D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2023

(Sampling for Tidewater Goby under USFWS Endangered Species Recovery Permit TE-793645-5)

Reach 3- Upper Soquel Lagoon, Beyond the Railroad Trestle, August 2023

Reach 1- Lower Soquel Lagoon with Flume Inlet, August 2023

Prepared for the
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SOQUEL CREEK LAGOON MONITORING REPORT, 2023

ACKNOWLEDGMENTS

Ed Morrison and Matt Kotila (heavy equipment operator and field supervisor and the entire Capitola Public Works Department did well in constructing the sandbar, preparing the flume and maintaining the lagoon in 2023. They teamed to daily monitor the lagoon. They adjusted the flume inlet as needed to maximize lagoon depth, maintain light penetration to the bottom to maintain oxygen levels and to provide steelhead passage through the flume as baseflow declined. Every year is different, and we are grateful for their attentiveness, along with that of other Public Works staff. We thank Cooper Sanden for assisting in relocating fish from the lateral channel prior to sandbar construction in May. We thank Steve Needens for weekend beach and sand berm maintenance and for keeping the flume inlet and outlet clear through the dry season. We again thank Nels and Susan Westman 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. They were local residents and other volunteers interested in preserving the steelhead population in Soquel Creek. Robin Aston, math teacher at Soquel High School, brought her students and children. They were important in providing enough help. Avid angler, Bobby Ceja, his wife, Elena, and family joined us again this year to work the seine and process the captured steelhead. Bruce Ashley, world-traveled fisherman and photographer, also joined in again this year. William Ware from California Trout assisted in sampling and data collection. College student, Nigel Circhir, returned to assist in capturing fish and recording data. Biologists Josie Moss and Inger Marie Laursen provided their positive energy in working the seine and recording data. Chad Steiner was key in setting the seine, capturing fish and assisting in their measure. 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.

Loading the beach seine into the boat. October 2022

Setting the beach seine to capture steelhead in Soquel Lagoon. October 2022

Pulling in the beach seine. October 2022

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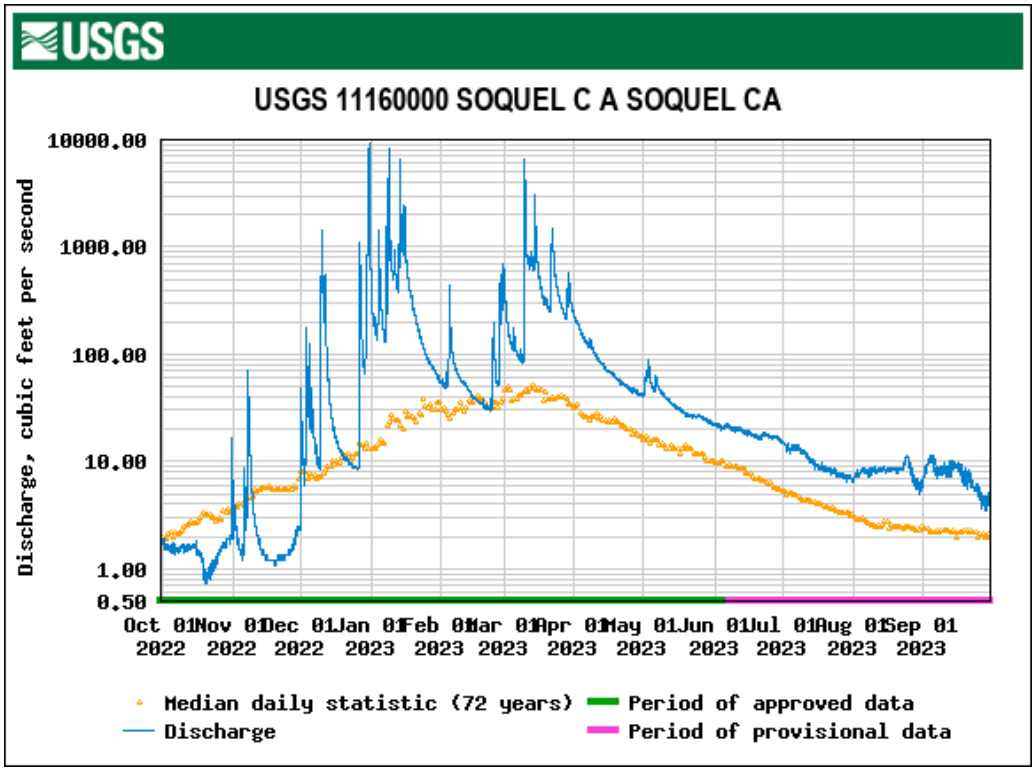
REPORT SUMMARY

Sandbar Construction. As per the 2023 permit conditions, sandbar construction with lagoon formation began on 22 May 2023 and was completed on 25 May 2023. Previous winter stormflows had been frequent during a relatively wet winter. There were at least 15 stormflows greater than 100 cfs at Soquel Village from December 2022 through April 2023. Nine likely bankfull events occurred, with 6 stormflows greater than 6,000 cubic feet per second (cfs) at the USGS gage located in Soquel Village. The numerous stormflows offered ample adult steelhead passage opportunity with good spawning conditions in the upper watershed. When sandbar construction began on 22 May, streamflow had declined to 27.1 cfs (0600 hr) at the USGS gage.



As required in permits, a fishery biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our thirty-third year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first thirty-two years are available at the City (**Alley 1991-2022**). 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.

During the week prior to 22 May, the flume had been cleared of sand. Stream was flowing through the flume by the afternoon of 22 May, providing steelhead smolt passage to the Bay after the diagonal channel through the beach was covered over during sandbar construction. All streamflow was travelling through the flume overnight during the 22-25 May construction period to insure adult steelhead (*Oncorhynchus mykiss*) and smolt passage during sandbar construction.

The usual lateral channel had not developed across the beach in the spring prior to sandbar construction. Instead, a fast-moving, diagonal outlet channel nearer the flume was present. Only staghorn sculpins (*Leptocottus armatus*) inhabited the fast-moving channel, and they were dipnetted and relocated upstream of Stockton Avenue Bridge during sandbar construction.

Kelp and seagrass were present primarily in the lower estuary prior to sandbar construction. The estuary bottom was relatively hard with mostly undecomposed kelp and some decomposing plant material underneath, located downstream of Stockton Bridge. Public Works staff raked decomposing plant material out of the lagoon each day of sandbar construction. Raking of plant material was limited to within approximately 100 feet of the flume. Alley provided a training session for Public Works staff. Alley surveyed upstream for potentially stranded fish each day the sandbar was opened for sandbar preparation. Approximately 50% of the decomposing plant material was raked from Reach 1, downstream of Stockton Bridge. Three manual, daily openings of the sandbar were required during sandbar construction before the sandbar was closed for the season on 25 May. Fish passage through the flume for emigrating adult steelhead and steelhead smolts was maintained each night.

Prior to sandbar construction, the plumbing of Esplanade businesses was inspected for leaks by City staff, and repairs were made as necessary (**Appendix B**). On 24 May, Cooper Sanden, Public Works staff, inspected the flume interior for possible erosion damage to the previously applied protective lining in spring of 2021. Damaged areas were noted.

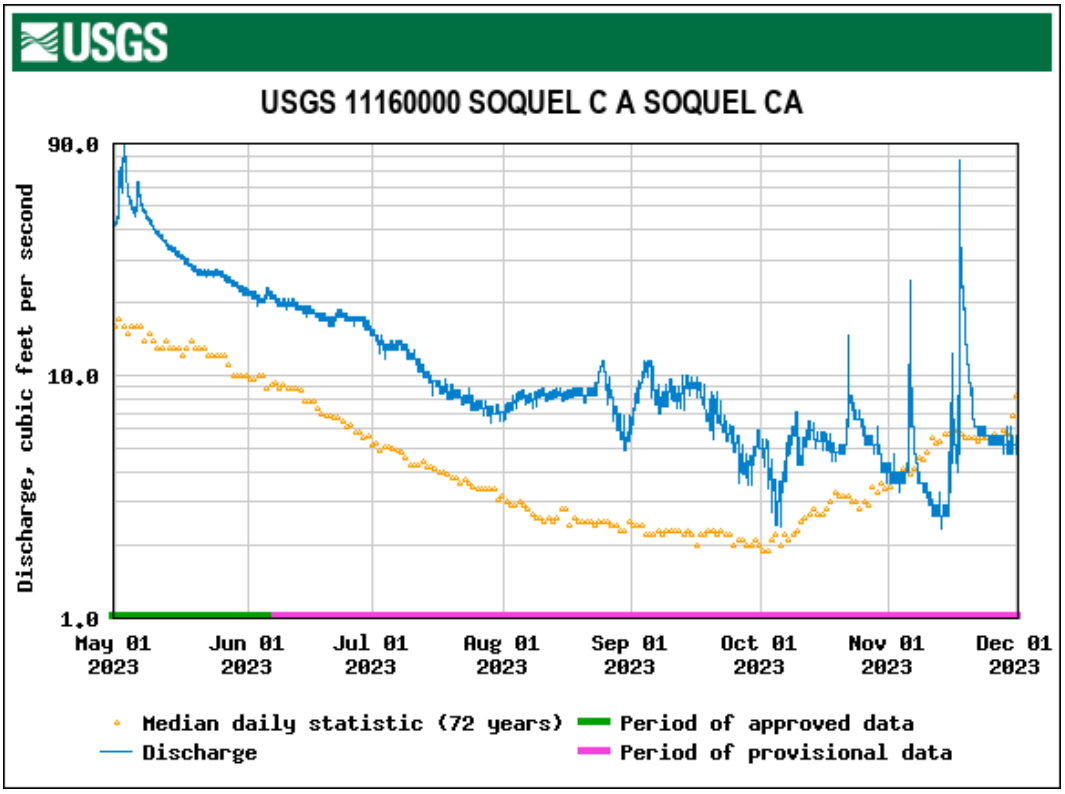
No stream underflow was observed near the flume outlet throughout the monitoring period, indicating that the flume repair and placement of cut-off walls beneath the flume in 2021 were successful in sealing cracks and preventing leaks. The flume's interior had been lined with fiberglass and a protective resin. This insured that the City could continue to operate the flume and create good steelhead nursery habitat into the future.

No YOY steelhead were captured in the outlet channel in 2023. However, some YOY steelhead may have moved into the estuary from spawning areas above the lagoon. None were seen feeding on the surface during sandbar construction, however. With the late May sandbar closure in 2023, most steelhead smolt outmigration had likely been completed. One steelhead smolt was observed in the upper lagoon during sandbar construction. Salmonid smolts passively drift downstream at night and are facilitated by late spring stormflows, which occurred in late March to early May. The two late stormflows of 80 and then 50 cfs in early May 2023 likely encouraged late smolts to pass through to the Bay prior to sandbar construction. During sandbar construction, adults and smolts had access to the Bay through the flume every night.

No tidewater gobies were observed in the lagoon outlet channel at the time of sandbar closure. Due to the lack of overwinter cover and the poor swimming ability of this species, we suspect that few tidewater gobies were present. If present, they prefer to spawn in freshwater, away from tidal influence at the upper end of estuaries. We found no tidewater gobies along the estuary margin during drawdowns required for sandbar construction. We judged impacts to tidewater gobies to be minor during sandbar construction in 2023, and no fish mortalities were observed. Later during fall sampling for tidewater goby in 2023, none were observed or captured, as was the case in Aptos Lagoon.

Sandbar Opening. Previous to the facilitated sandbar breach that was completed on 18 November, Kotila had cut a 30-foot wide notch across the beach by 6 November with an inner berm constructed near the lagoon periphery and an outer berm constructed near the surf to prevent wave action with high swells from opening the sandbar without stormflow. The facilitated breaching of the sandbar was required after prior removal of a total of 4 boards from one side of the flume inlet and 1 board from the other. The lagoon surface elevation had rapidly approached the lowermost bolt on the restaurant piling that was originally installed a foot below imminent flooding at the low point of the streambank along River View Road in Reach 3. The breaching was facilitated by Kotila with the tractor 0658 hr, with a Soquel Village gage streamflow estimate peaking at 77.4 cfs at 0630 hr and declining to 71.8 cfs at 0700 hr. The flume capacity for passing stormflow is approximately 30 cfs. Flooding was prevented.

Lagoon Depth. Gage height in 2023 was consistently near the highest recorded through the last 4 years at above a gage height of 2.50 from early July until late September and then again in November (**Figure 2**). **Appendix A** provides detailed water quality and lagoon height data. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was rated "fair" during the first 2-week monitoring (10 June) and rated "good" for the remainder of the monitoring period until 11 November, the last monitoring before the sandbar was opened..



Water Temperature. Lagoon water temperature was well within the tolerance range of steelhead in 2023. Water temperature in 2023 near the bottom at lagoon monitoring stations in the morning and afternoon were cooler compared to those in the lower baseflow year of 2022

from mid-June through September despite warmer inflow temperatures from mid-August through September in 2023 (**Figure 3k**). This is because the lagoon warmed up considerably more during the day in 2022 with the low inflow rate than in 2023 with the much higher inflow rate (**Table 9**). Average water temperatures in the afternoon in 2023 were most similar to conditions in other higher baseflow years of 2017 and 2019. Almost all lagoon water temperature environmental goals were met for steelhead in 2023 except for 4 days in mid-August. Daily minimum water temperature at dawn near the bottom (within 0.25 m) remained below 20 °C except for 15-18 August (**Figure 4a**). Daily maximum water temperature near the bottom remained below 22 °C. The average 7-day rolling average was less than 21 °C from sandbar closure to 15 September. During 2-week monitorings in 2023, lagoon Station 4 was often the coolest near the bottom (**Figure 3g**). In 2023, water temperatures near the bottom at dawn were rated "good" at all lagoon stations (<20 °C) on 11 of 12 sampling days throughout the dry season, with a "fair" rating at 3 of 4 stations on 19 August (**Tables 2 and 3**). Site 4 was in the "good" range throughout the dry season. The annual trend in 7-day rolling temperature averages with respect to the maximum, average and minimum for the dry season indicates that they increase substantially in dry/drought years when stream inflow rate is much reduced and decrease in wetter years when stream inflow rate is increased (**Figure 4i**).

Stream Inflow and Influence on Lagoon Water Temperature. Lagoon water quality is generally best with higher summer baseflow from the cooler Soquel Creek. Soquel Creek in 2023 maintained a relatively high baseflow through the dry season that was much above the median flow (**Table 9; Figures 25−26; Appendix C. Figures 1−3**). Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than lower 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 and more completely overnight when inflow is higher. With less inflow in June−August, lagoon water temperature heats up more during the day and cools off less at night, as indicated by higher average lagoon water temperature at dawn in 2015 (low drought inflow) (**Alley 2020**) and in 2022, with cooler conditions in 2023 (**Figure 3i**). The annual trend in 7-day rolling average temperature with respect to the maximum, average and minimum for the dry season indicates that they increase substantially in dry/drought years (2009, 2013-2015 and 2021-2022) when stream inflow rate is much reduced (**Table 4; Figure 4i**). However, the trend toward reduced lagoon water temperature during higher baseflow years was less evident in 2017, 2019 and 2023, when the maximum temperature and the maximum and average 7-day rolling averages were similar or higher than in intermediate baseflow years of 2016, 2018 and 2020. For 2016 and 2018, we suspect this was partially because they had cooler air temperature in late summer and fall with more stream shading than after wet winters that would have contributed to warmer inflow in 2017, 2019 and 2023 due to loss of streamside vegetation and less shade (**Figure 3l**). In 2023, morning water temperatures of stream inflow from mid-August to the end of September were warmer than in any other recent years. In 2023, afternoon water temperatures of stream inflow in mid-July and mid-August were warmer than in any other recent years.

To maximize summer baseflow, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer surface 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. Baseflow atypically

increased during the latter half of August before diminishing substantially. This was likely caused by a change in water diversion/well pumping patterns. Lower Soquel Creek maintained its continuity in 2023. A streamside nursery closed in 2023, which may increase summer baseflow in the future.

Aquatic Vegetation. In 2023, bottom algae developed slowly and no pondweed was observed. Bottom filamentous algae increased in thickness and coverage through August (**Table 5**). It was most abundant in Reach 1 below Stockton Bridge and at the mouth of Noble Gulch in Reach 3. Although filamentous algae thickness was as much as 3.5 feet in patches, it usually averaged between 0.5 and 1.0 feet thick by Reach. Pondweed had been scoured out during the winter 2022/2023 and apparently failed to recover in the coarser substrate of the lagoon bottom in 2023. There was little surface algae in 2023. It was not observed in Reach 1 or 2 on monitoring days. It was observed only once in Reach 3 at only 2% coverage in August. Surface algae was observed only twice at the mouth of Noble Gulch, that being in late July and early August at 10 and 20% coverage, respectively. Tules had maintained themselves under the railroad trestle over the wet winter of 2022/2023. Additional tules were planted there during sandbar construction in 2023.

Oxygen Concentration. Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was used by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen levels are most importantly measured and rated because they are typically the lowest. No stressfully low oxygen concentrations for steelhead (< 5 mg/L) were detected near the lagoon bottom during the two-week monitorings in 2023 except on two occasions at Station 3 (under the railroad trestle) in the morning in September and two occasions at Station 2 (deep hole adjacent to the Venetian Court wall) in late October and November after the tidal overwash (**Table 3; Figure 6a-1 and 6a-2**). Oxygen was ample higher in the water column on each occasion at these stations. Oxygen concentration typically increased up through the water column (**Appendix A**). Oxygen levels near the bottom at dawn were mostly in the "good" range at stations with fewer in the "fair" range during the remainder of the monitoring period. Oxygen was ample in the afternoon at all stations near the bottom during the monitoring period except in the deeper hole at Station 2 after the tidal overwash that had created a stagnant saline layer along the bottom and near the bottom. The low morning oxygen levels under the railroad trestle likely resulted from higher algae concentration there, below where gulls commonly roosted in 2023 with pigeons, providing excrement nutrients to algal growth beneath. Relatively higher afternoon oxygen concentrations from high photosynthetic rate on the days with relatively low morning oxygen concentrations near the bottom from high respiration rates under the trestle support this hypothesis.

Salinity. A thin saltwater lens was detected along the lagoon bottom in the deep pocket adjacent the Venetian Court wall on 30 May, with adequate streamflow after sandbar closure on 25 May to remove it. Therefore, the shroud was not installed on the flume inlet. The very dilute saltwater lens was still present on the very bottom on 10 June, but did not cause elevated water temperature or low oxygen within 0.25 m above the bottom. The saline layer was gone by 24 June. A freshwater lagoon persisted until 19 October when tidal overwash of ocean saltwater occurred along the Venetian Court wall. Public Works installed a shroud on the flume inlet to facilitate evacuation of saline water from the lagoon bottom. This breach of the sandberm at that location may have been facilitated by someone in the public. From the surface to 1.25 m below

the surface after the tidal overwash, oxygen levels were good and available to fish. Water temperature was good to the bottom at Station 2. Thus, much of the lagoon had good water quality throughout the water column except nearer the lagoon bottom in deeper pockets. The saline layer was approximately 0.25 m thinner and more dilute by 28 October compared to 21 October. At the final monitoring on 11 November, prior to sandbar opening, the saline layer was approximately 0.25 m thinner than on 28 October and more dilute. The tidal overwash did not create water temperature or conductivity stress for steelhead, and they could move to other, shallower areas of the lagoon to obtain adequate oxygen concentrations.

Fish Sampling Results. On 1 October, 7 seine hauls were made with the smaller, fine-meshed seine to sample for tidewater gobies on 1 October. No tidewater gobies were observed or captured. This indicated low overwinter survival of tidewater gobies in Soquel Creek after multiple high stormflow events. A total of 56 steelhead were captured, measured and marked on 1 October after 6 seine hauls with the larger, more coarse-meshed seine. There were no mortalities. This low capture indicated that the juvenile steelhead population was likely small in the lagoon in 2023. A total of 65 steelhead were captured on 8 October in 6 seine hauls. There were 5 recaptures and no mortalities. The steelhead lagoon population estimate was 728, with a large standard error of 299. This estimate was below average and below the median compared to the 29-year average of 1,461 (median= 875), including the 2021 estimate (**Table 10; Figure 24**). The low lagoon population size may have occurred because, with the many significant stormflows over the winter/spring, most adult steelhead likely spawned far up in the watershed, some distance from the lagoon. Juvenile densities were low at stream sites in the lower watershed, indicating low spawning effort and/or scour of redds constructed in the lower watershed. These factors likely resulted in few YOY seeding the lagoon. Also, yearling growth in the spring was likely above average with the high baseflow, resulting in fewer yearlings staying a second growing season in the lagoon. This, too would have led to a smaller lagoon population.

Bird and Pond Turtle Censusing. Mergansers were not commonly observed in 2023 as they had been in previous drought years, 2013−2015 and 2021−2022 (**Table 13)**. Other piscivorous birds observed in 2023 included Pied-billed Grebe, Cormorant, Black-crowned Night Heron, Belted Kingfisher and Lesser Scaup (in November). Pied-billed Grebes continued to be less common in 2023 than 2021. A Cormorant spent the entire day in the lagoon on one monitoring day in 2023, which was unusual.

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge and did so in 2023. However, in past years when people were observed feeding the ducks in upstream reaches, a few gulls were attracted to the food source. 2019 was the first year in 31 years of monitoring that rafts of Western gulls consisting of as many as 24 birds were commonly observed in Reach 3. They were also observed perching in groups on lagoon-side house roofs in Reach 3 in 2019. This has continued in 2020−2023. In 2023, as many as 22 western gulls were observed in the afternoon in the Reach 3 lagoon (maximum of 17 gulls in 2022 and 22 gulls in 2021). Gull numbers counted during monitoring days in 2023 fluctuated between 21 (10 June) and 93 (28 October), when Hermann's gulls were well represented in the count in Reach 1from mid-August to mid-November (**Figure 27**). The average gull count per monitoring day for 2014−2023 was 63, 68, 42, 40, 46, 63, 36, 44, 109 and 47, respectively.

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 28**). In 2023, mallard numbers on monitoring days were lower than in the previous 9 years. They increased from early June to a maximum of 20 birds in late June and never increased above that for the remainder of the dry season. The average mallard count per monitoring day for 2014– 2023 was 27, 26, 31, 18, 30, 21, 44, 23, 28 and 14, respectively, giving 2020 the highest average in the last 10 years and 2023 was the lowest.

A Southwestern Pond Turtle was observed on 25 May in the Reach 3 mainstem during sandbar construction. After sandbar closure and lagoon formation in 2023, another Southwestern Pond Turtle was observed on the afternoon of 8 July. It was hauled out, sunning itself on a long, emergent log on the west side, upstream of the east side Noble Gulch confluence with the lagoon. A California Natural Diversity Data Base (CNDDB) report was submitted regarding the sighting of this protected, special status species.

Recreational Use and Pollution Solutions. The Nautical Parade occurred on the evening of 23 September 2023. No adverse environmental effects were detected. Through the summer, the lagoon near the beach was posted with warning signs about potential health risks from contact with the water. However, greater human use of the lagoon has been observed since 2016 than previously. In 2016, a paddle-board concession began in Capitola village. Paddle-boarders have become commonplace during weekend monitorings (observed on 8 of 12 monitorings in 2023, 9 of 12 2022; 9 of 10 in 2021; 5 of 13 in 2019; 5 of 12 in 2018, 10 of 12 in 2017; 7 of 9 in 2016), along with kayakers, pedal boaters, row boaters, canoers and barge users. In 2023, the most paddle boarders counted in a reach was 6 in Reach 1 on 5 August. Waders and swimmers have been commonly observed in the lagoon during warm, sunny weekend afternoon monitorings since 2016 and not previously (usually near the beach in Reach 1; 4 of 12 afternoon monitorings in 2023; 6 of 12 in 2022; 2 of 10 in 2021; 6 of 13 in 2019, 5 of 12 in 2018, 4 of 12 in 2017; 6 of 9 in 2016). The most waders seen at one time in Reach 1 in 2023 was 9 on 19 August. Much fewer waders were observed in 2023 than 2022 when on two weekends, 22 and 26 waders were counted each afternoon.

Reach 3 on 23 July and 21 August. Waders and swimmers have been commonly observed in the lagoon during warm, sunny, weekend afternoon monitorings since 2016 and not previously (usually near the beach in Reach 1; 6 of 12 afternoon monitorings in 2022). The most waders observed at one time during monitoring in 2022 was 26 on 11 June in Reach 1 in the afternoon (22 observed on 25 June).

The common congregation of mallards in Margaritaville Cove in 2023 resulted from feeding by diners at Esplanade restaurants. As in previous years, mallard ducks patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on regularly there. This feeding should be discouraged because it is unhealthy. Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria from their excrement. They forage through human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on buildings surrounding the lagoon. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been successful in other locales to prevent gull roosting.

The parallel wires strung across the roof of the Paradise Grill and other Esplanade 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, Public Works staff, pers. comm.**). 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 since 2016 has interfered with gull use in Reach 1. Gulls take wing when recreationists appear in/on their floatation devices and return quickly to bathe and congregate after they passed. Gulls avoid waders along the lagoon periphery near the flume. Human impact from gull disturbance upon 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. On 3 monitorings in 2023 at dawn, Site 3 under the railroad trestle had the lowest oxygen concentration of the lagoon sites (**Figures 6a-1**). However, oxygen levels were ample for steelhead higher in the water column in all cases. Afternoon oxygen levels at Site 3 were the highest in the lagoon on days when morning oxygen levels were lowest of all the sites (**Figure 6a-2**). This indicates that higher algal production under the trestle may be responsible with higher respiration at night and higher photosynthesis during the day leading to the extremes in oxygen levels. Greater algal production was likely caused by gull and pigeon excrement as a bio-nutrient stimulant. These birds commonly roosted on the railroad trestle. As stated in the original Management Plan, the trestle could be screened to eliminate pigeon roosting areas.

Gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch in the past. Gray water was observed from Noble Gulch during sandbar construction and on 2 of 12 monitorings during the lagoon period.

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. An example of urban runoff likely leading to fish mortality was in 2022, when much of Bay Avenue in Capitola was repaved that summer. For the first time in 32 years of lagoon monitoring, steelhead mortality was observed in Reaches 1 and 2 of the lagoon after the first flush runoff on 18 September. Mortality of starry flounder and staghorn sculpin also occurred. Thorough street cleaning of freshly repaved streets may reduce pollution from urban runoff.

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 chronic pollution problem and high flashiness in streamflow during the first small storms of the fall, as occurred in mid-September 2022. 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 2022, the lagoon required emergency breaching because the flume could not accept all of the stormflow with flooding imminent. Although costly, 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.

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, as a pilot project, tules were planted in the cove under the railroad trestle. Some of the original plantings survived the relatively mild winter of 2017-2018 and the heavier stormflows of the 2018-2019 winter. They persisted in 2020 after a moderate winter and then expanded and grew to their greatest height in 2022 after a very mild winter. The tules persisted in 2023 after a wet winter. Additional tules were planted under the trestle during sandbar construction in 2023. City staff will continue to monitor and look into augmenting plantings in additional areas in the creek that would serve as good habitat.
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LAGOON AND ESTUARY FORMATION

Results of Fish Relocation during Construction Activities

22 May 2023. An atypical diagonal outlet channel had developed through the beach near the flume prior to sandbar construction. Streamflow moved quickly through this channel that was 9 feet wide at the upstream end and 20 feet wide at the surf. At 27.1 cfs (latest calibrated discharge at Soquel Village gage reading at 0600 hr; falsely reading 17.5 cfs that day), the water velocity was too great for tidewater goby to inhabit this channel. Alley and Public Works staff member, Jesse Franchi, dip-netted the diagonal channel on 22 May to capture and relocate fish to above the Stockton Bridge before the channel was covered over with sand. The diagonal channel was used by staghorn sculpins (*Leptocottus armatus*). No other species were detected. There were no fish mortalities during the fish relocation. Each day during sandbar construction when the sandbar was opened in the morning, Public Works staff and Alley raked kelp and seagrass from the lower estuary through the outlet channel Alley surveyed upstream each day to search for potentially stranded fish as the water surface went down. Fish observed and relocated are summarized in **Table 1.** A Southwestern Pond Turtle (*Actinemys marmorata pallida*) was observed in the main channel on 25 May in Reach 3.

Table 1. Fish and turtles observed and relocated during sandbar construction, 2023.

Date	Location	Tidewater goby (Observed/ Relocated)	Juvenile Steelhead (Observed/ Relocated)	Threespine stickleback (Observed/ Relocated)	Staghorn sculpin (Observed/ Relocated)	Prickly sculpin (Observed/ Relocated)	Sacramento Sucker (Observed/ Relocated)	Southwestern Pond Turtle (Observed/ Relocated)
5-22	**Diagonal Outlet Channel**	0/0	0/0	0/0	10/10	0/0	0/0	0/0
5-24	**Stockton Ave Bridge to upstream of Shadowbrook Restaurant**	0 /0	1 /0 stranded	0 /0 stranded	2/2 stranded and relocated	2/ 1 stranded/1 relocated	1/ 0 stranded	0/0
5-25	**Stockton Ave Bridge to upstream of Shadowbrook Restaurant**	0/0	0/0	Approx. 200 YOY and 1 adult/ 0 stranded	0 /0	0 /0	0/0	1/ 0 stranded

Monitoring of Flume Maintenance and Sandbar Construction

22 May 2023. The biologist arrived at 0607 hr. An atypical diagonal outlet channel had developed through the beach near the flume prior to sandbar construction. Streamflow moved quickly through this channel that was 9 feet wide at the upstream end and 20 feet wide at the surf. At 27.1 cfs (latest calibrated discharge at Soquel Village gage reading at 0600 hr; falsely reading 17.5 cfs that day), the water velocity was too great for tidewater goby to inhabit this channel. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. Alley surveyed the margin of the lower lagoon for juvenile coho salmon. None were observed. Alley and a Public Works staff dipnetted staghorn sculpin from the outlet channel. Public Works staff provided an underwater portal in the flashboards that filled the flume inlet, and they notched the top board to further facilitate fish passage. Kotila covered the outlet channel with sand, and a berm was graded around the lagoon periphery. All streamflow was directed through the flume. Kotila buried some of the drift wood that had collected on the beach during the winter. Alley left at 1430 hr.

23 May 2023. Alley arrived at 0600 hr. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. Water was flowing through the flume, and the lagoon was very full. The water surface was approximately 6 inches above the flume, and the sand around the lagoon periphery was very saturated with water. The latest calibrated discharge at the Soquel Village gage was again 27.1 cfs at 0600 hr. Alley surveyed the margin of the lower lagoon for juvenile coho salmon. None were observed. Kotila opened the sandbar at 0650 hr. However, he began to lose too much sand to the outlet channel and closed it again at 0730 hr. The flashboards were removed from the flume inlet, and both sides of the flume inlet were screened. Flagged underwater portals were created in the screens on both sides for adult steelhead passage. The lagoon level increased during the night and provided adequate smolt passage through the flume. The berm was raised and reinforced around the lagoon periphery. The biologist left at 1540 hr.

24 May 2023. Alley arrived at 0547 hr. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. The lagoon had completely filled overnight, with a latest calibrated discharge of 27.1 cfs at 0600 hr at the Soquel Village gage (falsely reading 17.5 cfs that day). The flume inlet screens had been removed to increase flow through the flume. Alley surveyed the margin of the lower lagoon for juvenile coho salmon. None were observed. Considerable gray water was exiting Noble Gulch into the lagoon. The sandbar was opened at 0615 hr. Alley surveyed upstream for potentially stranded fish from 0910 hr to 1030 hr. Fish observed were 2 prickly sculpin (one relocated), 2 staghorn sculpin (both relocated), an adult Sacramento sucker and a steelhead smolt (**Table 1**). Public Works staff, Cooper Sanden, inspected inside the flume for cracks in the epoxy lining and reported findings to Kailash Mozumder through open manholes on the flume. Later in the day a mole was observed near the flume inlet. Alley relocated it under the pier. Gulls had been attacking it on the beach. The weir inside the flume was intact to insure a splash pool for out-migrating steelhead. The sidewalk drains that empty into the lagoon were covered this day to prevent trash and cigarette butt deposits into them. Kotila closed the sandbar at 1200 hr at low tide, and the screens were inserted into the flume inlet. The biologist left at 1330 hr.

25 May 2023. Alley arrived at 0608 hr. The lagoon was full. The screens on the flume inlet had

been removed, and the lagoon was full with the latest calibrated discharge of 27.8 cfs (0600 hr) at the Soquel Village gage (falsely reading 18.2 cfs that day). Streamflow passed through the flume to provide steelhead passage the previous night. Alley surveyed the margin of the lower lagoon for juvenile coho salmon. None were observed. Kotila opened the sandbar next to the flume at 0749 hr. Alley surveyed upstream for potentially stranded fish from 0930 hr to 1030 hr. One southwestern pond turtle was observed in the main channel across from Noble Gulch and downstream of the only west side cabin (Golino's cabin) (**Table 1**). A cloud of approximately 200 small YOY fish (likely threespine stickleback) was observed in a deep side pool beside an alder rootwad that had created scour. One adult stickleback was observed in a side pool further downstream. Additional tules were planted in the cove beneath the railroad trestle. Public Works provided 7 rakers who moved decomposing plant material from the estuary from 0920 to 1030 hr. Kotila packed the sand around the flume inlet. Clear visquine was laid around the flume inlet. Kotila closed the sandbar at low tide for the dry season at 1152 hr. Public Works staff surrounded the flume inlet with sandbags to prevent water seepage under the flume and covered the visquine with sand, using shovels. Screened frames were installed in the flume inlet to complete lagoon preparation at 1210 hr. Kotila continued to grade sand to the berm around the lagoon periphery. Alley left the lagoon at 1300 hr.

Diagonal outlet channel nearer the flume than usual. 22 May 2023

Fast-moving outlet channel with Ed Morrison walking alongside. 22 May 2023

Log collected on Stockton Bridge abutment, offering fish cover. 22 May 2023

Steelhead passage provided through the flume inlet. 22 May 2023

Very full lagoon with water surface above the flume inlet in early morning. 23 May 2023

Steelhead passage provided the previous night. 23 May 2023

Early morning lagoon with overhanging box elder and willow. 23 May 2023

Tules survived the winter under the railroad trestle. 23 May 2023

Screened flume inlet covered with plywood because steel plate and grate were lost over the winter. 23 May 2023 (Replacement steel grate installed by 24 June 2023)

Flume inlet with screens pulled in early morning, lagoon filled overnight. 24 May 2023

Flume providing fish passage the previous night. 24 May 2023

Outlet channel cut through sandbar next to the flume. 24 May 2023

Sidewalk drains covered. 24 May 2023

Intact weir inside the flume near the inlet. 24 May 2023

Cooper Sanden inspects the flume for cracks in the epoxy lining. 24 May 2023

Public Works staff raking decomposing kelp from the lower estuary. 24 May 2023

Potential location (looking upstream) for future tule planting on west bank, downstream of the west side cabin along a protected margin. 24 May 2023

Kotila contouring western lagoon bottom and flume inlet pad above the water line during estuary drawdown. 24 May 2023

Deep hole beside Venetian Court wall. 24 May 2023

Flume inlet with screens pulled in early morning. Lagoon filled overnight. 25 May 2023

Flume providing steelhead passage the previous night. 25 May 2023

Southwestern pond turtle observed in main stream channel 25 May 2023

Tule planting under the railroad trestle 25 May 2023

Small fish (likely YOY threespine stickleback) near alder rootwad. 25 May 2023

Entrained redwood log adjacent to restaurant pilings. 25 May 2023

Public Works staff raking decomposing kelp from estuary. 25 May 2023

Estuary at maximum drawdown. 25 May 2023

Public Works staff covering visquine with sand at flume inlet. 25 May 2023

Pad completed around flume inlet. 25 May 2023

Screen installed in flume inlet with underwater portals. 25 May 2023

30 May 2023. Alley measured water quality at the Venetian Court wall. A pocket of saltwater was detected in the lower 0.25 meter of the lagoon water column. However, water temperature was only slightly elevated in this localized saline layer and did not warrant placement of the shroud on the flume inlet, considering the ample streamflow passing through the lagoon to dissipate the saline layer. No saltwater was detected in shallower areas upstream of Stockton Bridge. The flume inlet was obstructed with leaves and small woody debris. Alley notified Kotila of the problem.

31 May 2023. Public Works staff cleaned the flume inlet screen.

Steelhead smolt passage under the plywood cover at head of the flume. 30 May 2023. (The replacement stainless-steel grate was installed by 24 June 2023.)

Flume inlet screen cleaned of debris. 31 May 2023

Effects of Sandbar Construction on Tidewater Goby and Steelhead in 2023

No tidewater gobies or steelhead were observed or relocated from the fast moving outlet channel through the beach during sandbar construction in 2023. Construction occurred after a very wet winter/spring with at least 6 bankfull events in Soquel Creek. With the very limited overwintering fish cover in the estuary, we suspect from experience that most tidewater gobies were flushed from Soquel Creek over the winter. Three manual breaching of the sandbar with partial drawdown occurred during sandbar construction. The drawdown was slow, with very slight water velocity beyond approximately 25 feet from the flume inlet, and slackwater was present along the margin of the lagoon during drawdown that could have provided refuge for tidewater goby. Any tidewater gobies potentially present in the upper lagoon (Reach 3),

upstream of the railroad trestle would need to retreat to the deeper slackwater in the main channel as the estuary drew down, which was similar to daily tidal fluctuations when the sandbar was open prior to construction. The smooth lagoon bottom in the center channel above the railroad trestle and smooth sloping of the lagoon margin adjacent to the Shadowbrook restaurant prevented isolated pools from developing during drawdown that may strand tidewater gobies, steelhead and or other fishes. Only stranding of 3 sculpins was observed at the base of wooden pilings. Tidewater gobies prefer to nest in freshwater, upstream of lagoon areas that are subjected to tidal and salinity fluctuations, especially when very high tides occur. The lower estuary locations as far upstream as at least Noble Gulch confluence are subjected to tidal fluctuations with saltwater mixing. Because of the slow, partial drawdowns during sandbar construction in 2023, lagoon width was maintained, and slackwater was abundant, likely having little effect on tidewater goby distribution. Where some lagoon bed was temporarily dewatered in Reach 3, located upstream of the railroad trestle to just beyond Shadowbrook Restaurant, did not strand tidewater gobies or steelhead, based on survey observations. Tidewater goby nesting likely occurred where loss of lagoon margin was minor. We detected no tidewater goby mortalities during drawdowns and flume preparations, with minimal recession of the lagoon margin downstream of Stockton Avenue Bridge. We judged impacts to tidewater gobies to be minor during sandbar construction in 2023, and no fish mortalities were observed.

The channel in lower Soquel Creek lacks sheltered backwaters for tidewater gobies to escape high water velocities during high stormflows, except possibly under the Esplanade restaurants. Some of the tules planted in the backwater beneath the railroad trestle in June 2017 survived the winter and may serve as overwintering habitat for tidewater goby in the future if they continue to grow and multiply. Additional tules were planted under the railroad trestle during the 2023 sandbar construction effort. Because of the lack of winter escape cover, tidewater goby populations that have re-occurred at Soquel Lagoon during the dry years of 2008−2009, 2013−2016 and in 2020−2022 may be transitory.

No YOY steelhead were captured in the outlet channel in 2023. However, some YOY steelhead may have moved into the estuary from spawning areas above the lagoon. None were seen feeding on the surface during sandbar construction, however. With the late May sandbar closure in 2023, most steelhead smolt outmigration had likely been completed. One steelhead smolt was observed in the upper lagoon during sandbar construction. Salmonid smolts passively drift downstream at night and are facilitated by late spring stormflows, which occurred in late March to early May. The two late stormflows of 80 and then 50 cfs in early May 2023 likely encouraged late smolts to pass through to the Bay prior to sandbar construction. During the sandbar construction period, adults and smolts had access to the Bay through the flume.

Our data collected on smolt out-migration and YOY downstream movements in the lower San Lorenzo River just above the estuary in the late 1980's during drought indicated that smolt out-migration had ended by June, when YOY had begun drifting into the estuary (**Alley, personal observation**). Predatory mergansers were observed on two days of sandbar related construction by Alley and Morrison. But deeper slackwater existed for steelhead refuge downstream and upstream of Stockton Bridge on the west side for about 100 m under overhanging box elder and willows providing shade and cover. These areas offered ample refuge for juvenile steelhead during manual estuary drawdown. The lower lagoon bottom was uniformly wide and flat to

minimize water velocity during the slow drawdown. No high water velocity conditions developed above the entrance of the outlet channel in 2023, and considerable slackwater refuge existed during drawdown when smolts would seek refuge during daylight hours. With all factors considered, we judged impacts to steelhead to be minor during sandbar construction, and no salmonid mortalities were observed in 2023.

The seasonal effect of typically removing organic material and constructing the sandbar is to create good summer rearing habitat for salmonids and tidewater goby. Compared to allowing unmanaged 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 plant respiration. Kelp and seagrass removal, when necessary, and sandbar closure create better fish habitat for tidewater goby and salmonids than if the sandbar was allowed to close without management, and trapped kelp and seagrass was left to decompose.

In 2023, the sandbar likely would have closed permanently for the summer several weeks after the timing of the managed closure. The unmanaged lagoon would have had more decomposing kelp and seagrass trapped than the constructed lagoon. Less saltwater was trapped in the lagoon in 2023 compared to unmanaged conditions because no tidal overwash or tidal inflow of saltwater occurred after 22 May. Under unmanaged sandbar conditions, a lagoon would have formed with more saltwater trapped to create a thicker, unmixed, anoxic lagoon bottom, which would collect more heat and raise lagoon water temperature higher than will occur with the flume and high sandbar berm now functioning during the dry season of 2023. The unmanaged 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 by perpetuating the stagnant saltwater lens on the bottom, making the lagoon less hospitable for salmonids and tidewater gobies. Under constructed conditions, the lagoon will convert completely to freshwater to maintain better conditions for fish (deeper, cooler, better oxygenated) than would have occurred under unmanaged conditions. With a freshwater lagoon created by management, the entire water column circulates to the water surface with onshore breezes to be cooled by the cooler night air. By morning, the entire water column is at the same minimal temperature.

Emergency Sandbar Breaching and Post-Breaching Bacterial Monitoring

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 piling bolt is at elevation 9.25 ft mean low low water (mllw) and 1.77 ft above the top of the flume, which is at 7.48 ft mllw. 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 original bolt. A red line is present on a piling to indicate this elevation. The environmental 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 constructed in the flume inlet in 2003.

Typically, 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.

By 6 November, Kotila cut a 30-foot wide notch across the beach with an inner berm constructed near the lagoon periphery and an outer berm constructed near the surf to prevent wave action with high swells to open the sandbar without stormflow. On 7 November, the shroud that had been installed after tidal overwash in October was removed, along with 2 flashboards from the east side and 1 flashboard from the west side, in anticipation of rain. On 14 November, 2 more flashboards were removed from the east side in preparation of stormflow.

At about 0600 hr on 18 November, Alley was notified by Morrison by phone that a facilitated sandbar breaching was imminent to prevent flooding. The breaching was facilitated by Kotila with a loader at 0658 hr, with a Soquel Village gage streamflow estimate peaking at 77.4 cfs at 0630 hr and declining to 71.8 cfs at 0700 hr, 2 miles upstream of the lagoon. Surface runoff from Capitola streets added to the gage estimate. Alley arrived on the beach at 0703 hr, 5 minutes after the breach. The estimated capacity of the flume is between 30 and 35 cfs. Four boards had previously been removed from the flume inlet to facilitate water passage through the flume. The lagoon water surface had increased to the original restaurant piling bolt at the time of the breach and declined to 2 inches below the bolt by 0706 hr. The management goal is to breach the lagoon if it reaches this bolt. No flooding into streamside properties occurred. Water spilled over the bulkhead at Stockton Bridge. The beach was flagged with caution tape on either side of the outlet channel. However, before this occurred, 4 teenage surfers approached the outlet channel to surf its standing waves. Public Works staff stopped them and successfully turned them away. The water sample required by the Water Resources Control Board was collected by Kotila. The sandbar was now open for the wet season.

Kotila delivered water samples to Monterey Bay Analytical Services that were collected before and after sandbar opening water samples taken at the mouth of Soquel Creek. Lab analysis indicated that the pre-opening enterococcus bacterial count was 12,033 cfu/100 ml on 18 November. The post-opening count on 18 November was 2,682 cfu/100 ml, requiring additional weekly water sampling until the count was less than 104 cfu/100 ml. Water quality sampling ended on 1 December 2023 with an Enterococcus bacterial count of <10 cfu/ 100 ml.

Beach notch with inner and outer berms. 6 November 2023

Mouth of outlet channel through sandbar at sandbar opening. 0708 hr, 18 November 2023

Outlet channel through sandbar at sandbar opening. 0708 hr, 18 November 2023

Outlet channel through sandbar at sandbar opening. 0711 hr, 18 November 2023

City of Capitola
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831.375.MBAS (6227)
www.MBASinc.com
ELAP Certification Number: 2385

Wednesday, November 29, 2023

Sample Results

Lab Number: 231118_08-01

Collection Date/Time: 11/18/2023 6:00 | Sample Collector: Kotila M | Client Sample #:
Received Date/Time: 11/18/2023 9:33 | System ID: | Coliform Designation:

Sample Description: Pre-Breach Lagoon Water @Ocean

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time	Analyst
Enterococci	Enterolert	MPN/100mL	12033		10	10	11/18/2023 13:20	DH

Comments:

Report Approved by: David Holland, Laboratory Director

The results in this report are related only to the samples analyzed.
This certificate of analysis shall not be reproduced except in full, without written approval of the laboratory.

Abbreviations/Definitions: mg/L: Milligrams per liter (=ppm) | µg/L: Micrograms per liter (=ppb) | MPN: Most Probable Number
MDL: Method Detection Limit | PQL: Practical Quantitation Limit | MCL: Maximum Contamination Level | ND: Not Detected at the PQL (or MDL, if shown)
E: Analysis performed by External Laboratory, see Report attachments | H: Analyzed outside of method hold time | QC: Quality Control
J: Result is < PQL but ≥ MDL, the concentration is an approximate value.

11/29/23 SS

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Monday, December 4, 2023

Sample Results

Lab Number: 231201_14-01

Collection Date/Time: 12/1/2023 10:00 Sample Collector: Nerdens, S Client Sample #:
Received Date/Time: 12/1/2023 10:55 System ID: Coliform Designation:

Sample Description: Main Beach

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time	Analyst
Enterococci	Enterolert	MPN/100mL	<10		10	10	12/1/2023 14:51	TWH

Comments:

Report Approved by: David Holland, Laboratory Director

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12/4/23 RO

WATER QUALITY MONITORING IN 2023

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 21.6 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 1.86 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, 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, 6 HOBO temperature loggers were launched on 7 June 2023, just downstream of the railroad trestle in Reach 2 (as in 2008−2022) 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 8 October 2023 prior to sandbar opening.

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. Saltwater was detected as a thin layer in 2023 in the lagoon 4 days after the sandbar closure.

Because the saline layer was very dilute with water temperature cool within it and stream inflow was relatively high, the biologist did not recommend placement of a shroud on the flume inlet as it was unnecessary.

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	21.6-23	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 environmental goal for water temperature with regard 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. The early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). The lagoon environmental goal is somewhat higher in temperature than the enhancement goal that we established for Soquel Creek upstream during the development of a watershed plan, 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 water temperature between 20 and 24ºC was 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, San Jose State University, pers. comm.**). Therefore, the environmental target for making Soquel Creek Lagoon habitable for coho should be to maintain water temperature below 20ºC (68ºF). The 2010 lagoon was the coolest in the previous 21 years, with relatively high baseflow and a deeper lagoon. Water temperature near the bottom exceeded 20° C for only a 3-day period in early June and a 4-day period in mid-July in 2010. However, it is unlikely that the lagoon will cool sufficiently to support juvenile coho salmon in most years.

The environmental 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 later summer baseflow, and juvenile salmonids are rapidly feeding and growing. From June 1 to September 1, 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 by Farrel et al. (**2015**) and 5) our data on steelhead growth rate and water temperature in Central Coast steelhead streams. They are also 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 environmental 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 after a mild winter 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 during drought.

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Depth

Gage height in 2023 was consistently near the highest recorded through the last 4 years at above a gage height of 2.50 from early July until late September and then again in November (**Figure 2**). **Appendix A** provides detailed water quality and lagoon height data. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was rated "fair" during the first 2-week monitoring (10 June) and rated "good" for the remainder of the monitoring period until 11 November, the last monitoring before the sandbar was opened. It is important to note that the staff gage does not extend to the lagoon bottom. For example, on 21 September 2022 at the gage reading of 0.07 ft, water depth just above Stockton Bridge where the staff plate is positioned was 0.5 m (1.6 ft), which represented much of the lagoon from Stockton Bridge up to and beyond Noble Gulch and the Shadowbrook Restaurant. In 2023, tidal overwash occurred on 19 October, and Kotila installed a shroud on the flume inlet. The lagoon depth remained in the "good" zone at 2.28 ft on the staff plate. After Kotila installed the shroud, the lagoon level increased to over 2.50 ft by 28 October and remained high through 11 November, despite the shroud being removed along with 2 flashboards on the east side and 1 board on the west side on 7 November. This was prior to rain forecasted and the facilitated breach on 18 November 2023.

With proper flume management and the grated flume ceiling installed in 2003, it has been easier to maintain lagoon depth and prevent fluctuations in lagoon level when the summer begins with high baseflow. During the summer of 2023, baseflow was consistently high at above 8 cfs through mid-August. But streamflow dropped precipitously to 2 cfs by 2 September, according to the gage, and remained there through the mid-September monitoring. Streamflow estimates at the USGS Gage after that until the last streamflow estimate of 2.4 cfs on 11 November were inaccurately high presumably due to rock dam building downstream of the streamflow gage. Despite the decline in streamflow through the dry season of 2023, lagoon depth was maintained in the good range. Typically, it is more difficult for the City to maintain the highest water surface elevation after wetter winters that bring higher baseflow during the summer.

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 2023. The flume outlet was maintained open throughout the sandbar construction period for nocturnal smolt and adult steelhead passage.

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, and was not covered until early September, well after smolt passage requirements were met. The shroud was installed in late October after tidal overwash. But this was long after fish passage requirements were necessary. It was removed on 7 November, prior to sandbar opening on 18 November. The flume as open to the Bay throughout the dry season.

Water Temperature Results from Two-Week Monitorings at Lagoon Stations

Air temperature is an important factor in determining lagoon water temperature. It partially determines the overnight cooling of the lagoon as overnight breezes circulate the entire freshwater column to contact with surface air. The warmer the air temperature at night, the less the lagoon will cool overnight. A second factor affecting lagoon water temperature and cooling is the inflow rate from Soquel Creek. Soquel Creek is cooler than the lagoon. So, the more inflow from the creek, the cooler the lagoon water temperature will be. Air temperatures were cooler in 2023 than 2022 in June and July and warmer than 2022 in August and September (**Figure 3f**). Lagoon water temperatures were much cooler in 2023 compared to 2022 throughout that period due to higher baseflow in 2023, with additional cooling from cooler air the first two months (**Table 9; Figures 3i and 3j**). Water temperature in 2023 near the bottom at lagoon monitoring stations in the morning and afternoon were cooler compared to those in the lower baseflow year of 2022 from mid-June through September despite warmer inflow temperatures from mid-August through September in 2023 (**Figure 3k**). This is because the lagoon warmed up considerably more during the day in 2022 with the low inflow rate than in 2023 with the much higher inflow rate (**Table 9**). Average water temperatures in the afternoon in 2023 were most similar to conditions in other higher baseflow years of 2017 and 2019.

Fluctuations in lagoon water temperatures near the bottom where steelhead would mostly inhabit tracked well with Soquel Creek water temperature in 2023, as in past years, except in mid-September when stream inflow was relatively warm in the morning (**Figures 3g and 3h**). Lagoon water temperatures near the bottom were mostly 1−2.5°C warmer than the inflow temperatures in the morning for June through early September. However, unlike other years, the afternoon lagoon in 2023 remained cooler than stream inflow in June and July when the morning and afternoon air temperatures were so relatively cool.

Saltwater trapped in the lagoon also affects water temperature where saltwater lenses form in deeper pockets. Heavy, stagnant saltwater lenses on the lagoon bottom become warm and anoxic because they cannot circulate to the water surface overnight to cool. Water temperatures were elevated near the bottom at the deep Station 2 near Stockton Bridge after tidal overwash in October (**Figures 3b, 3g and 3h**).

In most years, morning lagoon water temperatures near the bottom are coolest at the upper Station 4 (mouth of Noble Gulch) and are warmer progressively downstream. In 2023, the coolest temperature was generally at Station 4. But with the higher streamflow through the lagoon and the relatively deep lagoon, water temperature at the other 3 stations was very similar without the progressive pattern through mid-September (**Figure 3g**). At dawn in 2023, lagoon Station 4 was often the coolest near the bottom (**Figure 3g**). In 2023, water temperatures near the bottom at dawn were rated "good" at all lagoon stations (<20 °C) on 11 of 12 sampling days throughout the dry season, with a "fair" rating at 3 of 4 stations on 19 August (**Tables 2 and 3**). Site 4 was in the "good" range throughout the dry season.

In the afternoon lagoon in 2023, Station 1 was generally the warmest near the bottom, while Station 4 generally remained the coolest. These are typical annual patterns. In the afternoon lagoon in 2023, Station 1 at the flume and Station 3 at the trestle had the warmest water

temperature near the bottom of 20.9 °C on 19 August (**Figure 3h**). The warmest surface water temperature that day was 21.4 °C at Station 4. At Station 1 in the afternoon in 2023, water temperature near the bottom ranged from 16.4 to 20.9 °C between mid-June and mid-September compared to 21.7 to 24.4°C in 2022. At the coolest Station 4 at the mouth of Noble Gulch, water temperatures in the afternoon ranged from 15.8 to 19.4 °C in 2023 compared to 19.3 to 22.4°C in 2022. In 2023, the water temperature goal to keep maximum daily afternoon water temperature below 22°C near the bottom was met at all stations throughout the dry season. In 2023, the warmest water temperatures occurred from early July to mid-August and peaking in mid-August.

Table 3. 2023 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	Salin-ity	Lagoon In-flow Esti-mated @ 0.5 cfs less than Soquel Village Gage Readings (cfs)
30May23 (Station 2 only)	open	2.99 good	good	fair	good	26.5 cfs
10June23	open	2.08 fair	good*	good	good	18.9 cfs
24June23	open	2.55	good	good	good	17.5 cfs
08July23	open	2.58	good	good	good	12.9 cfs
21July23 (foggy)	open	2.69	good	good	good	8.2 cfs
05Aug23 (overcast)	open	2.68 good	good	good	good	7.4 cfs
19Aug23 (overcast)	open	2.41 good	fair fair fair good	good	good	8.3 cfs
02Sep23	open	2.34 good	good	good good fair good	good	1.9 cfs
16Sep23 (overcast)	open	2.73 good	good	good good poor good	good	1.9 cfs
30Sep23 (light showers on 29Sep23)	open	2.78 good	good	good fair critical fair	good	4.1 cfs (inaccurate)
14Oct23	open	2.65 good	good	good	good	5.9 cfs (inaccurate)
28Oct23 (after tidal overwash)	open	2.55 good	good	good critical good fair	good	5.2 cfs (inaccurate)
11Nov23	open	2.53 good	good	good critical good good	good	2.4 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 and bedrock outcrop, results were consistent with temperature data collected at 2-week intervals through the water column at monitoring stations over the past 33 years. Keep in mind that our 2-week monitoring at Station 3 near the railroad trestle was closest to these data loggers. The following analysis pertains to the vicinity of these continuous data loggers only. A 7-day rolling average on any particular day was calculated from averaging the 7 day period beyond that date. All lagoon water temperature environmental goals were met for steelhead in 2023 except for 4 days in mid-August, as they were met after another wet winter in 2019. None were met in 2022, with warmer water temperatures after a dry winter.

Juvenile steelhead likely spend most of their time near the bottom to avoid predators 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 and oxygen concentration recorded near the lagoon bottom (0.5 feet from the bottom) have greatest relevance to assessing habitat quality in the lagoon.

Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead. Therefore, an environmental goal to maintain a daily water temperature maximum below 22ºC near the bottom in the afternoon. For fish, as water temperature increases, their metabolic rate and food demand increase while scope for activity may decline. The 22°C maximum temperature goal was met in 2023 (**Figure 4a**). By comparison, it was not met in 2022 for the first 10 weeks of the lagoon period until mid-August except 5 days in mid-June and then was met afterwards except for 11 days from 7 September to 17 September before the first stormflow (**Figure 4g**). It was met in 2019 and 2020 except for 5 days in mid-August 2020 (**Figure 4h; Alley 2021**).

A second lagoon environmental goal is to maintain early morning water temperature below 20°C near the bottom. In 2023, this goal was met except 15-18 August (**Figure 4a**). In 2022, this goal was met only 4 days in mid-June and after the first stormflow on 18 September (**Figure 4g**). A third goal is to maintain the 7-day rolling average near the bottom at 21°C or less. In 2023, it was met at the data logger. By comparison in 2022, it was met for only 5 days in mid-June and after mid-September. The 7-day rolling average near the bottom exceeded 20°C for 12 days in August 2023 and for more than 13 continuous weeks in 2022 from early June to mid-September.

We see from **Table 4** and **Figure 4i** that in wetter years (2006, 2010-2012, 2017, 2019 and 2023) the lagoon temperature environmental goals near the bottom for steelhead were mostly met (20°C daily maximum at dawn; 22°C daily maximum by early evening; 7-day rolling average <= 21°C). Lagoon water temperature has typically been warmer in years with reduced baseflow entering, such as drought years of 2009, 2013-2015 and 2021-2022, as indicated by maximum and minimum temperatures and maximum, minimum and average 7-day rolling averages. But air temperature also contributes to stream inflow temperature to determine lagoon water temperatures, as when summer air temperature was cooler in 2016 (**Alley 2021**), allowing environmental goals to be met, and when air temperature was warmer in August and September 2017 (**Figure 3f**), causing environmental goals not to be met, despite high baseflow.

The difference between inflow average 7-day rolling average temperature and lagoon average 7-day rolling average temperature near the bottom is less during higher baseflow years (2010-2012, 201, 2019 and 2023) (**Alley 2020**). Typically, the lower the baseflow, the higher the stream inflow temperature will be. However, in 2023 despite having higher baseflow than in 2022, early morning water temperature of stream inflow at Nob Hill was warmer than in 2022 in July and August (**Figures 5a-b**). The 2019 baseflow year yielded the typical cooler stream inflow water temperatures (**Figures 5c**). With the continuous data loggers, when the daily temperature *maxima* and *minima*, as well as the overall maximum, minimum and average 7-day rolling averages were compared between the lagoon and the stream, all metrics were warmer in the lagoon than in the stream inflow (**Table 4**). These lagoon metrics also greatly decreased in 2023 near the lagoon bottom compared to 2022 metrics and to those in other lower baseflow years of 2020 and 2021. However, when the metrics were compared between years for the stream inflow, the maximum water temperature, maximum 7-day rolling average and average 7-day rolling average were higher in 2023 than in 2020-2022, despite the higher baseflow in 2023.

As in past years, in 2023 no lagoon thermocline developed. A thermocline has a warm, well-mixed, oxygen-rich epilimnion above it and a cool, non-circulated, oxygen-poor hypolimnion below. The data loggers were collected on 8 October, prior to tidal overwash. So, the stagnant saline layer that developed afterwards that caused stratification of water temperature and oxygen was not detected. Prior to the tidal overwash, the lagoon was subject to daily inland breezes that circulated the fresh water from surface to bottom. There was complete, diurnal (daily) mixing of the water column at the data loggers (**Figures 4a-4f**). In most years, water temperature was cooler nearer the bottom and warmer near the surface, based on the continuous data loggers. This was the case in 2023.

Table 4. Water Temperature Statistics from Continuous Water Temperature Probes at 30-Minute Intervals in Soquel Lagoon after Freshwater Conversion and Immediately Upstream. (Late May to 15 September in 2013−2023.)

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
2023	Maximum Water Temperature °C	**22.0 (22 Aug)**	**21.8 (17 Aug)**	**21.3 (17 Aug)**
2023	Minimum Water Temperature °C	**13.6 (8 June)**	**15.2 (8 June)**	**14.7 (8 June)**
2023	Maximum 7-Day Rolling Average*	**19.7 (17 Aug)**	**21.1 (17 Aug)**	**20.3 (17 Aug)**
2023	Minimum 7-Day Rolling Average	**16.0 (8 June)**	**16.9 (8 June)**	**16.4 (8 June)**
2023	**Average 7-Day Rolling Average**	**18.2**	**19.5**	**18.9**
2022	Maximum Water Temperature °C	**20.4 (11 June)**	**25.0 (12 Aug)**	**24.7 (11 Aug)**
2022	Minimum Water Temperature °C	**14.7 (1 June)**	**18.2 (1 June)**	**19.3 (20 June)**
2022	Maximum 7-Day Rolling Average*	**18.9 (5 Aug)**	**24.0 (7 Aug)**	**23.7 (7 Aug)**
2022	Minimum 7-Day Rolling Average	**16.7 (31 May)**	**20.6 (15 Sep)**	**17.6 (15 Sep)**
2022	**Average 7-Day Rolling Average**	**17.8**	**22.2**	**22.0**
2021	Maximum Water Temperature °C	**19.8 (12 Aug)**	**23.4 (10 July)**	**23.2 (10 July)**
2021	Minimum Water Temperature °C	**15.6; 15.8 (14 Sep; 26 Aug)**	**19.7 (26 Aug)**	**19.4 (26 Aug)**
2021	Maximum 7-Day Rolling Average*	**18.3; 18.1 (26 June; 5 July)**	**22.2 (5 July)**	**22.1 6 July)**
2021	Minimum 7-Day Rolling Average	**16.2 (11 Sep)**	**19.7 (14 Sep)**	**19.6 (13 Sep)**
2021	**Average 7-Day Rolling Average**	**17.4**	**21.4**	**21.2**
2020	Maximum Water Temperature °C	**21.3 (16 Aug)**	**23.6 (16 Aug)**	**23.2 (16 Aug)**
2020	Minimum Water Temperature °C	**14.1 (3July, 12 Sep)**	**16.0 (15 Sep)**	**16.4 (3 July)**
2020	Maximum 7-Day Rolling Average*	**19.0 (13 Aug)**	**21.2 (13 Aug)**	**21.8 (14 Aug)**
2020	Minimum 7-Day Rolling Average	**15.4 (9 Sep)**	**17.2 (9 Sep)**	**17.4 (10 Sep)**
2020	**Average 7-Day Rolling Average**	**16.7**	**18.8**	**19.2**

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
2019	Maximum Water Temperature °C	**20.2 (11 June)**	**24.4 (14 Aug)**	**21.0 (12 June)**
2019	Minimum Water Temperature °C	**14.5 (9,17,19,22,23,28 June)**	**14.5 22-23 June)**	**16.4 16-18, 21 June)**
2019	Maximum 7-Day Rolling Average*	**18.2 (Aug 29)**	**19.8 (9 Aug)**	**19.9 (Aug 29)**
2019	Minimum 7-Day Rolling Average	**15.2 (15 June)**	**16.7 (15 June)**	**17.3 (14 June)**
2019	Average 7-Day Rolling Average	**17.2**	**18.7**	**18.8**
2018	Maximum Water Temperature °C	**20.6 (22July, 4 Oct)**	**23.2 (25 July, 16 Aug)**	**22.1 (11 and 22 July)**
2018	Minimum Water Temperature °C	**12.9 (1 June)**	**16 (30 June, 5 July)**	**15.6 (17 June)**
2018	Maximum 7-Day Rolling Average*	**19 (19July)**	**21.9 (23 July)**	**21.3 (20 July)**
2018	Minimum 7-Day Rolling Average	**15.9 (13 June)**	**18 (28 June)**	**17.3 (15 June)**
2018	**Average 7-Day Rolling Average**	**17.7**	**19.9**	**19.3**
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 & 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**

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
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**

***Rolling averages were averaged for the 7 days forward from the date they were recorded on graphs and presented in this table.**

In 2023, a high baseflow year, the coho environmental goal of keeping maximum lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was met much of the dry period. It was not met 16 July to 18 July, 10 August to 30 August and 4 September (**Figure 4a**). Generally, the pattern has been that more days exceed the environmental goal as baseflow is reduced. Water temperature met the coho goal for the entire dry period only in 2011, a year with relatively high baseflow (**Table 9**). 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 mid-August to mid-September and generally warm inflow temperatures through the summer/fall, despite higher baseflow (**Alley 2018**).

The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2023, which was typical for previous years except 2010. The maximum daily lagoon water temperature near the bottom typically occurs between 1600 and 2100 hr.

Reach 1- Flume inlet with Venetian Court on left, Stockton Bridge in center and Margaritaville Cove on right. 30 September 2023

Flume outlet to the Capitola Beach and Monterey Bay. 30 September 2023

Reach1- Looking downstream from Venetian Court wall with waders along beach periphery of lagoon. 11 June 2022

Reach 3- Gulls roosting on lagoon-side houses beyond Noble Gulch. 11 June 2022

Soquel Creek at Nob Hill, looking downstream. 8 August 2021

Aquatic and Emergent Vegetation Monitoring.

In 2023, bottom algae developed slowly and no pondweed was observed. Filamentous algae increased in thickness and coverage through August (**Table 5**). It was most abundant in Reach 1 below Stockton Bridge and at the mouth of Noble Gulch in Reach 3. Although filamentous algae thickness was as much as 3.5 feet in patches, it usually averaged between 0.5 and 1.0 feet thick by Reach. Algae was thicker and covered more area in the two previous dry years that had higher water temperature, as well as in the wet year, 2019 (**Tables 6-8**). Lagoon monitoring was not funded in 2020, when only morning monitoring was done before aquatic vegetation became visible later in the day. Pondweed was common prior to 2023, especially in 2022. Pondweed had been scoured out during the winter 2022/2023 and apparently failed to recover in the coarser substrate of the lagoon bottom in 2023. Surface algae was mostly absent in 2023. It was not observed in Reach 1 or 2 on monitoring days. It was observed only once in Reach 3 at only 2% coverage in August. It was observed only twice at the mouth of Noble Gulch, that being in late July and early August at 10 and 20% coverage, respectively. Surface algae and pondweed fragments were more commonly observed in the two previous dry years, especially in Reach 3 and at the mouth of Noble Gulch, and in Reach 3 in 2019. This floating plant material was considerably more prominent in 2022 than in 2018, 2019 and 2021, and the 2021 lagoon had more than during the higher inflow year of 2019. Surface algae was also relatively high in previous drought years of 2014 and 2015, but with few pondweed fragments. Evidence of nutrient inputs from Noble Gulch in 2013−2015, 2017-2019 and 2021−2022 was expressed by recurrent thick planktonic algae blooms and sporadically high levels of surface algae nearby.

Tules had maintained themselves under the railroad trestle over the wet winter of 2022/2023. Additional tules were planted in that area during sandbar construction in 2023.

