D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2020

(Sampling for Tidewater Goby under USFWS Endangered Species Recovery Permit TE-793645-4)

A Smoky Sunrise in Capitola During the CZU Fire, 2020.

Prepared for the

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

D.W. ALLEY & Associates, Aquatic Biology

February 2021 **Project # 106-30**

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SOQUEL CREEK LAGOON MONITORING REPORT, 2020

ACKNOWLEDGMENTS

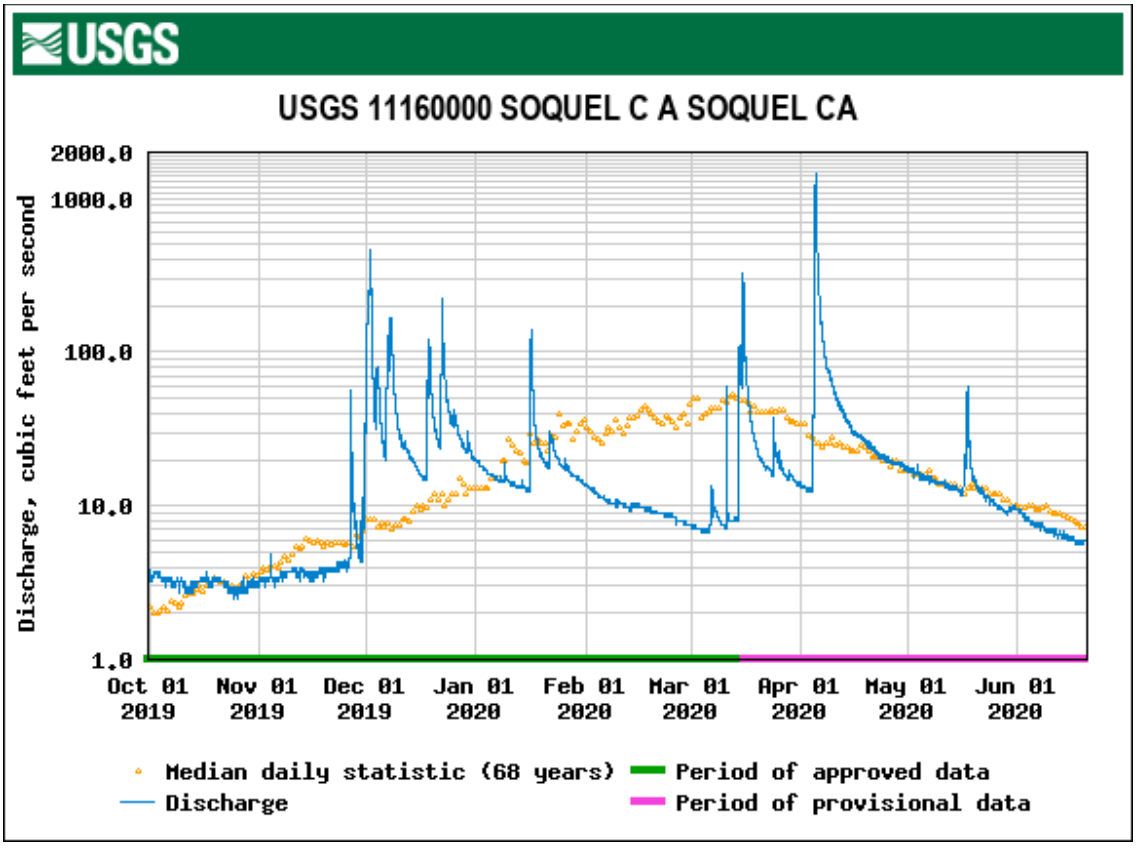
Ed Morrison and the Capitola Public Works Department did well in constructing the sandbar and maintaining the lagoon in 2020. We appreciate that Matt Kotila, as heavy equipment operator and field supervisor, and Ed Morrison, as consultant contractor and former Public Works supervisor, teamed to daily observe the lagoon and adjust the flume inlet as needed to maximize lagoon depth, light penetration to the bottom and to maintain oxygen levels as baseflow declined and as several small storms occurred in fall and early winter before sandbar opening. Every year is different, and we are grateful for their attentiveness, along with that of other Public Works staff. We thank Ed Morrison for assisting in relocating fish from the lateral channel prior to sandbar construction in June. We thank Steve Needens for weekend beach and sand berm maintenance and for keeping the flume inlet and outlet clear through the dry season. He was also on hand on Christmas Day in the event that an emergency sandbar breach was necessary. 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, despite the threat of infection by the COVID-19 virus. They were local residents and other volunteers interested in preserving the steelhead population in Soquel Creek. Robin Aston, math teacher at Soquel High, brought her students and children. They were important in providing enough help. Avid angler, Bobby Ceja, and his 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. Susanne Fork, a biologist from Elkhorn Slough, was a valuable volunteer. Biologists Josie Moss, Inger Marie Laursen, Debie Chirco MacDonald and Tyler Suttle provided their positive energy in working the seine and recording data. Chad Steiner was key to setting the seine, capturing fish and assisting in their measure. Chad's daughter, Lucinda, helped with the seining and recording of data. 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.

Pulling in the beach seine during fish sampling. October 2019 (Pre-COVID-19)

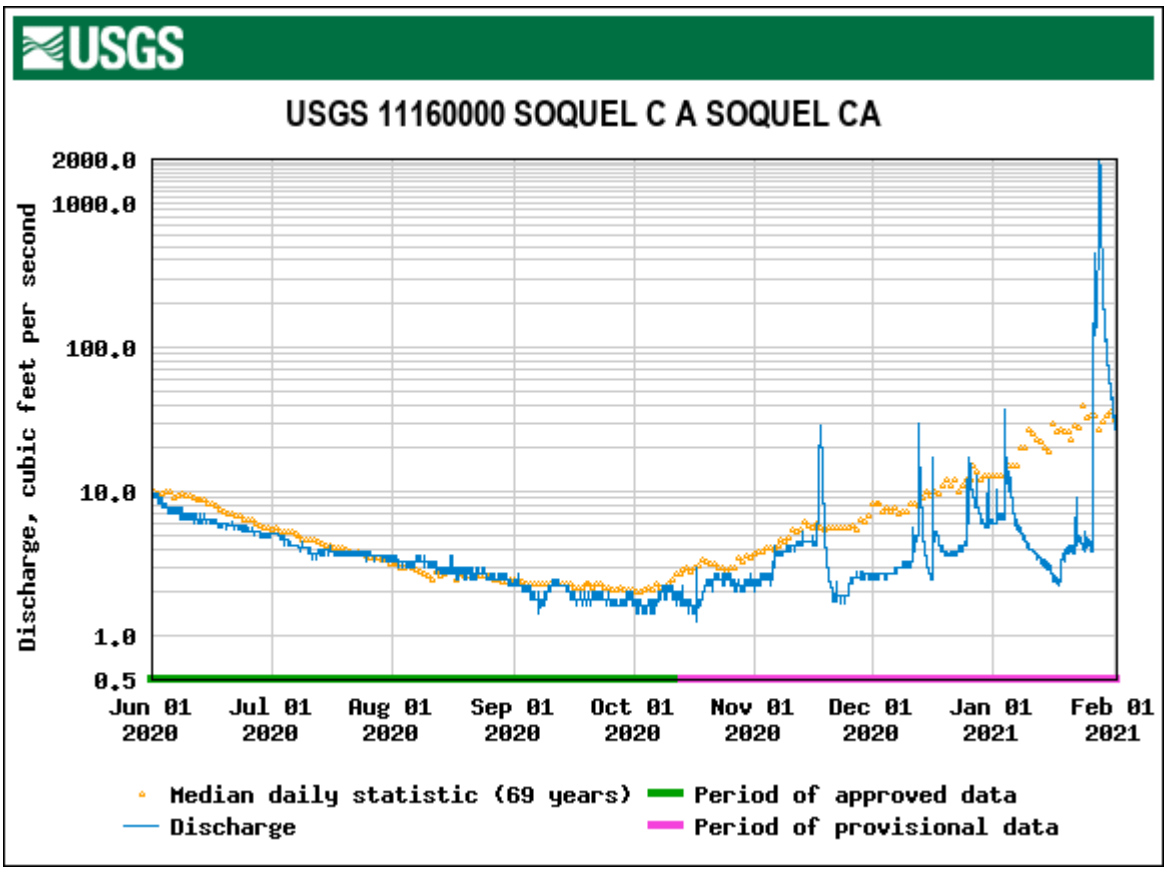
REPORT SUMMARY

As per the 2020 permit conditions, sandbar construction began on 8 June 2020 and was completed on 11 June 2020. Sandbar construction was delayed because of restricted beach use and severe fiscal impacts due to the COVID-19 pandemic. Previous winter stormflows had been infrequent during a relatively mild winter. No storms occurred in February 2020. One bankfull event of nearly 1,700 cfs came in early April, with 6 smaller stormflows 100−500 cfs between December 2019 and 1 April 2020, as measured at the Soquel Village USGS gage, 2 miles upstream of the lagoon. The bankfull event scoured sand out of the lagoon and deepened it from 2019 conditions in Reach1 below Stockton Bridge and in isolated spots upstream. It encouraged steelhead smolt outmigration and bolstered dry season baseflow somewhat. When sandbar construction began on 8 June 2020, streamflow had declined to 7.2 cfs (0600 hr) at the Soquel Village streamflow gage.



As required in the 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 thirtieth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 29 years are available at the City (**Alley 1991-2020**). 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.

Kelp and seagrass were scarce in the estuary prior to sandbar construction. However, the estuary bottom was soft with considerable decomposing plant material downstream of Stockton Bridge and along the margins upstream. Raking out of decomposing plant material was of limited value because most material had decomposed into soft ooze which could not be easily dislodged. An estimated 90% of the decomposing plant material remained in the lagoon after raking. The lagoon depth was increased from the previous year, with apparent scour occurring during the late bankfull event in early April. The typical lateral channel had developed across the beach in the spring prior to sandbar construction, with a high bar between the narrow, fast-moving stream channel and the surf zone, and went diagonally across the beach to the upper end of the jetty. One redwood rootwad lay in the lateral channel. Instream wood had collected at the railroad trestle cove. Two artificial sandbar breachings were required during sandbar construction and estuary preparation.



As the dewatering occurred the first day of sandbar construction, 14 small, young-of-the-year (YOY) steelhead (*Oncorhynchus mykiss*) and 2 smolt-sized steelhead yearlings were rescued from the upper lateral channel and relocated under the Stockton Bridge. The other species present and relocated was 1 staghorn sculpin (*Leptocottus armatus*). No tidewater gobies (*Eucyclogobius newberryi*) were observed or were observed to have suffered mortality in the estuary/ lagoon and upstream during sandbar construction activities. The lateral channel was covered over and buried after the fish rescue was completed. The channel was slowly covered from upstream to downstream toward the jetty. Upstream of the railroad trestle, threespine stickleback were rescued and relocated during the two drawdowns associated with sandbar construction.

Prior to sandbar construction, the plumbing of Esplanade businesses was inspected for leaks by City staff and none were found. Steelhead passage was maintained at night through the flume during sandbar construction that was completed on 11 June. On 11 June, the pad around the flume inlet was covered with clear visquine and secured with sandbags. Sandbags were stacked around the flume inlet. Sand was hand-broadcasted by shovel to cover the visquine, and the sandbar was closed for the season by Kotila at 1227 hr. The tules planted 3 years previously in the cove beneath the railroad trestle had survived the relatively mild winter.

Sandbar Opening. In preparation for the first major storm forecasted in the winter season, on 26 January 2021, Public Works added 2 flashboards to restaurant side of flume inlet, leaving one board out on either to prevent wood from jamming the flume inlet during stormflow. On 26 January, the inner and outer berms on the beach were reduced in height to minimize the hydraulic the head on lagoon at the time of sandbar opening so as to minimize estuary evacuation and minimize water velocity. Kotila collected a water sample in the lagoon on 26 January, prior to sandbar opening.

Soquel Creek connected with the Bay by midnight, 26 January 2021. Gage readings at Soquel Village began elevating rapidly after about 1130 pm on 26 January. Morrison traveled to lagoon and arrived at approximately midnight to observe sandbar conditions. The sandbar had breached a few minutes before his arrival, and the stream was flowing through the cut notch in the beach, approximately 10 feet wide and 0.5 ft as it passed across the beach. The streamflow estimate at the Soquel Village gage was approximately 23 cfs at midnight, and rainfall was heavy in Capitola at the time. Streamflow at the beach was likely more than 30 cfs at the time of the sandbar opening with contributions from Noble Gulch and urban surface runoff in Capitola. The biologist, who lives in the Santa Cruz Mountains where heavy rainfall and wind were occurring, decided it was unsafe to travel to the lagoon at the time of sandbar opening because roads may soon close if trees blew down, which in fact occurred overnight. However, Morrison was present at the creekmouth just as the creek was exiting across the beach and observed no fish mortality. Morrison observed that the estuary water surface elevation increased to within 0.5 feet of the middle piling bolt that indicated the elevation of flooding conditions along the lagoon bulkhead before it began to recede. Thus, flooding was prevented.

The streamflow increased through the early morning of 27 January 2021 to a maximum estimated 450 cfs by 0800 hr at the Soquel Village gage. Kotila collected another water sample on the morning of 27 January in the surf near the exiting stream channel and delivered the before and after sandbar opening samples to Monterey Analytical. Lab analysis indicated that the pre-breach enterococcus bacterial count was less than 10 cfu/100 ml. The post-breach count was also less than 10 cfu/100 ml, requiring no additional weekly water sampling because the count was below 104 cfu/100 ml. Another storm on 28 January increased stormflow to approximately 2,000 cfs at Soquel Village.

Stream Inflow and Influence on Lagoon Water Temperature. Lagoon water quality is generally best with higher summer baseflow. Soquel Creek in 2020 maintained a baseflow through the dry season that was near the median flow from mid-July to September 1 and slightly below the median before from June to mid-July and afterwards to mid-November (**Table 9; Figures 25−26**). 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**). We observed cooler lagoon water temperature in 2019 (high inflow) than in 2018 or 2020 (intermediate inflows) for the months of June through August (**Figures 3a-d; 3h**). 2015 had relatively warm air temperature, warm inflow and very high lagoon water temperatures at dawn and the afternoon. 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 (**Figure 4h**).

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. To maximize summer baseflow, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

Water Temperature. Lagoon water temperature was well within the tolerance range of steelhead in 2020 and was not likely stressful during the season of sandbar closure except for 2 weeks in August. Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead, making that a management goal to maintain a daily water temperature maximum below 22ºC near the bottom. This goal was met at the data logger location and at all 4 stations monitored at 2-week intervals, at least in the morning (**Figures 3a-3d; 4a**). Another lagoon management goal is to maintain early morning maximum water temperature below 20°C near the bottom. In 2020, water temperatures near the lagoon bottom in the early morning were rated "good" (<=20°C) at all stations during 2-week monitorings except "fair" ratings at some stations in early and late August (**Tables 2 and 3**). In 2020, this management goal was met at the data logger location near the bottom except for a week in mid-August and at all monitoring stations except on 9 August at Station 1 (Flume) and 22 August at the lower 3 stations, excepting Station 4 (Noble Gulch). The highest water temperature near the bottom on 22 August was 20.5°C. A reasonable assumption would be that daily water temperature would not increase more than 2°C from the morning low. Thus, 22°C maximum daily water temperature goal may have been exceeded at monitoring stations on 9 and 22 August. A third lagoon management goal for steelhead is to maintain the daily 7-day rolling average at 21°C or less near the bottom. This goal was met at the data logger location except for a week in August. In 2020, the coho management goal of keeping maximum lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met for 36 days that were monitored (**Figure 4a**).

Aquatic Vegetation. Kelp and seagrass were not abundant in the estuary prior to sandbar construction in 2020. The sandbar closure occurred later than usual than was typical after a mild winter. After the sandbar was closed, a thick layer of decaying plant matter lined much of the lower estuary downstream of Stockton Bridge. Only an estimated 10% of the decomposing plant material was raked from the lagoon in 2020. Thus, there were more nutrients available for plant growth in 2020 than in most years. However, aquatic vegetation was not monitored in 2020

because only early morning monitoring was done, and the aquatic vegetation was not visible.

Oxygen Concentration. No stressfully low oxygen concentrations for steelhead were detected in 2020. Oxygen concentrations near the bottom at dawn were in the "fair" to "good" range at all 4 monitoring stations throughout the monitoring period and above 6 mg/L (**Table 3; Figure 6a**). The average oxygen level near the bottom for the 4 sites at dawn was in the good range (=>7 mg/L), as was typically the case in other years (**Figures 6a and 6b**). From late June to mid-October, the average lagoon oxygen concentration was higher than the oxygen level at the Nob Hill stream inflow (7 of 9 monitorings). Oxygen concentration near the bottom was highest at the flume (Station 1) and lowest half of the time under the railroad trestle (Station 3).

Salinity. In 2020, no saline conditions were detected in the lagoon until 12 December after the tidal overwash on 8 December. Saline conditions were very dilute at depth, with a maximum of 2.4 parts per thousand (ocean saltwater has 35 ppt) along the Venetian Court wall (Station 2). Freshwater conditions existed in the upper 0.5 meter of the lagoon on 12 December, and maximum water temperature was only 10.1°C near the bottom, less than 1°C warmer than at the surface. Lagoon conditions returned to freshwater until a 1.9 ppt salinity was detected at Station 2 at the bottom on 23 January.

Fish Sampling Results. A total of 192 steelhead were captured and marked on 4 October after 6 seine hauls. There were no mortalities. A total of 147 steelhead were captured on 11 October in 6 seine hauls. There were 21 recaptures and no mortalities. The lagoon population estimate was 1,344 juvenile steelhead (8^{th} highest in 27 years), using the Lincoln index for a closed population (**Table 10;** methods in **Ricker 1971**). Steelhead were relatively large (**Table 11; Figure 7a**. The population estimate was near average and above the median compared to the 26-year average of 1,492 (median= 928) (**Figure 24**). This relatively average lagoon population size was higher than expected with the very low densities of juvenile steelhead detected at most stream sampling sites in 2020 (**Alley 2021**). Other fish species captured in 2020 with the large seine were 1,000+ threespine stickleback, 117+ tidewater gobies, 6 staghorn sculpins, 1 prickly sculpin (*Cottus asper*) and Sacramento suckers (10 adults and 4 YOY).

Recreational Use. No nautical parade took place in 2020 due to Covid-19 related restrictions on social gatherings. The lagoon near the beach was posted with warning signs about potential health risks. However, increasing human use of the lagoon has been observed since 2016, when a paddle-board concession began in the village. In 2020, monitoring was reduced to morning observations only, which was before most recreational use of the lagoon began each day. The only aquatic recreation observed in 2020 was kayaking in July and boating with an electric motor in October. Paddle-boarders have become commonplace in past years, along with more kayakers, pedal boaters, row boaters, canoers and barge users on the lagoon.

Bird Counts. Mergansers were uncommonly observed in 2020 as in 2019 and much less common than in 2013−2015 (**Table 13)**. Other piscivorous birds observed in 2020 included pied-billed grebe, cormorant, snowy egret, black-crowned night heron and common goldeneye duck. Common goldeneye counts varied between 11 and 24 from 15 November through 23 January.

The average gull count per monitoring day until 1 December for 2014−2020 has been 63, 68, 42, 40, 46, 63 and 36, respectively, making 2020 the lowest in 7 years. Gulls counts were relatively low in 2020 until October compared to other recent years (**Figure 54**). The average mallard duck count per monitoring day to 1 December for 2014−2020 was 27, 26, 31, 18, 30, 21 and 44, respectively, giving 2020 the highest average in the last 7 years. In 2020, the mallard counts ranged between 17 (23 January) and 67 (3 October).

LAGOON AND ESTUARY FORMATION

Fish Rescue Activities Required before Sandbar Construction

8 June 2020. The typical lateral channel developed across the beach just days prior to sandbar construction, and went diagonally across the beach to the outer end of the jetty. The lateral channel was partially blocked off at 0715 hr. Ten seine hauls were made through the lateral channel with a fine-meshed (1/8-inch), 30-foot long beach seine from 0730 hr to 845 hr. Areas underneath undercut riprap adjacent to Zelda's Restaurant were probed with a dipnet. The seine hauls and probing yielded no rescued fish. Ed Morrison, Public Works part-time employee and former field supervisor, assisted Don Alley in the seining and probing to capture and relocate fish. After the lateral channel was completely blocked from the estuary at 0847 hr, 14 small YOY steelhead and 2 smolt-sized steelhead were dip-netted and rescued from the upper lateral channel and relocated under the Stockton Bridge until 0945 hr. The other species present and relocated was 1 staghorn sculpin (**Table 1**). No tidewater gobies (*Eucyclogobius newberryi*) were observed or were observed to have suffered mortality in the estuary/ lagoon and upstream during sandbar construction activities. After the flume was cleared of sand by 1356 hr on 8 June, streamflow passed through the flume. The lateral channel and a small redwood rootwad in the lateral channel were covered over and buried after the fish rescue was completed. The lateral channel was slowly covered from upstream to downstream toward the jetty.

