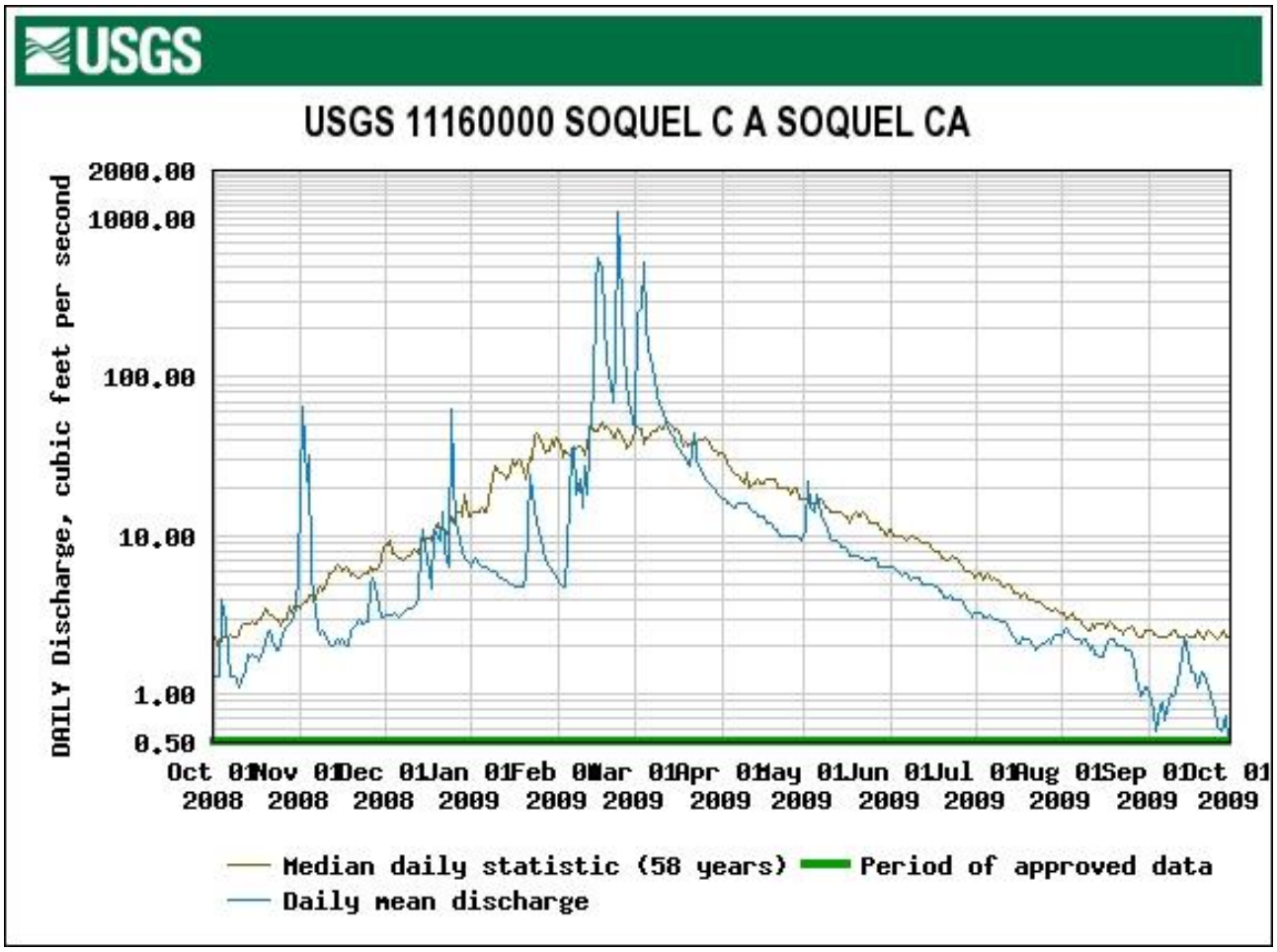


Figure 44. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

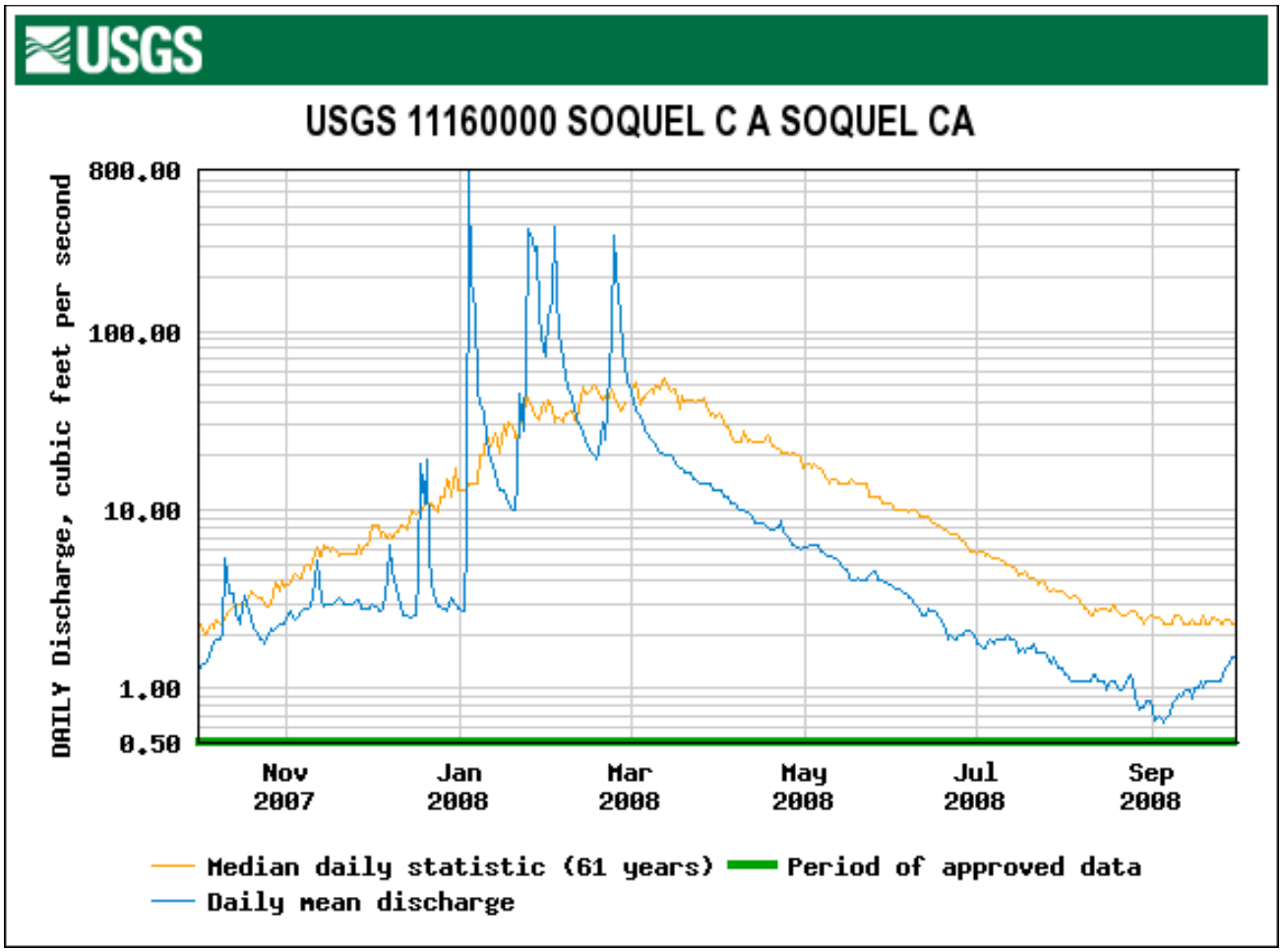


Figure 45. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.

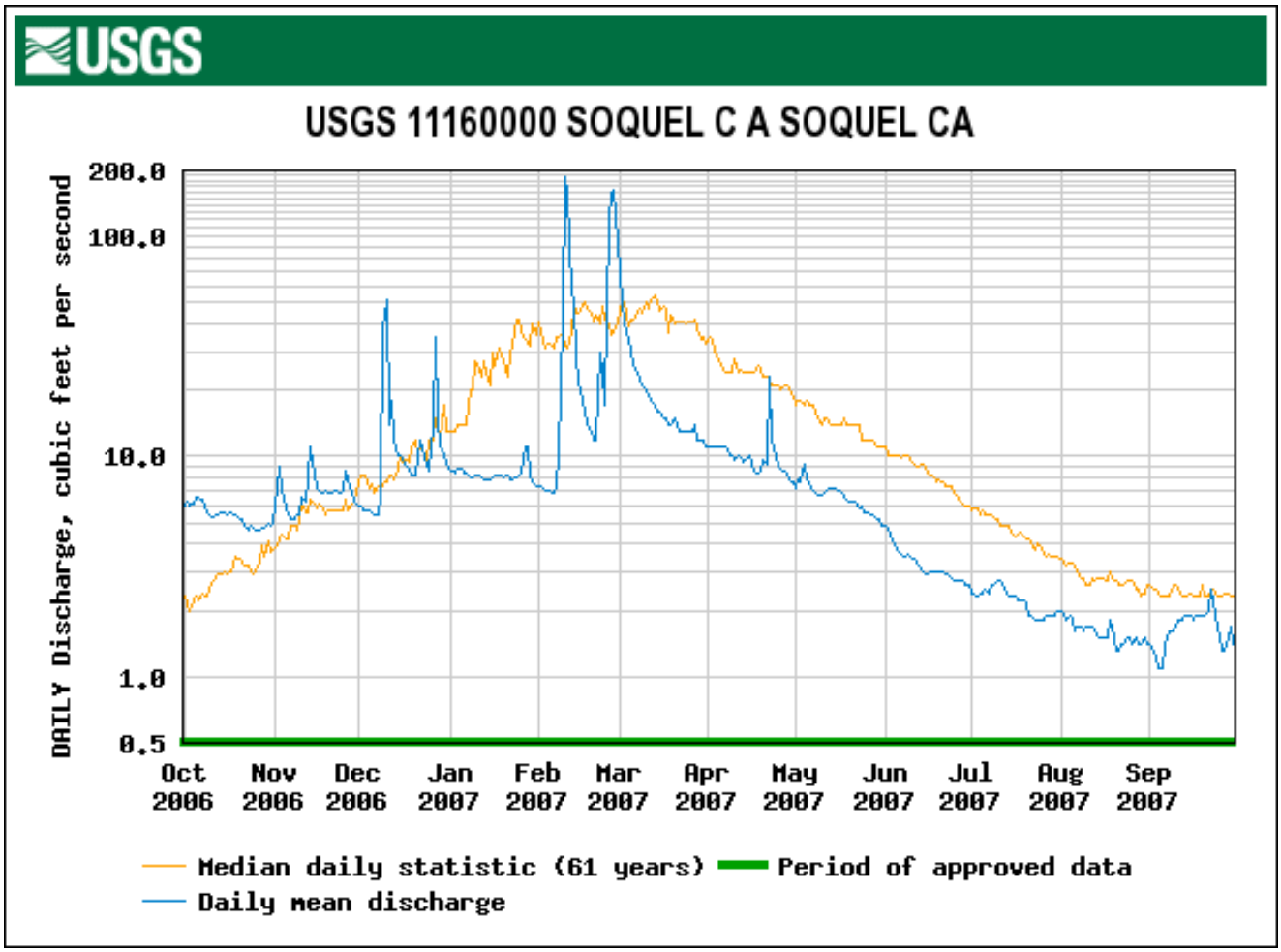


Figure 46. Maximum Visual Gull Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2013–2017.