Absence of pondweed in Reach 3, looking upstream from the railroad trestle. 19 August 2023

Absence of pondweed in Reach 2, looking downstream from the railroad trestle. 19 August 2023

Tules in railroad trestle cove, looking upstream. Golino cabin on the west side, upstream. 30 September 2023

Table 5. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2023.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover
6-10	0.1 (no pond-weed)	100 film	**0**	0.1 (no pond-weed)	100 film	**0**	0.1 (no pond-weed)	100 film	**0**	0.1 (no pond-weed)	100 film	**0**
6-24	0.5 (no pond-weed)	30 (70 film)	**0**	0.5 (no pond-weed)	30 (70 film)	**0**	0.4 (no pond-weed)	20 (80 film)	**0**	0.2 (no pond-weed)	100 film	**0**
7-8	0.5 (no pond-weed)	30 (70 film)	**0**	0.5 (no pond-weed)	40 (60 film)	**0**	0.5 (no pond-weed)	15 (85 film)	**0**	0.3 (no pond-weed)	25 (75 film)	**0**
7-21	1.0 (no pond-weed)	90 (10 film)	**0**	0.5 (no pond-weed)	50 (50 film)	**0**	0.5 (no pond-weed)	20 (80 thick film)	**0**	1.5 (no pond-weed)	100	**10**
8-5	Invisible windy	Invis. windy	**0**	1.0 (no pond-weed)	60 (40 thick film)	**0**	1.0 (no pond-weed)	20 (80 thick film)	**2**	1.0 (no pond-weed)	100	**20**
8-19	1.0 (no pond-weed)	90 (10 film)	**0**	1.0 (no pond-weed)	50 (50 thick film)	**0**	0.5 (no pond-weed)	40 (60 thick film)	**0**	2.0 (no pond-weed)	70 (30 thick film)	**0**
9-02	Invisible cloudy	Invis. cloudy	0	Invis. cloudy	Invis. cloudy	0	Invis. cloudy	Invis. cloudy	0	Invis. cloudy	Invis. Cloudy	0
9-16	Invisible cloudy	Invis. cloudy	0	Invis. cloudy	Invis. cloudy	0	Invis. cloudy	Invis. cloudy	0	Invis. cloudy	Invis. Cloudy	0
9-30	Invisible cloudy windy	Invis. Cloudy windy	0	Invis. cloudy	Invis. cloudy	0	Invis. Cloudy windy	Invis. Cloudy Windy	0	Invis. Cloudy windy	Invis. Cloudy windy	0
10-14	0.5 (no pond-weed)	60 (30 film)	**0**	Invisible Shaded		0	Invisible Shaded	Invisible Shaded	0	2.5 (no pond-weed)	70 (30 thick film)	**0**
10-28	Invisible shaded		0	Invisible shaded		0	Invisible shaded		0	1.0 (no pond-weed)	100	**0**
11-11	Invisible shaded		0	Invisible shaded		0	Invisible shaded		0	Invisible Shaded		0
Avg-(when visible)	**0.6 algae (no Pond Weed)**	**67 Algae (no Pond Weed)**	**0**	**0.6 algae (no Pond Weed)**	**63 algae (no Pond-Weed)**	**0**	**0.5 algae (no Pond Weed)**	**49 Algae (54 Pond-weed)**	**0.2**	**1.1 Algae (3.4 Pond weed)**	**58 Algae (no Pond weed)**	**2.5**

Table 6. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2022.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover
6-11	0.2 (3.0 pond-weed)	50 (50 pond-weed)	**0**	0.1 (1.0 pond-weed)	60 (40 pond-weed)	**0**	0.2 (1.0 pond-weed)	70 (30 pond-weed)	**0**	film (2.5 pond-weed)	60 (40 pond-weed)	**0**
6-25	Invis. (4.0 pond-weed)	60 (40 pond-weed)	**0**	1.0 (2.0 pond-weed)	40 (60 pond-weed)	**0**	1.0 (1.5 pond-weed)	70 (30 pond-weed)	**0**	1.5 (3.5 pond-weed)	60 (40 pond-weed)	**0**
7-8	3.0 (5.0 pond-weed)	60 (40 pond-weed)	**<1**	2.5 (3.5 pond-weed)	30 (70 pond-weed)	**<1**	2.0 (3.0 pond-weed)	70 (30 pond-weed)	**<1**	1.5 (3.3 pond-weed)	60 (40 pond-weed)	**5**
7-23	2.0 (4.0 pond-weed)	50 (50 pond-weed)	**1**	2 (3.5 pond-weed)	30 (70 pond-weed)	**<1**	1.0 (3.0 pond-weed)	30 (70 pond-weed)	**<1**	Invis. (3.5 pond-weed)	60 (40 pond-weed)	**1**
8-7	1.0 (3.5 pond-weed)	35 (60 pond-weed)	**0**	1.0 (2.5 pond-weed)	60 (40 pond-weed)	**1**	0.5 (2.0 pond-weed)	60 (40 pond-weed)	**1**	1.0 (3.5 pond-weed)	60 (60 pond-weed)	**0**
8-21 (over-cast)	Invis.	Invis.	**0**	Invis. (3.0 pond-weed)	30 (70 pond-weed)	**2**	Invis. (4.0 pond-weed)	20 (80 pond-weed)	**15**	1.0 (3.8 pond-weed)	60 (40 pond-weed)	**15**
9-04	2.0 (4.5 pond-weed)	30 (60 pond-weed)	**7**	1.5 (3.5 pond-weed)	30 (70 pond-weed)	**15**	2.5 (3.5 pond-weed)	20 (80 pond-weed)	**30**	1.0 (2.5 pond-weed)	50 (50 pond-weed)	**40**
9-17	Invis. (4.5 pond-weed)	30 (60 pond-weed)	**0**	2.0 (4.0 pond-weed)	40 (60 pond-weed)	**3**	2.0 (4.0 pond-weed)	30 (70 pond-weed)	**50**	2.0 (4.5 pond-weed)	50 (40 pond-weed)	**30**
10-1 (over-cast)	Invisible dark		0	Invisible Shaded		2	Invisible Shaded		15	Invisible dark		15
10-15 (over-cast breezy)	Invisible Dark tea color		0	Invisible Shaded tea color		0	Invisible Shaded tea color		3	Invisible Dark tea color		0
10-30 (hazy)	Invisible Dark tea color		0	Invisible Dark tea color		0	Invisible Dark tea color		3	Invisible Dark tea color		0
Avg-6-11 – 9-17	**1.6 algae (4.1 Pond Weed)**	**45 Algae (51 Pond Weed)**	**1.1**	**1.4 algae (2.9 Pond-Weed)**	**45 algae (55 Pond-Weed)**	**2.6**	**1.3 Algae (2.8 Pond-Weed)**	**46 Algae (54 Pond-weed)**	**7.0**	**1.1 Algae (3.4 Pond weed)**	**50 Algae (44 Pond weed)**	**11.4**

Table 7. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2021.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover
6-13	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-27	0.3	85	0	0.2	100	0	0.2	100	0	1.0	80	0
7-10	Invisible Breezy		<1	Invisible Breezy		2	0.7	100	2	2.0	60	5
7-25	Invisible Breezy		0	Invisible Breezy		0	0.8 (2.0 pond-weed)	99 (1 pond-weed)	0	2.0	60	0
8-8	95% Invisible Dark	Pondweed visible adjacent Restaurants	<1	1.0	100	0	1.5 (2.0 pond-weed)	99 (1 pond-weed)	<1	1.0	60	0
8-22	95% Invisible Dark (3.5 pond-weed	Pondweed visible adjacent Restaurants	<1	1.0 (1.5 pond-weed)	80 (20 pond-weed)	0	2.0 (3.0 pond-weed)	80 (20 pond-weed)	1	1.0 (3.0 pond-weed)	30 (30 pond-weed)	5
9-05	95% Invisible breezy (3.5 pond-weed	Pondweed visible adjacent Restaurants	10	Invisible breezy		2	1.5 (2.0 pond-weed)	60 (40 pond-weed)	2	1.0 (3.0 pond-weed)	40 (60 pond-weed)	10
9-19	95% Invisible breezy (4.0 pond-weed	Pondweed visible adjacent Restaurants	3	1.5 (3.0 pond-weed)	60 (40 pond-weed)	<1	1.5 (3.0 pond-weed)	40 (60 pond-weed)	7	1.0 (4.0 pond-weed)	40 (60 pond-weed)	15
10-2	95% Invisible Dark (4.0 pond-weed	Pondweed visible adjacent Restaurants	0	Invisible Shaded		<1	Invisible Shaded		3	1.0 (4.0 pond-weed)	30 (70 pond-Weed)	20
10-16	Invisible Dark breezy		2	Invisible Shaded		2	Invisible Shaded		10	1.0 (4.0 pond-weed)	30 (50 pond-Weed; 20 bare sand)	25
Avg-6-13 – 10-16			**1.5**	**0.7 algae (0.9 Pond-Weed)**	**68 algae (12 Pond-Weed)**	**0.6**	**1.0 Algae (1.5 Pond-Weed)**	**72 Algae (15.3 Pond-weed)**	**2.5**	**1.1 Algae (1.8 Pond weed)**	**43 Algae (27 Pond weed)**	**8**

Table 8. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2019.

.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ pondweed Cover
6-8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-24	0.8	40	<1	0.5	40	<1	0.3	20	0	1.2	80	0
7-6	0.8	80	<1	0.5	50	0	0.4	40	0	1	70	0
7-21	1.0	80	0	1.0	60	0	0.8	80	0	1	80	0
8-4	0.5	50	<1	0.5	70	<1	0.4	60	1	0.5	60	10
8-18	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0
9-01	Dark Glare	Dark Glare	0	1.5 (3.0 Pond-Weed)	60 (20 pond-Weed)	0	1.0 (2.5 pond-weed)	60 (1 pond-weed)	0	3.0	10	5
9-15	Dark Glare	Dark Glare	0	0.8 (3.0 pond-weed)	70 (30 pond-weed)	2	0.5 (3.0 pond-weed)	95 (5 pond-weed)	2	Soupy plankton bloom (3.0 pond-weed)	Soupy plankton bloom (15 pond-weed)	15
9-28	1.5 (4.0 pond-weed)	60 (25 pond-Weed)	0	0.5 (3.5 pond-weed)	65 (35 pond-Weed)	5	0.7 (3.5 pond-weed)	75 (5 pond-Weed)	5	0.5 (3.5 pond-weed)	85 (15 pond-Weed)	0
10-12	0.5 (4.0 pond-weed)	80 (15 pond-Weed)	0	1.0 (3.5 pond-weed)	50 (50 pond-Weed)	<1	0.5 (2.5 pond-weed)	90 (10 pond-Weed)	0	Murky Invisible	Murky plankton bloom-Bottom Invisible	0
10-26	Shaded Invisible	Shaded Invisible	0	1.0 (3.0 pond-weed)	60 (40 pond-Weed)	0	1.0 (3.0 pond-weed)	95 (5 pond-Weed)	0	1.0 (3.0 pond-weed)	75 (15 pond-Weed)	5
11-09	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0
11-23	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**
Avg-6-08 – 10-26	**0.7 algae (1.1 pond-Weed)**	**56 Algae (6 Pond-Weed)**	**0**	**1.3 algae (1.1 Pond-Weed)**	**46 algae (18 Pond-Weed)**	**0.5**	**0.6 algae (1.1 Pond-Weed)**	**62 algae (2.6 Pond-weed)**	**0.6**	**1.0 Algae (1.1 Pond weed)**	**58 Algae (3.5 Pond weed)**	**2.7**

Dissolved Oxygen Results from Two-Week Monitorings

Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was used by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen levels are most importantly measured and rated because they are typically the lowest. No stressfully low oxygen concentrations for steelhead (< 5 mg/L) were detected near the lagoon bottom during the two-week monitorings in 2023 except on two occasions at Station 3 (under the railroad trestle) in the morning in September and two occasions at Station 2 (deep hole adjacent to the Venetian Court wall) in late October and November after the tidal overwash (**Table 3; Figure 6a-1 and 6a-2**). Oxygen was ample higher in the water column on each occasion at these stations. Oxygen concentration typically increased up through the water column (**Appendix A**). Oxygen levels near the bottom at dawn were mostly in the "good" range at stations with fewer in the "fair" range during the remainder of the monitoring period. Oxygen was ample in the afternoon at all stations near the bottom during the monitoring period except in the deeper hole at Station 2 after the tidal overwash that had created a stagnant saline layer along the bottom and near the bottom. The low morning oxygen levels under the railroad trestle likely resulted from higher algae concentration there, below where gulls commonly roosted in 2023 with pigeons, providing excrement nutrients to algal growth beneath. Relatively higher afternoon oxygen concentrations from high photosynthetic rate on the days with relatively low morning oxygen concentrations near the bottom from high respiration rates under the trestle support this hypothesis. The 4-station lagoon average near the bottom at dawn was above 7 mg/L (good range) on 9 of 12 monitorings (**Figure 6a-1**). It was in the fair range on the other 3 monitorings at the end of September and after the tidal overwash in October. In comparison to other recent years, average morning oxygen levels in 2023 were lower than levels of other years near the same times on 7 of 12 monitorings and less than in 2022 on 10 of 11 monitorings at similar times (**Figure 6b**). This was consistent with relatively slow algal growth in 2023, producing less oxygen the day before monitoring days, than other recent years. Oxygen levels increased through the day to afternoon measurements that were often supersaturated unless the day remained overcast (**Figure 6a-2; Appendix A**). Afternoon oxygen levels near the bottom were above 7 mg/L (good range) at all sites during all 2-week monitorings. In comparison with other recent years for afternoon oxygen levels at similar times, average afternoon oxygen levels in 2023 were the lowest on 4 of 12 monitorings and not the highest at any time except in November (**Figure 6c**). This was consistent with slow algal growth in the 2023 lagoon.

When water clarity is reduced after small stormflows with a closed sandbar still intact, light does not penetrate to photosynthesizing plant life nearer the bottom, and oxygen concentrations decline rapidly. This was not a concern in 2023 because the early stormflow prior to sandbar opening did not prevent light penetration to the bottom except in the deepest pockets of the lagoon, and oxygen production was already low there due to the stagnant saline layer that had formed after tidal overwash on 19 October. Reducing the lagoon depth any further at that time would not have increased oxygen production in most of the lagoon but would have decreased the depth of the water column to allow bird predation on steelhead to increase. Therefore, lagoon depth was not reduced by removing flashboards until prior to forecasted rain (7 and 14 November) that could potentially require facilitated sandbar breaching, which occurred on 18 November. As a result of this management, oxygen levels remained high near the bottom at 3 of 4 monitoring stations after the tidal overwash.

Salinity Results

Results of monitoring salinity may be found in **Appendix A.** A thin saltwater lens was detected along the lagoon bottom in the deep pocket adjacent the Venetian Court wall on 30 May, with adequate streamflow after sandbar closure on 25 May to remove it. Therefore, the shroud was not installed on the flume inlet. The very dilute saltwater lens was still present on the very bottom on 10 June, but did not cause elevated water temperature or low oxygen at 0.25 m above the bottom. The saline layer was gone by 24 June. A freshwater lagoon persisted until 19 October when tidal overwash occurred along the Venetian Court wall. This breach of the sandberm at that location may have been facilitated by someone in the public. Public Works installed a shroud on the flume inlet to draw saline water off the lagoon bottom. Water quality was measured above and below the Stockton Bridge (Station 2 at Venetian Court wall) on 21 October. A dilute saline layer (4.4 − 8.6 parts per thousand) was detected below 1.25 m from the surface to the bottom at the Venetian Court wall, with oxygen nearly absent from 1.5 m from the surface to the bottom (**Appendix A**). From the surface to 1.25 m below the surface, oxygen levels were good and available to fish. Water temperature was good to the bottom at Station 2. Thus, much of the lagoon had good water quality throughout the water column except nearer the lagoon bottom in deeper pockets. On 28 October during the 2-week monitoring, the secchi depth (depth of light penetration) was determined to be 1.75 m from the surface, with the depth center-channel below the bridge of 1.9 m deep and the depth along Venetian Court wall at 2.15 m. A portion of the stagnant saline layer was also aphotic. The saline layer was approximately 0.25 m thinner and more dilute by 28 October compared to 21 October. At the final monitoring on 11 November, prior to sandbar opening, the saline layer was approximately 0.25 m thinner than on 28 October and more dilute. The tidal overwash did not create water temperature or conductivity stress for steelhead, and they could move to other, shallower areas of the lagoon to obtain adequate oxygen concentrations.

Conductivity Results

As stated earlier, 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**). The thin saline layer detected 5 days after sandbar closure was less than 0.25 m thick and only detected in the deepest hole in the lagoon (**Appendix A**). It had dissipated by 24 June at Station 2 (**Figure 3b**) and was not indicated by any elevated water temperatures at the temperature data logger site below the railroad trestle (**Figure 4a**). The conductivity and salinity remained well below stressful levels above the bottom at the time of the tidal overwash on 19 October and afterwards. Steelhead could avoid any elevated conductivity along the bottom in deep pockets by swimming above the saltwater lens or into shallower habitat elsewhere. Therefore, it is unlikely that the thin saltwater lens caused any physiological stress to steelhead inhabiting the lagoon in 2023.

Stream In-Flow to the Lagoon

There were at least 15 stormflows greater than 100 cfs at Soquel Village from December 2022 through April 2023. The heaviest stormflows occurred in January and March 2023. Nine likely bankfull events occurred, with 6 stormflows greater than 6,000 cubic feet per second (cfs) at the USGS gage located in Soquel Village, 2 miles upstream of the lagoon. There was only one stormflow between mid-January and mid-February 2023. The numerous stormflows offered ample adult steelhead passage opportunity with good spawning conditions in the upper

watershed. Streamflow had declined to 27.1 cfs (0600 hr) on 22 May at the USGS gage (falsely reading 17.5 cfs that day). The sandbar was closed to the Bay at low tide on 25 May. Hydrographs for water years, 2007−2023, may be found in **Appendix C**.

Lagoon water quality is generally best with relatively higher summer baseflow. Soquel Creek in 2023 maintained a relatively high baseflow through the dry season that was much above the median flow (**Table 9; Figures 25−26; Appendix C. Figures 1−3**). However, streamflow estimates at the Soquel Village gage took a rapid and substantial increase after 1 September, indicating that streamflow estimates after that were likely inaccurately high. Later, a constructed rock dam was discovered just downstream of the gage, which changed the hydraulic control and increased water surface elevation at the gage, leading to overestimation of streamflow.

Higher summer baseflow improves habitat conditions in the lagoon. Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than lower 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 and more completely overnight when inflow is higher. With less inflow in June−August, lagoon water temperature heats up more during the day and cools off less at night, as indicated by higher average lagoon water temperature at dawn in 2015 (low drought inflow) (**Alley 2020**) and in 2022, with cooler conditions in 2023 (**Figure 3i**). The annual trend in 7-day rolling average temperature with respect to the maximum, average and minimum for the dry season indicates that they increase substantially in dry/drought years (2009, 2013-2015 and 2021-2022) when stream inflow rate is much reduced (**Table 4; Figure 4i**). However, the trend toward reduced lagoon water temperature during higher baseflow years was less evident in 2017, 2019 and 2023, when the maximum temperature and the maximum and average 7-day rolling averages were similar or higher than in intermediate baseflow years of 2016, 2018 and 2020. For 2016 and 2018, we suspect this was partially because they had cooler air temperature in late summer and fall with more stream shading than after wet winters that would have contributed to warmer inflow in 2017, 2019 and 2023 due to loss of streamside vegetation and less shade (**Figure 3l**). In 2023, morning water temperatures of stream inflow from mid-August to the end of September were warmer than in any other recent years. In 2023, afternoon water temperatures of stream inflow in mid-July and mid-August were warmer than in any other recent years.

To maximize summer baseflow in the creek, 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 minimized and curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek. One of the nurseries along Soquel Creek closed in 2023, which may increase summer baseflow in the future.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon

The 5 restaurants that were contiguous with Soquel Creek Lagoon were tested for leaks and deficiencies in plumbing connections. All deficiencies were repaired prior to sandbar construction (**Appendix B**).

Table 9. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2023.

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	27	16.4	9.7	6.2	5.5
2018	8.8	4.9	2.9	2.9	2.1
2019	21	10.1	7.0	4.8	3.5
2020	9.7	5.1	3.3	2.3	1.8
2021	3.1	1.2	1.2	0.7	0.5
2022	2.7	1.0	1.0	1.4	1.7
2023	22.2	15.3	7.04	7.27 (Artifact)	5.47 (Artifact)

* Red denotes drier water years. ** White denotes intermediate water years. *** Blue denotes wetter water years.

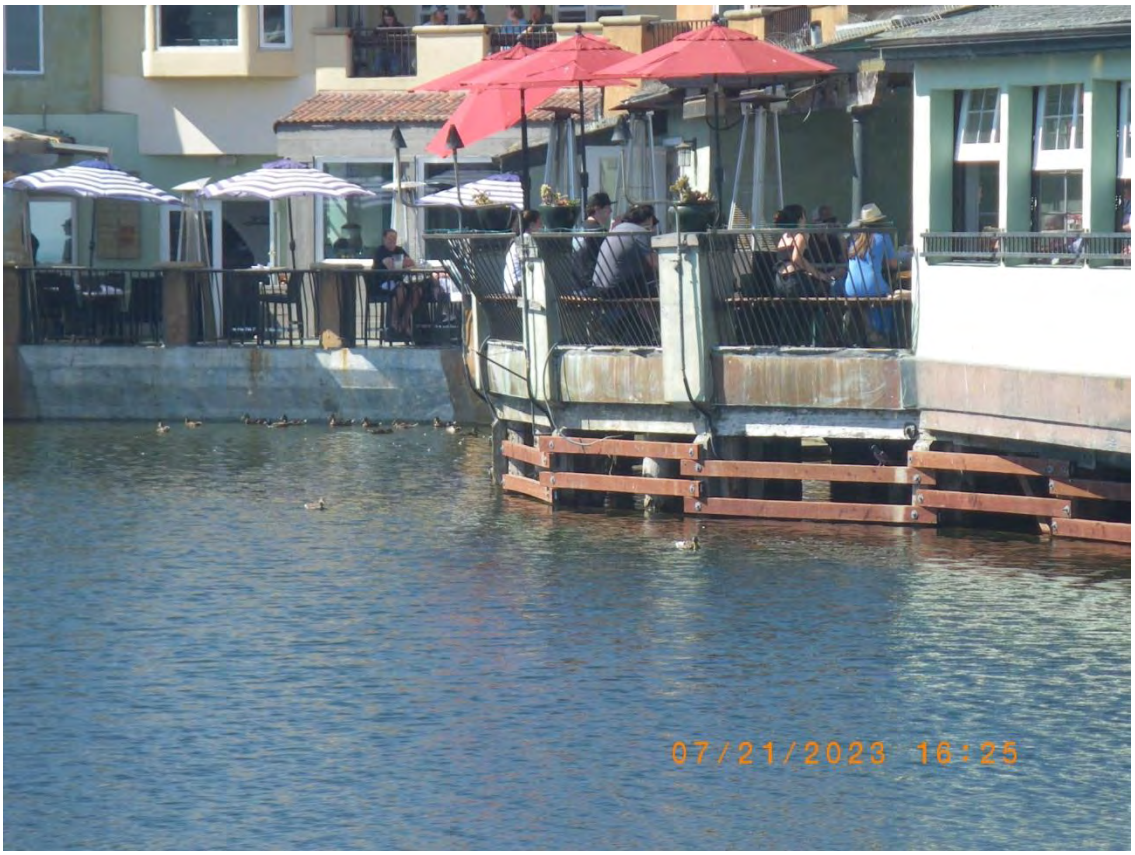
RECREATIONAL USE, POLLUTION SOURCES AND SOLUTIONS

The Nautical Parade occurred on the evening of 23 September 2023. No adverse environmental effects were detected. Through the summer, the lagoon near the beach was posted with warning signs about potential health risks from contact with the water. However, greater human use of the lagoon has been observed since 2016 than previously. In 2016, a paddle-board concession began in Capitola village. Paddle-boarders have become commonplace during weekend monitorings (observed on 8 of 12 monitorings in 2023, 9 of 12 2022; 9 of 10 in 2021; 5 of 13 in 2019; 5 of 12 in 2018, 10 of 12 in 2017; 7 of 9 in 2016), along with kayakers, pedal boaters, row boaters, canoers and barge users. In 2023, the most paddle boarders counted in a reach was 6 in Reach 1 on 5 August. Waders and swimmers have been commonly observed in the lagoon during warm, sunny weekend afternoon monitorings since 2016 and not previously (usually near the beach in Reach 1; 4 of 12 afternoon monitorings in 2023; 6 of 12 in 2022; 2 of 10 in 2021; 6 of 13 in 2019, 5 of 12 in 2018, 4 of 12 in 2017; 6 of 9 in 2016). The most waders seen at one time in Reach 1 in 2023 was 9 on 19 August. Much fewer waders were observed in 2023 than 2022 when on two weekends, 22 and 26 waders were counted each afternoon.

Vegetation was trimmed to expose the no fishing sign along the lagoon path to discourage illegal summer/fall fishing. No fishing was observed during monitoring in 2023.

Separation of waders/swimmers from gulls in Reach 1 (Contamination warning signs posted). 23 July 2022

Paddle boarder and canine companion. 8 July 2023



Mallards congregating in Margaritaville Cove, waiting for food handouts. 21 July 2023

The common congregation of mallards in Margaritaville Cove in 2023 resulted from feeding by diners at Esplanade restaurants. As in previous years, mallard ducks patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on regularly there. We observed visitors feeding the ducks and gulls on 2 of 12 monitoring days in 2023.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria from their excrement. They forage through human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. In recent years, they have been using Reach 3 to bathe, and many roost on the railroad trestle. Low morning oxygen and high afternoon oxygen under the trestle at Station 3 indicated bio-stimulation of algal growth there. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other Esplanade 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 since 2016 has interfered with gull use in Reach 1. Gulls take wing when recreationists appear in/on their floatation devices and return quickly to bathe and congregate after they passed. Gulls avoid waders along the lagoon periphery near the flume. Human impact from gull disturbance upon the rate of gull defecation is unknown. Gull harassment in Reach 1 may be partially responsible for increased congregation of bathing gulls in Reach 3 since paddle boarding became popular. Below average oxygen concentrations (indicating some oxygen depletion) have been detected in recent years in mid- summer, including 2020−2023, but not in 2018 or 2019. On 3 monitorings in 2023 at dawn, Site 3 under the railroad trestle had the lowest oxygen concentration of the lagoon sites (**Figures 6a-1**). However, oxygen levels were ample for steelhead higher in the water column in all cases. Afternoon oxygen levels at Site 3 were the highest in the lagoon on days when morning oxygen levels were lowest of all the sites (**Figure 6a-2**). This indicates that higher algal production under the trestle may be responsible with higher respiration at night and higher photosynthesis during the day leading to the extremes in oxygen levels. Greater algal production was likely caused by gull and pigeon excrement as a bio-nutrient stimulant. These birds commonly roosted on the railroad trestle. 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 among these would be storm drains emptying into Noble Gulch. Gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch in the past. Gray water was observed on 2 of 12 monitoring days in 2023. None was observed in 2022. Though no gray water was detected during 2-week monitorings in 2014−2016, 2018 and 2020−2022, gray water plumes were observed after wetter winters on 6 of 12 monitoring days in 2017 and 2 monitoring days in 2019, especially in the latter weeks of the monitoring period. Another drain into the lagoon exists under the railroad trestle, which may be a source of pollution. This drain could be capped if summer runoff could be re-directed into the sewer.

Central Coast lagoons are naturally productive steelhead habitats with abundant aquatic plant

populations. Juvenile steelhead grow rapidly in these lagoons where food is abundant. Plant life is the base of the food web and translates into food abundance for fast-growing juvenile steelhead in Soquel Lagoon. Also, abundant pondweed creates a forest that predators must negotiate to prey upon juvenile steelhead, offering some refuge from piscivorous birds like mergansers and pied billed grebes. Eutrophication from a biological perspective occurs when excessive nutrients induce overgrowth of plants and algae that cause oxygen depletion and fish kills if severe enough. In regard to steelhead habitat, habitat-degrading eutrophication indicated by stressfully low oxygen concentrations seldom occurs near the lagoon bottom and has not thus far prevented adequately high oxygen levels higher in the water column when it does occur.

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. An example of urban runoff likely leading to fish mortality was in 2022, when much of Bay Avenue in Capitola was repaved that summer. For the first time in 32 years of lagoon monitoring, steelhead mortality was observed in Reaches 1 and 2 of the lagoon after the first flush runoff on 18 September. Mortality of starry flounder and staghorn sculpin also occurred. Thorough street cleaning after freshly repaved streets may reduce pollution from urban runoff.

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 chronic pollution problem and high flashiness in streamflow during the first small storms of the fall, as occurred in mid-September 2022. 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 2023, the lagoon required emergency breaching because the flume could not accept all of the stormflow with flooding imminent. Although costly, 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.

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, as a pilot project, tules were planted in the cove under the railroad trestle. Some of the original plantings survived the relatively mild winter of 2017-2018 and the heavier stormflows of the 2018-2019 winter. They maintained their abundance in 2023 after a wet winter and after expanding in 2021 after a very mild winter. The City had additional tules planted in 2023 during the sandbar construction in May. City staff will continue to monitor and augment plantings in pilot project areas. Other potential areas of tule planting include across the lagoon and downstream of the only west side cabin and in the Margaritaville cove adjacent the Esplanade restaurants.

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

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2023, as was the case in 2003–2022. CDFW has only allowed juvenile planting of smolts in spring 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 and tidewater goby occurred on 1 and 8 October 2023, from upstream of the Stockton Avenue Bridge to the beach. To sample steelhead, a bag-seine with dimensions 106 feet long by 6 feet high by 3/8-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and upstream of it, to be beached next to Venetian Court. It was also set parallel to the restaurants on the eastern margin and beached next to Venetian Court. Juvenile steelhead congregate in the shade under the bridge and under the willows on the west side. A total of 65 steelhead were captured, measured and marked on 1 October after 6 seine hauls. This indicated that juvenile steelhead population was likely small in the lagoon in 2023. There were no mortalities. A total of 56 steelhead were captured on 8 October in 6 seine hauls. There were 5 recaptures and no mortalities.

Using the Lincoln index for mark and recapture, the steelhead lagoon population estimate was 728, with a large standard error of 299. This estimate was below average and below the median compared to the 29-year average of 1,461 (median= 875), including the 2021 estimate (**Table 10; Figure 24**). The low lagoon population size may have occurred because, with the many significant stormflows over the winter/spring, most adult steelhead likely spawned far up in the

watershed, some distance from the lagoon. Juvenile densities were low at stream sites in the lower watershed, indicating low spawning effort and/or scour of redds constructed in the lower watershed. These factors likely resulted in few YOY seeding the lagoon. Also, yearling growth in the spring was likely above average with the high baseflow, resulting in fewer yearlings staying a second growing season in the lagoon. This also would have lead to a smaller lagoon population.

Some young-of-the-year (YOY) steelhead were relatively large in 2023 with the relatively cool water temperature conditions that reduced metabolic demands and the reduced competition for the estimated small steelhead population size (**Table 11; Figure 7a**). However the median size of all captured steelhead was moderate, and the median size decreased on the second weekend of sampling, which was unusual. Reasons for the relatively modest median size may be that many YOY that seeded the lagoon drifted in later in the summer from long distance and could not grow as large as if they had entered the food-rich lagoon earlier in the summer from closer spawning redds. Also, although there were larger yearlings captured in the lagoon, they constituted a small proportion of the lagoon population. This could be because fewer of them likely stayed a second growing season in the summer lagoon to reach sufficient size and instead smolted earlier in the spring after high baseflow and high insect production that promoted rapid fish growth and sufficient smolt size. With juveniles larger than 150 mm SL designated as yearlings in 2023, 36 of the 121 captured (30%) were yearlings. Another factor contributing to moderate steelhead size in 2023 may have been below average food (invertebrates) availability when no pondweed was observed and algae abundance was low.

Threespine Stickleback. October 2017. (Photo by T. Suttle.)

Starry Flounder. October 2021. (Photo by T. Suttle.)

Young-of-the-Year Juvenile Steelhead. October 2021. (Photo by T. Suttle.)

Tidewater Gobies. October 2017. (Photo by T. Suttle.)

Sacramento Sucker. October 2017. (Photo by T. Suttle.)

Staghorn Sculpin. October 2021. (Photo by T. Suttle.)

Size histograms of steelhead captured from the lagoon in 2023 and other years back to 1998 may be found in **Figures 7a−23**. No scale samples were taken to age fish in 2023. Examination of the size histogram of captured fish in 2023 indicated a gap in numbers in the 140-150 mm SL range. This was likely a separation between smaller YOY and larger yearlings. In past years, the yearling size class typically occurred in the range of 150-160 mm SL. Other fish species captured in 2023 with the large seine were 2,000+ threespine stickleback (uncounted), 4 adult Sacramento suckers, 92 juvenile Sacramento suckers, 12 staghorn sculpins, 6 prickly sculpins and 2 starry flounders. Juvenile suckers were captured in relatively high numbers in 2023.

On 1 October 2023, 7 seine hauls were made to capture tidewater gobies with the 30-foot x 4-foot x 1/8-inch mesh beach seine along a portion of the lagoon periphery in Reach 1 where the larger seine had not been used. No tidewater gobies were captured in 2023. Other species captured included 127 threespine stickleback, 2 staghorn sculpin, 28 juvenile Sacramento suckers and 5 starry flounders. An annual record of tidewater goby captures may be found in **Table 12**. The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until the drought years of 2008 and 2009 and their absence in 2023 captures, 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 three, less severe droughts (2007-2009, 2013-2015 and 2020−2022). 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 in 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, after mild winters in 2007 and 2008. They likely re-colonized Soquel Lagoon again in 2013 after large stormflows in December 2012 and in 2020 after a mild winter. They were detected in Aptos Lagoon in 2011−2014 and 2017−2022 (no sampling in 2015 and 2016) (**Alley 2023**). None were captured in Aptos Lagoon in 2023 (**Alley 2024**). A jetty at the mouth of Aptos Lagoon provides cover for overwintering tidewater gobies.

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, when watershed estimates were made. In 1993, the lagoon production estimate of nearly 2,800 fish represented 10% of the estimated smolt production (juveniles =>75 mm SL in the fall) in the 16.6 miles of steelhead habitat in the mainstem and East and West Branches. The 2004 lagoon population estimate of 3,900 steelhead, all > 75 mm SL, represented an estimated 47% of the smolt production for the 16.6 miles of stream and lagoon habitat. Though we do not have 2007–2023 juvenile 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. All of the juveniles captured in 2023 were >75 mm SL and soon-to-smolt the next spring. The lagoon provides valuable habitat through proper management.

Two factors that may influence juvenile steelhead growth by the time of fall sampling are population size and time of lagoon closure prior to sampling. Another factor may be the timing of YOY entry into the lagoon. If some YOY enter the lagoon later in the summer or after a stormflow that occurs before lagoon sampling, 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, 1998−2023 (**Table 11**), 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 and juvenile steelhead size when considered separately.

It is reasonable to predict that if the steelhead population was large, then food competition would be high, and juvenile size at the time of fall sampling would be smaller, at least for YOY. 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 in most years. Usually the lagoon population is overwhelmingly dominated by YOY steelhead, based on past scale analysis. We suspect from the size distributions of juveniles captured that steelhead grew faster in 2006, 2009, 2011, 2014, 2016, 2018, 2020 and 2023 due to less competition for food with much smaller populations compared to large populations, such as those in 2007, 2008 or 2019 (**Table 10; Figure 24**). 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, 2008 or 2019. 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 must influence growth rate. The period of sandbar closure to final fish sampling in 2023 was slightly above the 133-day average at 136 days, which was the median.

Famously large Prickly Sculpins from Soquel Creek (also inhabit the Lagoon). August 2012

Table 10. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2023.

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. Only 2 unmarked fish caught on day 2.
2015-	No Estimate Possible. 10 fish marked in 6 seine hauls. Only 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.
2018-	46 +/- 10 (standard error), 13 fish marked from 6 effective seine hauls.
2019-	3,322 +/- 697 (standard error), 299 fish marked from 3 effective seine hauls.
2020-	1,344 +/- 256 (standard error), 192 fish marked from 6 effective seine hauls
2021-	2,500 estimated based on catch-per-unit-effort.335 captured; 299 marked from 5 seine hauls
2022-	1,674 +/- 1,632 (standard error) , 85 captured (total both days): 31 marked from 6 seine hauls
2023-	728 +/- 299 (standard error), 121 captured (total both days): 56 marked from 6 seine hauls

Table 11. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2023.

Year	Sandbar Closure Date	Fish Sampling Dates	Weeks of Sandbar Closure Prior to Final Fish Sampling	Days of Sandbar Closure Prior to Final Fish 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 (Day 1)
1999	18 May	3/10 Oct	20.6	144	928	120-124 (Day 1)
2000	7 June	1/8 Oct	17.4	122	875	135-139 (Day 1)
2001	14 June	7/14 Oct	17.3	121	454	125-129 (Day 1)
2002	23 May	6/13 Oct	20.3	142	1,042	105-109 (Day 1)
2003	22 May	5/12 Oct	20.3	142	849	110-114 (Day 1)
2004	26 May	3/10 Oct	19.4	136	3,869	115-119 (Day 1)
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 (Day 1)
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	21.3	149	None possible (No recap.)	155-159 (Day 1)
2015	21 May	4/11 Oct	20.4	143	None possible (No recap.)	95-99 (Day 1)
2016	27 May	2/9 October	19.1	134	237	155-159 & 165-169
2017	1 June	8/15 October	19.4	136	259	160-164 & 155-159
2018	24 May	7/14 October	20.4	143	46	160-164 & 170-174
2019	31 May	6/13 October	19.1	134	3,322	95-99 Both days
2020	11 June	4/11 October	17.3	121	1,344	130-134 Both days
2021	1 June	3/10 October	18.6	130	2,500 C per Unit E	140-144 & 150-154
2022	26 May	2/9 October	19.4	136	1,674	130-`34 & 135-139
2023	25 May	1/8 October	19.4	136	728	120- 124 & 110- 114
Avg/Median			18.9	**133/ 136**	**1,461/ 875**	

Table 12. Number of Tidewater Gobies Captured at Soquel Lagoon in October.

Year	# of Tidewater Gobies Captured in Soquel Lagoon	# of Seine Hauls (30-foot fine-mesh seine)
1988 drought	102	2
1992 drought	2	?
1993	0	4
1994 mild	35	4
1995 wet	0	8
1996 wet	0	6
1997 below avg	1	8
1998 wet	0	4
1999 wet	0	5
2000	0	5
2001	0	5
2002	0	5
2003	0	5
2004	0	5
2005	0	4
2006 wet	0	5
2007 drought	0	5
2008 drought	33	4
2009 drought	8	4
2010 above avg	0	6
2011 wet	0	6
2012 below avg	0	5
2013 drought	10	7
2014 drought	481	6
2015 drought	309	5
2016 mild	98	4
2017 wet	0	6
2018 mild	1	6
2019 wet	1	5
2020 mild	117	6 (106-ft coarse-mesh seine)
2021 drought	210	5
2022 drought	87	5
2023 wet	0	7

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. No pondweed was observed in the 2023 lagoon Algal production was relatively low, too. So, food availability in the 2023 lagoon may have been below average. 2012−2015 and

2021−2022 had high densities of pondweed with attached algae (15-70% of bottom coverage in various reaches) from mid-August onward in years up to 2022**.** The 2022 summer was unusual in that pondweed was dense all summer from June onward. 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 that result from higher summer baseflow will reduce fish metabolic rate for maintenance and will allow more food intake to be used for growth. However, cooler lagoons may have less production of aquatic vegetation, as occurred in 2019 and 2023, compared to drought years. Fish digestion rate is also slower in cooler lagoons. This slows the processing of food for growth. The 2013−2015 and 2021−2022 lagoons with very limited stream inflow were relatively warm. The lagoons in 2011−2012, 2016−2017, 2019 and 2023 were cooler. Aquatic plant production was less in 2011, 2016, 2017, 2019 and 2023 than in the warmer lagoons of 2008, 2009, 2012, 2013−2015, 2018 and 2021−2022 (more pondweed), indicating less food available in cooler lagoons (**Alley 2018a; 2020**). There may have been a higher proportion of yearlings in the lagoon population in 2011 and 2016−2018 compared to other years due to overall low YOY production in the watershed. In 2016−2018, juvenile densities were extremely low in the lower mainstem Soquel Creek (**Alley 2018b**). A higher proportion of yearlings would have increased the median size of juveniles in those years. In drought years, more adults may spawn in the lower creek near the lagoon due to restricted passage flows to the upper watershed. This has lead to high lagoon steelhead densities during the drought years of 2007 and 2008, presumably of mostly YOY fish. We suspect the same large population in 2021 and 2022 but cannot confirm this due to the apparent interference of the Soquel Creek Water District treated water spill into Noble Gulch in 2021 and the early, mid-September stormflow in 2022 that caused high lagoon turbidity and likely impacted steelhead distribution and survival in the lagoon prior to our fish censusing.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. The 2023 lagoon remained deeper than recent years in Reaches all reaches after deepening in 2017, with scour at the base of the exposed bulkheads visible.

In order to minimize water temperature, 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). But flashboards must be added steadily through the summer as baseflow recedes. 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. 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 2013−2020. 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 2020. In 2021, seven permanent, hard plastic sheets were evenly positioned under the flume from the inlet to near the outlet. No stream underflow beneath the flume has been observed since.

In 2023, the lagoon water surface was maintained at the top of the flume until tidal overwash on 19 October, at which time a shroud was installed on the flume inlet. The water surface declined slightly afterwards, but had regained depth by our monitoring on 28 October. On 7 and 14 November, in preparation for forecasted rain and stormflow, flashboards were removed to allow the flume to pass stormflow that required facilitated sandbar breaching on 18 November. Usually, in drier years it is easier to maintain a high water surface elevation because streamflow recedes early and requires all flashboards in place early on. In 2023, early stormflows were a minimum with little need to reduce lagoon depth before the one that required facilitated sandbar breaching in mid-November.

If the lagoon water surface drops, steelhead habitat in the upper lagoon is lost. Therefore, the lagoon should be maximized while promoting light penetration to the bottom. The flume's flashboards must be secured against vandals and against tidal backpressure to 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. Minimization of pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

BIRD AND POND TURTLE 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 is 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 not commonly observed in 2023 as they had been in previous drought years, 2013−2015 and 2021−2022 (**Table 13)**. Other piscivorous birds observed in 2023 included Pied-billed Grebe, Cormorant, Black-crowned Night Heron, Belted Kingfisher and Lesser Scaup (in November). Pied-billed Grebes continued to be less common in 2023 than 2021. A Cormorant spent the entire day in the lagoon during one monitoring day in 2023, which was unusual.

Common Mergansers in Reach 2 (with mallards in the foreground), 7 August 2022

Cormorant roosting on emergent redwood in Reach 1, adjacent to Esplanade Restaurants. 14 October 2023

Table 13. Number of Sighting Days of Piscivorous Birds and Turtles at Soquel Lagoon on Monitoring Days (2-week intervals).

Year/ # Monitoring Days	Common Goldeneye	Com-mon Mergan-ser	Pied-billed Grebe	Black-crowned Night Heron	Green Heron	Snowy Egret	Corm-orant	Great Blue Heron	Lesser Scaup	South-western Pond Turtle
2023/12	0	2	3	1	0	0	3	0	1	1 (+1 @ sandbar construc-tion
2022/11	0	7	3	1	3	2 (+2 com-mon egrets)	3	0	0	2
2021/10	0	8	6	0	2	2 (+2 com-mon egrets)	2	1	0	0
2020/16 (morning only)	6	3	9	1	0	1	1	0	0	0
2019/13	1	3	5	0	0	0	1	0	0	0
2018/ 12	0	2	7	2	1	1	1	1	0	0
2017/ 12	0	4	6	0	0	0	1	0	0	0
2016/ 13	0	3	4	1	3	0	2	0	0	0
2015/ 12	0	6	4	1	2	1	7	0	0	0
2014/ 13	0	6	7	3	2	4	1	0	0	0
2013/ 18	3	9	10	3	3	0	3	0	0	0
2012/ 12	0	3	8	0	0	1	4	0	0	6

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge and did so in 2023. However, in past years when people were observed feeding the ducks in upstream reaches, a few gulls were attracted to the food source. 2019 was the first year in 31 years of monitoring that rafts of Western gulls consisting of as many as 24 birds were commonly observed in Reach 3. They were also observed perching in groups on lagoon-side house roofs in Reach 3 in 2019. This has continued in 2020–2023. In 2023, as many as 22 western gulls were observed in the

afternoon in the Reach 3 lagoon (maximum of 17 gulls in 2022 and 22 gulls in 2021). In 2023, Western Gulls were observed congregating in Reach 3 on afternoons in June through August but not after that, even when large numbers of Hermann's gulls congregated with Western gulls in Reach 1 in September and October (**Figure 27**). In 2022, gulls were most common in Reach 3 in June and July and not after that. In 2021, the gull rafts in Reach 3 were most common until early August, and only a few were observed after that. Some gulls may choose Reach 3 to bathe in to avoid human interference. Because paddle-boarding and wading have become more common at the lagoon since 2016, more paddleboard traffic has occurred, especially in Reach 1, along with human wading along the margin of Reach 1. These activities were minimal before that. Now, wading persists heavily on sunny weekends until early September when school resumes and weather cools down. Previously, individual gulls were occasionally observed beyond Reach 1 when someone was feeding the ducks. Gulls are a threat to ducklings when they spread into Reach 3. More gulls are using the lagoon-side roofs in Reach 3 to roost as well, to the dismay of residents.

Gull numbers counted during monitoring days in 2023 fluctuated between 21 (10 June) and 93 (28 October), when Hermann's gulls were well represented in the count in Reach 1from mid-August to mid-November. The average gull count per monitoring day for 2014–2023 was 63, 68, 42, 40, 46, 63, 36, 44, 109 and 47, respectively.

Gulls bathing in Reach 1 (mostly Hermann's Gulls). Notch prepared in sandbar preliminary to stormflows. 29 October 2022

In most years, 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 28**).

In 2023, mallard numbers on monitoring days were lower than in the previous 9 years. They increased from early June to a maximum of 20 birds in late June and never increased above that for the remainder of the dry season. The average mallard count per monitoring day for 2014−2023 was 27, 26, 31, 18, 30, 21, 44, 23, 28 and 14, respectively, giving 2020 the highest average in the last 10 years and 2023 was the lowest. The cottonwood log used for mallard roosting that was washed away during the wet 2016−2017 winter was replaced by another log in 2023.

Mallards roosting on a barge near Noble Gulch, Reach 3. 21 August 2022

American Coots arrived in the lagoon in fall, 2023, as is typical. Two coots were first detected on 2 September 2023 (17 September in 2022 having a sudden increase (2 coots were there all summer); 19 September in 2021; 3 October in 2020; 28 September in 2019), as coots typically arrive in late September and early October. Coots were much less common in 2023 than other recent years. The maximum number of coots counted on a monitoring day in 2015−2023 was 113, 13 (early breach), 34, 147, 58, 38 (early breach), 30 and 10, respectively. No domestic waterfowl were observed in 2023. On the last day of monitoring, 11 November, a pair of female Lesser Scaups was observed in Reach 3.

A Southwestern Pond Turtle was observed on 25 May in the Reach 3 mainstem during sandbar construction. After sandbar closure and lagoon formation in 2023, another Southwestern Pond Turtle was observed on the afternoon of 8 July. It was hauled out, sunning itself on a long, emergent log upstream of the only cabin on the west side of the lagoon and upstream of the Noble Gulch creekmouth. A CNDDB report was submitted regarding sighting of this protected,

special status species at the lagoon. In 2022 a turtle was observed hauled out on a short emergent piece of wood near the west side cabin in the morning on 11 June. Another turtle sighting occurred on 4 September 2022 when one was basking in the afternoon across from the west side cabin on the east side Arthur's dock at Site 4 near the Noble Gulch creekmouth. The dock was gone in 2023. The 2022 sightings were the first western pond turtle sightings since 2012, although a paddle-boarder observed a turtle (species unknown) in the upper lagoon in 2015. Previously, they basked on the instream cottonwood log across from the Noble Gulch mouth and on additional logs further downstream, adjacent to the west side cabin. In 2012, as many as 3 pond turtles were observed at one time on the cottonwood log and another nearby log. The cottonwood log had sagged and was mostly underwater in 2013−2015, offering limited basking area. In 2016, the log had moved upstream a few feet and was still partially submerged. Then it was flushed out to the beach during the wet 2016-2017 winter.

Southwestern Pond Turtle hauled out half way up on emergent log (legs extended) on the west side, upstream of the west side cabin and Noble Gulch creekmouth entering on the east side. 8 July 2023

NEW AND CONTINUING MANAGEMENT RECOMMENDATIONS

Recommendations for Lagoon Preparation and Sandbar Construction

1. During morning 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 matter is present and decomposition is occurring there.

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 to 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 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 when fish survival is in jeopardy, 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 during preparation for sandbar construction and 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 of 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. 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.

8. Continue to rake as much kelp and sea grass out of the lagoon as is possible before final closure, including plant material trapped under the restaurants and in depressions around the bridge piers. Focus efforts from the Stockton Avenue Bridge downstream to the flume. 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 matter 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 to quickly rake out decomposing kelp and to clear the sand-filled flume initially.

9. 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 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**).

10. 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.

11. 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.

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

13. 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.

14. Continue to 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.

15. Continue to maintain an underwater portal in the flume intake for out-migration of adult steelhead until at least June 15, while maintaining a notched top plank for out-migration of smolts until at least 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 to exit the lagoon.

16. Continue to 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.

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

18. 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.

19. 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.

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

21. Continue to retrieve visquine from around the flume inlet immediately after the fall sandbar opening, if possible.

22. 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.

Recommendations Regarding Sandbar Breaching

1. 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. Continue

to orient the notch laterally (diagonally) across the beach to also maximize the probability of maintaining an estuary with some depth after the breach. The purpose is to maximize the residual estuary depth after the emergency breach.

2. 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 make 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.

3. 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. If turbidity still prevents light penetration to the bottom, remove enough boards to lower the water level to a point where light penetrates to the lagoon bottom. 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. Repeat this process for each succeeding small stormflow that does not require sandbar breaching.

4. 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.

5. In preparation for sandbar opening 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 if high tides obliterate it. If a storm is predicted, the sandbar may require a fresh notch.

6. 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.

7. Just as the first storm of the fall season begins, remove boards from at least one 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.

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

9. Take water samples for fecal bacteria analysis within 24 hours prior to the anticipated facilitated sandbar breach and within 12 hours after the breach in the surf near the creekmouth. While the sandbar remains open, collect weekly water samples for analysis until the fecal indicator bacterial count meets the standard of 104cfu/100 ml.

10. If a stagnant, kelp-filled lagoon forms in fall after an early breach followed by 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. Upstream 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.

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

1. Increase enforcement efforts to prevent unauthorized individuals from vandalizing and notching the sandbar berm around the lagoon, which will result in tidal overwash and water quality problems in the lagoon.

2. If a significant saltwater layer (0.25−0.5 m thick) is trapped in deeper pockets along the lagoon bottom adjacent Venetian Courts and upstream after sandbar construction under drought conditions (low stream inflow), then pump water from the very warm, oxygen-depressed saltwater lens through a hose to the flume until the saltwater lens is substantially removed and water quality is restored. The pump intake shall be screened to prevent fish mortality.

3. Since tules planted in the cove under the railroad trestle withstood winter stormflow, pursue planting more tules under the trestle and in other lagoon locations. Seek volunteers to re-establish tules near the only west side 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.

4. 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.

5. 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. Thorough street cleaning of recently repaved roads prior to the rainy season may also reduce pollution from urban runoff.

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

7. 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 proceeded down the lagoon and then back up before dismantling back at the bridge.

8. Continue to have the biologist monitor the annual nautical parade.

9. Regarding the nautical parade, require that all floats, boats, kayaks, barges, paddle boards, etc., be clearly lit at night to make them clearly visible and to avoid collisions.

10. Regarding the nautical parade, protect tules from destruction by floats during nautical parade-related activities and from recreational boating activities, in general.

11. Regarding the nautical parade, restrict the number/weight of float participants allowed to ride on the floats to a safe level during nautical processions.

12. Regarding the nautical parade, enforce the ban on waders during future nautical parades.

13. Regarding the nautical parade, 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.

14. Regarding the nautical parade, continue to recommend to the lagoon parade organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

15. Regarding the nautical parade, continue to retain all flume boards to maintain maximum lagoon depth during the nautical parade.

16. 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.

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

18. Continue to maximize lagoon depth through the dry season, while maintaining passage through the flume for adult steelhead until at least June 15 and for steelhead smolts until at least 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.

19. 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.

20. Maximize the number of boards in the flume entrance to maximize lagoon depth. Seal the boards with visquine or plywood to prevent leakage.

21. To prevent draining of the seasonal lagoon, continue to secure the flume boards at all times to prevent their lifting by vandals or by bay back-flushing.

22. 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 updates.

23. "Gull Sweeps" should be installed on Esplanade roofs to test their effectiveness in deterring gulls.
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24. 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.

25. 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 before the first stormflow in fall.

26. 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 to protect aquatic and streamside wildlife habitat.

27. The City should continue to seek funding to secure large wood to the lagoon bottom with anchor boulders to provide additional fish cover and scour objects to deepen the lagoon and enhance rearing habitat. Consider appropriate locations along the west bank near the railroad trestle or upstream, closer to the only west side cabin but downstream of it.

28. Continue to retain large woody material that naturally enters the lagoon.

29. 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 CDFW 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 streamflow.

Recommendations Regarding Fish Management

1. Do not plant steelhead from a hatchery into Soquel Creek unless the broodstock originate from Soquel Creek, which contain sufficient genetic diversity regarding spawning timing.

2. Maintain the postings of the fishing season at the entrance to the lagoon path to Noble Gulch and the path to the park on the west side of the lagoon upstream of the Stockton Bridge.

3. Maintain the ecological interpretive signs and the no bird feeding signs in the lagoon vicinity.

4. Report any illegal fishing at the lagoon outside of the fishing season to CDFW via the Cal-Tip hotline: 1-888-334-2258.

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

6. If the sandbar is still in place after November 15, create an opening in the upper flashboards of the flume inlet just prior to forecasted stormflow to allow early spawning adult steelhead or coho salmon to pass through the flume from the Bay.

7. Continue to census steelhead and tidewater goby in the fall to monitor lagoon use as important nursery habitat under varying streamflow conditions, management scenarios and restoration efforts.

Community Support during steelhead censusing. October 2021

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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

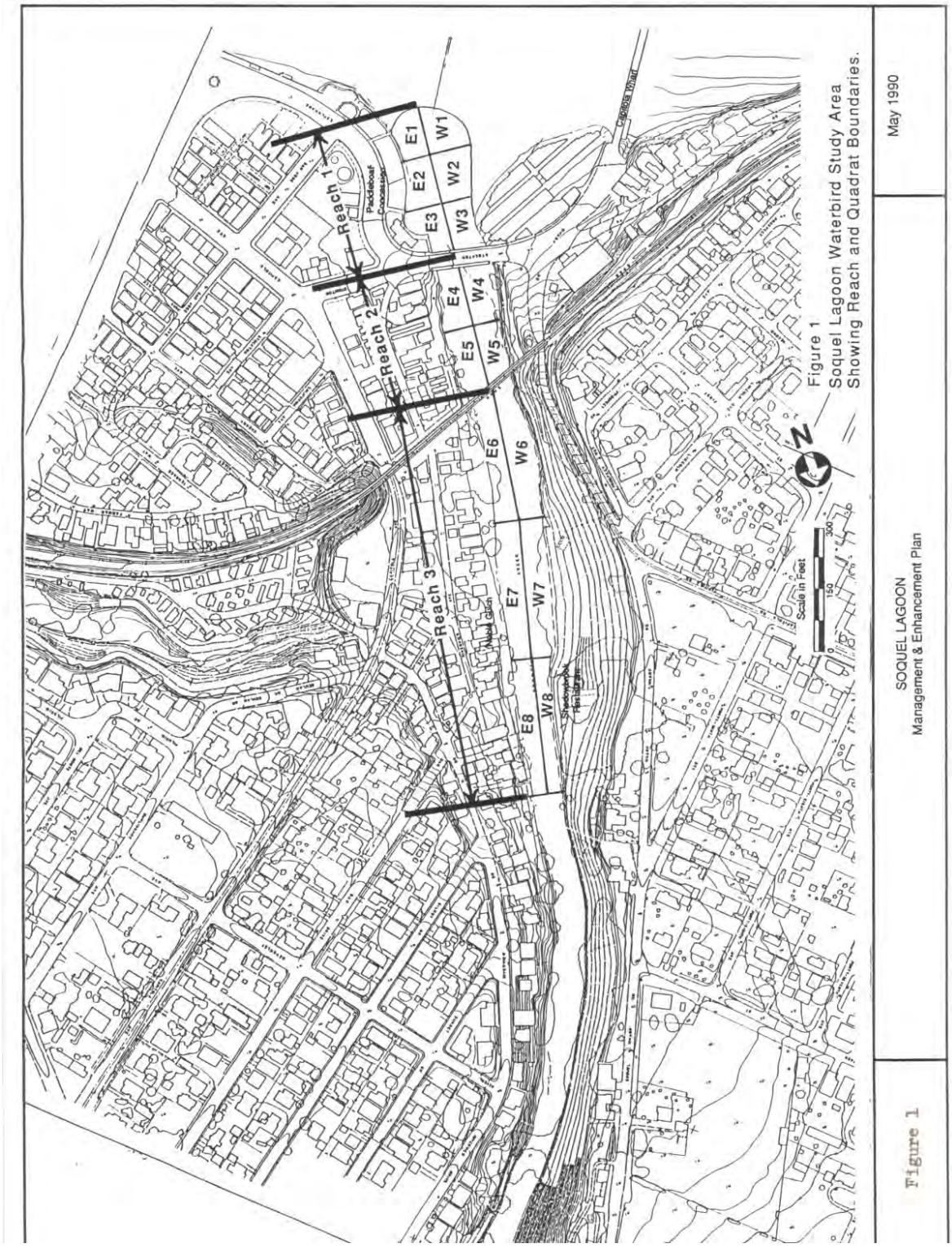


Figure 1. Map of Reaches in Soquel Creek Lagoon

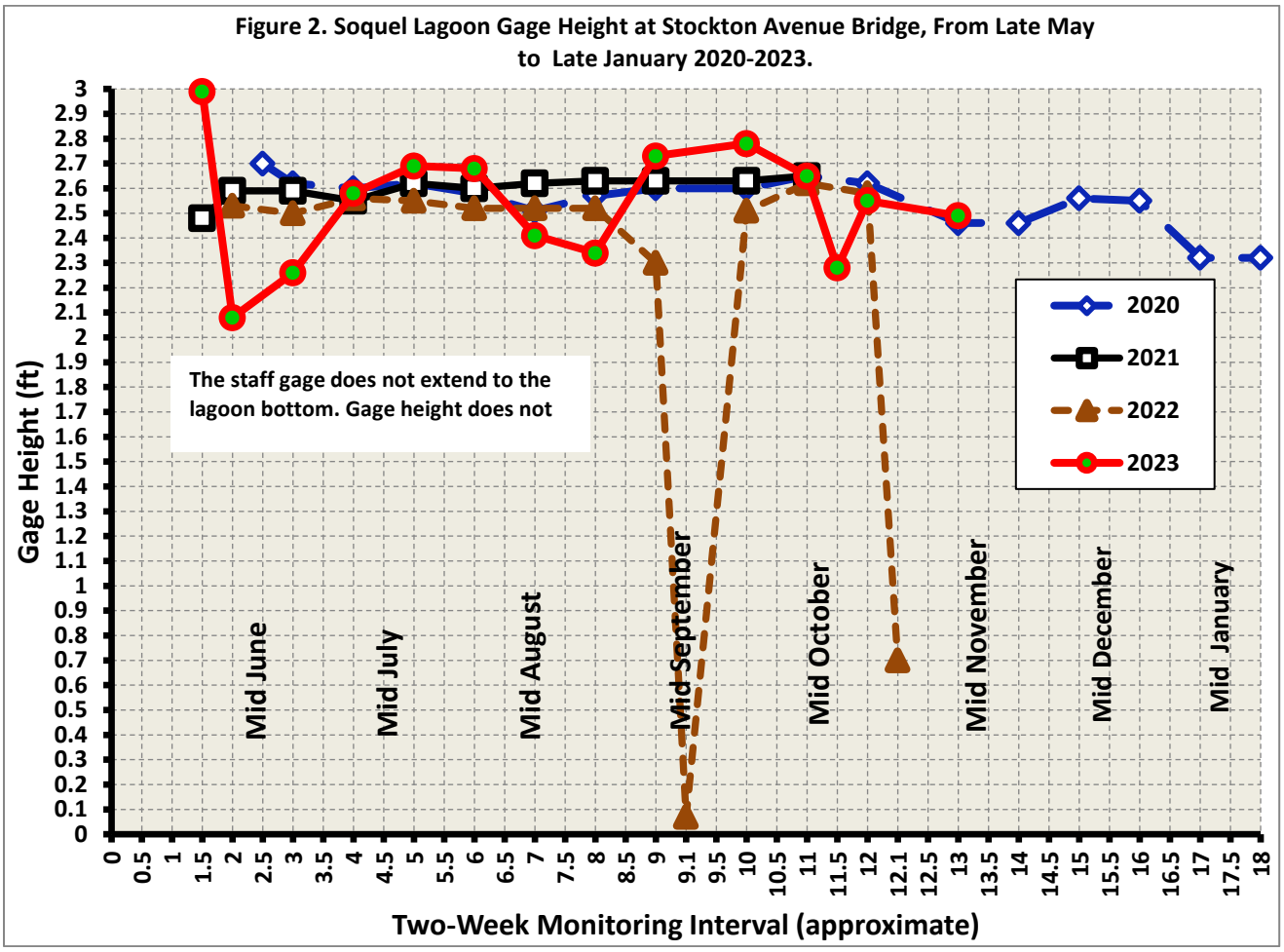


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2020-2023

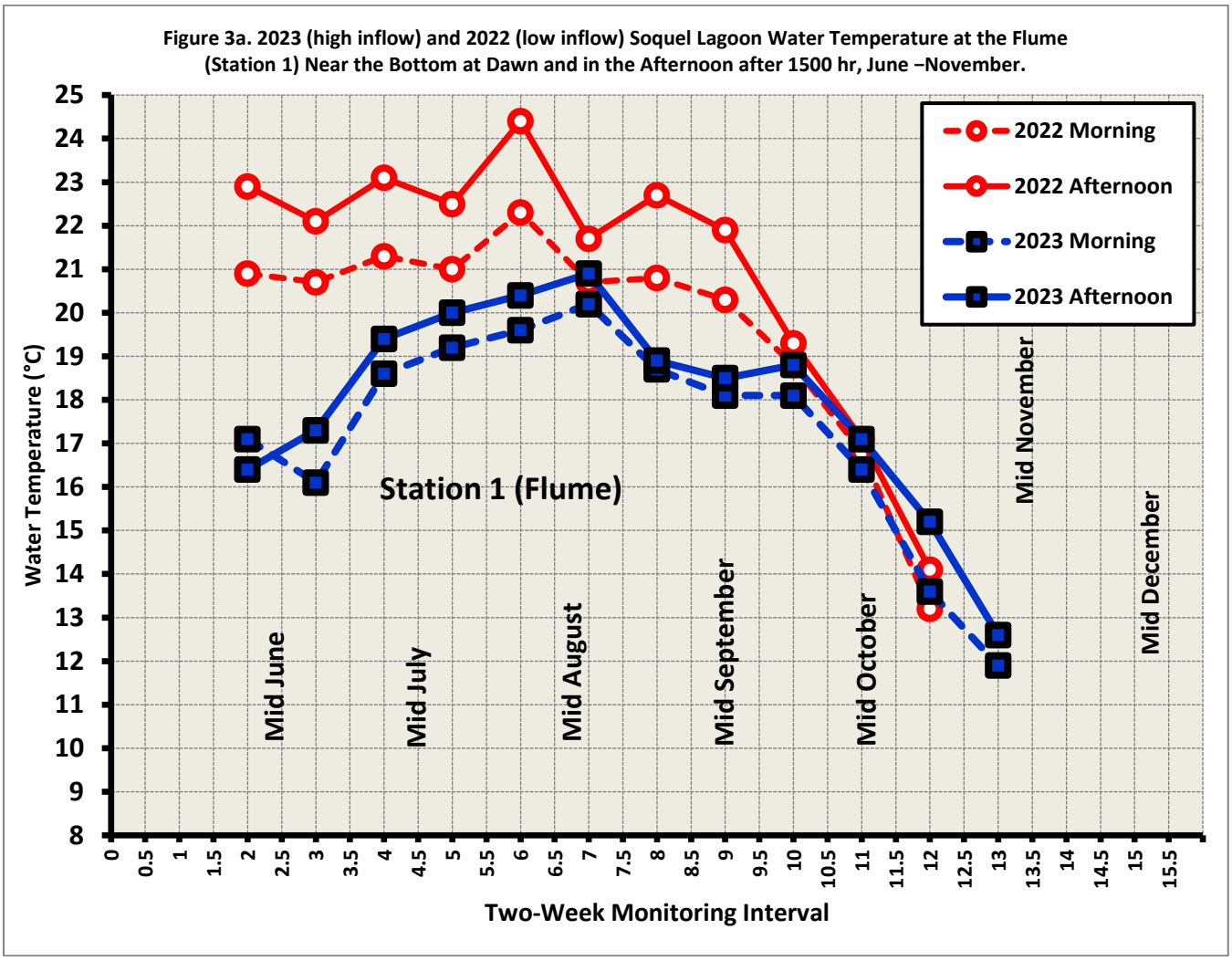


Figure 3a. Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon, Comparing 2023 to the lower flow year, 2022, June – Mid-November.

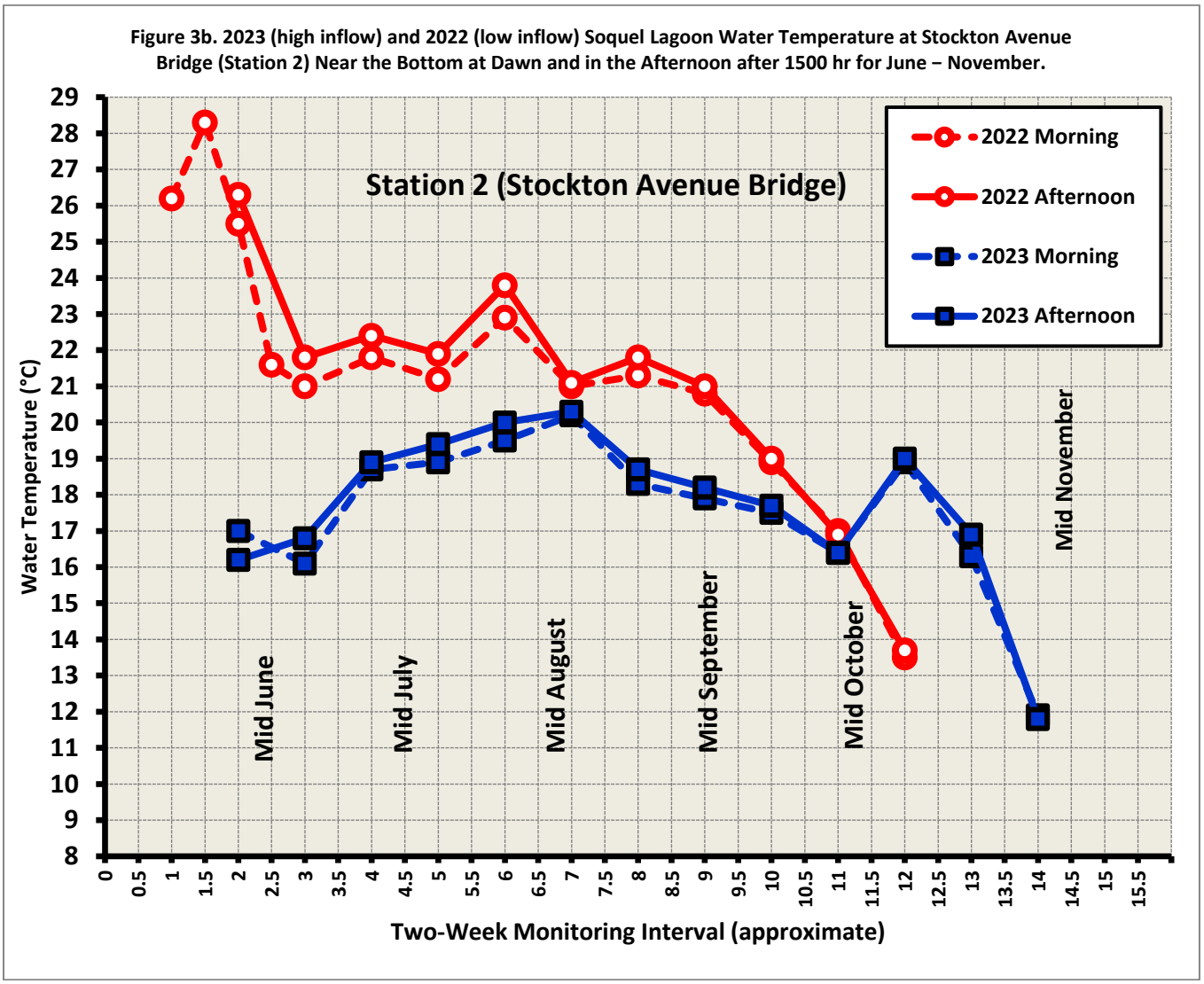


Figure 3b. Soquel Lagoon Water Temperature at Stockton Avenue Bridge (Station 2) Near the Bottom at Dawn and in the Afternoon, Comparing 2023 to the Lower Flow Year, 2022, June – Mid-November.

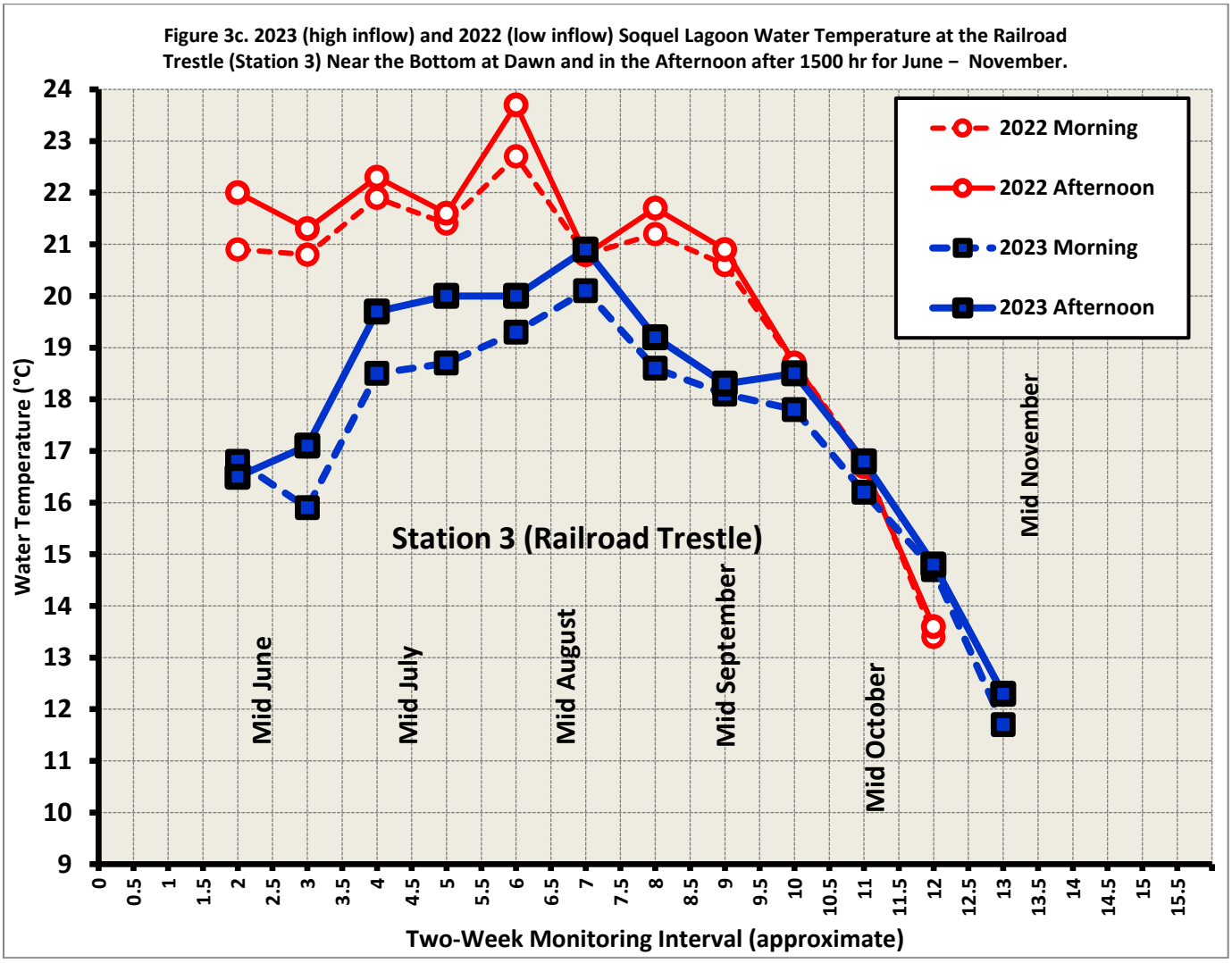


Figure 3c. Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon, Comparing 2023 to a Lower Flow Year, 2022, June – Mid-November.