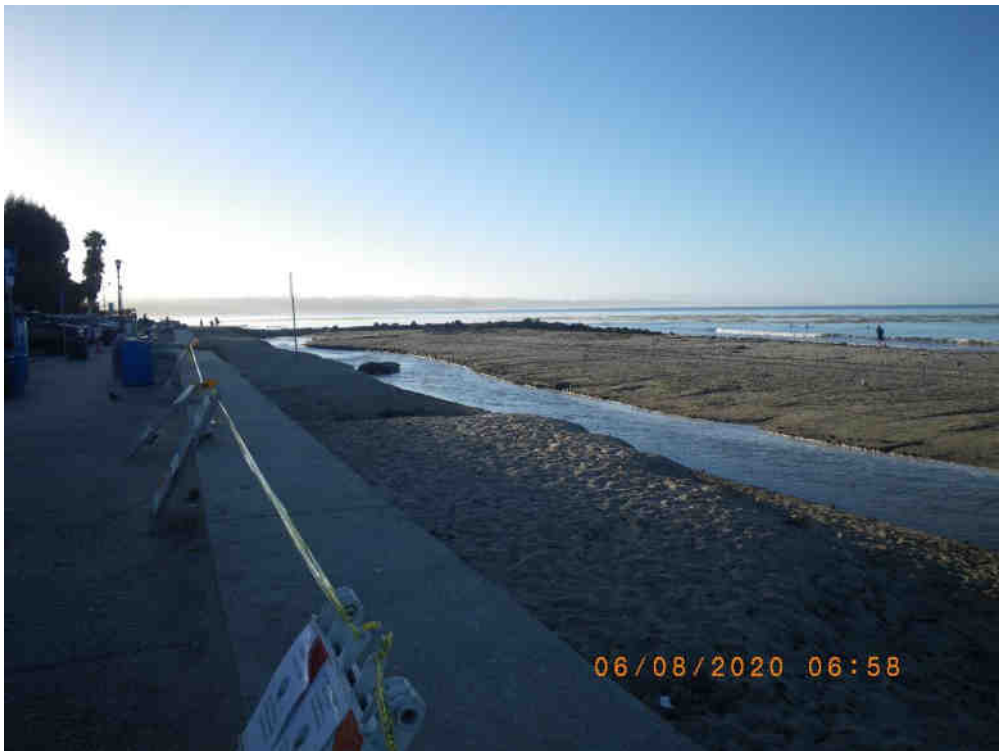
Table 1. Observation and relocation of fish during sandbar construction, 2020.

Date	Location	Tidewater goby (Observed/ Relocated)	Juvenile Steelhead (Observed/ Relocated)	Threespine stickleback (Observed/ Relocated)	Staghorn sculpin (Observed/ Relocated)	Prickly sculpin (Observed/ Relocated)
6-8-2020	Lateral Channel	0/0	16/16	0/0	3/1	0/0
6-9-2020	Upstream of Stockton Ave Bridge	0/0	1/1	50+ YOY/ 50+ YOY	0/0	11/11
6-11-2020	Upstream of Stockton Ave Bridge	0/0	0/0	0/0	0/0	1/1

Monitoring of Flume Maintenance and Sandbar Construction

8 June 2020. The fishery biologist, Alley, arrived at 0653 hr. The gauged discharge at Soquel Village was 7.2 cfs at 0600 hr. The estuary was full to just above the top of the flume. There was a relatively large amount of sand deposited on the beach after a dry winter/spring, especially west of the flume. The typical lateral channel developed across the beach prior to sandbar construction, and went diagonally across the beach to the upper end of the jetty. The channel was narrow (12-15 feet wide) and the current was more than 1 ft/s. The bottom was uniformly sandy. The bull-dozer was checked for fluid leaks before it was operated this day by Matt Kotila, and none were found. The beach around the bull-dozer was inspected for animals before it was moved. The lagoon periphery was surveyed for salmonids up to Noble Gulch, 0700 hr – 0735 hr, with none observed. The lateral channel was partially blocked off at 0715 hr and seined for fish. It was completely blocked off at 0847 and dipnetted for fish, with captured fish relocated to underneath the Stockton Bridge. The bull-dozer operator, Matt Kotila, did not cut an outlet channel along the flume this day. Therefore, no raking of kelp or seagrass occurred. Cracks in the flume were patched at low tide with concrete applied on its roof near the flume exit. After the flume was cleared of sand, the stream flowed through the flume by 1356 hr. Kotila stockpiled sand from the lower beach as he graded it to the upper beach around the lagoon periphery. This would prevent tidal overwash overnight. The biologist left at 1521 hr as the lateral channel was being covered over with sand.

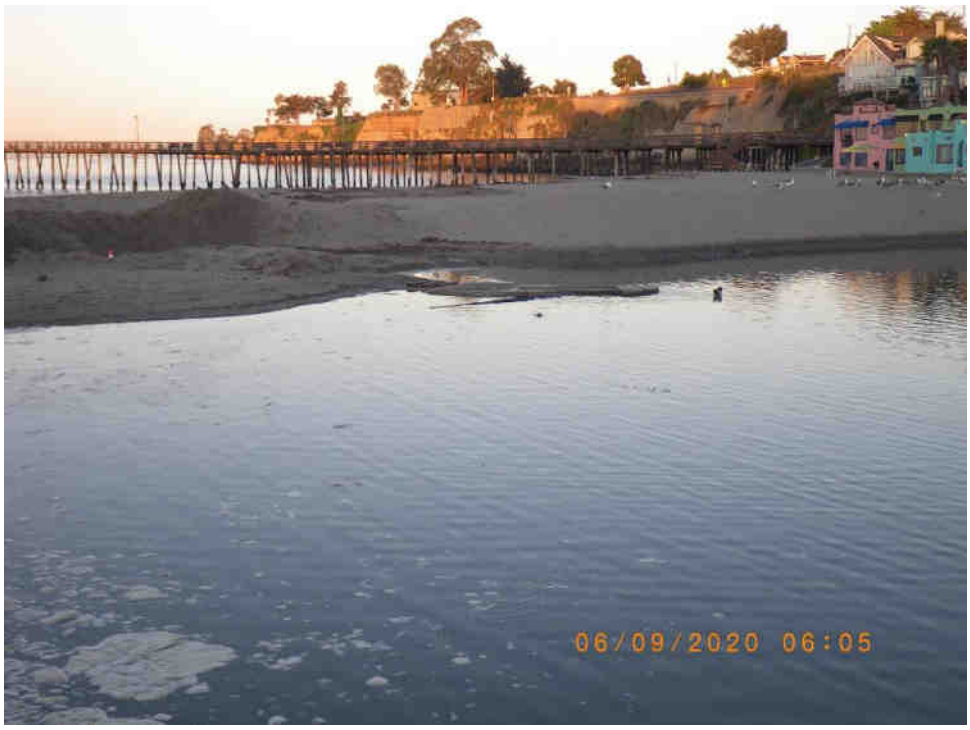
Soquel Estuary during flume clearing of sand, prior to sandbar construction.
8 June 2020



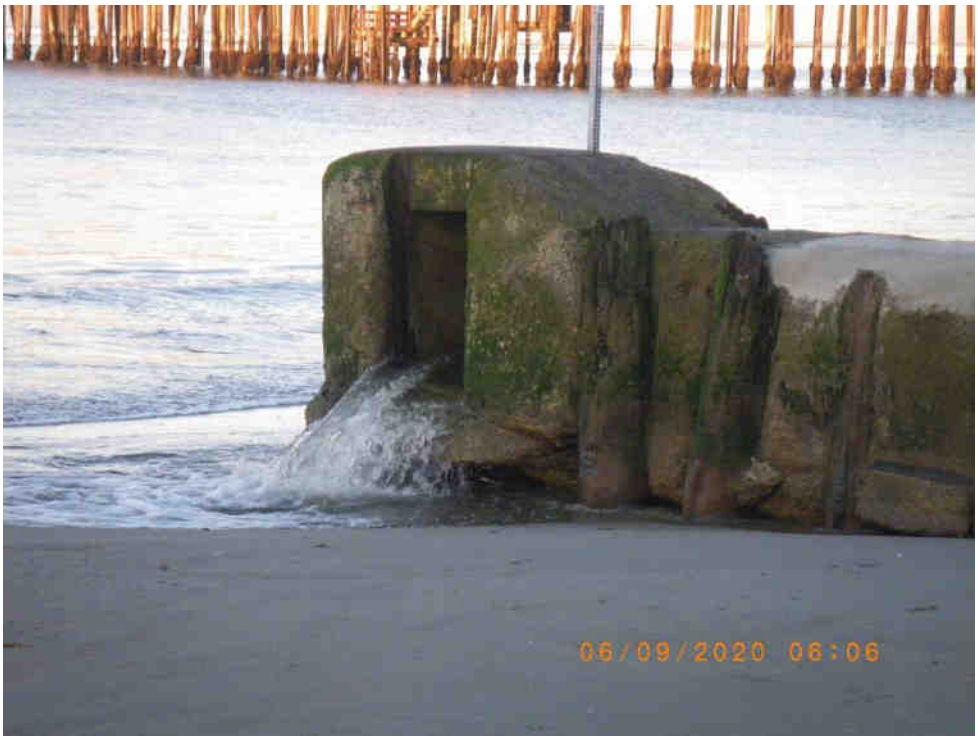
Lateral channel flowing diagonally across the beach to the end of the jetty. 8 June 2020

Flume cleared of sand with its first flush of streamflow from the lagoon that had overtopped the flume before clearance. 8 June 2020

9 June 2020. The biologist arrived at 0603 hr. The flume was functioning as it outletted water from the lagoon. The lagoon water level was at the top of the flume. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected for animals before it was moved. The gauged discharge at Soquel Village was 7.2 cfs at 0600 hr. The sand berm around the lagoon margin remained overnight, and the lagoon had filled up and spilled over the top flashboard. Smolt steelhead passage through the flume was maintained through the night. The lagoon periphery was walked by the fishery biologist, 0615 hr – 0740 hr, and no fish or mergansers were observed. The outlet channel was cut alongside the flume, and the sandbar was breached at its head by Kotila by 0700 hr. The outlet channel was flowing alongside the flume on the east side. The lagoon evacuated slowly at a rate of 1.0 feet loss in elevation per hour for the first hour but rapidly after that to a partially evacuated state. The lagoon margin was gentle for about 15 feet into the lagoon but dropped off sharply to the center of a well-scoured basin. A deep, slackwater zone existed from the Venetian Court wall upstream 100 m beyond Stockton Bridge. Six Public Works staff began raking at 0745 hr. The biologist surveyed the estuary margin for isolated pools and stranded fish from 0745 to 0855 hr. Rescued fish that were relocated to the main lagoon channel included 11 adult prickly sculpin, 2 adult and 50+ YOY threespine stickleback and 1 YOY steelhead. Isolated pools were lacking in the estuary with a down-sloping margin except just downstream of the Golino cabin and the Shadowbrook Restaurant. No piscivorous birds were observed. The lagoon bottom downstream of Stockton Bridge and along margins of the lagoon beyond Stockton Bridge was very soft with considerable decaying plant matter beyond recognition. Raking was difficult and restricted to within 75 feet of the flume. Raking was suspended as a school of 20-30 steelhead smolts were observed migrating to Monterey Bay through the outlet channel. During the upstream survey to Nob Hill, no salmonid or lamprey redds were observed. Several clumps of cattails survived the generally mild winter and one bankfull stormflow in April in the backwater under the railroad trestle. More scour had occurred there over the winter/spring, and the bottom was boulder and cobble strewn upstream of Stockton Bridge. During the walk upstream, gulls were bathing as a group in Reach 3 It was unusual for gulls to congregate in Reach 3 before 2019. The west side of the lagoon required no grading or berm establishment except near the Venetian Court wall. Morrison and Alley checked the plumbing under Esplanade Restaurants and observed no leakage. Restaurant plumbing had been previously pressure tested (**Appendix A**). The sand around the flume inlet was contoured before the lagoon filled. Sand was contoured along the lagoon margin between the flume and the restaurants. The bull-dozer did not enter the water during these activities. After raking ended, the estuary was allowed to clear up, and the sandbar was closed by Kotila at 0920 hr. A school of 20 steelhead smolts and an adult steelhead were observed downstream of the Stockton Bridge from the Stockton Bridge after sandbar closure. It was unusual to see steelhead smolts still leaving Soquel Creek this late in the year. The biologist left the lagoon at 1150 hr after work around the lagoon margin was ended.



Lagoon filled overnight with steelhead adult and smolt passage over the flashboards.
9 June 2020

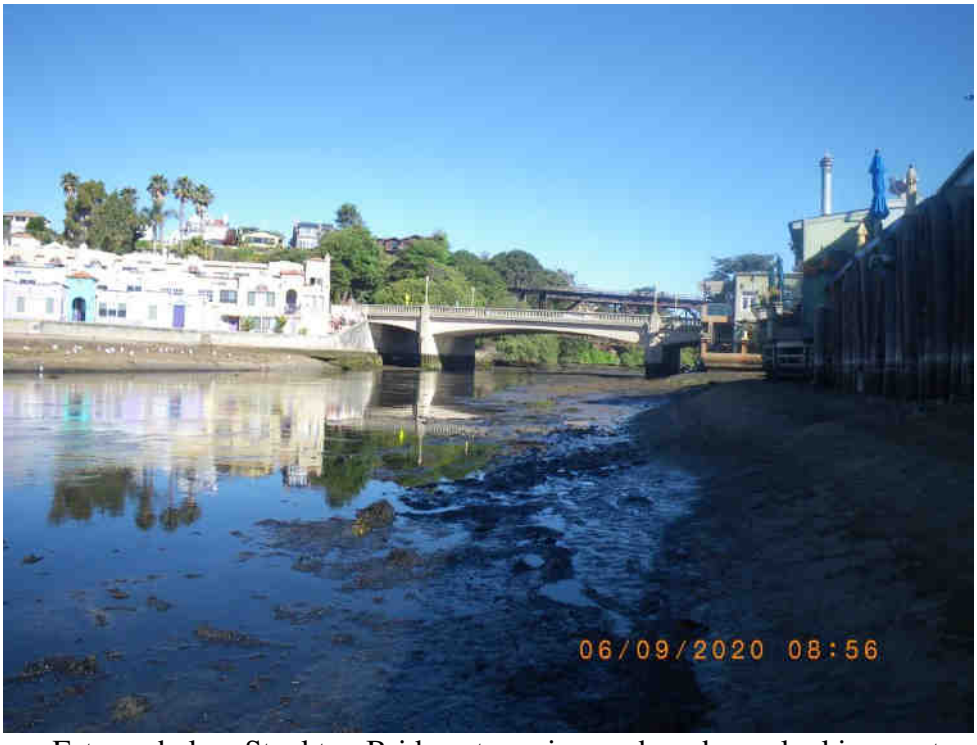


Streamflow passing through the flume overnight to provide steelhead smolt passage.
9 June 2020

Cattails planted in 2017, surviving in railroad trestle cove. 9 June 2020

Lagoon draining through breached sandbar. 9 June 2020

Raking of rotting kelp and seagrass near outlet channel. 9 June 2020



Lower Estuary below Stockton Bridge at maximum drawdown, looking upstream. 9 June 2020

Estuary, looking upstream from Stockton Bridge at maximum estuary drawdown. 9 June 2020

Kotila contouring around the flume inlet after sandbar closure. 9 June 2020

10 June 2020. The sandbar was not breached this day as water outletted through the flume. The previous night, the lagoon level rose to within 16 inches of the top of the flume, preventing smolt

passage overnight. No work was done around the lagoon margin, and no fishery monitoring was required.

11 June 2020. The fishery biologist arrived at 0656 hr. The gauged discharge at Soquel Village was 7 cfs at 0600 hr. The lagoon was full overnight, allowing smolt passage through the flume. Kotila had removed 2 flashboards from the flume inlet at 0630 hr to reduce the speed of drainage, minimize the width of the outlet channel and minimize the sand lost from the sandberm when the sandbar was opened at 0800 hr. The lagoon evacuated very slowly. The biologist surveyed up the lagoon for isolated pools and stranded fish, 1013−1110 hr. One prickly sculpin was relocated to the main channel. No mergansers were observed, Gulls were congregating in Reach 3, downstream of Noble Gulch confluence. Considerable sediment was observed inside the Noble Gulch culvert and at the mouth of Noble Gulch. Clear visquine was spread around the flume inlet and secured with sandbags. Then it was covered with sand by hand shovel. Sandbags were placed around the flume inlet to prevent seepage underneath. The biologist raked kelp and seagrass into the outlet channel. Plywood was installed at the base of the flashboards to prevent water leakage into the flume from lower down that would inhibit filling of the lagoon and maintaining the level during a dry summer. The weir inside the flume remained to create a pool at the flume inlet for fish entering. An underwater portal for adult and smolt steelhead out-migration was constructed. The sandbar was closed for the season by Kotila at 1227 hr. The bull-dozer was used to increase the berm elevation along the lagoon margin between the flume and the restaurants. Sheetmetal covers had been installed over sidewalk drains previously. The biologist left at 1400 hr. Later that day, the eastern berm was extended to the Venetian Court wall.

Lagoon filled overnight, and 2 boards were removed at 0630 hr to reduce the head of water when the sandbar was opened 11 June 2020

Visquine covered with sand by hand shovel, with sandbags around the flume inlet.
11 June 2020

Weir inside flume intact, creating a pool for fish at inlet. 11 June 2020

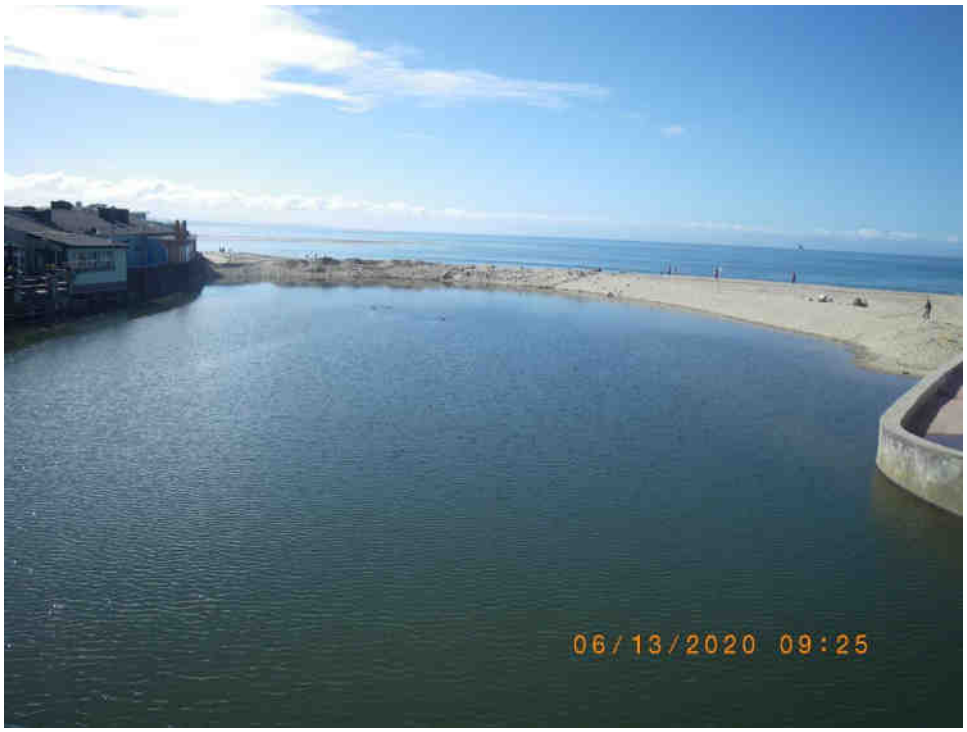
Underwater portal constructed with flashboards installed to the top of the flume inlet. 11 June 2020

Kotila packing sand under and beside the flume during sandbar closure to reduce seepage from the lagoon to the Bay. 11 June 2020

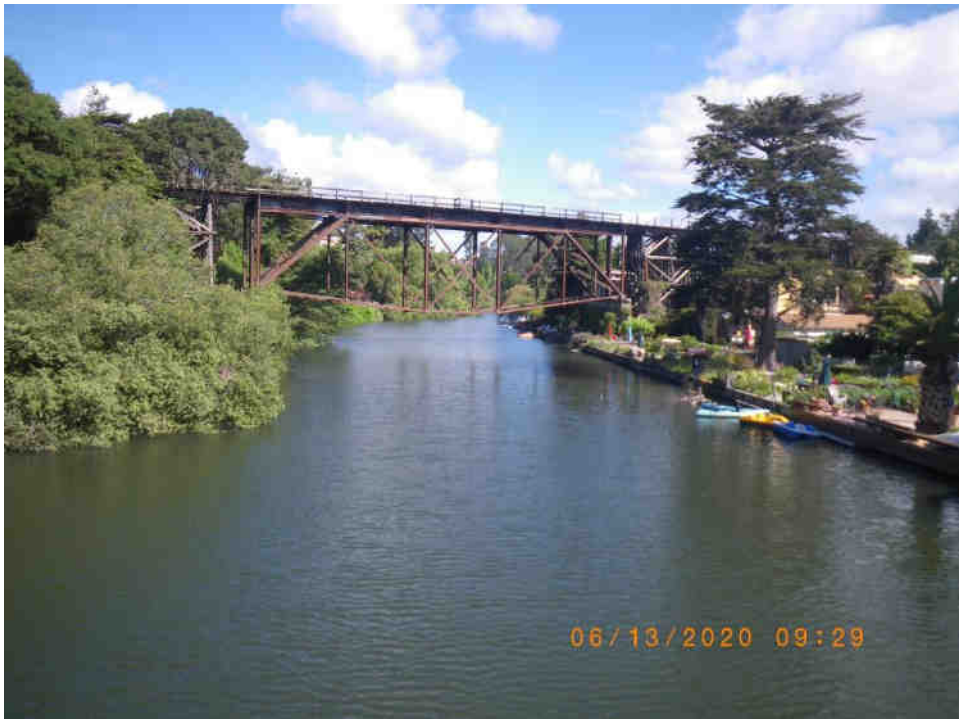
Lagoon filling after sandbar closure, showing steep drop-off created by good spring stormflow scour to deepen the lagoon. 11 June 2020

13 June 2020. The biologist visited the lagoon to observe the completed creation of the lagoon and berm around its periphery. The lagoon was full with a functioning flume. Gage height was an excellent 2.60. The berm was connected to the Venetian Court wall. An adult pied-billed grebe was observed in the lagoon, across from the mouth of Noble Gulch.