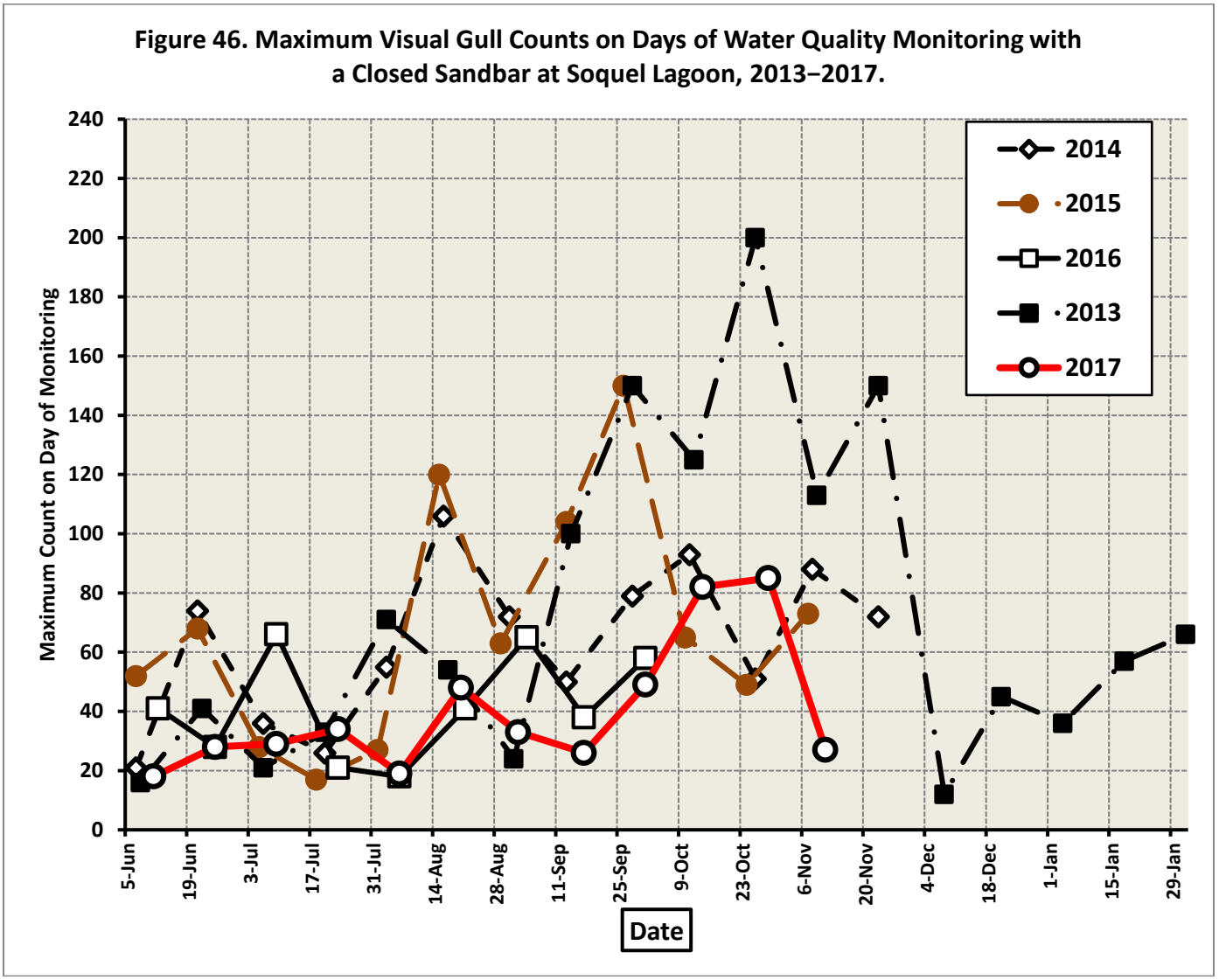
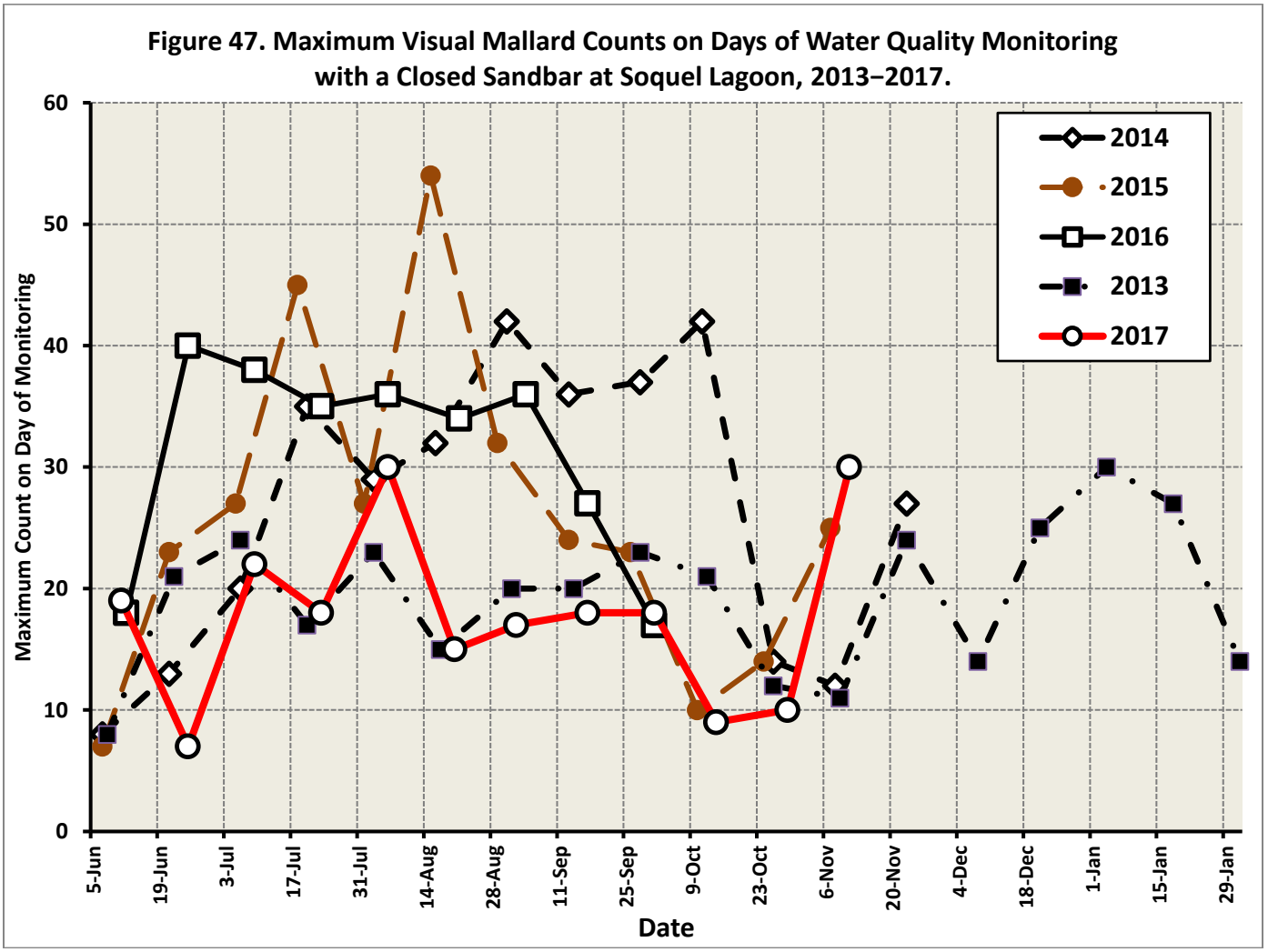


Figure 47. Maximum Visual Mallard Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2013–2017.



APPENDIX A. Water Quality Data and General Observations of Birds and Aquatic Vegetation.

4 June 2017– 11 November 2017.

4 June 2017. The sandbar had been closed since 1 June. Temperature probes were launched on 7 June in the lagoon and upstream. The lagoon water surface was above the top of the flume on 4 June. An underwater portal was present for adult out-migrants. Gage height was 2.67. No saltwater was detected along the Venetian Court wall on 4 June. The biologist recommended no need to install the shroud on the flume inlet, and it was not installed.

			4 June 2017				
	Venetian Court Wall 1345 hr						
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00	18.5	0.3	11.09	547				
0.25	18.4	0.3	10.93	541				
0.50	17.9	0.3	10.90	537				
0.75	17.6	0.3	11.44	533				
1.00	17.3	0.3	12.54	529				
1.25	17.0	0.3	11.97	527				
1.50	16.9	0.3	11.99	525				
1.75	16.8	0.3	11.82	525				
2.00 bott	17.0	0.3	9.61	531				
2.25								
2.50								
2.75								

7 June 2017. Temperature probes were launched into the lagoon and upstream at Nob Hill.

9 June 2017. To maximize lagoon depth, the flume inlet boarded up on Venetian side within one 4-in/4-in board of the top of the flume. One side of the flume exit was boarded up.