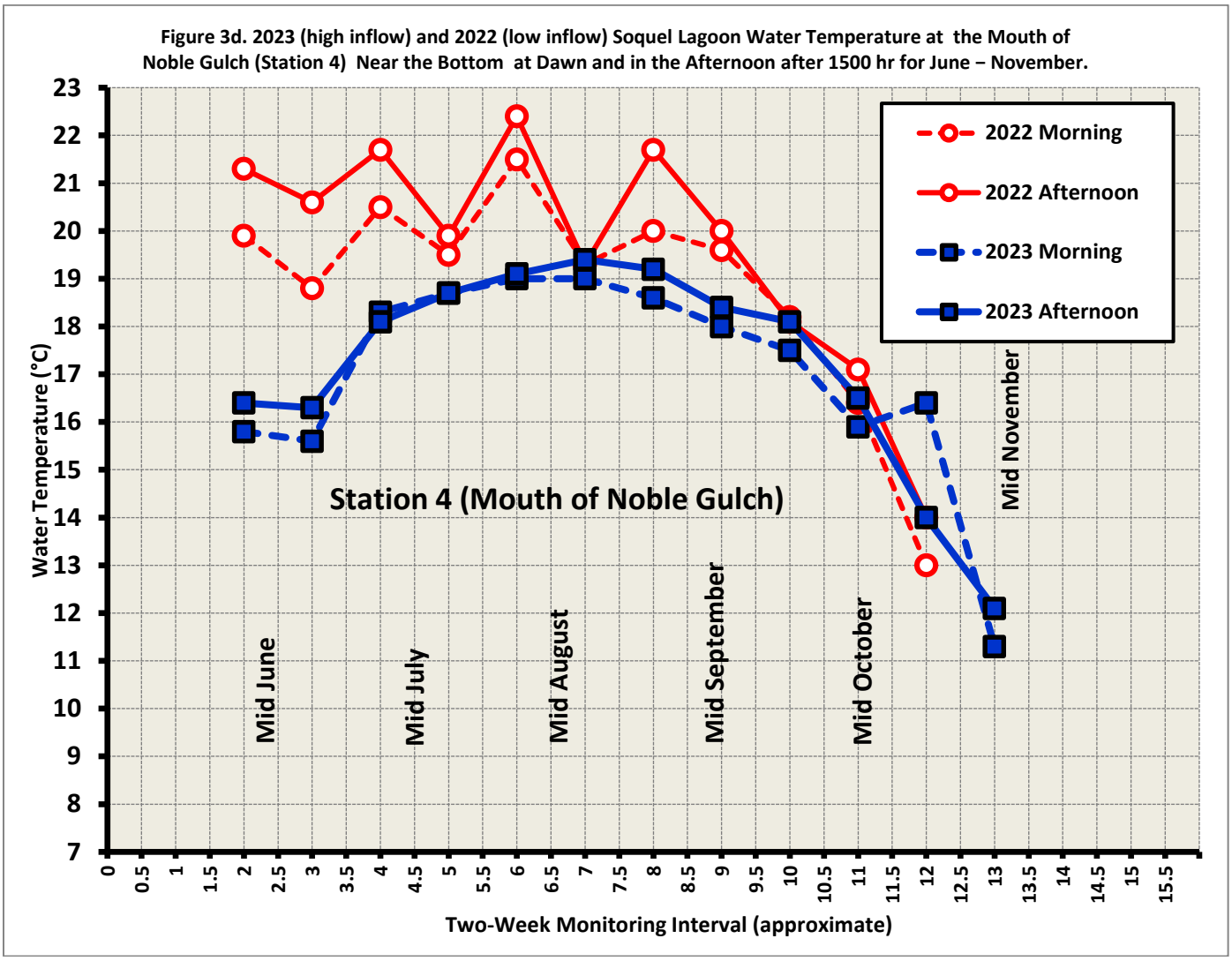


Figure 3d. Soquel Lagoon Water Temperature at the Mouth of Noble Gulch (Station 4) Near the Bottom at Dawn and in the Afternoon, Comparing 2023 to a Lower Flow Year, 2022, June – Mid-November.

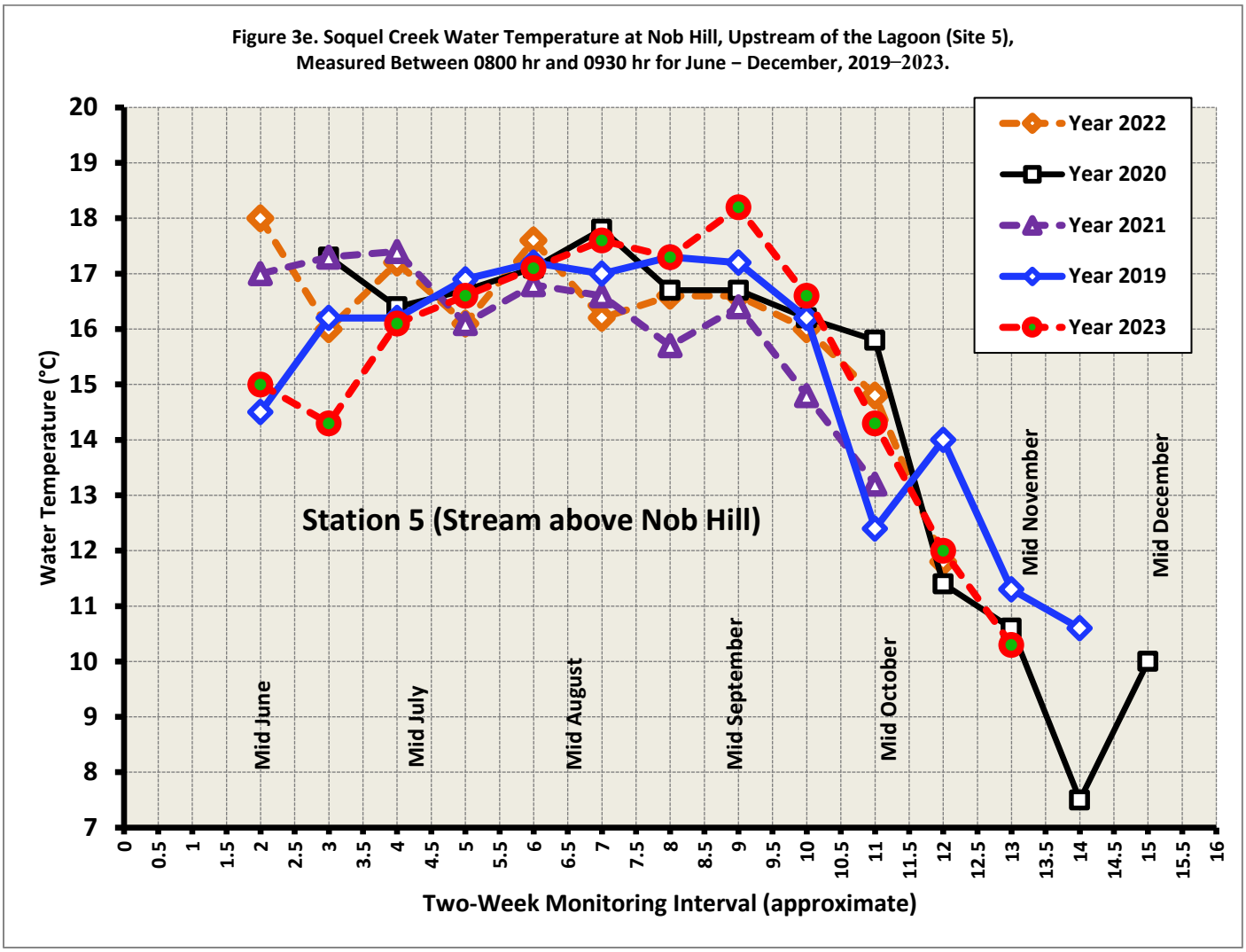


Figure 3e. Soquel Creek Water Temperature at Nob Hill Upstream of the Lagoon, 2019–2023. Measured Between 0800 hr and 0930 hr for June – Mid-December.

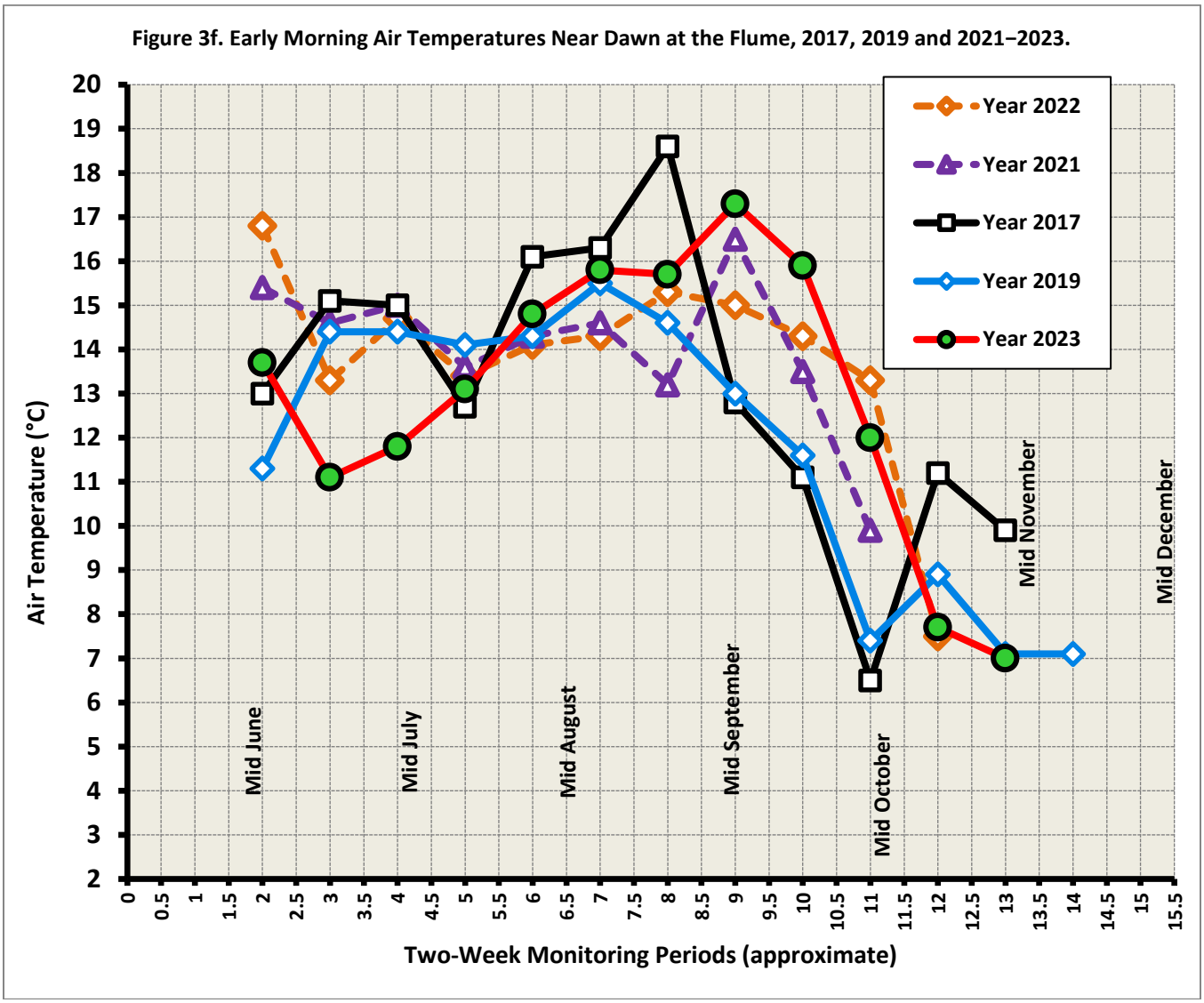


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, June − Mid-December, 2017, 2019 and 2021−2023.

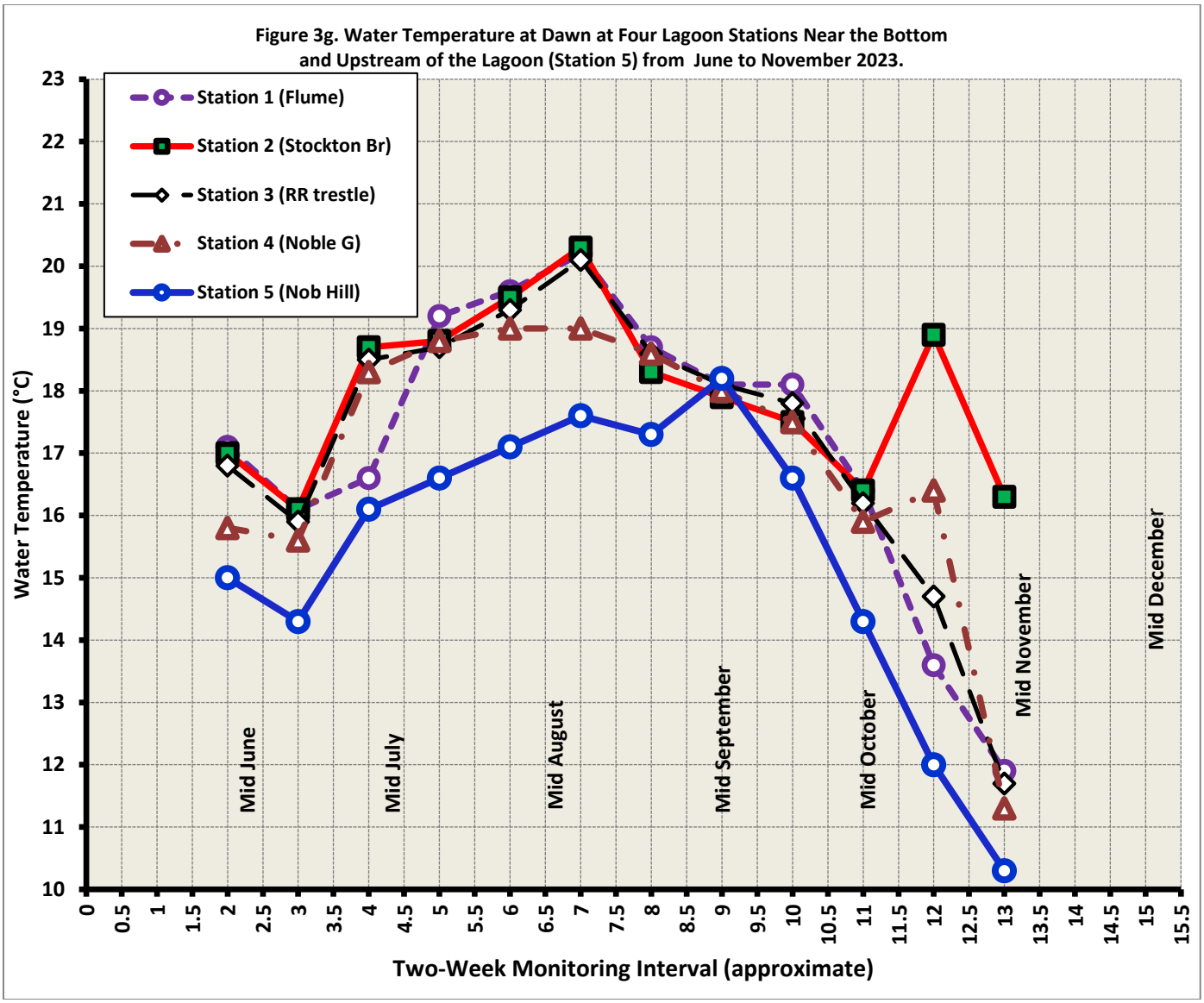


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream in Soquel Creek from June to Mid-November, 2023.

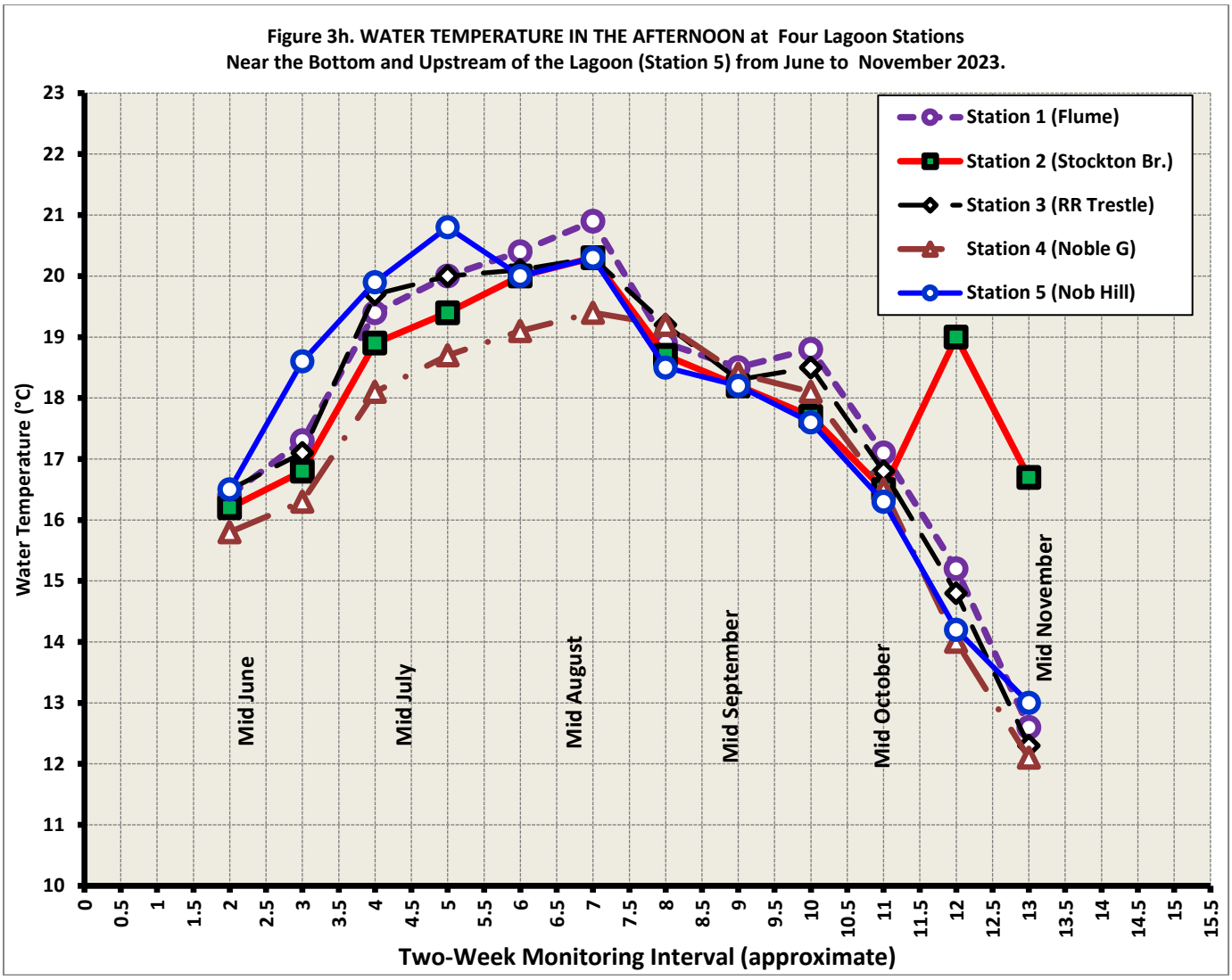


Figure 3h. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to Mid-November, 2023.

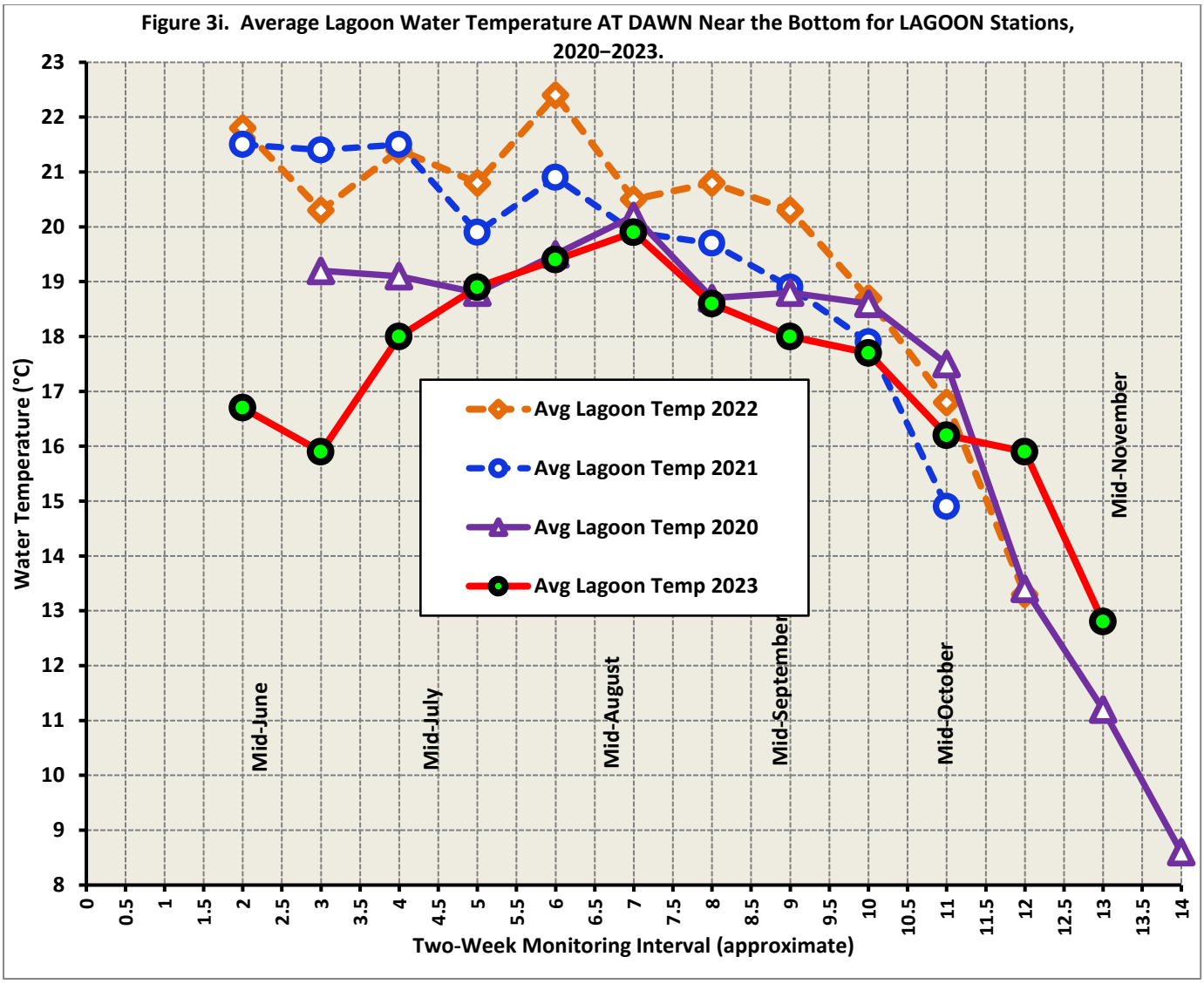


Figure 3i. AVERAGE Lagoon Water Temperature at Dawn Near the Bottom for 4 Stations, 2020–2023.

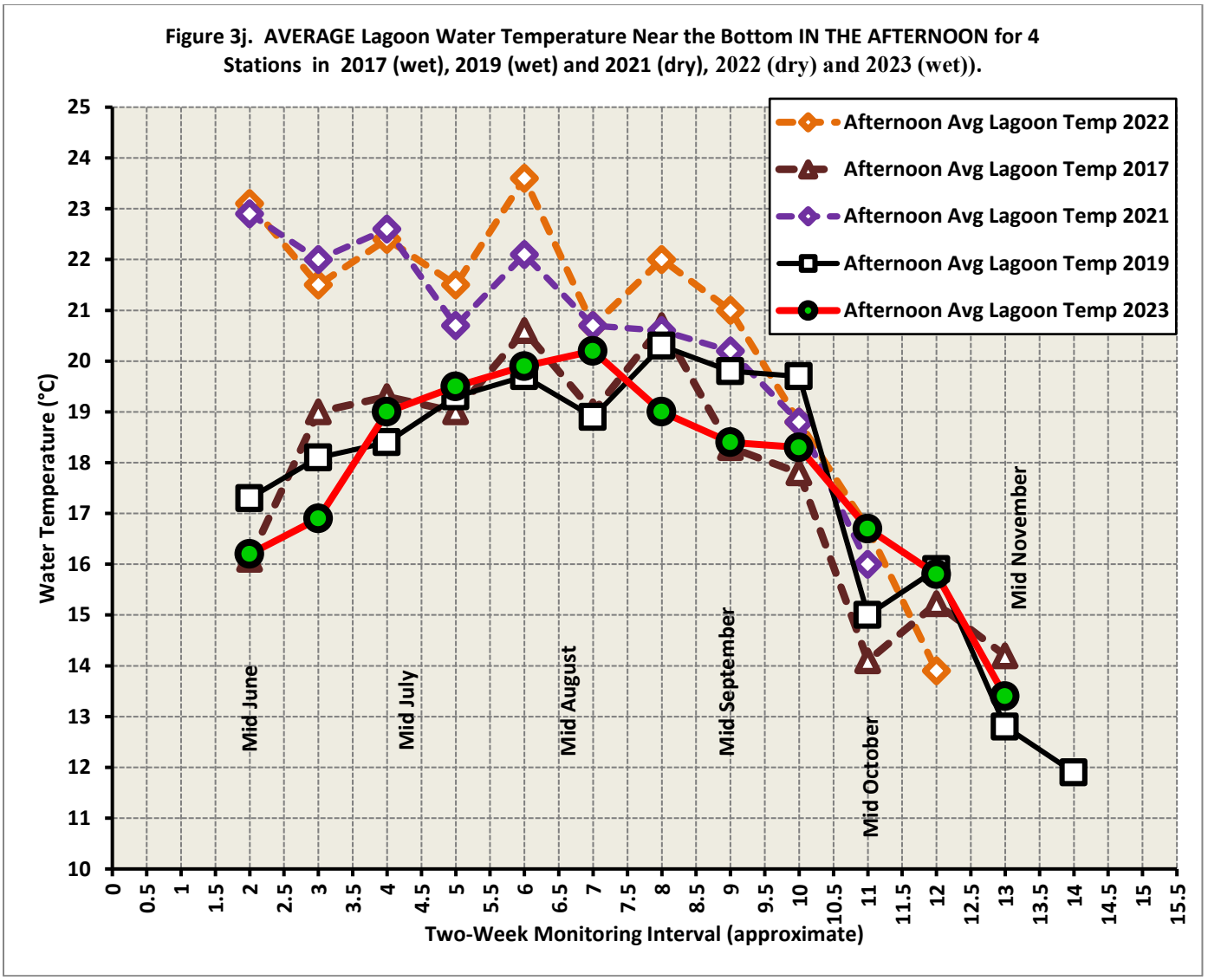


Figure 3j. AVERAGE Lagoon Water Temperature Near the Bottom in the Afternoon for 4 Stations, 2017, 2019 and 2021-2023.

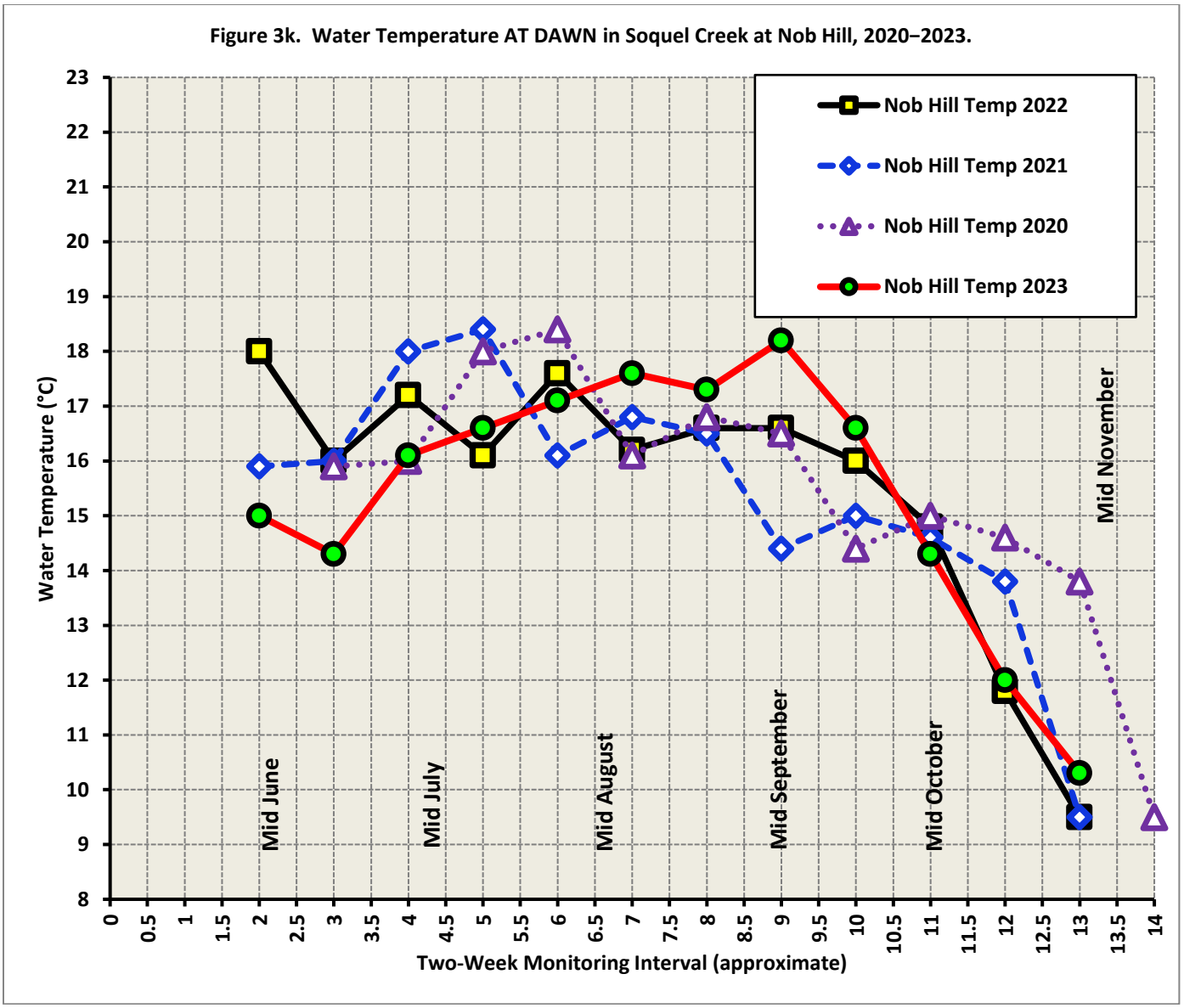


Figure 3k. Water Temperature AT DAWN in Soquel Creek at Nob Hill, 2020−2023.

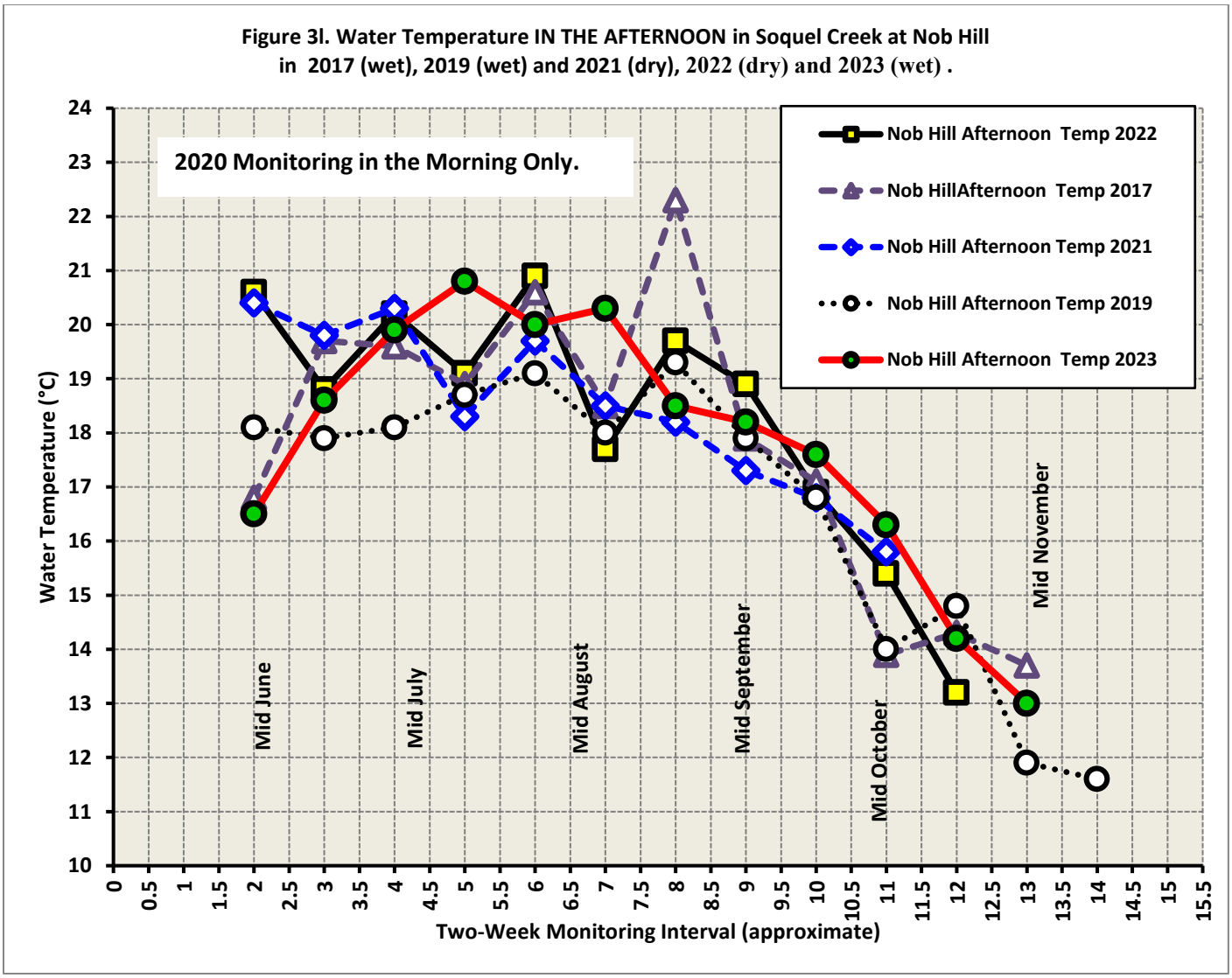


Figure 3l. Water Temperature IN THE AFTERNOON in Soquel Creek at Nob Hill in 2017 (wet), 2019 (wet), 2021 (dry), 2022 (dry) and 2023 (wet).

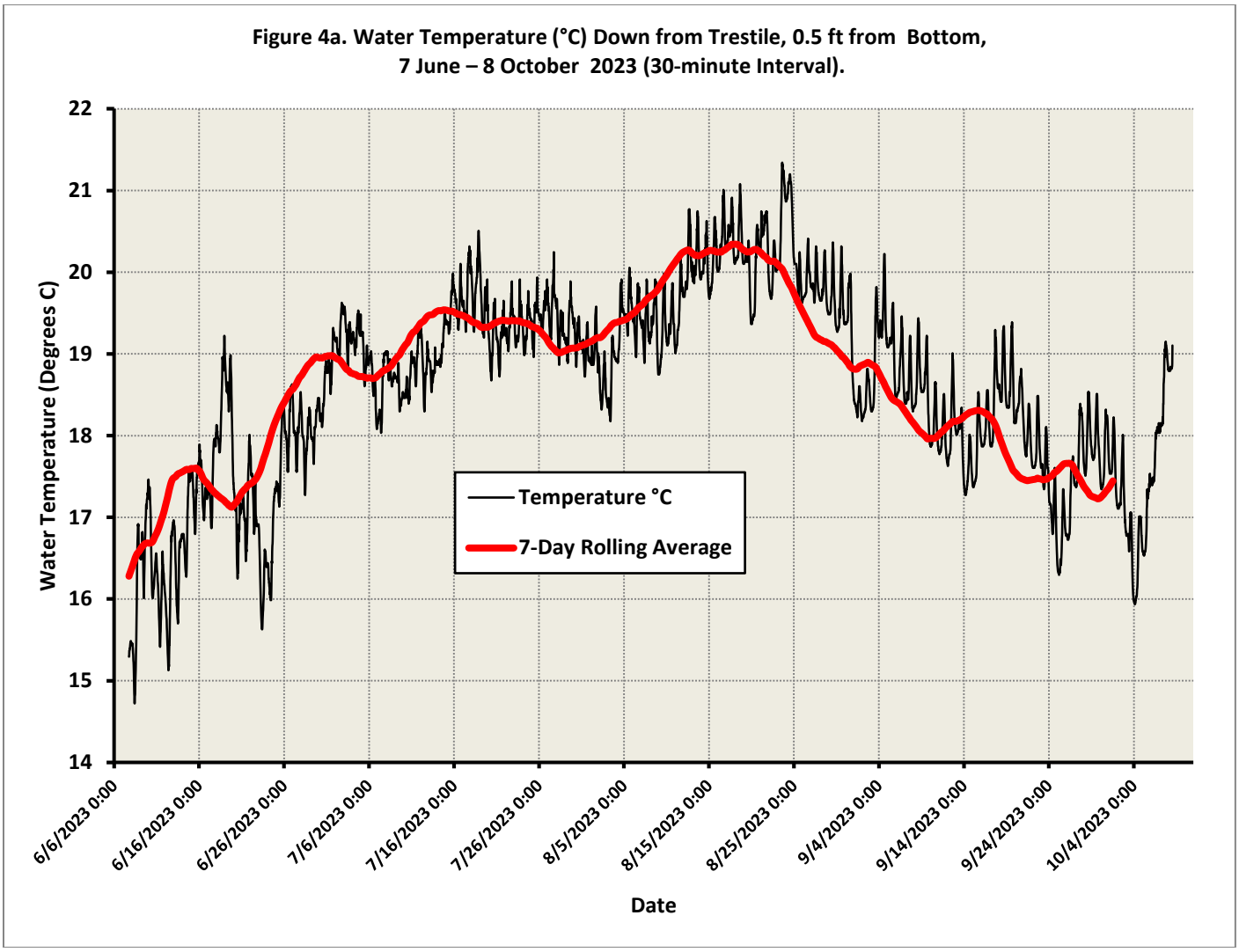


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

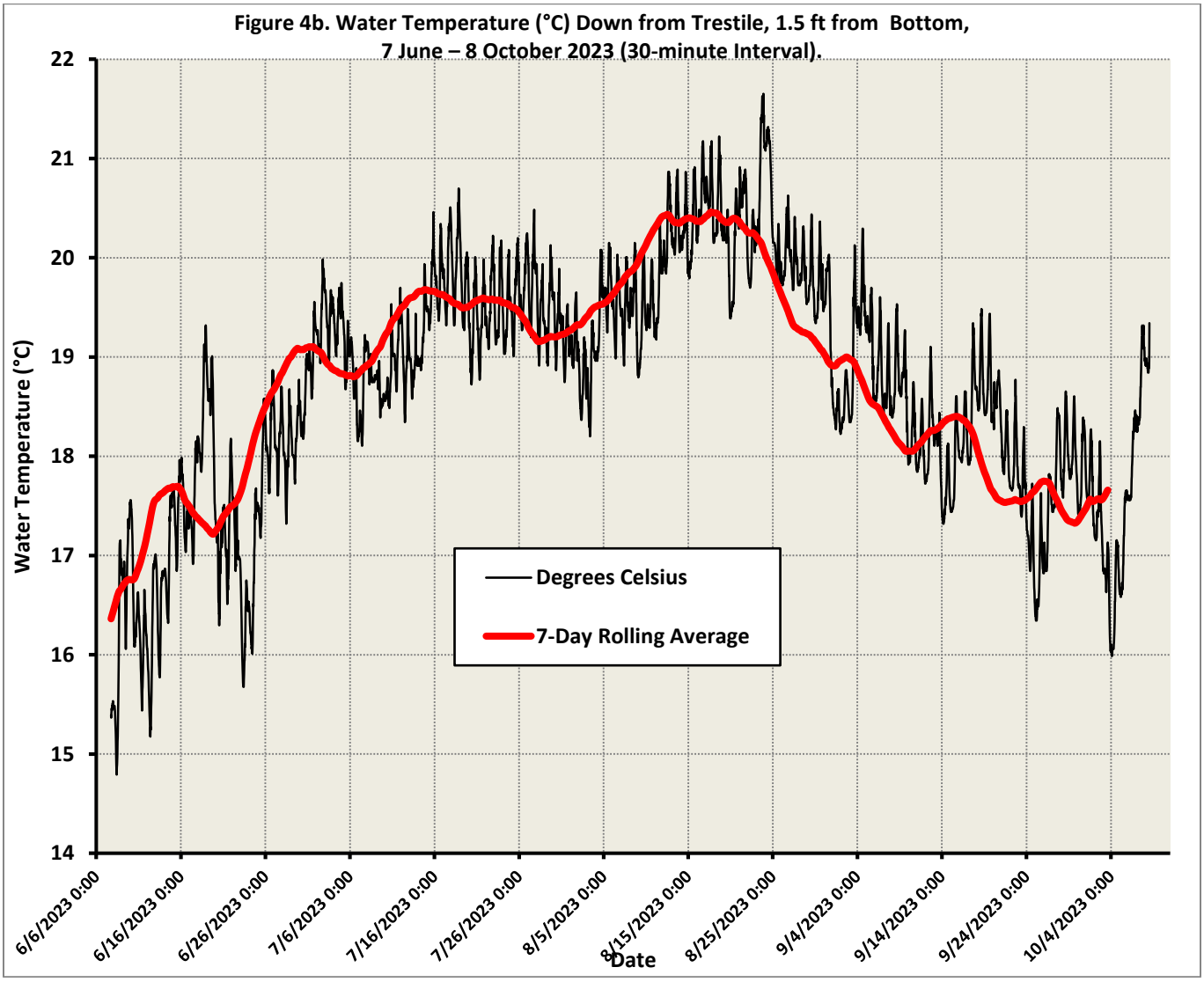


Figure 4b. Water Temperature (°C) Down from Trestle, 1.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

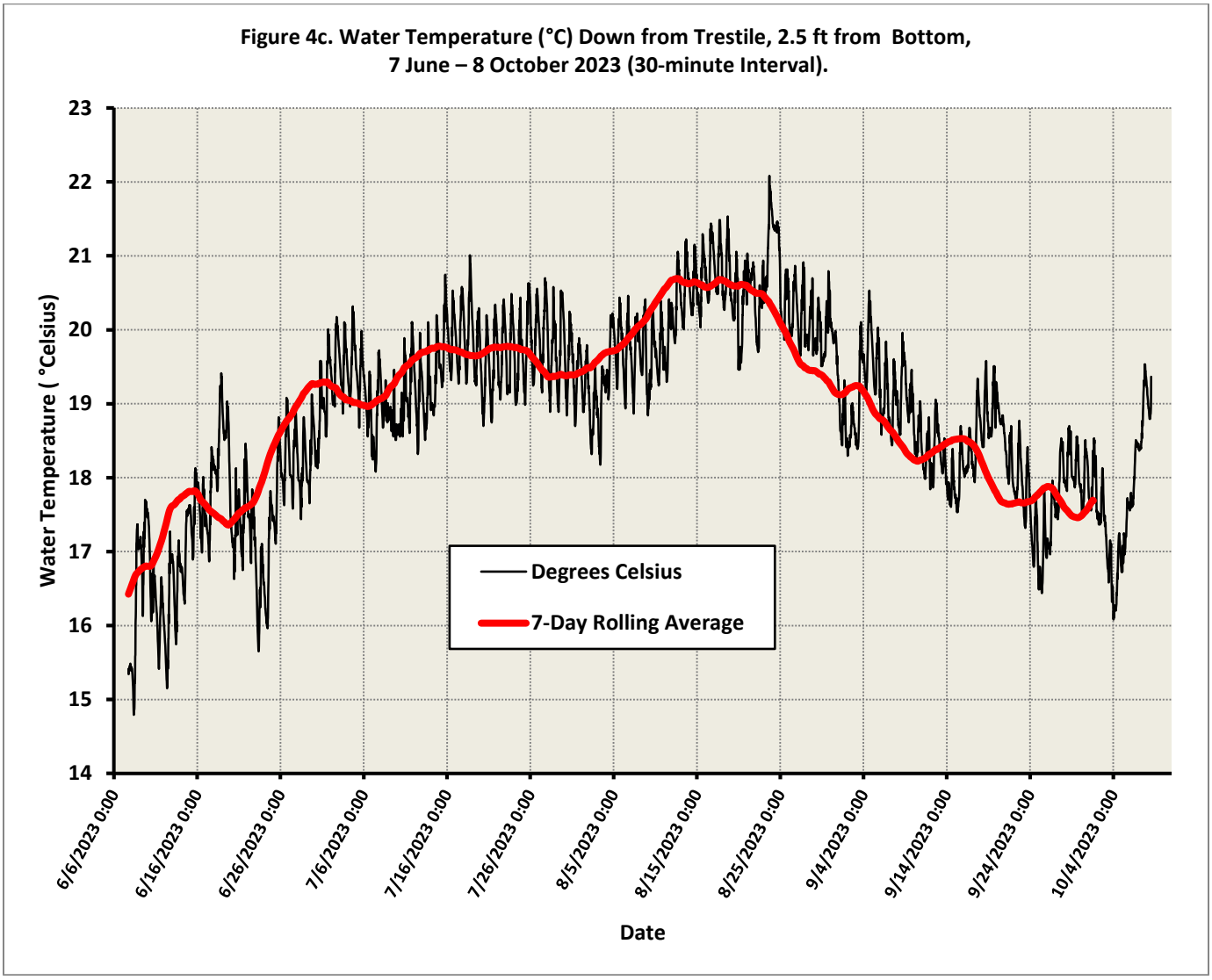


Figure 4c. Water Temperature (°C) Down from Trestle, 2.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

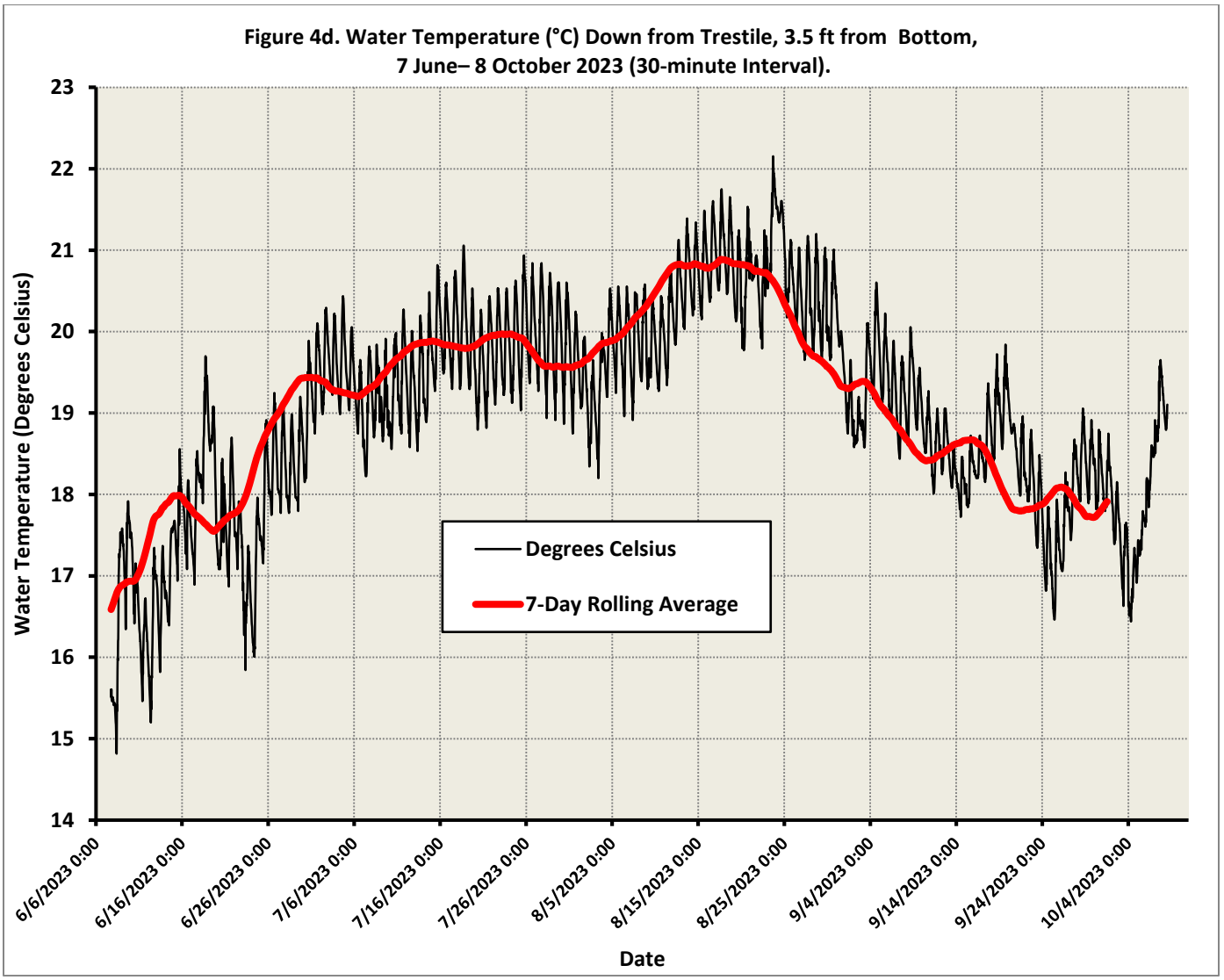


Figure 4d. Water Temperature (°C) Down from Trestle, 3.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

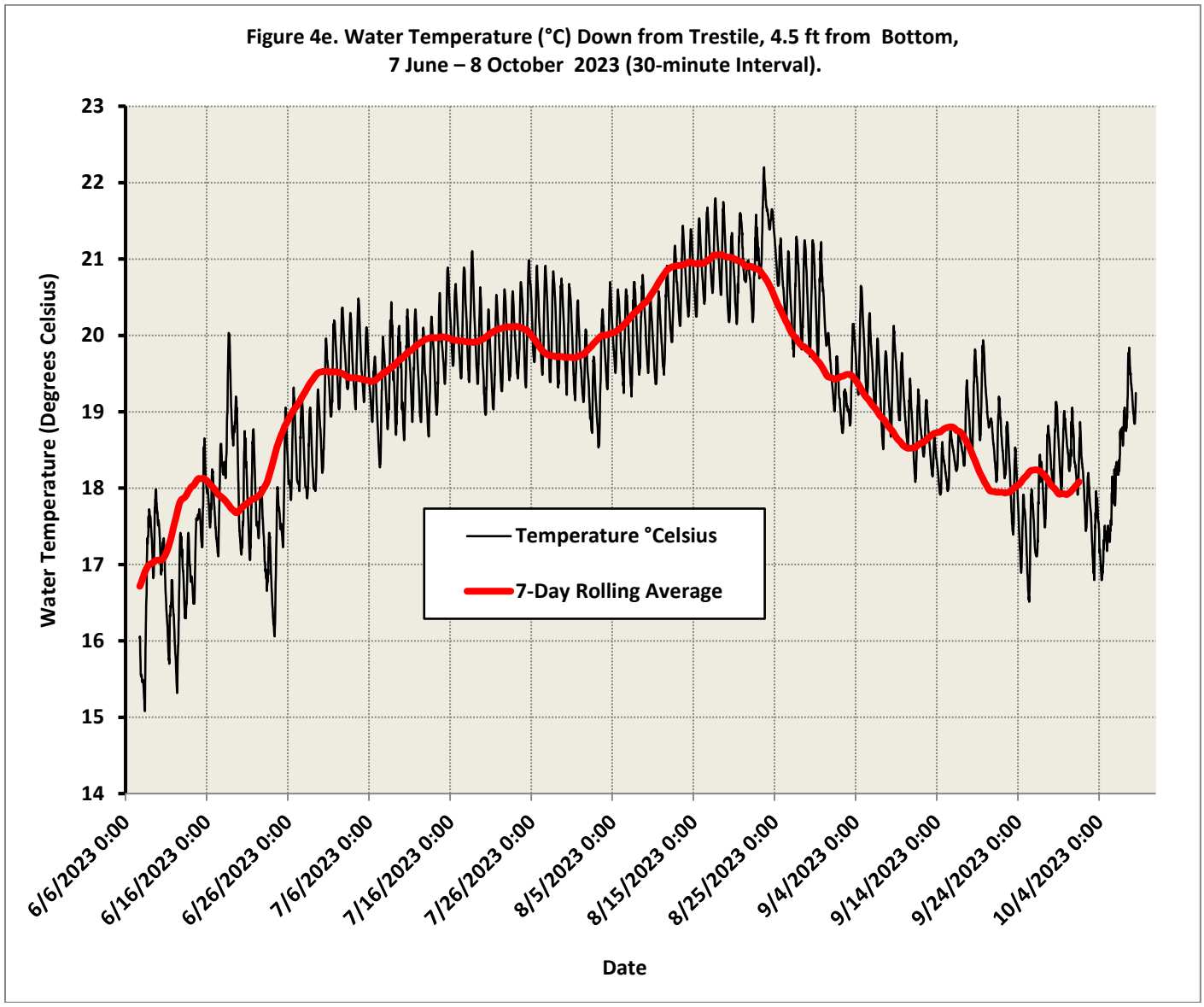


Figure 4e. Water Temperature (°C) Down from Trestle, 4.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

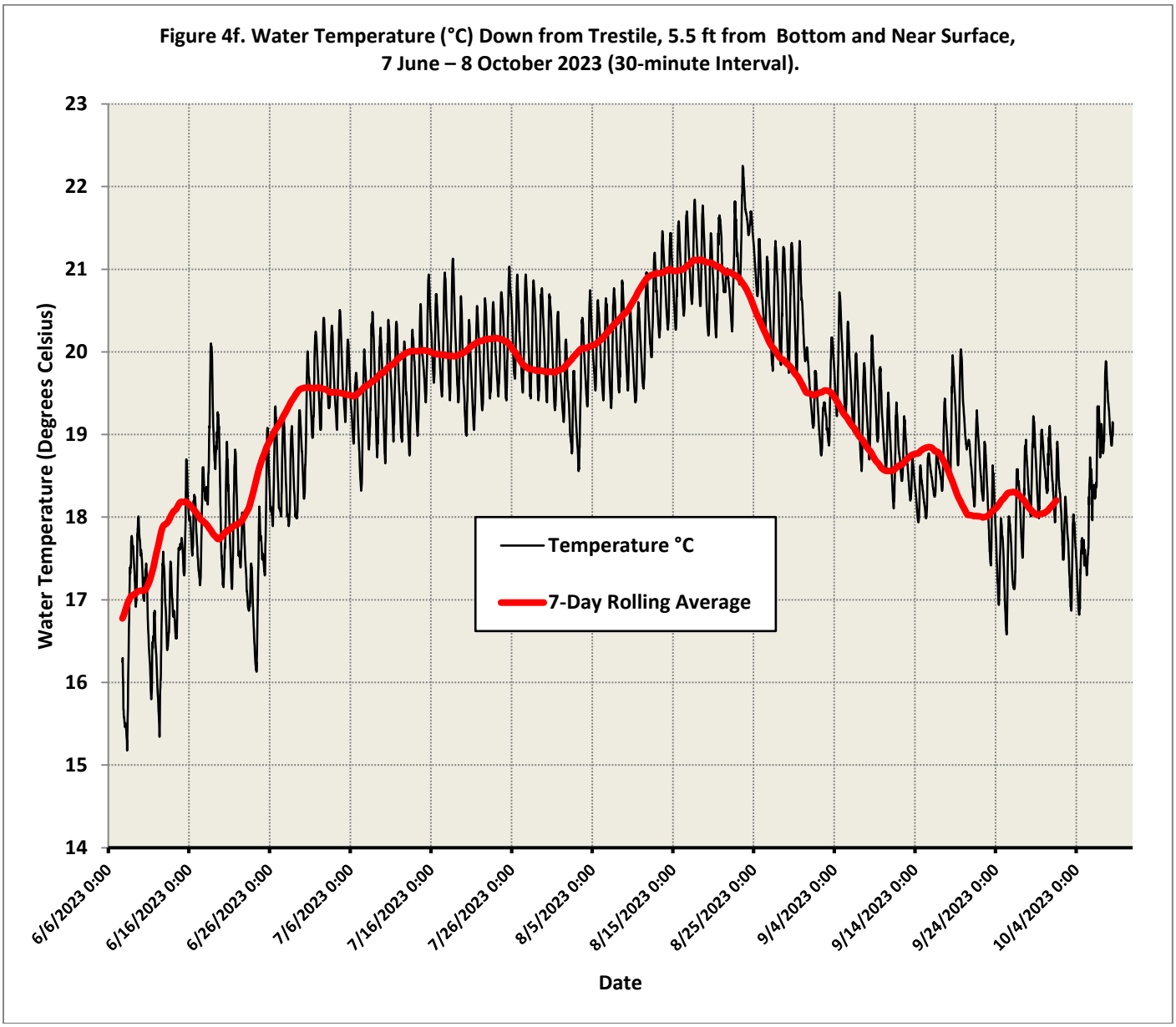


Figure 4f. Water Temperature (°C) Down from Trestle, 5.5 ft from the Bottom, 7 June – 8 October 2023 (30-minute Interval).

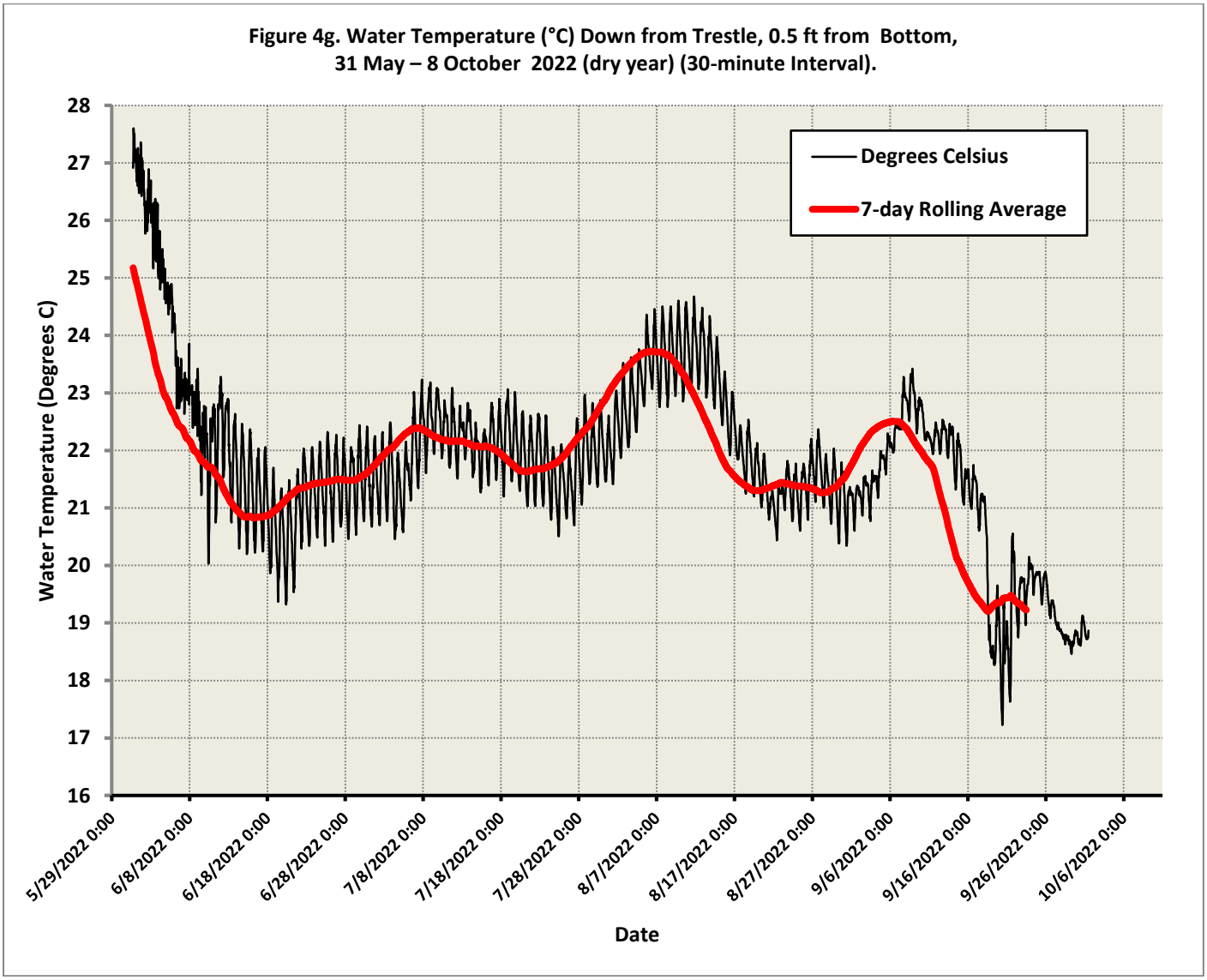


Figure 4g. Water Temperature (°C) Down from Trestle, 0.5 ft from the Bottom, 31 May − 8 October 2022 (dry) (30-minute Interval).

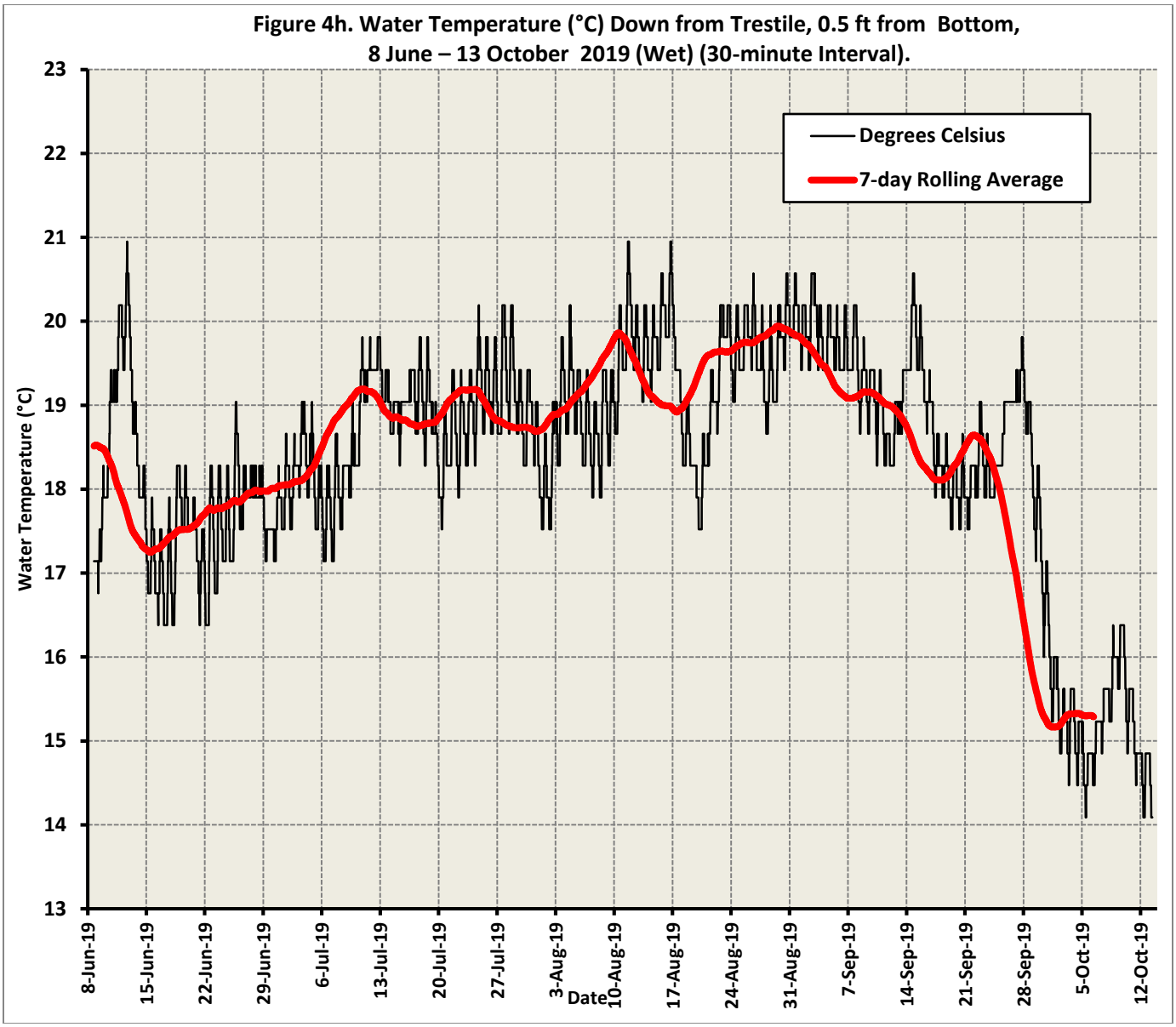


Figure 4h. Water Temperature (°C) Down from Trestle, 0.5 ft from the Bottom, 8 June – 13 October 2019 (30-minute Interval).

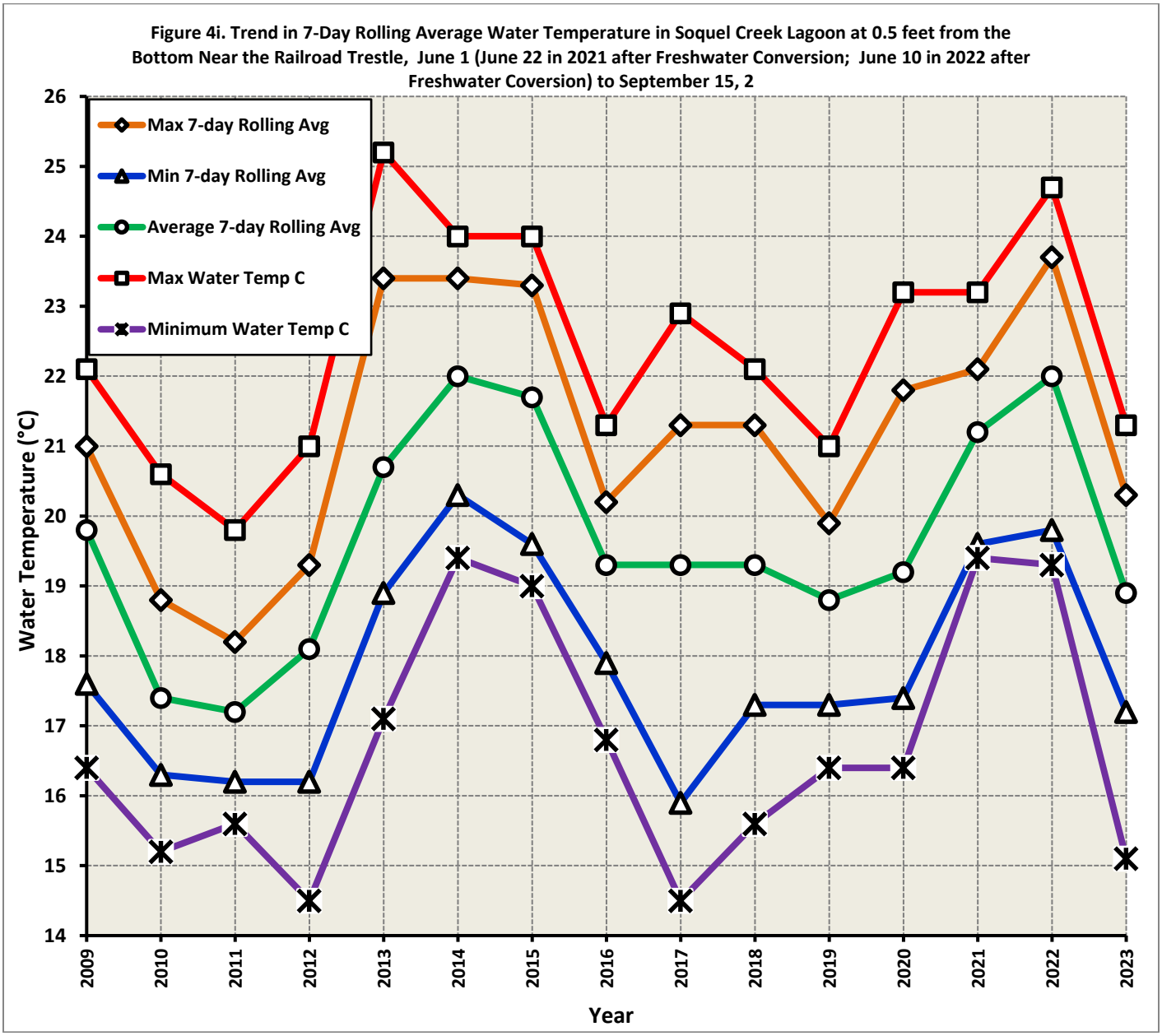


Figure 4i. Trend in 7-day Rolling Average Water Temperature in Soquel Creek Lagoon at 0.5 ft from the Bottom in Reach 2, Near the Railroad Trestle, 2009–2023.

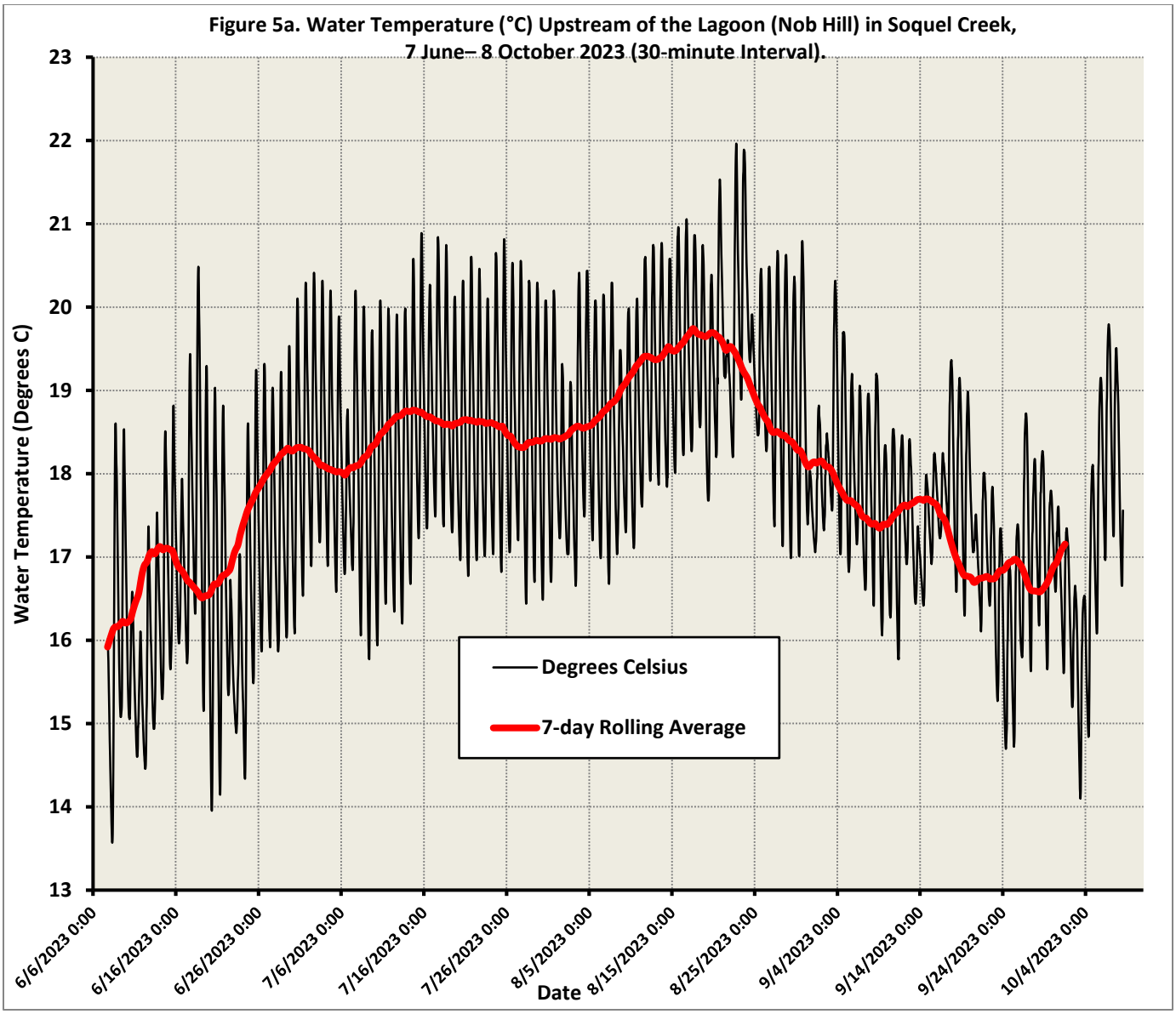


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 7 June − 8 October 2023 (Wet) (30-minute Interval).