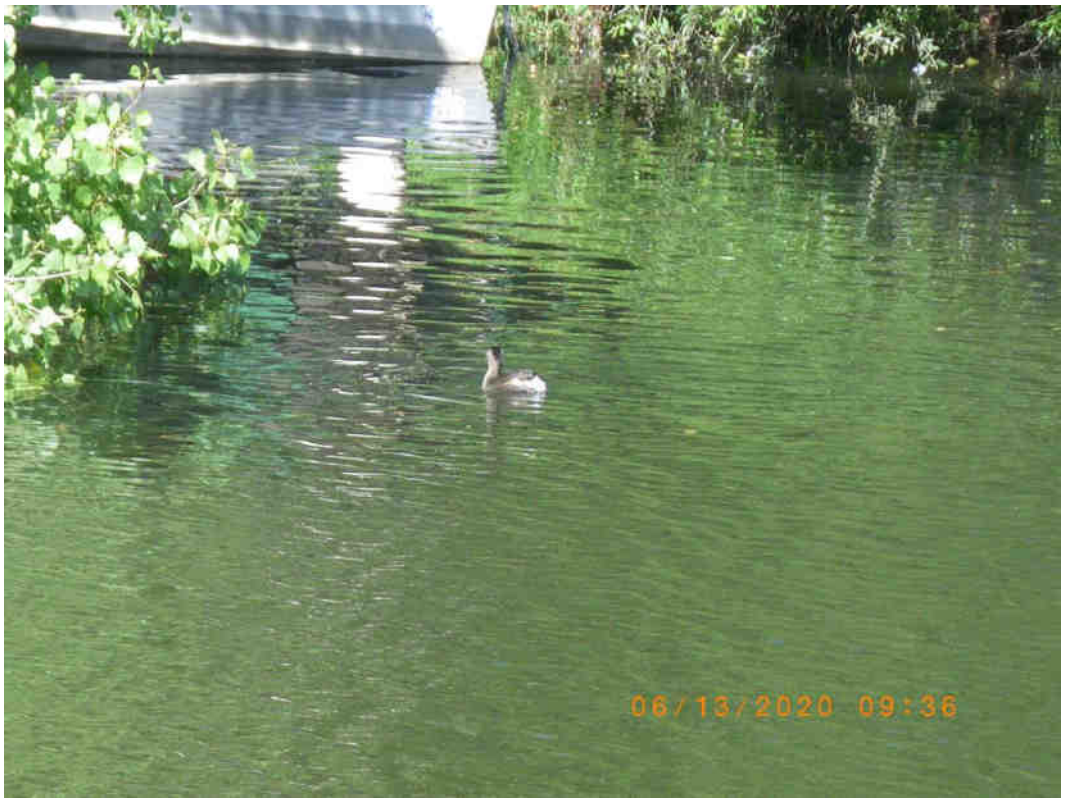
Sandberm tied into Venetian Court wall. 13 June 2020



Lower Soquel Lagoon, Reach 1 below Stockton Bridge. 13 June 2020



Middle and upper Soquel Lagoon, Reaches 2 and 3 above Stockton Bridge.
13 June 2020



Adult pied-billed grebe observed across from mouth of Noble Gulch. 13 June 2020

16 June 2020. The biologist visited the lagoon to detect any remaining salinity in the lagoon. The lagoon was full with a functioning flume. Gage height was an excellent 2.70. No saltwater was detected in the deep pocket beside the Venetian Court wall or at the bridge abutments. Therefore, no shroud needed to be installed on the flume inlet to draw saltwater off the lagoon bottom. At 1320 hr, water temperature ranged from 20.6 ° C at the surface to 19.6° C at the bottom at 2.0 meters, adjacent to the Venetian Court wall. Oxygen ranged from 9.75 to 7.87 mg/L from the surface down through the water column to 1.75 m from the surface. Then it abruptly declined to 0.53 mg/L at the bottom at 2 m. green from an algae bloom developing. The biologist recommended that the underwater portal be left in place until stream inflow is insufficient to maintain the high lagoon level. Temperature probes were launched in the lagoon and upstream at Nob Hill on 17 June.

Effects of Sandbar Construction on Salmonids and Tidewater Goby in 2020

No tidewater gobies, 15 YOY steelhead and 2 steelhead smolts were observed and relocated during sandbar construction in 2020 after a mild winter/spring with one late, bankfull event in April. Only two artificial breachings of the sandbar were necessary during sandbar construction. Tidewater gobies were captured during fish sampling in October 2020. Therefore, tidewater gobies were present in June 2020, and they were likely in small numbers and using the upper estuary to avoid tidal action and salinity during the sandbar construction. They would need to retreat to the deeper slackwater in the main channel as the estuary drew down. There were only two isolated pools found in 2020 during drawn. One was downstream of the Golino property

where old wooden pilings formed a wall out in the channel to cause isolation. Threespine sticklebacks were rescued from this pool. The other was near the Shadowbrook Restaurant wall. One YOY steelhead was rescued from it. But no tidewater gobies were found. These lower estuary locations were subject to tidal influences that would prevent tidewater goby nesting. A well defined, bathtub-like margin still existed in the estuary in 2020 except for the tidally influenced mid-channel bars up and downstream of the railroad trestle. The gradual, bathtub-like margins allowed easy retreat of fish into deeper water in the more freshwater upper estuary. We detected no tidewater mortalities during sandbar preparation, though habitat disturbance occurred during each artificial sandbar breaching. However, we judged impacts to any tidewater gobies that were present to be minimal during sandbar construction.

The channel in lower Soquel Creek lacks sheltered backwaters for tidewater gobies to escape high water velocities during high stormflows, except possibly under the restaurants. 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 grow and multiply. Tidewater goby populations that have re-occurred during the dry years of 2008, 2009, 2013−2016 and 2018 and the wet year of 2019 may be transitory.

Fourteen YOY steelhead were captured in the lateral channel and relocated at the Stockton Bridge near wood cover. This indicated that YOY had begun moving into the estuary from spawning areas above the lagoon. A small mid-May stormflow of about 60 cfs may have encouraged YOY to drift into the estuary. With the late sandbar closure in 2020, most smolt outmigration had likely been completed. Salmonid smolts drift downstream at night. During the sandbar construction period, smolts had access to the Bay through the flume except for 2 nonconsecutive nights. Data collected on smolt outmigration and YOY downstream movements in the lower San Lorenzo River just above the estuary in the late 1980's indicated that smolt out-migration had ended by June and YOY had begun drifting into the estuary (**Alley, personal observation**). Potentially predatory mergansers were not observed during sandbar construction. No salmonid mortalities were observed in 2020. Deeper slackwater existed upstream of Stockton Bridge on the west side for about 100 m under overhanging willows providing shade and cover. These areas offered refuge for juvenile steelhead during the two artificial estuary drawdowns. The lower lagoon bottom was uniformly wide and flat to minimize water velocity. Because the high water velocity section near the top of the outlet channel was short and because considerable slackwater refuge existed during drawdown, we judged impacts to steelhead to be minimal during sandbar construction.

The seasonal effect of removing organic material and constructing the sandbar is to create good summer rearing habitat for salmonids and tidewater goby. Compared to allowing natural lagoon formation, a lagoon is created with cooler, deeper, freshwater conditions, with reduced potential for eutrophication and associated increased biological oxygen demand from plant decomposition and nighttime respiration by live algae. Kelp and sea grass removal, when necessary, and sandbar closure create better fish habitat for tidewater goby and salmonids than if the sandbar was allowed to close naturally. Natural sandbar formation would allow considerable kelp and sea grass to become trapped in the lagoon to decompose, as would have been the case in 2020. Under natural sandbar conditions, a lagoon would have formed with much more saltwater trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon

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

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 management goal is to pass stormflow through the flume from the first small storm events in the fall while keeping the lagoon surface below the original bolt. This is done by the City removing boards from the flume inlet prior to and during increased stormflow. Water also flows through the top grate 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.

In 2020, a notch across the beach was cut 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.

In preparation for the first major storm forecasted in the winter season, on 26 January 2021, Public Works added 2 flashboards to the restaurant side of flume inlet, leaving one board out on either side to prevent wood from jamming the flume inlet during stormflow. On 26 January, the inner and outer berms on the beach were reduced in height to minimize the hydraulic the head on lagoon at the time of sandbar opening so as to minimize estuary evacuation and minimize water velocity. Kotila collected a water sample in the lagoon earlier in the afternoon on 26 January, prior to sandbar opening.

Soquel Creek connected with the Bay at the end of the day, 26 January 2021. Gage readings at Soquel Village began elevating rapidly after about 1130 pm on 26 January. Morrison traveled to lagoon and arrived at approximately midnight to observe sandbar conditions. The sandbar had

breached a few minutes before his arrival, and the stream was flowing through the cut notch in the beach, approximately 10 feet wide and 0.5 ft as it passed across the beach. The streamflow estimate at the Soquel Village gage was approximately 23 cfs at midnight, and rainfall was heavy in Capitola at the time. Streamflow at the beach was likely more than 30 cfs at the time of the sandbar opening with contributions from Noble Gulch and urban surface runoff in Capitola. The biologist, who lives in the Santa Cruz Mountains where heavy rainfall and wind were occurring, decided it unsafe to travel to the lagoon at the time of sandbar opening because roads may soon close if trees blew down, which in fact occurred overnight. However, Morrison was present at the creekmouth just as the creek was exiting across the beach and observed no fish mortality. Morrison observed that the estuary water surface elevation increased to within 0.5 feet of the piling bolt that indicated the elevation of flooding conditions along the lagoon bulkhead before it began to recede. Thus, flooding was prevented.

The streamflow increased through the early morning of **27** January 2021 to a maximum estimated 450 cfs by 0800 hr at the Soquel Village gage. Kotila collected another water sample on the morning of 27 January in the surf near the exiting stream channel and delivered the before and after sandbar opening samples to Monterey Analytical. Lab analysis indicated that the pre-opening enterococcus bacterial count was less than 10 cfu/100 ml. The post-opening count was also less than 10 cfu/100 ml, requiring no additional weekly water sampling because the count was less than 104 cfu/100 ml. Another storm on 28 January increased stormflow to approximately 2,000 cfs at Soquel Village.

No fish mortality or water quality problems were observed during the sandbar opening. Streamflows are provisional and subject to change. Streamflow at the lagoon was somewhat higher than flows measured in Soquel Village once it reached the lagoon due to added surface runoff in Capitola and contributions from Noble Gulch.

27 and 29 January 2020. This was the day after and 2 days after the sandbar opening. The sandbar was open to the Bay at low tide due high streamflow on both days. City staff member, Kailash Mozumder, took pictures of the estuary on 27 January after the stormflow that opened the sandbar. Alley took pictures on 29 January after another large stormflow. See photos below. The estuary was flowing from bank to bank on both days. On 29 January, the water was muddy. The lagoon gage height at approximately 0.8 ft. Streamflow was approximately 200 cfs at Soquel Village, and there was an incoming tide at midday. No fish mortality was observed.

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ELAP Certification Number: 2385

Monday, February 1, 2021

Lab Number: 210127_06-01

Collection Date/Time: 1/26/2021 14:00 Sample Collector: Kotila M Client Sample #:
Received Date/Time: 1/27/2021 10:22 System ID: Coliform Designation:

Sample Description: Ocean

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time	Analyst
Enterococci	Enterolert	MPN/100mL	<10	BV	10	10	1/27/2021 16:24	MW

Comments: BV: Sample received after holding time expired.

Lab Number: 210127_06-02

Collection Date/Time: 1/27/2021 8:00 Sample Collector: Kotila M Client Sample #:
Received Date/Time: 1/27/2021 10:22 System ID: Coliform Designation:

Sample Description: Cap Beach

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time	Analyst
Enterococci	Enterolert	MPN/100mL	<10		10	10	1/27/2021 16:24	MW

Comments:

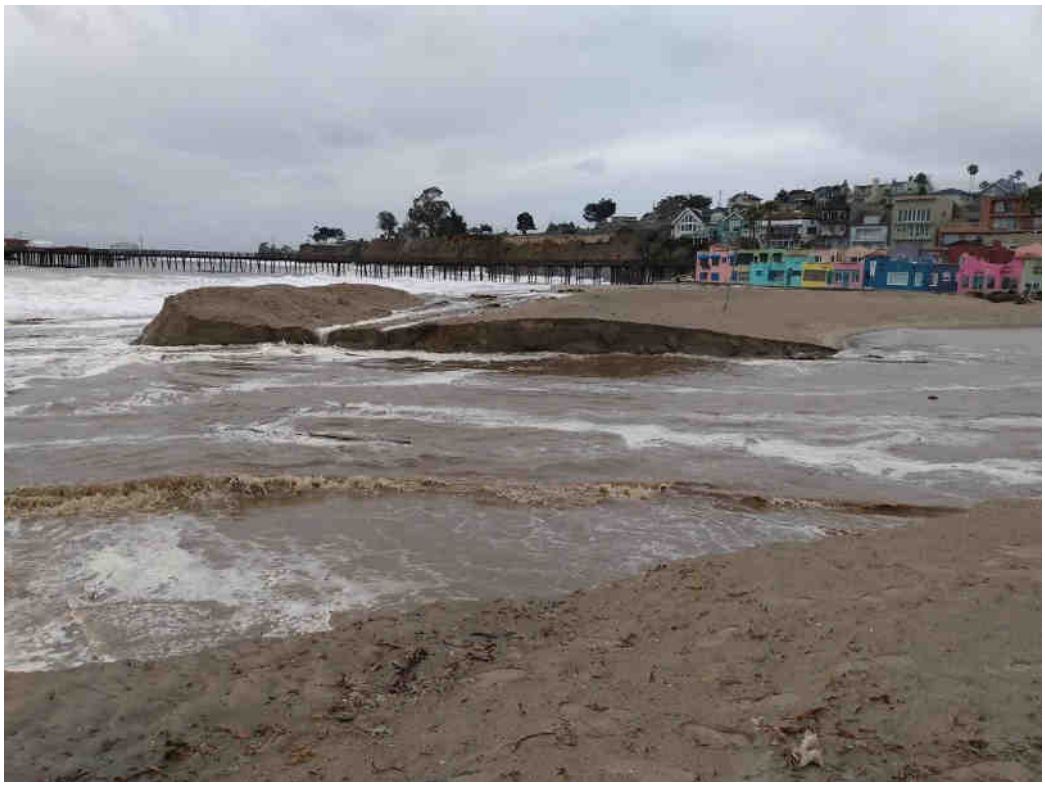
Report Approved by: David Holland, Laboratory Director

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.

Outlet channel through sandbar after opening, with Wharf lights in distance (Morrison photo).
Midnight- 26 January 2021

Soquel Creek stormflow after 1-26-21 sandbar opening, viewed from railroad trestle looking downstream at high tide (Mozumder photo). Between 0930 and 0945 hr, 27 January 2021.

Soquel Creek stormflow after 1-26-21 sandbar opening, viewed from upstream of Stockton Avenue Bridge looking downstream at high tide (Mozumder photo). Between 0930 and 0945 hr, 27 January 2021.



Soquel Creekmouth at high tide (Mozumder photo).
Between 0930 and 0945 hr, 27 January 2021.

Soquel Estuary during incoming tide, looking upstream from Stockton Bridge with approximately 200 cfs streamflow. 29 Jan 2021.

Lower Soquel Estuary during incoming tide with approximately 200 cfs streamflow. 29 January 2021.

Soquel Creekmouth during incoming tide (flume visible) with approximately 200 cfs streamflow.
29 January 2021

WATER QUALITY MONITORING IN 2020

Rating Criteria

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

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

in late afternoon or early evening (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-4º C from a morning minimum, after a sunny, fog-less day.

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

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

Locations and Timing of Water Quality Monitoring

As required under the CDFW permit for 2018, water quality was monitored in late afternoon, as well as in the early morning near first light. Water quality was monitored at four lagoon stations and one stream station. Station 1 was at the flume inlet (**Figure 1**). Station 2 was just downstream of the Stockton Avenue Bridge in the deepest thalweg area. Station 3 was just downstream of the railroad trestle on the east side. Station 4 was at the mouth of Noble Gulch. Station 5 was monitored in the morning and afternoon in Soquel Creek near the Nob Hill shopping center, just upstream of the lagoon. Stream data were compared to lagoon conditions of water temperature and oxygen levels in early morning.

As required by the CDFW permit for 2020, 6 HOBO temperature loggers were launched on 17 June, just downstream of the railroad trestle in Reach 2 (as in 2008−2019) 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 11 October 2020 prior to any rain.

Water quality in terms of oxygen concentration, temperature, conductivity and salinity was measured at each lagoon station at two-week intervals after the sandbar was constructed until the sandbar breached in the fall. Prior to the first full monitoring, salinity was measured in deeper portions of the lagoon to determine if saltwater had been trapped during sandbar construction. No saltwater was detected in 2018 in the lagoon 4 days after the sandbar closure. Thus, the

biologist judged that the inlet shroud was unneeded to pull saltwater off of the bottom.

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

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

Water Temperature Goals for Soquel Creek and Lagoon

Regarding Soquel Creek Lagoon in summer, where food is more abundant than upstream, the temperature management goal for steelhead should be to maintain water temperature below 20ºC at dawn within 0.25 m of the bottom and below 22ºC near the bottom in the afternoon, with the 7-day rolling average near the bottom equal to 21°C or less. This early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). This lagoon management goal is somewhat higher in temperature than the enhancement goal 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 temperatures between 20 and 24ºC were responsible for high maintenance requirements and low conversion efficiency of food into growth for his stock of juvenile steelhead. However, measurement of juvenile steelhead from Soquel Lagoon indicates that growth rate has been greater than in upstream stream reaches (**Alley 2008a; 2008b**), with nearly all young-of-the-year juveniles rearing in the lagoon reaching soon-to-smolt size the first summer each year. This indicates that despite higher water temperature in the lagoon, growth rate of juveniles is rapid because food is abundant. The Farrel et al. (**2015**) work indicated that near peak activity (at least 95%) can be maintained up to 24.6˚C in warm-water acclimated steelhead in the Toulumne River, and the Myrick and Cech (**2005**) work with steelhead indicated that growth rate increased with temperature provided that food was abundant.

Water temperatures above 20ºC (68ºF) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and lagoon temperatures below 16ºC (60.8ºF) are preferred (**J. Smith, personal communication**). Therefore, the management target for making Soquel Creek Lagoon habitable for coho should be to maintain summer water temperature below 20ºC (68ºF). The 2010 lagoon was the coolest in the previous 20 years, with relatively high baseflow and deeper lagoon. Water temperature near the bottom exceeded 20° C for a 3-day period in early June and a 4-day period in mid-July. However, it is unlikely that Soquel Creek Lagoon may cool sufficiently to support juvenile coho salmon in most years.

The management goal for water temperature in stream habitat upstream of the lagoon should be

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

The temperature optimum is a moving target, increasing and decreasing with food supply. As stated earlier, according to Moyle (**2002**), Baltz et al. (**1987**) reported that optimal temperatures for growth of rainbow trout (not steelhead) to be around 15-18ºC, a range that corresponded to temperatures selected in Sierran streams when possible. As stated earlier, according to Moyle (**2002**), regarding temperature optima, "*many factors affect choice of temperatures by trout (if they have a choice), including the availability of food*." As stated earlier, the Santa Ynez River Technical Advisory Committee (SYRTAC) proposed guidelines with upper limits of 20ºC average daily temperature and 25ºC daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River, south of the Santa Maria River (**SYRTAC 2000**), much further south of Soquel Creek and the Santa Maria River and in the southern ESU for steelhead. The SYRTAC (**2000**) decided that a mean daily temperature of 22ºC may be the threshold between acceptable and unsuitable from a long-term perspective. This was based on studies by Hokanson et al. (**1977;** Cited in Santa Ynez River Technical Advisory Committee 2000), who concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23ºC.