			11 June 2017					
	Flume		0805 hr		**Stockton Avenue Bridge**			0710 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.8	0.3	8.82	498	15.8	0.3	8.48	514
0.25	15.9	0.3	8.90	513	15.8	0.3	8.51	512
0.50	15.9	0.3	8.94 (90%)	513	15.8	0.3	8.68	512
0.75b	15.9	0.3	8.95	513	15.8	0.3	8.87	512
1.00					15.8	0.3	9.09	512
1.25					15.8	0.3	8.89	513
1.50					15.8	0.3	8.59	513
1.75					15.8	0.3	8.46	515
2.00b					15.8	0.3	8.42	512
	Railroad Trestle			0736 hr	**Mouth of Noble Gulch**			0749 hr
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.2	0.3	5.58	498	14.7	0.3	8.80	
0.25	15.2	0.3	8.53	497	14.7	0.3	8.78	
0.50	15.2	0.3	8.48	498	14.7	0.3	8.76	
0.75	15.2	0.3	8.49	498	14.7	0.3	8.78	
1.00	15.2	0.3	8.48	498	14.7	0.3	8.71 (86%)	
1.25b	15.2	0.3	8.44	498	14.7	0.3	8.44	
1.50	15.2	0.3	8.49 (85%)	498				
1.75b	15.2	0.3	8.06	498				
2.00								

11 June 2017. The first complete water quality monitoring was accomplished after the sandbar had been closed on 1 June. Oxygen was 85-90% full saturation in the morning near the bottom and good. Inflow oxygen in the morning was 91% full saturation at Nob Hill. Water temperature was 15.6-16.8 ° C in the afternoon in the lagoon, about 2°C cooler than in 2016. Oxygen was supersaturated in the afternoon at all stations measured near the bottom in the lagoon except for 96% near Stockton Ave Bridge. Oxygen was supersaturated at the stream site near Nob Hill in the afternoon. Algae was not developing in the lagoon as in previous drought years.

			11-June 2017					
	Flume		1602 hr		**Stockton Avenue Bridge**			1547 hr
Depth	**Temp 1**	**Salin 1**	**O2 1(sat.)**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2(sat.)**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	16.6	0.3	9.77	524	16.8	0.3	9.84	528
0.25	16.6	0.3	9.82	526	16.6	0.3	9.82	528
0.50	16.6	0.3	9.81 (101%)	525	16.7	0.3	9.79	527
0.75b	16.6	0.3	9.83	526	16.5	0.3	9.76	524
1.00					16.4	0.3	9.70	522
1.25					16.3	0.3	9.59	522
1.50					16.3	0.3	9.44	520
1.75b					16.2	0.3	9.38 (96%)	522
2.00					16.2	0.3	7.37	522
2.25								
	Railroad Trestle			1530 hr	**Mouth of Noble Gulch**			1505 hr
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4(sat.)**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	16.4	0.3	10.46	526	16.0	0.3	10.55	541
0.25	16.3	0.3	10.25	520	15.8	0.3	10.49	522
0.50	16.2	0.3	10.14	519	15.7	0.3	10.63	516
0.75	16.2	0.3	10.19	519	15.6	0.3	10.60	513
1.00	16.1	0.3	10.19	518	15.6	0.3	10.65 (107)	513
1.20b					15.6	0.3	10.44	515
1.25	16.1	0.3	10.21 (104%)	518				
1.46b	16.0	0.3	9.69	517				

11 June 2017. Gage height went up to 2.77 in the morning and then 2.72 in the afternoon. These are the highest gage readings ever monitored. Clear in morning and sunny and breezy in afternoon.
Station 1: Flume at 0805 hr- Air temp. 13.0 C. no surface algae and no planktonic algal bloom. Reach 1- 16 gulls bathing; 1 cormorant. At 1602 hr- Air temp. 15.3 C. no surface algae. No bottom algae. Reach 1- 18 gulls bathing. No sinkholes along flume. Underwater portal in place.
Station 2: Stockton Avenue Bridge at 0710- hr- No surface algae. Secchi depth to bottom. Reach 2- no waterfowl in water. At 1547 hr- no surface or bottom algae. Reach 2- 1 mother mallard and 10 ducklings moved down from Reach 3.
Station 3: Railroad Trestle at 0736 hr- no surface algae. Reach 3- 7 mallards in water. 1 mallard roosting on vertical wood trunk. At 1530 hr- no surface or bottom algae. Reach 3- 1 mother mallard and 4 ducklings. 1 mother mallard and 10 ducklings. 3 other adult mallards. - 2 paddle boarders and 1 barge.
Station 4: Mouth of Noble Gulch at 0748 hr. No surface or bottom algae. Cottonwood gone. Gray water plume.
Station 5: Nob Hill at 0830 hr/ 1635 hr- Water temp. =13.8/16.8 C; morning oxygen= 9.44 (91%) saturation/10.42 mg/L (107%); cond. = 481/528 umhos. Salinity =0.3/0.3 ppt. Streamflow cfs at Soquel Village gage.

25 June 2017. Afternoon water temperature cooler near the bottom than previous drought years. Morning oxygen levels were very good (80-90% full saturation). Lagoon depth was good. Inflow oxygen in the morning was 85% full oxygen saturation at Nob Hill. Afternoon oxygen was near full oxygen saturation (90-102%) in at all lagoon stations measured near the bottom and at the stream site near Nob Hill (105%). Water temperature had increased 2°C from 2 weeks earlier, and oxygen concentration had decreased accordingly. Afternoon water temperature about 1.5°C cooler than in 2016. Still little algae developing in the lagoon- a film on the bottom 0.1-0.2 ft thick mostly.

			25-June-2017					
	Flume			0718 hr	**Stockton Avenue Bridge**			0728 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.7	0.3	8.59	591	18.5	0.3	8.48	577
0.25	18.7	0.3	8.33	592	18.6	0.3	8.52	576
0.50	18.7	0.3	8.42	590	18.6	0.3	8.47	575
0.75b	18.6	0.3	8.57	590	18.6	0.3	8.42	574
1.00					18.6	0.3	8.30	574
1.25					18.6	0.3	8.44	574
1.50					18.6	0.3	8.32	579
1.75					18.6	0.3	8.09 (85%)	583
1.87b					18.7	0.3	4.72	612
2.00								
	Railroad Trestle			0743 hr	**Mouth of Noble Gulch**			0755 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.3	0.3	7.71	566	17.7	0.3	7.65	568
0.25	18.3	0.3	7.66	569	17.8	0.3	7.57	562
0.50	18.3	0.3	7.62	569	17.8	0.3	7.58	562
0.75	18.3	0.3	7.60	569	17.8	0.3	7.56 (80%)	562
1.00	18.3	0.3	7.54 (80)	568	17.7	0.3	7.61 (80%)	562
1.15b					17.7	0.3	6.99	571
1.25	18.3	0.3	7.50 (80)	568				
1.44b	18.3	0.3	6.96	570				

25 June 2016. Gage height of 2.42 in morning. Overcast at 0718 hr. Air temperature of 15.1 C.
Station 1: Flume 0718 hr. Reach 1- 5 gulls bathing, 1 mallard in water; 1 merganser roosting on log under Stockton Bridge. Recent high tide left drift wood against berm around lagoon. Pooled water on Venetian side of beach, flooding volleyball court. No surface algae.
Station 2: Stockton Bridge 0728 hr. Reach 2-no waterfowl. No surface algae.
Station 3: Railroad trestle 0743 hr. Reach 3- 7 mallards.
Station 4: Noble Gulch 0755 hr. Cottonwood gone. No surface algae.
Station 5: Nob Hill at 0826 hr. Water temperature 17.0° C. Conductivity 550 umhos. Salinity 0.3 ppt. Oxygen 8.24 mg/l (85% saturation). - cfs at Soquel Village.

			25 June 2017					
	Flume			1538 hr	**Stockton Avenue Bridge**			1524 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.7	0.3	8.81	593	19.7	0.3	8.87	601
0.25	19.6	0.3	8.73	592	19.7	0.3	8.75	601
0.50	19.6	0.3	8.77 (96%)	590	19.6	0.3	8.59	601
0.75b	19.2	0.3	8.84	584	19.3	0.3	8.60	595
1.00					19.3	0.3	8.81	592
1.25					19.1	0.3	8.76	589
1.50					19.0	0.3	8.57 (92%)	587
1.75					18.9	0.3	8.30(90%)	586
1.87b					18.9	0.3	7.19	587
	Railroad Trestle			1510 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.4	0.3	8.69	599	20.2	0.3	8.76	605
0.25	20.1	0.3	8.66	596	19.9	0.3	8.75	596
0.50	20.0	0.3	8.64	593	19.5	0.3	8.80	588
0.75	19.6	0.3	8.86	589	18.9	0.3	9.04	586
1.00	19.3	0.3	9.54	586	18.6	0.3	9.47 (102)	577
1.15b					18.6	0.3	9.42	578
1.25	18.9	0.3	9.47	580				
1.46b	18.9	0.3	8.93	580				

25 June 2016. Gage height of 2.46 in afternoon. Sunny. Air temperature of 18.1° C at 1538 hr. Flume inlet = 1.5 ft. Flume outlet = 1.3 ft.
Station 1: Flume 1558 hr. Reach 1- 28 gulls bathing; 1 paddle boarder; 5 waders near margin near flume. 100% bottom algal film <0.1 ft thick. No surface algae or planktonic algal bloom.
Station 2: Stockton Bridge 1524 hr. Reach 2- no surface algae; 100% bottom algal film <0.1 ft thick. No waterfowl.
Station 3: Railroad trestle 1510 hr. Reach 3- 1 female mallard with 1 duckling; 1 other mallard in water; 1 cormorant. No surface algae. 100% bottom algal film <0.1 ft thick. No surface algae. 2 paddle boarders.
Station 4: Noble Gulch 1500 hr. No cottonwood for roosting. 100% bottom algal film <0.1 ft thick. No surface algae. Noble Gulch outflow clear.
Station 5: Nob Hill at 1620 hr. Water temperature 19.7° C. Conductivity 583 umhos. Salinity 0.3 ppt. Oxygen 9.57 mg/l (105%). cfs at Soquel Village.

			9 July 2017					
	Flume 0651 hr				**Stockton Avenue Bridge** 0704 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.7	0.3	9.47	602	19.6	0.3	9.64	603
0.25	19.8	0.3	9.54	609	19.6	0.3	9.63	607
0.50	19.8	0.3	9.53 (104%)	609	19.6	0.3	9.60	607
0.75b	19.8	0.3	9.53	607	19.6	0.3	9.70	607
1.00					19.6	0.3	9.64	604
1.25					19.5	0.3	9.41	607
1.50					19.5	0.3	9.52 (104%)	606
1.75					19.4	0.3	9.60 (105%)	605
1.95b					19.4	0.3	5.60	605
	Railroad Trestle 0723 hr				**Mouth of Noble Gulch**			0746 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.2	0.3	9.35	592	18.8	0.3	8.64	592
0.25	19.2	0.3	9.26	599	18.8	0.3	8.54	594
0.50	19.3	0.3	9.29	599	18.8	0.3	8.64	595
0.75	19.2	0.3	9.26	599	18.8	0.3	8.57	594
1.00	19.2	0.3	9.24 (100%)	599	18.7	0.3	8.67 (93%)	594
1.25b	19.2	0.3	9.25 (100%)	599	18.6	0.3	8.22	595
1.50b	19.2	0.3	8.67	599				

9 July 2017. Gage height of 2.59 in morning. Clear. Air temp. = 15.0° C at 0651 hr.

Station 1: Flume 0651 hr. Reach 1- 12 adult mallards in water, 13 gulls bathing. No surface algae. Underwater portal still present.
Station 2: Stockton Bridge 0704 hr. Reach 2- 13 adult mallards (some had moved up from R-1). No surface algae.
Station 3: Railroad trestle 0723 hr. Reach 3- In water- 16 adult mallards in water (some had moved up from R-2). No surface algae.
Station 4: Noble Gulch 0746 hr. No cottonwood. No surface algae. Planktonic algal bloom.
Station 5: Nob Hill at 0825 hr. Water temperature 16.9° C. Conductivity 565 umhos. Salinity 0.34 ppt. Oxygen 9.93 mg/l (103% saturation). cfs at Soquel Village.