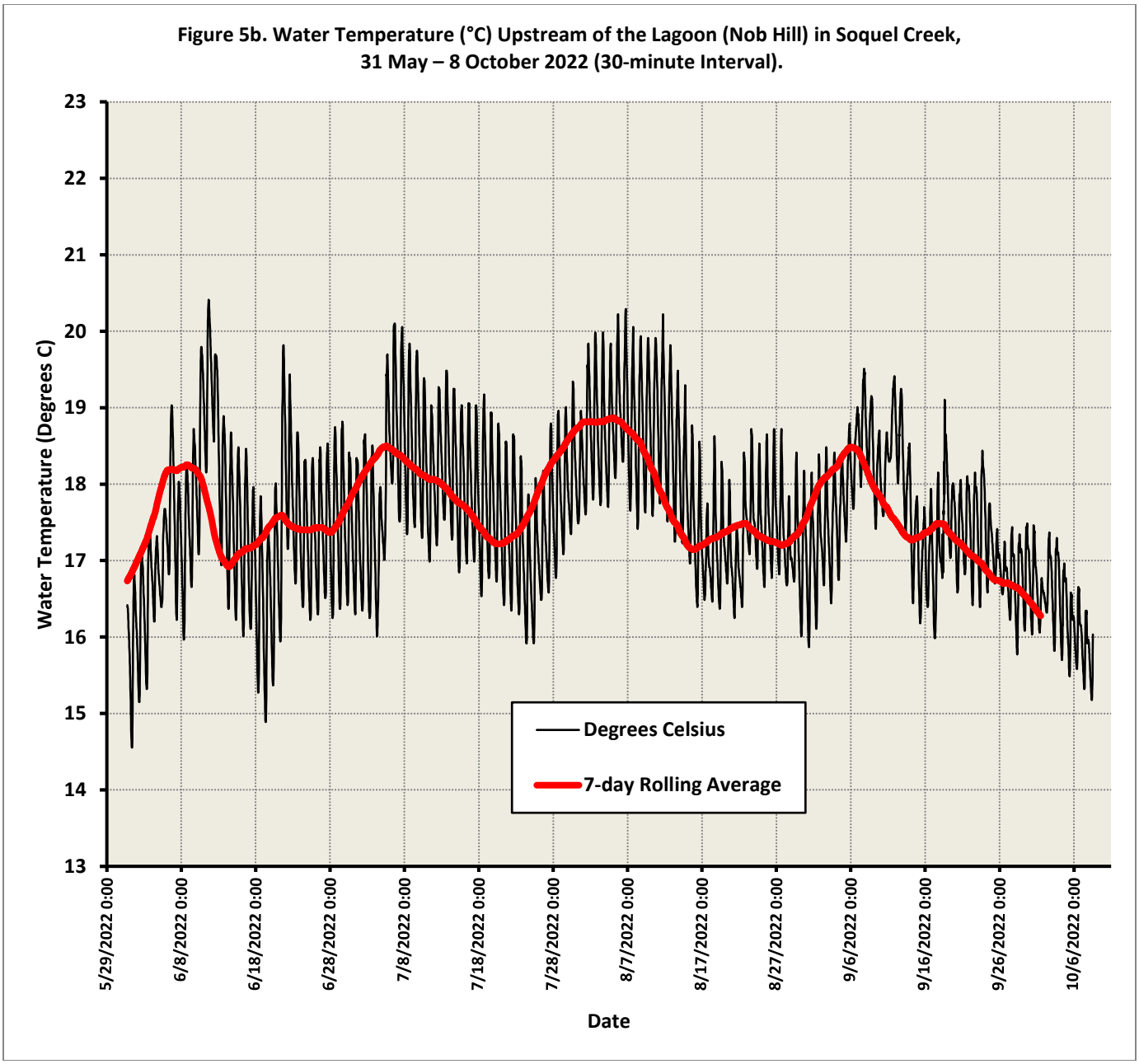


Figure 5b. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 31 May – 8 October 2022 (Dry) (30-minute Interval).

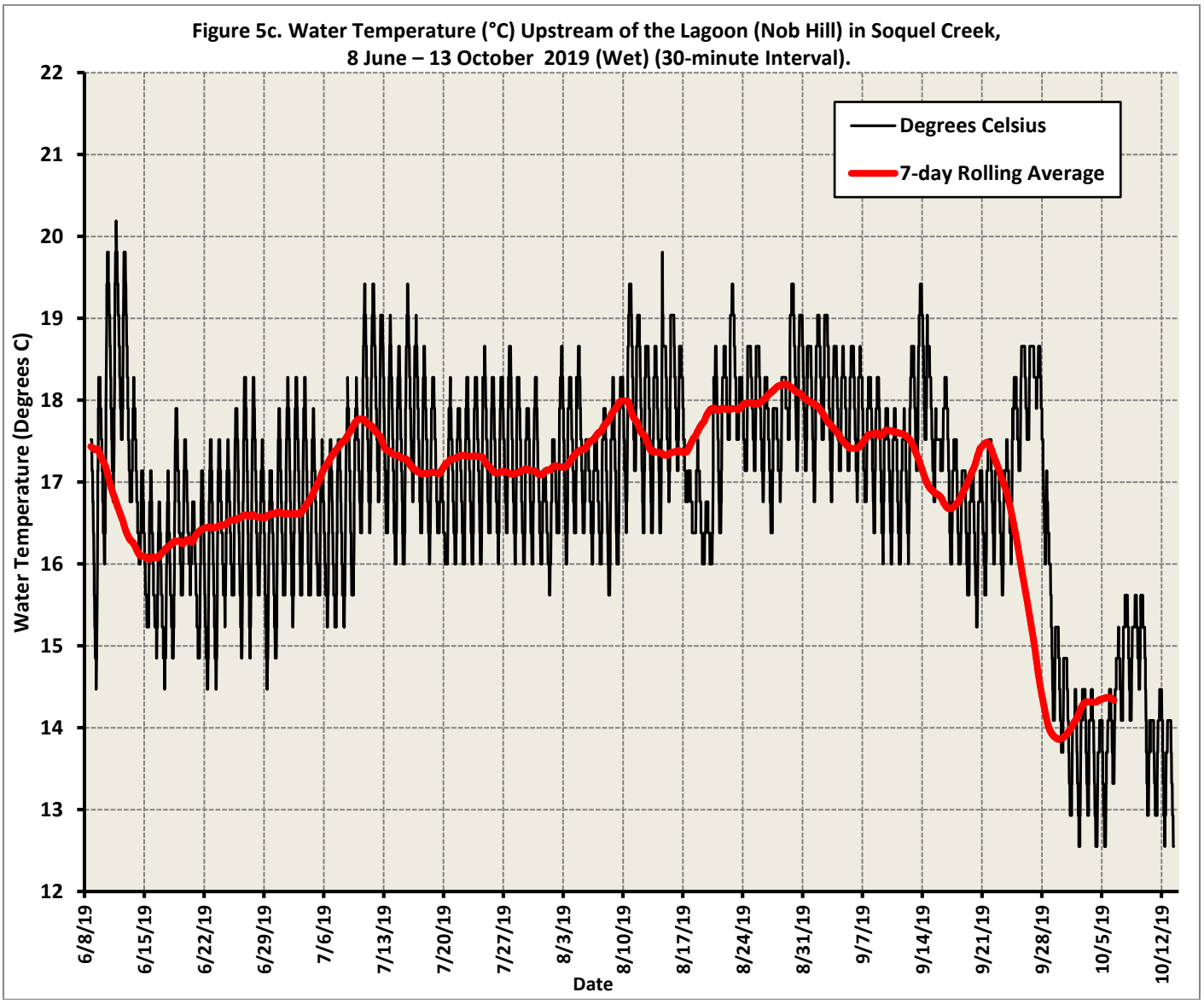


Figure 5c. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June – 13 October 2019 (Wet) (30-minute Interval).

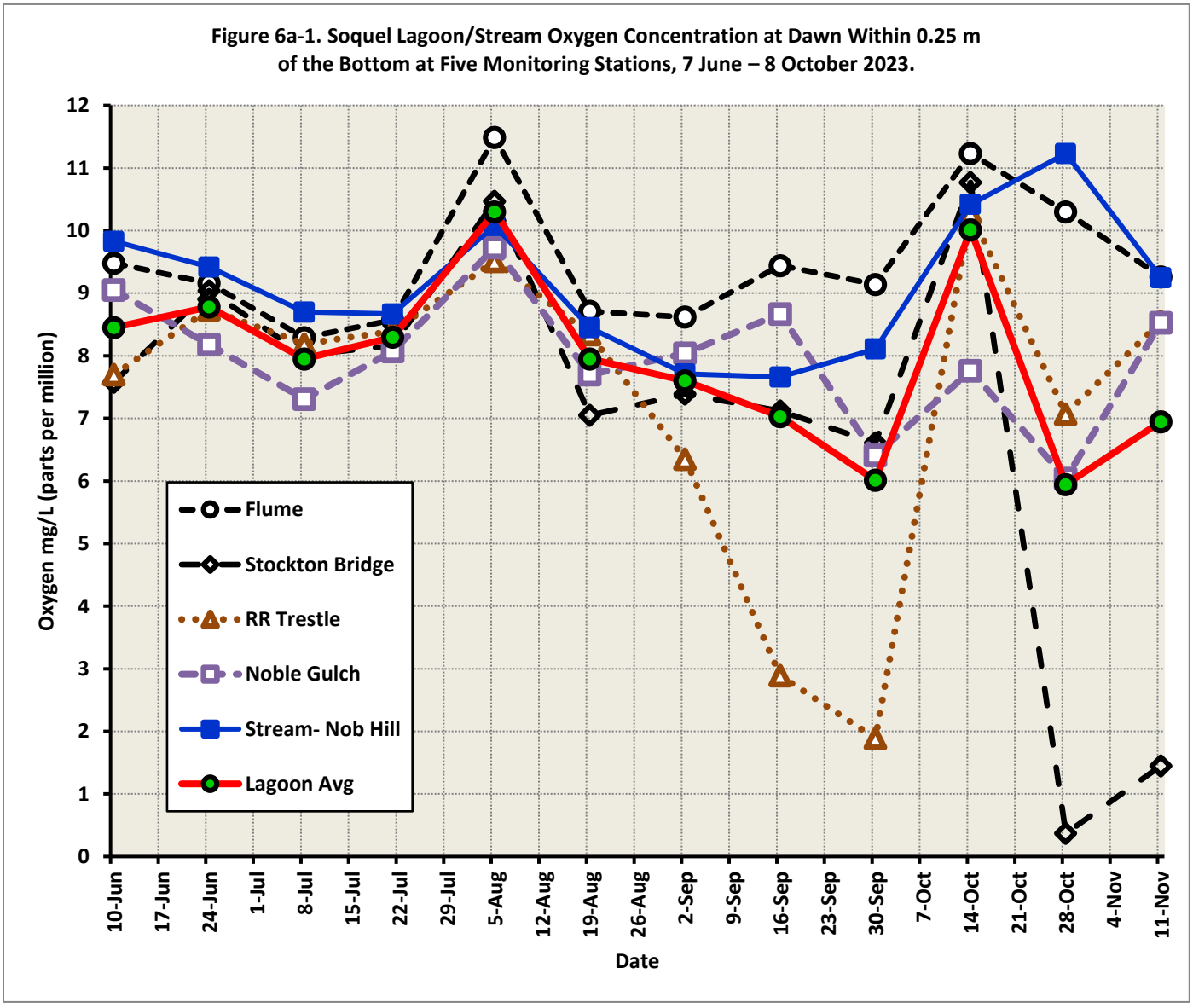


Figure 6a-1. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 11 June – 29 October 2022.

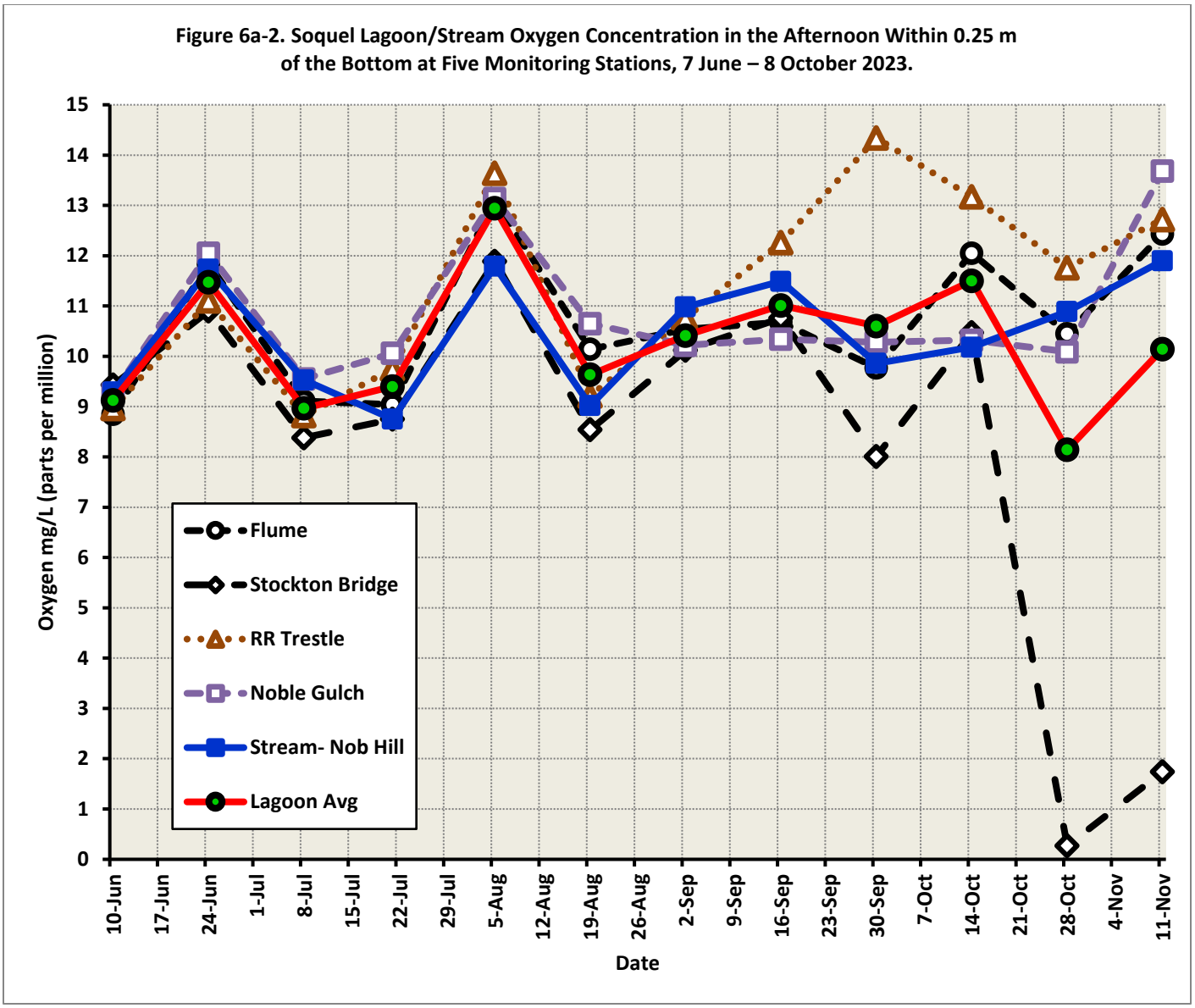


Figure 6a-2. Soquel Lagoon/Stream Oxygen Concentration in the Afternoon Within 0.25m of the Bottom at Five Monitoring Stations, 7 June – 8 October 2023.

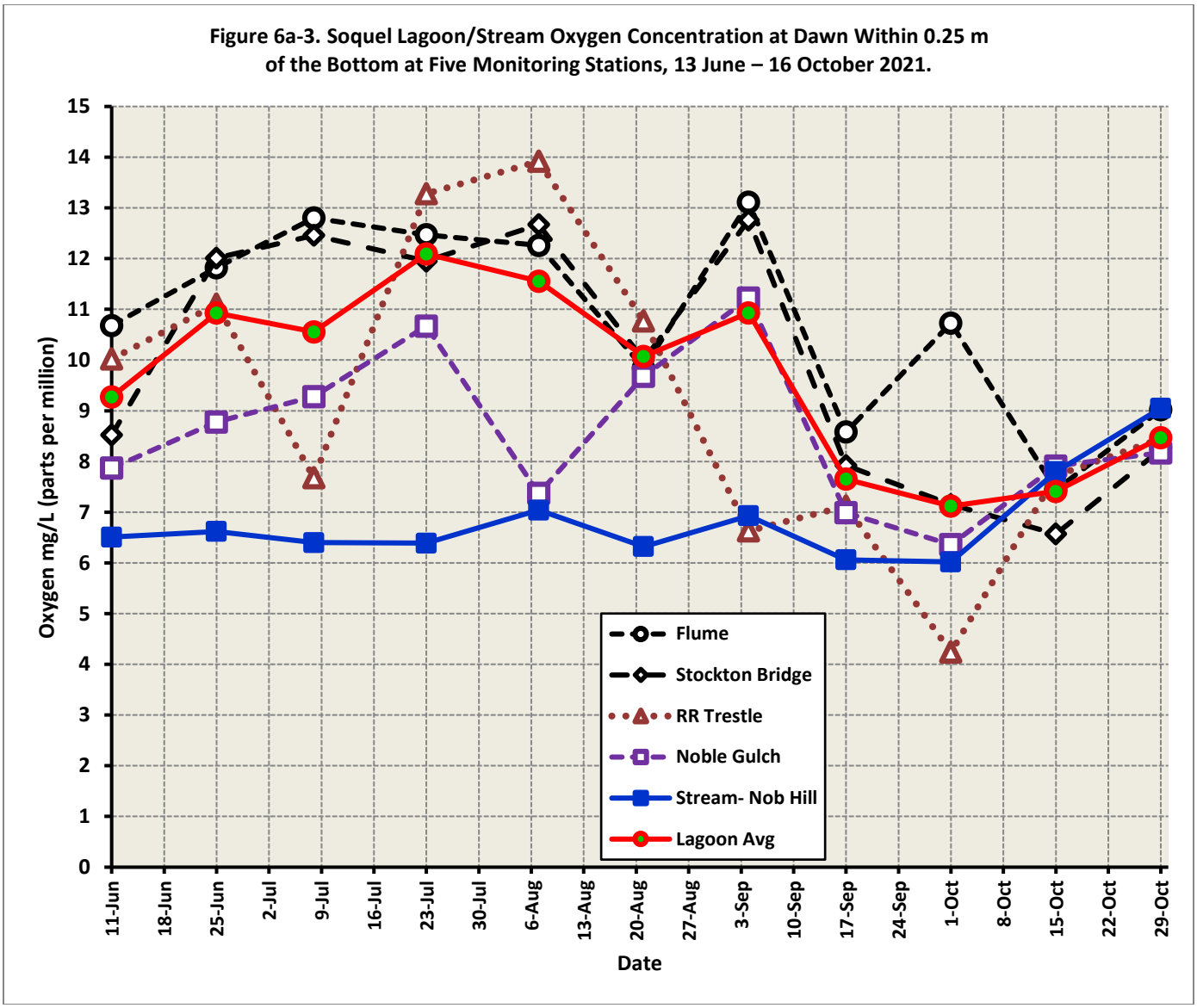


Figure 6a-3. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 7 June – 8 October 2023.

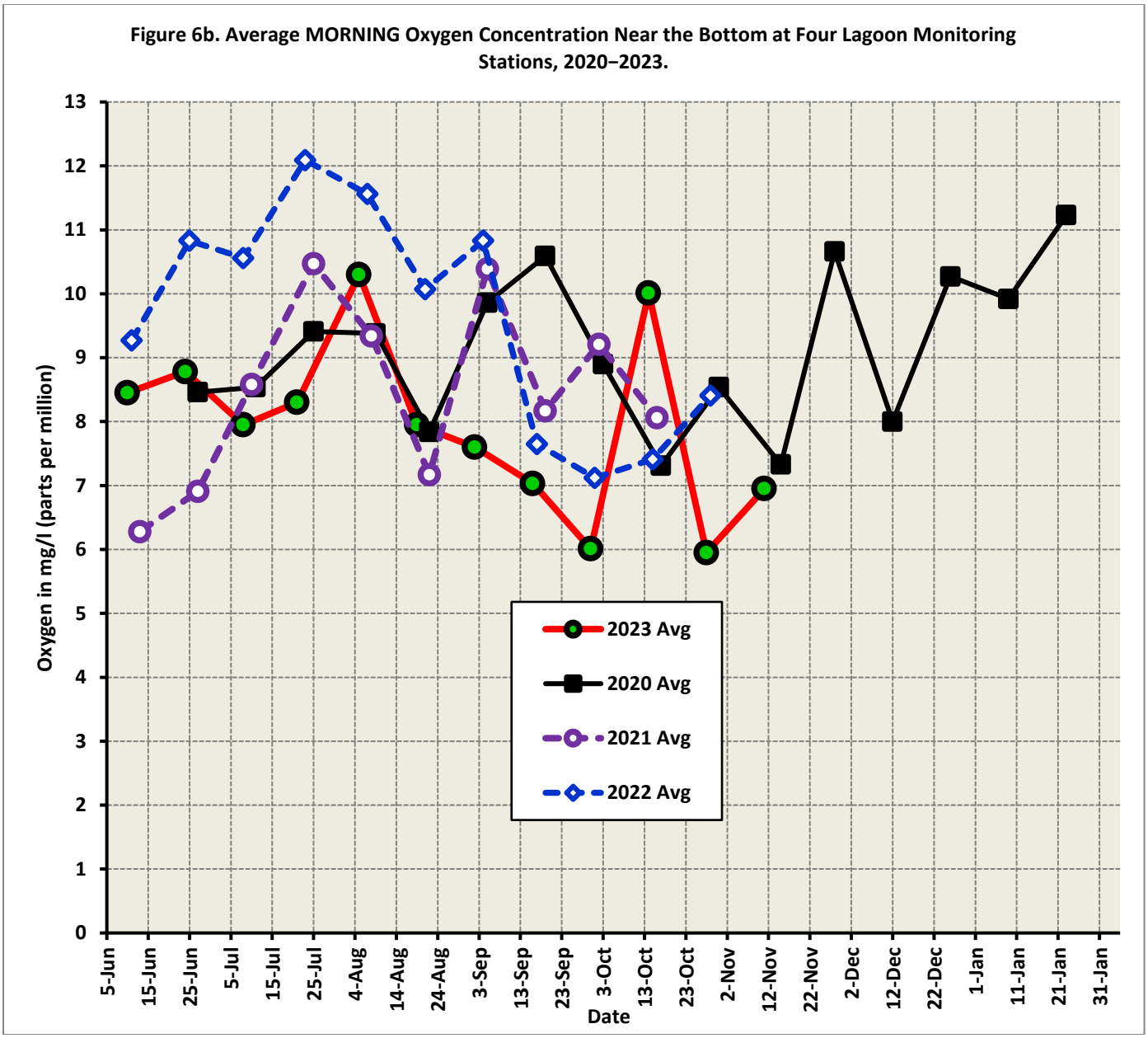


Figure 6b. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2020−2023.

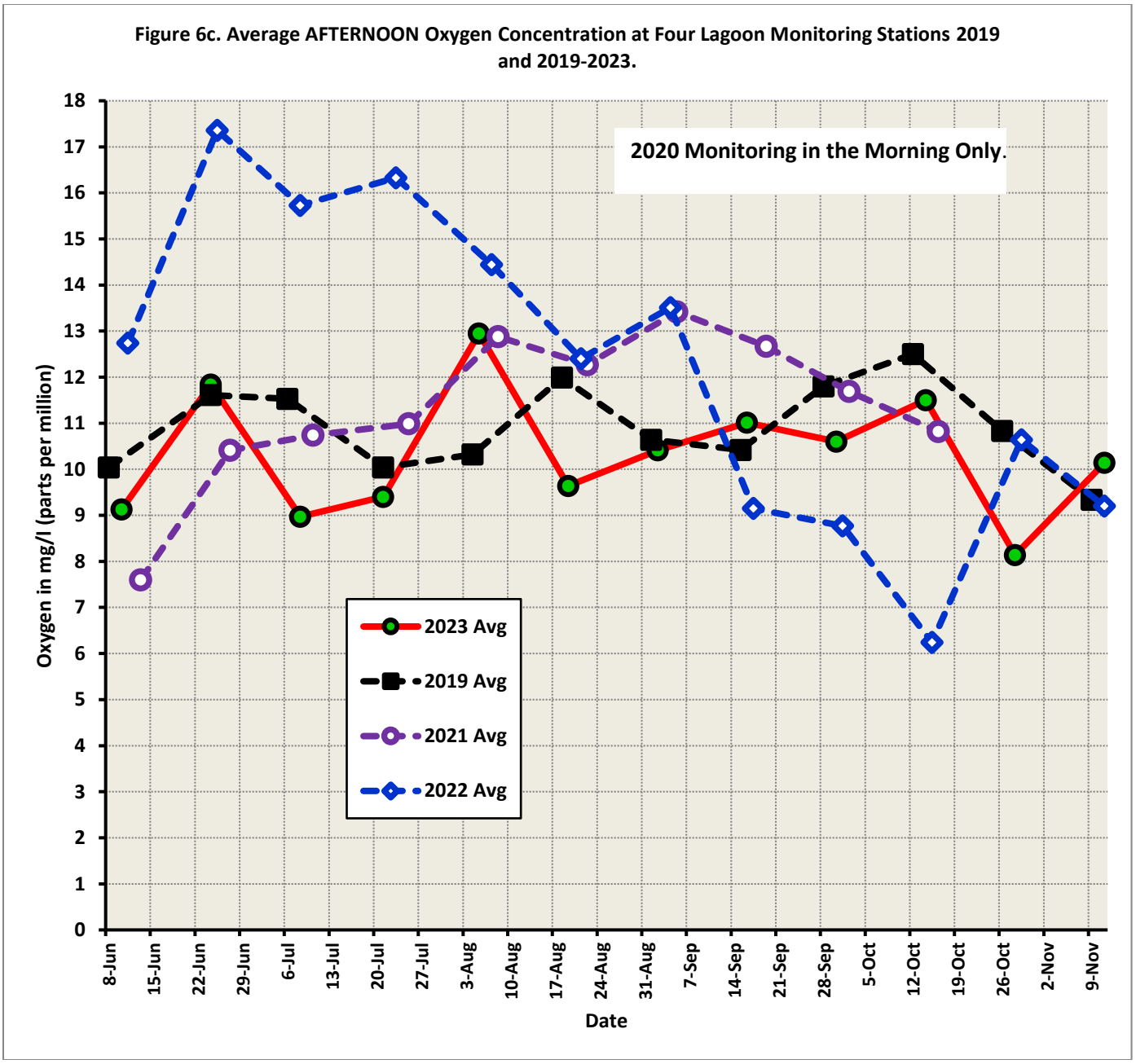


Figure 6c. Average AFTERNOON Oxygen Concentration at Four Lagoon Monitoring Stations, 2018−2019 and 2021−2022.

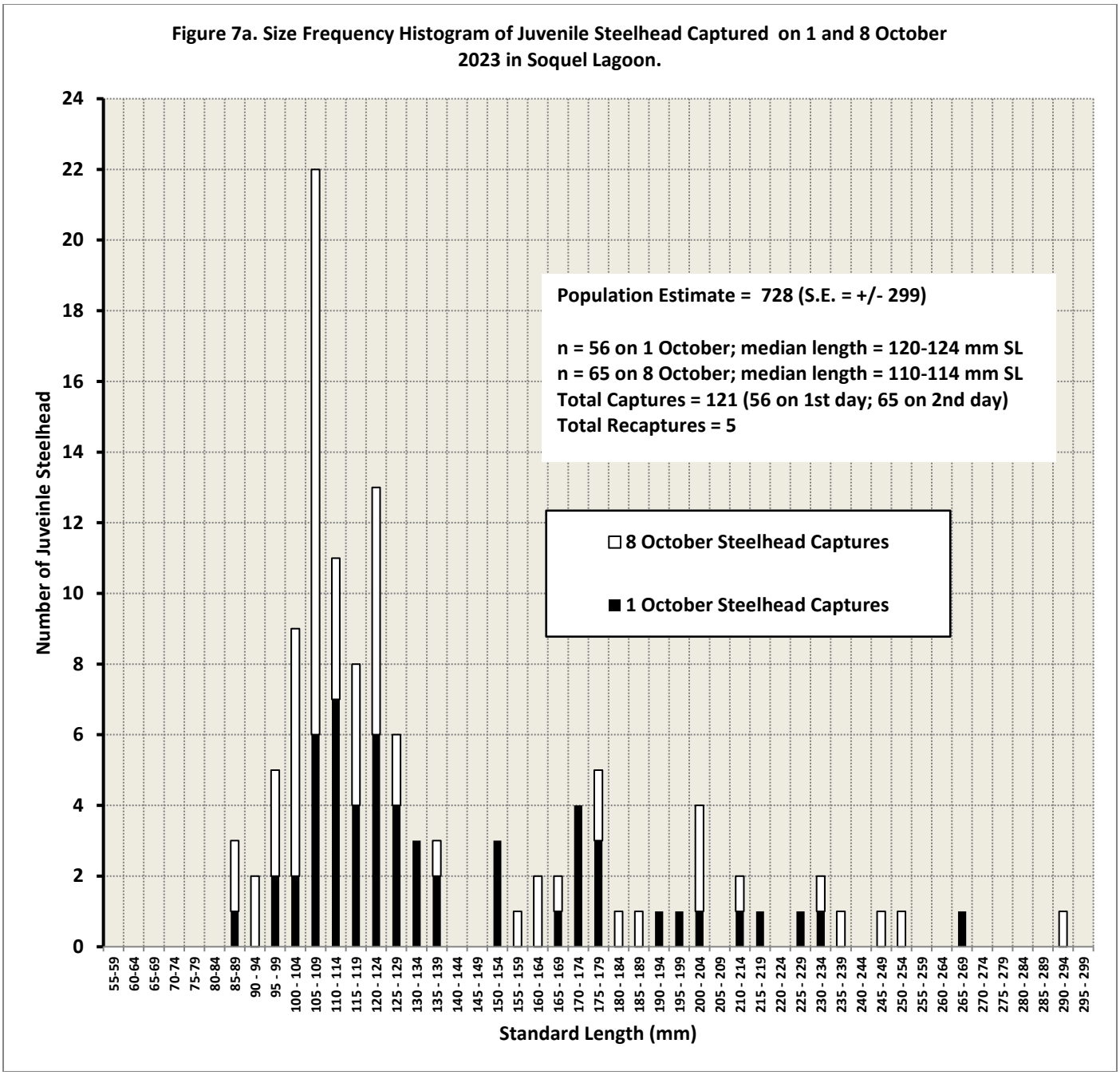


Figure 7a. Size Frequency Histogram of Steelhead Captured on 1 and 8 October 2023 in Soquel Lagoon.

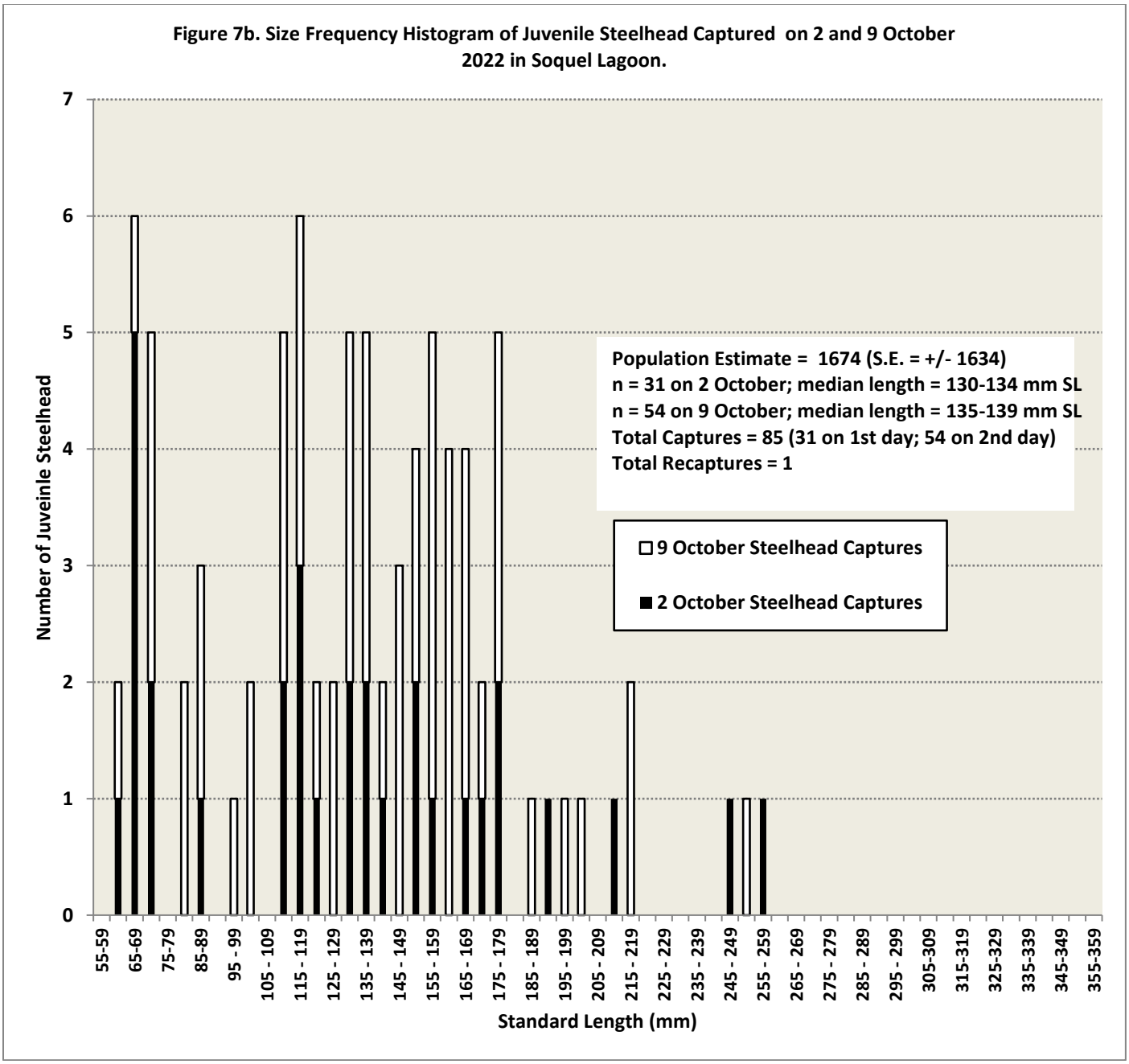


Figure 7b. Size Frequency Histogram of Steelhead Captured on 2 and 9 October 2022 in Soquel Lagoon.

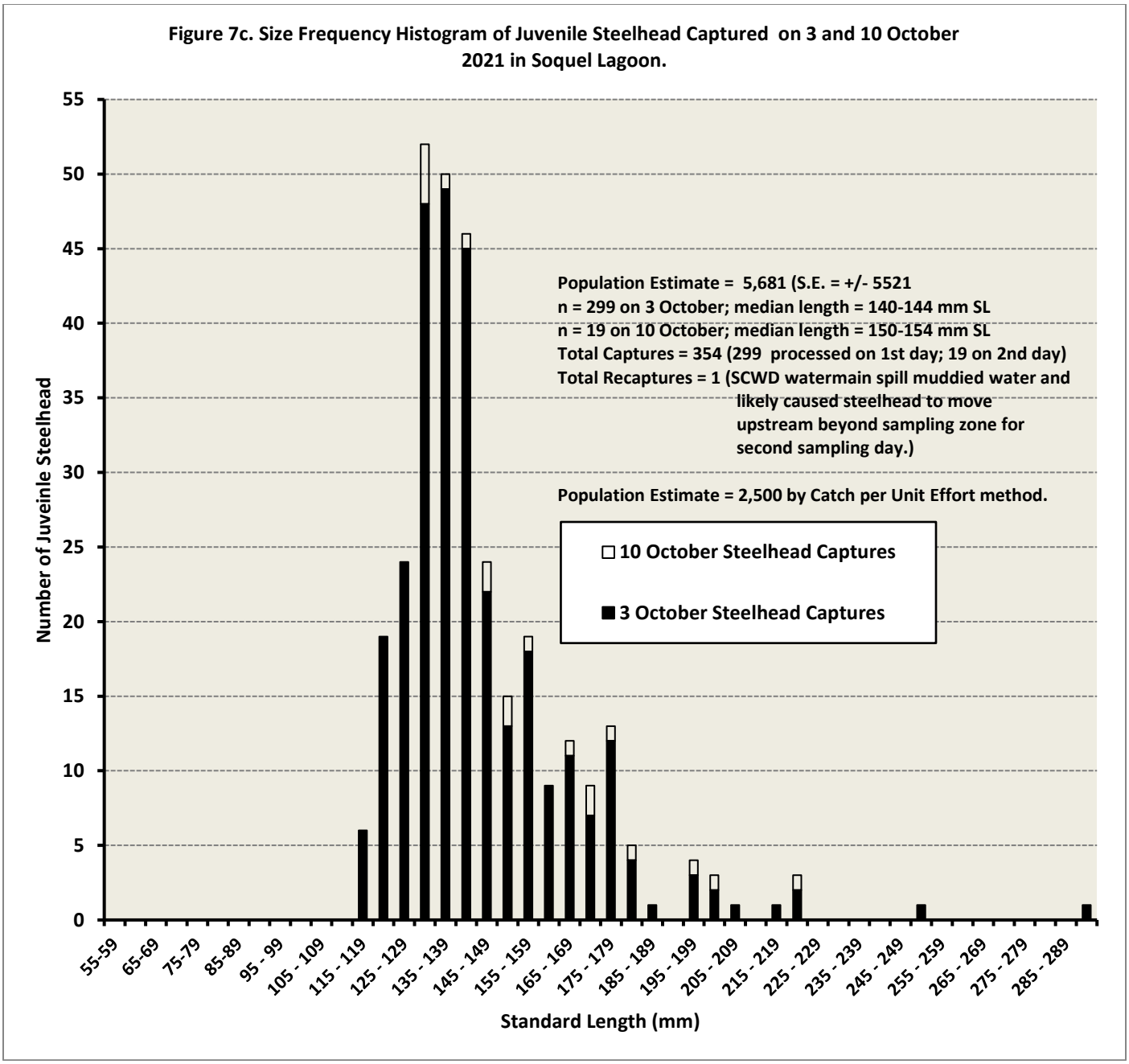


Figure 7c. Size Frequency Histogram of Steelhead Captured on 3 and 10 October 2021 in Soquel Lagoon

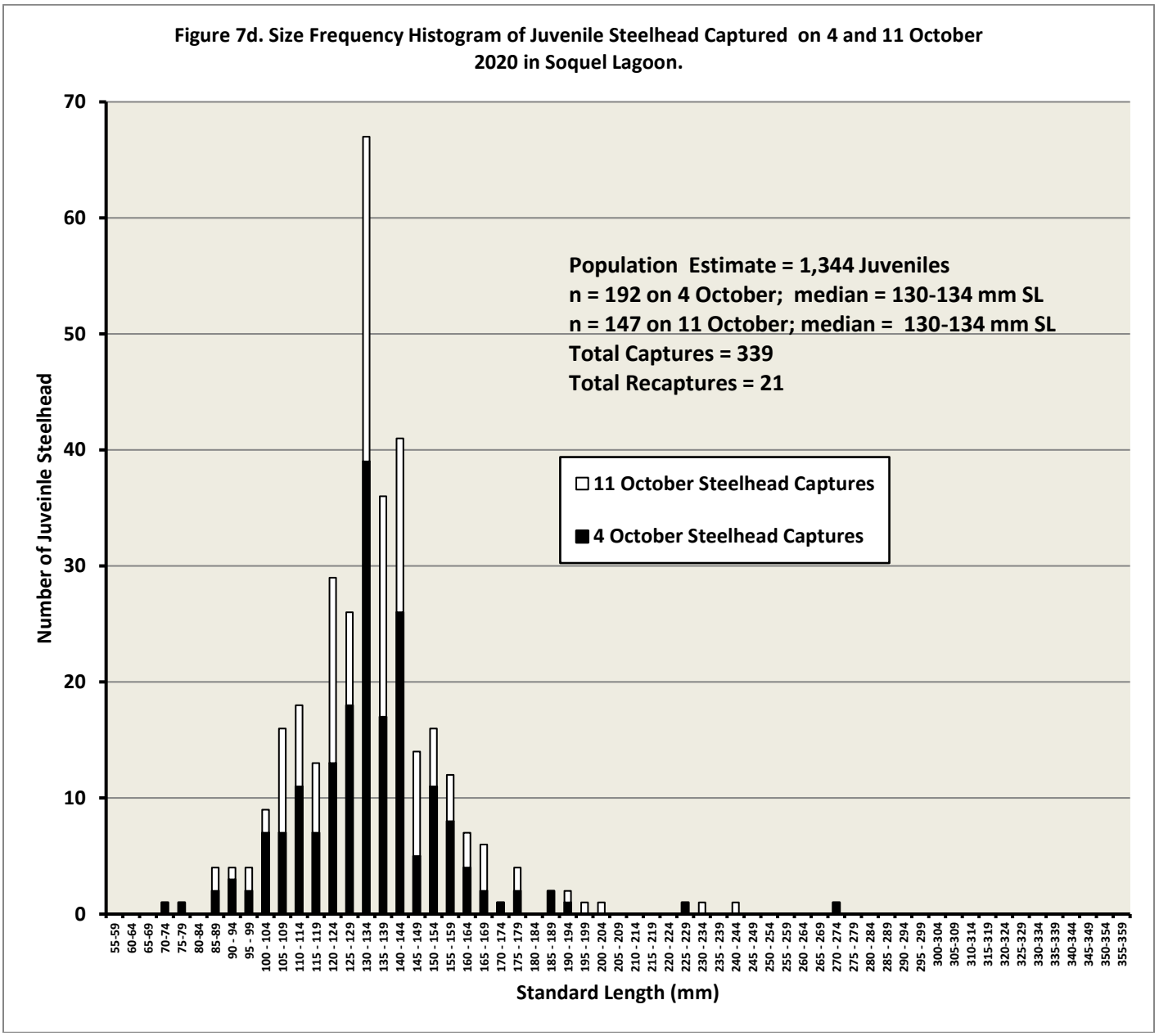


Figure 7d. Size Frequency Histogram of Steelhead Captured on 4 and 11 October 2020 in Soquel Lagoon

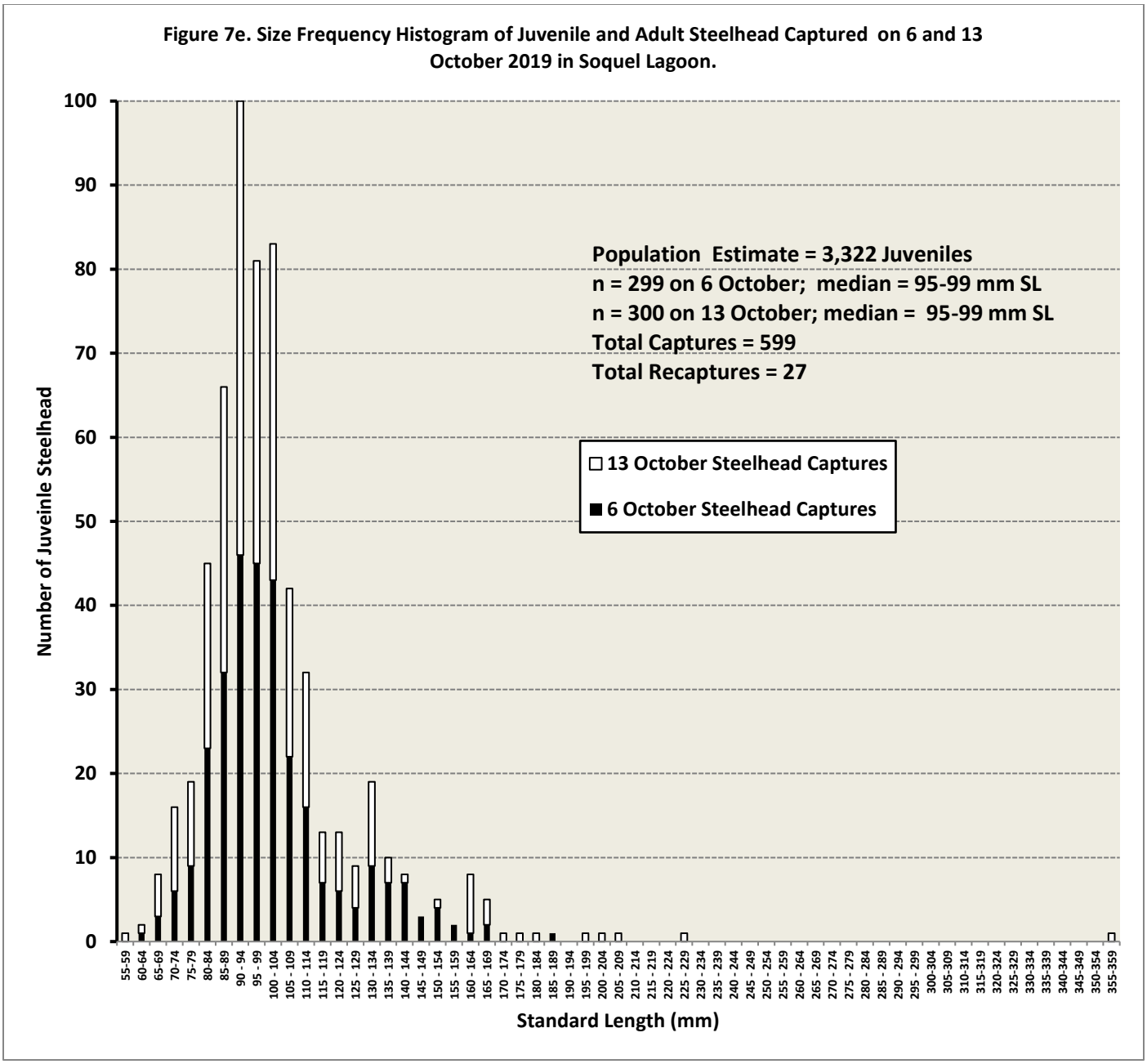


Figure 7e. Size Frequency Histogram of Steelhead Captured on 6 and 13 October 2019 in Soquel Lagoon.

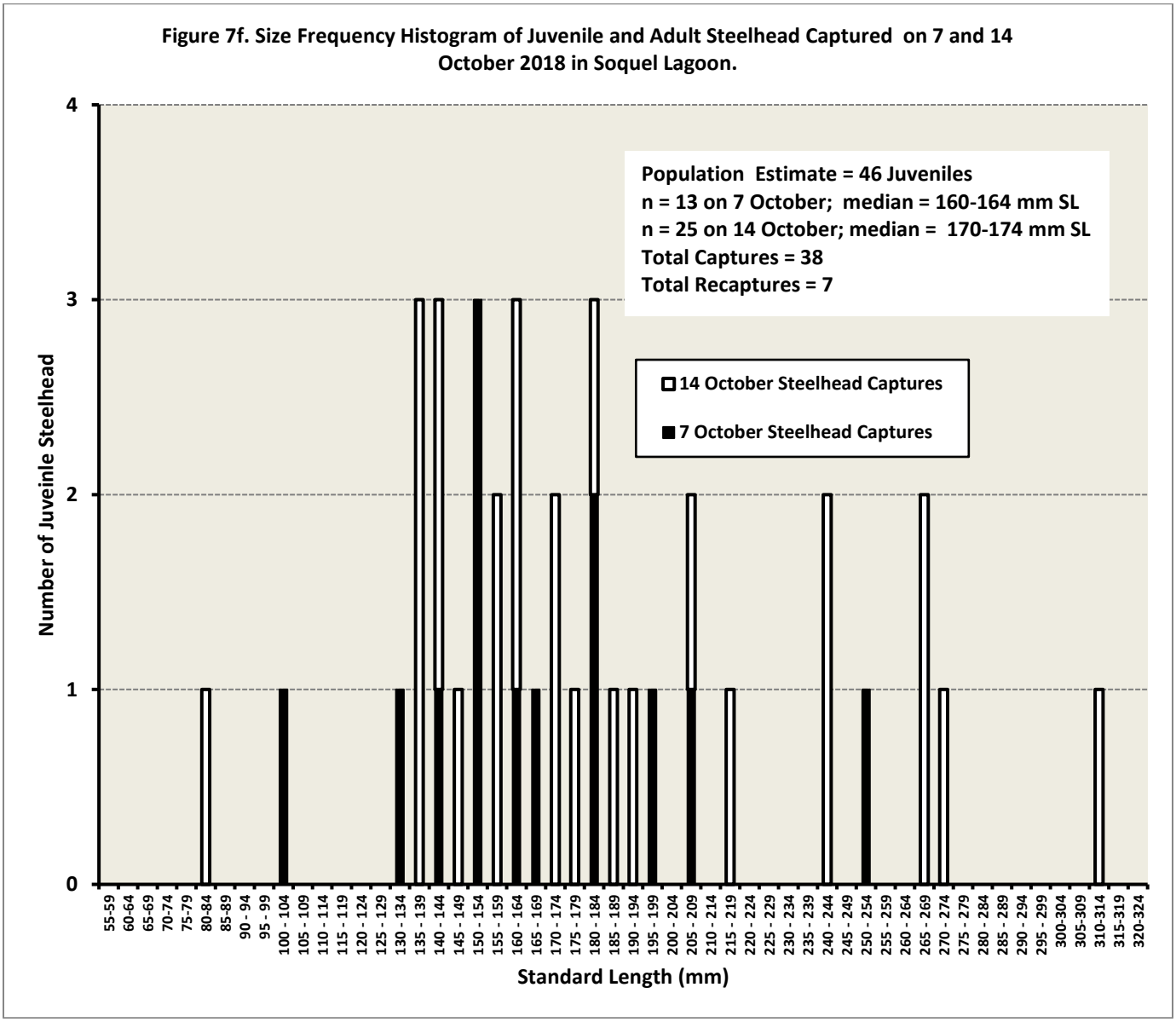


Figure 7f. Size Frequency Histogram of Steelhead Captured on 7 and 14 October 2018 in Soquel Lagoon.

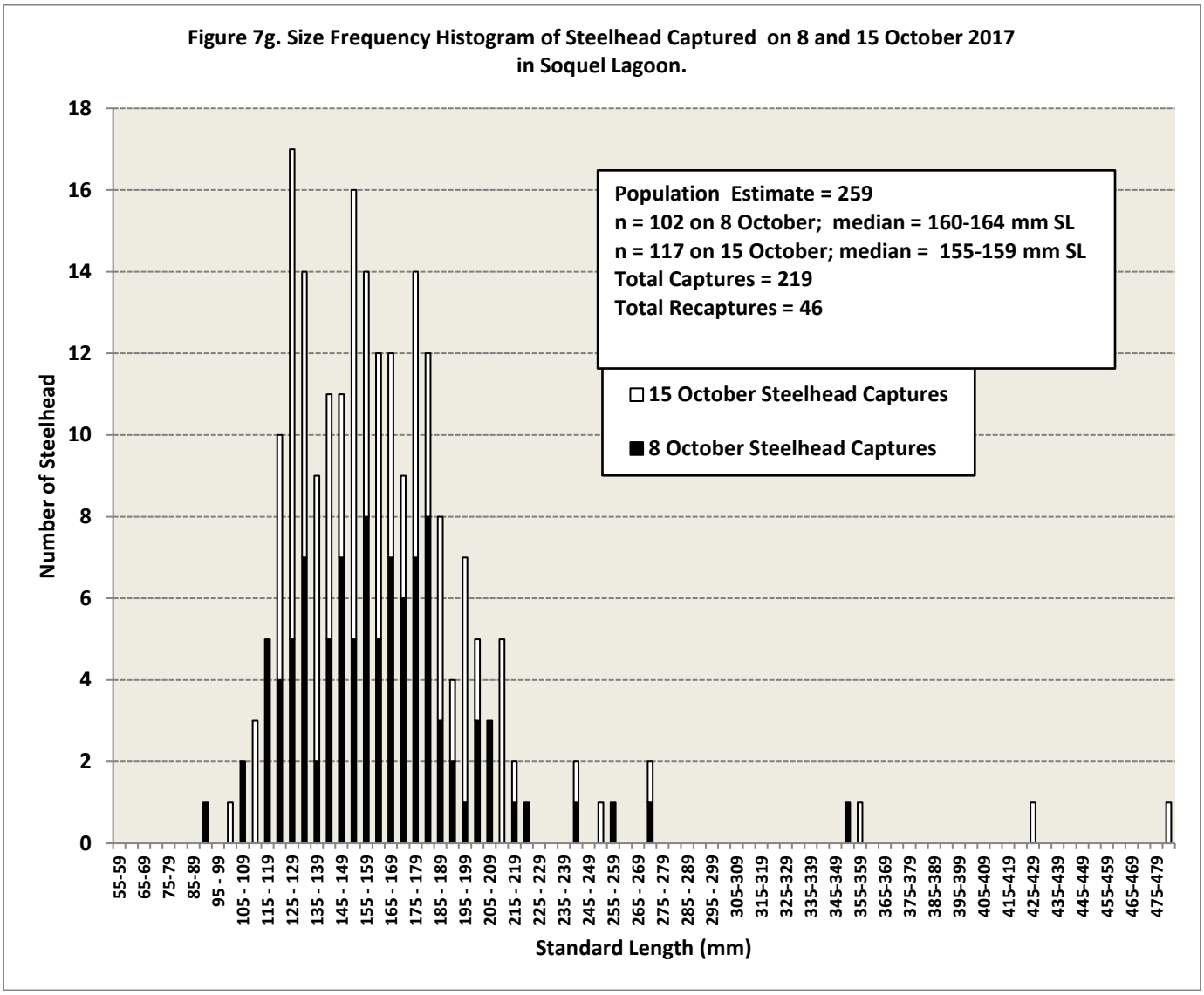


Figure 7g. Size Frequency Histogram of Steelhead Captured on 8 and 15 October 2017 in Soquel Lagoon.

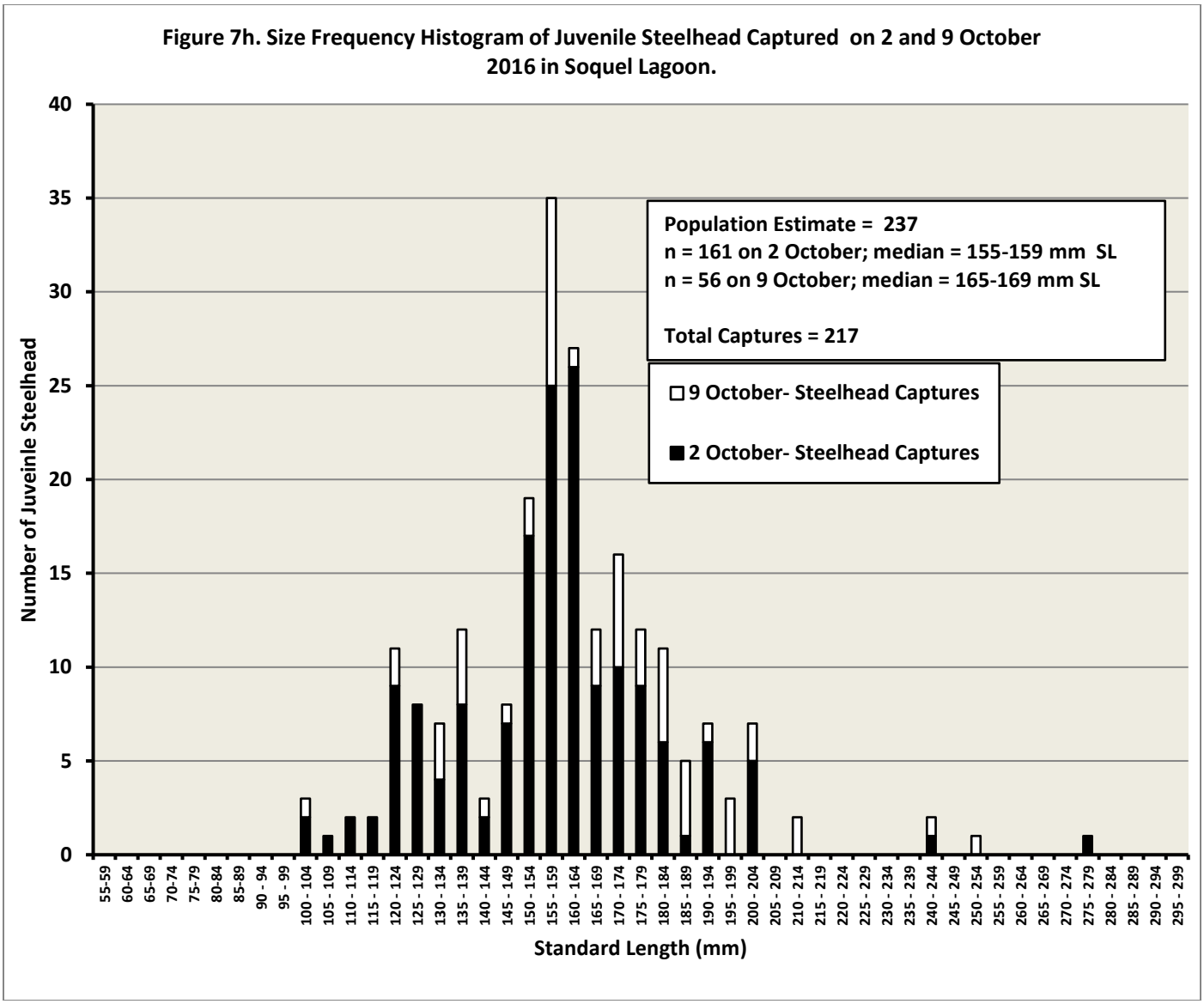


Figure 7h. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 9 October 2016 in Soquel Lagoon.

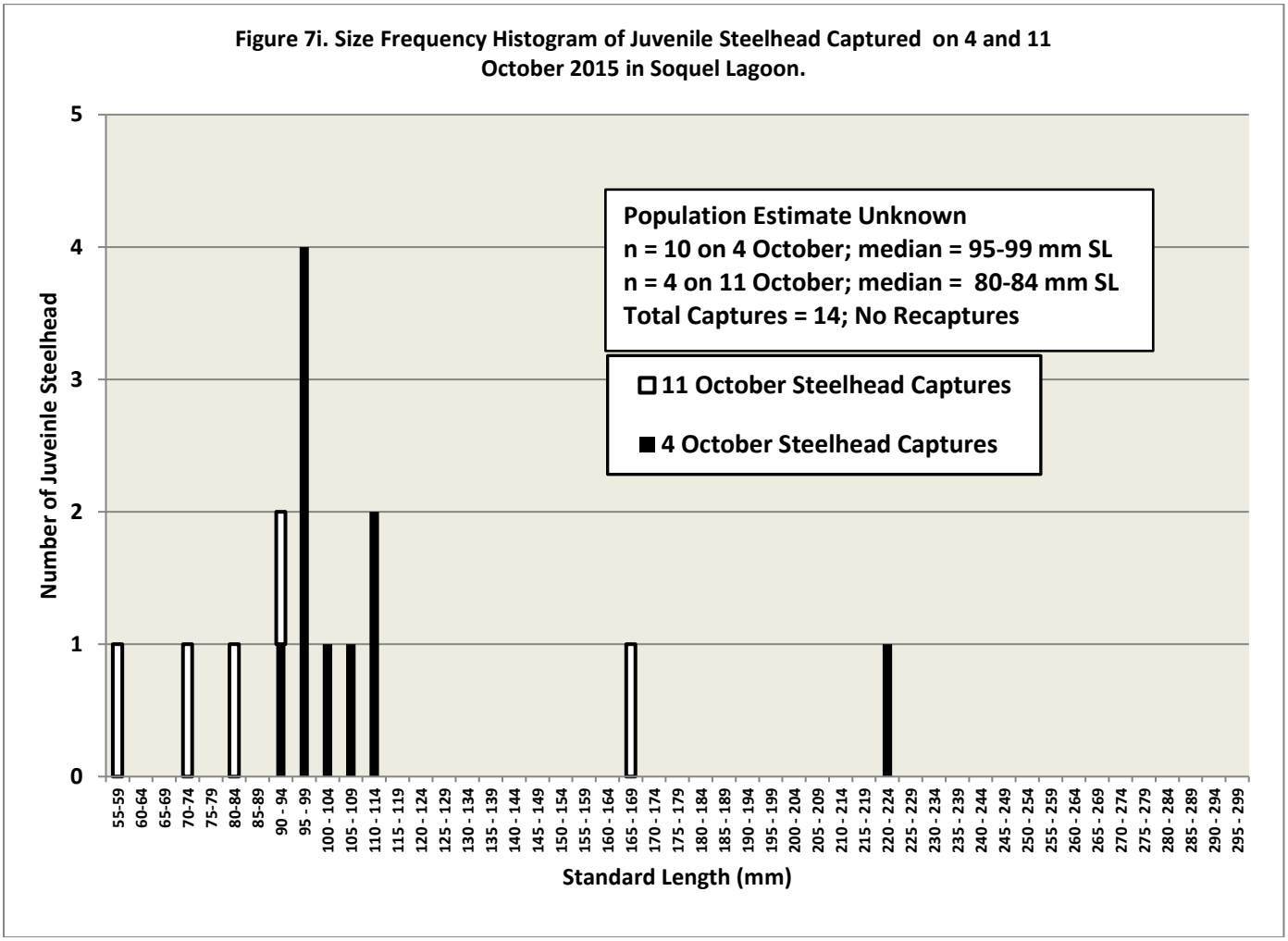


Figure 7i. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2015 in Soquel Lagoon.