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

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Water Level

Appendix A provides detailed water quality and lagoon height data. The lagoon level was monitored 5 days after sandbar closure (16 June) and 16 times at 2-week intervals from 27 June 2020 to 23 January 2021. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was rated "good" throughout the monitoring period. The sandbar opened on 26 January due to stormflow that exceeded the capacity of the flume.

Gage height in 2020 was consistently near the highest recorded through the last 4 years at above a gage height of 2.50 until mid-November (**Figure 2**). 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. Also, in 2020 the water seepage into the lower portion of the flume inlet was reduced with newly fabricated flashboards that sealed the opening better. After that a series of small stormflows required flashboard removal to maintain light penetration to the bottom followed by re-installation as water clarity increased. On monitoring days that followed, the lagoon level was still in the good range. During the summer, baseflow was near the seasonal median, allowing good management of the flume inlet to maximize lagoon depth through the dry period. 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. No saltwater was detected on the lagoon bottom in the deep pocket adjacent the Venetian Court wall on 16 June, 5 days after final sandbar closure for the season. Therefore, the shroud was not installed on the flume inlet. No vandalism of the flume inlet was detected in 2020.

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 2020. The flume outlet was maintained open throughout the sandbar construction period. Nocturnal smolt passage was not delayed during sandbar construction.

Once sandbar construction was complete, the Venetian side of the flume inlet was left completely boarded up. The underwater portal was provided for adults through 15 June as required by the permit, and was removed by 11 July. The flume outlet remained open continuously until the sandbar opening on 26 January. The streamflow at the Soquel Village USGS gage was an estimated 23 cfs and streamflow likely above 30 cfs at the lagoon at the time of the opening, with stormflow reaching an estimated 450 cfs in the next 8 hours. The stormflow at the flume was somewhat higher than at the gage due to surface street runoff and contributions from Noble Gulch. The flume capacity is 25-30 cfs at best. 28 January brought another stormflow that reached 2,000 cfs at Soquel Village gage. The sandbar was open at the time of this reporting, with a streamflow of 30 cfs on 1 February and over 114 cfs on 2 February after rain overnight.

Water Temperature Results from Two-Week Monitoring

In 2020, early morning water temperature of stream inflow at Nob Hill was similar to that of the higher baseflow year of 2019 (well above the median) despite much lower baseflow year of 2020 (slightly below the median) (**Figure 3e**). It was warmer than 2019 in late June, late August and early October. But it was cooler than 2019 in late August and early September, possibly due to smoky conditions. Water temperature near the bottom at lagoon monitoring stations in 2020 followed a different pattern, it being warmer than in 2019 from late June to mid-August but cooler than 2019 in late August and early September during smoky conditions caused by the CZU fire (**Figures 3a-3d; 3h**). Morning air temperatures at the flume in 2020 were noticeably warmer than in 2019 in mid-August and mid-September through mid-October, and may have contributed to the warmer lagoon water temperatures in mid-August and early October 2020 (**Figure 3f**). These annual differences in water temperature typically paralleled differences in early morning air temperatures between the years except in mid September 2020 when air temperature was warmer than in 2019 but 2019 water temperature was warmer than in 2020. The warmer stream inflow in 2019 at that time may have overshadowed differences in air temperature measured at the beach (**Figure 3e**). Morning water temperature near the bottom at lagoon monitoring stations closely paralleled the cooler inflow water temperature and was 1.5−2°C warmer than the inflow temperature for late June to late October (**Figure 3g**).

In 2020, water temperatures near the bottom at dawn were generally similar through the dry season from June to late September, with a peak in mid-August and did not increase in late August and September as they had 2019 (**Figure 3g**). But water temperature in September and October in 2020 was warmer than in the similar baseflow year of 2018, presumably because of the much warmer air temperatures in 2020 at that time (**Figures 3f and 3h**).

In 2020, *water temperatures near the lagoon bottom in the early morning* were rated "good" (<=20°C) at all stations during 2-week monitorings except "fair" ratings at some stations in early and late August (**Tables 2 and 3**). A reasonable assumption would be that daily water temperature would not increase more than 2°C from the morning low. Thus, 22°C maximum daily water temperature goal may have been exceeded at monitoring stations on 9 and 22 August, as was the goal to have early morning water temperature not exceed 20°C.

At the mouth of Noble Gulch in 2020, as in most years, the water temperature near the bottom in the morning was usually cooler than other lagoon monitoring sites by 0.5−1.5°C from June through late October (cooler on 15 of 16 monitoring dates than all other sites) (**Figure 3g**). The slightly cooler conditions resulted from cooler Noble Gulch inflow that traveled along the lagoon bottom at its mouth.

In most years, morning lagoon water temperatures near the bottom are coolest at the upper Station 4 (mouth of Noble Gulch) and warm progressively downstream (**Figure 3g**). However, in 2020, Station 2 in the deep area below Stockton Bridge, water temperature near the bottom was slightly warmer than at the flume on many occasions.

Table 3. 2020 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)
16June20 (Station 2 only)	open	2.70 good	good	good	good	5.6 cfs
27June20	open	2.62 good	good*	good fair good good	good	4.2 cfs
11July20	open	2.60 good	good	good	good	2.9 cfs
25July20	open	2.62 good	good	good	good	3.1 cfs
09Aug20	open	2.58 good	fair good good good	good ` `	good	2.9 cfs
22Aug20	open	2.51 good	fair fair fair good	good good good fair	good	2.0 cfs
05Sep20	open	2.57 good	good	good	good	1.3 cfs
19Sep20	open	2.60 good	good	good	good	1.1 cfs
03Oct20	open	2.60 good	good	good	good	1.1 cfs
17Oct20	open	2.65 good	good	good good fair fair	good	0.9 cfs
31Oct20	open	2.62 good	good	good	good	2.0 cfs
15Nov20	open	2.46 good	good	good	good	4.5 cfs (leaf dam artifact?)
28Nov20	open	2.46 good	good	good	good	2.0 cfs
12Dec20	open	2.56 good	good	good fair Fair good	good	4.4 cfs
26Dec20	open	2.55 good	good	good	good	2.0 cfs

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow Estimated @ 0.5 cfs less than Soquel Village Gage Readings (cfs)
09Jan21	open	2.32 good	good	good	good	4.5 cfs
23Jan21	open	2.32 good	good	good	good	4.5 cfs

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

Water Temperature Results from Continuous Data Loggers

In analyzing water temperature data from the 6 data loggers down the water column in the deepest portion of the lagoon, just downstream of the railroad trestle, results were consistent with temperature data collected at 2-week intervals through the water column at monitoring stations over the past 30 years. All lagoon water temperature management goals for steelhead were met in 2020 except for 4 weeks in August when the 7-day rolling average near the bottom exceeded 20°C and went as high as 21.8°C (**Figure 4a-f**). Water temperatures were warmer than in 2019 when all management goals were met (**Figure 4g**). The following analysis pertains to the vicinity of these continuous data loggers only. Keep in mind that our 2-week monitoring at Station 3 near the trestle was closest to these data loggers.

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.

As in past years, lagoon water temperatures near the bottom in 2020 somewhat reflected water temperature of stream inflow (**Figures 4a-f; 5a**). Daily temperature *maxima* and *minima*, as well as maximum, minimum and average 7-day rolling averages in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2020 (**Table 4**).

In 2020, early morning water temperature of stream inflow at Nob Hill was similar to 2019 in June and July and then in September (**Figures 5a-b**). But it was warmer than 2019 in August. Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead, making that a management goal to maintain a daily water temperature maximum below 22ºC near the bottom. This goal was met in 2020 at the data logger location near the bottom and at all monitoring stations (**Figures 3a-3d; 4a**). Another lagoon management goal is to maintain early morning maximum water temperature below 20°C near the bottom. In 2020, this management goal was met at the data logger location near the bottom except for a week in mid-August and at all monitoring stations except on 9 August at Station 1 (Flume) and 22 August at the lower 3 stations, excepting Station 4 (Noble Gulch). The highest water temperature near the bottom on 22 August was 20.5°C. A third lagoon management goal is to maintain the daily 7-day rolling average at 21°C or less near the bottom. This goal was met at the data logger location except for a week in August.

We see from **Table 4** and **Figure 4h** that in wetter years (2006, 2010-2012, 2017 and 2019) the lagoon temperature management goals near the bottom for steelhead were mostly met (20°C daily minimum at dawn; 22°C daily maximum in early evening; 7-day rolling average <= 21°C). Lagoon water temperature has typically been warmer in years with reduced baseflow entering, as indicated by maximum and minimum temperatures and maximum, minimum and average 7-day rolling averages (**Table 4; Figure 4h**). But air temperature also contributed to stream inflow temperature to determine lagoon water temperatures, as when summer air temperature was cooler in 2016 (**Figure 3f**), allowing management goals to be met, and when warmer in August and September 2017, causing management goals not to be met some of the time, despite high baseflow. The stream inflow maintains a cooler lagoon during higher baseflow years in terms of 7-day rolling averages, with the difference between inflow average 7-day rolling average temperature and lagoon average 7-day rolling average temperature near the bottom being more similar during higher baseflow years (2010-2012, 2017 and 2019) (**Alley 2020**).

As in past years, no lagoon thermocline (a thermocline has a warm, well-mixed, oxygen-rich epilimnion above it and a cool, non-circulated, oxygen-poor hypolimnion below) or temperature stratification was detected in 2020 by the data loggers in the deep area near the railroad trestle. The mostly freshwater lagoon was likely 7−8 feet deep, at most, and subject to daily inland breezes that circulated the water, surface to bottom. There was complete, diurnal (daily) mixing of the water column (**Figures 4a-4f**) until dilute saline conditions occurred for approximately a week after tidal overwash on 8 December, when the saline layer stagnated on the bottom. In most years, water temperature was cooler nearer the bottom and warmer near the surface, based on the continuous data loggers. However, in 2020 the warmest conditions were at 2.5 ft from the bottom. In 2017 the warmest location was 3.5 feet from the bottom, and in another relatively high baseflow year, 2006, water temperatures at 4.5 feet from the bottom were cooler than 0.5 feet from the bottom (**Alley 2018; 2006a**). Water temperatures at 0.5 and 5.5 feet from the bottom were similar in 2006.

Table 4. Water Temperature Statistics from Continuous Water Temperature Probes at 30-Minute Intervals in Soquel Lagoon and Immediately Upstream.
(Late May to 15 September in 2013−2020.)

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
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*	**9.0 (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**
2019	Maximum Water Temperature °C	**20.2 (11 June)**	**24.4 Ignoring June Artifact (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**

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
2016	Maximum Water Temperature °C	**21.0 (19 June)**	**21.7 (20-23 June, 25 June, 9-13 July, 20-24 July, 31 Aug)**	**21.3 (24 and 29 July, 2 Aug)**
2016	Minimum Water Temperature °C	**13.7 (15-16 June)**	**17.1 (14 Sep)**	**16.8 (16 June)**
2016	Maximum 7-Day Rolling Average*	**17.7 (18 June)**	**20.8 (19 July)**	**20.2 (18-20 July)**
2016	Minimum 7-Day Rolling Average	**15.4 (11 Sep)**	**18.4 (10 Sep)**	**17.9 (11 Sep)**
2016	**Average 7-Day Rolling Average**	**16.7**	**19.9**	**19.3**
2015	Maximum Water Temperature °C	**20.6 (15 August)**	**24.8 (15-16 August)**	**24.0 (16-17 and 19 Aug)**
2015	Minimum Water Temperature °C	**14.5 (1, 5-6 June)**	**17.9 (30 May, 1 and 5-6 June)**	**19.0 (6-7 June)**
2015	Maximum 7-Day Rolling Average	**18.3 (16 July)**	**23.7 (13-14 August)**	**23.3 (13-15 August)**
2015	Minimum 7-Day Rolling Average	**15.7 (31 May)**	**19.2 (4 June)**	**19.6 (4-6 June)**
2015	**Average 7-Day Rolling Average**	**17.4**	**21.9**	**21.7**
2014	Maximum Water Temperature °C	**20.2 (18-20 July)**	**24.8 (23,24,30 July)**	**24.0 (2 June; 30 July)**
2014	Minimum Water Temperature °C	**14.5 (1-4, 17-18,22-25 June; 9 Sep)**	**18.3 (6 June)**	**19.4 (9-10 Sep)**
2014	Maximum 7-Day Rolling Average	**18.2 (15 July)**	**23.7 (19-20, 23-26 July)**	**23.4 (25-27 July)**
2014	Minimum 7-Day Rolling Average	**15.5 (1 June)**	**19.3 (1 June)**	**20.3 (5-7 Sep)**
2014	**Average 7-Day Rolling Average**	**16.8**	**21.9**	**22.0**
2013	Maximum Water Temperature °C	21.0 (26 Jun)	23.2 (5 July; 31Aug–5 Sep)	25.2 (1 June due to saline layer)
2013	Minimum Water Temperature °C	14.1 (31 May; 4-5June)	17.1 (5 June)	17.1 (26 June)
2013	Maximum 7-Day Rolling Average	18.7 (26 June–2 July)	22.5 (30 Aug–5 Sep)	23.4 (30 May–5 June)
2013	Minimum 7-Day Rolling Average	15.7 (3-9 June)	18.4 (4-10 Jun)	18.9 (20 June–26 June
2013	**Average 7-Day Rolling Average**	**17.0**	**20.8**	**20.7**

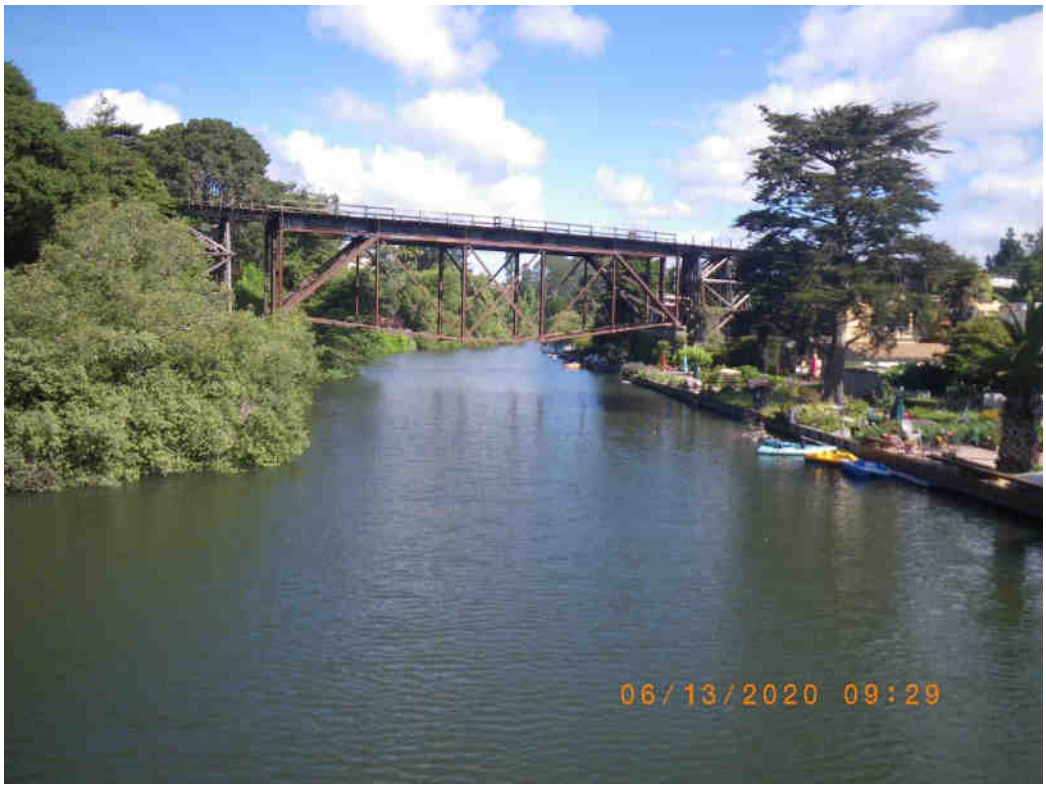
*Rolling averages were averaged for the 7 days forward from the date they were recorded on graphs and presented in this table.

In 2020, the coho management goal of keeping maximum lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met for 36 days that were monitored (**Figure 4a**). Generally, the pattern has been that more days exceed the management goal as baseflow is reduced. Water temperature met the coho goal for the entire dry period only in 2011, a year with higher baseflow (**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 (**Figure 3f**) and generally warm inflow temperatures through the summer/fall, despite higher baseflow (**Alley 2018**).

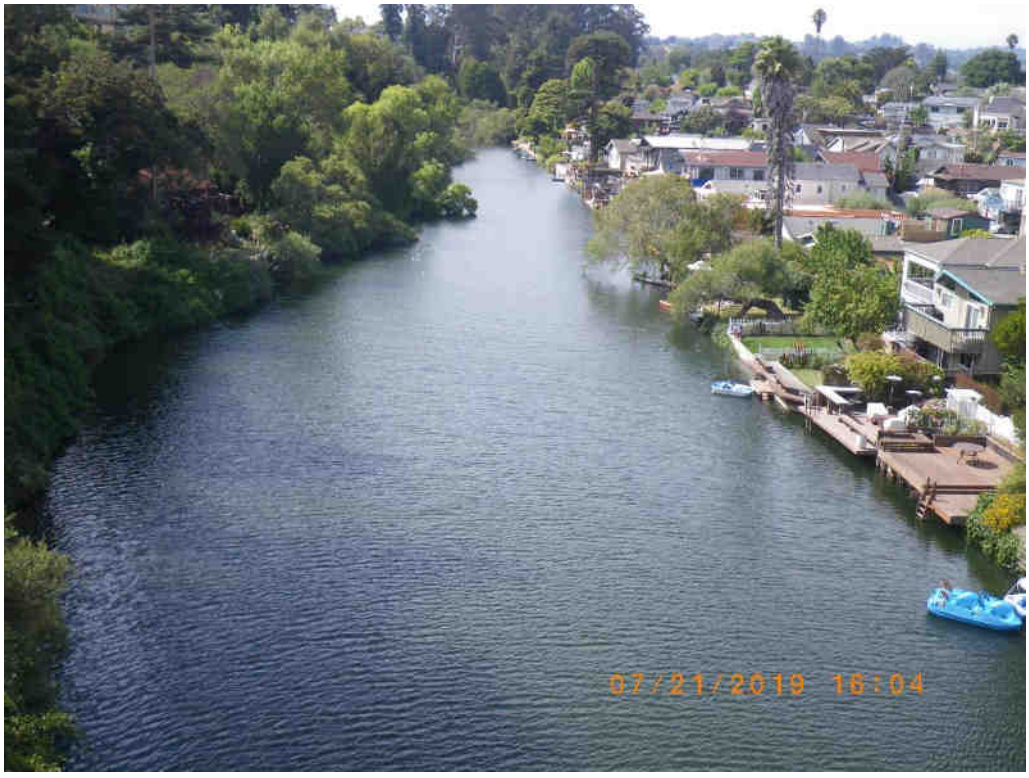
The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2020, which was typical for previous years except 2010. The maximum daily lagoon water temperature near the bottom typically occurred between 1600 and 2100 hr.

Aquatic Vegetation Monitoring.

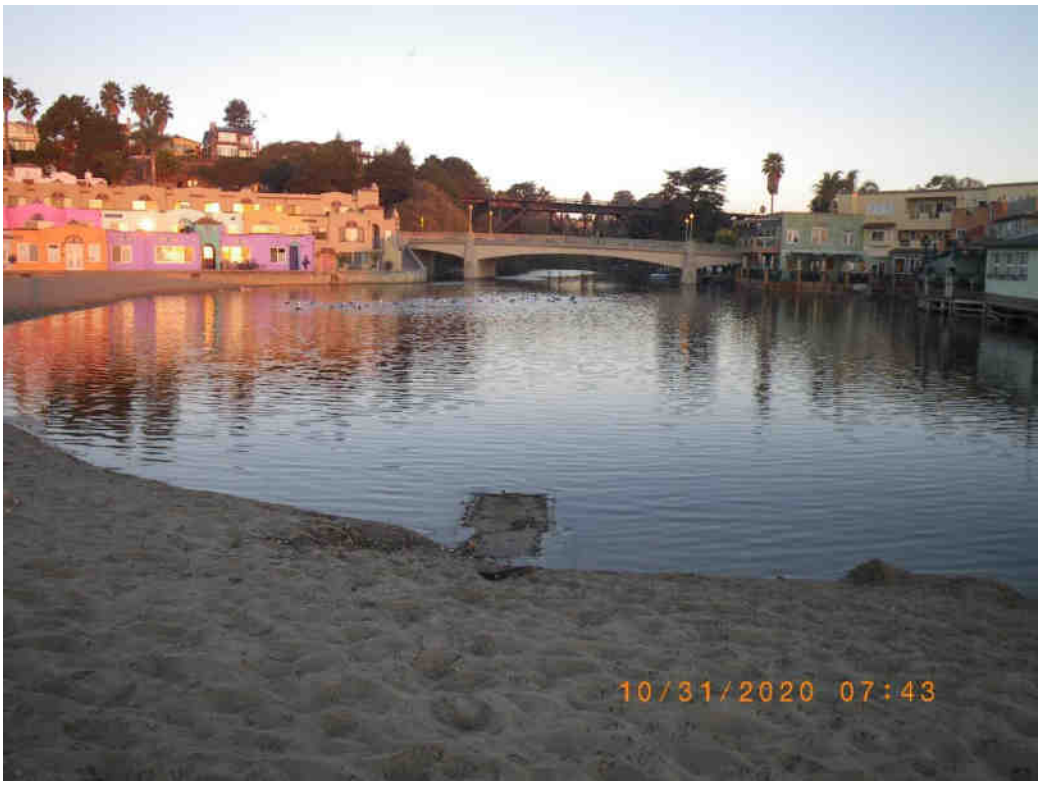
Kelp and seagrass were not abundant in the estuary prior to sandbar construction in 2020. The sandbar closure occurred later than usual than was typical after a mild winter. A thick layer of decaying plant material lined much of the lower estuary downstream of Stockton Bridge when the sandbar was closed. Only an estimated 10% of the decomposing plant material was raked from the lagoon in 2020 (30% in 2019, 90% in 2018, none present in 2017, 90% in 2016 and 70% in 2015). Thus, there were more nutrients available for plant growth in 2020 than in most years. However, aquatic vegetation was not monitored in 2020 because only early morning monitoring was done, and the aquatic vegetation was not visible.