			9 July 2017					
	Flume			1532 hr	**Stockton Avenue Bridge**			1520 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.1	0.3	8.65	614	20.4	0.3	8.69	616
0.25	20.0	0.3	8.79	614	20.4	0.3	8.65	617
0.50	20.0	0.3	8.75 (96%)	609	20.4	0.3	8.59	617
0.75b	19.6	0.3	8.76	606	20.3	0.3	8.51	616
1.00					20.1	0.3	8.81	610
1.25					19.7	0.3	8.92	609
1.50					19.3	0.3	8.37	603
1.75					19.3	0.3	8.13 (88%)	603
2.00b					19.3	0.3	7.65	603
	Railroad Trestle			1505 hr	**Mouth of Noble Gulch**			1455 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.0	0.3	8.75	623	21.2	0.3	8.52	
0.25	20.8	0.3	8.44	623	21.0	0.3	8.37	
0.50	20.7	0.3	8.56	620	20.6	0.3	8.43	
0.75	20.6	0.3	8.52	619	20.0	0.3	8.55	
1.00	19.5	0.3	9.17	615	18.8	0.3	9.68(104%)	
1.25b	19.1	0.3	9.75(106%)	600	18.9	0.3	9.73	
1.50b	19.1	0.3	9.04	599				

9 July 2017. Gage height of 2.58 in afternoon. Clear. Air temperature of 15.6°C at 1532 hr. Afternoon water temperature generally 1.5°C cooler than in 2016. Flume inlet approx. 1.5 ft depth. Flume exit depth 1.5 ft.

Station 1: Flume at 1532 hr. Reach 1- 29 gulls bathing. 8 waders near flume; 5 paddle boarders. No surface algae. 5% bottom algae 0.5-1.0 ft thick, avg 0.8 ft. Remainder thick algal film 0.1-0.2 ft thick.
Station 2: Stockton Avenue Bridge at 1520 hr. Secchi depth to bottom. Reach 2- No surface algae. No waterfowl. 2 paddle boarders moving upstream, 1 moving downstream. 15% bottom algae avg 0.3 ft. Remainder thick algal film <0.1 ft thick.
Station 3: Railroad Trestle at 1505 hr. Reach 3- No surface algae. 15% bottom algae avg 0.3 ft thick, avg 0.1 ft. Remainder thick algal film <0.1 ft thick. 18 adult mallards, 4 ducklings. 19 of the mallards near Noble Gulch.
Station 4: Mouth of Noble Gulch at 1455 hr. no surface algae. Bottom invisible. Planktonic algal bloom occurring. No cottonwood.
Station 5: Nob Hill at 1622 hr. Water temperature 19.6°C. Conductivity 600 umhos. Salinity 0.3 ppt. Oxygen 9.31 mg/l (102%). cfs at Soquel Village.

			23-July-2017					
	Flume 0710 hr				**Stockton Avenue Bridge** 0724 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	18.6	0.3	9.15	605	18.8	0.3	9.13	611
0.25	18.7	0.3	9.03	611	18.8	0.3	9.15	613
0.50	18.6	0.3	9.01 (97%)	612	18.8	0.3	9.18	613
0.75b	18.5	0.3	9.06	608	18.7	0.3	9.14	612
1.00					18.6	0.3	9.08	609
1.25					18.4	0.3	8.87	610
1.50					18.4	0.3	8.67	610
1.75					18.3	0.3	8.83 (95%)	609
2.00b					18.3	0.3	8.60	608
	Railroad Trestle 0740 hr				**Mouth of Noble Gulch**			0754 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	18.6	0.3	9.10	607	18.0	0.3	7.68	598
0.25	18.6	0.3	9.07	610	18.0	0.3	7.67	602
0.50	18.6	0.3	9.08	610	18.0	0.3	7.55	602
0.75	18.6	0.3	9.01	610	18.0	0.3	7.58	603
1.00	18.3	0.3	8.29	608	18.0	0.3	7.58 (80%)	603
1.25b	18.2	0.3	8.35 (89%)	603	17.7	0.3	7.61	601
1.50b	18.2	0.3	7.78	603				

23 July 2017. Gage height of 2.59 in morning. Overcast and foggy. Air temperature of 12.7°C at 0710 hr. More than 2°C cooler in the afternoon than in 2016.

Station 1: Flume at 0710 hr. Reach 1- 34 gulls bathing, 1 female mallard and 8 ducklings. No surface algae.
Station 2: Stockton Avenue Bridge at 0724 hr. Reach 2- 4 mallards. Dog feces on path. No surface algae.
Station 3: Railroad Trestle at 0740 hr. Reach 3- 5 mallards and 1 cormorant in water. 3% surface algae.
Station 4: Mouth of Noble Gulch at 0754 hr. 3% surface algae.
Station 5: Nob Hill at 0819 hr. Water temperature 16.2° C. Conductivity 671 umhos. Oxygen 8.69 mg/1 2(88% full saturation). Salinity 0.3 ppt. cfs at Soquel Village.

			23-July-2017					
	Flume 1608 hr				**Stockton Ave Bridge** 1555 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	19.3	0.3	10.9	620	19.7	0.3	9.57	625
0.25	19.4	0.3	10.14	621	19.7	0.3	9.51	624
0.50	19.3	0.3	10.47 (114%)	618	19.6	0.3	9.43	623
0.75b	19.2	0.3	10.69	617	19.4	0.3	9.37	622
1.00					19.4	0.3	9.49	619
1.25					19.3	0.3	9.55	619
1.50					19.0	0.3	9.55	618
1.75					18.9	0.3	9.36 (100%)	614
2.00b					18.6	0.3	6.96	615
	Railroad Trestle 1521 hr				**Mouth of Noble Gulch** 1504 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	19.3	0.3	9.54	619	19.5	0.3	9.05	625
0.25	19.3	0.3	9.56	618	19.3	0.3	8.93	619
0.50	19.3	0.3	9.56	618	19.1	0.3	9.13	616
0.75	19.2	0.3	9.68	618	18.9	0.3	9.49	613
1.00	19.2	0.3	9.70	617	18.7	0.3	9.59 (102%)	609
1.25b	19.2	0.3	10.18 (109%)	617	18.6	0.3	10.82 (115%)	606
1.50b	18.7	0.3	10.23	609				
1.75								

23 July 2017. Gage height of 2.61 in afternoon. Clear and onshore breeze. Air temp. = 15.6° C at 1608 hr.

Station 1: Flume at 1608 hr. Reach 1- 22 gulls. No surface algae. 100% bottom algae 0.3-1.5 ft thick, avg 0.5 ft. 1 rubber raft; 1 paddle boarder. 2 waders near flume.
Station 2: Stockton Avenue Bridge at 1555 hr. Secchi depth to bottom. Reach 2- No surface algae. 100% bottom algae 0.3-1.5 ft thick, avg 0.5 ft. No waterfowl. 1 kayaker.
Station 3: Railroad Trestle at 1521 hr. Reach 3- 1% surface algae. 100% bottom algae 0.2-1.0 ft thick, avg 0.4 ft. 8 adult mallards. 1 row boat and 3 paddle boarders.
Station 4: Mouth of Noble Gulch at 1504 hr. 1% surface algae. 100% bottom algae 0.2-0.7 ft thick, avg 0.5. No waterfowl roosting without cottonwood.
Station 5: Nob Hill at 1650 hr. Water temperature 18.9 ° C. Conductivity 601 umhos. Oxygen 8.88 mg/L (96% full saturation). Salinity 0.3 ppt. cfs at Soquel Village.

			6-Aug-2017					
	Flume 0704 hr				**Stockton Avenue Bridge** 0719 hr			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00	20.1	0.3	10.90	641	20.1	0.3	10.78	637
0.25	20.2	0.3	11.07	640	20.2	0.3	10.69	639
0.50	20.2	0.3	10.89	641	20.2	0.3	10.64	640
0.75	20.2	0.3	11.01 (122%)	641	20.2	0.3	10.51	640
0.80b	20.2	0.3	10.73	641				
1.00					20.2	0.3	10.52	641
1.25					20.2	0.3	10.33	641
1.50					20.2	0.3	10.33	642
1.75					20.2	0.3	8.97 (99%)	646
2.00b					20.1	0.3	5.87	654
	Railroad Trestle 0740 hr				**Mouth of Noble Gulch** 0752 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	19.8	0.4	8.81	778	19.1	0.4	9.75	748
0.25	19.8	0.4	8.47	783	19.2	0.4	9.51	759
0.50	19.8	0.4	8.22	783	19.2	0.4	9.48	760
0.75	19.8	0.4	8.03	782	19.2	0.4	9.41	760
1.00	19.8	0.4	7.88	782	19.2	0.4	9.40 (102%)	760
1.25b	19.8	0.4	7.92 (82%)	782	19.0	0.4	2.45	762
1.37b	19.8	0.4	7.49	782				

6 August 2017. Gage height of 2.63 (morning) and 2.63 (afternoon). Overcast/misty at 0704 hr with warm air temperature of 16.1 ° C at flume. Air temperature 19.5 ° C at 1548 hr at flume; clear and breezy. Flume inlet 1.5 ft deep. Flume outlet 1.5 ft deep in afternoon. Water temperatures generally 1°C warmer in afternoon due to warmer air temp in 2017.

Station 1: Flume at 0704 hr. Reach 1- In water 19 gulls bathing; 4 mallards in water; 3 mallards and 2 mergansers at Venetian margin. A large juvenile steelhead hit surface. No surface algae.
Station 2: Stockton Avenue Bridge at 0719 hr. Secchi depth to the bottom. Reach 2- 7 mallards in water near trestle (mostly large YOY); No surface algae.
Station 3: Railroad trestle at 0740 hr. Reach 3- 9 mallards following me around, hungry. 7% surface algae.
Station 4: Mouth of Noble Gulch at 0752 hr. 5% surface algae. No waterfowl roosting with no cottonwood.
Station 5: Nob Hill at 0825 hr. Water temperature at 18.0°C. Conductivity 605 umhos, Oxygen 9.47 mg/L (100%). Salinity 0.3 ppt. Estimated streamflow = cfs at Soquel Village.