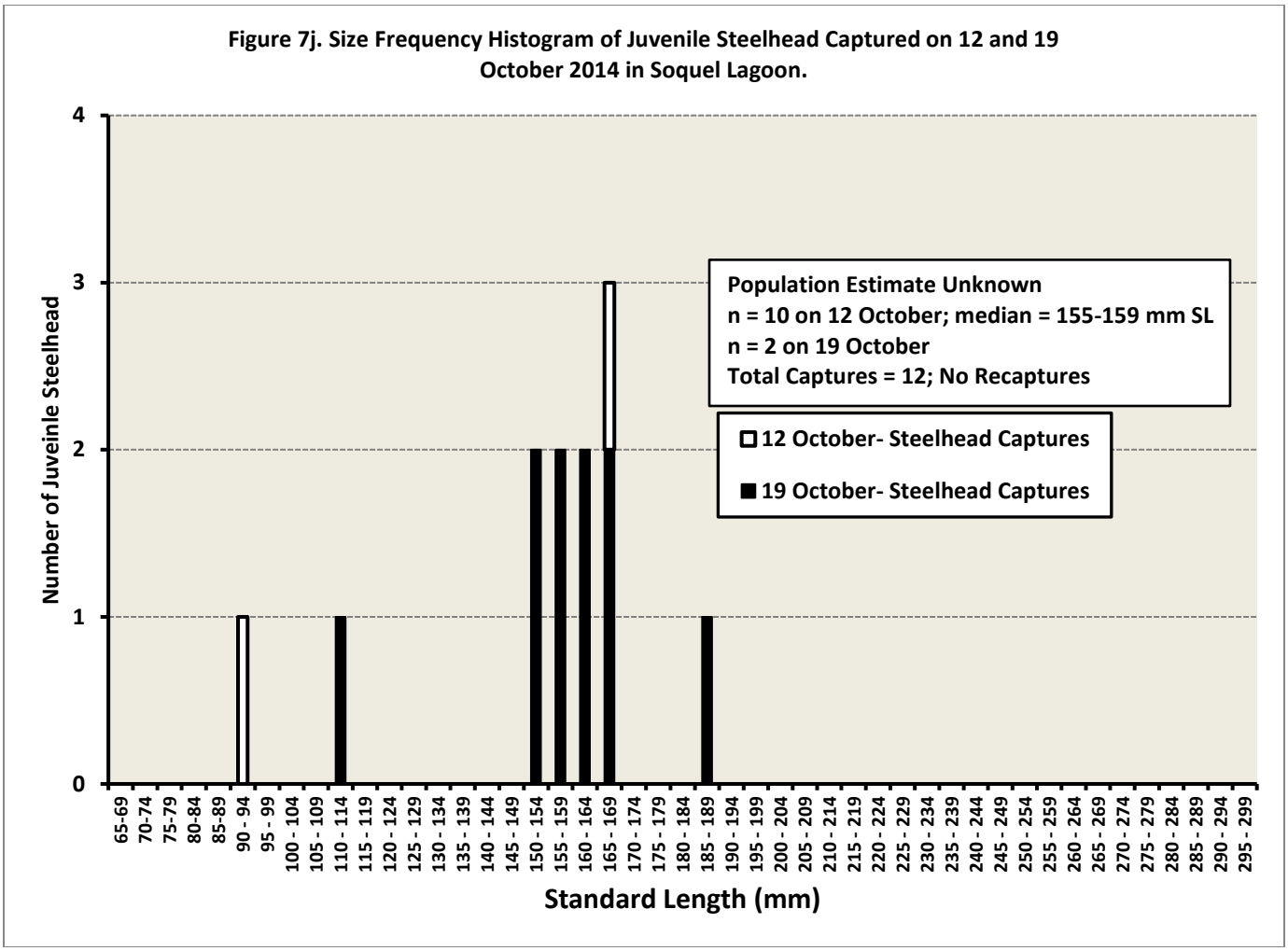


Figure 7j. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

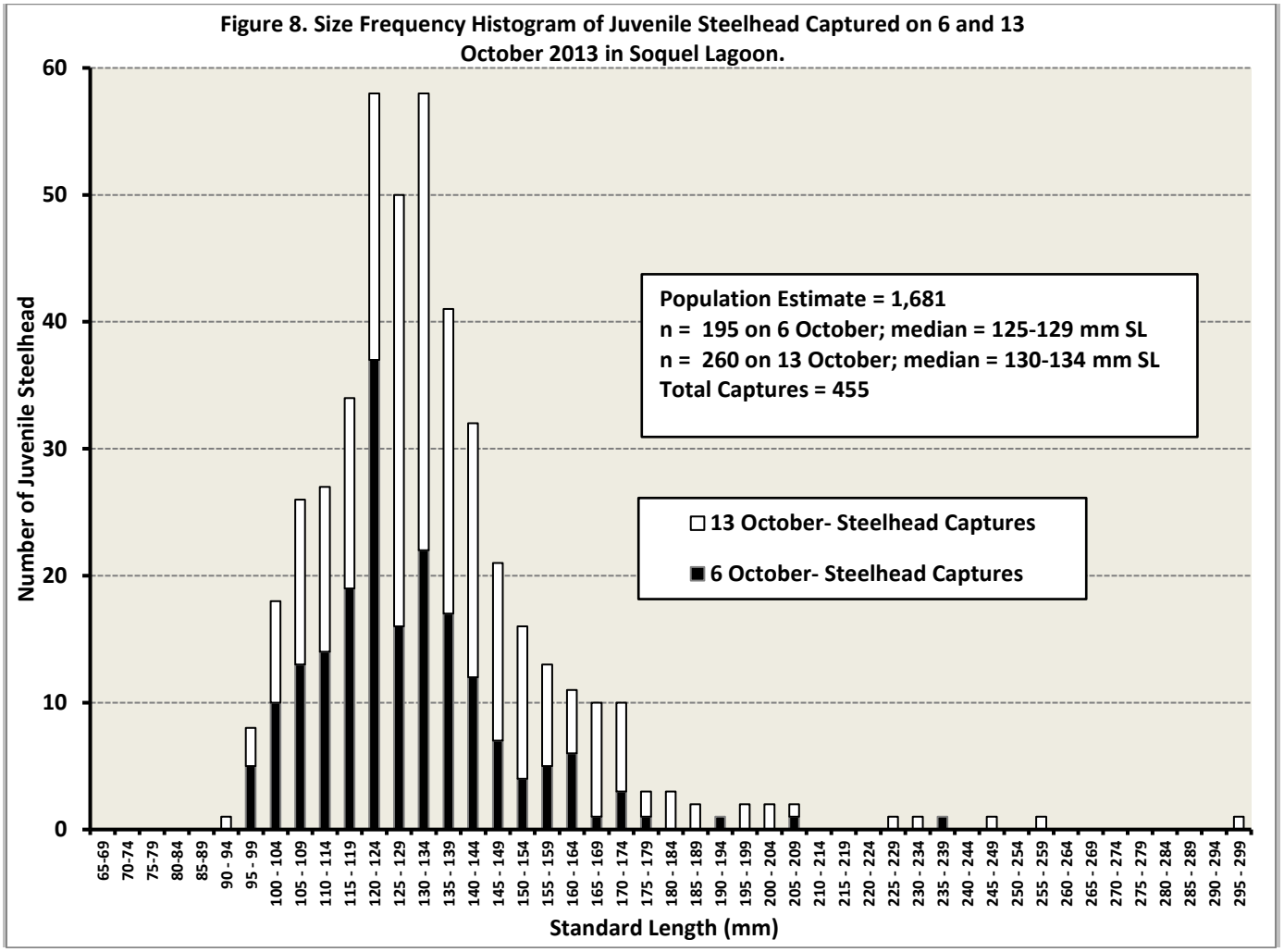


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

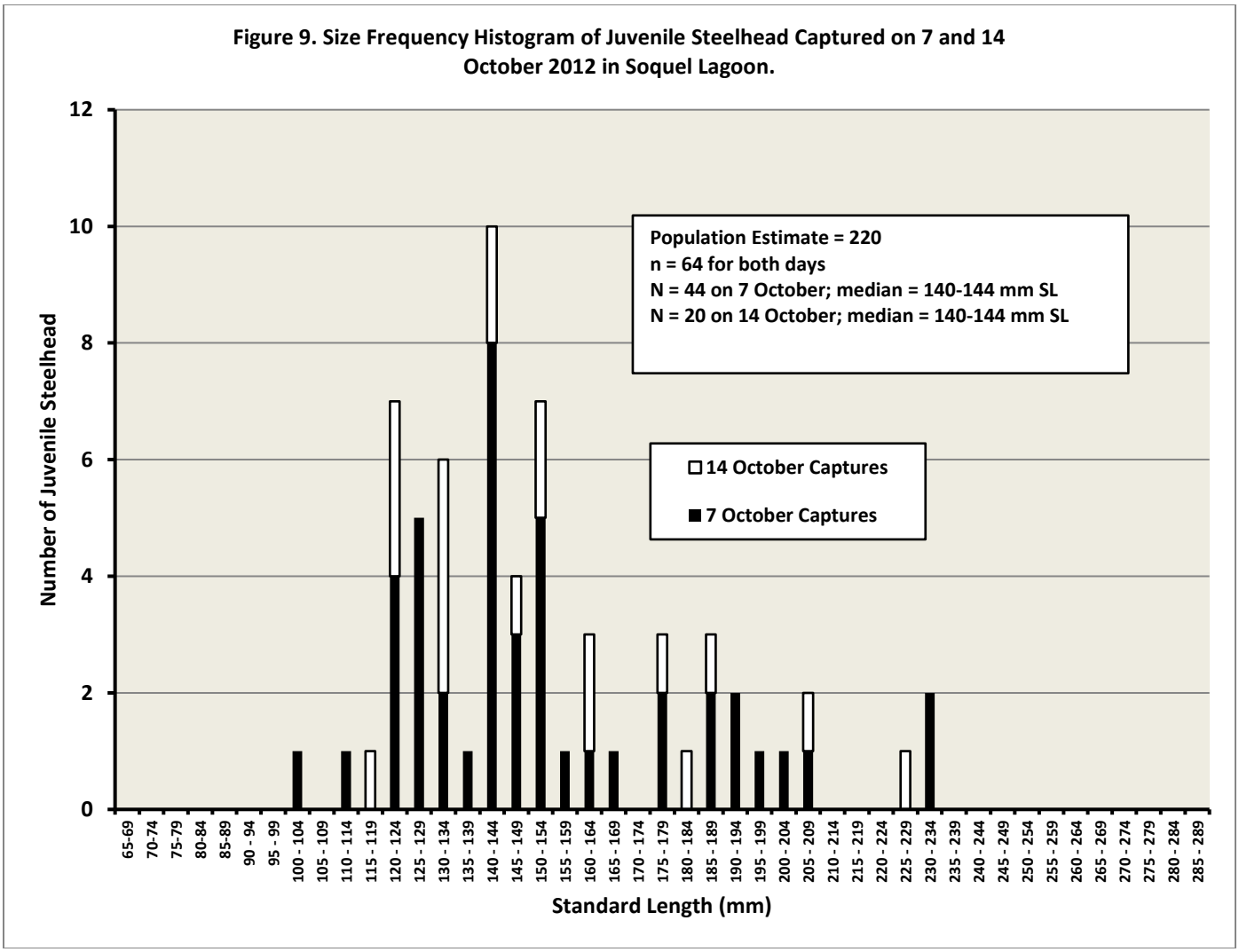


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

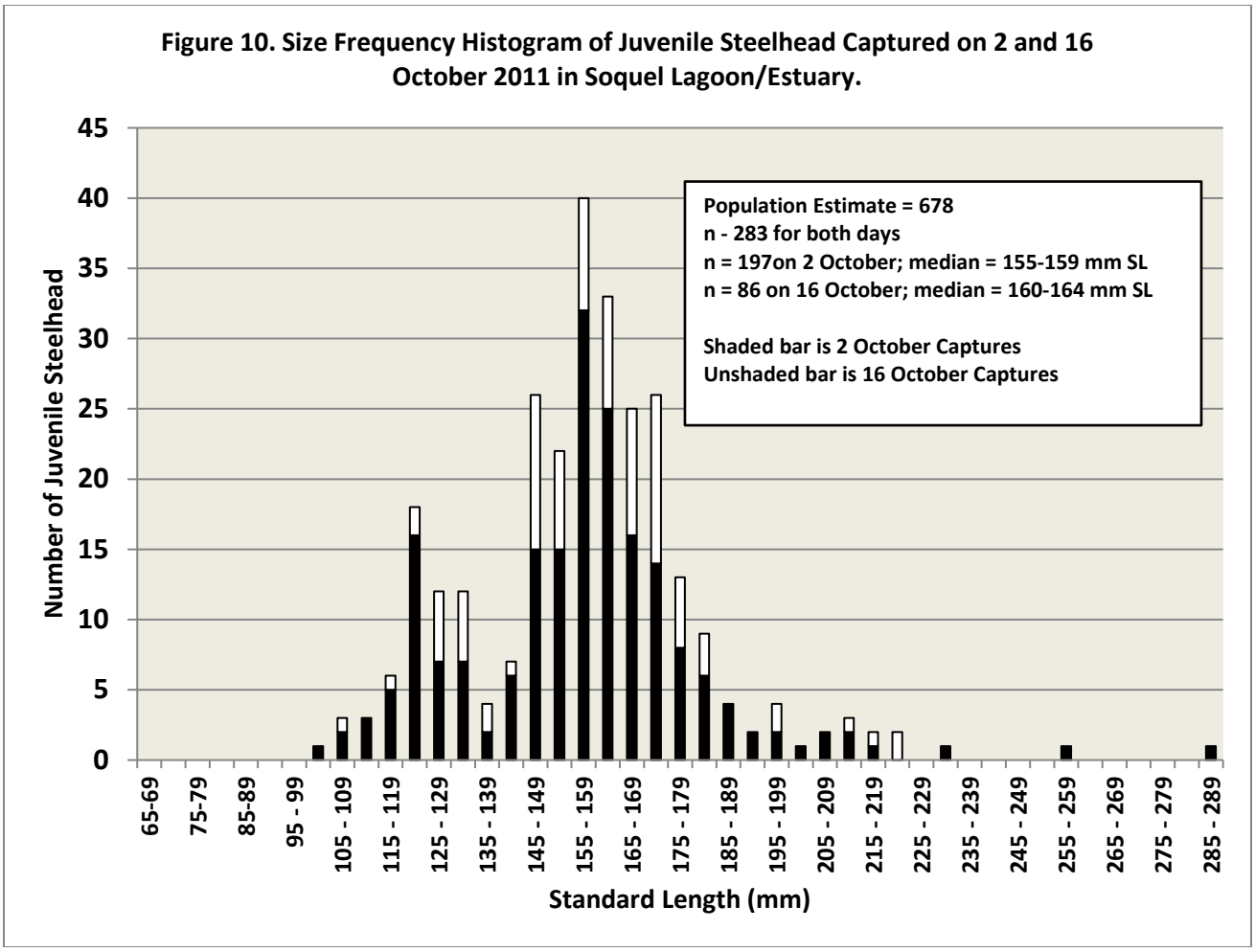


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

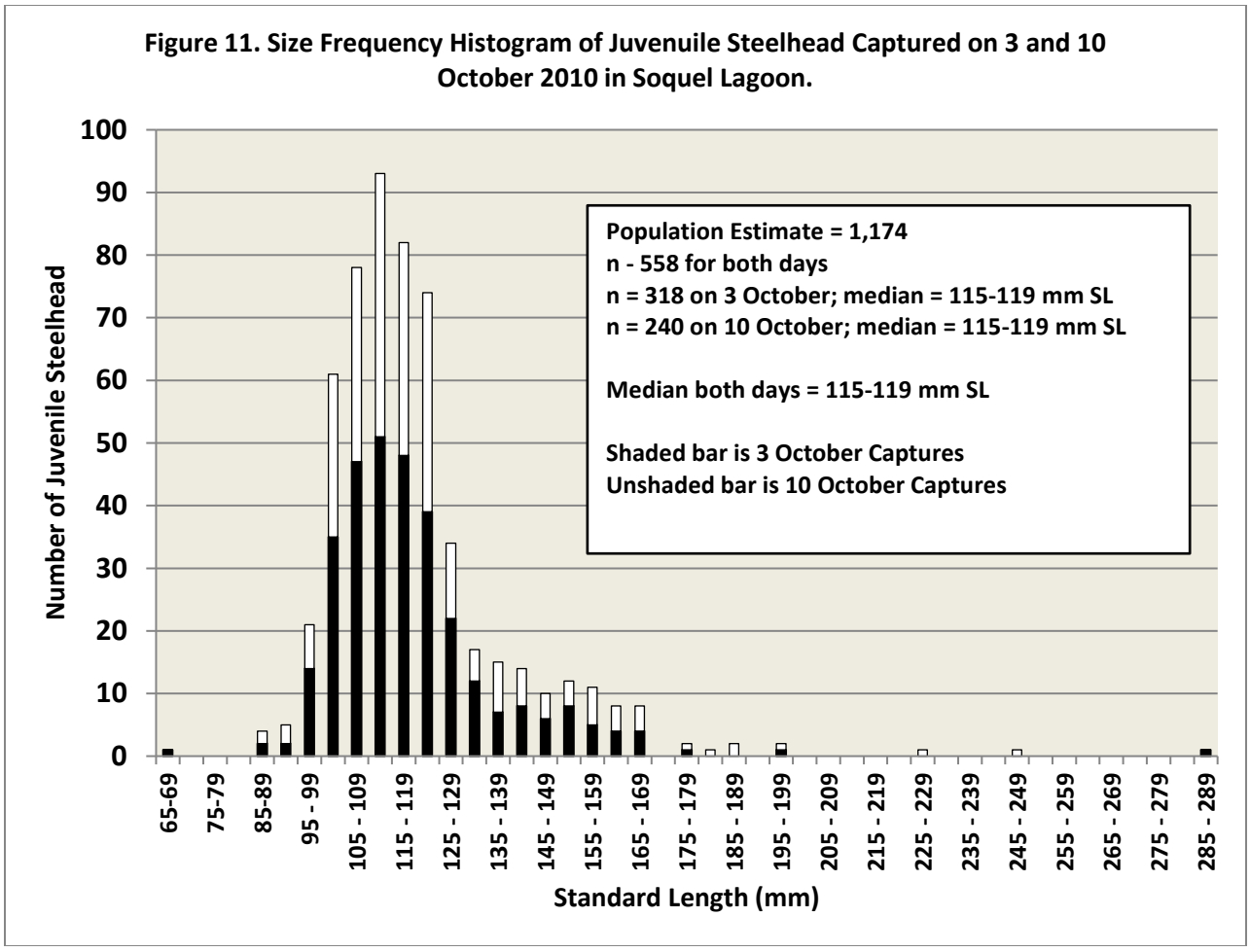


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

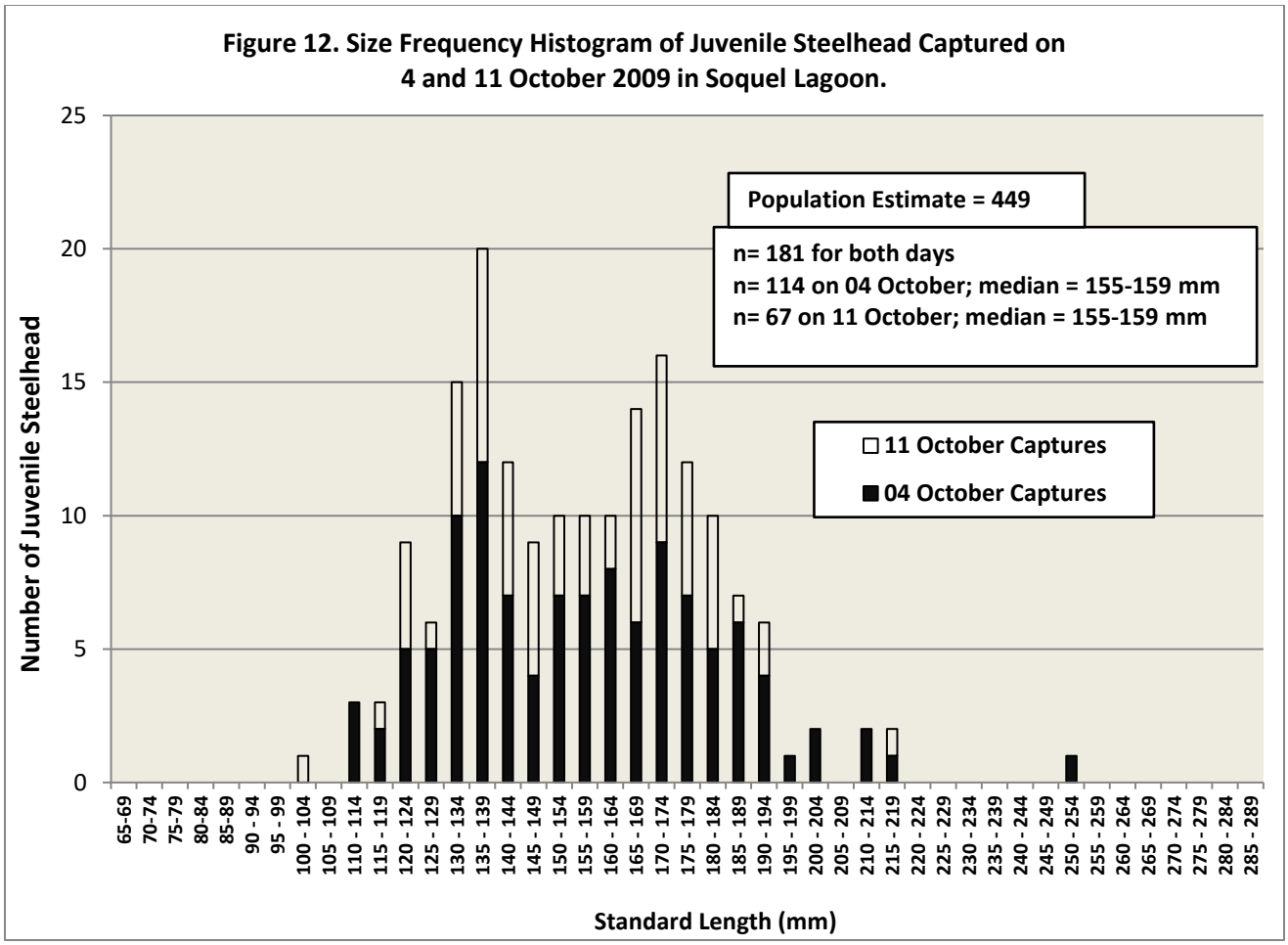


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

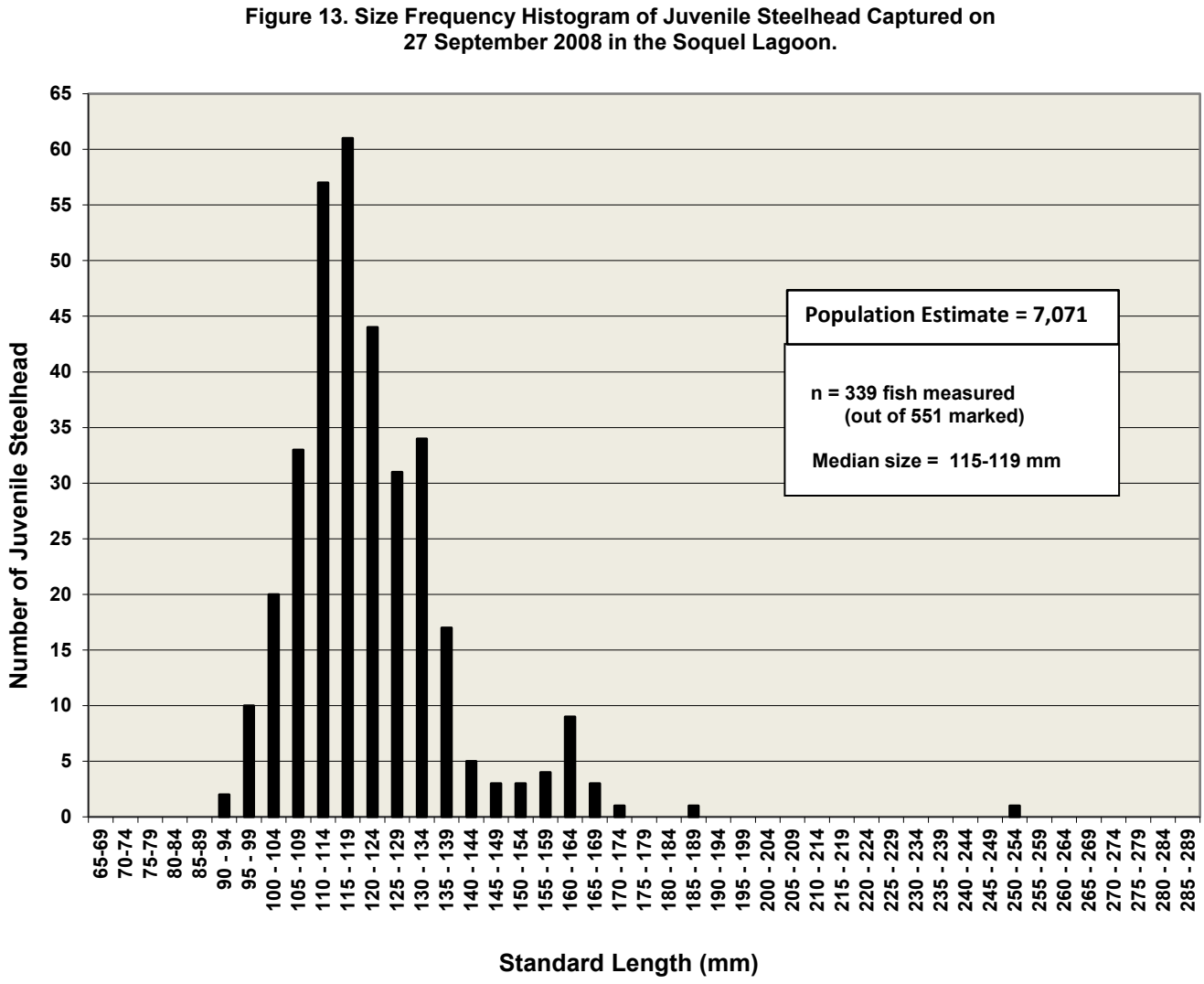


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

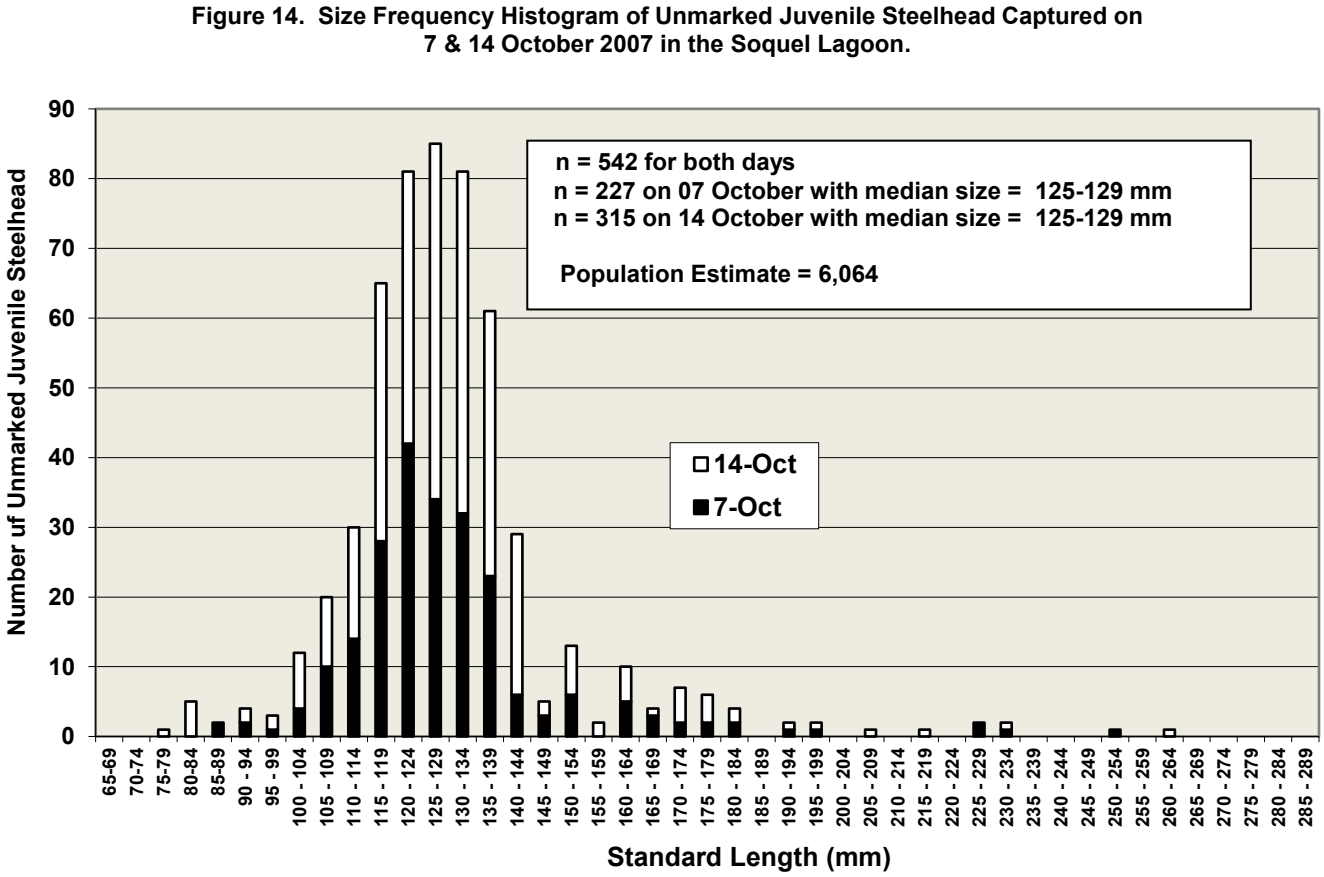


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

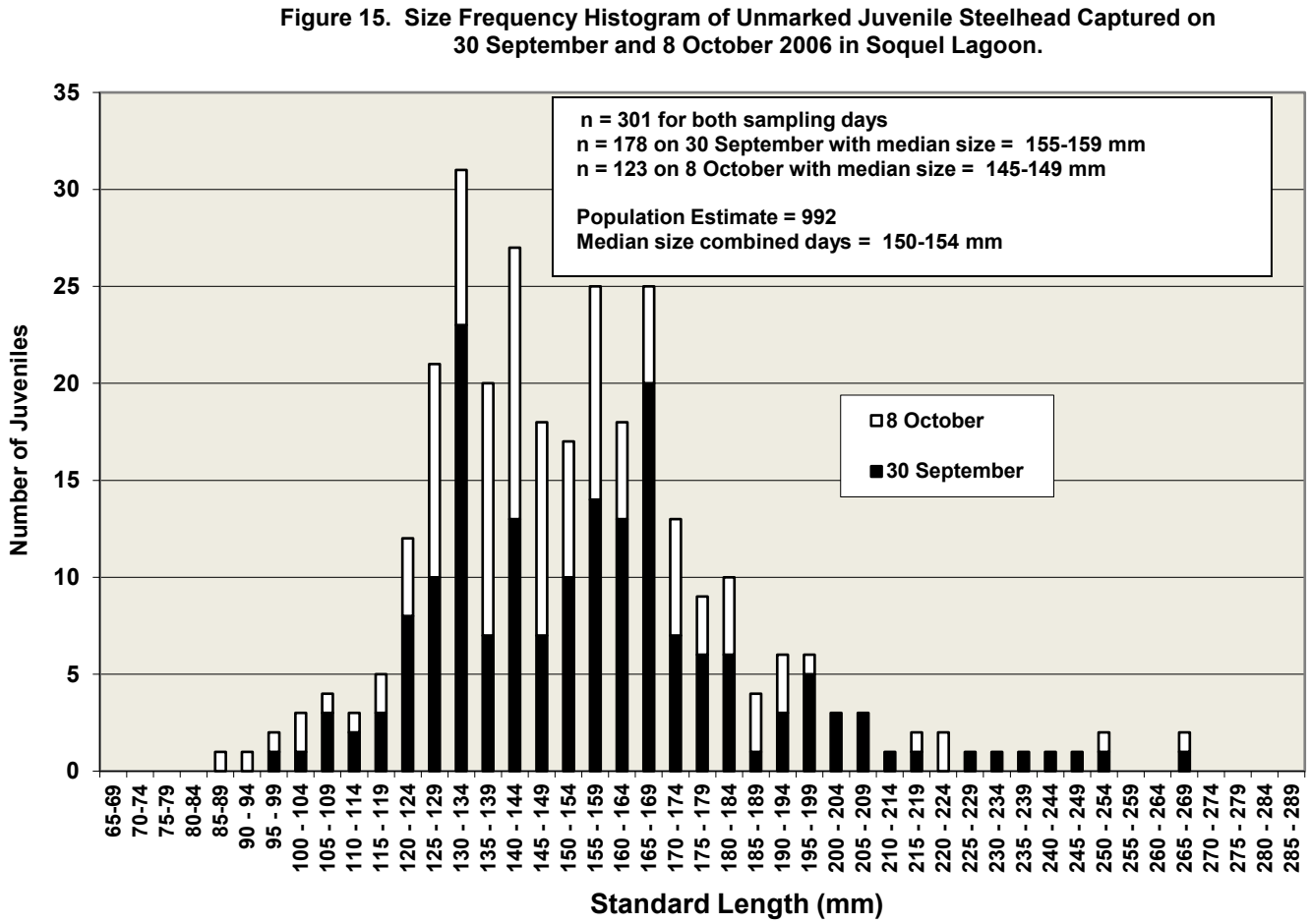


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

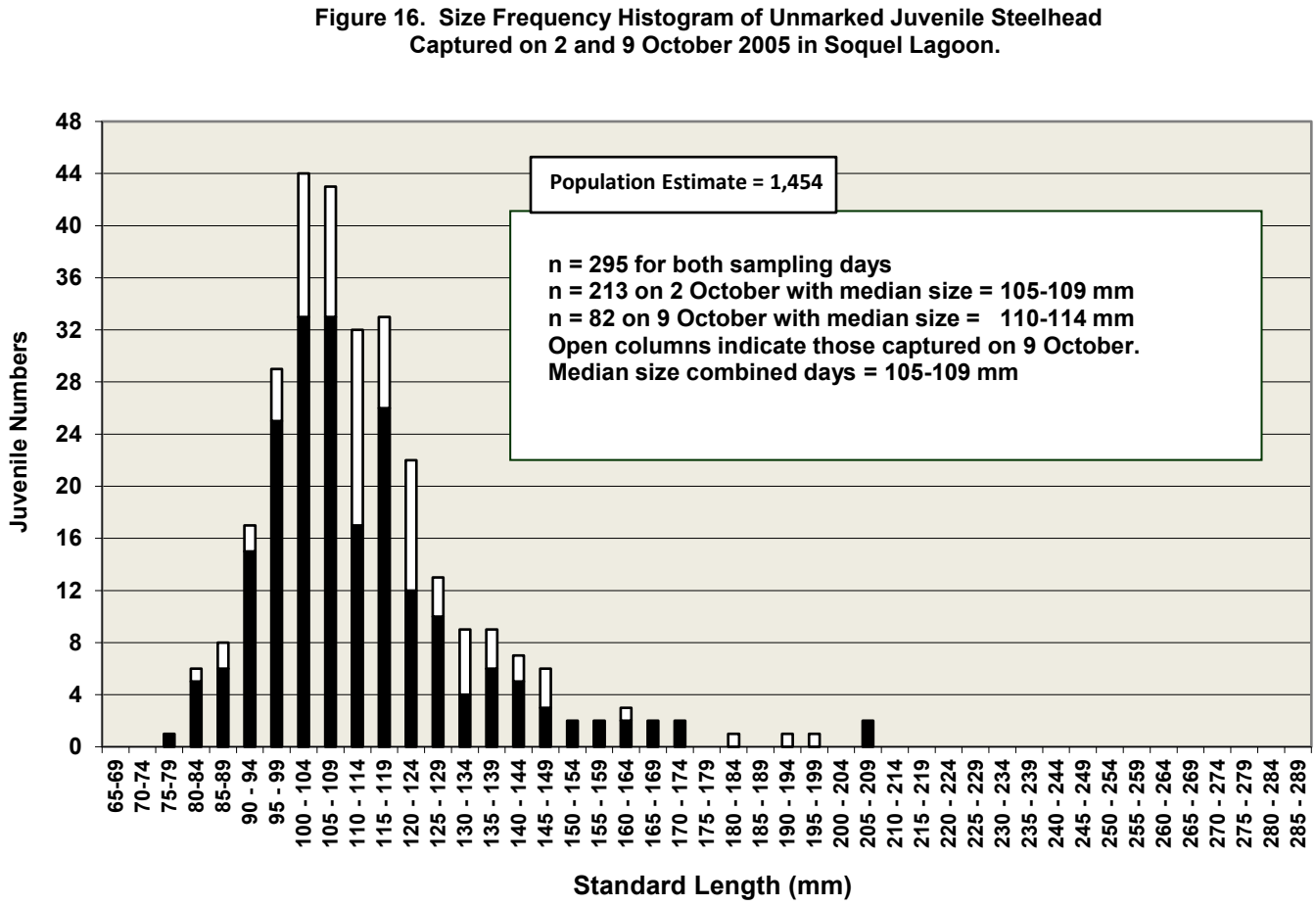


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

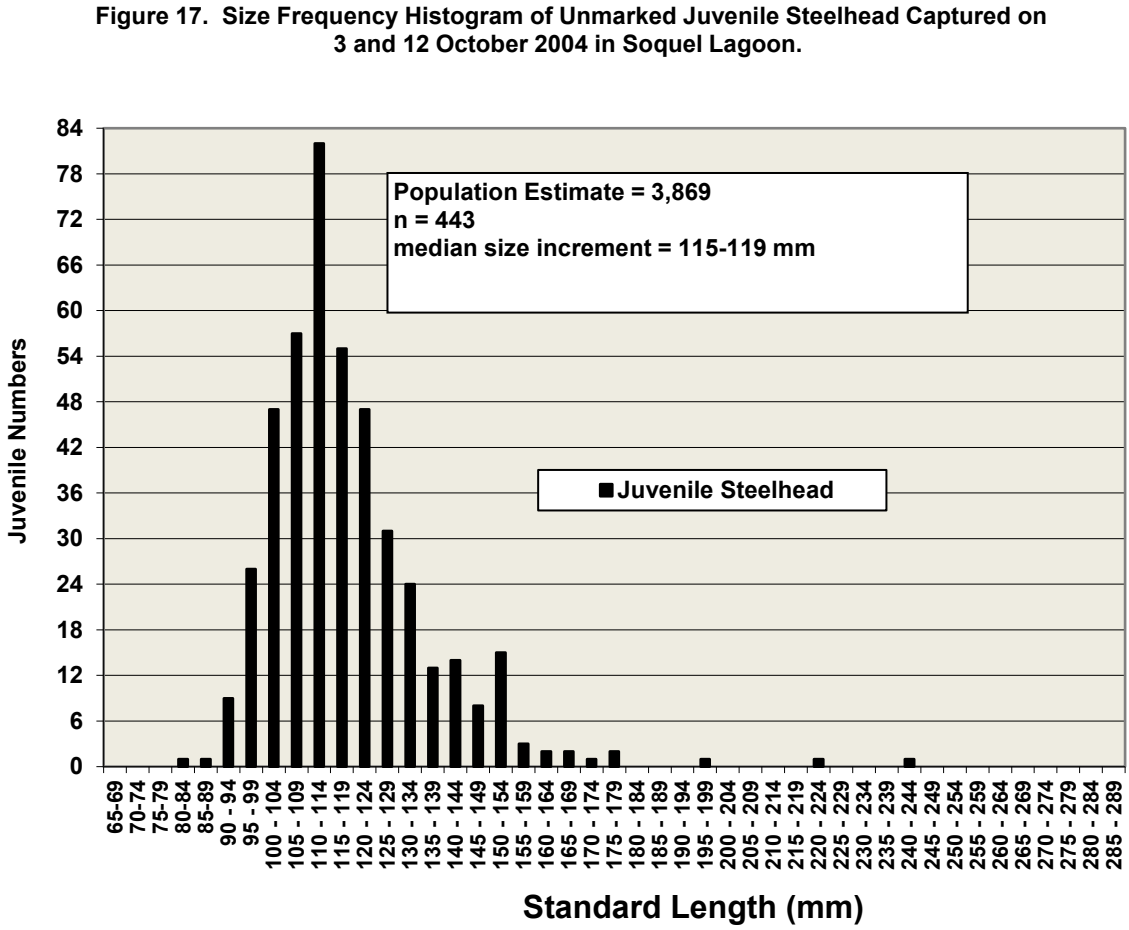


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

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

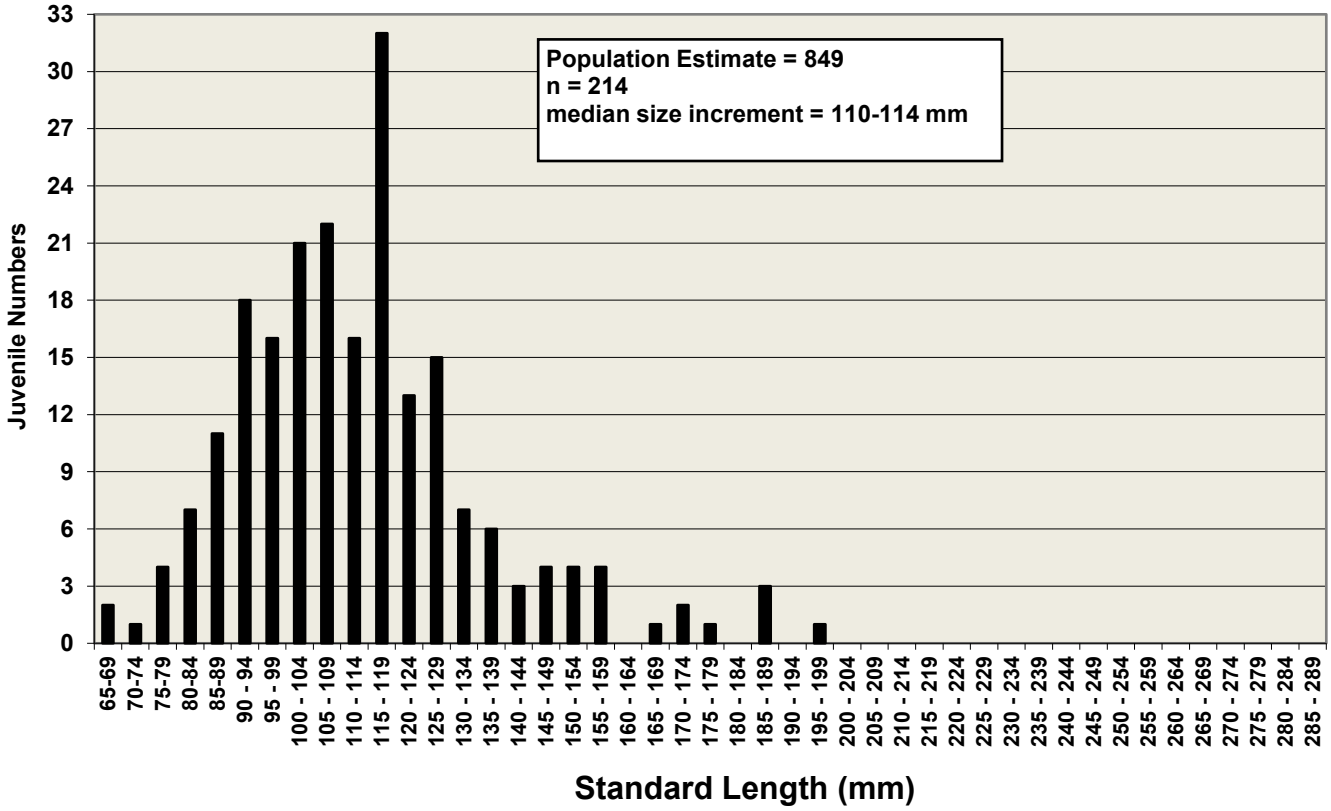


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

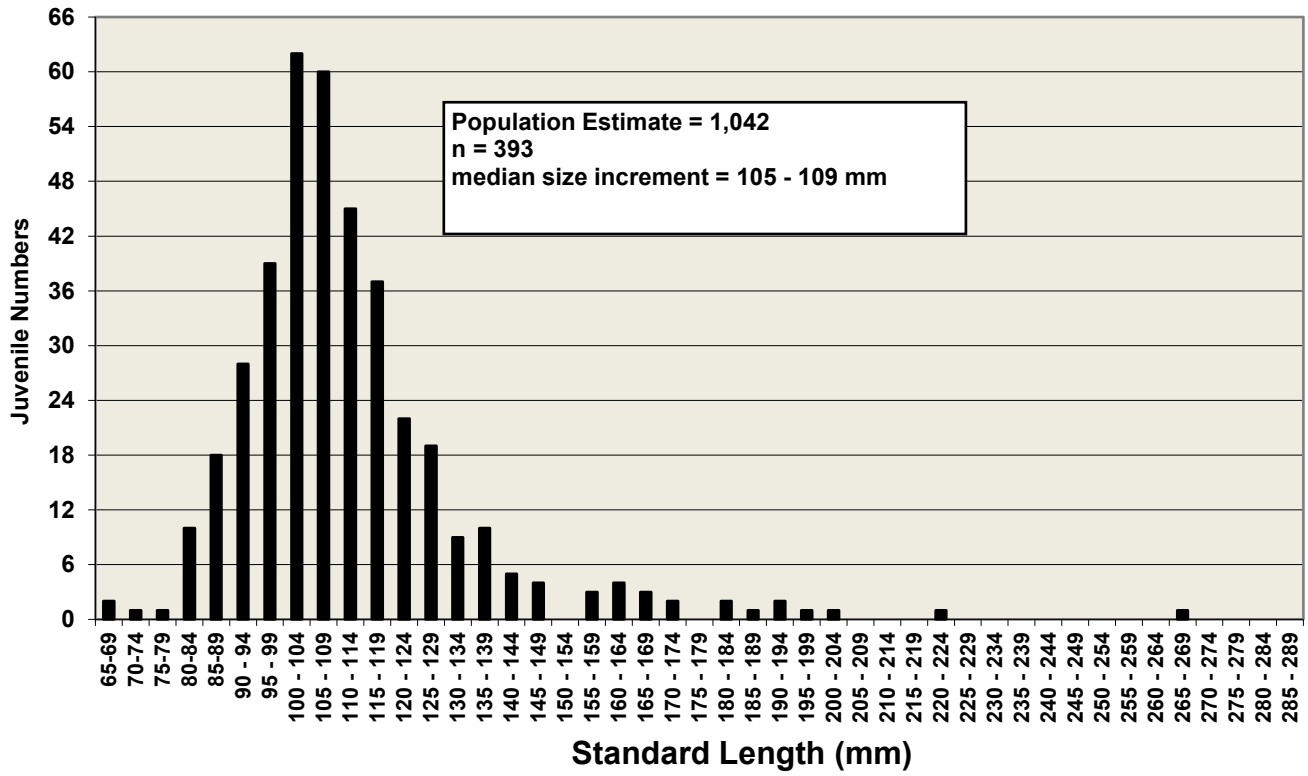


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

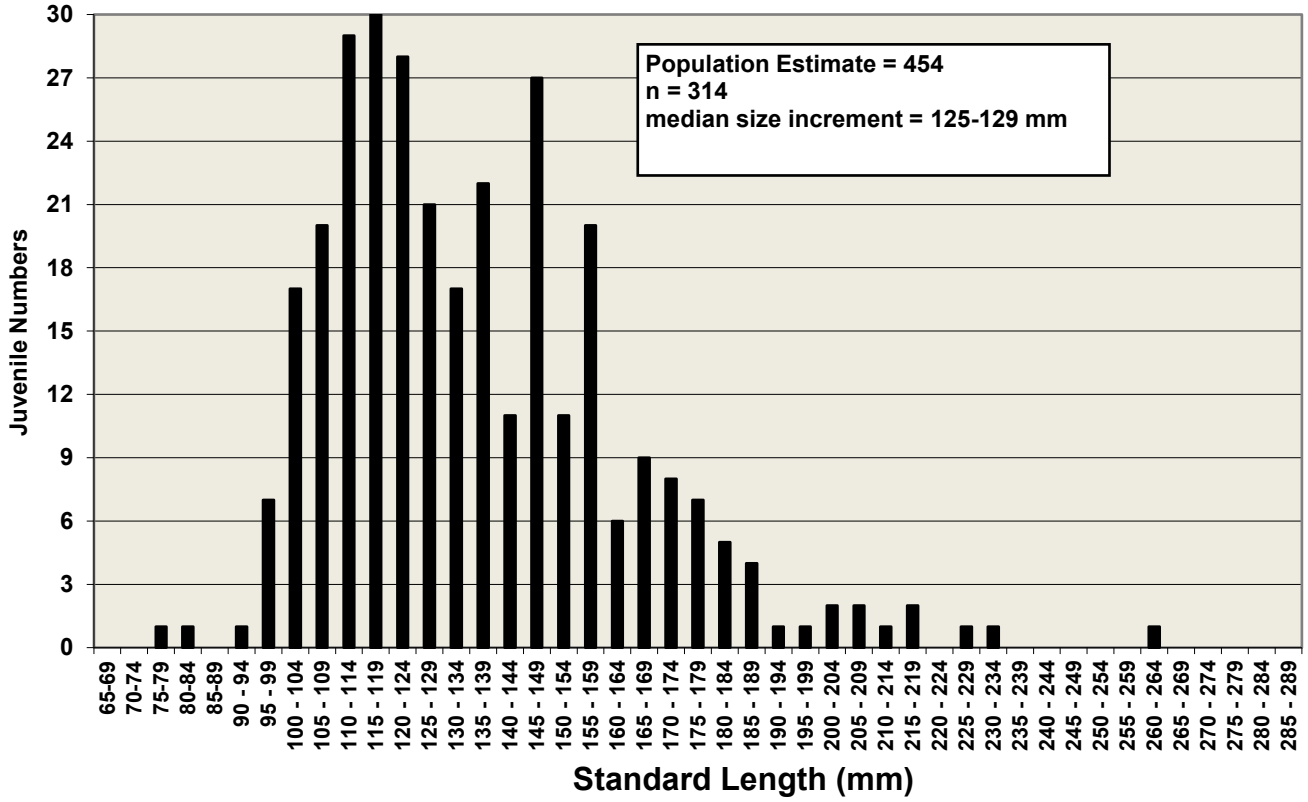


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

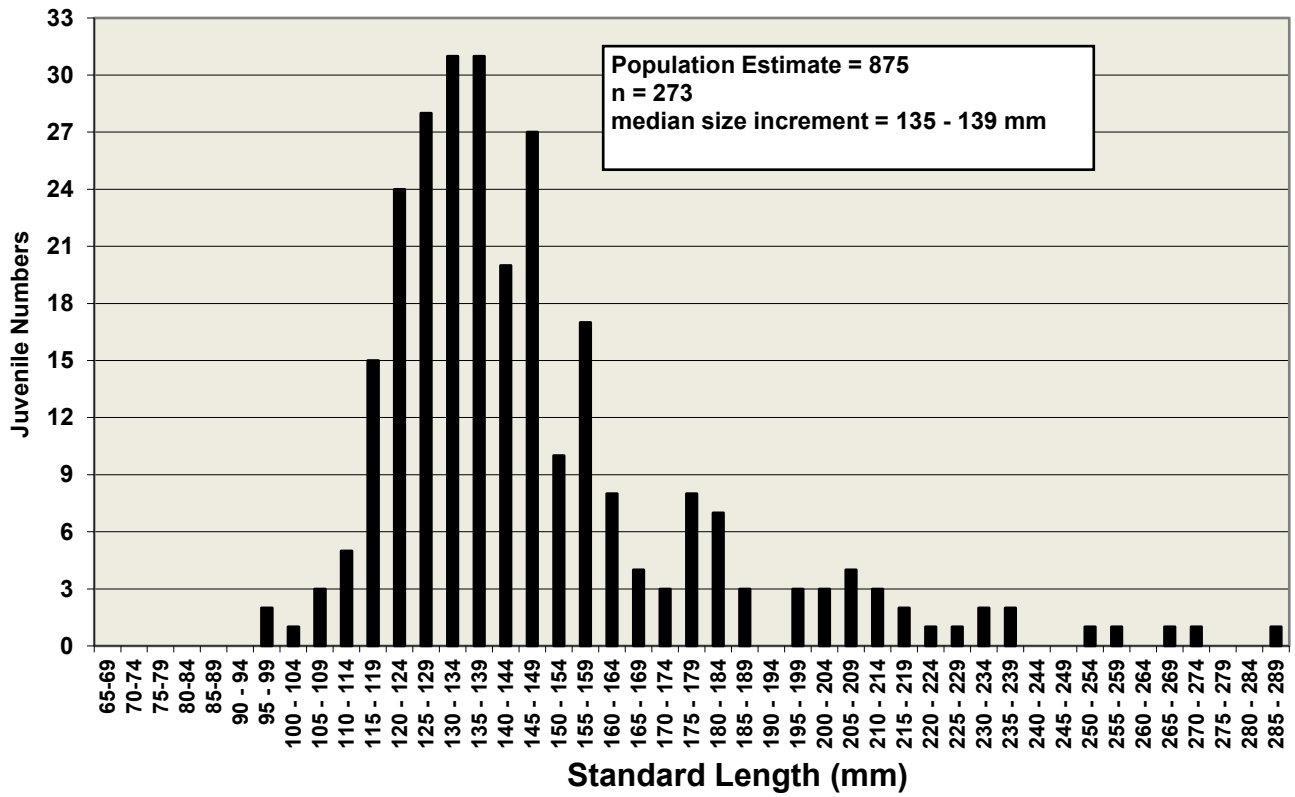


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

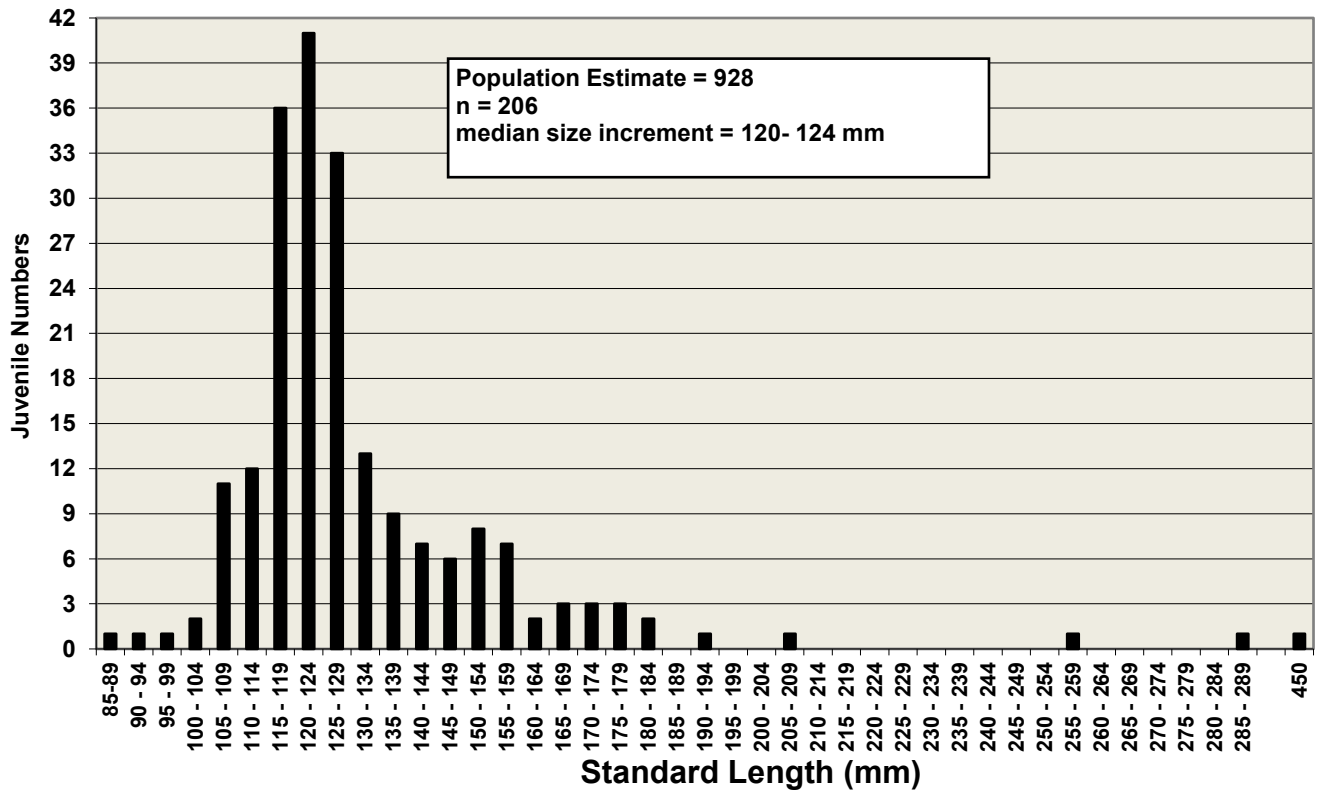
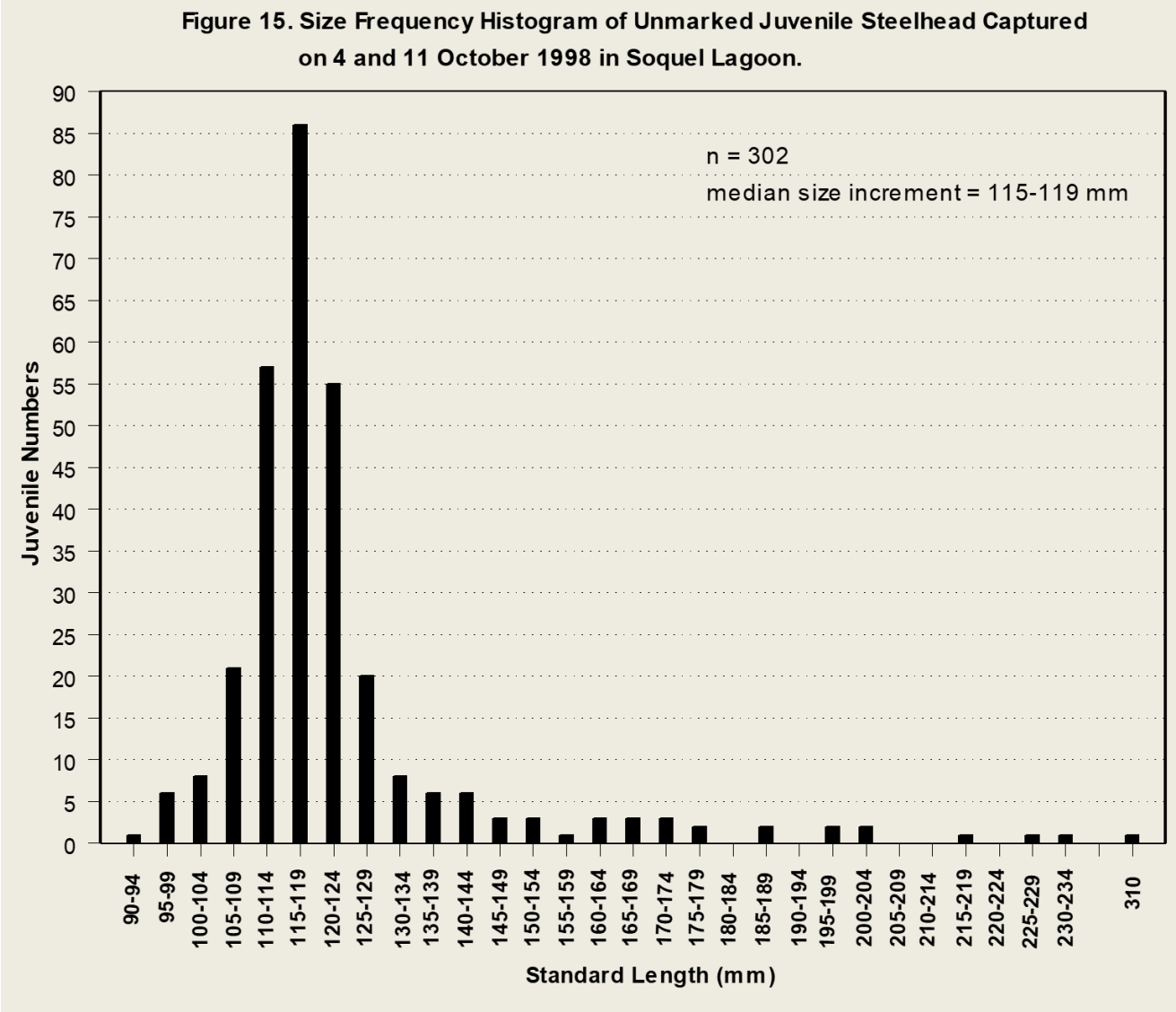


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.



Population Estimate in 1998 = 671.

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

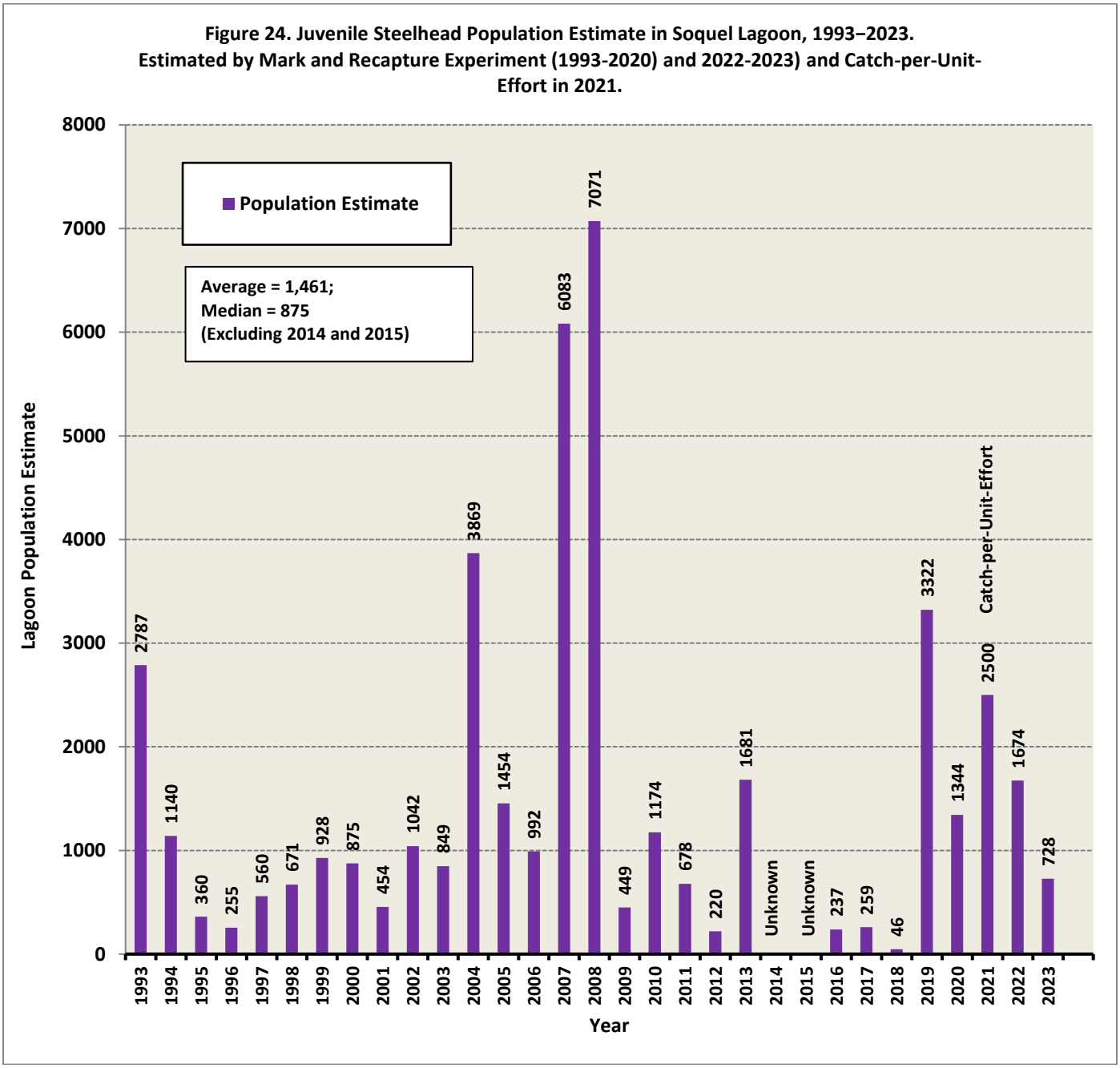


Figure 24. Steelhead Population Estimate in Soquel Lagoon, 1993−2023.

Figure 25. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2023.

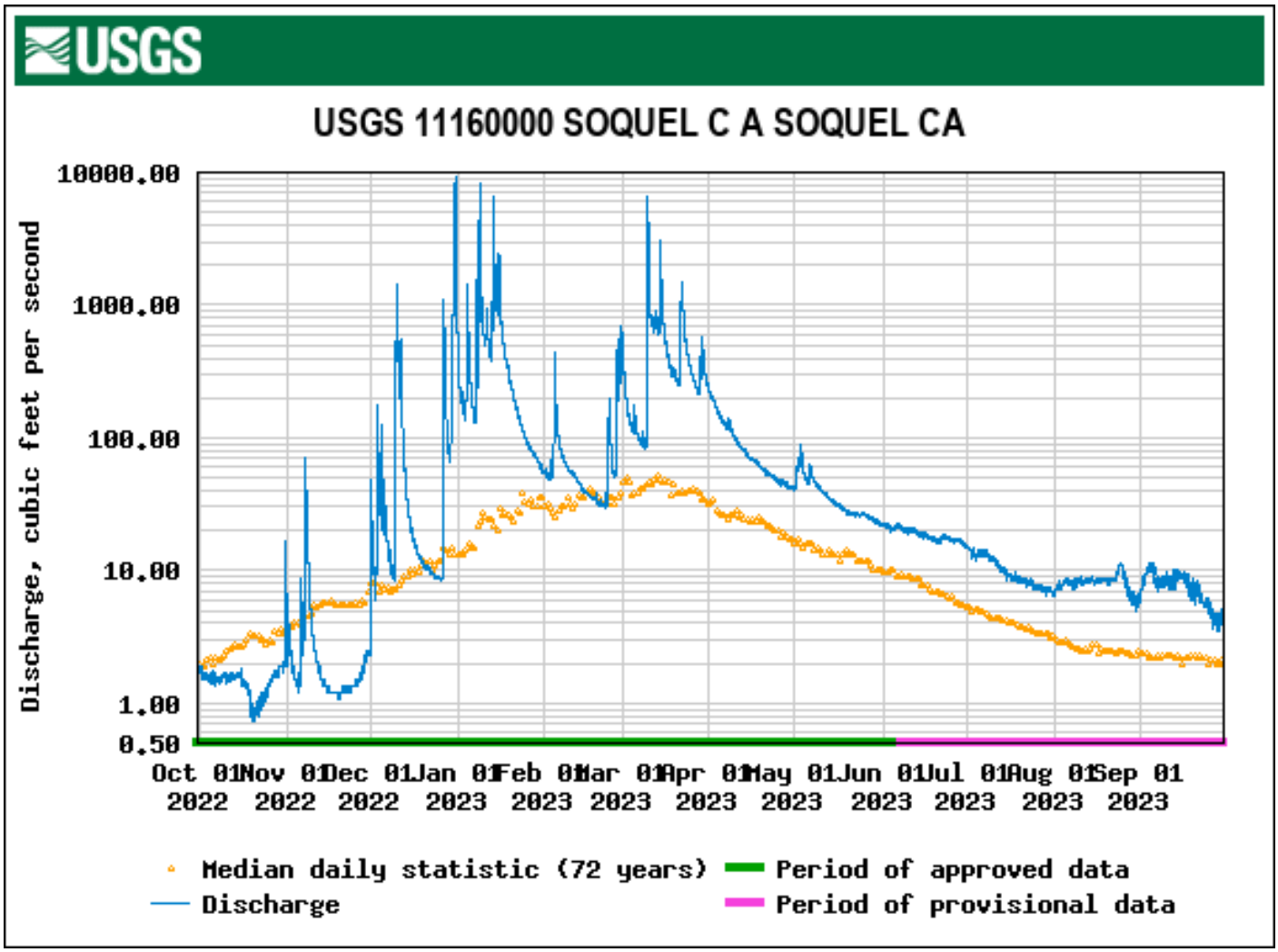


Figure 26. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1May 2023−1 December 2023.

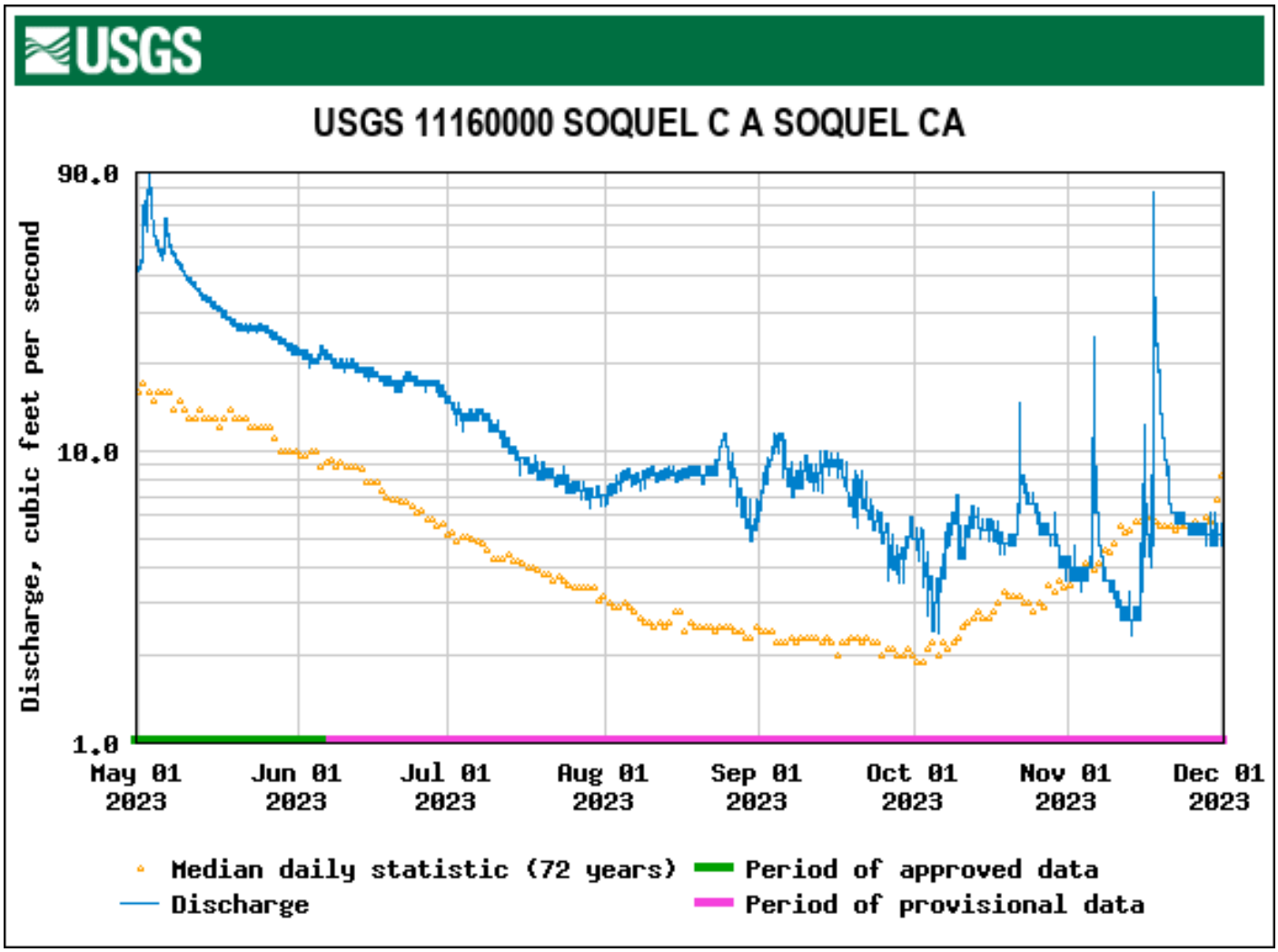


Figure 27. Maximum Visual Gull Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2019–2023.

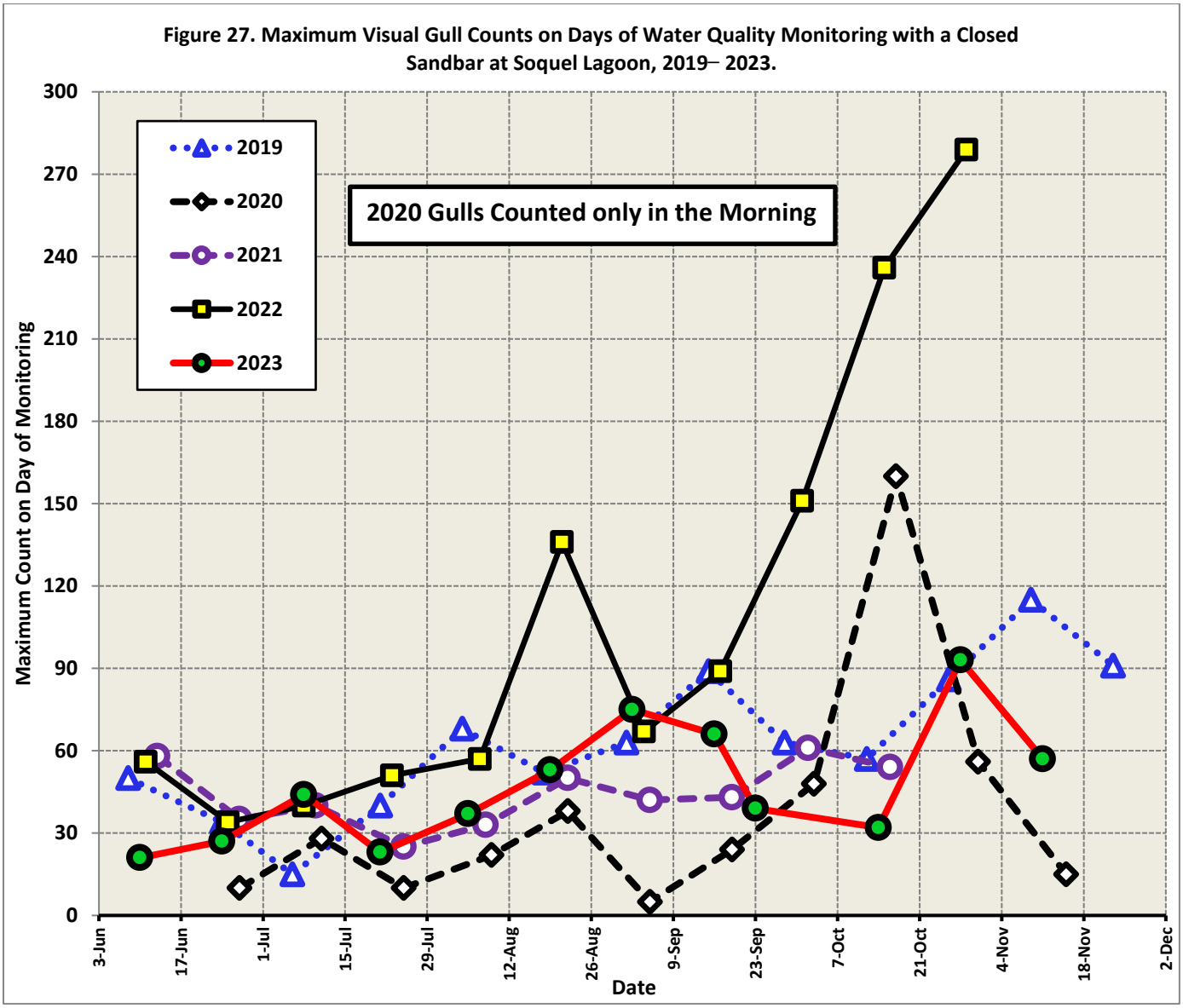
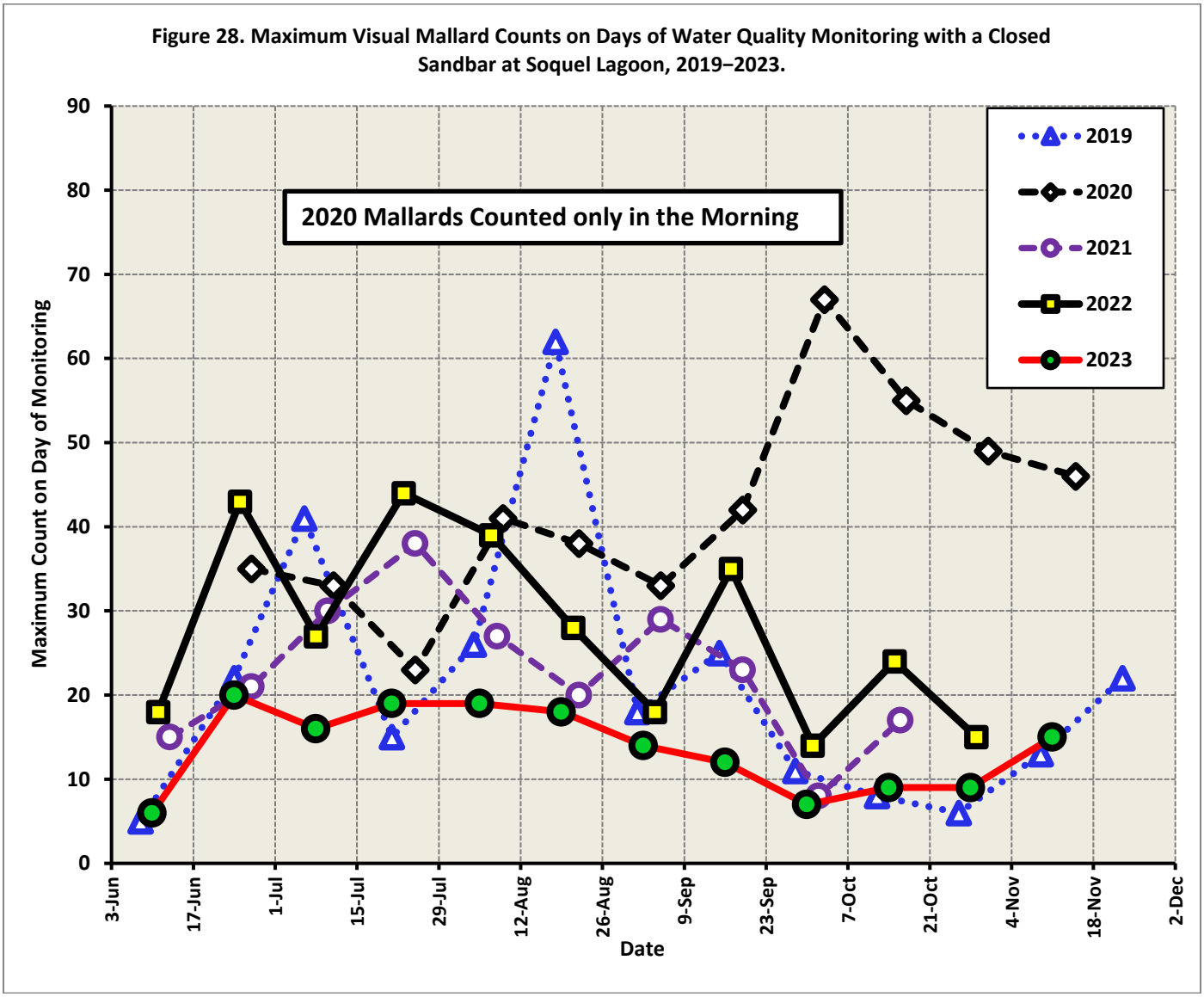


Figure 28. Maximum Visual Mallard Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2019–2023.