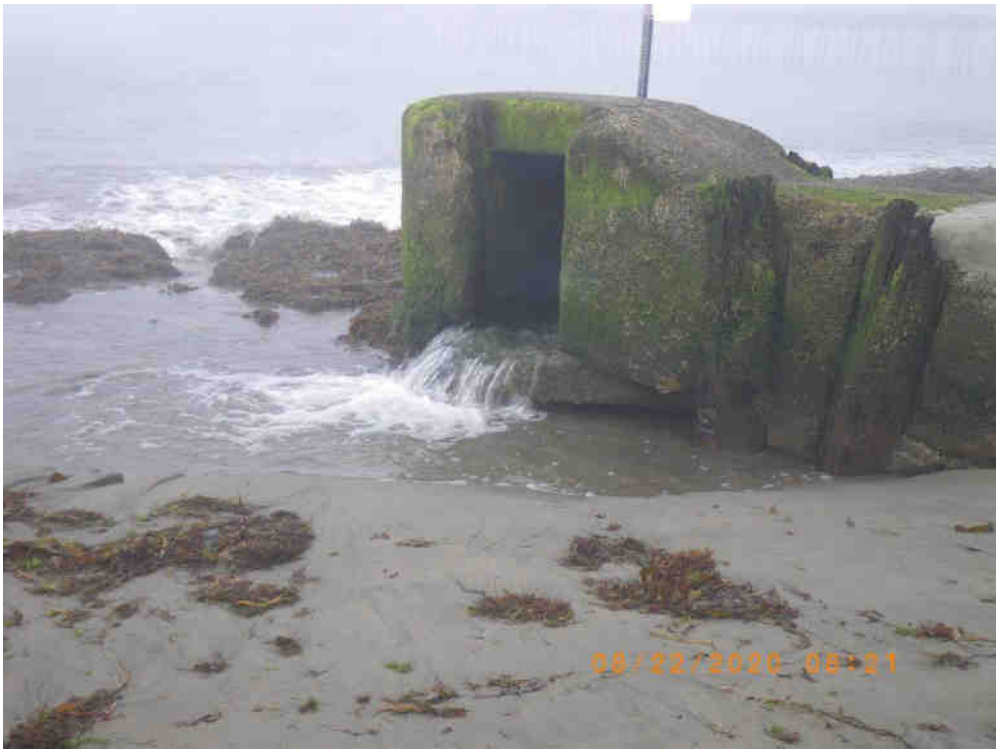
Reach 2, looking upstream from Stockton Bridge toward Reach 3 (past railroad trestle)
13 June 2020



Reach 3, looking upstream past Noble Gulch mouth. 21 July 2019



Reach 1, looking upstream from the flume inlet (foreground) −Venetian Court on the left; Esplanade restaurants and Margaritaville Cove on the right; Stockton Bridge in center.
31 October 2020



Flume outlet to the Monterey Bay. 22 August 2020

Dissolved Oxygen Results During the 2-Week Monitorings

Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was depleted by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen levels are most importantly measured and rated because they are typically the lowest (**Alley 2020**). No stressfully low oxygen concentrations for steelhead were detected in 2020. Oxygen concentrations near the bottom at dawn were in the "fair" to "good" range at all 4 monitoring stations throughout the monitoring period and above 6 mg/L (**Table 3; Figure 6a**). The average oxygen level for the 4 sites near the bottom at dawn in 2020 was in the good range (>7 mg/L), as was typically the case in other years (**Figures 6a and 6b**). From late June to mid-October, the average lagoon oxygen concentration was higher than the oxygen level at the Nob Hill stream inflow (7 of 9 monitorings). Oxygen concentration near the bottom was highest at the flume (Station 1) during this period and lowest half the times under the railroad trestle (Station 3).

With clear water conditions, reduced oxygen concentration at dawn is usually associated with more algae present in concert with a previously cloudy/foggy day or a stagnant saline layer along the bottom that prevents the bottom layer from circulating with the surface and other oxygen-rich water. The lagoon remained completely freshwater with excellent water clarity until a series of small storms and tidal overwash occurred, beginning on 13 November. When water clarity is reduced after small stormflows with a closed sandbar still intact, light does not penetrate to photosynthesizing plant life, and oxygen concentrations decline rapidly, as occurred in fall 2014 and 2015. A series of 11 small stormflows occurred between 13 November 2020 and 26 January 2021, before the sandbar opened that night. A tidal overwash into the lagoon occurred on 8 December. These events required removal of flashboards at the flume inlet when turbidity prevented light penetration to the lagoon bottom and flashboard replacements to deepen the lagoon after water clarity was regained. Thus, stressful oxygen depletion near the bottom was avoided for steelhead in 2020 from turbid conditions that typically occur after early storms that do not breach the sandbar.

Salinity Results

In 2020, no saline conditions were detected in the lagoon until 12 December after the tidal overwash on 8 December. Saline conditions were very dilute at depth, with a maximum of 2.4 parts per thousand (ocean saltwater has 35 ppt) along the Venetian Court wall (Station 2). Freshwater conditions existed in the upper 0.5 meter of the lagoon on 12 December, and maximum water temperature was only 10.1°C near the bottom, less than 1°C warmer than at the surface. Lagoon conditions returned to freshwater until a 1.9 ppt salinity was detected at Station 2 at the bottom on 23 January.

Conductivity Results

Conductivity was not at stressful levels for steelhead. Monitored conductivity was higher in 2020 than 2019, ranging between 760 umhos at Station 2 in mid June to 889 umhos at the bottom at Station 4 (Noble Gulch confluence) to a low of 544 at Station 4 on 15 November after the first small stormflow of the season. In 2019 with higher baseflow into the lagoon, the conductivity ranged between 533 umhos in early June and 684 umhos *near the bottom* in mid-September, aside from 2237 umhos at Station 2 (Venetian Court wall) on 4 June 2019, prior to the conversion to freshwater after sandbar closure. After the tidal overwash on 8 December that caused a 3241 umhos reading on 12 December, the conductivity returned to the 550–630 umhos

range until a slight uptick to 2659 at the bottom on 23 January, prior to sandbar opening on 26 January. Presumably, back-flush of saltwater at the flume inlet during high tide/swell events resulted in limited saltwater reaching the lagoon prior to sandbar opening. As in other years, in 2020 the conductivity was usually slightly lower at Station 5 above the lagoon than in the lagoon through the summer/fall (**Appendix A**).

Stream In-Flow to the Lagoon

Lagoon water quality is generally best with relatively higher summer baseflow. Soquel Creek in 2020 maintained a baseflow through the dry season that was near the median flow from mid-July to September 1 and slightly below the median before from June to mid-July and afterwards to mid-November (**Table 9; Figures 25–26**). Previous winter stormflows had been infrequent during a relatively mild winter. No storms occurred in February. One bankfull event of nearly 1,700 cfs occurred in early April, with 6 smaller stormflows 100–500 cfs between December 2019 and 1 April 2020, as measured at the Soquel Village USGS gage, 2 miles upstream of the lagoon. The bankfull event scoured sand out of the lagoon and deepened it from 2019 conditions. It would have encouraged smolt outmigration and bolstered dry season baseflow somewhat. Streamflow had declined to 7.2 cfs (0600 hr) on 8 June 2020 at Soquel Village gage when construction began. Hydrographs for previous water years, 2007–2019, are in **Appendix C**.

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 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**). We observed cooler lagoon water temperature in 2019 (high inflow) than in 2018 or 2020 (intermediate inflows) for the months of June through August (**Figures 3a-d; 3h**). 2015 had relatively warm air temperature, warm inflow and very high lagoon water temperatures at dawn and the afternoon. 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 (**Figure 4h**). However, the trend toward reduced water temperature during higher baseflow years was less evident in 2017 and 2019, 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 20016 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 2016-2017 and 2018-2019 winters that would have contributed to warmer inflow in 2017 and 2019 due to loss of streamside vegetation and less shade. Maximum 7-day rolling average and maximum lagoon temperature increased 2°C in WY2020 (intermediate baseflow) compared to WY2019 (high baseflow), but only increased slightly in WY2020 for minimum and average 7-day rolling averages compared to WY2019.

To maximize summer baseflow, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

As stated earlier 11 small stormflows passed through the flume beginning on 13 November, prior to sandbar opening on 26 January, with one tidal overwash on 8 December. Streamflow at Soquel Village gage was estimated from hydrographs. They were **13 Nov** (6 cfs); **17-18 Nov** (28 cfs); **11 Dec** (5.6 cfs); **13 Dec** (30 cfs); **17 Dec** (17.4 cfs); **26 Dec** (17 cfs); **28 Dec** (13 cfs); **31 Dec** (13 cfs); **2 Jan** (11 cfs); **4 Jan** (36 cfs); **22 Jan** (9 cfs). Light penetration to the lagoon bottom with maximum lagoon depth possible during turbidity-caused stormflows were maintained by flashboard manipulation in order to insure photosynthesis and minimize oxygen depletion.

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. None were detected (**Appendix B**).

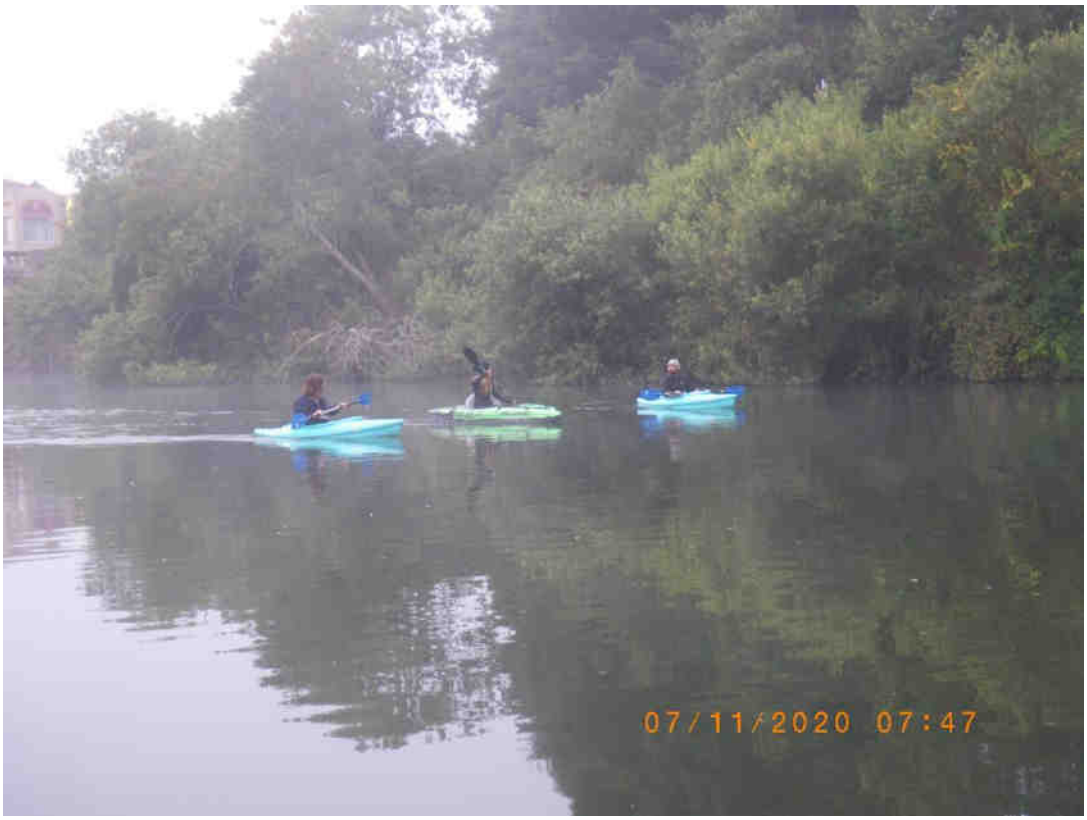
Table 5. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2020.

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

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

Recreational Use, Pollution Sources and Solutions

The lagoon near the beach was posted with warning signs about potential health risks. However, increasing human use of the lagoon has been observed since 2016, when a paddle-board concession began in the village. In 2020, monitoring was reduced to morning observations only, which was before most recreational use of the lagoon began each day. The only aquatic recreation observed in 2020 was kayaking in July and boating with an electric motor in October. Paddle-boarders have become commonplace in past years (observed 5 of 13 afternoon weekend monitorings in 2019, 5 of 12 in 2018, 10 of 12 in 2017; 7 of 9 in 2016), along with more kayakers, pedal boaters, row boaters, canoers and barge users on the lagoon. The most paddle boarders counted in a reach were 6 in Reach 1 in 2019, though usually they traveled in pairs. The most boat/paddleboard traffic was observed during the 3 separate monitoring days in September 2019, especially on the day of the Nautical Parade (28 September). Waders and swimmers were commonly observed in the lagoon in past years (usually near the beach in Reach 1; 6 of 13 afternoon monitorings 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 2019 was 6 in Reach 1. On 21 July 2019, two high school age boys jumped off the Stockton Bridge and swam over to Venetian Court wall. That was the first observed swimming in 29 years. Human contact with the lagoon occurred despite warning signs being posted in close proximity. No waders or boaters/paddle boarders were observed during October and November monitorings in 2020. Vegetation was trimmed to expose the no fishing sign along the lagoon path to discourage illegal summer/fall fishing.



Illegal fishing was not observed in 2020. Legal fishing was observed on 23 January 2021 by 2 fishermen before any adult steelhead had entered the lagoon. No bird feeding was observed in 2020. The common high congregation of mallards in Margaritaville Cove in 2020 may have resulted from feeding from the adjacent restaurants, though none was observed in early morning. In previous years, mallard ducks patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on regularly there.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been observed to be successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other restaurants have been effective in discouraging roosting. All of the refuse cans on the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, pers. comm.**). Refuse containers with gull-proof lids may reduce gull numbers. City building permit conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, Public Works Director, pers. comm.**). The increased presence of paddle boarders and boaters since 2016 interfered with gull use in Reach 1. Gulls took wing when visitors appeared on their floatation devices and returned quickly to bathe and raft after they passed. Gulls avoided waders along the lagoon periphery near the flume. Human impact from disturbance on the rate of gull defecation is unknown.

Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf

and the railroad trestle over Soquel Creek Lagoon. They may increase the biological oxygen demand somewhat under the trestle (Station 3). As stated in the original Management Plan, the trestle could be screened to eliminate pigeon roosting areas.

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included in these would be storm drains emptying into Noble Gulch. Gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch in the past. None was observed in 2020. Though no gray water was detected during 2-week monitorings in 2014–2016 and 2018, gray water plumes were observed 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, where slight oxygen depletion has been detected in recent years, including 2020, but not in 2018 or 2019. This drain could be capped if summer runoff was 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 at the Noble Gulch creekmouth and has never occurred lagoon-wide in the last 29 year of Soquel Creek Lagoon monitoring.

Water quality monitoring was conducted along Noble Gulch in summer/fall 2017 to pinpoint potential anthropogenic pollution sources. Noble Gulch was also monitored upstream of urban storm drains to establish a baseline. On one occasion in 2017 when a thick gray plume emanated from the Noble Gulch culvert into the lagoon, water from a residential hose entered a lateral drain approximately 60 feet from the mouth, with plant material decomposing within. If pollution sources can be identified, source control efforts should be made to control illicit discharges or, where feasible, to direct dry weather flows from storm drains to sanitary sewers. The thick planktonic algal bloom present much of the summer of 2015 at the mouth of Noble Gulch was absent in 2016, but reappeared in 2017. That was the only location where a planktonic bloom was observed in the lagoon in 2017. At times the bloom was so thick that the bottom was invisible (4 of 12 monitoring days) (**Alley 2020**). In conclusion, there were indications of nutrient pollution and increased eutrophication at the mouth of Noble Gulch in 2017. In 2019 this algal bloom soup was observed on 2 of 13 monitoring days (**Alley 2020**).

Results of the 2017 water quality study in Noble Gulch are as follows. The water samples collected in Noble Gulch as it emptied into Soquel Lagoon and at upstream stations on Noble Gulch satisfied the Central Coast Ambient Monitoring Program (CCAMP) attention levels and EPA recommendations for total phosphates, as best we could tell, except for a 2.4 mg/L total nitrogen concentration detected just downstream of the Brookvale Terrace impoundment on 18 June 2017. However, plant growth, and potentially eutrophication, may be encouraged at nutrient concentrations below the CCAMP accepted attention levels. However, it appeared that nutrient

levels (total nitrogen and phosphorus) in Noble Gulch were within acceptable levels for nitrogen as nitrate and phosphorus as orthophosphate on 9 of 10 monitoring days spread out over 20 weeks in summer and early fall, 2017.

On only one monitoring day of 10 in 2017 did total nitrogen increase at succeeding downstream stations in Noble Gulch, and that was the 4th monitoring, occurring in mid-July. One recurrent nutrient pattern throughout the water monitoring period was that phosphorus concentration was below detectable levels at all stations during the entire 20-week monitoring period, June through early October. The other nutrient pattern was that for the last 8 of 20 weeks monitored (and last 4 of 10 monitorings), the source of nitrogen narrowed to only nitrate, with less total nitrogen detected during those last 8 weeks compared to earlier in the season. This was positive in that no nutrient pollution from animal waste was detected during the last 8 weeks. Evidence of organic sources of nitrogen in water samples indicated that dead plant or animal wastes were entering Noble Gulch during the first 12 weeks of the study. However, nutrient concentrations often decreased between the station closest to the creekmouth (adjacent to City Hall) and the creekmouth station. The results did not indicate consistently higher nutrient levels at any one station throughout the monitoring period that might imply chronic sewage pipe leaks.

Indication of human/ animal waste pollution as organic nitrogen and ammonia was detected as kjeldahl nitrogen for at least 1 of the 5 stations during 5 of the first 6 monitorings. The most consistent location for kjeldahl nitrogen during the first 6 monitorings (12 weeks) was below the Brookvale Terrace Dam, often at the 0.5−0.6 mg/L level. But the highest kjeldahl nitrogen level was 1.0 mg/L, occurring in late July at the culvert entrance below Noble Gulch Park.

No elevation of dissolved phosphates, nitrates or organic nitrogen and ammonia was detected during the Noble Gulch study in 2017 when white or gray suspended particles from Noble Gulch entered Soquel Lagoon. On 16 July when the highest nitrogen concentration at the Noble Gulch creekmouth was measured, a green, planktonic algal bloom was observed without gray or white cloudiness. Nutrient analysis of cloudy water samples collected on 10 and 24 September and 8 October detected no increased total nitrogen levels and, in fact, relatively low ones with undectable phosphorus. It was likely that plant life was absorbing nutrients at a rapid rate at the Noble Gulch mouth. On one occasion when a thick gray plume formed at the Noble Gulch creekmouth in the lagoon, surface runoff into the storm drain feeding Noble Gulch closest to Soquel Lagoon was observed. Organic debris accumulated in this storm drain. Perhaps accumulated organic debris in multiple storm drains between City Hall and the creekmouth experienced surface runoff to create the volume of gray plume turbidity that was observed. Regarding pollution from urban runoff, once the rains start in fall, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff. There has been a pollution problem and high flashiness in streamflow in the past during the first small storms of the fall. Early storms turn the lagoon water turbid (cloudy), requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2019, 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. City staff will continue to monitor and augment plantings in the pilot project area.

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

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2020, as was the case in 2003–2019. 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 4 and 11 October 2020, from upstream of the Stockton Avenue Bridge to the beach. A bag-seine with

dimensions 106 feet long by 6 feet tall by 3/8-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and upstream of it. Juvenile steelhead congregate in the shade under the bridge and under the willows on the west side. The seine was pulled to the beach in front of Venetian Court. A total of 192 steelhead were captured and marked on 4 October after 6 seine hauls. There were no mortalities. A total of 147 steelhead were captured on 11 October in 6 seine hauls. There were 21 recaptures and no mortalities. The lagoon population estimate was 1,344 juvenile steelhead (8th highest in 27 years), using the Lincoln index for a closed population (**Table 6;** methods in **Ricker 1971**). Steelhead were relatively large (**Table 7; Figure 7a)**. The population estimate was near average and above the median compared to the 26-year average of 1,492 (median= 928) (**Figure 24**). This relatively average lagoon population size was higher than expected with the very low densities of juvenile steelhead captured at most stream sampling sites in 2020 (**Alley 2021**).