			6-Aug-2017					
	Flume 1548 hr				**Stockton Avenue Bridge** 1533 hr			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**
0.00	21.1	0.3	12.73	653	21.4	0.3	11.61	657
0.25	21.2	0.3	12.63	653	21.4	0.3	11.62	657
0.50	21.2	0.3	12.39	654	21.5	0.3	11.64	657
0.75	21.2	0.3	12.27 (138%)	654	21.3	0.3	11.36	657
0.80b	21.3	0.3	12.15	654				
1.00					21.3	0.3	11.50	654
1.25					21.1	0.3	11.37	654
1.50					20.6	0.3	11.48	650
1.75					20.5	0.3	10.23 (120%)	650
2.00b					20.3	0.3	7.81	646
	Railroad Trestle 1516 hr				**Mouth of Noble Gulch** 1500 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	21.5	0.3	11.24	659	22.1	0.3	10.58	672
0.25	21.4	0.3	11.10	658	21.9	0.3	10.23	667
0.50	21.4	0.3	11.05	659	21.3	0.3	10.30	662
0.75	21.4	0.3	10.94	658	20.3	0.3	11.03	643
1.00	21.1	0.3	13.35	654	20.0	0.3	12.12 (133%)	636
1.25b	20.6	0.3	13.80 (154%)	645	20.0	0.3	13.51	635
1.50b	20.3	0.3	11.93	643				

6 August 2017.

Station 1: Flume at 1548 hr. Reach 1- No gulls initially with 1 canoer, 1 barge and 5 paddle boarders, later 6 gulls. No surface algae. 60% bottom algae 1.0 ft thick; margins with algal film.
Station 2: Stockton Avenue Bridge at 1533 hr. Reach 2- No waterfowl. No surface algae. 100% bottom algae 0.2- 1 ft thick; avg 0.5 ft. 3 paddle boarders and 3 swimmers.
Station 3: Railroad trestle at 1516 hr. Reach 3- No surface algae. 100% bottom algae 0.2- 1 ft thick; avg 0.5 ft. 32 mallards in water. 1 pedal boat, 5 paddle boarders.
Station 4: Mouth of Noble Gulch at 1500 hr. <1% surface algae. 80% of bottom covered by algae 0.3 – 1.0 ft thick, averaging 0.8 ft. Man feeding ducks with child- all 32 ducks attended.
Station 5: Nob Hill at 1500 hr. Water temperature at 20.6°C. Conductivity 634 umhos, Oxygen 10.32 mg/l (115%). Salinity 0.3 ppt. cfs at Soquel Village

			20-Aug-2017					
	Flume 0710 hr				**Stockton Avenue Bridge** 0730 hr			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00	18.7	0.4	8.06	631	18.8	0.4	8.47	632
0.25	18.7	0.4	8.21	631	18.8	0.4	8.68	632
0.50	18.7	0.4	8.20 (88%)	632	18.8	0.4	8.63	633
0.75	18.7	0.4	7.79 (84%)	632	18.9	0.4	8.51	633
0.87b	18.6	0.4	7.59	632				
1.00					18.9	0.4	8.31	632
1.25					18.6	0.4	7.78	635
1.50					18.5	0.4	7.91	636
1.75					18.5	0.4	7.83 (84%)	636
2.00b					18.5	0.4	7.46	637
2.25								
	Railroad Trestle 0747 hr				**Mouth of Noble Gulch** 0801 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	18.7	0.4	8.72	630	18.3	0.4	7.83	620
0.25	18.8	0.4	8.73	630	18.3	0.4	7.80	622
0.50	18.8	0.4	8.63	631	18.3	0.4	7.85	625
0.75	18.7	0.4	8.61	631	18.2	0.4	7.81	624
1.00	18.7	0.4	8.54	630	18.2	0.4	7.72 (82%)	625
1.25b	18.4	0.4	7.89 (89%)	629	18.3	0.4	7.46	625
1.50b	18.4	0.4	6.90	628				

20 August 2017. Gage height of 2.67 (morning) and 2.66 (afternoon). Overcast/misty at 0710 hr with warm air temperature of 16.3 °C at flume. Air temperature 18.6 °C at 1624 hr and cloudy all day. Flume inlet 1.5 ft. Flume outlet 1.3 ft in afternoon at flume. 6.4 tide the night before. Peripheral berm built up prior to that to prevent tidal overwash. The berm has been elevated around the lagoon margin. Lake at volleyball courts on beach.

Station 1: Flume at 0710 hr. Reach 1- 48 gulls bathing. 3 mallards roosting on Venetian Court periphery. No surface algae.

Station 2: Stockton Avenue Bridge at 0730 hr. Reach 2- 12 mallards roosting on logs under Stockton Bridge. 1 mallard and 2 mergansers in water. 2 steelhead hits on surface. No surface algae.

Station 3: Railroad trestle at 0747 hr. Reach 3- 5 mallards and 1 pied-billed grebe in water. No surface algae.

Station 4: Mouth of Noble Gulch at 0801 hr. No surface algae. Large gray water plume, 25 ft in diameter, at mouth.

Station 5: Nob Hill at 0842 hr. Water temperature at 17.5°C. Conductivity 604 umhos, Oxygen 7.59 mg/l (80%). Salinity 0.3 ppt. Estimated streamflow = cfs at Soquel Village.

			20-Aug-2017					
	Flume 1624 hr				**Stockton Avenue Bridge** 1611 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	19.5	0.4	9.75	640	19.7	0.4	9.44	645
0.25	19.5	0.4	9.67	640	19.7	0.4	9.44	645
0.50	19.5	0.4	9.71	641	19.6	0.4	9.27	644
0.75	19.5	0.4	9.66 (106%)	642	19.4	0.4	9.46	641
0.87b	19.4	0.4	10.13 (110%)	638				
1.00					19.3	0.4	10.10	636
1.25					19.2	0.4	9.66	636
1.50					19.1	0.4	9.55	635
1.75					19.0	0.4	8.82 (95%)	636
2.00b					18.9	0.4	6.33	639
2.25								
	Railroad Trestle 1552 hr				**Mouth of Noble Gulch** 1513 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.7	0.4	9.14	648	20.3	0.4	9.15	658
0.25	19.7	0.4	9.13	644	20.3	0.4	9.07	652
0.50	19.7	0.4	9.10	643	19.4	0.4	8.46	642
0.75	19.6	0.4	9.16	642	18.8	0.4	8.93	626
1.00	19.5	0.4	10.15	640	18.7	0.4	9.10 (97%)	626
1.25b	18.9	0.4	10.73 (116%)	631	18.9	0.4	10.88	619
1.50b	18.9	0.4	9.88	630				

20 August 2017.

Station 1: Flume at 1624 hr. Reach 1- 31 gulls bathing. No surface algae; bottom too dark for visual vegetation estimate- pondweed present at 1.5 feet thick. Cloudy all day and oxygen levels lower and water temp approx. 0.5 C lower than previous year due to less algae and less solar radiation and lower air temp.1 kayaker. Small log lodged in adult portal, which I removed.

Station 2: Stockton Avenue Bridge at 1611 hr. Secchi depth to the bottom. Reach 2- No surface algae. Bottom invisible. 7 mallards in water. 1 mallard roosting on log under Stockton bridge.

Station 3: Railroad trestle at 1552 hr. Reach 3- No surface algae. Bottom invisible. 7 mallards, 1 merganser, 1 pied-billed grebe in water. 2 paddle boards, 1 pedal boat.

Station 4: Mouth of Noble Gulch at 1513 hr. No surface algae. Bottom invisible. No waterfowl without cottonwood to roost on.

Station 5: Nob Hill at 1701 hr. Water temperature at 18.5°C. Conductivity 618 umhos, Oxygen 8.65 mg/l (92%). Salinity 0.3 ppt. cfs at Soquel Village.

			2-Sep-2017					
	Flume 0716 hr				**Stockton Avenue Bridge** 0730 hr			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00	19.7	0.4	9.32	652	19.8	0.4	9.70	651
0.25	19.8	0.4	9.33	650	19.8	0.4	9.61	651
0.50	19.8	0.4	9.37	650	19.8	0.4	9.58	650
0.75	19.8	0.4	9.29 (102%)	650	19.9	0.4	9.38	651
0.87b	19.8	0.4	9.18	650				
1.00					19.9	0.4	9.51	651
1.25					19.9	0.4	9.60	651
1.50					19.8	0.4	9.45	651
1.75					19.5	0.4	7.38 (81%)	652
2.00b					19.3	0.4	5.54	654
2.25								
	Railroad Trestle 0747 hr				**Mouth of Noble Gulch** 0803 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	19.8	0.4	9.59	650	19.7	0.4	8.80	646
0.25	19.8	0.4	9.53	650	19.7	0.4	8.73	644
0.50	19.8	0.4	9.48	649	19.7	0.4	8.73	645
0.75	19.8	0.4	9.46	649	19.7	0.4	8.68	645
1.00	19.8	0.4	9.54	649	19.6	0.4	10.71 (117%)	640
1.25b	19.8	0.4	10.89 (115%)	649	19.4	0.4	9.07	641
1.50b	19.2	0.4	5.48	647				

2 September 2017. Gage height of 2.65 (morning) and 2.66 (afternoon). Clear morning but smokey and breezy. At 0716 hr- warm air temperature of 18.6 ° C. Warm afternoon air temperature 23.3 ° C at 1606 hr and clear/ typical onshore breeze. Warm (90+ F) previous day. Morning water temp warmer than in 2016. Afternoon water temp similar to 2016 at lower 2 lagoon sites but warmer at upper 2 sites. Afternoon oxygen levels lower in 2017 due to less algae except near the bottom at upper 2 sites.

Station 1: Flume at 0716 hr. Reach 1- 3 gulls, few on beach. 4 steelhead hit water surface. No surface algae.
Station 2: Stockton Avenue Bridge at 0730 hr. Reach 2-17 mallards in water; 2 mallards foraging in Stockton Bridge park; 2 mergansers roosting on trestle abutment. <1% surface algae.
Station 3: Railroad trestle at 0747 hr. Reach 3- 4 mallards in water. 5% surface algae downstream of Noble Gulch. 20% surf algae beyond Shadowbrook Restaurant.
Station 4: Mouth of Noble Gulch at 0814 hr. 2 mallards on cottonwood. 5% surface algae.
Station 5: Nob Hill at 0837 hr. Water temperature at 18.7°C. Conductivity 625 umhos, Oxygen 7.30 mg/l (77%). Salinity 0.4 ppt. Estimated streamflow = cfs at Soquel Village.