APPENDIX A. Water Quality and Stormflow Data and Observations of Birds and Sandbar Opening.

30 May 2023–18 November 2023.

25 May 2023. The sandbar was closed for the summer season with an adult portal present in the flume inlet and flashboards installed.

30 May 2023. The lagoon had reached maximum filling with a gage height of 2.99 and an air temperature of 17.8 C at 1036 hr. A thin saline layer existed at the bottom in the deep hole next to the Venetian Court wall. However, no shroud was judged necessary on the flume inlet because of the high lagoon inflow, low water temperatures and good oxygen concentration near the bottom. Water quality was good in more shallow portions of the lagoon, as indicated above Stockton Avenue Bridge.

			30 May 2023					
	Below Stockton Ave Bridge (Venetian Court Wall)			1036 hr	**Above Stockton Ave Bridge**			1056 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	15.9	0.3	9.40	516	15.9	0.3	8.42	515
0.25	15.8	0.3	9.12	515				
0.50	15.6	0.3	9.17	513				
0.75	15.4	0.3	9.65	511				
1.00	15.3	0.3	10.03	508				
1.25	14.9	0.3	9.60	508				
1.50	14.9	0.3	9.47	507				
1.60 b					15.0	0.3	8.32	504
1.75	14.9	0.3	9.42	508				
2.00	14.9	0.3	9.35	510				
2.25	14.9	0.3	6.31	510				
2.50b	16.4	16.8	0	22330				
	Railroad Trestle				**Mouth of Noble Gulch**			
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**
	Nob Hill							
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**

10 June 2023. The first complete water quality monitoring of the season was accomplished after

the sandbar had been closed on 25 May. Temperature probes were launched on 7 June in the lagoon and upstream. Gage height was 2.17 in morning and 2.08 in afternoon. Flume inlet 3+ ft deep; flume outlet 2+ ft deep in afternoon. Sky overcast in morning and afternoon. Air temperature cool 13.7.8°C at 0705 hr; 16.1 C at 1605 hr at the flume. Oxygen in the morning was 75- approx. 92% full saturation near the bottom and rated good at all 4 lagoon sites. Inflow stream's oxygen in the morning was good (98% full saturation) at Nob Hill. Oxygen in the afternoon was 90-96% full saturation near the bottom and rated good at all 4 lagoon sites. Water temperature ranged 15.7-17.0 °C in the morning near the bottom at the 4 sites in the good range. In the afternoon, water temperature near the bottom ranged 15.8-16.4 C (good) at the 4 sites. No surface algae. Secchi depth to the bottom. No phytoplankton bloom. No pondweed. Car show occurred this day.

			10 June 2023					
	Flume		0705 hr	Air temp 16.8 C	**Belo Stockton Avenue Bridge**			0720 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	17.1	0.3	9.16	542	17.1	0.3	9.27	544
0.25	17.2	0.3	9.32	542	17.1	0.3	8.94	547
0.50	17.1	0.3	9.44	543	17.1	0.3	8.68(90)	547
0.75	17.1	0.3	9.48	544	17.2	0.3	8.14	548
0.87b	17.1	0.3	9.41	544				
1.00					17.2	0.3	8.45	550
1.25					17.1	0.3	8.35	551
1.50					17.1	0.3	8.28	554
1.75					17.1	0.3	8.17	557
2.00					17.0	0.3	7.58	574
2.13b					16.8	5.6	0	8300
	Railroad Trestle			0741 hr	**Mouth of Noble Gulch**			0755 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	16.9	0.3	8.43	546	16.2	0.3	9.07	534
0.25	16.9	0.3	8.22	548	16.2	0.3	8.79	537
0.50	16.9	0.3	8.17	548	16.2	0.3	8.74	538
0.75	16.8	0.3	8.19	548	16.0	0.3	8.83(90)	538
1.00	16.8	0.3	8.14(84)	547	16.0	0.3	8.86	538
1.25b	16.8	0.3	7.70	547	15.8	0.3	9.05	538
1.37b					15.7	0.3	8.80	543
	Nob Hill			0855 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**
	15.0	0.3	9.83(98%)	514				

Station 1: Flume at 0705 hr- Air temp. 13.7°C. no surface algae, no planktonic algal bloom and no pondweed throughout the lagoon. Reach 1- 3 gulls bathing. Lagoon water level at below top of the flume. **Station 2:** Stockton Avenue Bridge at 0720- hr- Secchi depth to bottom. Reach 2- 4 mallards.
Station 3: Railroad Trestle at 0741 hr- Reach 3- 2 mallards.
Station 4: Mouth of Noble Gulch at 0755 hr. No gray water plume.

Station 5: Nob Hill at 0855 hr- Water temp. 0.8-2.1° C cooler than lagoon near the bottom in morning. Oxygen same as -2.13 mg/l more than in lagoon in the morning at those sites near the bottom. Streamflow 19.4 cfs at Soquel Village gage.

			10 June 2023					
	Flume		1605 hr	Air temp 16.1 C	**Stockton Avenue Bridge**			1548 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	16.9	0.3	7.94	546	17.2	0.3	9.54	552
0.25	16.8	0.3	8.14	546	17.1	0.3	9.65	549
0.50	16.4	0.3	8.65	539	17.2	0.3	8.77	549
0.75	16.4	0.3	8.85(90)	538	17.1	0.3	9.92	547
0.87b	16.4	0.3	8.85	537				
1.00					16.6	0.3	9.61	543
1.25					16.4	0.3	9.48	542
1.50					16.2	0.3	9.24	542
1.75					16.2	0.3	9.41	542
2.00					16.2	0.3	8.09(82)	544
2.18b					17.3	11.1	0	15038
	Railroad Trestle			1516 hr	**Mouth of Noble Gulch** 1500 hr			Air temp. 14.7 C
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	17.0	0.3	8.86	548	17.0	0.3	8.98	547
0.25	17.0	0.3	8.74	547	16.9	0.3	8.79	549
0.50	17.0	0.3	8.77	546	16.4	0.3	8.86	541
0.75	16.8	0.3	8.80	544	15.9	0.3	9.59	540
1.00	16.5	0.3	8.96(92)	541	15.8	0.3	9.39	539
1.25	16.1	0.3	9.64	537	15.8	0.3	9.56(94)	545
1.37b					15.7	0.3	8.13	545
	Nob Hill			1641 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**
	16.5	0.3	9.29(95)	480				

Station 1: Flume at 1605 hr- Air temp. 16.1 °C. Reach 1- no surface algae, bottom algae or pondweed throughout the lagoon. Only 10 gulls bathing, 5 mallards @ Margaritaville. Gage height 2.08.
Station 2: Stockton Avenue Bridge at 1548 hr. Secchi depth to bottom. Reach 2- no waterfowl.
Station 3: Railroad Trestle at 1516 hr- Reach 3- 11 gulls, no waterfowl.
Station 4: Mouth of Noble Gulch at 1500 hr. Gray water at depth.

Station 5: Nob Hill at 1700 hr- Water temp. similar or 0.7° C warmer than lagoon near the bottom in afternoon on an overcast day. Oxygen similarly high as in lagoon at all sites.

24 June 2023. Gage height was 2.55 morning and 2.26 afternoon. Screen was plugged with leaves in the morning and then cleared. The new stainless steel grate was in place on the flume inlet. No sinkholes on beach. Sky partly cloudy in morning and clear and breezy in afternoon. Air temp. 11.1 °C (morning); 18.7 C (afternoon at flume); 20.4 C afternoon at Noble Gulch). Saline lens dissipated adjacent Venetian Court wall. Oxygen was 82-91% full saturation in the morning near the bottom and rated good; 115-125% full saturation in the afternoon near the bottom and good. Oxygen at Nob Hill inflow was 02% full saturation and good in the morning and supersaturated at 100+% in the afternoon. Water temperature ranged 15.6-16.1 °C in the morning in the lagoon near the bottom and rated good, it being approximately 1.5-2 °C warmer than the stream inflow water temperature. No surface algae. Secchi depth to the bottom. Flume inlet 2+ ft deep.

			24 June 2023					
	Flume		0703 hr		**Stockton Avenue Bridge**			0719 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	16.1	0.3	9.26	541	16.0	0.3	9.13	550
0.25	16.1	0.3	9.15	547	16.1	0.3	9.20	551
0.50	16.1	0.3	9.19	550	16.2	0.3	8.87	552
0.75	16.1	0.3	9.16	551	16.4	0.3	7.96	558
0.95b	16.1	0.3	9.05	550				
1.00					16.2	0.3	8.71	554
1.25					16.2	0.3	8.87	554
1.50					16.1	0.3	9.02	552
1.75					16.1	0.3	9.04	551
2.00					16.1	0.3	9.04(91)	551
2.25					16.1	0.3	7.69	552
	Railroad Trestle			0740 hr	**Mouth of Noble Gulch**			0755 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	15.9	0.3	9.01	543	15.5	0.3	8.66	539
0.25	15.9	0.3	8.86	547	15.6	0.3	8.29	543
0.50	15.9	0.3	8.77	547	15.5	0.3	8.26	542
0.75	15.9	0.3	8.77	547	15.6	0.3	8.19	542
1.00	15.9	0.3	8.79	547	15.6	0.3	8.18(82)	544
1.25b	15.9	0.3	8.74(89)	548	15.9	0.3	7.97	543
1.37b	15.9	0.3	8.52	548				
	Nob Hill			0828 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**
	14.3	**0.3**	**9.42(92)**	**520**				

Station 1: Flume at 0703 hr- Air temp. 11.1 C. no surface algae throughout lagoon. Reach 1- 6 gulls bathing ; 1 female mallard and 5 ducklings.

Station 2: Stockton Avenue Bridge at 0719- hr- Secchi depth to bottom. Reach 2- 2 adult mallards.

Station 3: Railroad Trestle at 0740 hr- Reach 3- 3 mallards. 7 gulls.
Station 4: Mouth of Noble Gulch at 0755 hr. No gray water plume. Green, planktonic bloom.
Station 5: Nob Hill at 0825 hr- Water temp. 1.5-2 °C cooler than lagoon near the bottom in morning. Oxygen 0.3-0.7 mg/l more than at lagoon sites near the bottom in the morning. Streamflow – 18 cfs at Soquel Village gage.

			24 June 2023					
	Flume		1605 hr		**Stockton Avenue Bridge**			1540 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	17.5	0.3	11.62	572	17.6	0.3	11.26	
0.25	17.5	0.3	11.45	570	17.6	0.3	11.26	
0.50	17.3	0.3	11.56	568	17.7	0.3	11.35	
0.75	17.3	0.3	11.84(125)	568	17.5	0.3	11.94	
1.00b	17.3	0.3	11.89	568	17.3	0.3	11.56	
1.25					17.2	0.3	11.20	
1.50					17.1	0.3	11.19	
1.75					16.9	0.3	11.05	
2.00					16.8	0.3	10.90(112)	
2.25					16.8	0.3		
	Railroad Trestle			1524 hr	**Mouth of Noble Gulch**			1500 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	17.6	0.3	10.89	574	18.3	0.3	11.03	585
0.25	17.6	0.3	10.86	571	18.0	0.3	10.94	575
0.50	17.5	0.3	10.91	571	17.9	0.3	11.02	575
0.75	17.2	0.3	11.02	569	17.6	0.3	11.66	571
1.00	17.3	0.3	11.05	568	16.3	0.3	12.05(124)	559
1.25b	17.1	0.3	11.10	566	16.2	0.3	11.33	558
1.65b	17.1	0.3	10.85	565				
	Nob Hill			1657 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**
	18.6	**0.2**	**11.73**	**445**				

Station 1: Flume at 1605 hr- Air temp. 18.7 C. No surface algae in lagoon. Reach 1- 5 gulls bathing ; 22 adult mallards and 5 ducklings. 30% bottom algae 0.3-2 ft thick; avg 0.5 ft; remainder of lagoon bottom algal film to 0.2 ft thick. No phytoplankton bloom. 4 waders, 2 inflatable kayaks.
Station 2: Stockton Avenue Bridge at 1540 hr- hr- Secchi depth to bottom. Reach 2- 3 mallards from Reach 1, 1 gull in water and 15 gulls on trestle. 30% bottom algae 0.3-2 ft thick avg 0.5 ft; 70% algal film. 1 paddle boarders, 2 kayaks.
Station 3: Railroad Trestle at 1524 hr- Reach 3- 1 merganser observed capturing a steelhead. 21 gulls in water. 20% bottom algae 0.2-1.5 ft thick: avg 0.4 ft; remainder covered with algal film.
Station 4: Mouth of Noble Gulch at 1500 hr. No gray water plume. 100% bottom algae 0.2 ft thick.
Station 5: Nob Hill at 1657 hr- Water temp. 1.3-2.3 °C warmer than lagoon near the bottom in

afternoon. Oxygen slightly more than in lagoon near the bottom in the afternoon and supersaturated.

8 July 2023. Gage height of 2.58 in morning and 2.75 in afternoon. Flume inlet 2.0 ft. Flume outlet overtopped with waves in the afternoon. No flume underflow or sink holes on beach. Clear sky and breezy at 0717 hr; air temperature of 11.8 C. Afternoon conditions the same with air temperature of 18.2 C at flume and 21.8 C at Noble Gulch. Morning oxygen levels were good (78% – 88% saturation), oxygen concentration slightly lower compared to 2 weeks previous in morning with 2 C warmer water temperatures in the good range near the bottom (18.3-18.7 C). Secchi depth to bottom. Oxygen levels near full saturation in afternoon near the bottom (90-101%) with warmer water temperatures than 2 weeks previous near the bottom (18.2-19.7 C). Stream water temperature at Nob Hill was 2 C cooler in the morning but slightly warmer than in the lagoon in the afternoon.

				8-July-2023				
	Flume			0717 hr	**Stockton Avenue Bridge**			0731 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	18.5	0.3	8.31	603	18.8	0.3	8.32	608
0.25	18.5	0.3	8.26	603	18.8	0.3	8.19	610
0.50	18.5	0.3	8.26	605	18.7	0.3	8.18	609
0.75	18.6	0.3	8.29(88)	606	18.7	0.3	8.27	609
1.00b	18.6	0.3	8.18	606	18.8	0.3	8.43	607
1.25					18.7	0.3	8.28	608
1.50					18.7	0.3	8.12	609
1.75					18.7	0.3	8.00	609
2.00					18.7	0.3	8.01	609(87)
2.25					18.7	0.3	7.94	609
2.37b					18.7	0.3	4.27	609
	Railroad Trestle			0751 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	18.5	0.3	8.42	599	18.3	0.3	7.59	603
0.25	18.5	0.3	8.24	602	18.3	0.3	7.30	606
0.50	18.5	0.3	8.27	602	18.3	0.3	7.32	606
0.75	18.5	0.3	8.25	602	18.3	0.3	7.33	606
1.00	18.5	0.3	8.20	602	18.3	0.3	7.26	606
1.25	18.5	0.3	8.19(87)	602	18.3	0.3	7.31(78)	605
1.30b	18.5	0.3	7.93	602				
1.32b					17.9	0.3	6.97	603
	Nob Hill			0842 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**
	16.1	0.3	8.70(88%)	558				

Station 1: Flume 0717 hr. Reach 1- 0 gulls bathing. No surface algae at the lagoon.
Station 2: Stockton Bridge 0731 hr. Reach 2- 9 mallards on trestle abutment, 2 gulls roosting on railroad trestle.
Station 3: Railroad trestle 0751 hr. Reach 3- 1 mallards, 2 gulls, 1 western pond turtle on log between Shadowbrook Restaurant and Noble Gulch.
Station 4: Noble Gulch 0805 hr. No gray water.
Station 5: Nob Hill at 0842 hr. 1.8° C warmer water temperature than 2 weeks previous and 2-2.6 °C cooler than lagoon near bottom. Streamflow– 13.4 cfs at Soquel Village gage.

				8-July-2023				
	Flume			1550 hr	**Stockton Avenue Bridge**			1535 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	20.4	0.3	8.88	635	20.0	0.3	8.89	641
0.25	20.1	0.3	8.58	632	20.1	0.3	8.60	629
0.50	19.7	0.3	8.96	628	20.1	0.3	8.60	629
0.75	19.4	0.3	9.11(99)	621	19.9	0.3	8.63	626
1.00b	19.5	0.3	9.00	621	19.7	0.3	8.59	623
1.25					19.4	0.3	8.53	619
1.50					19.3	0.3	8.47	618
1.75					19.0	0.3	8.40	617
2.00					18.9	0.3	8.38(90)	616
2.25					18.8	0.3	7.94	616
2.30					18.8	0.3	6.73	616
	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	20.7	0.3	8.63	639	20.7	0.3	8.52	648
0.25	20.6	0.3	8.46	637	20.5	0.3	8.30	637
0.50	20.3	0.3	8.35	633	20.4	0.3	8.22	634
0.75	20.2	0.3	8.23	632	20.3	0.3	8.24	632
1.00	20.0	0.3	8.32	629	18.3	0.3	9.41	618
1.25	19.7	0.3	8.82(96)	627	18.1	0.3	9.55(101)	598
1.37b					18.1	0.3	9.36	598
1.45b	19.3	0.3	8.82	619				
	Nob Hill			1642 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**
	19.9	0.2	9.53(104)	375??				

Station 1: Flume 1550 hr. Reach 1- 0 gulls bathing (2 large dogs in water). 11 adult mallard next to Margaritaville. 2 waders, one paddle boarder. 30% bottom algae 0.2-1 ft thick; avg 0.5 ft. remainder algal film to 0.1 ft thick.
Station 2: Stockton Bridge 1535 hr. Reach 2- 20 adult mallards and 2 ducklings, 22 gulls roosting on trestle. 40% bottom algae 0.22-1 ft thick; avg 0.5 ft. remainder algal film.

Station 3: Railroad trestle 1515 hr. Reach 3- 14 adult mallards and 5 ducklings, 1 merganser, 4 paddle boarders. <1% surface algae.70% bottom algae 1-3 ft thick; avg 2 ft. 30% pondweed 2-4 ft thick; avg 3 ft.
Station 4: Noble Gulch 1500 hr. air temperature 21.8 C. Slight gray water. 25% bottom algae 0.3 ft thick; remainder thin film to 0.1 ft thick.
Station 5: Nob Hill at 1642 hr. 1.3 °C warmer water temperature than 2 weeks previous and 0.2-1.8 °C warmer than lagoon near bottom.

21 July 2023. Gage height of 2.69 in morning; 2.71 in afternoon. Foggy at 0706 hr; clear and breezy in afternoon. Flume inlet 2.1 ft. Flume outlet 1.8 ft in afternoon. Air temperature of 13.1 C in morning and 16.8 C in afternoon at the flume; 25.6 C at Noble Gulch. Morning oxygen levels were rated good at 87-93% full saturation in the morning near the bottom, oxygen similarly high as 2 weeks previous in morning. Water temperature approximately 0.5 C higher in the morning than 2 weeks previously but still in the good range below 20 C near the bottom. Secchi depth to bottom. Oxygen levels near saturation in the afternoon at all 4 sites near the bottom (95-107%) with warmer water temperatures than 2 weeks previous near the bottom (18.7-20 C).

			21-July-2023					
	Flume			0706 hr	**Stockton Avenue Bridge**			0720 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	19.1	0.3	8.64	633	19.0	0.4	8.49	630
0.25	19.2	0.4	8.57	635	19.1	0.4	8.38	634
0.50	19.2	0.4	8.63	635	19.1	0.4	8.42	635
0.75	19.2	0.4	8.67(93)	635	19.1	0.4	8.08	635
1.00b	19.2	0.4	8.44	634	19.1	0.4	8.00	635
1.25					19.1	0.4	7.98	635
1.50					19.0	0.4	8.03	635
1.75					18.9	0.4	8.13	633
2.00					18.9	0.4	8.16(88)	632
2.25b					18.9	0.4	7.09	632
	Railroad Trestle			0738 hr	**Mouth of Noble Gulch**			0757 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	18.9	0.3	8.37	626	18.7	0.3	8.34	617
0.25	18.9	0.3	8.14	628	18.7	0.3	8.17	617
0.50	18.9	0.3	8.13	628	18.7	0.3	8.17	617
0.75	18.9	0.3	8.19	627	18.7	0.3	8.08	618
1.00	18.8	0.3	8.32	623	18.7	0.3	7.96	617
1.25	18.7	0.3	8.39(90)	620	18.7	0.3	8.07(87)	617
1.40b	18.7	0.3	8.10	620				617
1.50b					18.5	0.3	7.36	615
	Nob Hill			0828 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**
	16.6	0.3	867(89)	585				

Station 1: Flume 0706 hr. Reach 1- 31 gulls bathing, 4 mallards. No surface algae at the lagoon except at Noble Gulch..
Station 2: Stockton Bridge 0720 hr. Reach 2- 3 hungry mallards in water, numerous stickleback.
Station 3: Railroad trestle 0738 hr. Reach 3- 6 adult mallards, 5 gulls, 1 paddle boarder.
Station 4: Noble Gulch 0757 hr. 2% surface algae. No gray water.
Station 5: Nob Hill at 0828 hr. 2.1-2.6 °C cooler than lagoon near the bottom; water temperature 0.5 C warmer than 2 weeks previous. Streamflow– 8.65 cfs at Soquel Village gage.

			21-July-2023					
	Flume			1616 hr	**Stockton Avenue Bridge**			1559 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	20.2	0.3	9.16	649	20.2	0.3	8.89	646
0.25	20.2	0.3	8.99	648	20.2	0.3	8.85	647
0.50	20.2	0.3	9.07	649	20.3	0.3	8.84	648
0.75	20.0	0.3	9.04(99)	647	20.2	0.3	8.85	648
1.00b	19.9	0.4	9.08	645	20.1	0.3	8.85	646
1.25					20.0	0.3	8.90	645
1.50					19.6	0.4	8.84	642
1.75					19.4	0.4	8.89	640
2.00					19.4	0.4	8.75(95)	640
2.25b					19.3	0.4	6.83	643
	Railroad Trestle			1541 hr	**Mouth of Noble Gulch**			1509 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	20.9	0.3	8.42	657	21.0	0.3	8.80	658
0.25	20.7	0.3	8.59	655	21.0	0.3	8.89	657
0.50	20.7	0.3	8.62	654	20.8	0.3	8.87	655
0.75	20.5	0.3	8.59	652	20.5	0.3	8.83	649
1.00	20.3	0.3	8.97	649	18.9	0.3	9.36	631
1.25	20.0	0.3	9.75(107)	647	18.7	0.3	10.06(107)	611
1.50b	19.7	0.3	10.10	643	18.6	0.3	9.39	610
	Nob Hill			1715 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**
	20.8	0.3	8.75(97%)	636				

Station 1: Flume 1616 hr. Reach 1- 4 gulls, 16 adult mallards by Margaritaville (some from Reach 3?), 2 paddle boarders. No surface algae at lagoon except at Noble Gulch. Clear and breezy. 90% bottom algae 0.5-2 ft thick; avg 1 ft. Remainder algal film. No pondweed observed.
Station 2: Stockton Bridge 1559 hr. Reach 2- 1 adult mallard, 1 gull, 5 gulls roosting on trestle, 1 row boat. 100% bottom algae 2-3 ft thick; avg 0.5 ft. No pondweed observed,
Station 3: Railroad trestle 1541 hr. Reach 3- 12 adult mallards, 14 gulls. 100% bottom algae 0.2-3 ft thick; avg 2 ft. No pondweed observed.

Station 4: Noble Gulch 1509 hr. No gray water. 10% surface algae. 100% bottom algae 0.5-3.5 ft thick; avg 1.5 ft.
Station 5: Nob Hill at 1715 hr. 0.8 °C warmer water temperature than 2 weeks previous and 0.8-1.9 °C warmer than the lagoon near bottom.

5 August 2023. Gage height of 2.68 in morning; 2.70 in afternoon. Sky overcast and breezy in morning; clear and very breezy in afternoon. Flume inlet 2.0 ft. Flume outlet 1.2 ft in afternoon with incoming tide. Morning oxygen levels were good and supersaturated (105-125% near bottom) and somewhat higher than 2 weeks previous in morning with 0.5 C warmer water temperatures in the good range near the bottom (19.0-19.6 C). Secchi depth to bottom. Oxygen levels supersaturated in afternoon at all sites (131-145%) with similar water temperatures in the afternoon as 2 weeks previous near the bottom (19.1-20.4 C).

			5-August-2023					
	Flume			0707 hr	**Stockton Avenue Bridge**			0721 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	11.78	651	19.4	0.4	11.15	642
0.25	19.6	0.4	11.82	652	19.5	0.4	11.06	648
0.50	19.6	0.4	11.81	651	19.5	0.4	11.07	649
0.75	19.6	0.4	11.49(125)	652	19.5	0.4	10.78	649
1.00b	19.6	0.4	11.29	652	19.5	0.4	10.92	649
1.25					19.5	0.4	10.90	649
1.50					19.5	0.4	10.97	649
1.75					19.5	0.4	10.73	649
2.00					19.5	0.4	10.47 (114)	651
2.25b					19.5	0.4	8.62	653
	Railroad Trestle			0740 hr	**Mouth of Noble Gulch**			0757 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	19.4	0.4	10.20	641	19.0	0.4	10.25	635
0.25	19.4	0.4	9.97	645	19.1	0.4	10.03	636
0.50	19.4	0.4	10.10	645	19.1	0.4	10.04	636
0.75	19.4	0.4	9.88	645	19.1	0.4	9.98	636
1.00	19.3	0.4	9.46	644	19.0	0.4	10.07	636
1.25b	19.3	0.4	9.51(103)	643	19.0	0.4	9.77(105)	636
137b					18.9	0.4	8.45	633
1.45b	19.3	0.4	8.14	643				
	Nob Hill			0837 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**
	7.6	0.4	7.04 (74%)	645				

Station 1: Flume 0707 hr. Reach 1- 19 gulls bathing. 1 adult mallard. Flume inlet still open for fish passage. No surface algae at Reach 1.
Station 2: Stockton Bridge 0721 hr. Reach 2- From Reach 1- 8 adult mallards. 2% surface algae. 2

dog poops along path.
Station 3: Railroad trestle 0740 hr. Reach 3- 10 adult mallards. 20% surface algae below Noble Gulch and 10% upstream.
Station 4: Noble Gulch 0757 hr. 20% surface algae. Nor gray water.
Station 5: Nob Hill at 0837 hr. 0.5 °C warmer water temperature than 2 weeks previous and 1.9 – 2.5 °C cooler than lagoon near bottom. Streamflow– 7.94 cfs at Soquel Village gage.

				5-August-2023				
	Flume			1555 hr	**Stockton Avenue Bridge**			1538 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	20.4	0.4	12.47	659	20.5	0.4	12.45	658
0.25	20.4	0.4	12.89	659	20.5	0.4	12.42	661
0.50	20.4	0.4	12.96	660	20.5	0.4	12.46	661
0.75	20.4	0.4	13.11(145)	655	20.4	0.4	12.53	659
1.00b	20.3	0.4	12.76	656	20.4	0.4	12.34	659
1.25					20.2	0.4	12.26	659
1.50					20.1	0.4	12.23	657
1.75					20.0	0.4	12.09	656
2.00					20.0	0.4	11.89(131)	656
2.25b					19.8	0.4	9.56	656
	Railroad Trestle			1521 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	20.9	0.4	12.11	666	20.8	0.4	11.46	666
0.25	20.9	0.4	11.97	668	20.8	0.4	11.78	666
0.50	20.7	0.4	11.87	666	20.6	0.4	11.60	662
0.75	20.6	0.4	11.79	664	20.6	0.4	11.75	662
1.00	20.5	0.4	11.64	668	19.1	0.4	13.19	626
1.25	20.1	0.4	13.64(150)	656	19.1	0.4	13.19 (142)	624
1.45b	20.0	0.4	12.90	656				
1.50b					19.0	0.4	12.90	626
	Nob Hill			1628 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**
	20.0	0.3	11.79(128)	632				

Station 1: Flume 1555 hr. Air temp. = 15.4 C. Reach 1- 14 gulls bathing. 13 adult mallards being feed at Margaritaville. 3 waders, 6 paddle boarders. No surface algae. Could not observe bottom algae.
Station 2: Stockton Bridge 1538 hr. Reach 2- 13 gulls. 4 paddle boarders travelling from Reach 3 to Reach 1. 1 pedal boat. No surface algae. 60% bottom algae 0.2-3 ft thick; avg 1.0 ft. Remainder thick algal film 0.1-0.2 ft thick.
Station 3: Railroad trestle 1521 hr. Reach 3- 10 gulls. 4 adult mallards. 2% surface algae. 20% bottom algae 0.2-3.0 ft thick; avg 1.0 ft. Remainder thick algal film 0.1-0.2 ft thick.
Station 4: Noble Gulch 1500 hr. Air temp. = 18.9 C. 20% surface algae. No gray water. 1000% bottom algae 0.2-1.5 ft thick; avg 1.0 ft.
Station 5: Nob Hill at 1628 hr. 0.8 °C cooler water temperature than 2 weeks previous and similar to the lagoon near bottom.

19 August 2023. Sandberm built up. Gage height of 2.41 in morning; 2.42 in afternoon. Flume inlet 1.7 ft. Flume outlet 1.6 ft. Air temperature of 15.8 C at 0715 hr; 18.9 C at 1559 hr at the flume. Overcast in morning; clear and breezy in afternoon. Morning oxygen levels rated good (78% – 97% saturation near the bottom), oxygen lower than 2 weeks previous in morning with 0.5-0.6 C warmer water temperatures in the fair range near the bottom (20.1-20.2 C) except remaining cooler at Noble Gulch (19.0 C). Secchi depth to bottom. These were the warmest afternoon water temperatures measured during 2- week intervals in 2023. Oxygen levels increased during day but were less than 2 weeks previous (95-115% saturation)

			19-August-2023					
	Flume			0715 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	20.2	0.4	8.68	670	20.2	0.4	8.70	667
0.25	20.2	0.4	8.68	674	20.2	0.4	8.69	672
0.50	20.3	0.4	8.69	674	20.3	0.4	8.55	673
0.75	20.2	0.4	8.71(97)	674	20.3	0.4	8.50	674
0.95b	20.2	0.4	8.49	674				
1.00					20.3	0.4	8.54	673
1.25					20.3	0.4	8.54	674
1.50					20.3	0.4	8.53	673
1.75					20.3	0.4	8.08	674
2.00					20.2	0.4	7.05(78)	677
2.25b					20.2	0.4	4.97	683
	Railroad Trestle			0753 hr	**Mouth of Noble Gulch**			0810 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	20.1	0.4	8.43	665	19.9	0.4	8.02	665
0.25	20.1	0.4	8.27	666	19.9	0.4	7.93	665
0.50	20.1	0.4	8.38	666	19.9	0.4	8.03	666
0.75	20.1	0.4	8.41	666	19.9	0.4	8.09	665
1.00	20.1	0.4	8.34(92)	666	19.9	0.4	7.96	666
1.25b	20.1	0.4	7.40	666	19.0	0.4	7.70(82)	648
1.37b	20.1				18.7	0.4	6.93	614
	Nob Hill			0911 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**
	17.6	0.3	8.45(88%)	610				

Station 1: Flume 0715 hr. Sandberm built up. Reach 1- 17 gulls bathing (Some Hermann's). No surface algae.
Station 2: Stockton Bridge 0730 hr. Reach 2- <1% surface algae. 1 mallard.
Station 3: Railroad trestle 0753 hr. Reach 3- 5% surface algae. 11 adult mallards (9 moving downstream to Reach 1).

Station 4: Noble Gulch 0810 hr. No gray water.
Station 5: Nob Hill at 0911 hr. 0.5 °C warmer water temperature than 2 weeks previous and 2.5 °C cooler than lagoon near bottom. Streamflow– 8.85 cfs at Soquel Village gage (likely inaccurate).

				19-August-2023				
	Flume			1559 hr	**Stockton Avenue Bridge**			1539 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	21.6	0.4	9.87	684	21.1	0.4	9.18	684
0.25	21.1	0.4	9.77	684	21.1	0.4	9.07	684
0.50	21.0	0.4	10.13	683	21.1	0.4	9.12	684
0.75	20.9	0.4	10.19(114)	682	21.1	0.4	9.00	684
0.95b	20.9	0.4	9.32	684				
1.00					21.1	0.4	8.91	684
1.25					20.9	0.4	8.86	682
1.50					20.5	0.4	8.76	681
1.75					20.4	0.4	8.68	681
2.00					20.3	0.4	8.54(95)	682
2.25b					20.3	0.4	7.54	682
	Railroad Trestle			1517 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	21.0	0.4	8.93	688	21.4	0.4	9.09	686
0.25	21.0	0.4	8.91	685	21.4	0.4	8.90	687
0.50	21.0	0.4	8.84	685	21.3	0.4	8.75	685
0.75	20.9	0.4	8.99	683	20.7	0.4	9.93	679
1.00	20.9	0.4	9.21(103)	683	19.5	0.4	10.49	632
1.25b	20.6	0.4	8.38	682	19.4	0.4	10.65(115)	632
1.40b					19.4	0.4	9.43	639
	Nob Hill			1656 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**
	20.3	0.4	9.02(100 %)	655				

Station 1: Flume 1559 hr. Air temp. = 18.9 C. Reach 1- 30 gulls bathing (some Hermann's). 12 adult mallards. No surface algae. 2 paddle boarders, 9 waders. 90% bottom algae 0.5-2 ft thick; avg= 1.0 ft. Remainder algal film.
Station 2: Stockton Bridge 1539 hr. Reach 2- 1 mallard. 8 gulls roosting on trestle. 2 paddle boarders. No surface algae. 50% bottom 0.2-2 ft thick; avg 1 ft. remainder algal film 0.l- 0.2 ft.
Station 3: Railroad trestle 1517 hr. Reach 3- 15 gulls, 1 female mallard and 2 ducklings. 1 paddle boarder, 1 canoe. No surface algae. 40% bottom algae 0.2-1.5 ft thick; avg 0.5 ft, remainder algal film 0.l- 0.2 ft.
Station 4: Noble Gulch 1500 hr. No surface algae or gray water. 70% bottom algae 0.5-3.5 ft thick, avg 2 ft. Remainder thick algal film 0.1-0.2 ft.
Station 5: Nob Hill at 1656 hr. 0.3 C warmer water temperature than 2 weeks previous and up to 0.6 °C cooler than lagoon near bottom except at Noble Gulch, which was 0.9 C cooler near the bottom.

2 September 2023. Gage height of 2.34 in morning; 2.36 in afternoon. Flume inlet 1.3 ft. Flume outlet 1.1 ft across outlet in afternoon with incoming tide. Air temperature of 15.7 C at 0701 hr and cloudy in morning and afternoon without breeze. 18.1 C at flume and 21 C at Noble Gulch in afternoon. Morning oxygen levels fair to good (67% – 86% saturation near the bottom), oxygen slightly lower than 2 weeks previous in morning with slightly lower water temperatures in the good range near the bottom (18.3-18.7 C). Secchi depth to bottom. Oxygen levels supersaturated in afternoon at all 4 sites (108-115%) with cooler water temperatures near the bottom to 2 weeks previous when it was overcast (18.7-19.2 C).

			2-September-2023					
	Flume			0701 hr	**Stockton Avenue Bridge**			0716 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	8.77	658	18.7	0.4	8.71	658
0.25	18.6	0.4	8.76	659	18.7	0.4	8.70	660
0.50	18.6	0.4	8.77	659	18.7	0.4	8.32	660
0.75	18.7	0.4	8.62	660	18.7	0.4	8.45	661
0.9b	18.6	0.4	8.01	661				
1.00					18.7	0.4	8.56	661
1.25					18.7	0.4	7.96	660
1.50					18.4	0.4	7.43	658
1.75					18.3	0.4	7.47	655
2.00					18.3	0.4	7.39(79)	655
2.25b					18.3	0.4	6.82	655
	Railroad Trestle			0739 hr	**Mouth of Noble Gulch**			0753 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	18.6	0.4	8.02	659	18.7	0.4	8.24	648
0.25	18.6	0.4	8.06	658	18.7	0.4	8.16	650
0.50	18.6	0.4	8.24	658	18.7	0.4	8.17	650
0.75	18.6	0.4	7.79	658	18.7	0.4	8.04	649
1.00	18.6	0.4	6.35(67)	659	18.6	0.4	8.04(86)	647
1.25b	18.6	0.4	2.87	661	18.3	0.4	7.16	
	Nob Hill			0828 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**
	17.3	0.4	7.71(80%)	624				

Station 1: Flume 0701 hr. Reach 1- 28 gulls (Western and Hermann's). 1 mallard. No surf. algae in lagoon.
Station 2: Stockton Bridge 0716 hr. Reach 2- No waterfowl.
Station 3: Railroad trestle 0739 hr. Reach 3- 8 mallards. Steelhead 8 surface hits/ min.
Station 4: Noble Gulch 0753 hr. No gray water.
Station 5: Nob Hill at 0843 hr. 0.3° C cooler water temperature than 2 weeks previous and 1.0-1.4 °C cooler than lagoon near bottom. Streamflow– 2.40 cfs at Soquel Village gage.

			2 September-2023					
	Flume			1606 hr	**Stockton Avenue Bridge**			1548 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	19.0	0.4	11.07	660	19.2	0.4	10.75	663
0.25	19.0	0.4	11.07	659	19.1	0.4	10.66	663
0.50	19.0	0.4	10.92	659	19.1	0.4	10.76	663
0.75	18.9	0.4	10.54(113)	659	19.1	0.4	10.95	661
0.9b	18.9	0.4	10.48	661				
1.00					19.0	0.4	10.80	661
1.25					18.8	0.4	10.26	667
1.50					18.7	0.4	10.51	671
1.75					18.7	0.4	10.50	670
2.00					18.7	0.4	10.12(108)	664
2.25b					18.7	0.4	8.81	663
	Railroad Trestle			1528 hr	**Mouth of Noble Gulch**			1503 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	19.3	0.4	10.62	664	19.5	0.4	10.84	663
0.25	19.3	0.4	10.42	664	19.4	0.4	10.70	662
0.50	19.3	0.4	10.33	664	19.3	0.4	10.49	657
0.75	19.2	0.4	10.31	663	19.3	0.4	10.39	658
1.00	19.2	0.4	10.77(115)	663	19.2	0.4	10.22(109)	657
1.25b	19.0	0.4	12.05	663	18.5	0.4	10.57	651
	Nob Hill			1645 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**
	18.5	0.3	10.98(105%)	598				

Station 1: Flume 1606 hr. Air temp. = 18.1 C. Reach 1- 74 gulls bathing (Western and Hermann's). 10 mallards adjacent Margaritaville, 4 paddle boarders, 1 canoe. No surface algae in lagoon. Too dark to see bottom aquatic vegetation in lagoon due to cloudiness.
Station 2: Stockton Bridge 1548 hr. Reach 2- 3 mallards, 1 paddle boarder.
Station 3: Railroad trestle 1528 hr. Reach 3- 4 mallards, 2 coots, 1 gull, 3 paddle boarders, 3 kayaks. 2 steelhead surface hits/ min.
Station 4: Noble Gulch 1503 hr. Air temp. = 21 C. No gray water.
Station 5: Nob Hill at 1645 hr. 1.8 °C cooler water temperature than 2 weeks previous and 0.2-0.7 °C cooler than lagoon near bottom.

16 September 2023. Gage height of 2.73 in morning and afternoon. Overcast and cloudy in morning; overcast and partly cloudy in afternoon. Flume inlet 1.9 ft. Flume outlet 1.1 ft afternoon. Underwater portal now closed. Air temperature was 17.3 C at 0742 hr and 18.6 C in afternoon at flume; 19.3 C at Noble Gulch. Morning oxygen levels poor to good (30% – 100% saturation near the bottom), oxygen concentration higher than 2 weeks previous in morning except at trestle, with cooler water temperatures in the good range near the bottom (17.9-18.1 C). Secchi depth to bottom. Oxygen levels supersaturated in afternoon at all lagoon sites (110-130%) slightly cooler water temperatures compared to 2 weeks previous near the bottom (18.2-18.5 C) in the afternoon.

			16 September-2023					
	Flume			0742 hr	**Stockton Avenue Bridge**			0753 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	9.34	652	18.2	0.4	9.49	650
0.25	18.2	0.4	9.30	652	18.2	0.4	9.50	651
0.50	18.2	0.4	9.41	652	18.2	0.4	9.44	651
0.75	18.1	0.4	9.44(100)	652	18.2	0.4	9.24	651
1.00b	18.2	0.4	8.22	653	18.2	0.4	9.40	651
1.25					18.2	0.4	9.40	650
1.50					18.0	0.4	7.08	649
1.75					17.9	0.4	7.15	648
2.00					17.9	0.4	7.12(74)	647
2.25b					17.9	0.4	6.42	647
	Railroad Trestle			0811 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	18.2	0.4	7.33	652	18.0	0.3	8.51	608
0.25	18.2	0.4	6.27	654	18.0	0.3	8.66	605
0.50	18.2	0.4	6.96	653	18.0	0.3	8.69	597
0.75	18.2	0.4	7.57	653	18.0	0.3	8.67	596
1.00	18.2	0.4	4.91	653	18.0	0.3	8.67(92)	598
1.25b	18.1	0.4	2.89(30)	656	18.0	0.3	7.44	617
1.40b	18.1	0.4	2.89	655				
	Nob Hill			0859 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**
	16.6	0.3	6.06 (61%)	574				

Station 1: Flume 0742 hr. Reach 1- 21 gulls bathing, 2 mallards. No surface algae in lagoon.
Station 2: Stockton Bridge 0753 hr. Reach 2- No waterfowl.
Station 3: Railroad trestle 0811 hr. Reach 3- 2 mallards Intermittent rain sprinkles.
Station 4: Noble Gulch 0827 hr. Slight sheen on water surface; no gray water.
Station 5: Nob Hill at 0859 hr. Slightly cooler water temperature than 2 weeks previous and similar water temperature to lagoon near bottom. Streamflow– 2.43 cfs at Soquel Village gage.

			16 September-2023					
	Flume			1549 hr	**Stockton Avenue Bridge**			1537 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	10.69	655	18.6	0.4	11.15	655
0.25	18.5	0.4	10.77	654	18.6	0.4	11.09	655
0.50	18.6	0.4	10.84	655	18.6	0.4	11.02	655
0.75	18.5	0.4	10.68(113)	654	18.5	0.4	11.50	653
1.00b	18.4	0.4	10.04	653	18.5	0.4	11.26	653
1.25					18.4	0.4	11.66	653
1.50					18.4	0.4	11.11	652
1.75					18.3	0.4	11.12	651
2.00					18.2	0.4	10.76	649
2.25					18.2	0.4	10.30	649
	Railroad Trestle			1517 hr	**Mouth of Noble Gulch**			1502 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	18.7	0.4	10.69	654	18.5	0.4	10.77	649
0.25	18.6	0.4	10.64	654	18.4	0.4	10.55	646
0.50	18.5	0.4	10.83	652	18.5	0.4	10.51	647
0.75	18.4	0.4	10.94	651	18.5	0.4	10.72	644
1.00	18.3	0.4	11.21	649	18.5	0.4	11.31(120)	642
1.25	18.3	0.4	12.26(133)	648	18.4	0.4	10.34(110)	646
1.40b	18.3	0.4	13.10	648				
1.50b					18.0	0.4	5.68	661
	Nob Hill			1625 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**
	18.2	0.4	11.49(122 %)	631				

Station 1: Flume 1549 hr. Air temp. = 18.6 C. flume inlet = 1.9 ft; flume outlet = 1.1 ft. Reach 1- 66 gulls bathing (some Hermann's). 10 mallards, Reach 1- No surface algae in lagoon and too water too dark to see aquatic vegetation. .
Station 2: Stockton Bridge 1537 hr. Reach 2- No waterfowl.
Station 3: Railroad trestle 1517 hr. Reach 3- 2 mallards, 1 coot, Reach 3- 3 paddle boarders.
Station 4: Noble Gulch 1502 hr. Air temp. = 19.3 C. No gray water.
Station 5: Nob Hill at 1625 hr. 0.3 °C cooler water temperature than 2 weeks previous and 0- 0.2 °C cooler than lagoon near bottom.

23 September 2023. Evening Nautical Parade occurred.

30 September 2023. Light showers previous night. Partly cloudy and air temperature of 15.9 C at 0755 hr; partly cloudy, windy and 15 C in afternoon at flume; 17.4 C at Noble Gulch. Gage height of 2.78 in morning and 2.80 in afternoon. Flume inlet 2.0 ft. Flume outlet 1.0 ft in afternoon. Secchi

depth to bottom. Morning oxygen levels critical to good (19% – 97% saturation near the bottom), oxygen similar to 2 weeks previous in morning except very low at the trestle near the bottom. Water temperatures similar to then and in the good range near the bottom (17.5-18.1 °C). Still overcast at 1500 hr. Oxygen levels good in afternoon and with 2 of 4 sites supersaturated (84-154%) near the bottom, with similar water temperatures compared to 2 weeks previous near the bottom (17.7-18.8 °C) in the afternoon.

			30 September-2023					
	Flume			0755 hr	**Stockton Avenue Bridge**			0808 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	18.1	0.4	9.37	660	18.2	0.4	9.27	656
0.25	18.1	0.4	9.33	659	18.2	0.4	9.31	658
0.50	18.1	0.4	9.28	659	18.2	0.4	9.35	656
0.75	18.1	0.4	9.14(97)	659	18.2	0.4	9.22	658
1.00b	18.1	0.4	9.14	645	18.1	0.4	8.24	661
1.25					17.9	0.4	7.54	661
1.50					17.6	0.4	6.71	654
1.75					17.5	0.4	6.63(69)	650
2.00					17.5	0.4	6.61	650
2.25b					17.5	0.4	6.22	652
	Railroad Trestle			0824 hr	**Mouth of Noble Gulch**			0843 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	18.2	0.4	8.58	655	18.0	0.4	8.14	643
0.25	18.2	0.4	8.57	657	18.0	0.4	8.13	645
0.50	18.3	0.4	8.58	657	18.0	0.4	8.09	645
0.75	18.1	0.4	8.29	657	18.0	0.4	8.05	644
1.00	18.1	0.4	6.39	657	18.0	0.4	8.03	640
1.25	17.9	0.4	1.89(19)	659	17.5	0.4	6.47(69)	640
1.45b	17.5	0.4	1.23	659				
147b					17.4	0.4	2.55	656
	Nob Hill			0919 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**
	16.6	0.4	8.11(84%)	621				

Station 1: Flume 0755 hr. Reach 1- 28 gulls in lagoon (Western and Hermann's). No surface algae in lagoon.
Station 2: Stockton Bridge 0808 hr. Reach 2- 1 black-crowned night heron.
Station 3: Railroad trestle 0824 hr. Reach 3- 3 coots, 4 mallards, 1 pied billed grebe.
Station 4: Noble Gulch 0843 hr. No gray water.
Station 5: Nob Hill at 0919 hr. 1.6° C cooler water temp. than 2 weeks previous and 0.9-1.5 °C cooler than lagoon near bottom. Streamflow– 4.65 cfs at Soquel Village gage (Inaccurate due to rock dam).

			30 September 2023					
	Flume			1549 hr	**Stockton Avenue Bridge**			1530 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	18.8	0.4	9.60	665	18.7	0.4	9.95	666
0.25	18.8	0.4	9.71	665	18.7	0.4	9.83	665
0.50	18.8	0.4	9.78	666	18.7	0.4	9.92	664
0.75	18.8	0.4	9.77(105)	665	18.6	0.4	9.82	664
1.00b	18.8	0.4	9.27	664	1.86	0.4	9.82	663
1.25					8.84	0.4	9.96	660
1.50					18.3	0.4	10.18	657
1.75					18.0	0.4	10.25	653
2.00					17.8	0.4	9.07(95)	650
2.25					17.7	0.4	8.01(84)	651
2.35					17.7	0.4	7.32	651
	Railroad Trestle			1514 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	19.0	0.4	10.37	666	19.2	0.4	11.21	667
0.25	19.0	0.4	10.23	667	19.2	0.4	11.54	666
0.50	19.0	0.4	10.21	667	19.0	0.4	13.41	664
0.75	18.9	0.4	10.02	667	18.7	0.4	10.38	655
1.00	18.9	0.4	10.24	667	18.1	0.4	10.67	644
1.25	18.5	0.4	14.34(154)	657	18.1	0.4	10.28(109)	652
1.40b	18.5	0.4	14.84	653				
1.50b					**18.0**	0.4	9.35	667
	Nob Hill			1628 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**
	17.6	0.4	9.86(103 %)	639				

Station 1: Flume 1549 hr. Air temp. = 15.2 °C. Reach 1- 39 gulls bathing (Western and Hermann's). No surface algae in lagoon. Bottom shaded and invisible with partly cloudy sky.
Station 2: Stockton Bridge 1530 hr. Reach 2- No waterfowl in waterl. 7 mallards under Stockton Ave Bridge on concrete surface.
Station 3: Railroad trestle 1514 hr. Reach 3- 1 coot.
Station 4: Noble Gulch 1500 hr. Air temp. = 17.4 C. No gray water.
Station 5: Nob Hill at 1628 hr. 0.6 °C cooler water temperature than 2 weeks previous and 0.1- 1.2 °C cooler than lagoon near bottom.

8 October 2023. Temperature probes retrieved.

14 October 2023. Gage height of 2.65 in morning; 2.76 in the afternoon. Flume inlet 1.7 ft. Flume outlet 0.8 ft (both outlet portals are open. Air temperature of 12.0 C at 0804 hr (partly cloudy); 17.8 C in afternoon at the flume (20.3 C at Noble Gulch; partly cloudy and breezy). Morning oxygen levels good (78% – 115% saturation near the bottom), Oxygen higher than 2 weeks previous in morning, with much cooler water temperatures in the good range near the bottom (15.9-16.4 C). Secchi depth to bottom. Oxygen levels higher in afternoon than morning at all 4 sites in the good range (100-135% saturation) near the bottom. Much cooler water temperatures in the afternoon near bottom compared to 2 weeks previous (16.4-17.1 C).

			14 October-2023					
	Flume			0804 hr	**Stockton Avenue Bridge**			0823 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	16.4	0.4	11.25	633	16.3	0.4	11.05	639
0.25	16.4	0.4	11.29	642	16.4	0.4	11.04	642
0.50	16.4	0.4	11.27	643	16.4	0.4	11.24	642
0.75	16.4	0.4	11.26(115)	643	16.4	0.4	11.15	642
1.00b	16.4	0.4	10.81	643	16.4	0.4	10.95	643
1.25					16.4	0.4	10.82	643
1.50					16.4	0.4	10.84	643
1.75					16.4	0.4	10.77	643
2.00					16.4	0.4	10.77	643
2.25					16.4	0.4	10.59(108)	643
2.37b					16.4	0.4	9.98	643
	Railroad Trestle			0847 hr	**Mouth of Noble Gulch**			0907 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	16.2	0.4	10.24	635	16.1	0.4	10.08	633
0.25	16.2	0.4	10.20	638	16.1	0.4	10.06	633
0.50	**16.2**	0.4	10.22	638	16.1	0.4	10.01	633
0.75	**16.2**	0.4	10.23	638	16.1	0.4	10.00	633
1.00	**16.2**	0.4	10.31	638	16.1	0.4	9.94	633
1.25	16.2	0.4	10.29(104)	638	15.9	0.4	7.76(78)	634
1.33b	16.2	0.4	9.91	638				
1.45b					15.8	0.4	5.40	642
	Nob Hill			0945 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**
	14.3	0.4	10.42(101%)	608				

Station 1: Flume 0804 hr. Reach 1- 3 gulls, 3 mallards, 1 merganser; 1 cormorant, 1 coot and 1 mallard roosting on large wood near restaurants. No surface algae in the lagoon.
Station 2: Stockton Bridge 0823 hr. Reach 2- 2 coots, 5 mallards (3 from Reach 1?).
Station 3: Railroad trestle 0847 hr. Reach 3- 2 coots, 1 cormorant captured a stickleback near tules

under trestle, 4 mallards, 2 mergansers.
Station 4: Noble Gulch 0907 hr. No gray water.
Station 5: Nob Hill at 0945 hr. 2.3°C cooler water temp. than 2 weeks previous and 1.6-2.1 °C cooler than lagoon near bottom. Streamflow– 6.39 cfs at Soquel Village gage (Inaccurate due to rock dam).

				14 October-2023				
	Flume			1558 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	17.1	0.5	7.86	775	17.1	0.5	8.12	773
0.25	17.1	0.5	7.75	774	17.1	0.5	7.84	773
0.50	17.1	0.5	7.58	774	17.1	0.5	7.67	773
0.75	17.1	0.5	7.45	775	17.1	0.5	7.16	774
1.00	17.1	0.5	7.44	775	17.1	0.5	6.19	774
1.13b	17.1	0.5	6.97	774				
1.25					17.0	0.5	6.62	773
1.50					16.9	0.5	6.47	771
1.75					16.9	0.5	5.59 (58)	770
1.87b					16.9	0.5	4.41	771
	Railroad Trestle			1522 hr	**Mouth of Noble Gulch**			1505 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	17.0	0.4	949	768	16.7	0.4	10.41	659
0.25	17.0	0.4	949	768	16.8	0.4	10.20	739
0.50	17.0	0.4	948	767	16.8	0.4	9.96	743
0.75	17.0	0.4	940	767	16.7	0.4	9.40	744
1.00	16.9	0.4	868	765	16.2	0.5	5.10 (52)	759
1.25b	16.7	0.5	681 (70)	768	17.4	0.6	0.12	1040
1.47b	16.7	0.5	5.79	769				
	Nob Hill			1635 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**
	15.4	0.4	8.67 (87)	632				

Station 1: Flume 1558 hr. Air temp. = 17.8 C. Reach 1- 32 gulls bathing, 1 cormorant, 3 paddle boarders, 1 canoe, 2 waders. No surface algae in the lagoon. Bottom invisible due to shade except Station 4.
Station 2: Stockton Bridge 1540 hr. Reach 2- 8 mallards, 4 coots.
Station 3: Railroad trestle 1522 hr. Reach 3- 3 coots. 4 paddle boarders.
Station 4: Noble Gulch 1505 hr. No gray water. 70% bottom algae 2-3 ft thick; avg 2.5 ft. Remainder algal film to 0.2 ft thick.
Station 5: Nob Hill at 1635 hr. 1.3 °C cooler water temperature than 2 weeks previous and 0.2-0.8 C cooler than the lagoon near the bottom.

19 October 2023. Tidal overwash occurred along Venetian wall. Kotilla removed 1 board from either side of the flume inlet.

20 October 2023. Light penetration to lagoon bottom reported by Kotilla.

			21 October-2023					
	Above Stockton Bridge			0927 hr	**Below Stockton Avenue Bridge**			0957 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	15.9	0.5	9.83	763	16.0	0.4	10.23	723
0.25	15.9	0.5	9.89	760	15.8	0.4	10.07	719
0.50	15.9	0.5	9.88	762	15.8	0.4	9.91	713
0.75	16.0	0.5	9.83	774	15.8	0.4	10.37	716
1.00	16.3	0.5	8.41(86)	801	16.2	0.6	8.71	1074
1.25b	18.2	5.5	1.32	8481	18.2	4.4	8.39(89)	7038
1.50					18.3	6.0	0.69	9227
1.75					18.3	7.1	0.38	10860
2.00b					17.8	8.6	0.30	12661
	Railroad Trestle			0944 hr	**Mouth of Noble Gulch**			1505 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	9.38	695				
0.25	15.6	0.4	9.32	693				
0.50	15.6	0.4	9.36	693				
0.75	15.6	0.4	9.39(94)	696				
1.00	16.7	0.6	9.29	929				
1.25b	18.3	4.3	1.45	6779				
	Nob Hill							
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**

21 October 2023. Gage height 2.28. Secchi depth to bottom above Stockton Bridge. Dilute saline layer located 1.25 m from surface to the bottom. Loss of oxygen in this layer. Water temperature elevated slightly in saline layer but well within salmonid tolerance. Most of lagoon upstream of trestle is 1.25-1.5 m deep and having good oxygen and temperature levels except near the bottom. No need to remove more flume inlet boards and would reduce steelhead habitat if done so. Light penetration to bottom over most of the lagoon and would gain nothing in reducing lagoon depth. Steelhead had opportunity to avoid deeper pockets with low oxygen and use shallower habitat. Recommended leaving lagoon level the same and installing a shroud on flume inlet.

22 October 2023. One shroud was installed on the flume inlet.

28 October 2023. Shroud in place. Gage height of 2.55 in morning and afternoon. Flume inlet 1.8 ft. Flume outlet 0.6 ft with both outlet portals open. Air temperature of 7.7 C at flume at 0816 hr and clear sky. Air temperature in afternoon 14 C at flume and 16.4 C at Noble Gulch under clear, breezy sky. Morning oxygen levels rated fair to good (69% – 99% saturation down to 1.25 m) depleted below 1.25m to critical level (15% saturation) and slightly lower than 2 weeks previous. Much cooler water temperatures except in the deep saline pocket at Venetian wall, but in the good range near the bottom at all sites (13.6-18.9 C). Secchi depth to 1.75 m. Afternoon oxygen supersaturated near the bottom except in deep Venetian Wall pocket (up to 115% saturation). Cooler afternoon

water temperatures down to 1.00 m but warmer below 1.25 m compared to 2 weeks previous near bottom (14.0-19.0 C).

			28 October-2023					
	Flume			0816 hr	**Stockton Avenue Bridge**			0832 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	13.6	0.5	9.03	733	13.6	0.5	10.38	757
0.25	13.5	0.5	9.00	735	13.6	0.5	10.38	759
0.50	13.5	0.5	9.00	733	13.6	0.5	10.45	761
0.75	13.5	0.5	9.00	734	13.6	0.5	10.37	770
0.90b	13.5	0.5	9.02 (86)	733				
1.00				733	13.7	0.5	10.19	808
1.25					18.1	0.7	9.83	1021
1.50					18.2	2.8	10.27(110)	4598
1.75					19.7	5.2	0.46	8359
2.00					18.9	5.8	0.37	9188
2.15b					18.5	6.8	0.36	10348
	Railroad Trestle			0854 hr	**Mouth of Noble Gulch**			0910 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	13.6	0.5	9.98	792	13.1	0.5	10.38	638
0.25	13.7	0.5	9.90	797	13.1	0.5	10.32	638
0.50	13.7	0.5	9.89	815	13.1	0.5	10.38	639
0.75	13.7	0.5	9.93	804	13.1	0.5	10.29	640
1.00	13.8	0.5	9.89	822	13.7	0.5	9.04	7.42
1.25	14.7	0.5	7.07(69)	884	16.4	1.1	6.04(62)	1744
1.37b	17.0	1.5	1.17	2501	17.7	3.0	1.45(15)	4765
	Nob Hill			0945 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**
	12.0	0.4	11.23 (103)	561				

Station 1: Flume 0816 hr. Reach 1- 93 gulls. Shroud in place. No surface algae in the lagoon.
Station 2: Stockton Bridge 0832 hr. Reach 2- No waterfowl.
Station 3: Railroad trestle 0854 hr. Reach 3- 7 coots, 10 mallards, 2 pied-billed grebes.
Station 4: Noble Gulch 0910 hr. No gray water. Late senescence of cottonwoods across from Gulch.
Station 5: Nob Hill at 0945 hr. 4.3 °C cooler water temp. than 2 weeks previous and 1.6-6.9 °C cooler than lagoon near bottom. Streamflow–5.67 cfs at Soquel Village gage (Inaccurate due to rock dam).

7 November 2023. The shroud was removed along with 2 flashboards from the east side and 1 flashboard from the west side of the flume inlet.

				28 October-2023				
	Flume			1557 hr	**Stockton Avenue Bridge**			1541 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	15.2	0.7	10.32	1120	14.8	0.6	10.09	915
0.25	15.2	0.7	10.21	1116	14.8	0.6	9.97	942
0.50	15.2	0.7	10.28	1102	14.8	0.6	10.04	909
0.75	15.2	0.8	10.45(104)	1317	14.8	0.6	10.04	904
0.90b	15.1	0.8	10.30	1267				
1.00					14.8	0.6	10.09	931
1.25					16.2	1.4	9.47	2179
1.50					18.1	3.6	10.56	5695
1.75					20.0	5.5	0.24	8804
2.00					19.0	5.9	0.27	9244
2.12b					18.6	6.7	0.23	10287
	Railroad Trestle			1523 hr	**Mouth of Noble Gulch**			1502 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	14.3	0.5	10.36	679	14.5	0.4	11.08	679
0.25	14.3	0.5	10.17	642	14.3	0.4	10.28	692
0.50	14.3	0.5	10.09	693	14.3	0.4	10.19	693
0.75	14.3	0.5	10.15	691	14.2	0.4	10.89	691
1.00	14.3	0.5	10.19	716	14.0	0.4	10.23	716
1.25	14.8	0.6	11.76(116)	774	14.0	0.5	10.09(98)	774
1.37b	16.0	0.8	24.26??	863	15.9	0.5	8.15	863
	Nob Hill			1634 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**
	14.2	0.4	10.89 (104%)	596				

Station 1: Flume 1557 hr. Air temp. = 14 C. Reach 1- 37 gulls bathing, 4 mallards 1 cormorant. No surface algae in the lagoon. Bottom invisible due to shading at Stations 1-3.
Station 2: Stockton Bridge 1541 hr. Reach 2- 2 mallards in water initially, later a total of 10 mallards on bulkhead west side and none in water.
Station 3: Railroad trestle 1523 hr. Reach 3- 3 mallards in water and 3 mallards on emergent log across from Noble Gulch west side, 6 coots, 1 pied-billed grebe.
Station 4: Noble Gulch 1502 hr. Gray water present. 100% bottom algae 1 ft thick.
Station 5: Nob Hill at 1634 hr. 2.1 °C cooler water temperature than 2 weeks previous and 0.6-4.6 C cooler than the lagoon near the bottom at Stations 1-3; 0.2 C warmer than at Station 4 near bottom.

6 November 2023. Low turbidity and secchi depth to bottom above Stockton Bridge. Notch had been cut in the beach.

7 November 2023. Public Works had removed shroud. 2 boards removed from flume inlet on restaurant side and 1 board removed on Venetian Court side in preparation for predicted rain and stormflow.

11 November 2023. It was high tide in the morning with backwash into the flume. Gage height of 2.53 in morning and 2.49 in afternoon. Flume inlet 1.3 ft. Flume outlet 0.7 ft with both outlet portals open at low tide in afternoon. Air temperature of 7.0 C at flume at 0720 hr (off daylight saving time) and 13.2 C at flume; 16.6 C at Noble Gulch. With clear sky all day. Morning oxygen levels rated good (78% – 85% saturation down to 1.50 m from surface). Oxygen depleted below 1.5 m due to stagnant saline layer. Morning oxygen concentrations slightly lower than 2 weeks previous, with cooler water temperatures and in the good range near the bottom at all sites (11.3-16.3 C). Secchi depth to near the bottom (1.75 m) except in deeper pockets like Venetian Wall and to the bottom elsewhere. Afternoon oxygen near or supersaturated at 3 sites near the bottom and at Site 2 down to 1.5 m, with depletion below that. Much cooler afternoon water temperatures near the bottom compared to 2 weeks (12.1-16.7 C).

			11 November 2023					
	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	11.9	0.4	9.40	646	12.0	0.4	9.13	646
0.25	11.9	0.4	9.33	647	12.0	0.4	9.05	646
0.50	11.9	0.4	9.32	647	12.0	0.4	9.10	647
0.75	11.9	0.4	9.26(85)	648	12.0	0.4	9.08	646
0.87b	11.9	0.4	9.08	648				
1.00					12.0	0.4	9.01	645
1.25					12.0	0.4	9.02	644
1.50					12.2	0.4	8.92	662
1.75					16.3	2.5	1.45	3878
2.00					18.4	4.1	0.44	7291
	Railroad Trestle			0754 hr	**Mouth of Noble Gulch**			0809 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	11.7	0.4	8.62	610	11.3	0.4	8.62	574
0.25	11.7	0.4	8.53	611	11.3	0.4	8.49	576
0.50	11.7	0.4	8.51	612	11.3	0.4	8.55	576
0.75	11.7	0.4	8.50	612	11.3	0.4	8.55	575
1.00	11.7	0.4	8.59	611	11.3	0.4	8.53(77)	576
1.25b	11.7	0.4	8.55(78)	610	16.4	0.4	7.85	576
1.37b	11.7	0.4	7.15	618				
	Nob Hill			0837 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**
	10.3	0.4	9.25(82%)	550				

Station 1: Flume 0720 hr. Off daylight savings time. Reach 1- 1 gull. No surface algae in the lagoon.
Station 2: Stockton Bridge 0734 hr. Reach 2- 1 gull, 7 coots.
Station 3: Railroad trestle 0754 hr. Reach 3- 7 coots, 10 mallards in water; 5 roosting on log.

Station 4: Noble Gulch 0809 hr. No gray water.
Station 5: Nob Hill at 0837 hr. 3.9 °C cooler water temperature than 2 weeks previous and 1.3-6.3 °C cooler than lagoon near bottom. Streamflow– 2.94 cfs at Soquel Village gage.

			11 November 2023					
	Flume			1552 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	12.8	0.4	12.12	680	12.8	0.4	11.81	648
0.25	12.7	0.4	12.26	682	12.7	0.4	11.63	646
0.50	12.6	0.4	12.61	674	12.6	0.4	11.61	643
0.75	12.6	0.4	12.43(117)	706	12.4	0.4	11.76	639
0.87b	12.6	0.4	11.51	708				
1.00					12.3	0.4	11.75	635
1.25					12.3	0.4	11.79	635
1.50					13.1	0.5	12.12	838
1.75					16.7	3.1	1.74	4860
2.00b					18.4	5.3	0.30	8160
	Railroad Trestle			1517 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	13.4	0.4	11.83	644	12.6	0.4	11.64	587
0.25	13.2	0.4	11.56	639	12.7	0.4	11.64	601
0.50	12.8	0.4	11.68	628	12.5	0.4	11.46	603
0.75	12.6	0.4	12.13	617	12.4	0.4	12.33	604
1.00	12.4	0.4	12.49	615	12.1	0.4	13.68(127)	592
1.25	12.3	0.4	12.72(118)	612	12.1	0.4	11.83	592
1.30b	12.3	0.4	12.73	613				
	Nob Hill			1628 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**
	13.0	0.4	11.9(110 %)	557				

Station 1: Flume 1552 hr. Air temp. = 13.2 C. Reach 1- 57 gulls bathing. No surface algae in the lagoon. Bottom invisible due to shading.
Station 2: Stockton Bridge 1533 hr. Reach 2- 5 mallards and 4 gulls being fed near bridge, 2 coots.
Station 3: Railroad trestle 1517 hr. Reach 3- 2 mallards, 10 coots, 2 brown, female lesser scaups.
Station 4: Noble Gulch 1500 hr. No gray water.
Station 5: Nob Hill at 1628 hr. 1.2 °C cooler water temperature than 2 weeks previous and 0.4-0.9 C warmer than the lagoon near the bottom at Stations 1, 3 and 4; 3.9 C cooler than at Station 2 near bottom.

14 November 2023. Public Works removed 2 more boards from flume inlet.

18 November 2023. At about 0600 hr, Alley was notified by Morrison by phone that a sandbar breaching was imminent. The breaching was facilitated by Kotila with a loader at 0658 hr, with a Soquel Village gage streamflow estimate peaking at 77.4 cfs at 0630 hr and declining to 71.8 cfs at 0700 hr, 2 miles upstream of the lagoon. Surface runoff from Capitola streets added to the gage

estimate. Alley arrived on the beach at 0703 hr, 5 minutes after the breach. The estimated capacity of the flume is between 30 and 35 cfs. Four boards had previously been removed from the flume inlet to facilitate water passage through the flume. The lagoon water surface had increased to the original restaurant piling bolt at the time of the breach and declined to 2 inches below the bolt by 0706 hr. The management goal is to breach the lagoon if it reaches this bolt. No flooding into streamside properties occurred. Water spilled over the bulkhead at Stockton Bridge. The beach was flagged with caution tape on either side of the outlet channel. However, before this occurred, 4 teenage surfers approached the outlet channel to surf its standing waves. Public Works staff stopped them and successfully turned them away. The water sample required by the Water Resources Control Board was collected by Kotila. The sandbar was now open for the wet season.