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

Starry Flounder October 2017. (Photo by T. Suttle.)

Large Juvenile steelhead October 2017. (Photo by T. Suttle.)

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

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

Staghorn Sculpin October 2020. (Photo by I.M. Laursen.)

Size histograms of steelhead captured from the lagoon in 2020 and other years back to 1998 may be found in **Figures 7a−23**. No scale samples were taken in 2020 in order to minimize the holding and handling time for the large number of captured fish. Examination of the size histogram of captured fish in 2020 indicated no clear-cut demarcation between age classes, though there was a large drop in numbers for those larger than 145 mm SL. The large bell-

shaped curve indicated that most juveniles were YOY, with most juveniles larger than 145 mm SL likely being yearlings. Other fish species captured in 2020 with the large seine were 1,000+ threespine stickleback, 117+ tidewater gobies, 6 staghorn sculpins, 1 prickly sculpin (*Cottus asper*) and Sacramento suckers (10 adults and 4 YOY).

In 2020 because of the many tidewater gobies captured with the large seine, no additional seine hauls were necessary with the 30-foot x 4-foot x 1/8-inch mesh beach seine. A record of tidewater goby captures may be found in **Table 8**. The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until 2008 and 2009, probably indicated a lack of backwater areas for overwintering refuge during high winter stormflows. This species was plentiful in Soquel Lagoon during the previous drought years of the late 1980's and early 1990's and reappeared during the recent two, less severe droughts (2007-2009 and 2013-2015). It was surprising to find good numbers in the 2016 lagoon despite an 8,000 cfs stormflow the previous winter. Tidewater gobies were also detected upstream of the Stockton Avenue Bridge during sandbar construction in 2016. Perhaps they had migrated from adjacent lagoons after the high stormflow in March 2016. Tidewater gobies have been reported in recent years in adjacent Moran Lake Lagoon by Jerry Smith (**pers. communication**).

Tidewater gobies from up-coastal-current Moran Lake likely re-colonized Soquel Lagoon in 2008, after mild winters in 2007 and 2008. They likely re-colonized Soquel Lagoon again in 2013 after large stormflows in December 2012. They were present in Aptos Lagoon in 2011−2014 and 2017−2020 (**Alley 2012; 2013; 2014; 2015; 2018; 2019; 2020; 2021**).

Past calculations indicated that lagoon steelhead production represented nearly 1/3 of the smolt-sized steelhead production in the lower 7.2 miles of mainstem Soquel Creek in both 1999 and 2000. In 1993, the lagoon production estimate of nearly 2,800 fish represented 10% of the estimated smolt production (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 fish represented an estimated 47% of the smolt production for the 16.6 miles of stream and lagoon habitat. Though we do not have 2007–2020 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. The lagoon provides valuable habitat through proper management.

Two factors that may influence growth of juvenile steelhead at the time of fall sampling are population size and the time of lagoon closure prior to sampling. Another factor that will affect the size distribution in the fall is timing of YOY entry into the lagoon. If some YOY enter the lagoon later in the summer, they will be smaller than if they entered early on. Still another factor is the proportion of yearlings versus YOY in the lagoon population. The higher the proportion of yearlings, the larger the size distribution will be. A summary table was prepared for the years, 1998−2020 (**Table 7**), corresponding to scatter plots of the data presented in previous reports (**Alley 2011**). Scatter plots of median juvenile size versus weeks of sandbar closure and versus population size done for data in 1998−2010, indicated no strong relationship between these factors when considered separately.

It is reasonable to predict that if the population was large, then competition for food would be high and juvenile size at the time of fall capture would be 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. Usually the lagoon population is overwhelmingly dominated by young-of-the-year steelhead, based on past scale analysis. We suspect from the size distributions of juveniles captured that steelhead grew faster in 2006, 2009, 2011, 2014, 2016, 2018 and 2020 because of less competition for food with much smaller populations compared to large populations, such as those in 2007, 2008 or 2019 (**Table 7; 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 influence growth rate.

Famously large prickly sculpins from Soquel Creek (also found in the Lagoon) 30 August 2012

Table 6. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2020.

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

Table 7. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2020.

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 First Day
1999	18 May	3/10 Oct	20.6	144	928	120-124 First Day
2000	7 June	1/8 Oct	17.4	122	875	135-139 First Day
2001	14 June	7/14 Oct	17.3	121	454	125-129 First Day
2002	23 May	6/13 Oct	20.3	142	1,042	105-109 First Day
2003	22 May	5/12 Oct	20.3	142	849	110-114 First Day
2004	26 May	3/10 Oct	19.4	136	3,869	115-119 First day
2005	9 June	2/9 Oct	18.1	127	1,454	105-109& 110-114
2006	14 June	30Sep/8 Oct	16.4	115	992	150-154 & 145-149
2007	23 May	7/14 Oct	20.4	143	6,064	125-129 Both days
2008	22 May	27Sep/ 11 Oct	18.1	127	7,071	115-119 First day
2009	21 May	4/11 Oct	20.3	142	449	155-159 Both days
2010	2 June	3/10 Oct	18.4	129	1,174	115-119 Both days
2011	20 June	2/16 Oct	15.3+1.6 weeks estuary	106+11 days estuary	678	155-159 & 160-164
2012	24 May	7/14 Oct	20.3	142	220	140-144 Both days
2013	23 May	6/13 Oct	20.3	142	1,681	125-129 & 130-134
2014	22 May	12/19 Oct	21.3	149	None possible (No recap.)	155-159 First Day
2015	21 May	4/11 Oct	20.4	143	None possible (No recap.)	95-99 First day
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	19.6	137	3,322	95-99 Both days
2020	11 June	4/11 October	17.3	121	1,344	130-134 Both days
Avg/Median				**132/ 137**	**1,492/ 928**	

Table 8. 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)

Other factors that may strongly influence growth rate are water temperature and food availability. The density of aquatic vegetation, which may be an indirect indication of food availability, may vary considerably between years. Also, pondweed with attached algae may provide more invertebrate food than just filamentous algae alone. So, the density of pondweed is also important. 2012−2015 had good densities of pondweed with attached algae (15-70% of bottom coverage in various reaches) from mid-August onward**.** 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 resulting from higher summer baseflow will reduce fish metabolic rate for maintenance and may allow a higher portion of the food intake to be used for growth. However, cooler lagoons may have less production of aquatic vegetation as occurred in 2019 compared to drought years, and fish digestion rate is slower in cooler lagoons. This slows the processing of food for growth. The 2013−2015 lagoon was relatively warm with very limited stream inflow. The lagoons in 2011−2012, 2016−2017 and 2019 were cooler. Aquatic plant production was less in 2011, 2016, 2017 and 2019 than in the warmer lagoons of 2008, 2009, 2012 and 2013−2015 and 2018 (more pondweed), indicating less food available in 2011, 2016−2017 and 2019 (**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 order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. The 2020 lagoon remained deeper than recent years in Reaches 2 and 3 after deepening in 2017, with scour at the base of the exposed bulkheads visible.

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. The lagoon water surface was kept at the top of the flume inlet throughout the summer/ fall in 2020 until the series of small storms began in November, which required periodic lowering of the lagoon level to insure that light penetrated to the bottom for plant photosynthesis after stormflows that created turbidity. Lagoon height was increased after water clarity returned after these small stormflows. 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.

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

Maintenance of the lagoon in the fall after the first small storms is important. If the sandbar opens with the first small stormflows and closes again, kelp and seagrass may become trapped to rot and create an anoxic lagoon leading to a fish kill. In 2020 the sandbar remained closed until

26 January 2021 after 11 previous small stormflows beginning 13 November. They were in the 5−36 cfs range estimated at the Soquel Village gage. 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 uncommonly observed in 2020 as in 2019 and much less common than in 2013−2015 (**Table 9**). Other piscivorous birds observed in 2020 included pied-billed grebe, cormorant, snowy egret, black-crowned night heron and common goldeneye (every monitoring day from 15 November through 23 January).

Table 9. Number of Sighting Days of Less Common Piscivorous Bird Species at Soquel Lagoon on Two-Week Interval Monitoring Days.

Year/ # Monitoring Days	Common Goldeneye	Common Merganser	Pied-billed Grebe	Black-crowned Night Heron	Green Heron	Snowy Egret	Corm-orant	Great Blue Heron
2020/16 (morning only)	6	3	9	1	0	1	1	0
2019/13	1	3	5	0	0	0	1	0
2018/ 12	0	2	7	2	1	1	1	1
2017/ 12	0	4	6	0	0	0	1	0
2016/ 13	0	3	4	1	3	0	2	0
2015/ 12	0	6	4	1	2	1	7	0
2014/ 13	0	6	7	3	2	4	1	0
2013/ 18	3	9	10	3	3	0	3	0
2012/ 12	0	3	8	0	0	1	4	0

Common goldeneye female at Soquel Lagoon. 9 January 2021

No western pond turtles were observed in 2013−2020, although a paddle-boarder observed a turtle 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 Golino Property. 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, it 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.

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge and did so in 2020. 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 only year in 30 years of monitoring that rafts of 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. Gulls are a threat to ducklings. Previously, individual gulls were occasionally observed beyond Reach 1 when someone was feeding the ducks. 2020 gull numbers fluctuated between 0 (9 and 23 January) and 160 (17 October) on monitoring days (**Figure 27**). The average gull count per monitoring day until 1 December for 2014−2020 has been 63, 68, 42, 40, 46, 63 and 36, respectively. Gulls counts were relatively low in 2020 compared to other recent years until October.

On 9 November 2019, more than 100 pelicans and even more gulls congregated just beyond the creekmouth and were actively feeding, resulting in the highest gull count (115) in the lagoon for the season. Numbers in 2018 ranged between 23 and 87. Numbers in 2017 ranged between 18 and 85 (20 and 65 in 2016) during afternoon monitorings, when they are most common. The increased human waders, boats, barges and paddle boarders in 2016−2019 may have reduced gull bathing numbers on the weekends when monitoring took place. In 2019, the highest watercraft traffic was on 28 September (day of the Nautical Parade) with 6 paddle-boarders and 1 pedal boat in Reach 1 at one time in the afternoon. The gull count went from 62 down to 15 when the paddle-boarders passed through. The gulls tended to return quickly after watercraft left an area. There was no Nautical Parade in 2020. The highest gull count in 2018 occurred in early August when watercrafts were absent.

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**). This was not the case in 2020, with the maximum count coming in early October. The average mallard count per monitoring day to 1 December for 2014−2020 has been 27, 26, 31, 18, 30, 21 and 44, respectively, giving 2020 the highest average in the last 7 years. In 2020, the mallard counts ranged between 17 (23 January) and 67 (3 October). In 2019, mallard counts ranged between 5 and 62 birds on monitoring days. Clutches of mallards were high in early July 2018 to elevate their numbers then. However, mallard numbers trailed off afterwards and were relatively low by November. Mallards no longer had the cottonwood log across from Noble Gulch to roost on or congregate around because it was washed away during the wet 2016−2017 winter. In late September 2018, American coots began to appear at the lagoon, as annually occurs. Coots were common in 2020 in fall, as is typical. In 2020 their presence was detected first on 3 October (28 September in 2019), as coots typically arrive in late September and early October. The maximum number of coots counted on a monitoring day in 2015−2020 was 113, 13 (early breach), 34, 147, 58, respectively. A pair of gray domestic ducks was first observed together on 17 October. On 31 October, one of them had disappeared. A bird watcher reported one had died. The remaining gray duck was last observed on 9 January 2021 in Reach 1.

CONTINUING MANAGEMENT RECOMMENDATIONS

Recommendations for Lagoon Preparation and Sandbar Construction

1. During 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 (now a private contractor) and Public Works staff should capture and relocate the fish with available dip nets or seine and buckets filled with fresh estuary/ lagoon water, after consultation with the biologist. (Other public works staff should be given experience in relocating fish from the lateral channel in the future or during fall sampling so that they may fill in if Morrison is unavailable.) If the biologist is unavailable during emergency cases 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. Until concrete wings are constructed, continue to add plywood cutoff sheets between the pilings and perpendicular to underflow to maintain sand under the flume and to reduce water seepage and sink holes from forming.

20. 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.

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

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

23. 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, 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. To delay sandbar breaching in years when algae and pondweed are especially dense in the lagoon, install a perimeter fence around the flume inlet (2"x 4" mesh and with 6-foot panels) to collect floating aquatic vegetation and prevent plugging of the flume inlet

during the first small stormflows of the season. If necessary, install a perimeter fence with around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. The goal should be to maintain the lagoon until a pattern of larger storms occurs after Thanksgiving that will maintain an open sandbar through the winter.

9. 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.

10. 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.

11. 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. 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. 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 Golino property. When this becomes successful, approach the restaurants to allow tule plantings in Margaritaville Cove. This will provide additional cover for steelhead and tidewater gobies against predators and may reduce dissolved nutrients and bacteria in the lagoon.

2. 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.

3. 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.

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

5. 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.

6. 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.

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

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

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

10. 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.

11. 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.

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

13. 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.

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

15. 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.

16. 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.

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

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

19. 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.

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

21. 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.

22. 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.

23. 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.

24. The City should continue to seek funding to secure large wood to the lagoon bottom with anchor boulders as added fish cover and as scour objects to deepen the lagoon and enhance rearing habitat. Consider appropriate locations along the west bank under the railroad trestle or upstream adjacent to the Golino property.

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

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

Recommendations Regarding Fish Management

1. Do not plant steelhead from a hatchery into Soquel Creek unless the broodstock originate from Soquel Creek and 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 2019 (Pre-COVID-19)

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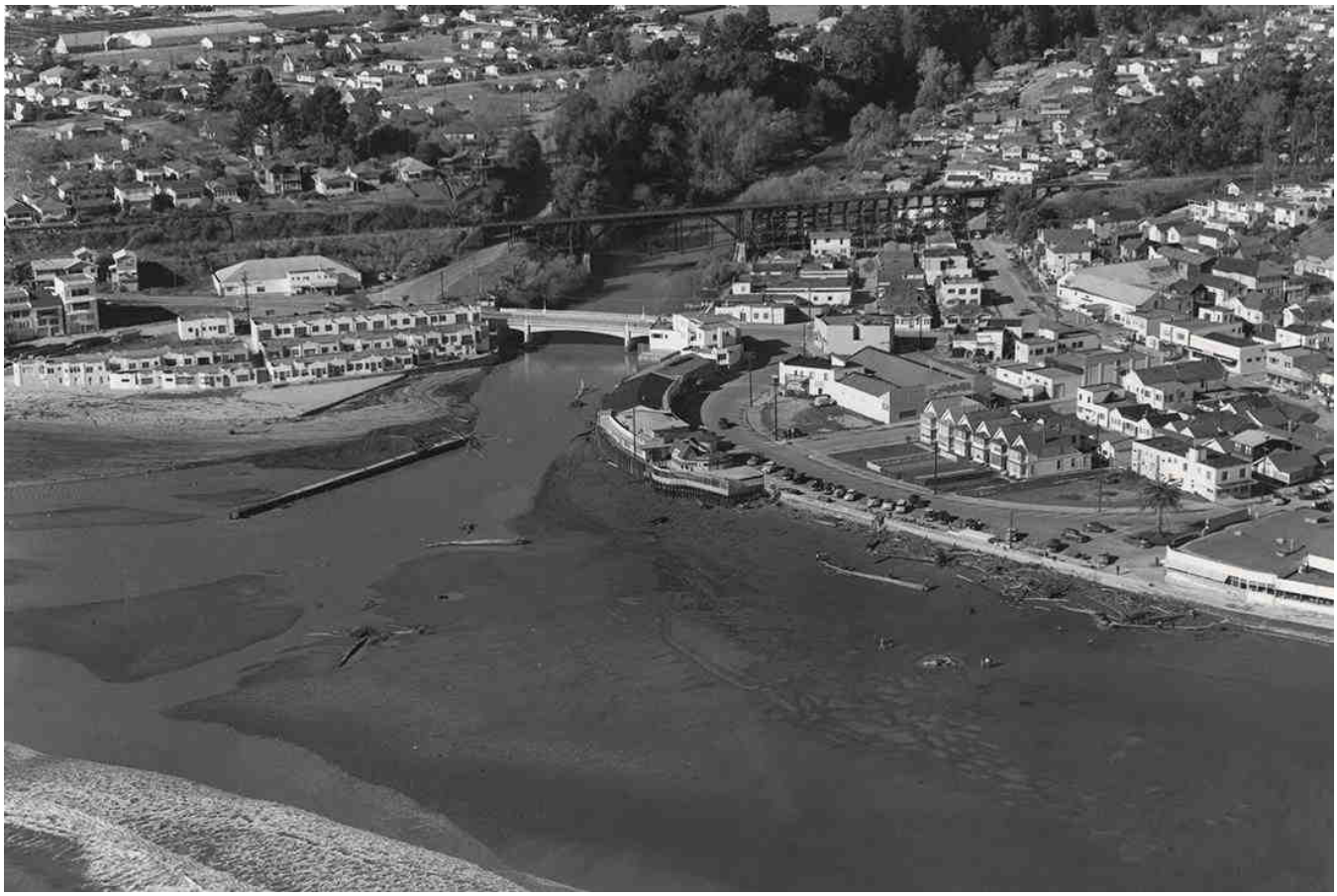
Soquel Lagoon Post-Venetian Court Construction- Older Stockton Avenue Bridge visible and prior to expanded development on eastern margin of the Lagoon, upstream and downstream of the Railroad Trestle; circa 1931.
(Courtesy of the Capitola Historical Museum)