			2-Sep-2017					
	Flume 1606 hr				**Stockton Avenue Bridge** 1550 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	21.5	0.4	11.65	673	21.4	0.4	11.70	673
0.25	21.5	0.4	11.59	672	21.4	0.4	11.61	671
0.50	21.4	0.4	12.19	665	21.4	0.4	11.61	671
0.75	20.9	0.4	12.72 (142%)	662	21.4	0.4	11.63	671
1.00b	20.9	0.4	12.41	662	21.4	0.4	11.32	669
1.25					20.7	0.4	10.91	662
1.50					20.6	0.4	10.68	662
1.75					20.4	0.4	9.32 (103%)	659
2.00b					19.8	0.4	7.65	656
2.25								
	Railroad Trestle 1524 hr				**Mouth of Noble Gulch** 1500 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.8	0.4	10.55	697	22.8	0.4	10.51	716
0.25	22.6	0.4	10.49	691	22.6	0.4	10.48	694
0.50	22.1	0.4	10.47	684	22.1	0.4	10.03	685
0.75	21.7	0.4	10.52	678	21.7	0.4	10.01	675
1.00	20.9	0.4	12.73	670	20.9	0.4	14.50 (160%)	658
1.25b	20.7	0.4	13.39 (150%)	662	20.7	0.4	19.24	649
1.50b	20.5	0.4	12.73	658	20.5	o.4		

Station 1: Flume at 1606 hr. Reach 1- 33 gulls; 4 mallards adj. Margaritaville. 90% bottom algae 1-3 ft thick; avg 2 ft. 1% pondweed 3 ft thick. No surface algae.
Station 2: Stockton Avenue Bridge at 1550 hr. Reach 2-2 mallards in water; 2 mallards on trestle abutment. 5% surface algae. 1 row boat and 3 paddle boarders.
Station 3: Railroad trestle at 1524 hr. Reach 3- 9 mallards in water. <1% surface algae. 99% bottom algae 0.5-2 ft thick; avg. 1.0 ft. <1% pondweed + algae 0.5- 2 ft thick, averaging 1.0 ft under trestle. 2 pedal boats, 1 barge, 1 canoer, 3 kayakers, 2 paddle boarders.
Station 4: Mouth of Noble Gulch at 1500 hr. 20% surface algae. Soupy planktonic algal bloom. 80% bottom algae 1-4 ft thick; avg. 3.5 ft.
Station 5: Nob Hill at 1700 hr. Water temperature at 22.3°C. Conductivity 663 umhos, Oxygen 9.01 mg/l (103%). Salinity 0.3 ppt. Estimated streamflow = cfs at Soquel Village.

3 September 2017. Begonia Festival Day. Gage height of 2.65 at 1015 hr. High cirrus clouds, mostly sunny. Warm afternoon air temperature 23.3 ° C at 1645 hr, the same as the day before. Conductivity slightly higher than previous day at depth. Lady feeding 18 mallards in Reach 3 in the morning.
Procession with 11 floats (all powered by electric motor, 1 assisted by boat paddlers.) One paddle boarder wading after procession and asked to stay on board. Largest crowd I can remember for the last, 65th Begonia Festival. The railroad trestle was labeled with no trespassing stenciling. Police were present to prevent viewing from the top of the trestle. About 25 people precariously climbed onto trestle abutments from the west side to view instead. Others viewed from the slope below the

trestle, west side. Very few blossoms in the water after procession.

			3-Sep-2017 After Nautical Procession					
	Flume				**Stockton Avenue Bridge 1**452 hr			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00					22.1	0.4	13.76	683
0.25					22.1	0.4	13.28	682
0.50					22.0	0.4	13.04	682
0.75					22.0	0.4	13.55	682
1.00					22.0	0.4	13.44	679
1.25					21.9	0.4	12.77	681
1.50					21.9	0.4	12.39	680
1.75					21.6	0.4	11.75 (135%)	679
2.00b					20.9	0.4	9.01	671
2.25								
	Railroad Trestle 1440 hr				**Mouth of Noble Gulch** 1426 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	22.2	0.4	12.48	685	22.3	0.4	12.19	687
0.25	22.2	0.4	12.42	684	22.3	0.4	12.16	685
0.50	22.2	0.4	12.36	685	22.2	0.4	12.12	685
0.75	22.2	0.4	12.39	685	22.1	0.4	12.63	682
1.00	22.2	0.4	12.43	684	21.6	0.4	15.80 (165%)	675
1.25b	22.1	0.4	13.06 (148%)	683	21.3	0.4	18.12	651
1.50b	21.9	0.4	10.69	679				

			17-Sep-2017					
	Flume			0720 hr	**Stockton Avenue Bridge**			0734 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.2	0.4	8.53	638	18.3	0.4	8.73	640
0.25	18.2	0.4	8.56	640	18.3	0.4	8.71	642
0.50	18.3	0.4	8.65	641	18.3	0.4	8.68	642
0.75	18.3	0.4	8.56 (91%)	643	18.3	0.4	7.83	642
0.87b	18.3	0.4	8.44	643				
1.00					18.4	0.4	8.03	645
1.25					18.3	0.4	8.50	643
1.50					18.3	0.4	8.58	643
1.75					18.3	0.4	8.54 (91%)	643
2.00b					18.3	0.4	4.45	642
	Railroad Trestle			0754 hr	**Mouth of Noble Gulch**			0813 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.9	0.4	8.43	629	17.6	0.4	8.59	622
0.25	18.0	0.4	8.56	637	17.6	0.4	8.48	630
0.50	18.0	0.4	8.67	636	17.7	0.4	8.51	632
0.75	17.9	0.4	8.77	636	17.7	0.4	8.54	632
1.00	17.9	0.4	8.77	636	17.7	0.4	8.41 (88%)	632
1.20b					17.7	0.4	7.54	635
1.25	17.9	0.4	8.72 (92%)	636				
1.45b	18.0	0.4	7.41	636				

17 September 2017. Gage height of 2.50 (morning) and 2.53 (afternoon). Overcast, breezy in morning and clear in afternoon. Air temperature of 12.8˚C at 0720 hr and 17.4 ° C at 1548 hr. Flume inlet 1.2 ft and exit 1.2 ft in afternoon.

Station 1: Flume at 0720 hr- Reach 1- 15 gulls bathing, 2 mallards in water, few gulls on beach. No surface algae. Flume at 1548 hr- Reach 1- 26 gulls bathing. No surface algae. 5% pondweed + algae 2-4 ft thick, averaging 3 ft thick. 85% bottom algae 0.5-3.0 ft thick, averaging 2 ft.

Station 2: Stockton Avenue Bridge at 0734 hr- Reach 11 mallards and 1 coot in water. <1% surface algae. Reach 2 at 1533 hr-. Secchi depth to bottom. 6 mallards roosting on trestle abutment; 9 mallards roosting on Stockton Park west side, 2 coots in water. 1% surface algae. 100% of bottom covered with algae 0.5-2.0 ft thick, averaging 1ft thick.

Station 3: Railroad trestle at 0754 hr- Reach 3- No waterfowl! 2% surface algae. At 1515 hr- 9 mallards, 1 coot, 2 pied billed grebes in water. 2% surface algae. 99% of bottom covered with algae 0.2-1.5 ft thick, avg 0.7 ft. <1% pondweed + algae 1- 3 ft thick, averaging 2.0 ft.

Station 4: Mouth of Noble Gulch at 0813 hr- 2% surface algae. Gray plume at mouth. At 1500 hr- 5% surface algae.

Station 5: Nob Hill at 0843 hr. Water temperature at 16.0 °C. Conductivity 603 umhos, Oxygen 8.53 mg/l (87% saturation). Salinity 0.4 ppt. cfs at Soquel Village in the morning. Nob Hill at 1634 hr. Water temperature 17.9 ° C. Oxygen 11.83 mg/l (125%). Conductivity 629 umhos. Salinity 0.4

ppt. Streamflow estimate- cfs at Soquel Village in the afternoon.

			17-Sep-2017					
	Flume			1548 hr	**Stockton Avenue Bridge**			1533 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.2	0.4	14.42	746	19.4	0.4	13.78	752
0.25	19.2	0.4	15.53	747	19.4	0.4	14.05	753
0.50	19.2	0.4	16.17 (175%)	746	19.4	0.4	14.12	752
0.70b	19.2	0.4	16.14	746				
0.75					19.3	0.4	14.03	752
1.0					19.0	0.4	13.58	750
1.25					18.9	0.4	13.31	748
1.50					18.8	0.4	12.81 (138%)	748
1.75b					18.5	0.4	9.40	745
2.00								
	Railroad Trestle			1515 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.0	0.4	12.24	769	20.7	0.4	11.19	784
0.25	20.0	0.4	12.46	766	20.2	0.4	11.45	775
0.50	19.7	0.4	12.42	764	19.7	0.4	11.52	764
0.75	19.3	0.4	12.82	758	18.5	0.4	12.07	755
1.00	19.0	0.4	12.97	753	18.4	0.4	11.91 (127%)	752
1.25b	18.9	0.4	12.70 (137%)	753	18.6	0.4	8.49	758
1.35b	18.8	0.4	11.29	752				

			1-Oct-2017					
	Flume			0720 hr	**Stockton Avenue Bridge**			0730 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.6	0.4	9.25	740	18.0	0.4	9.72	748
0.25	17.7	0.4	9.31	741	18.1	0.4	9.77	750
0.50	17.7	0.4	9.34 (97%)	741	18.1	0.4	9.77	751
0.75b	17.7	0.4	9.27	741	18.2	0.4	9.64	752
1.00					18.2	0.4	9.57	753
1.25					18.2	0.4	9.64	753
1.50					18.2	0.4	9.74 (104%)	752
1.75b					18.3	0.4	3.88	754
	Railroad Trestle			0746 hr	**Mouth of Noble Gulch**			0805 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.8	0.4	8.94	749	17.1	0.4	7.80	739
0.25	17.8	0.4	8.73	752	17.1	0.4	7.45	744
0.50	17.8	0.4	8.66	751	17.1	0.4	7.35	744
0.75	17.8	0.4	8.62	751	17.1	0.4	7.28	742
1.00	17.8	0.4	8.66	751	17.1	0.4	7.25 (75%)	741
1.25b	17.9	0.4	8.62 (91%)	751	17.2	0.4	6.09	753
1.30b	17.9	0.4	8.20	751				

1 October 2017. Gage height of 2.50 (morning) with cool, clear sunrise and 2.62 (afternoon) clear/ very breezy in afternoon, late. Air temperature of 11.1˚C at 0720 hr and 21.0 ° C at 1600 hr. Flume inlet 1.2 ft and flume exit 1.0 ft in afternoon. Water temp 0.5-1 C cooler in afternoon 2017- slightly lower oxygen at 3 sites and much lower at flume in 2017 due to reduced algae. Still supersaturated at 3 of 4 sites. **Station 1:** Flume at 0720 hr- Reach 1- 20 gulls bathing, 2 mallards in water. No surface algae. Flume at 1600 hr- Reach 1- 49 gulls bathing and left when 3 paddle-boarders arrived. 5% surf. algae fragments. 90% bottom algae 0.5-1.5 ft thick, avg 1.0 ft. 5% pondweed with algae 2-5 ft thick, avg 4 ft. Thin algae film on remainder.