APPENDIX B. 2023 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2023 DRAIN LINE STATIC PRESSURE TESTS FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK

RESTAURANT	NOTIFICATIONS	TEST DATE	COMMENTS	BUILDING PERMIT SIGN OFF
MY THAI BEACH **207 Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Pronpimol Suwonsupar Pinky2503@hotmail.com	4/8/22 1st letter sent email & 1st Class mail	2/7/2023		
BAY BAR **209-B Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Patrick & Mike Lynn Patricklynn11@gmail.com	4/8/22 1st letter sent email & 1st Class mail	2/7/2023		
PIZZA MY HEART **209-A Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com	4/8/22 1st letter sent email & 1st Class mail	2/7/2023		
SAND BAR **211 Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Jeff Lantis thesandbarcapitola@gmail.com	4/8/22 1st letter sent email & 1st Class mail	2/7/2023		
PARADISE BAR & GRILL **215 Esplanade** Owner: Esplanade Properties Manager: Bob Coe controller@paradisebeachgrille.com	4/8/22 1st letter sent email & 1st Class mail	1/26/2023		
ZELDA'S **203 Esplanade** Owner: Jill Ealy Jealy7@ao.com j.whitby@hotmail.com zelonbeach@aol.com	4/8/22 1st letter sent email & 1st Class mail	2/7/2023		

APPENDIX C. Hydrographs for USGS 11160000 Soquel Creek Stream Gage at Soquel, CA; Water Years 2007−2023.

Figure 1. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2023.

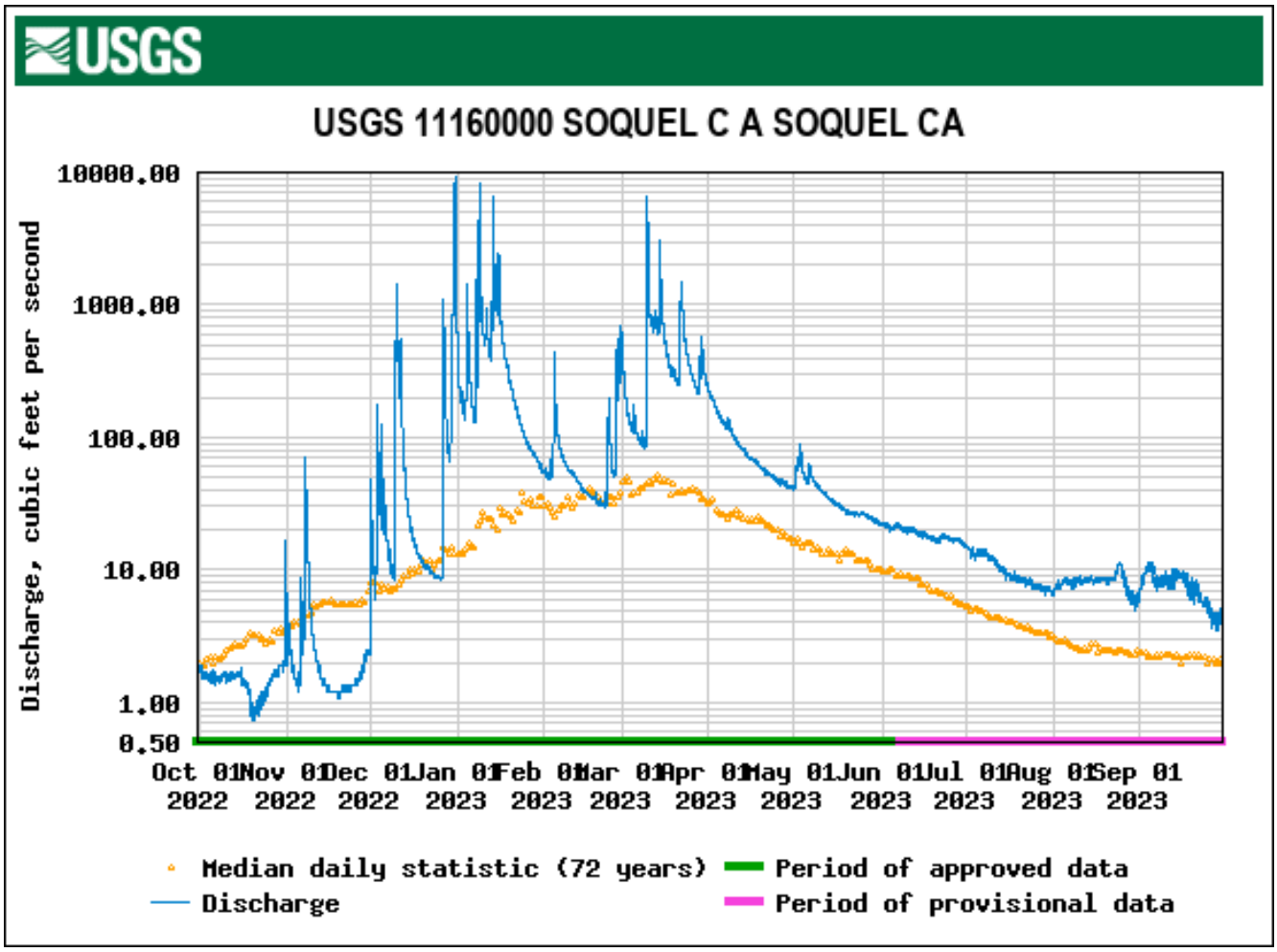


Figure 2. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2023.

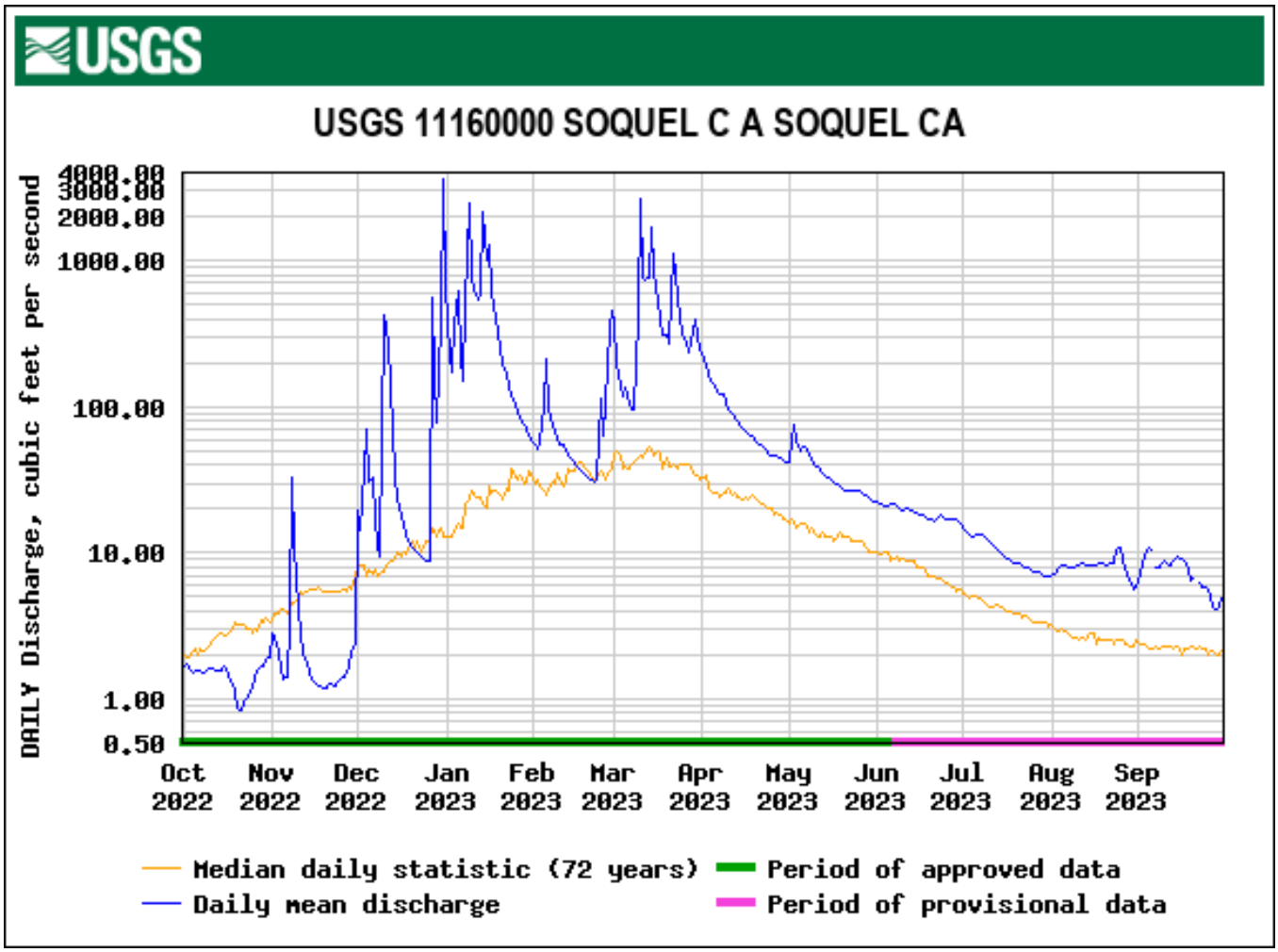


Figure 3. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2022.

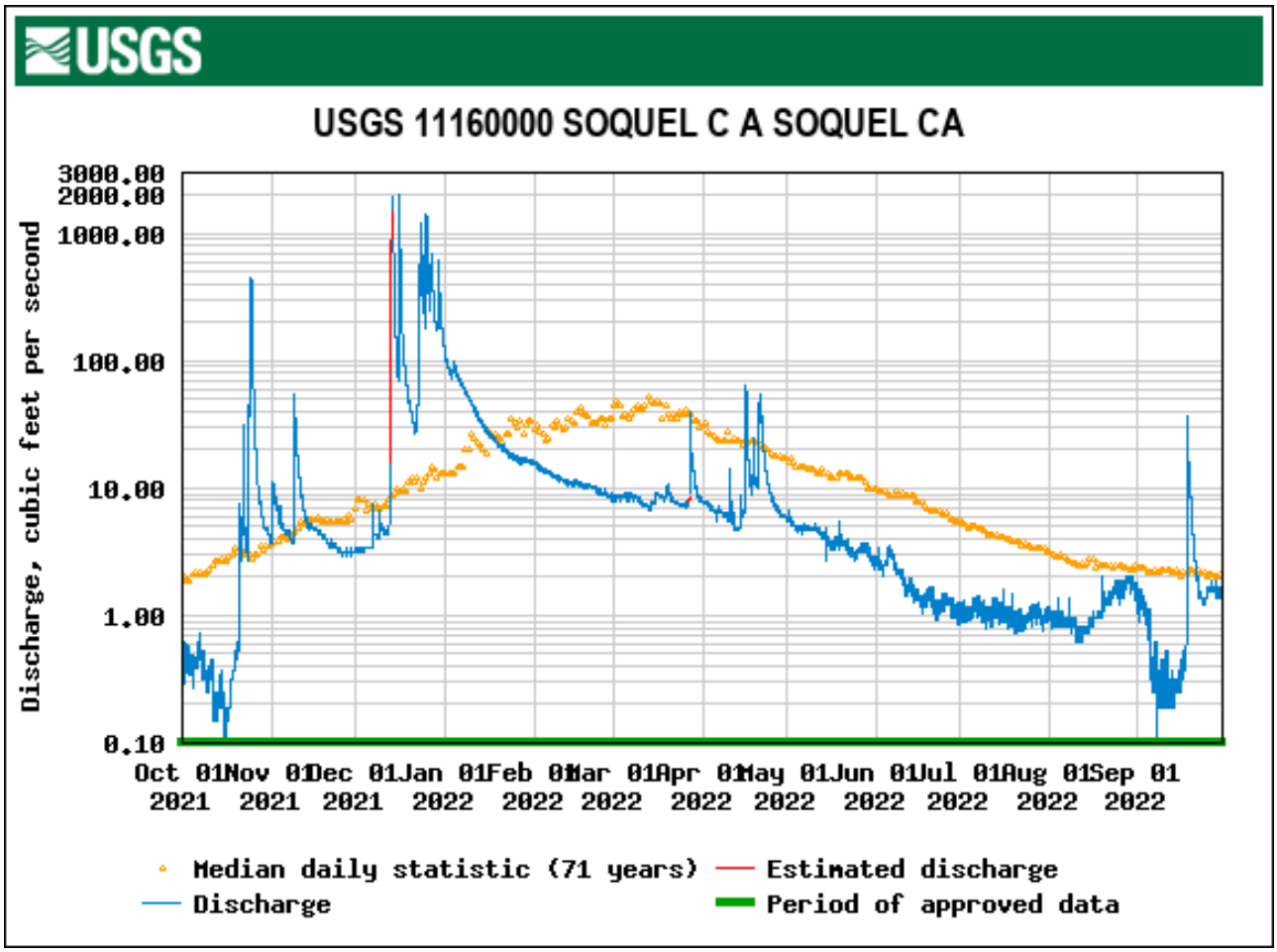


Figure 4. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2022.

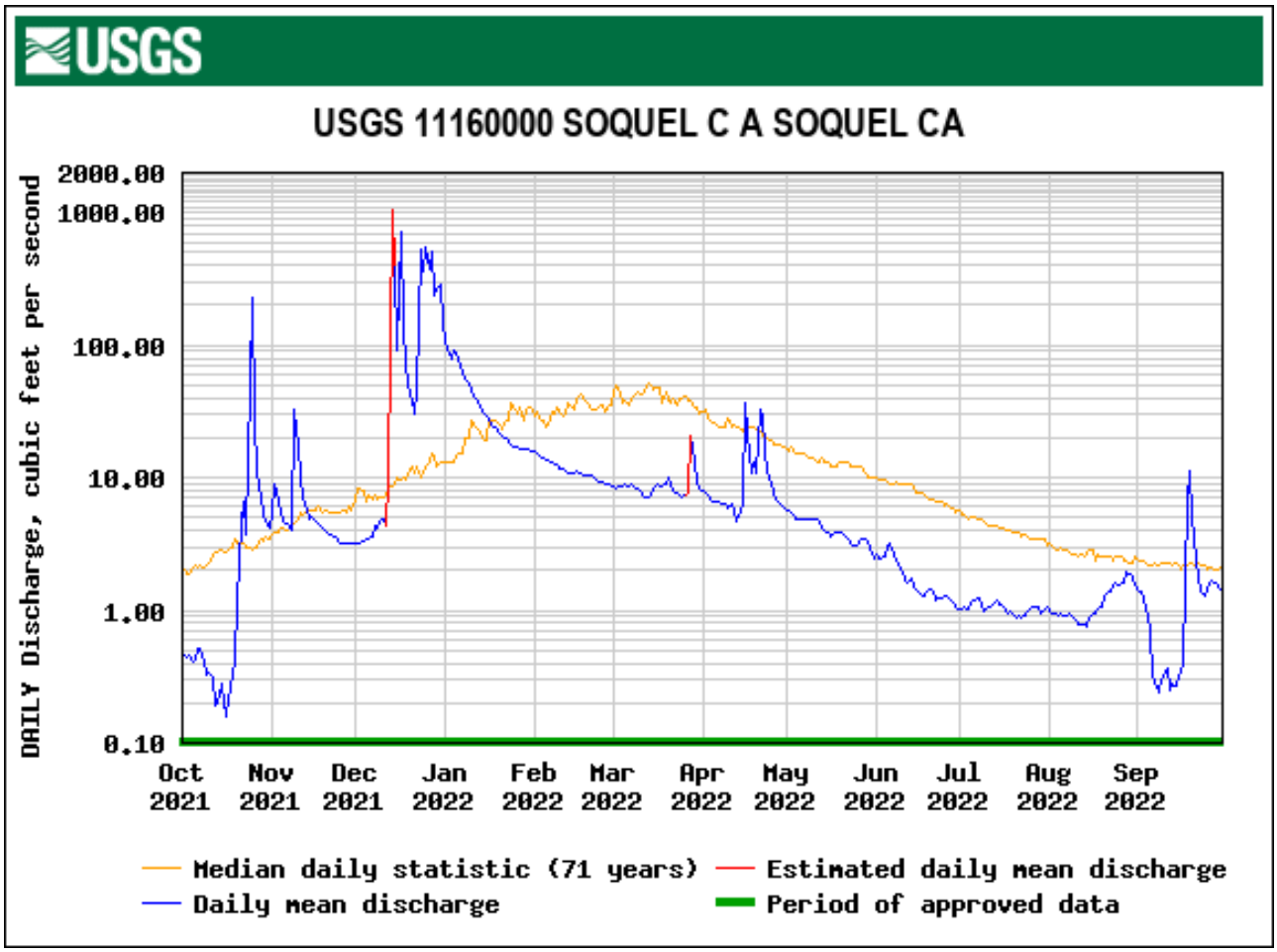


Figure 5. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2022 – 20 November 2022.

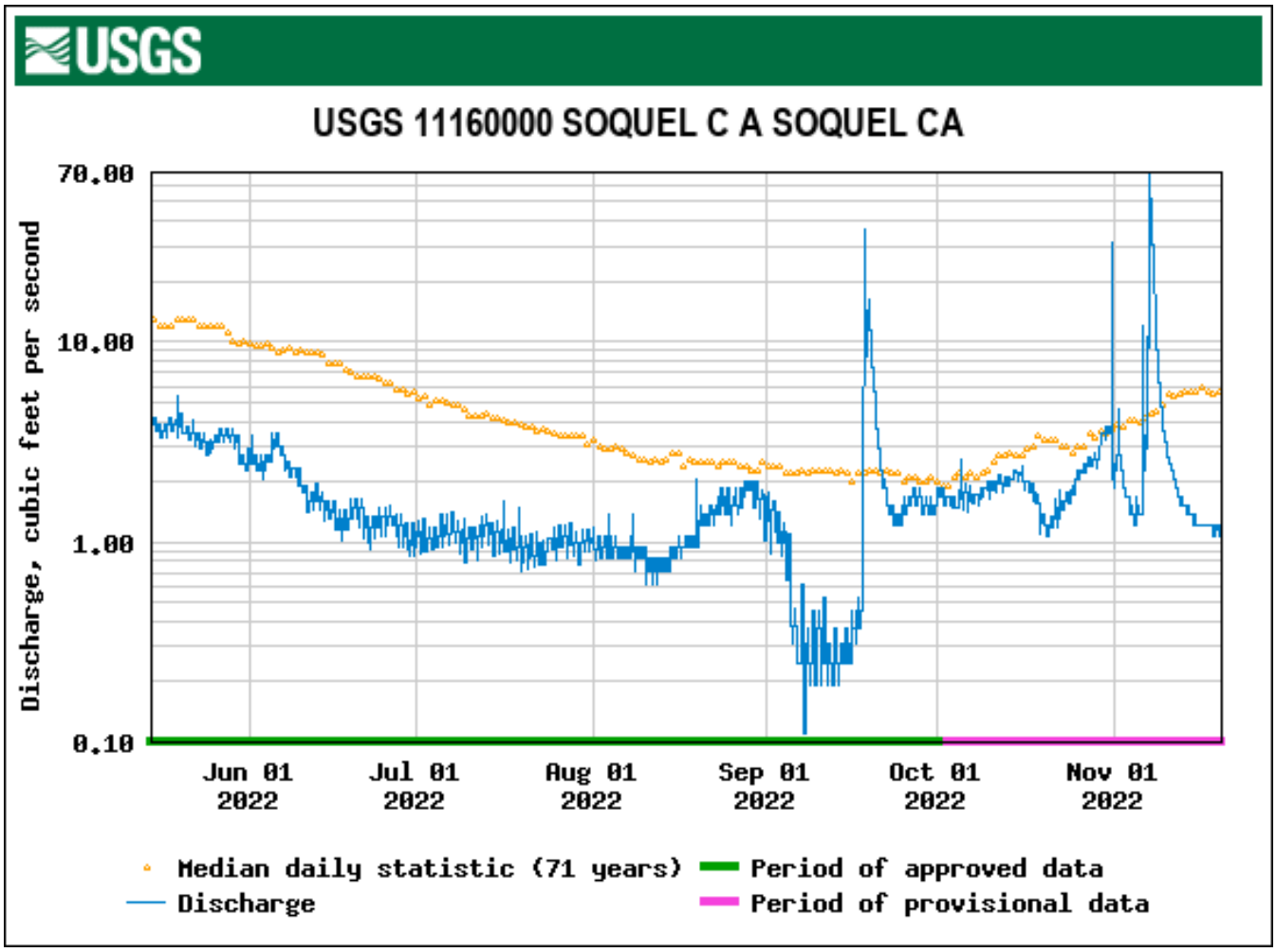


Figure 6. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2021.

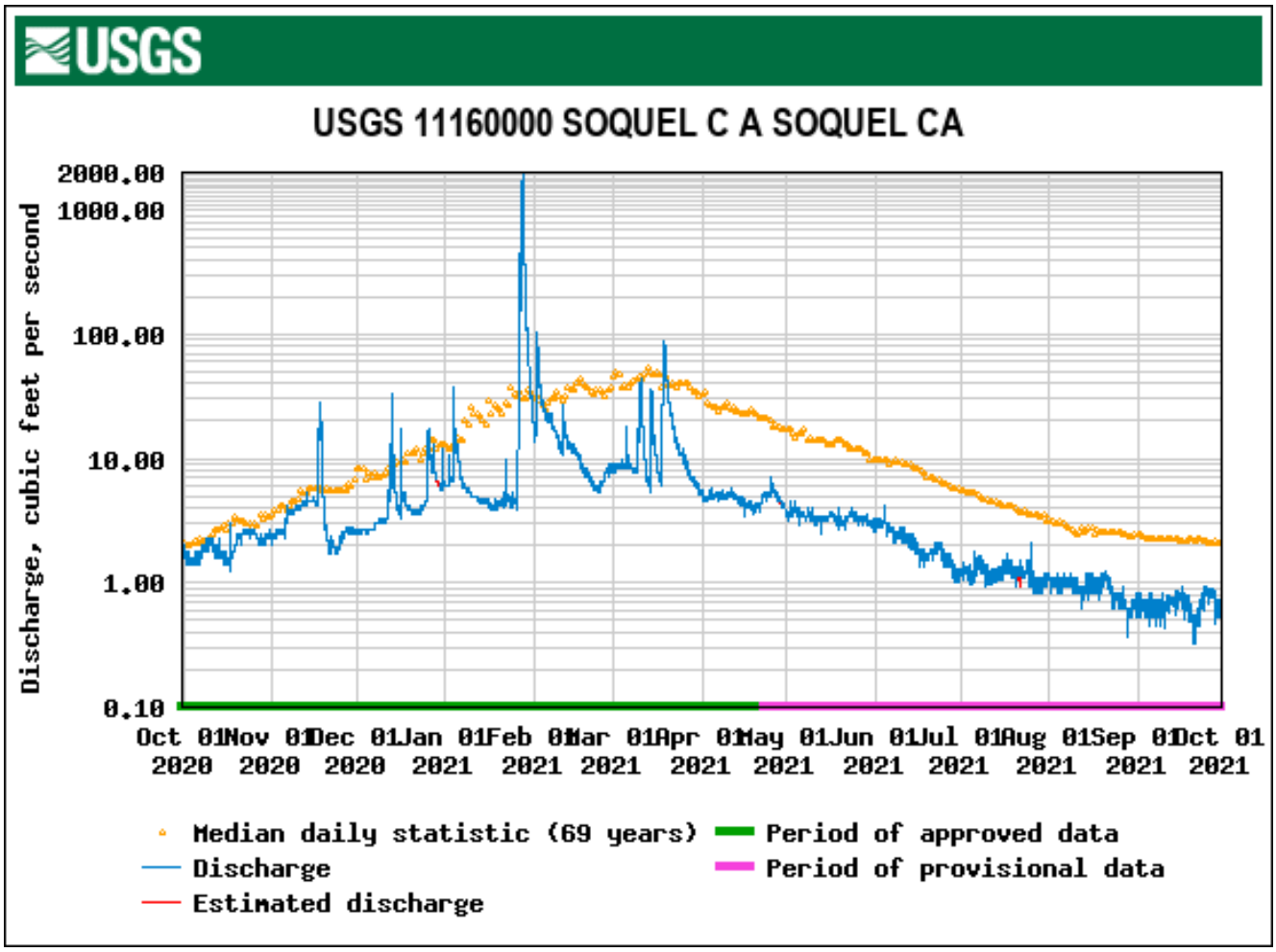


Figure 7. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2021.

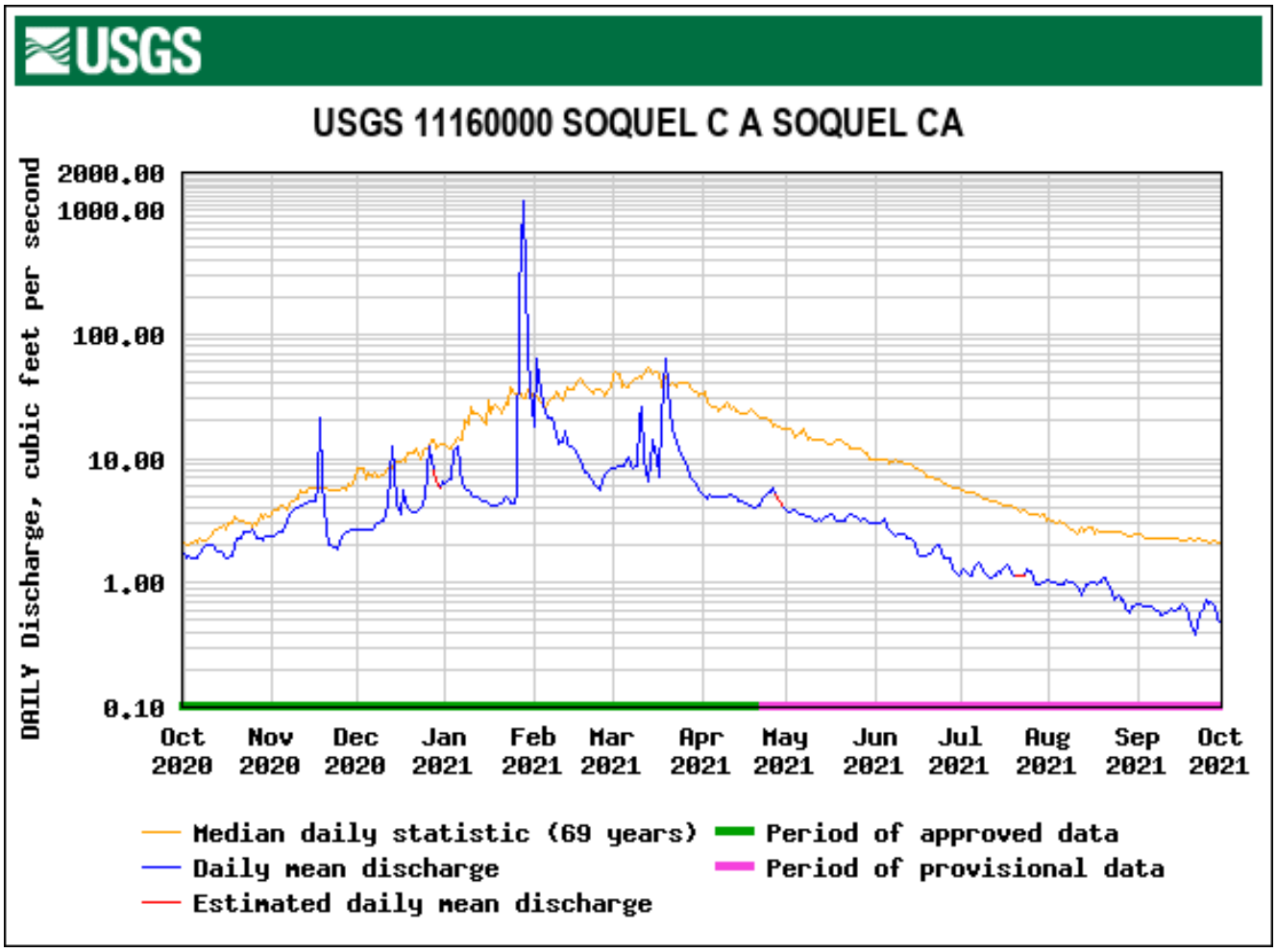


Figure 8. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 24 May 2021 – 25 October 2021.

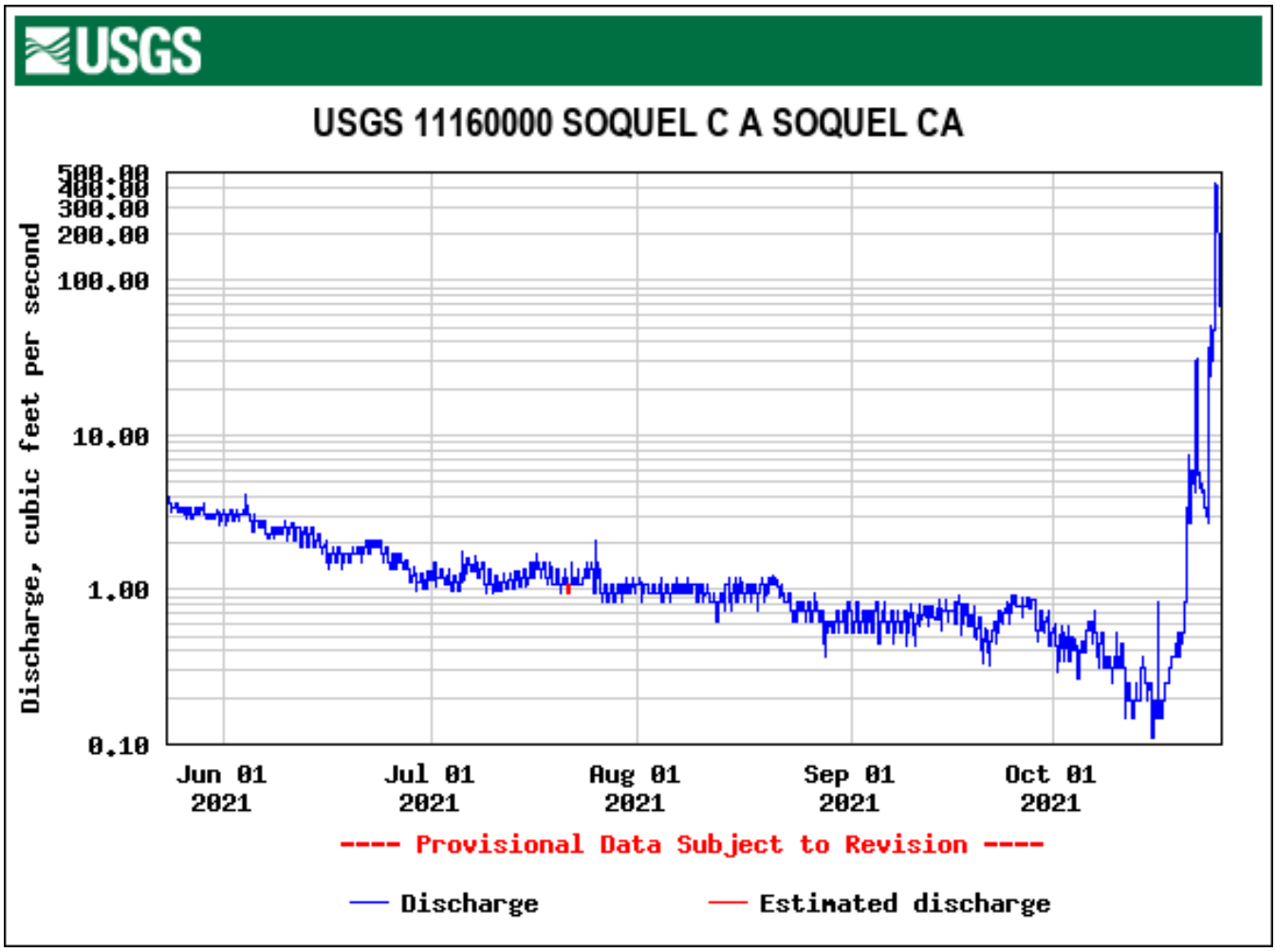


Figure 9. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2020.

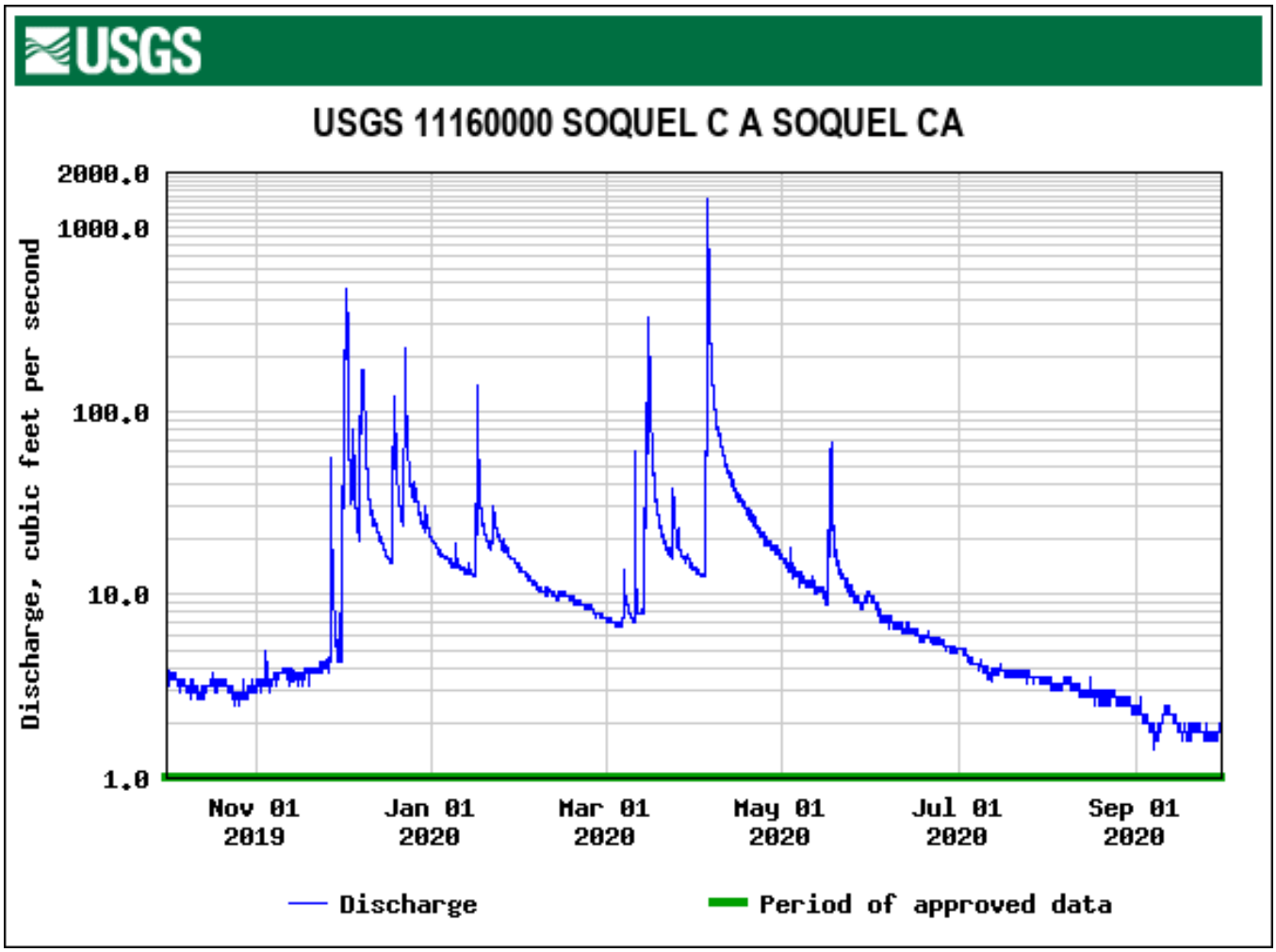


Figure 10. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2020.

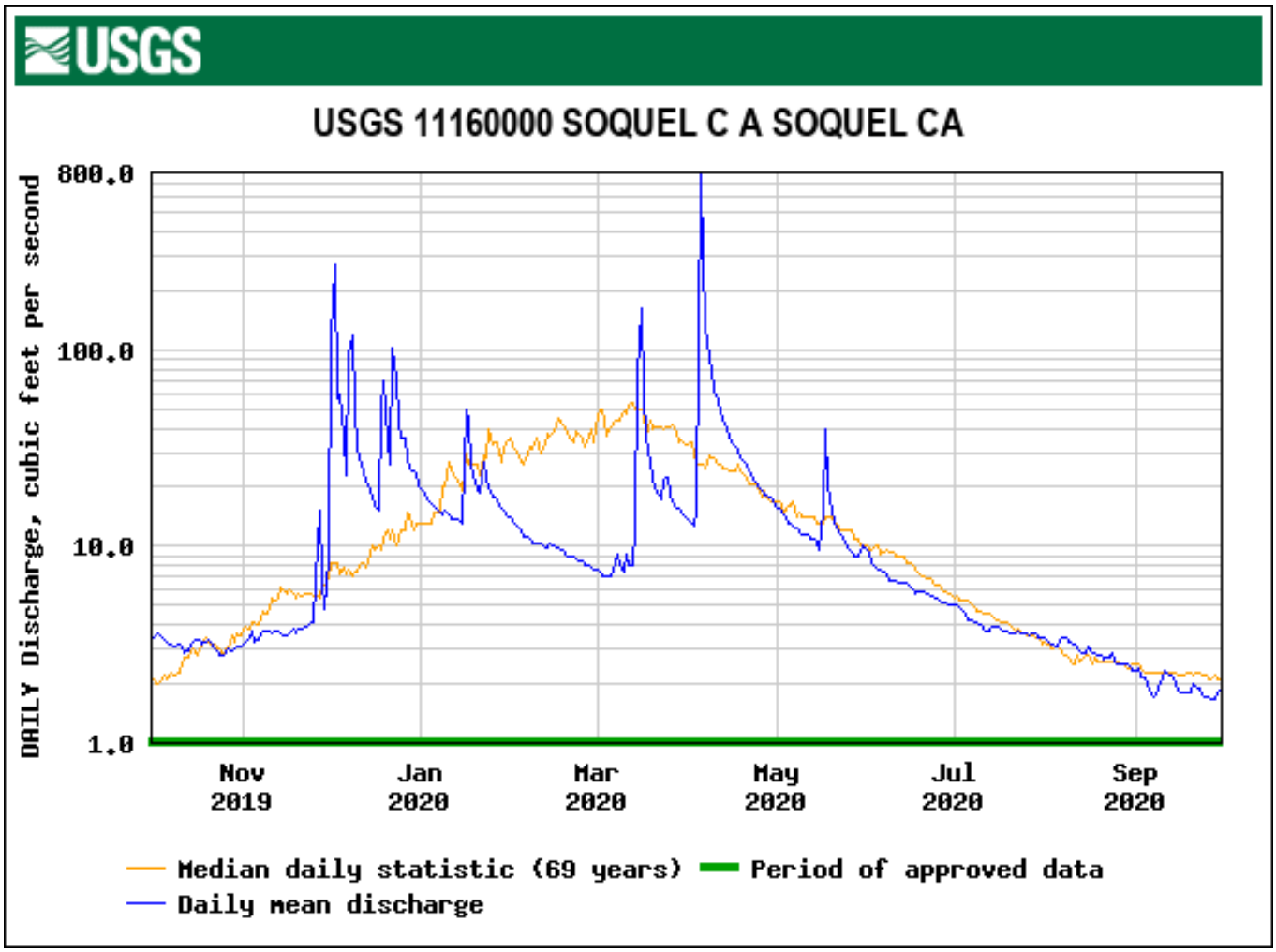


Figure 11. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2020– 1 February 2021.

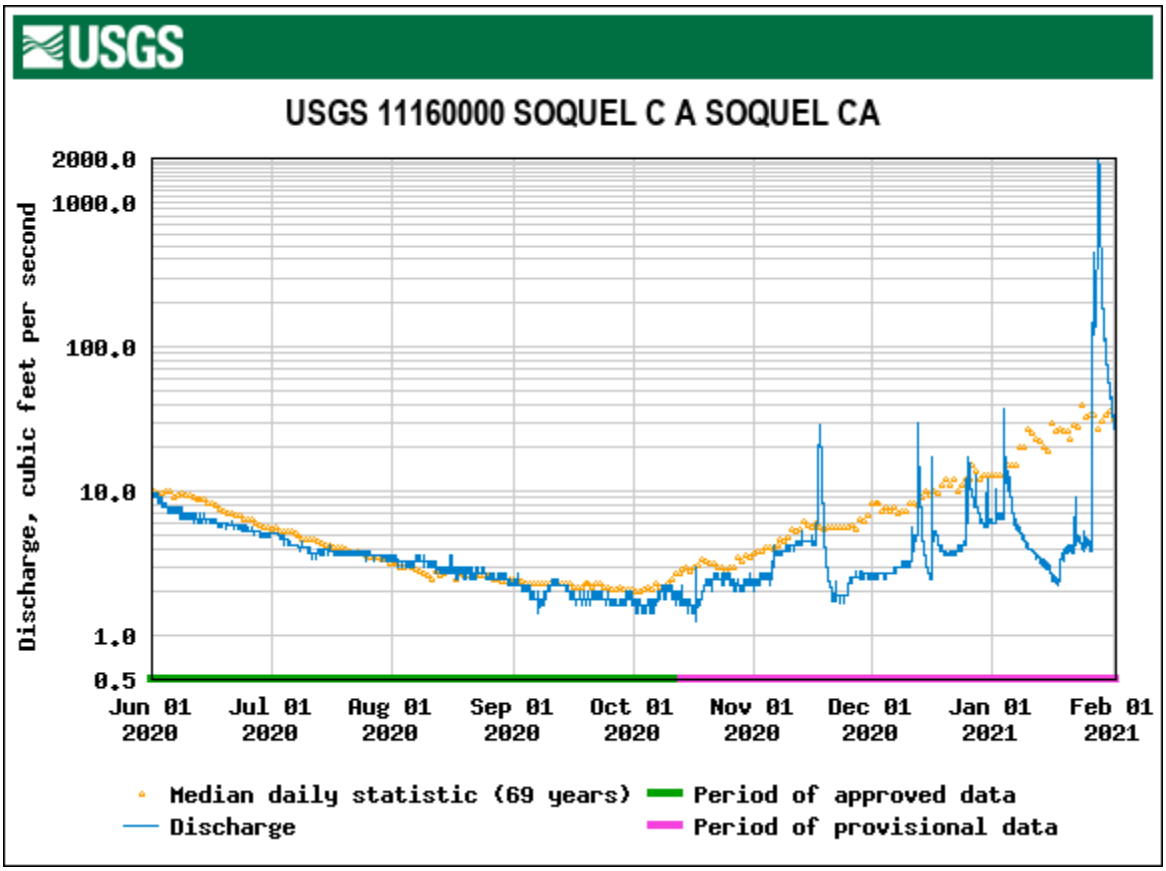


Figure 12. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

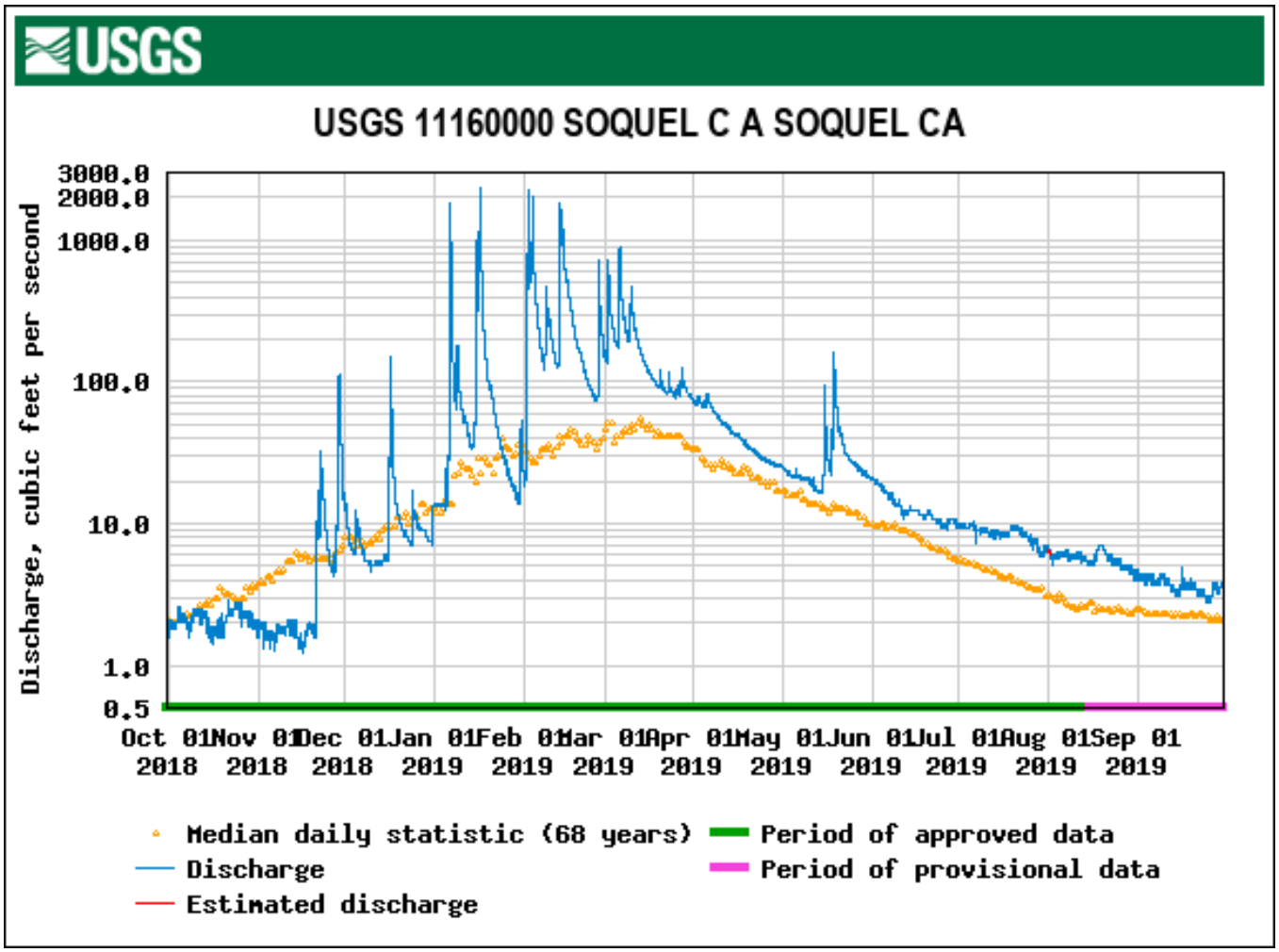


Figure 13. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

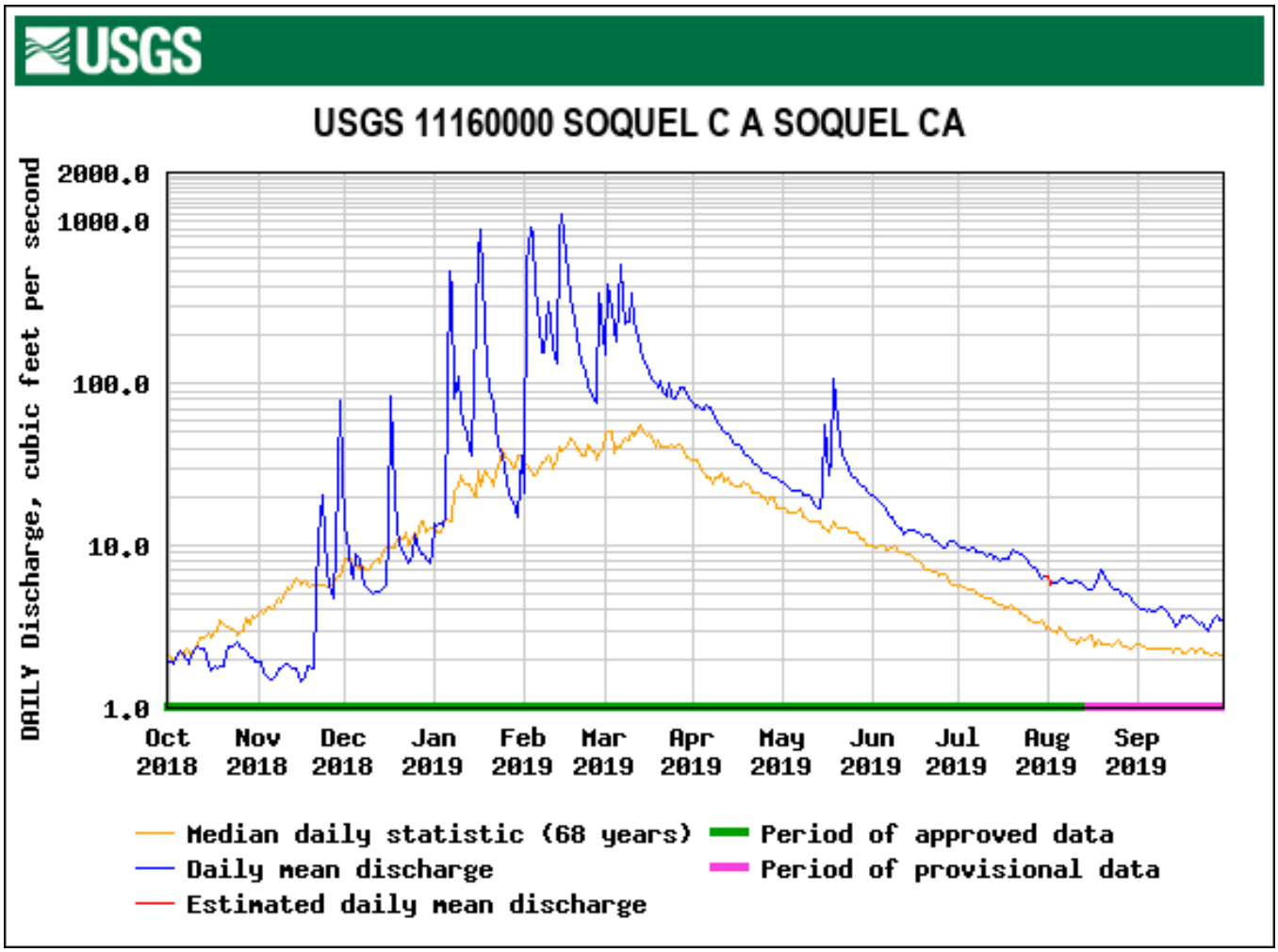


Figure 14. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May – 9 December 2019.

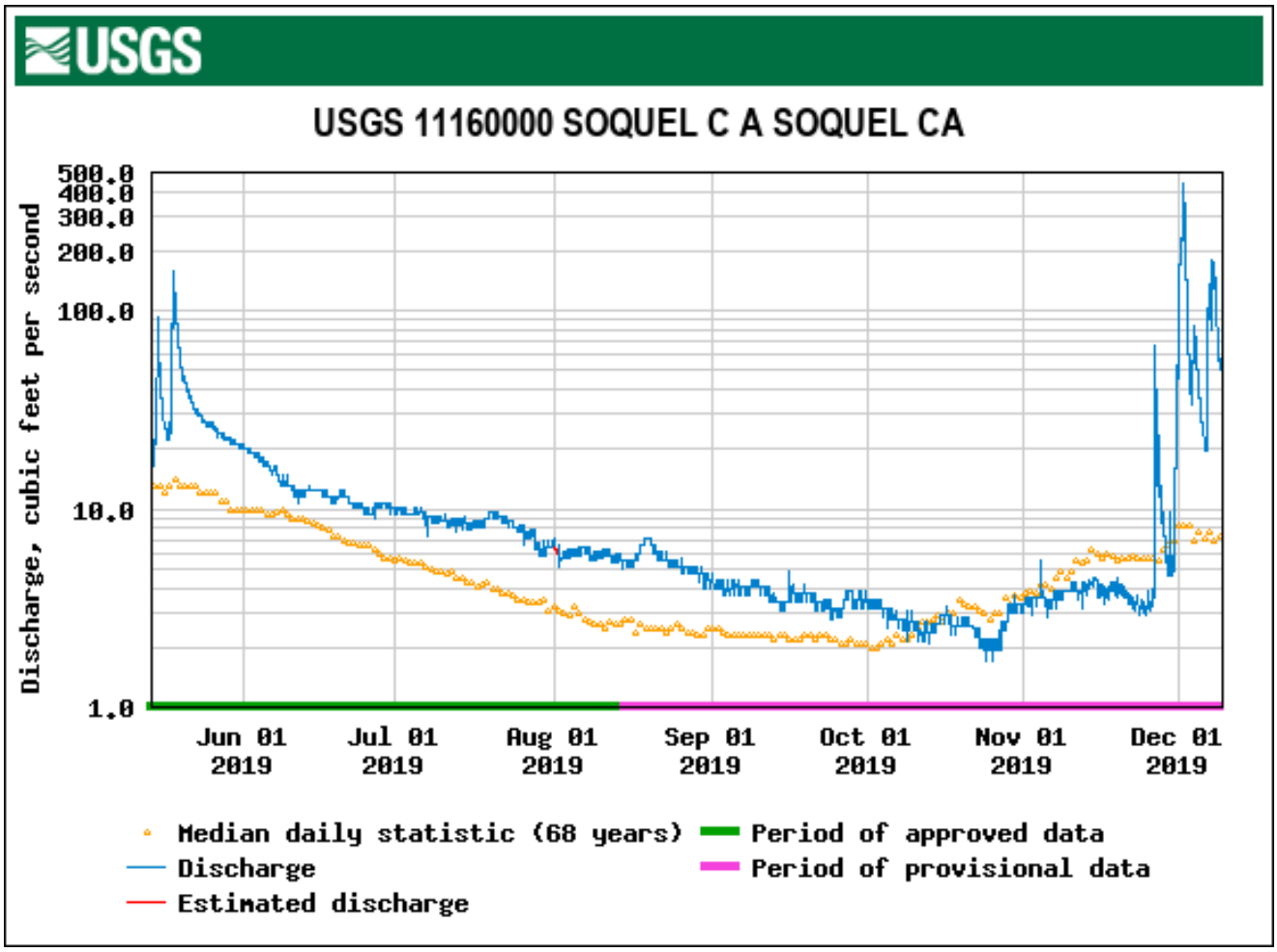


Figure 15. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

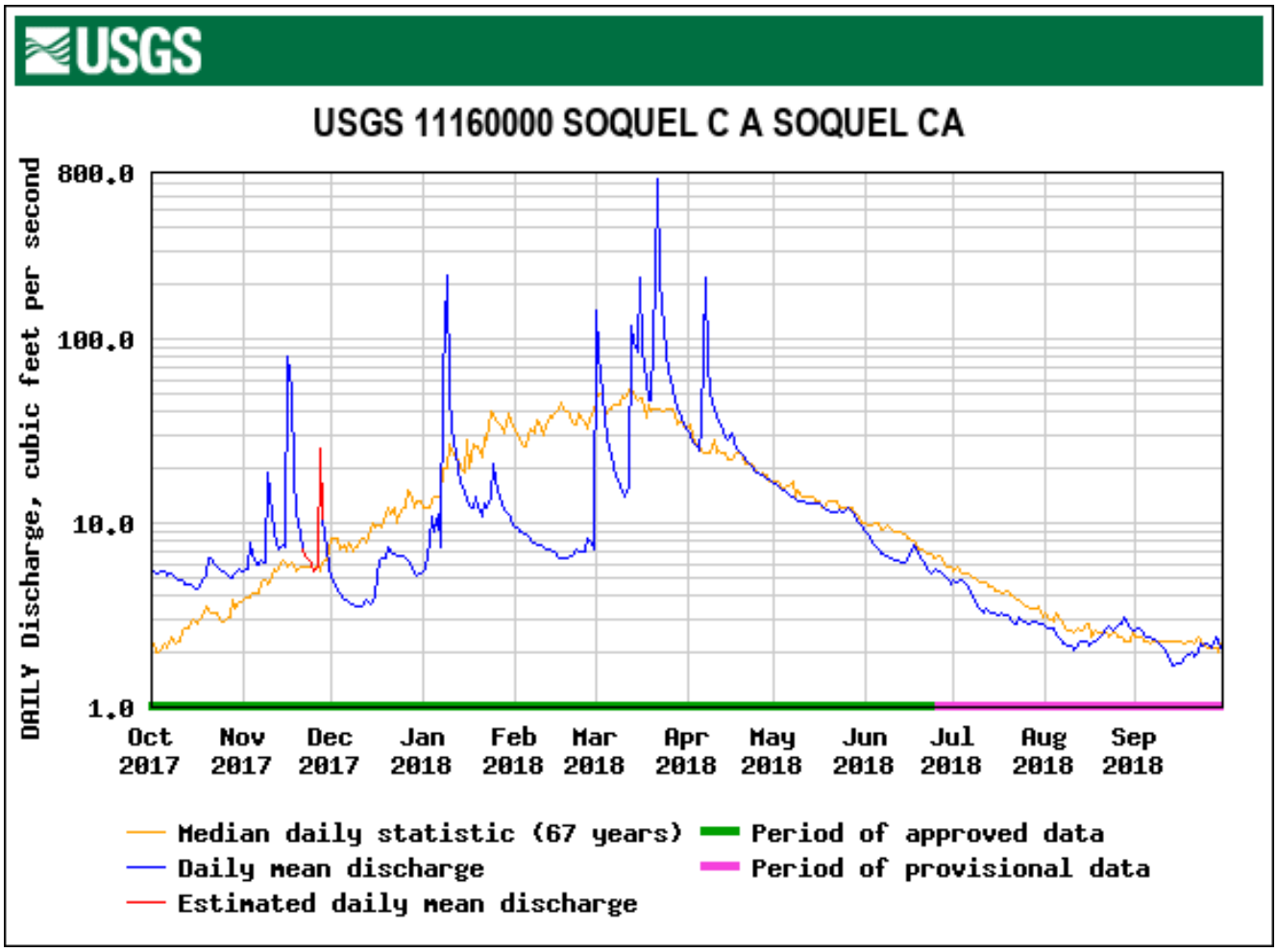


Figure 16. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

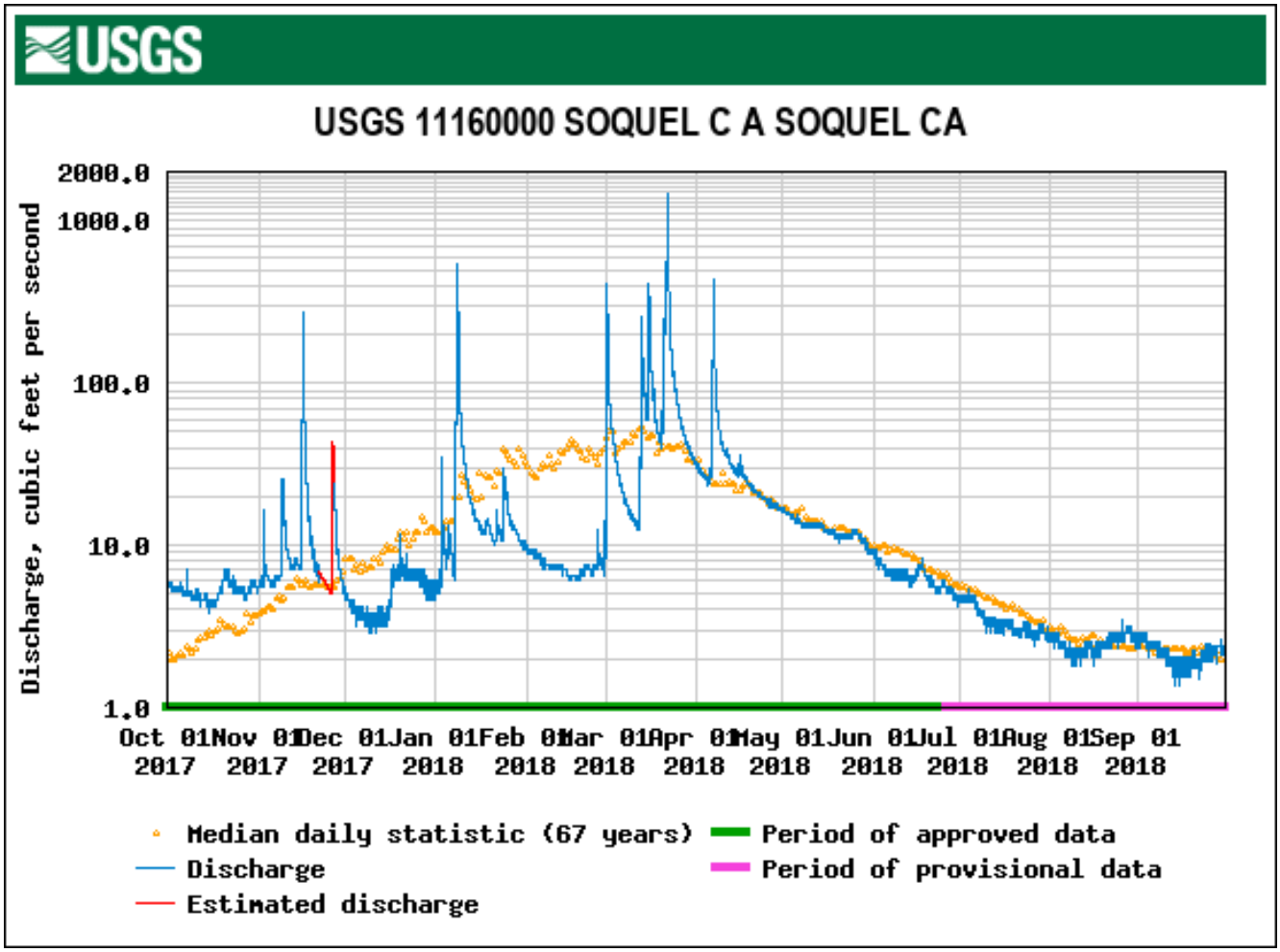


Figure 17. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 1 December 2018.

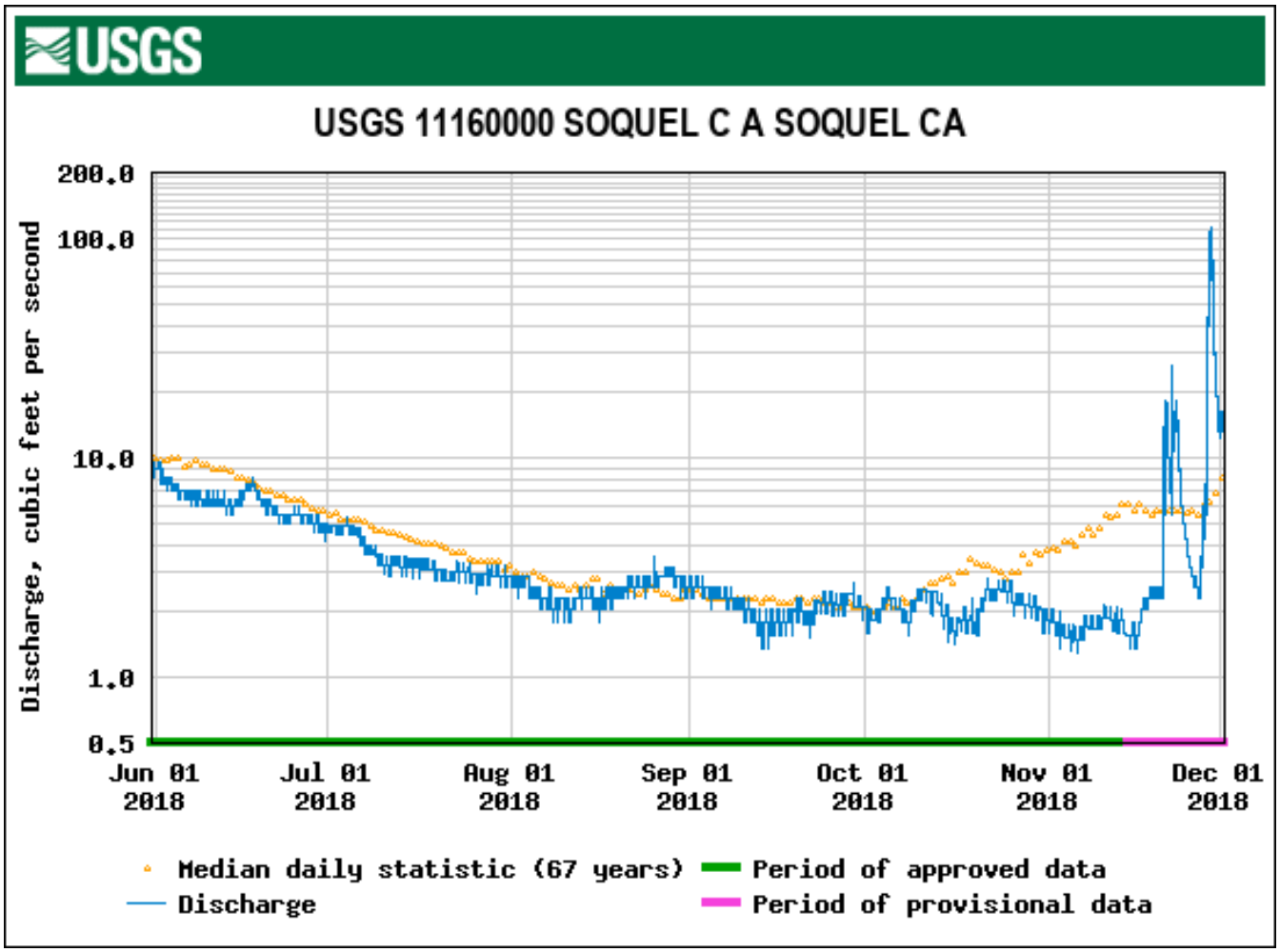


Figure 18. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

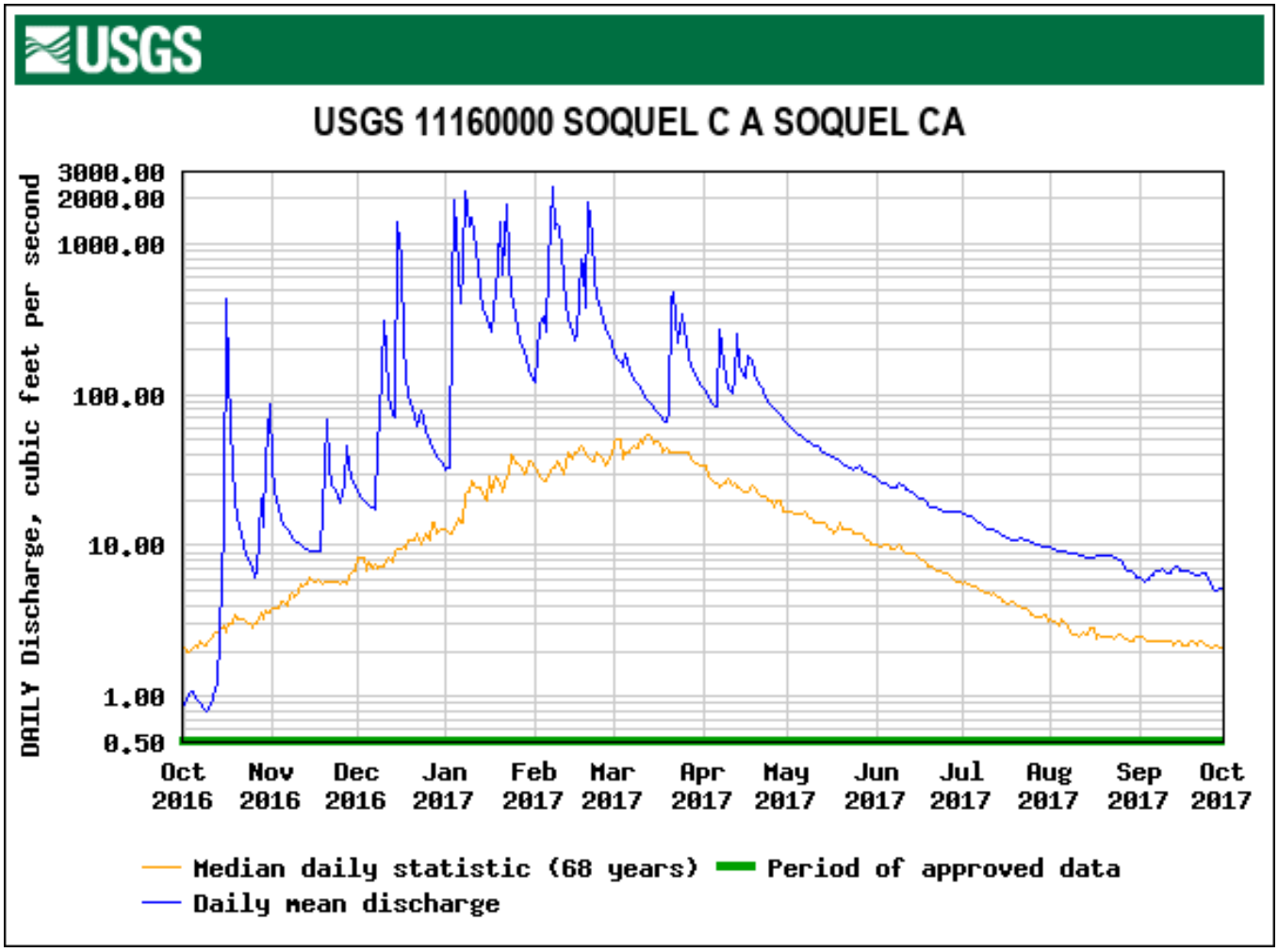


Figure 19. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

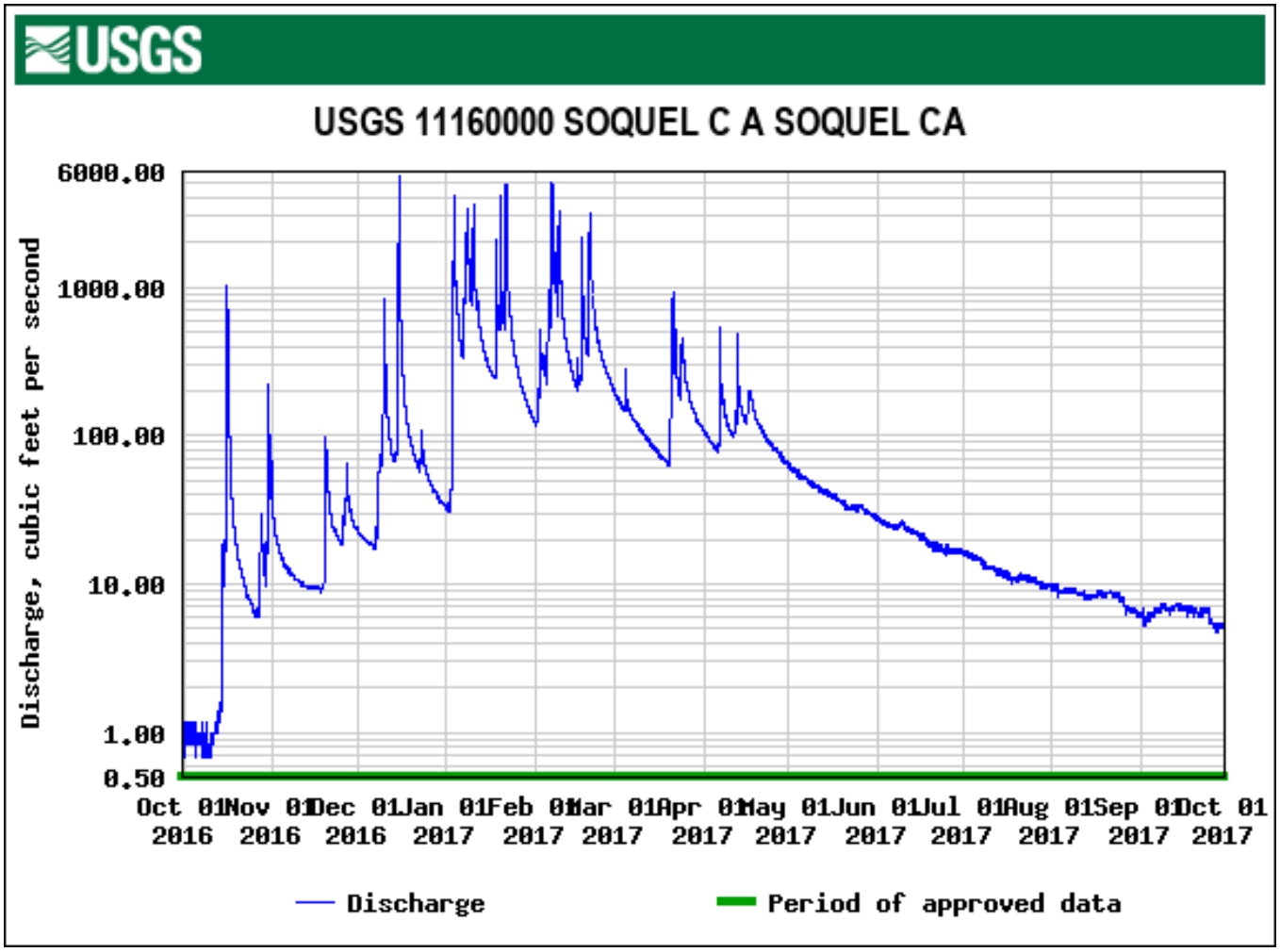


Figure 20. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 20 November 2017.