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

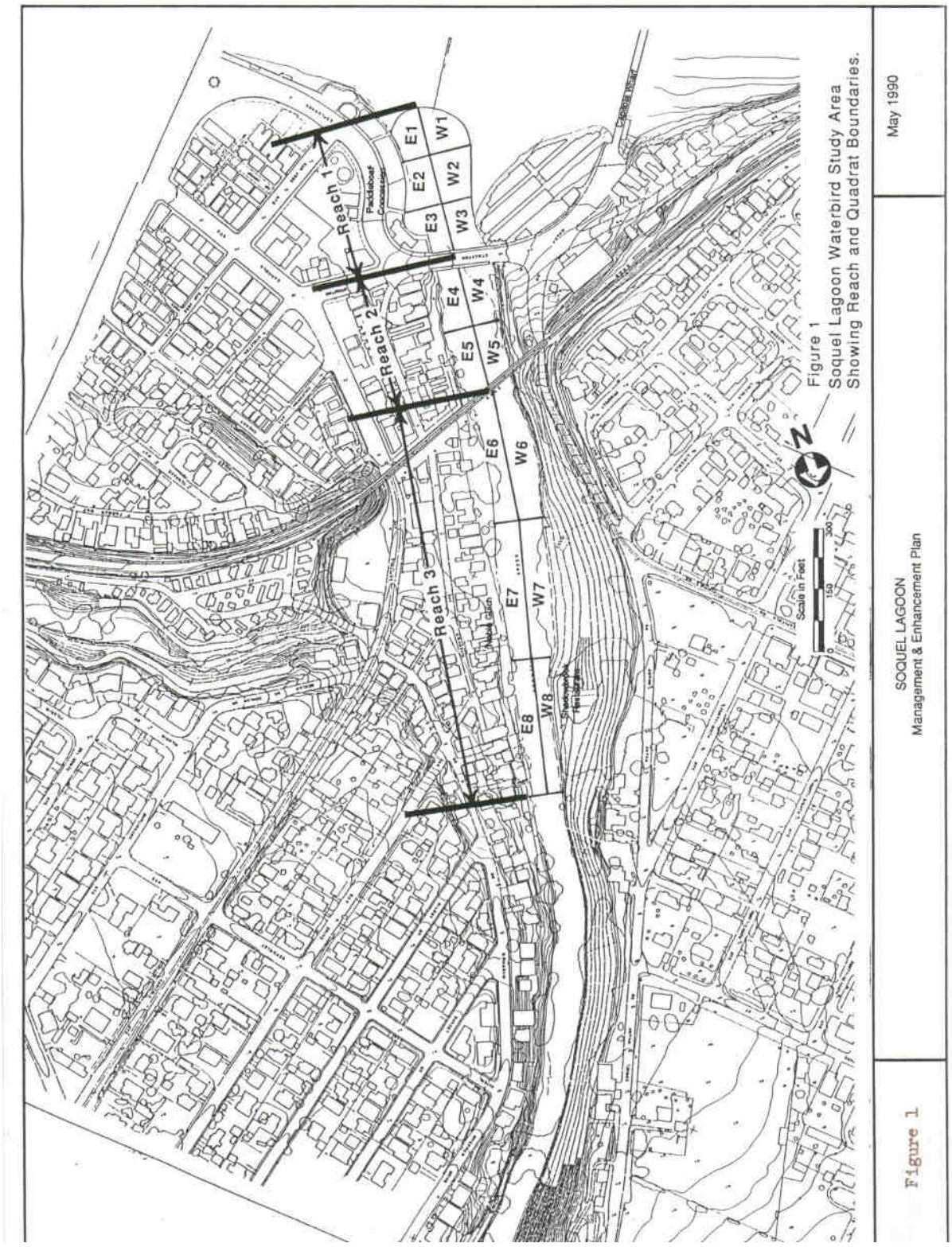


Figure 1. Map of Reaches in Soquel Creek Lagoon

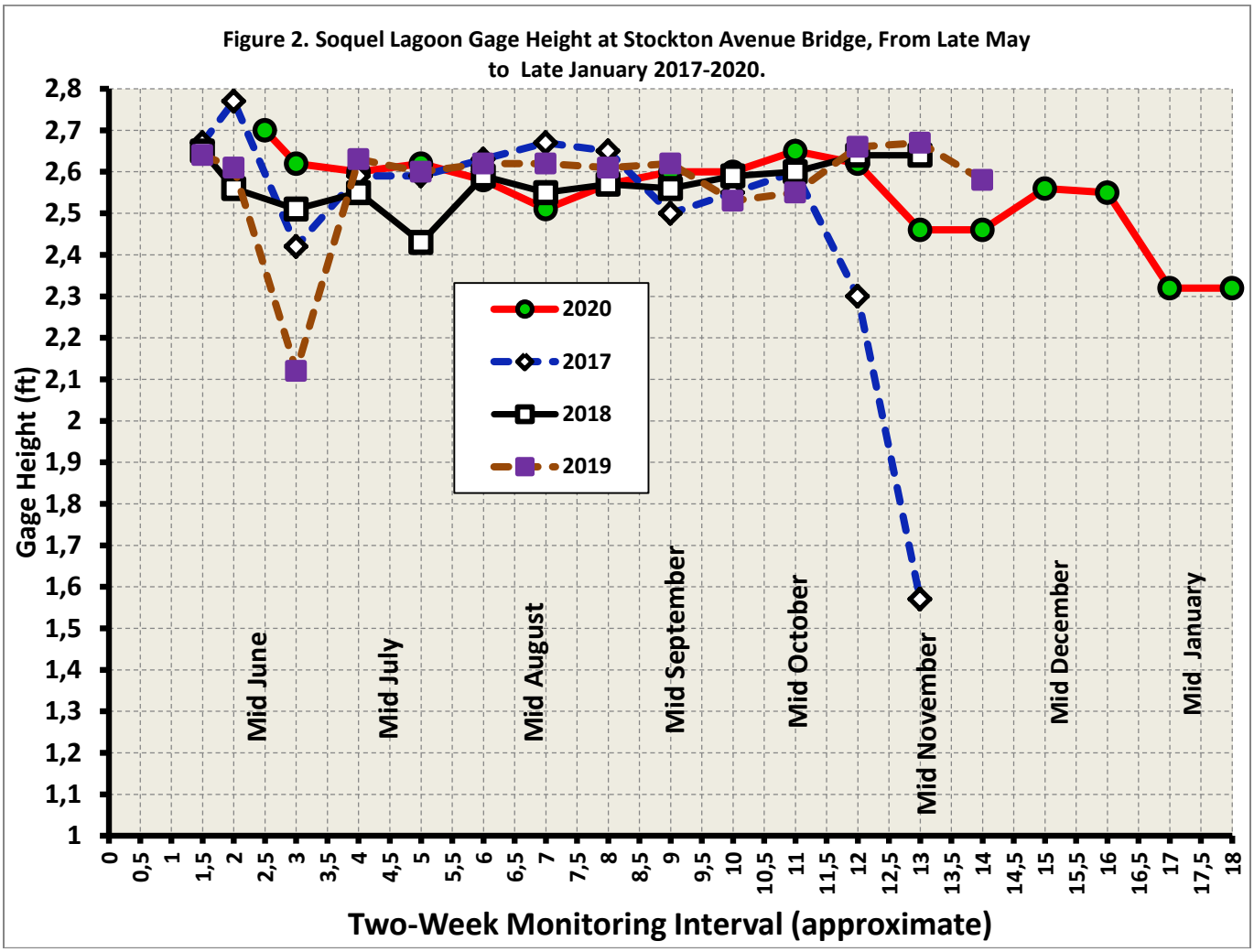


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2017-2020

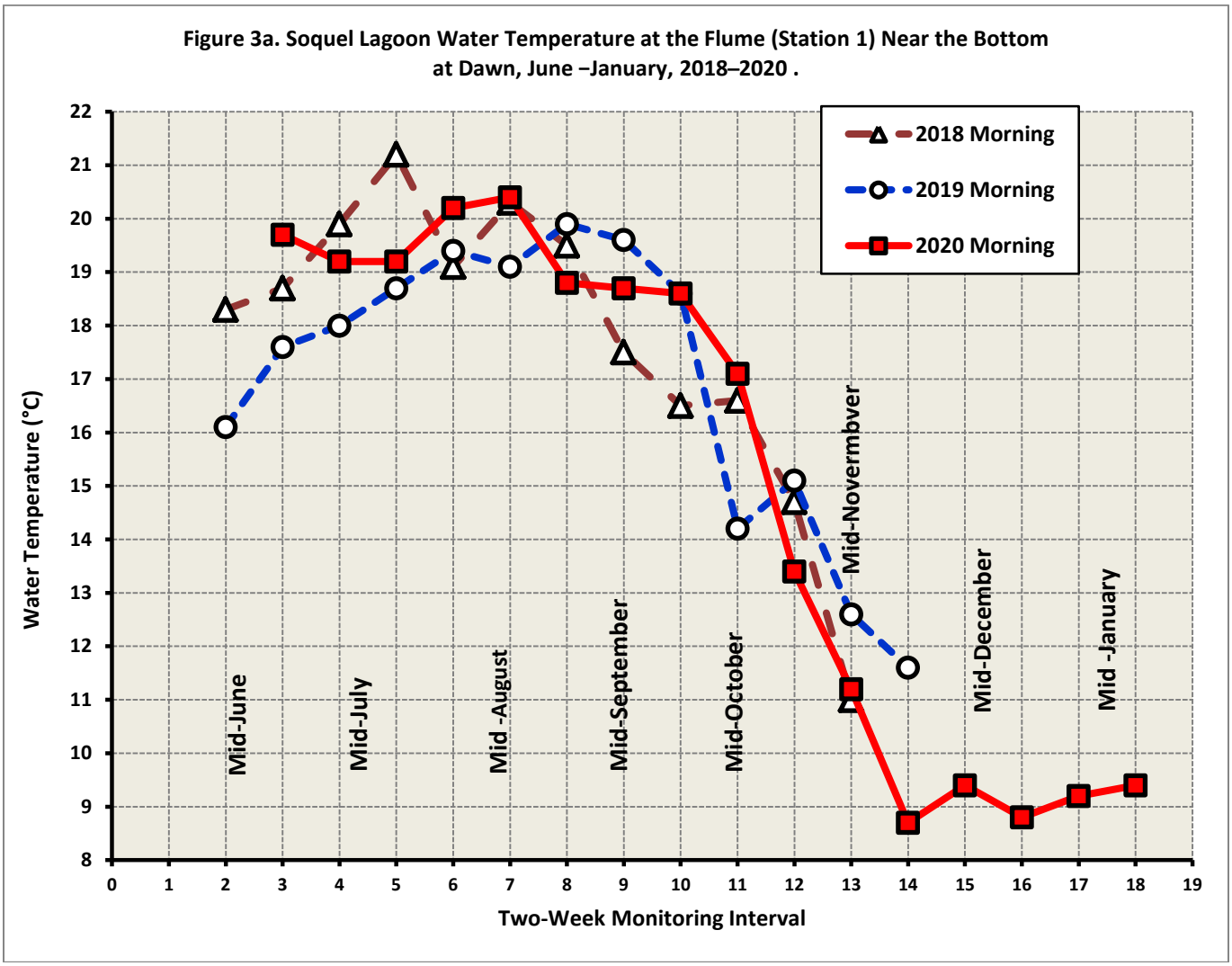


Figure 3a. Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn, June – January, 2018–2020.

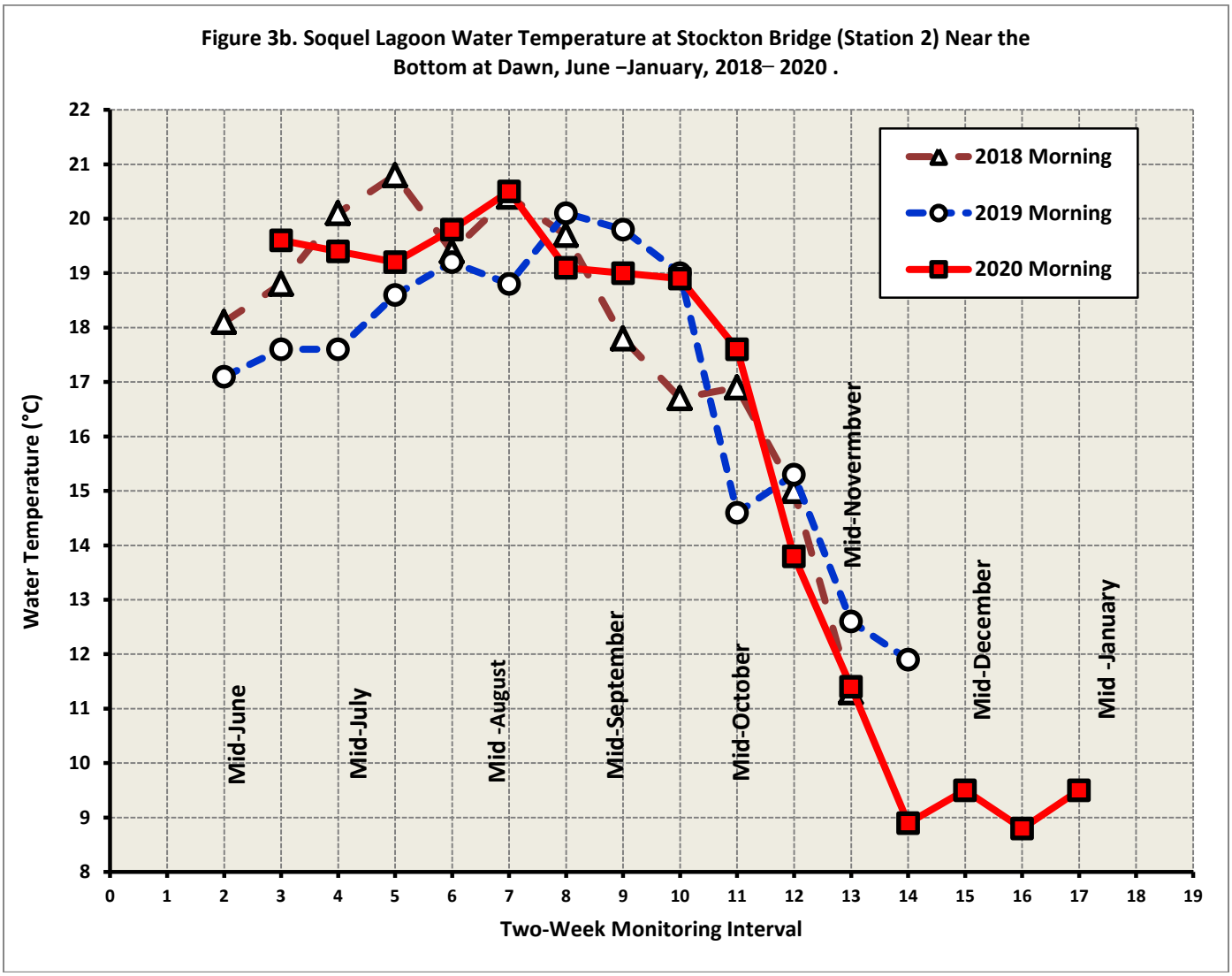


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Figure 3b. Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn for June – January, 2018–2020.

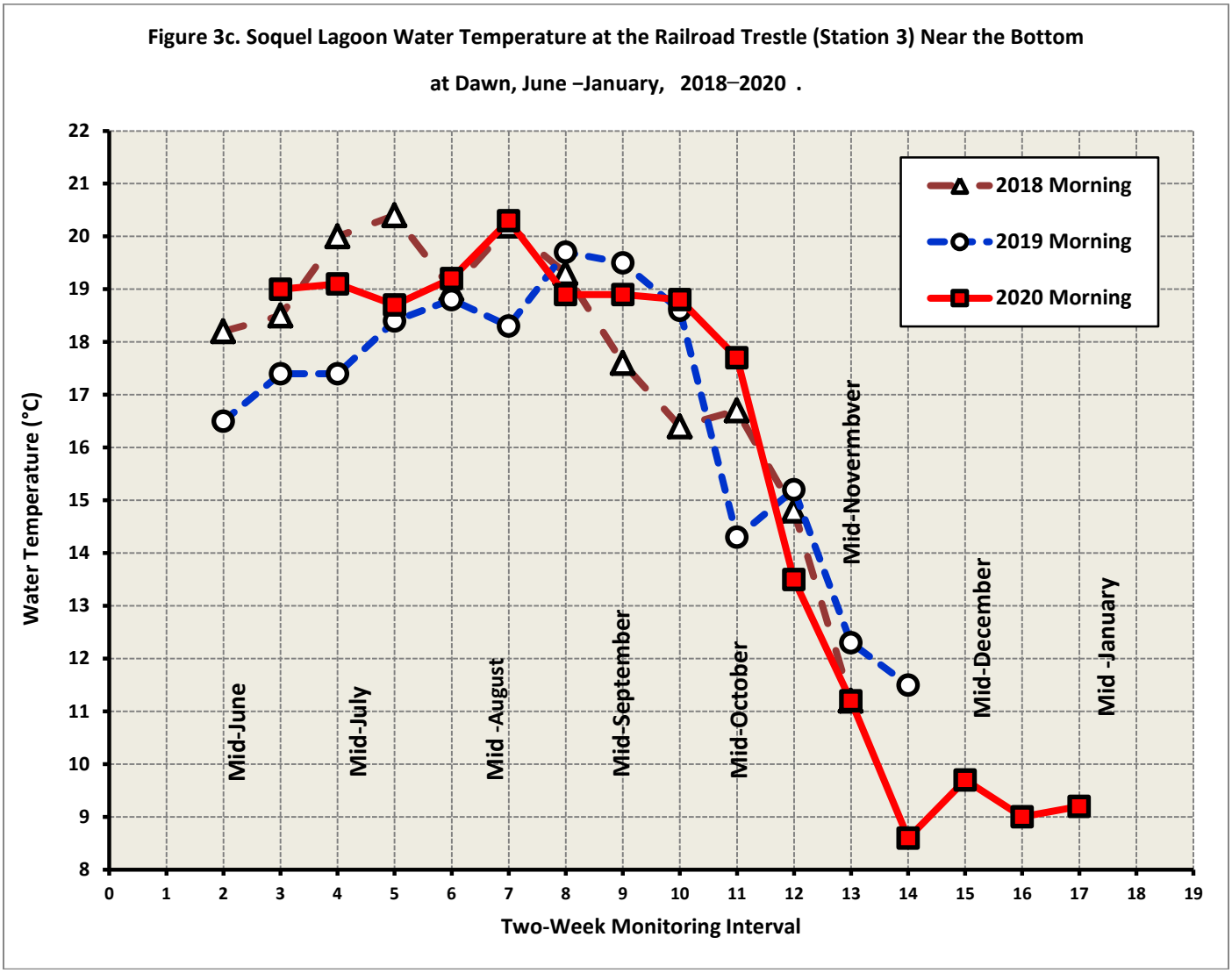


Figure 3c. Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn for June– January, 2018–2020..

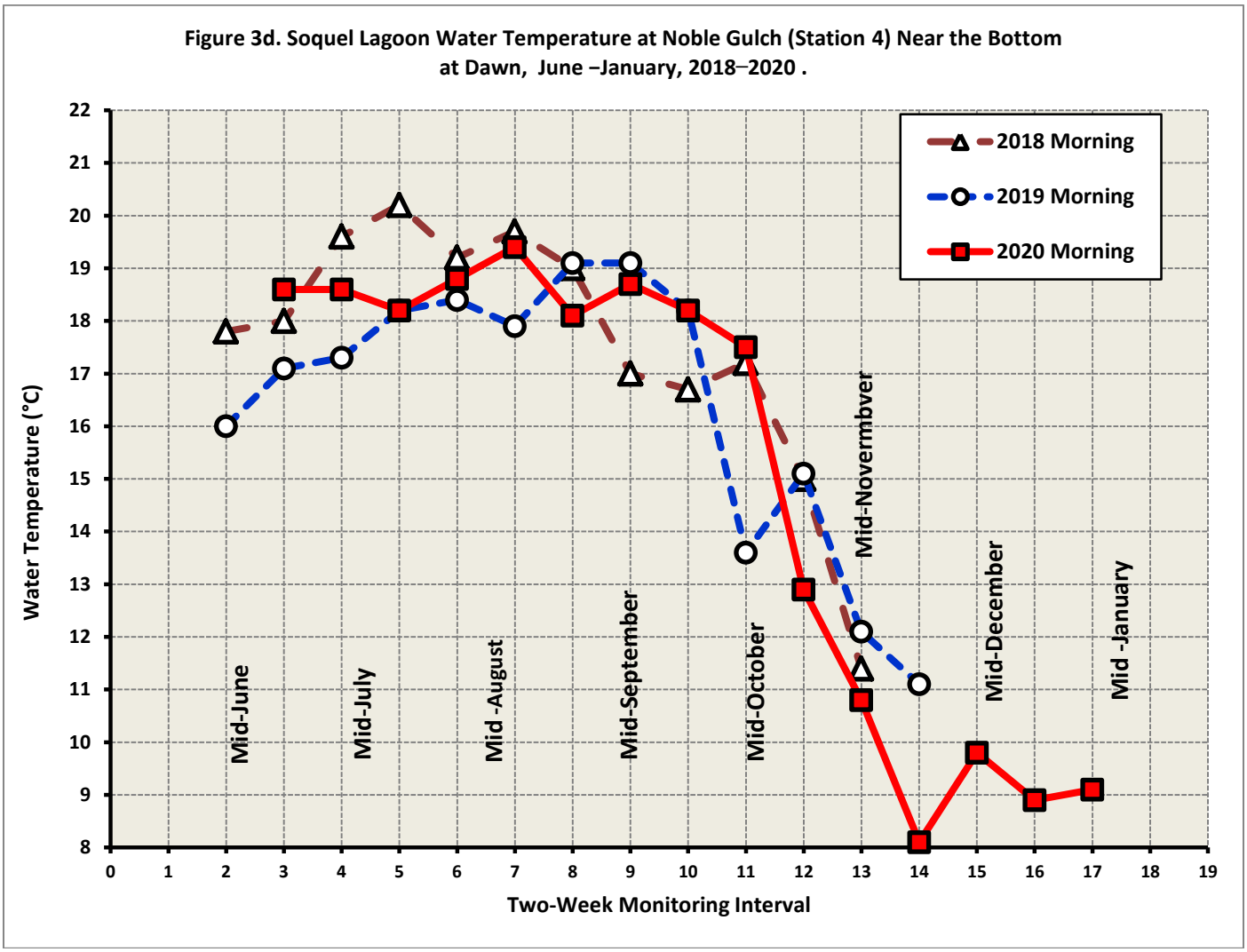


Figure 3d. Soquel Lagoon Water Temperature at Noble Gulch (Station 4) Near the Bottom at Dawn for June – January, 2018–2020.