Station 2: Stockton Avenue Bridge at 0735 hr- Reach 2- 4 coots in water, 11 mallards in water (7 from Reach 1 (approached me- appeared hungry), 4 mallards roosting on trestle abutment . No surface algae. Reach 2 at 1543 hr- Secchi depth to bottom. 2 mallards and 1 coot in water. 7 mallards roosting on west side bulkhead by Stockton park; 4 mallards roosting on logs under bridge. 5% surface algae in fragments. Planktonic algal bloom- soupy. Bottom invisible because in shade.

Station 3: Railroad trestle at 0755 hr- Reach 3- 3 mallards dabbling, 9 coots, 2 pied-billed grebes. 3% surface algae fragments. At 1525 hr- Reach 3- 1 gull, 8 coots and 1 pied-billed grebes in water. 5% surface algae fragments; 99 % bottom algae 0.5-4 ft thick, averaging 1 ft; <1 % pondweed with algae 3 ft thick under trestle. Planktonic algal bloom underway.

Station 4: Mouth of Noble Gulch at 0809 hr- No surf. Algae. Gray water plume at mouth. At 1500 hr- 7% surface algae fragments; Thick planktonic algal bloom making bottom invisible.

Station 5: Nob Hill at 0840 hr- Water temperature at 15.0°C. Conductivity 589 umhos, Oxygen

8.80 mg/l (82% saturation). Salinity 0.4 ppt. cfs in the morning. Nob Hill at 1647 hr- Water temperature 17.1 ˚C. Oxygen 10.03 (103%) mg/l. Conductivity 636 umhos. Salinity 0.4 ppt. - cfs in afternoon.

			1-Oct-2017					
	Flume			1600 hr	**Stockton Avenue Bridge**			1543 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.6	0.4	11.49	650	18.6	0.4	10.56	652
0.25	18.6	0.4	11.31	650	18.6	0.4	10.51	652
0.50	18.5	0.4	11.42	649	18.6	0.4	10.48	652
0.75	18.5	0.4	11.44 (122%)	649	18.1	0.4	10.39	651
0.85b	18.5	0.4	11.04	649				
1.00					18.1	0.4	10.28	646
1.25					17.9	0.4	10.72	642
1.50					17.9	0.4	10.78	641
1.75					17.7	0.4	8.82 (92%)	639
2.00b					17.4	0.4	7.23	638
	Railroad Trestle			1525 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.2	0.4	10.51	658	19.3	0.4	10.10	666
0.25	19.2	0.4	10.34	659	19.1	0.4	10.20	657
0.50	19.1	0.4	10.29	657	18.8	0.4	10.11	653
0.75	18.5	0.4	10.65	650	17.6	0.4	10.06	624
1.00	18.0	0.4	11.93	642	17.3	0.4	11.39 (118%)	631
1.25b	17.6	0.4	11.58 (121%)	632	17.5	0.4	16.12	628
1.50b	17.5	0.4	11.02	631				

			8-Oct-17 prior to fish sampling					0802 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					15.4	0.4	9.39	606
0.25					15.5	0.4	9.21	607
0.50								
0.75					15.5	0.4	9.10	608
1.00								
1.25					15.5	0.4	9.16	608
1.50								
1.75					15.5	0.4	9.30	608
2.00b					15.5	0.4	7.93	608
2.25								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.05b								
1.18b								
1.25								

8 October 2017. Monitoring prior to fish sampling.

			14-Oct-2017					
	Flume			0750 hr	**Stockton Avenue Bridge**			0804 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.4	0.4	8.82	582	13.7	0.4	8.63	583
0.25	13.6	0.4	8.88	582	13.8	0.4	8.70	586
0.50	13.5	0.4	8.87	581	13.8	0.4	8.71	585
0.75	13.6	0.4	8.84 (85%)	582	13.8	0.4	8.72	586
0.87b	13.6	0.4	8.65	583				
1.00					13.8	0.4	8.69	586
1.25					13.8	0.4	8.64	587
1.50					13.8	0.4	8.68	586
1.75					13.8	0.4	8.64 (83%)	587
2.00b					13.8	0.4	8.01	586
	Railroad Trestle			0820 hr	**Mouth of Noble Gulch**			0839 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.4	0.4	8.41	578	13.0	0.4	8.11	570
0.25	13.4	0.4	8.38	580	13.0	0.4	8.29	575
0.50	13.4	0.4	8.42	580	12.9	0.4	8.34	575
0.75	13.4	0.4	8.39	580	12.9	0.4	8.33	574
1.00	13.4	0.4	8.42	580	12.9	0.4	8.06 (78%)	575
1.25b	13.4	0.4	8.42 (81%)	580	13.7	0.4	0.31	603
1.50b	13.4	0.4	7.75	580				

14 October 2017. Gage height of 2.60 (morning) with cool, clear breezy (morning) and 2.60 (afternoon) clear in afternoon. Air temperature of 6.5˚C (very cool) at 0750 hr and 17.6 ° C at 1604 hr. Flume inlet 1.2 ft and flume exit 1.0 ft in afternoon.

Station 1: Flume at 0750 hr- Reach 1- 82 gulls bathing, 20 coots, 2 mallards roosting on logs under bridge. No surface algae. Flume at 1604 hr- Reach 1- 3 gulls bathing and 1 mallard initially with 1 kayak and 1 row boat present- later 53 gulls after boaters left. <1% surf. algae fragments. 80% bottom algae 0.3-1 ft thick, avg 0.5 ft. 10% pondweed with algae 3-5 ft thick, avg 4 ft. Thin algae film on remainder.

Station 2: Stockton Avenue Bridge at 0804 hr- Reach 2- 3 coots in water, 4 mallards roosting on trestle abutment, 3 coots and pied billed grebe in water . No surface algae. Reach 2 at 1545 hr- Secchi depth to bottom. 12 coots. No surface algae.

Station 3: Railroad trestle at 0755 hr- Reach 3- 3 mallards dabbling, 9 coots, 2 pied-billed grebes. 3% surface algae fragments. At 1525 hr- Reach 3- 1 gull, 8 coots and 1 pied-billed grebes in water. 5% surface algae fragments; 98% bottom algae 0.5-2 ft thick, averaging 1 ft; 2 % pondweed with algae 2-4 ft thick, avg 3 ft under trestle.

Station 4: Mouth of Noble Gulch at 0839 hr- No surf. algae. Gray water plume at mouth (12 ft x 20 ft expanded to 40 ft diameter). Lateral to Noble Gulch with wet debris and runoff from residential property into storm drain. At 1507 hr- Gray plume persistent at mouth. Bottom invisible due to shade. 10% surface algae.

Station 5: Nob Hill at 0912 hr- Water temperature at 11.6°C. Conductivity 557 umhos, Oxygen

8.84 mg/l (81% saturation). Salinity 0.4 ppt. cfs in the morning. Nob Hill at 1655 hr- Water temperature 13.9 ˚C. Oxygen 12.34 (119%) mg/l. Conductivity 588 umhos. Salinity 0.4 ppt. - cfs in afternoon.

			14-Oct-2017					
	Flume			1604 hr	**Stockton Avenue Bridge**			1545 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	14.9	0.4	14.65	600	14.7	0.4	14.32	599
0.25	14.6	0.4	14.83	599	14.6	0.4	14.09	597
0.50	14.4	0.4	15.70	592	14.6	0.4	13.88	596
0.75	14.3	0.4	15.66 (153%)	591	14.5	0.4	13.75	596
1.00b	14.3	0.4	15.23	591	14.3	0.4	13.91	592
1.25					14.1	0.4	13.99	591
1.50					14.0	0.4	13.96	589
1.75					13.9	0.4	12.43 (121%)	588
2.00b					13.8	0.4	11.45	588
	Railroad Trestle			1526 hr	**Mouth of Noble Gulch**			1507 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.6	0.4	14.49	615	16.1	0.4	13.34	629
0.25	15.3	0.4	14.05	607	15.6	0.4	13.62	611
0.50	15.0	0.4	13.94	605	15.4	0.4	13.40	607
0.75	14.9	0.4	13.96	603	14.3	0.4	14.51	594
1.00	14.2	0.4	15.72	595	13.8	0.4	15.11 (146%)	583
1.25b	14.2	0.4	15.69 (153%)	587	13.8	0.4	15.41	582
1.50b	13.9	0.4	15.20	586				

			15-Oct-17 prior to fish sampling					0802 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					13.7	0.4	9.77	574
0.25								
0.50								
0.75					13.8	0.4	9.60	584
1.00								
1.25								
1.50					13.8	0.4	9.85	585
1.75								
2.00b					13.8	0.4	9.15	586
2.25								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.05b								
1.18b								
1.25								

15 October 2017. Monitoring prior to fish sampling.

			29-Oct-2017					
	Flume			0800 hr	**Stockton Avenue Bridge**			0812 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.8	0.4	7.78	628	15.5	0.4	8.16	
0.25	15.8	0.4	7.87	629	15.6	0.4	8.19	
0.50	15.8	0.4	7.93	630	15.6	0.4	8.15	
0.67b	15.8	0.4	7.77	630				
0.75					15.7	0.4	8.03	
1.00					15.7	0.4	8.14	
1.25					15.7	0.4	8.18	
1.50					15.7	0.4	8.09 (82%)	
1.75b					15.7	0.4	7.62	
	Railroad Trestle			0833 hr	**Mouth of Noble Gulch**			0848 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.4	0.4	8.10	618	14.9	0.4	7.56	586
0.25	15.5	0.4	8.03	622	14.9	0.4	7.60	604
0.50	15.5	0.4	8.07	622	14.9	0.4	7.71	610
0.75	15.5	0.4	8.33	622	14.9	0.4	7.64	611
1.00	15.4	0.4	7.63	622	14.9	0.4	7.39 (73%)	612
1.15b	15.2	0.4	6.31 (63%)	622	14.9	0.4	6.97	613
1.45b	15.2	0.4	5.96	622				

29 October 2017. Gage height of 2.30 (morning) and overcast and 2.30 (afternoon) partly cloudy mostly sunny, breezy then overcast, late. Air temperature of 11.2˚C at 0800 hr and cool 14.7 ° C at 1552 hr. Flume outlet partially buried in sand in morning. Flume inlet 1.2 ft and flume exit 1.0 ft in afternoon.