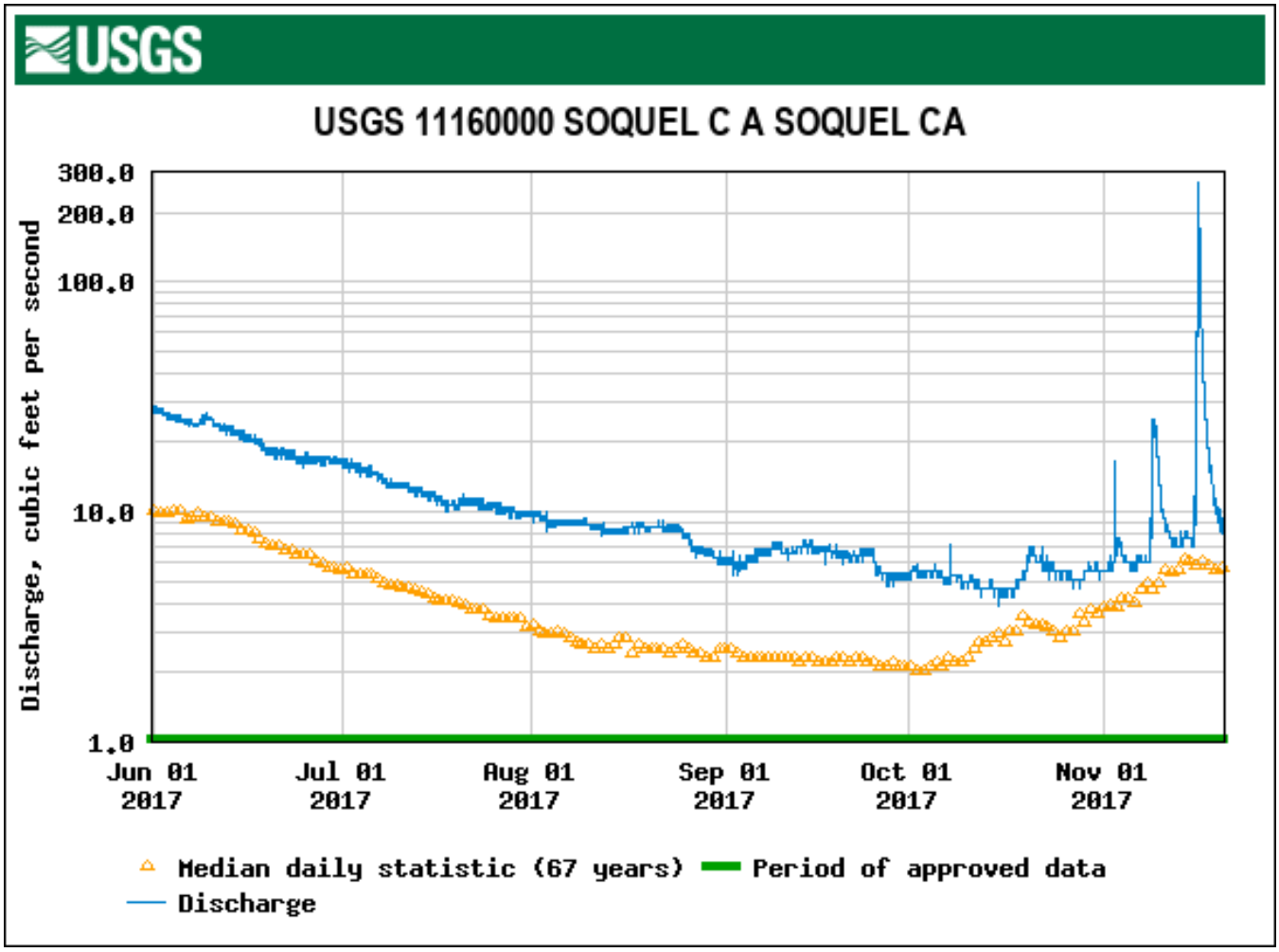


Figure 21. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016

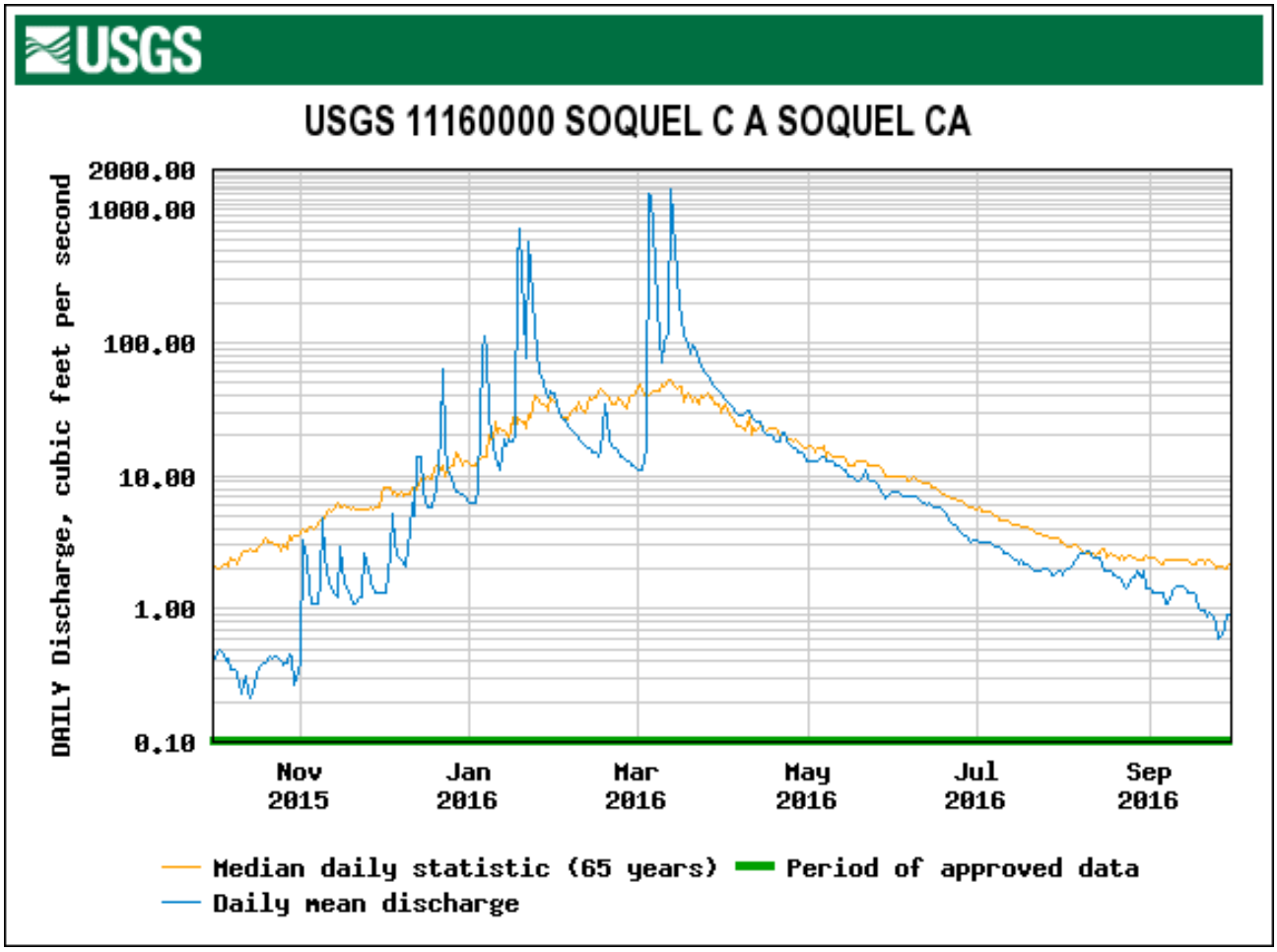


Figure 22. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016.

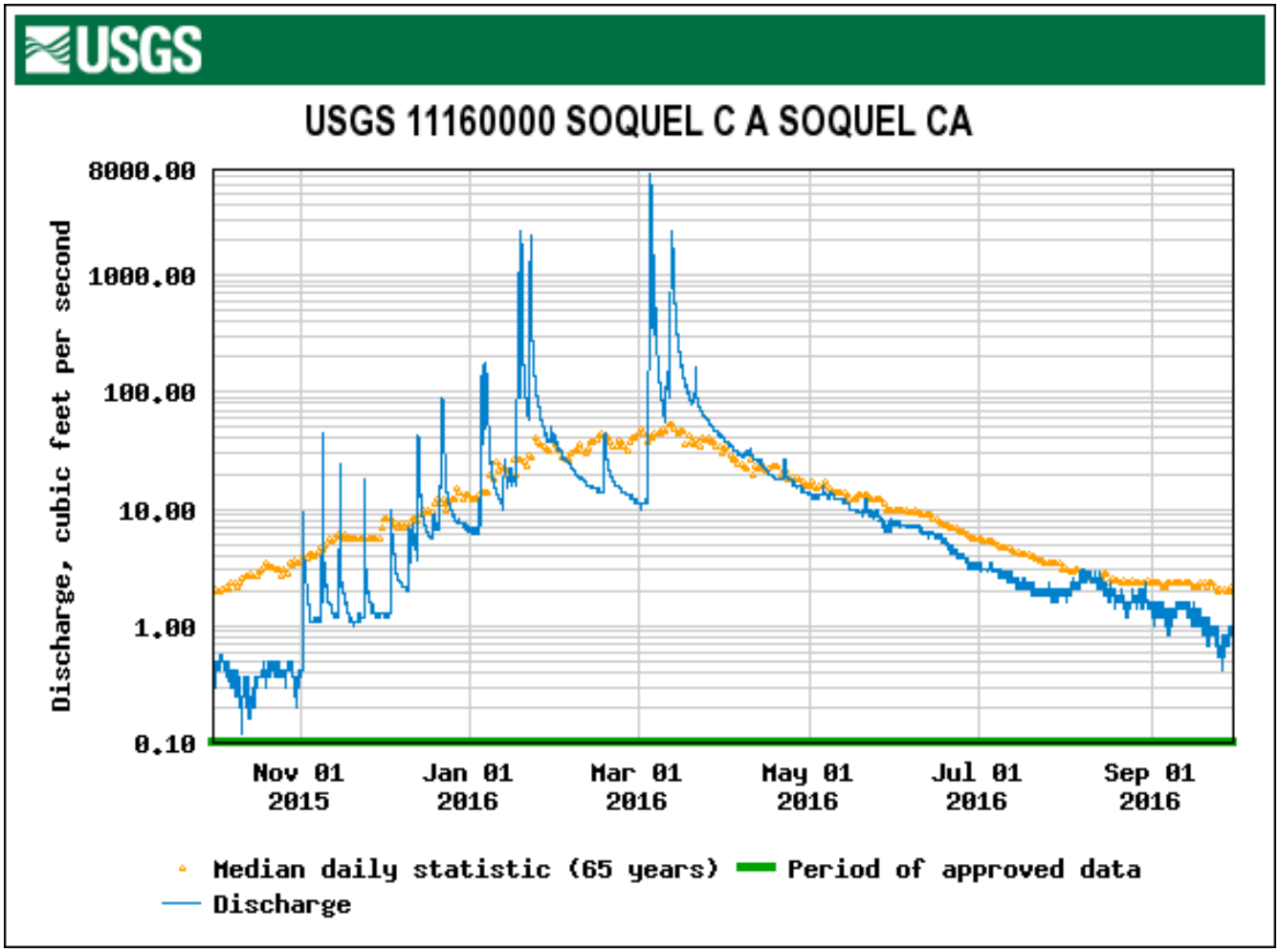


Figure 23. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2016 – 11 October 2016.

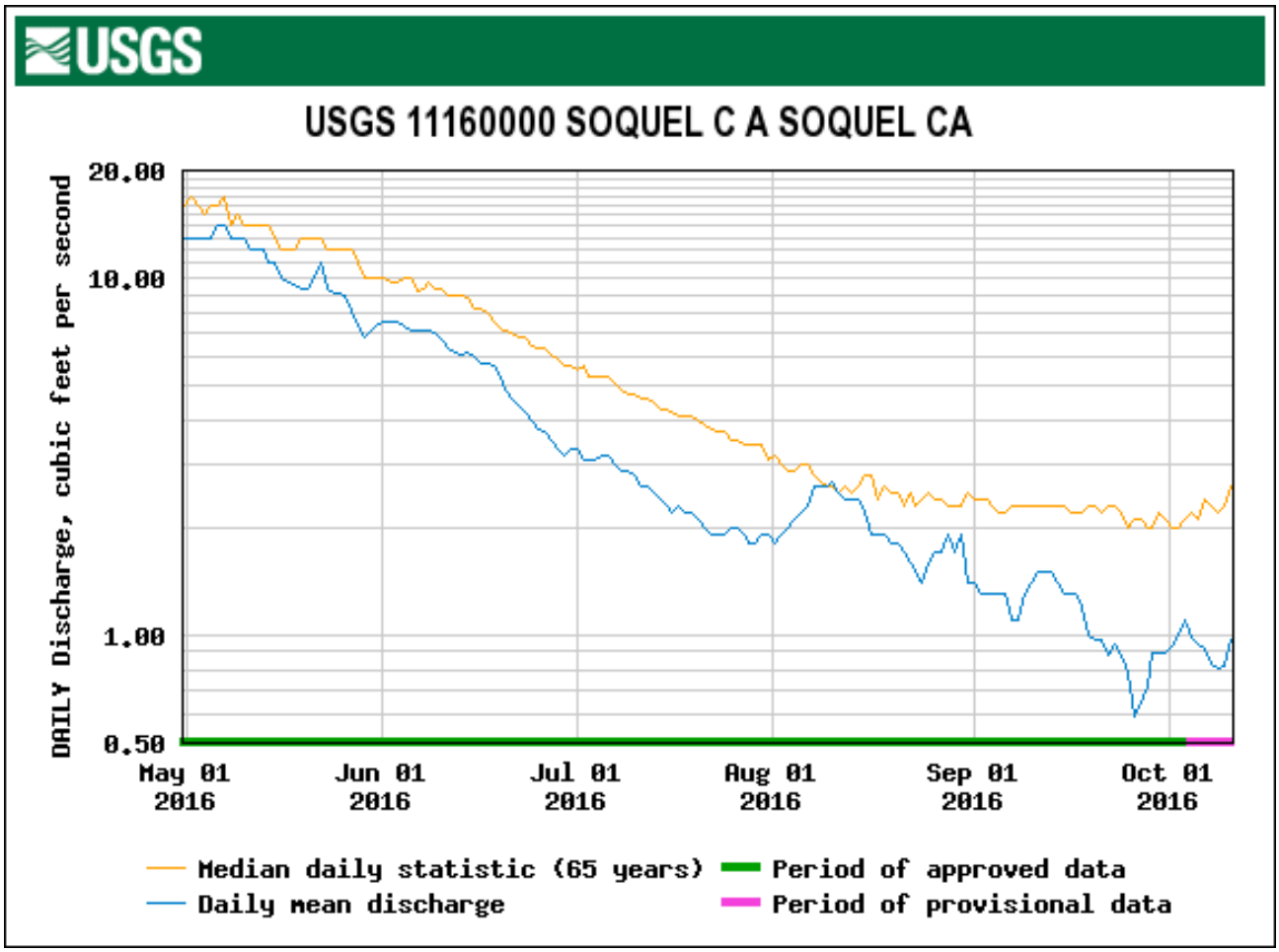


Figure 24. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

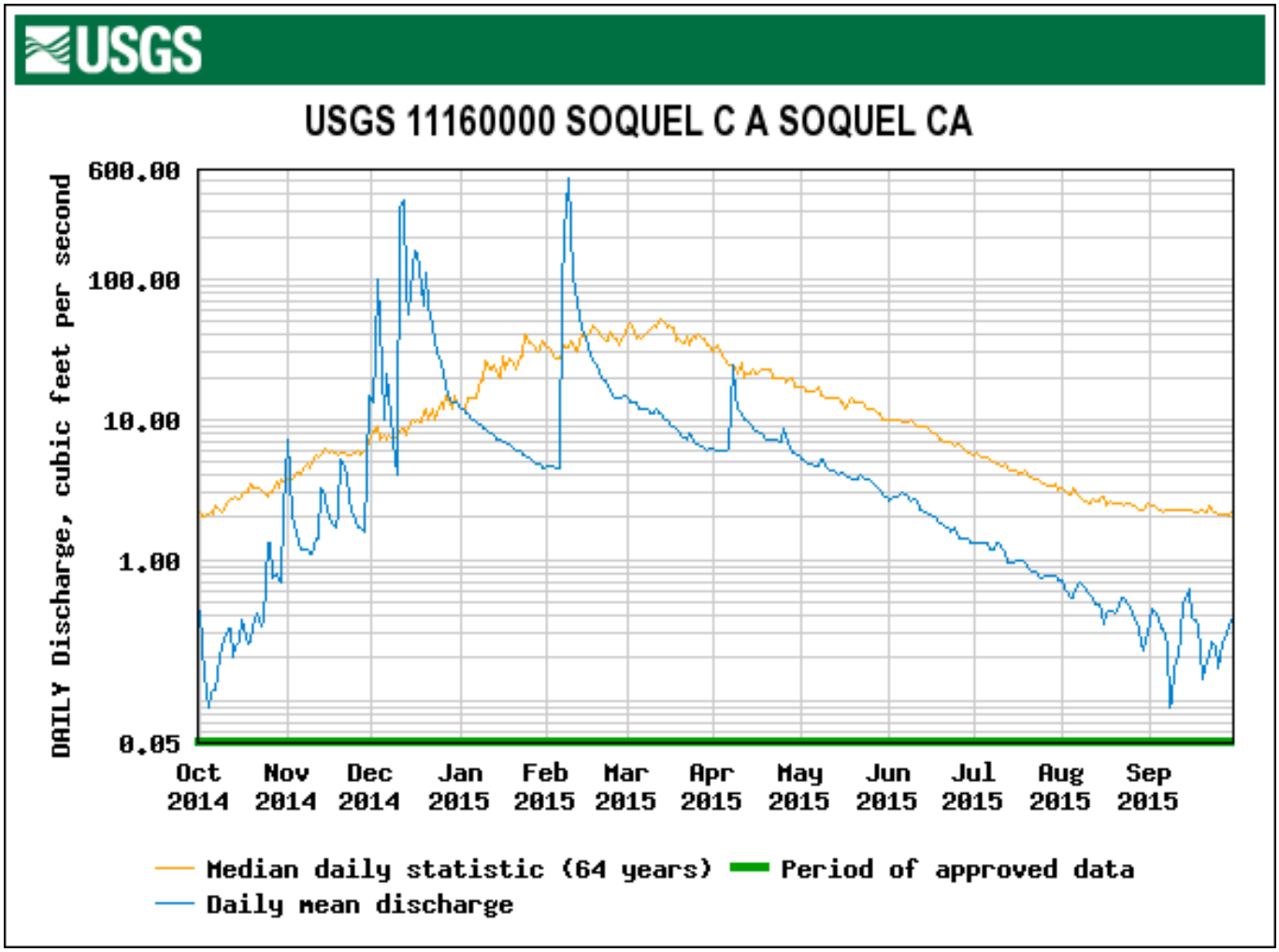


Figure 25. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

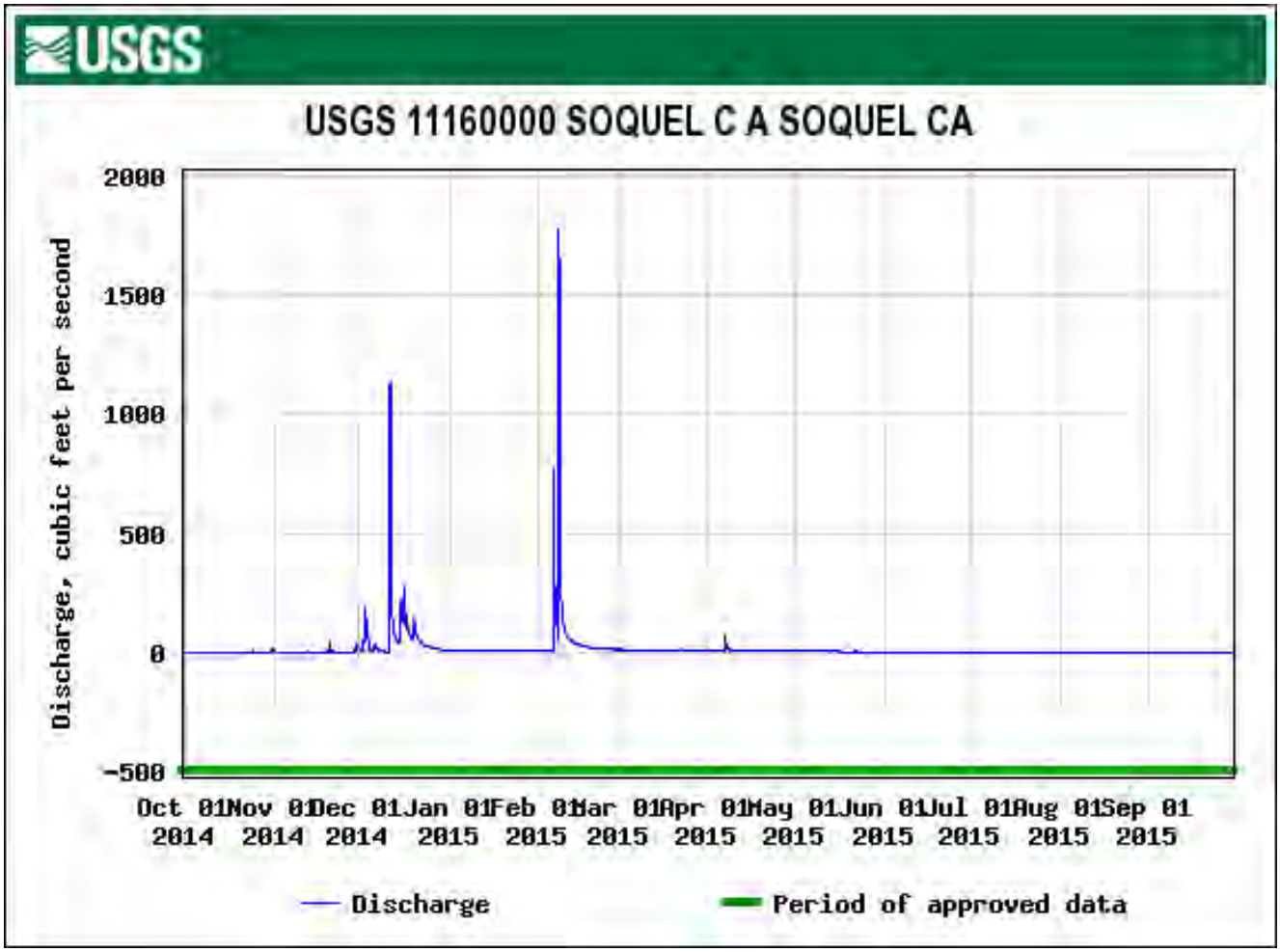


Figure 26. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2015 – 15 November 2015.

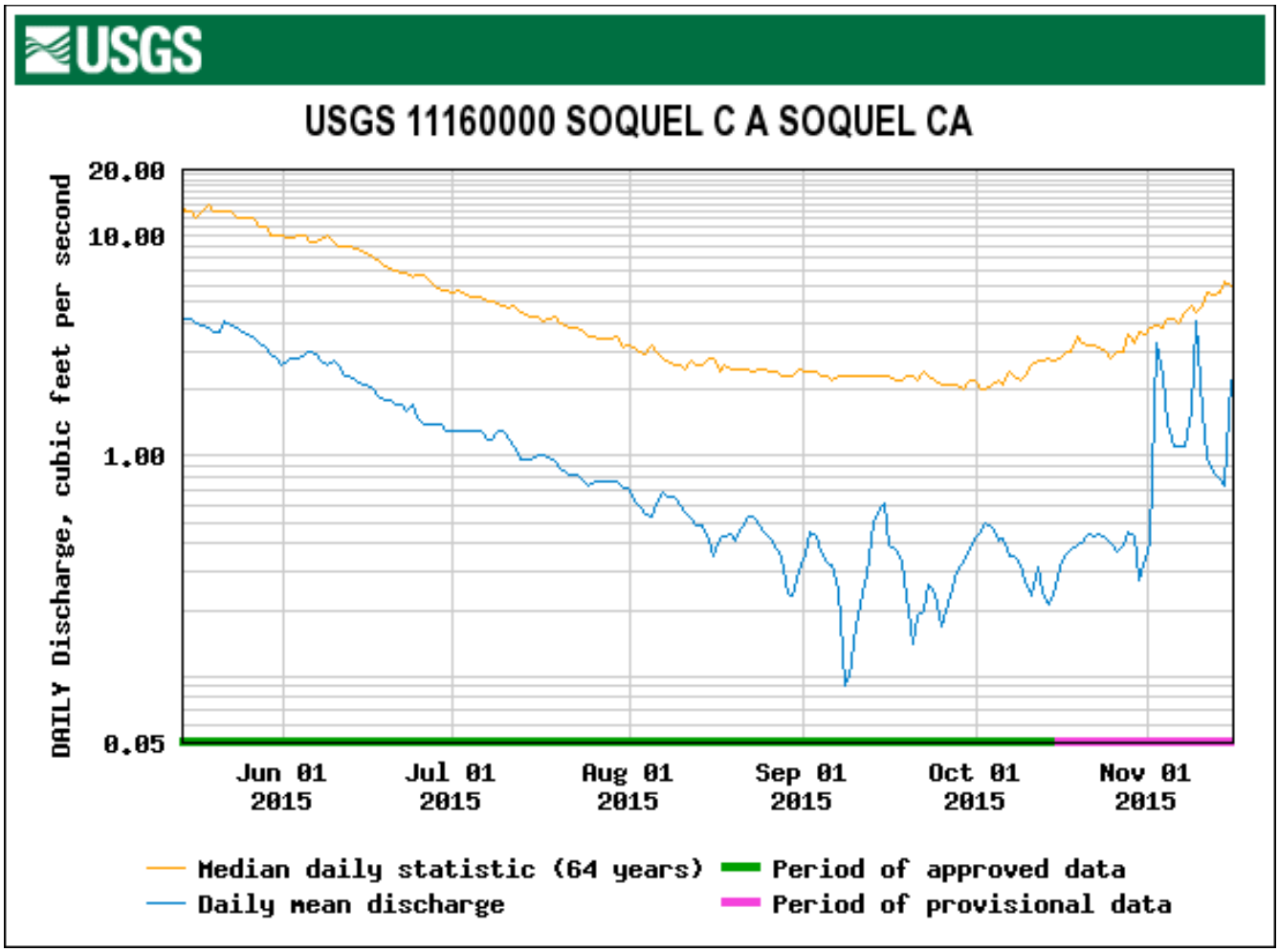


Figure 27. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

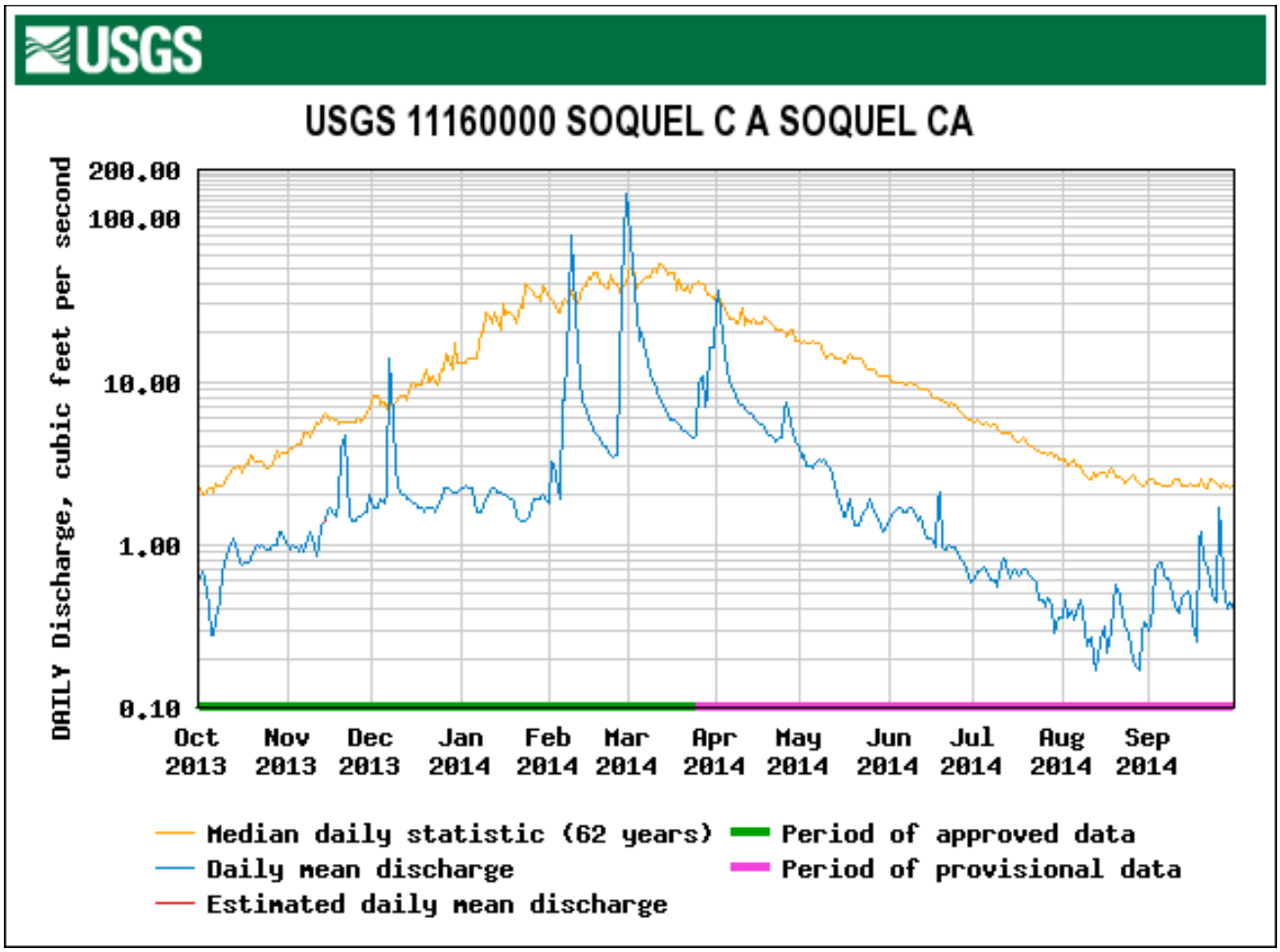


Figure 28. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

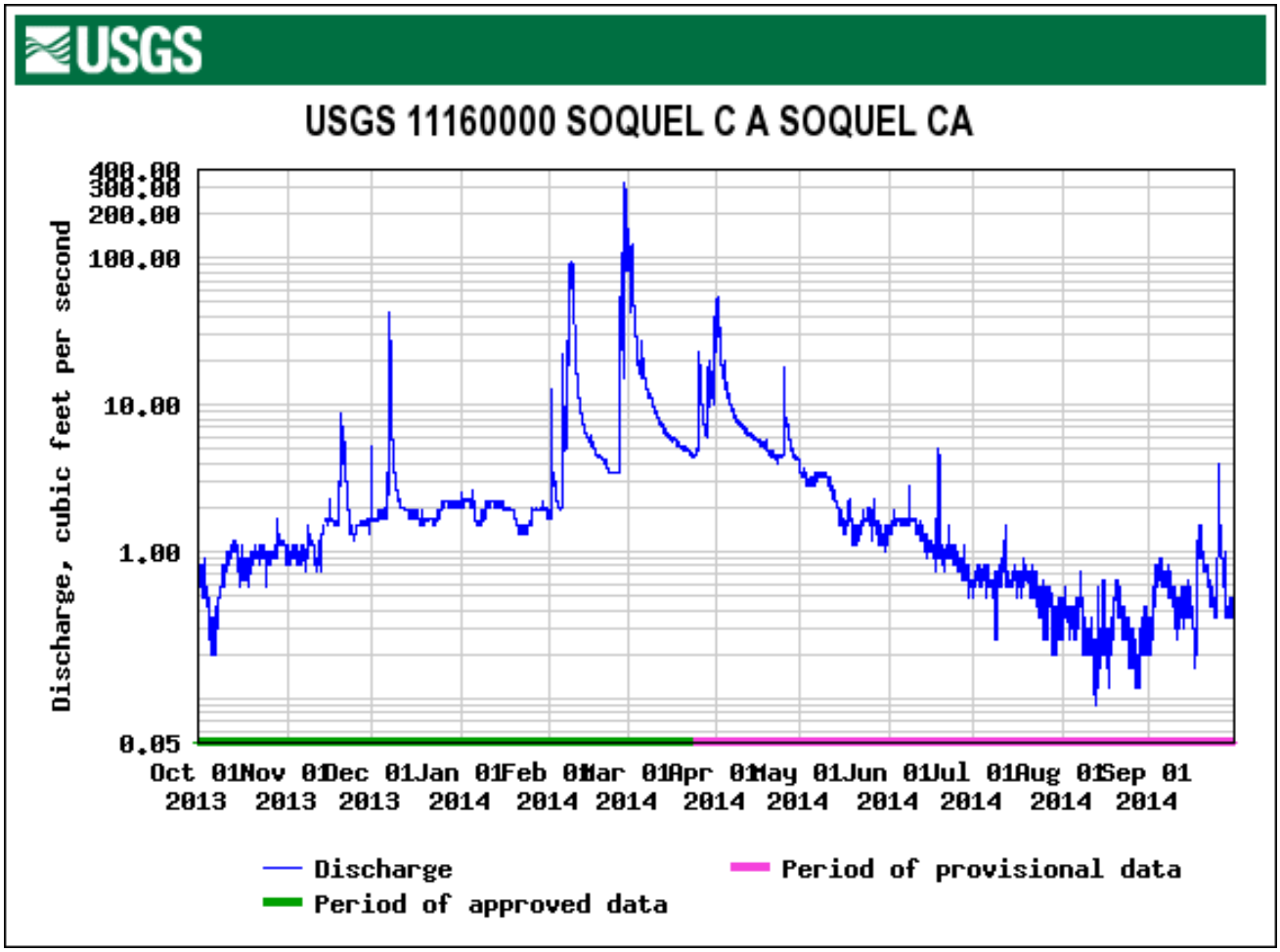


Figure 29. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

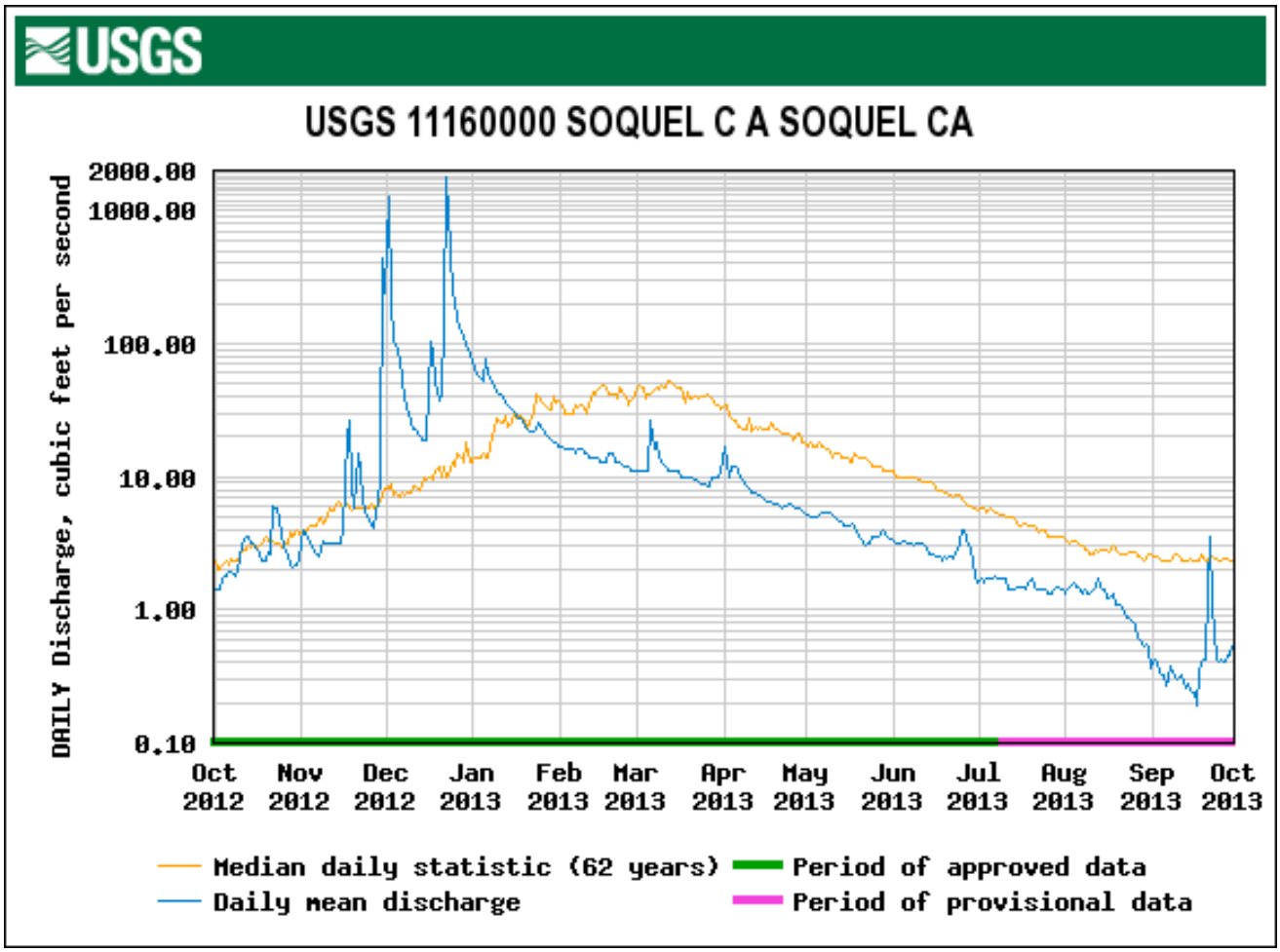


Figure 30. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

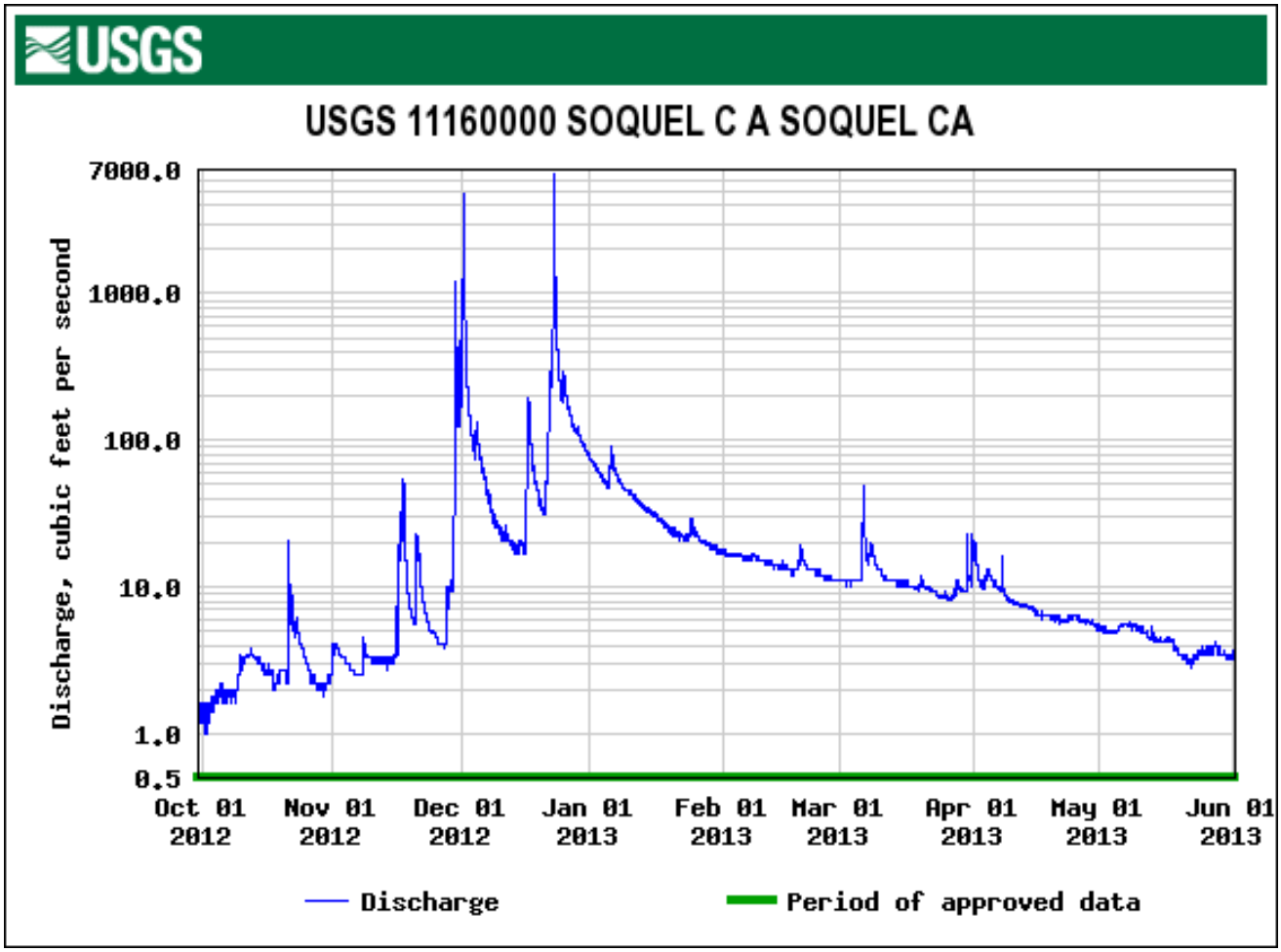


Figure 31. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

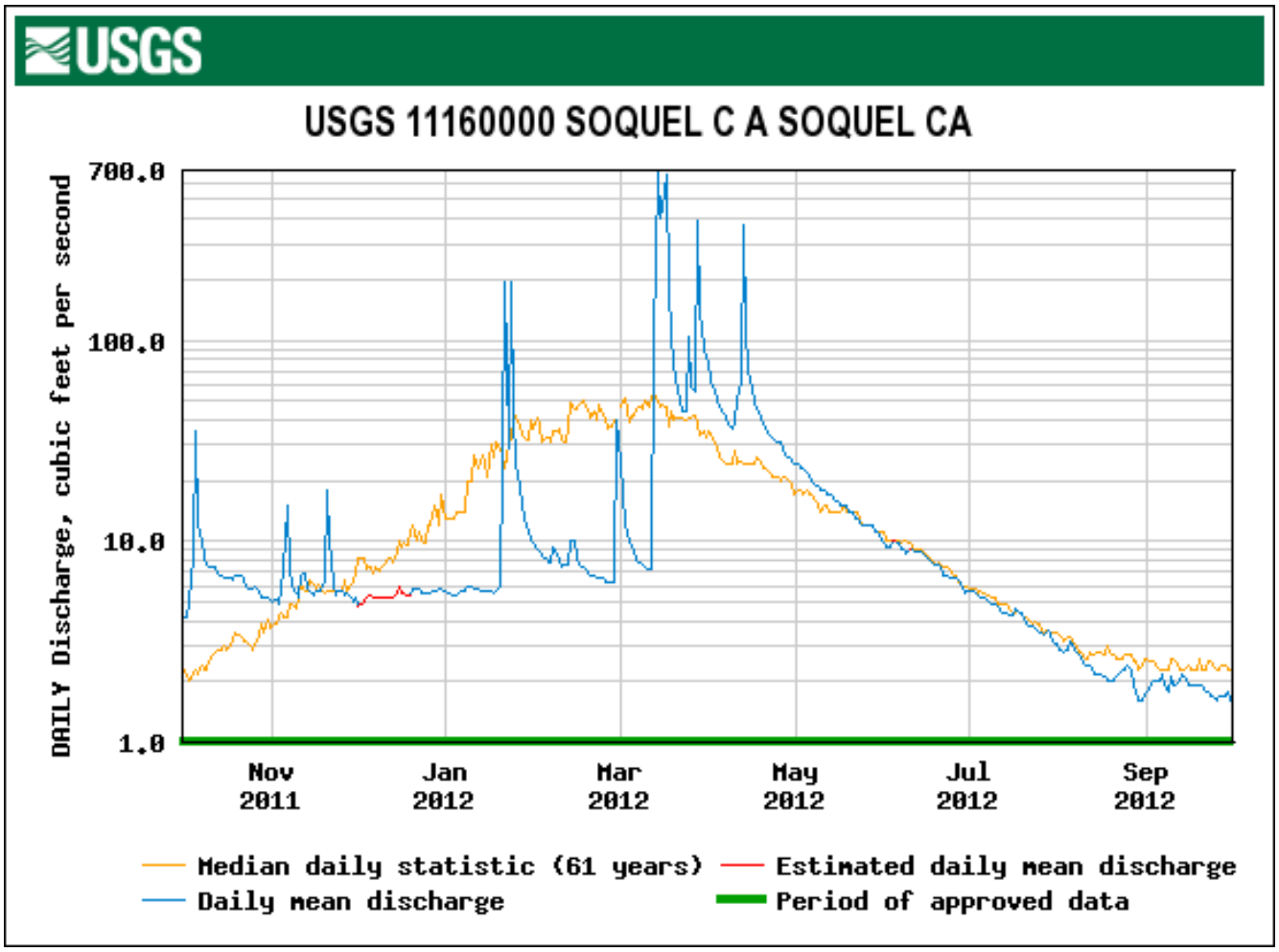


Figure 32. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

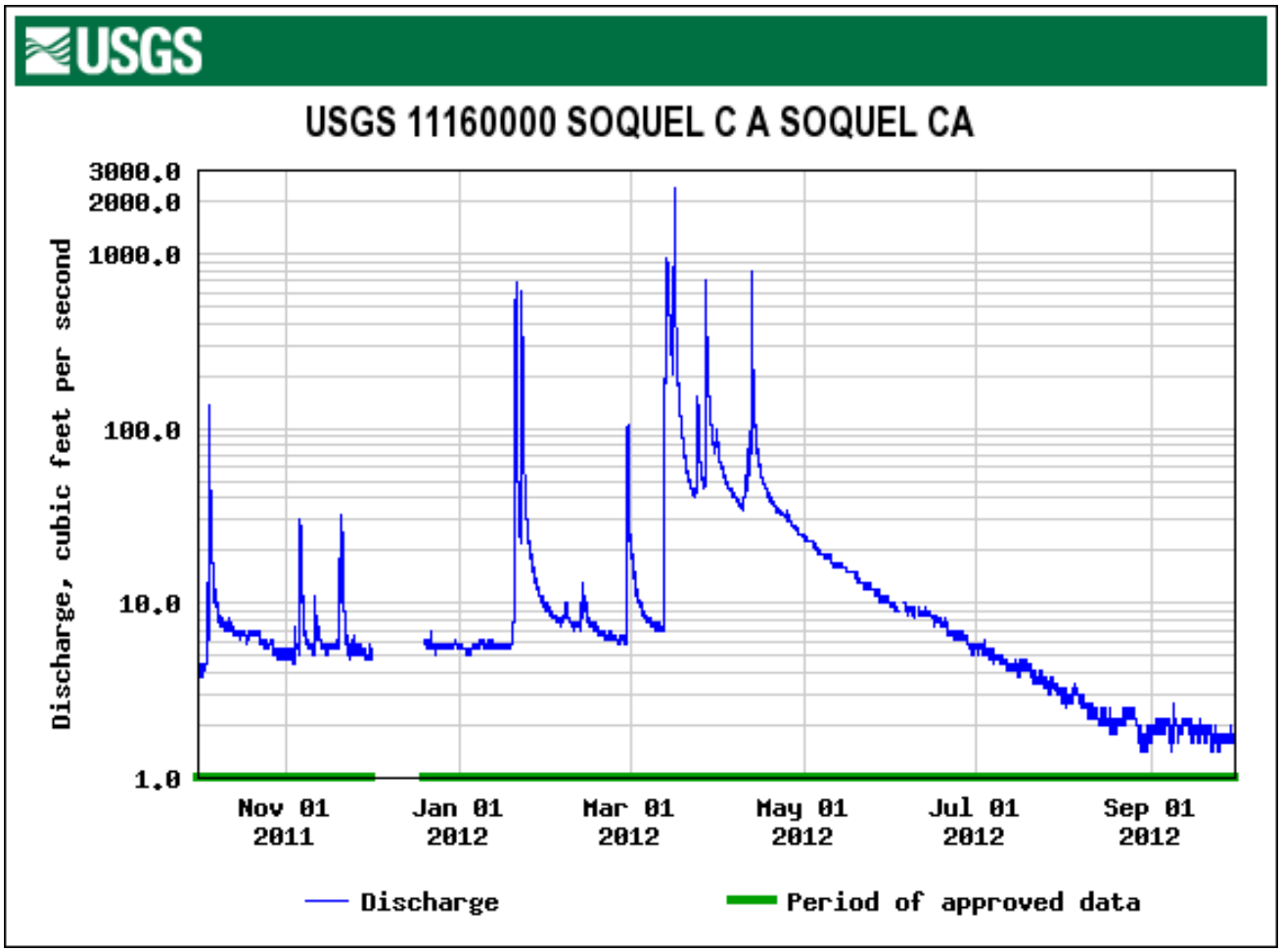


Figure 33. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

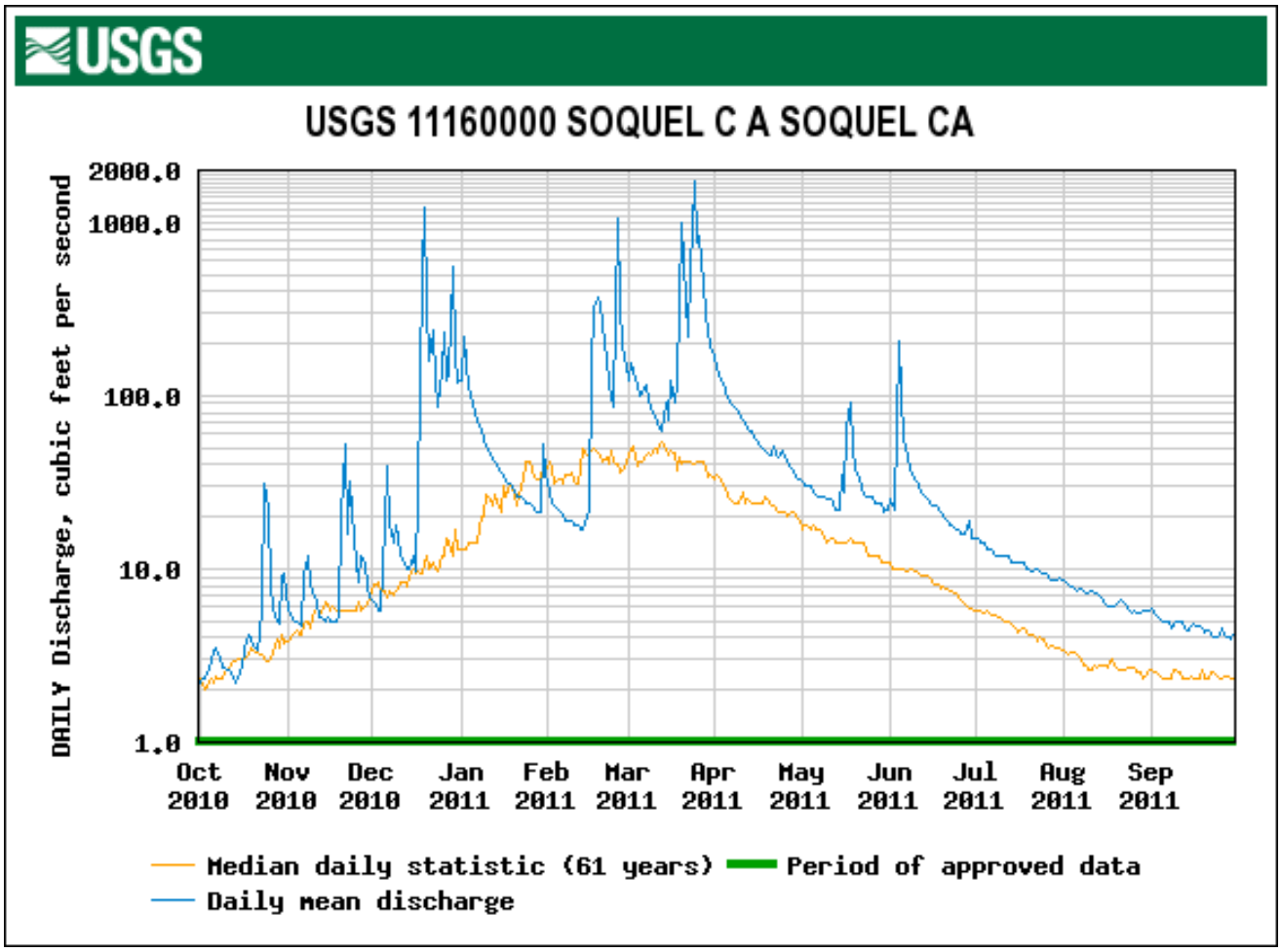


Figure 34. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

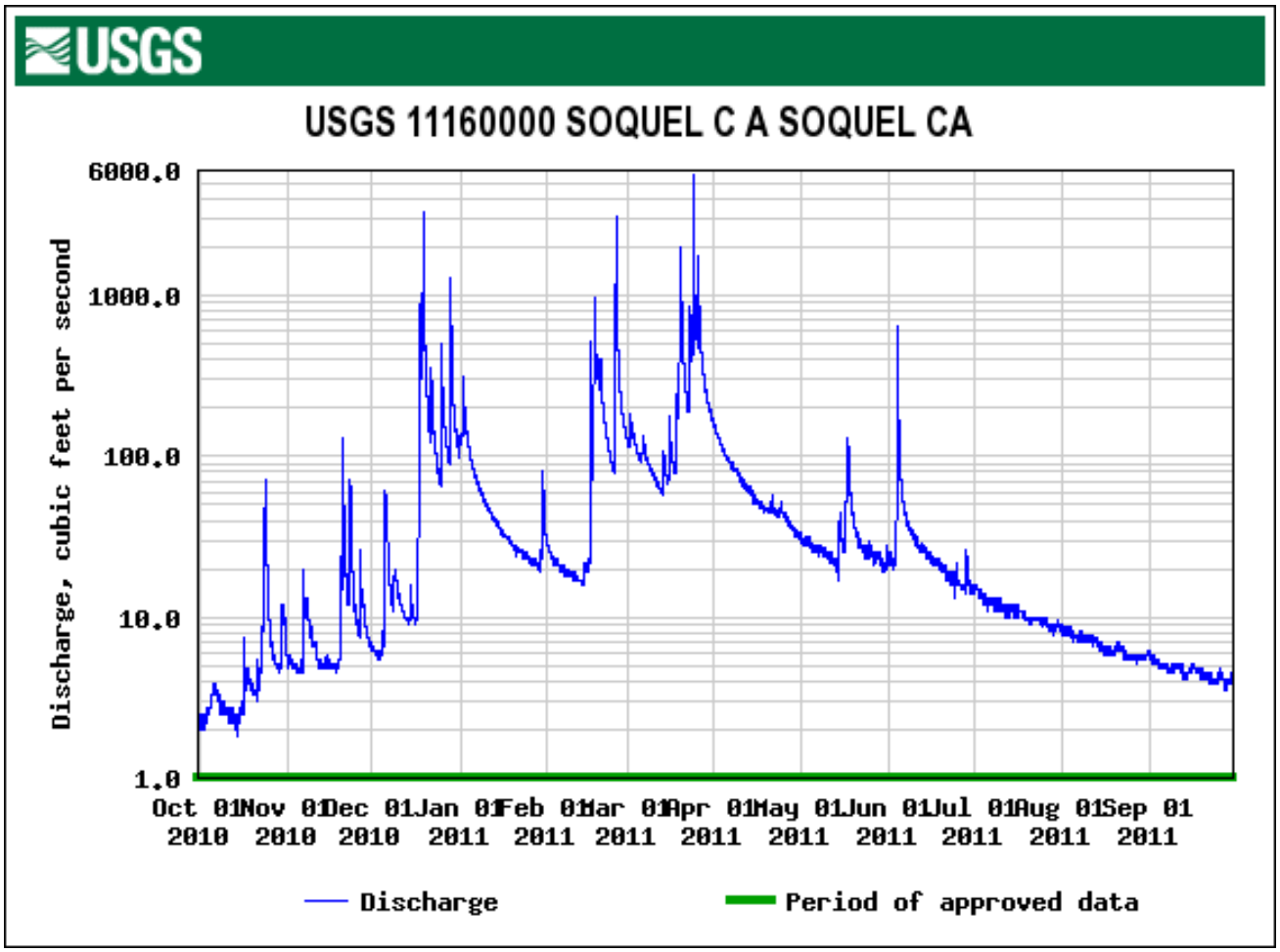


Figure 35. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

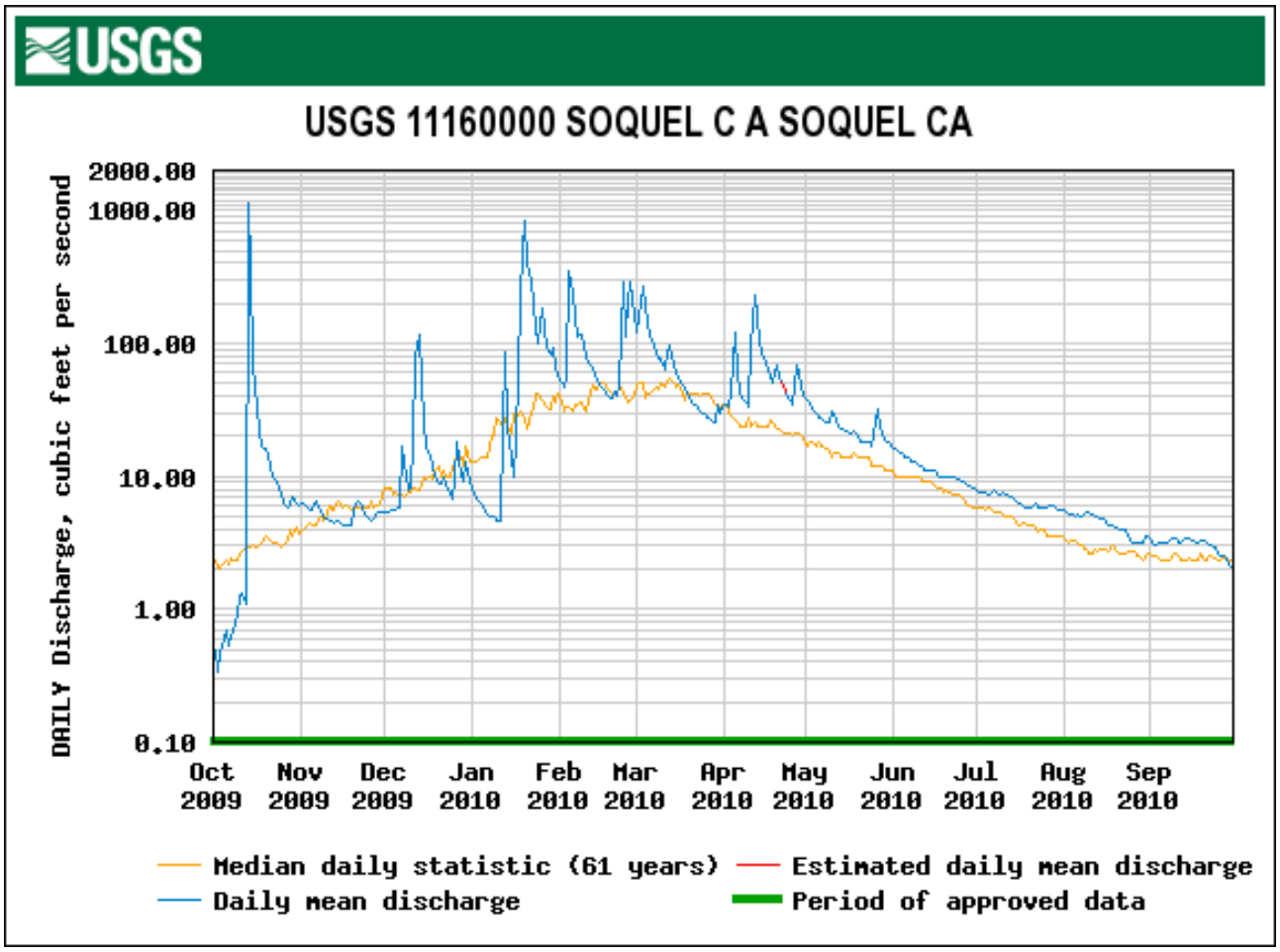


Figure 36. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

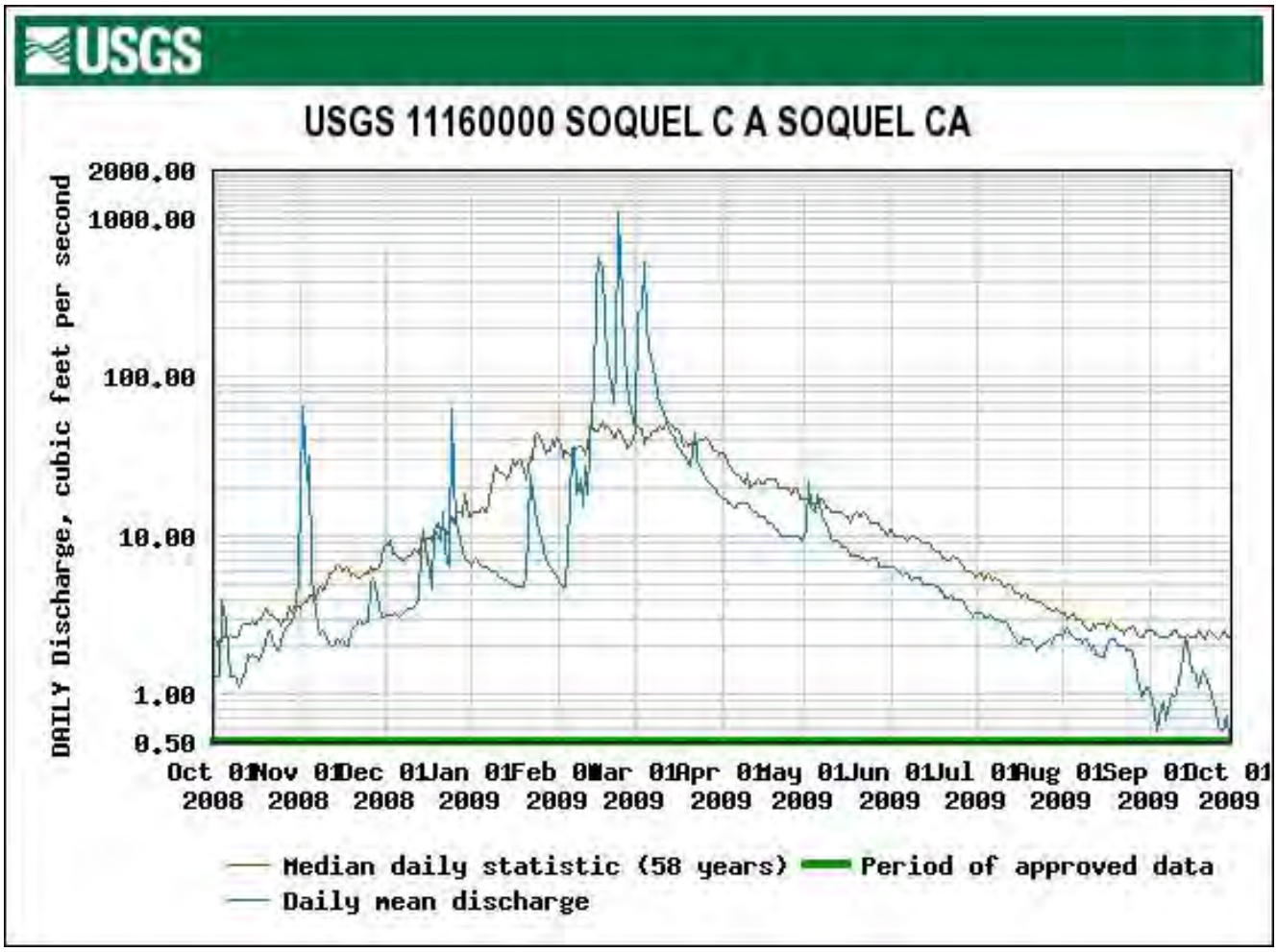


Figure 37. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

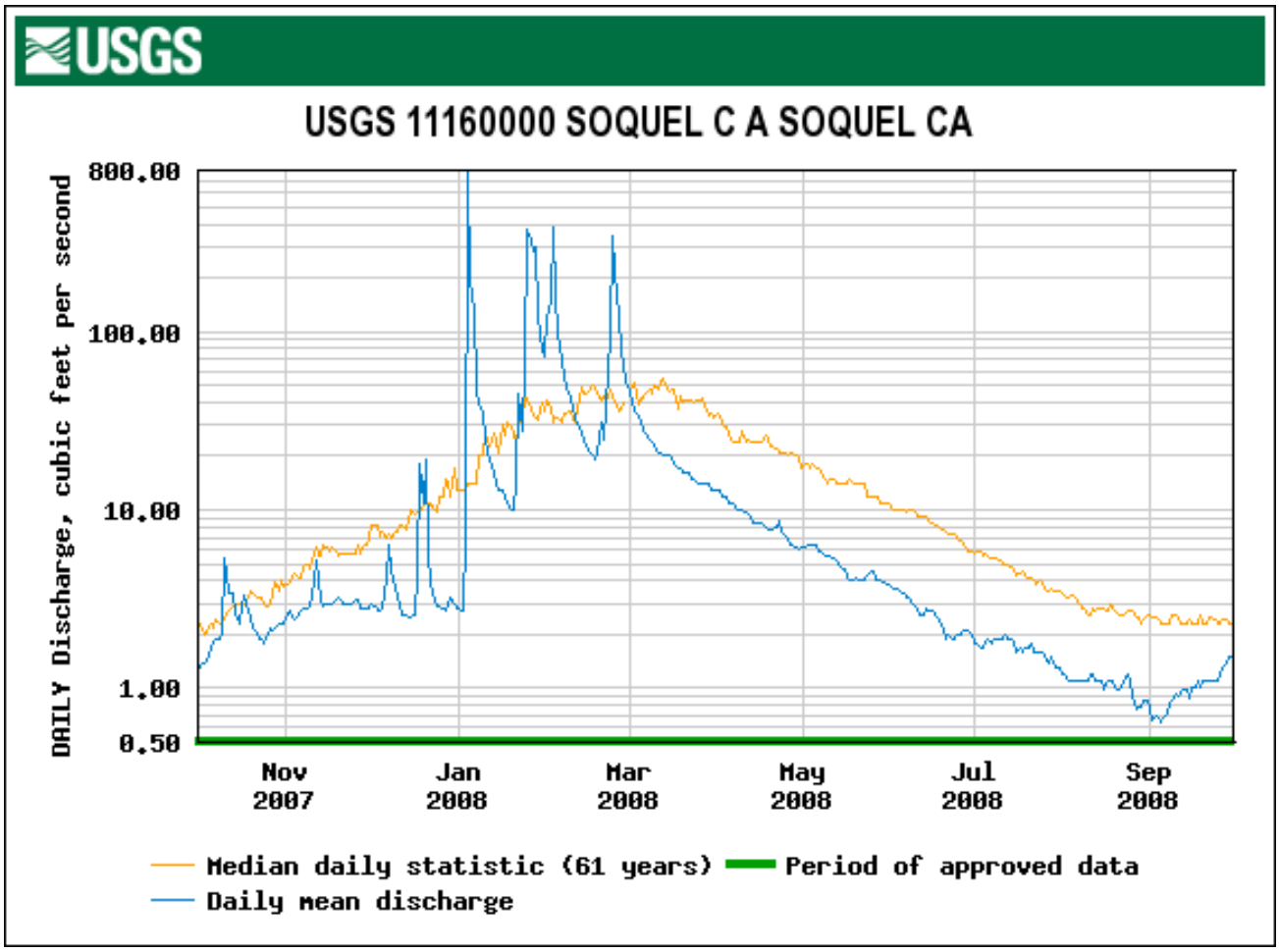


Figure 38. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.