Station 1: Flume at 0800 hr- Reach 1- 24 gulls bathing, 12 coots, 1 mallard in water. No surface algae. Flume at 1552 hr- Reach 1- 59 gulls bathing, 18 coots, 2 mallards. No surf. algae. Shaded bottom invisible.

Station 2: Stockton Avenue Bridge at 0812 hr- Reach 2- 4 coots in water, 3 mallards in water. No surface algae. Reach 2 at 1540 hr- Secchi depth to bottom. 2 mallards from R-3 in water. 3 mallards roosting at Stockton Park Westside. . No surface algae.. Bottom invisible due to shade.

Station 3: Railroad trestle at 0833 hr- Reach 3- 5 mallards dabbling (2 from R-2). 14 coots. No surface algae. At 1515 hr- Reach 3- 1 gull, 16 coots and 1 pied-billed grebe in water. No surf. Algae. Bottom invisible due to shade.

Station 4: Mouth of Noble Gulch at 0848 hr- No surf. algae. Dilute gray water plume at mouth 10 ft in diameter. Lateral to Noble Gulch dry. At 1500 hr- No surface algae. Bottom invisible due to shade.

Station 5: Nob Hill at 0922 hr- Water temperature at 13.9°C. Conductivity 576 umhos, Oxygen 8.52 mg/l. Stream water surface down approx. 0.2 ft from 14 October. Salinity 0.4 ppt. cfs in the morning. Nob Hill at 1625 hr- Water temperature 14.3 ˚C. Oxygen 9.13 mg/l (89%). Conductivity 589 umhos. Salinity 0.4 ppt. - cfs in afternoon.

			29-Oct-2017					
	Flume			1552 hr	**Stockton Avenue Bridge**			1540 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.8	0.4	8.12	630	15.9	0.4	8.70	629
0.25	15.8	0.4	8.20	629	15.8	0.4	8.31	629
0.50	15.7	0.4	8.23 (83%)	629	15.7	0.4	8.03	626
0.70b	15.7	0.4	8.74	627				
0.75					15.5	0.4	7.81	624
1.00					15.4	0.4	7.82	623
1.25					15.4	0.4	7.37	622
1.50					15.3	0.4	7.47	623
1.75					15.3	0.4	7.64 (77%)	622
2.00b					15.3	0.4	7.30	622
	Railroad Trestle			1515 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	15.9	0.4	7.87	632	15.7	0.4	10.52	622
0.25	15.9	0.4	7.78	630	15.7	0.4	10.19	622
0.50	15.9	0.4	7.68	629	15.4	0.4	8.51	619
0.75	15.8	0.4	7.77	628	14.9	0.4	8.13	609
1.00	15.2	0.4	8.85	615	14.8	0.4	8.28 (81%)	609
1.20b					14.9	0.4	8.45	610
1.25	15.1	0.4	8.86 (86%)	615				
1.45b	15.1	0.4	8.56	615				

			4 Nov-2017 one day after storm					1342 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					14.4		7.03	
0.25					14.4		7.06	
0.50					14.3		6.73	
0.75					14.0		5.83	
1.00					13.9		5.22	
1.25					13.9		5.20	
1.50					13.9		5.27	
1.75					13.8		5.38	
1.85b					13.9		5.22	
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.05b								
1.18b								
1.25								

4 November 2017. Monitoring after small stormflow on 3 November. Lagoon turbid. Secchi depth 1.5 feet. Requested that a total of 5 boards be removed from flume inlet to insure that light penetrated to the bottom and photosynthesis would continue. This was done on 4 November.

			6 Nov-2017 3 days after storm					0912 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					12.7	0.4	9.03	577
0.25					12.5	0.4	8.87	571
0.50					12.5	0.4	8.86	571
0.75					12.3	0.4	8.38	571
1.00					12.2	0.4	8.61	569
1.25					12.1	0.4	8.67	568
1.50b					12.1	0.4	8.48	567
1.75								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.05b								
1.18b								
1.25								

6 November 2017. Monitoring 3 days after small stormflow on 3 November and after 5 boards were removed from flume inlet. Lagoon water clearing up. Secchi depth to bottom. Oxygen levels had improved, indicating that photosynthesis was occurring. Recommended that boards be left out because another storm was forecasted in 3 days.

			11-Nov-2017					
	Flume			0737 hr	**Stockton Avenue Bridge**			0755 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.2	0.4	8.54	582	13.2	0.4	8.75	579
0.25	13.2	0.4	8.53	582	13.2	0.4	8.66	580
0.45	13.2	0.4	8.51	582				
0.50					13.3	0.4	8.51	581
0.75					13.3	0.4	8.43	579
1.00					13.2	0.4	8.46	580
1.25					13.2	0.4	8.42	580
1.50					13.3	0.4	8.33 (80%)	581
1.75b					13.3	0.4	7.53	581
	Railroad Trestle			0815 hr	**Mouth of Noble Gulch**			0827 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.2	0.4	8.06	575	13.3	0.4	8.02	569
0.25	13.2	0.4	8.07	576	13.3	0.4	7.99	571
0.50	13.3	0.4	8.12	576	13.3	0.4	7.97	570
0.75	13.2	0.4	8.13	576	13.2	0.4	7.98 (76%)	572
0.90b					13.3	0.4	7.54	573
1.00	13.2	0.4	8.09 (77%)	576				
1.20b	13.2	0.4	6.41	576				

11 November 2017. Gage height of 1.57 (morning) clear and 1.53 (afternoon) clear. Air temperature of 9.9˚C at 0737 hr and 15.3 ° C at 1538 hr. Flume inlet 1.2 ft and flume exit 1.75 ft in afternoon with incoming tide.

Station 1: Flume at 0737 hr- Reach 1- 17 gulls bathing, 9 coots, 2 mallards on logs beneath Stockton Bridge. No surface algae. Flume at 1538 hr- Reach 1- 26 gulls bathing, 9 coots in water. 3 mallards and 1 gull on log beneath Stockton Bridge. Bottom invisible in shade.

Station 2: Stockton Avenue Bridge at 0755 hr- Reach 2- 2 coots in water, kingfisher on trestle. No surface algae. Reach 2 at 1525 hr- Secchi depth to bottom. 4 mallards and 4 coots, 1 gull and 1 pied billed grebe in water. 2% surface algae in fragments. Bottom invisible because in shade.

Station 3: Railroad trestle at 0815 hr- Reach 3- 10 mallards dabbling, 12 coots, 2 pied-billed grebes. No surface algae fragments. At 1525 hr- Reach 3- 13 coots and 23 mallards. 1 paddle boarder. Bottom invisible in shade.

Station 4: Mouth of Noble Gulch at 0827 hr- No surf. Algae. Gray water plume at mouth. Lateral to Noble Gulch with debris but dry. At 1451 hr- no surf. Algae. 7-10 ft diameter gray water plume at mouth.

Station 5: Nob Hill at 0907 hr- Water temperature at 12.8°C. Conductivity 565 umhos, Oxygen 9.21 mg/l. Salinity 0.4 ppt. cfs in the morning. Nob Hill at 1614 hr- Water temperature 13.7 ˚C. Oxygen 9.59 mg/l. Conductivity 567 umhos. Salinity 0.4 ppt. - cfs in afternoon.

			11-Nov-2017					
	Flume			1538 hr	**Stockton Avenue Bridge**			1525 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	14.5	0.4	9.56	598	14.4	0.4	9.26	599
0.25	14.6	0.4	9.52 (94%)	597	14.4	0.4	9.12	596
0.50b	14.5	0.4	9.45	597	14.3	0.4	9.01	594
0.75					14.2	0.4	9.07	592
1.00					14.1	0.4	8.78	591
1.25					14.0	0.4	8.83	590
1.50					13.9	0.4	8.24 (80%)	590
1.75b					13.9	0.4	2.93	590
2.00								
	Railroad Trestle			1511 hr	**Mouth of Noble Gulch**			1451 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	14.4	0.4	9.30	595	14.3	0.4	9.17	590
0.25	14.4	0.4	9.12	593	14.1	0.4	9.31	580
0.50	14.4	0.4	9.33	592	14.0	0.4	9.50	581
0.75	14.3	0.4	9.49	591	14.0	0.4	9.49 (92%)	584
0.85					13.9	0.4	9.06	585
1.00	14.3	0.4	9.56 (94%)	591				
1.20b	14.2	0.4	8.76	591				

16 November 2017. Fish biologist arrived at lagoon at 0900 hr. Encountered rain on the way but it was not raining in Capitola. Water surface was just above the flume inlet at 20 cfs at the Soquel Village gage. Observed a common goldeye diving in Reach 1. Left at 1156 hr with absence of rain. Arrived second time at 1330 hr with bar still intact. Assisted Morrison to take water sample in surf at 1346 hr. Sandbar breach was facilitated at 1410 hr with 48 cfs at the Soquel Village gage. Flume capacity between 25 and 30 cfs. Lagoon water surface 0.5 ft below bent bolt and approximately 1 foot below flood stage. Biologist left for Monterey Analytical at 1430 hr to deliver the water sample for enterococcus bacterial analysis. Streamflow at Soquel Village gage-

105 cfs at 1530 hr;
146 cfs at 1545 hr;
193 cfs at 1645 hr;
256 cfs at 1730 hr
295 cfs at 1800 hr;
200 cfs at 2215 hr.

Streamflows are provisional and subject to change.

22 November 2017. County analysis of enterococcus bacterial counts yielded 10.

APPENDIX B. 2017 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2017 DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK				
RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS	SIGN OFF
MY THAI BEACH	831-464386	5-14-17	Approved.	
BAY BAR	LEFT LETTER & CARD IN DOOR → SON 5/10/17 @ 3:00 PM	5-2-17.	Approved	
PIZZA MY HEART	Brittney RAYNOR 408476 5364	5-2-17	Approved Reviewed for Code Compliance Signed Date 5-14-17 Permit No. Final.	
SAND BAR	Elizabeth Loftin 462-1881	5-3-17	Approved	
PARADISE BAR & GRILL	Kristie Wilson 476-4900	5-11-17	Approved	
ZELDA'S	Josh Whitby 345-2666	5-18-17	Approved	