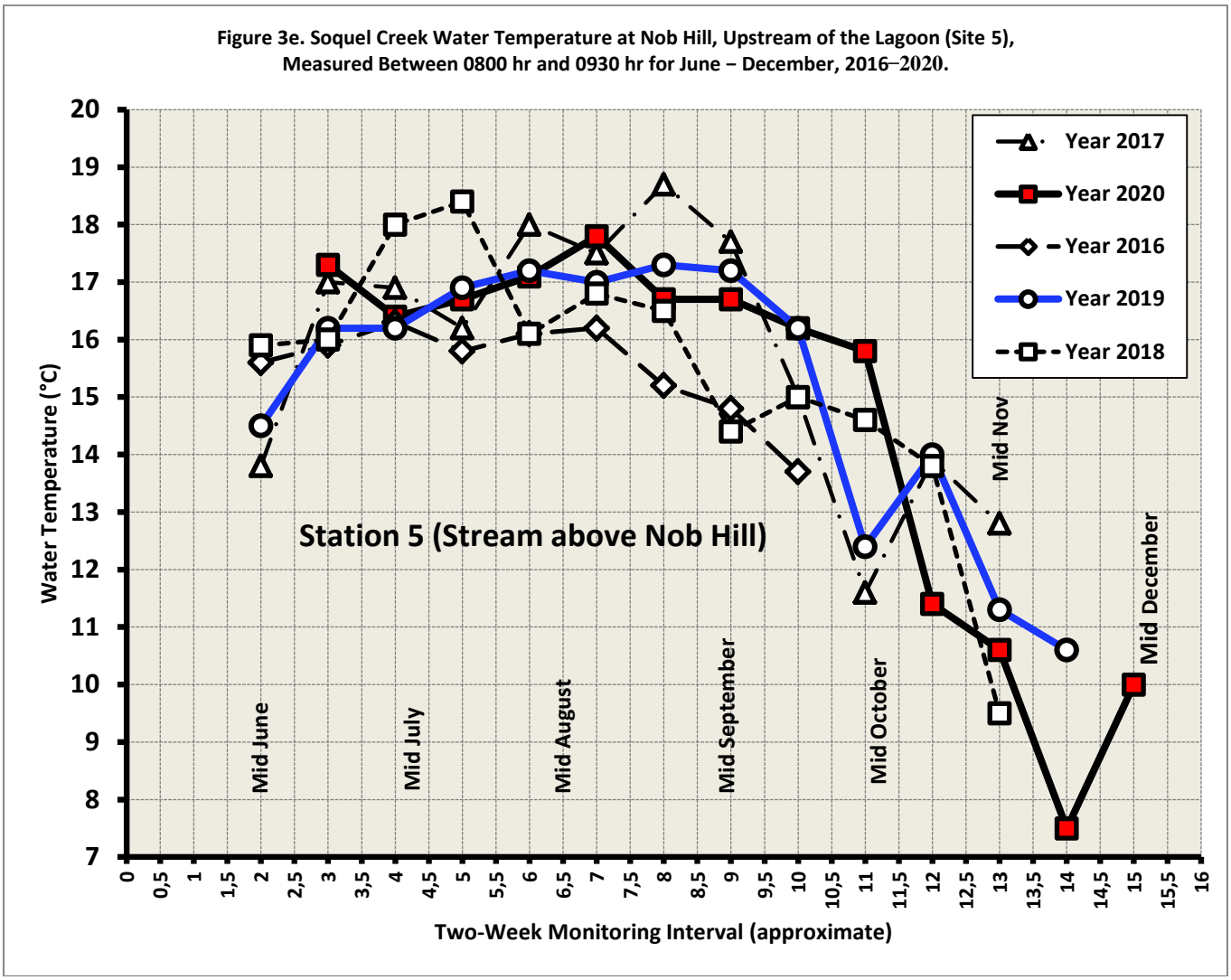


Figure 3e. Soquel Creek Water Temperature at Nob Hill Upstream of the Lagoon, 2016–2020. Measured Between 0800 hr and 0930 hr for June – Mid-December.

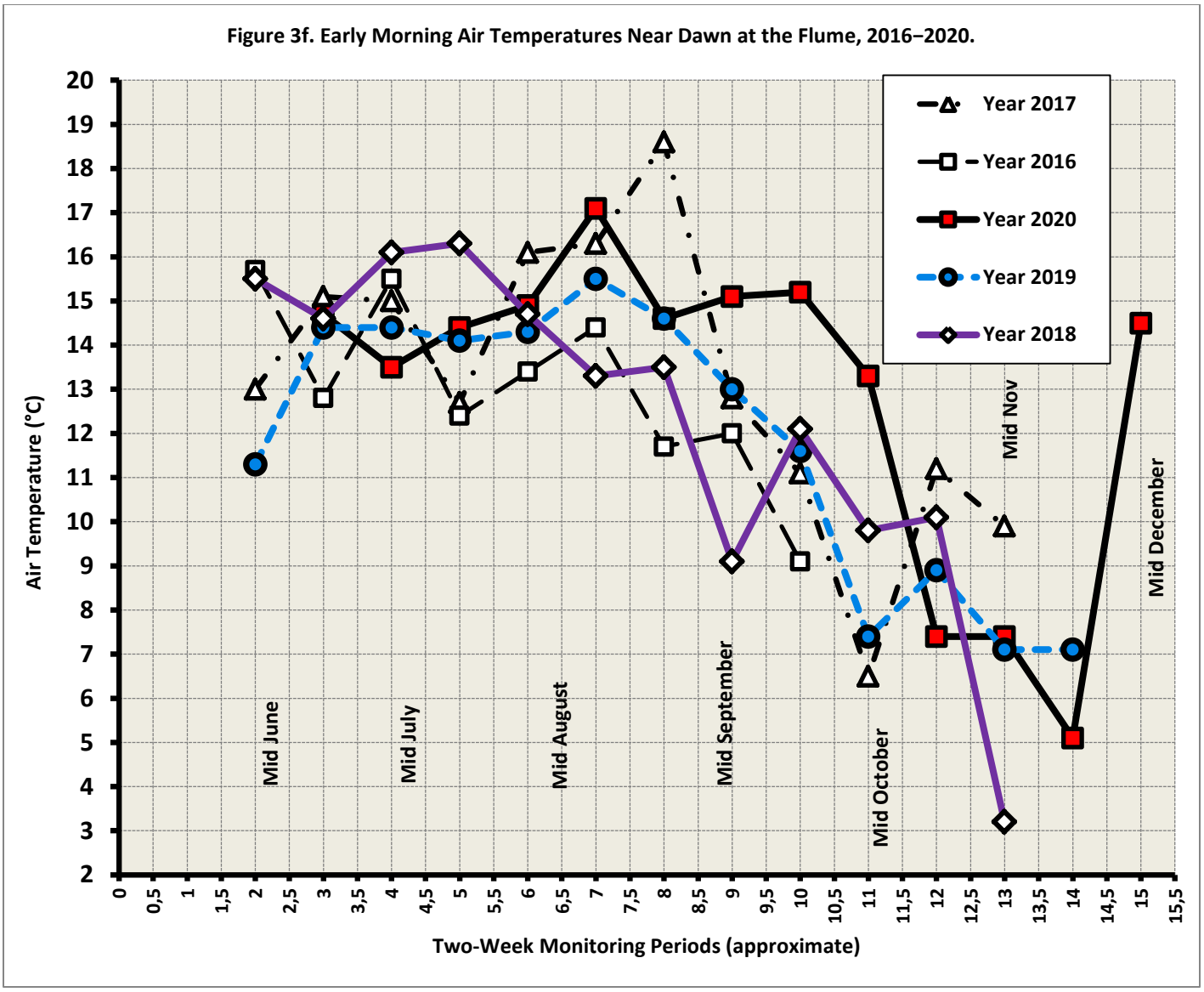


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, 2016−2020.

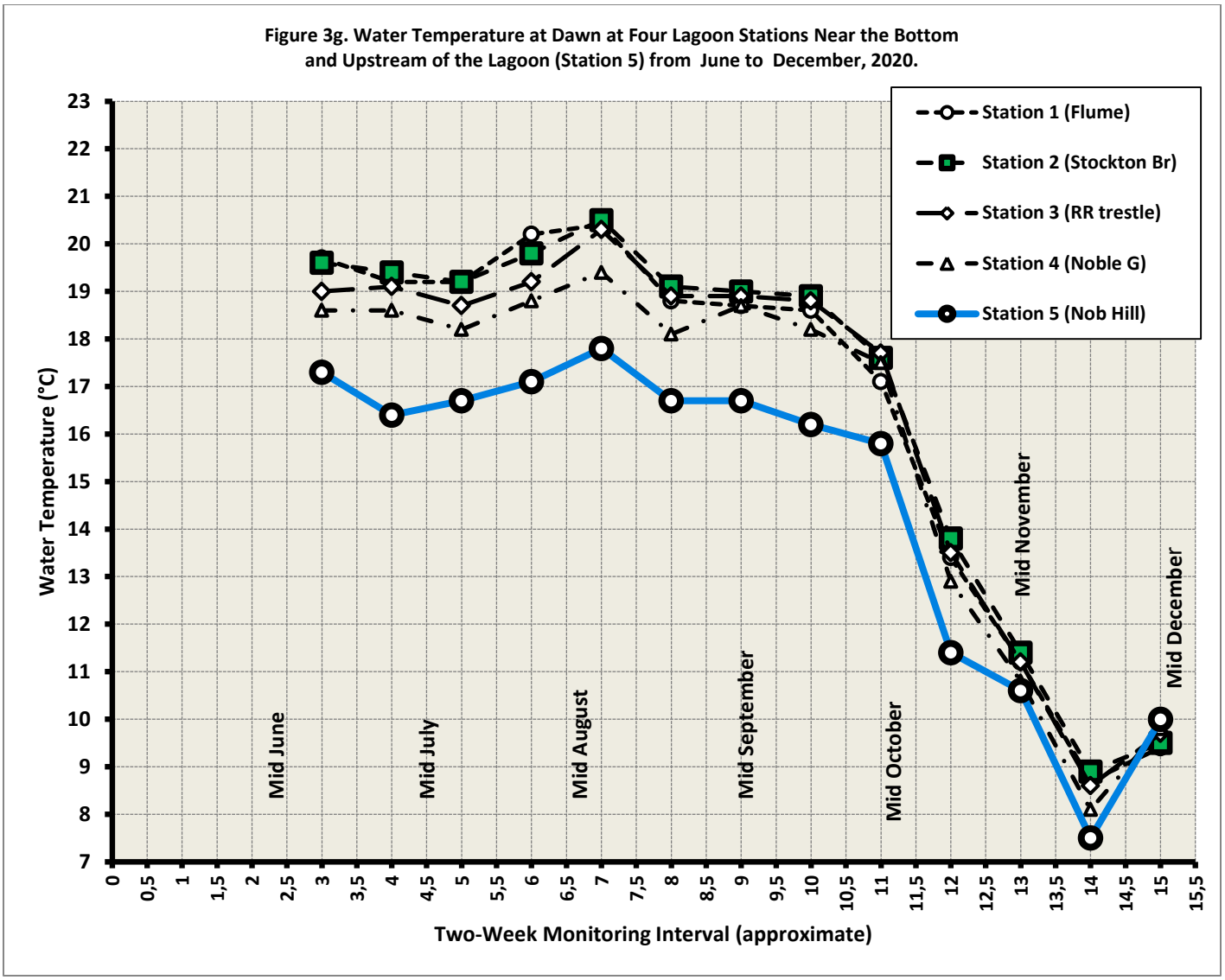


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to Mid-December 2020.

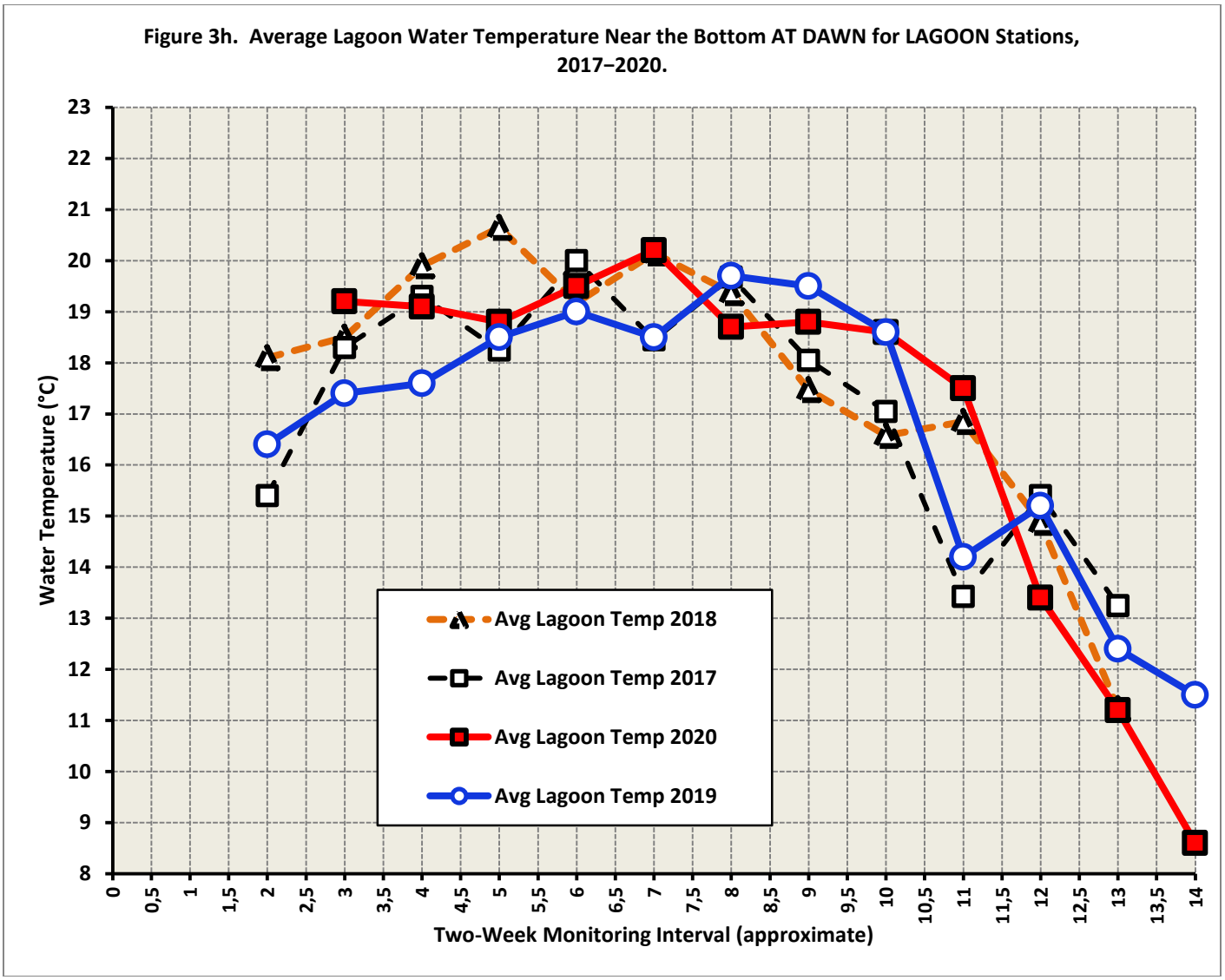


Figure 3h. Average Lagoon Water Temperature Near the Bottom at Dawn for 4 Stations, 2017–2020.

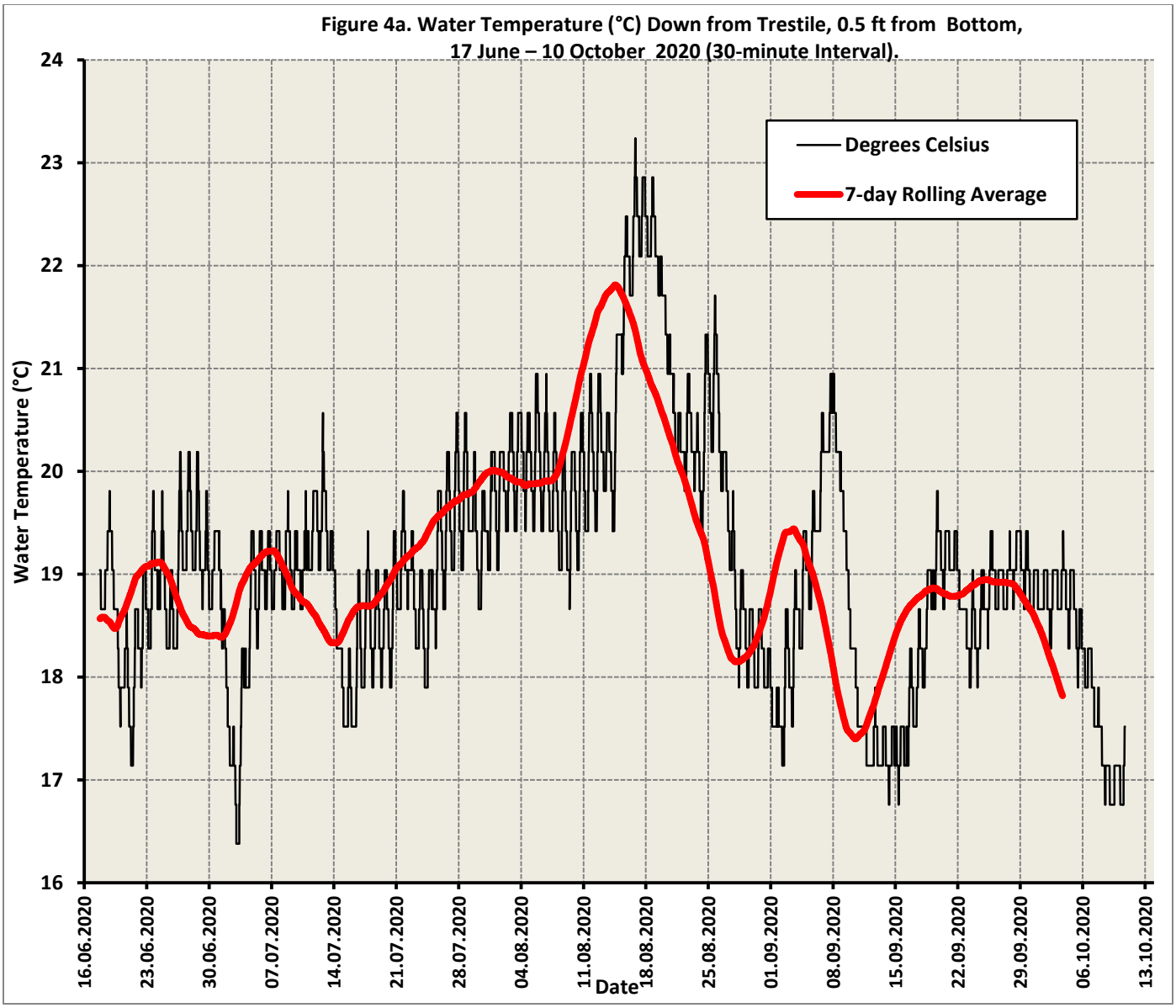


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

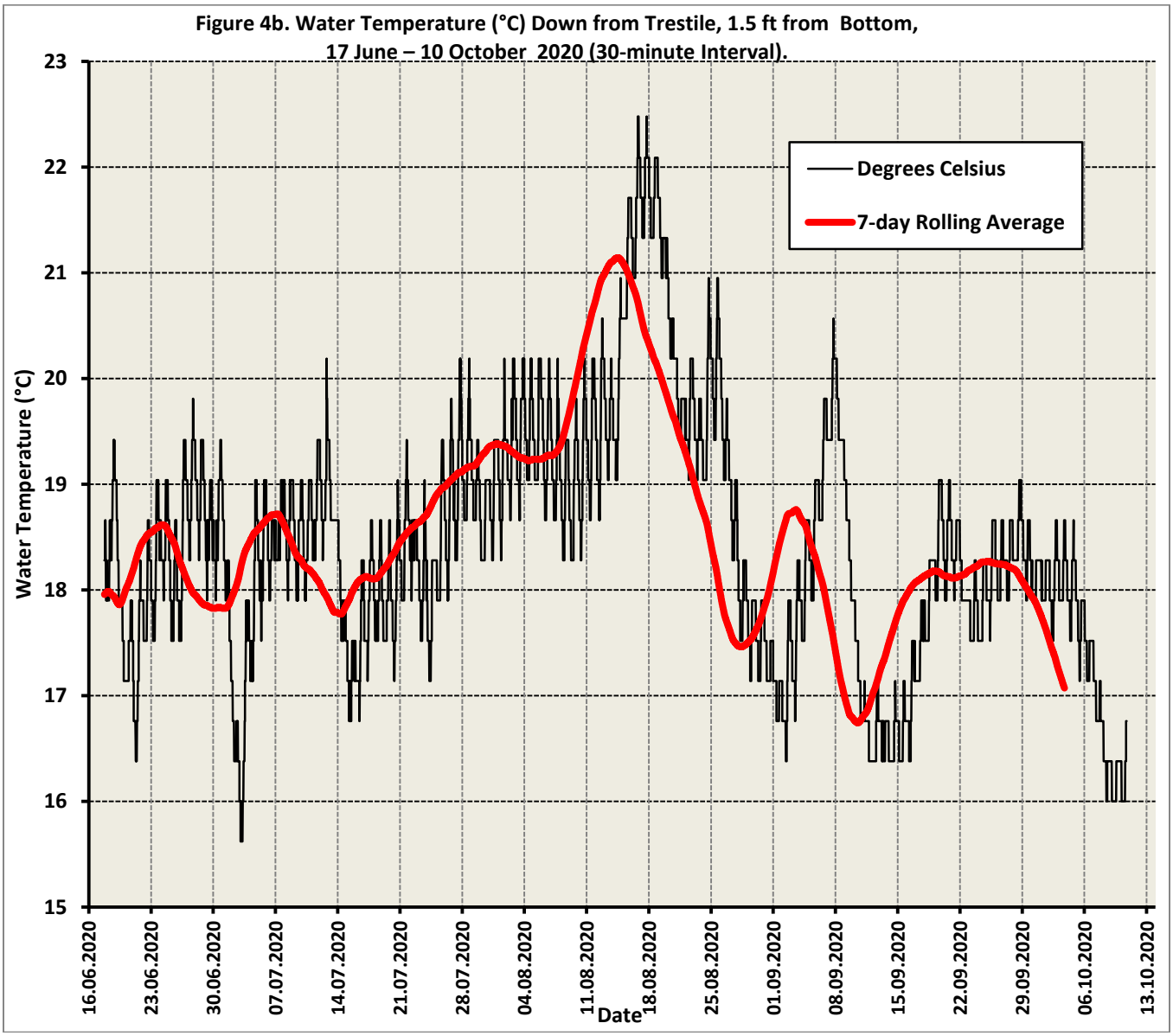


Figure 4b. Water Temperature (°C) Down from Trestle, 1.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

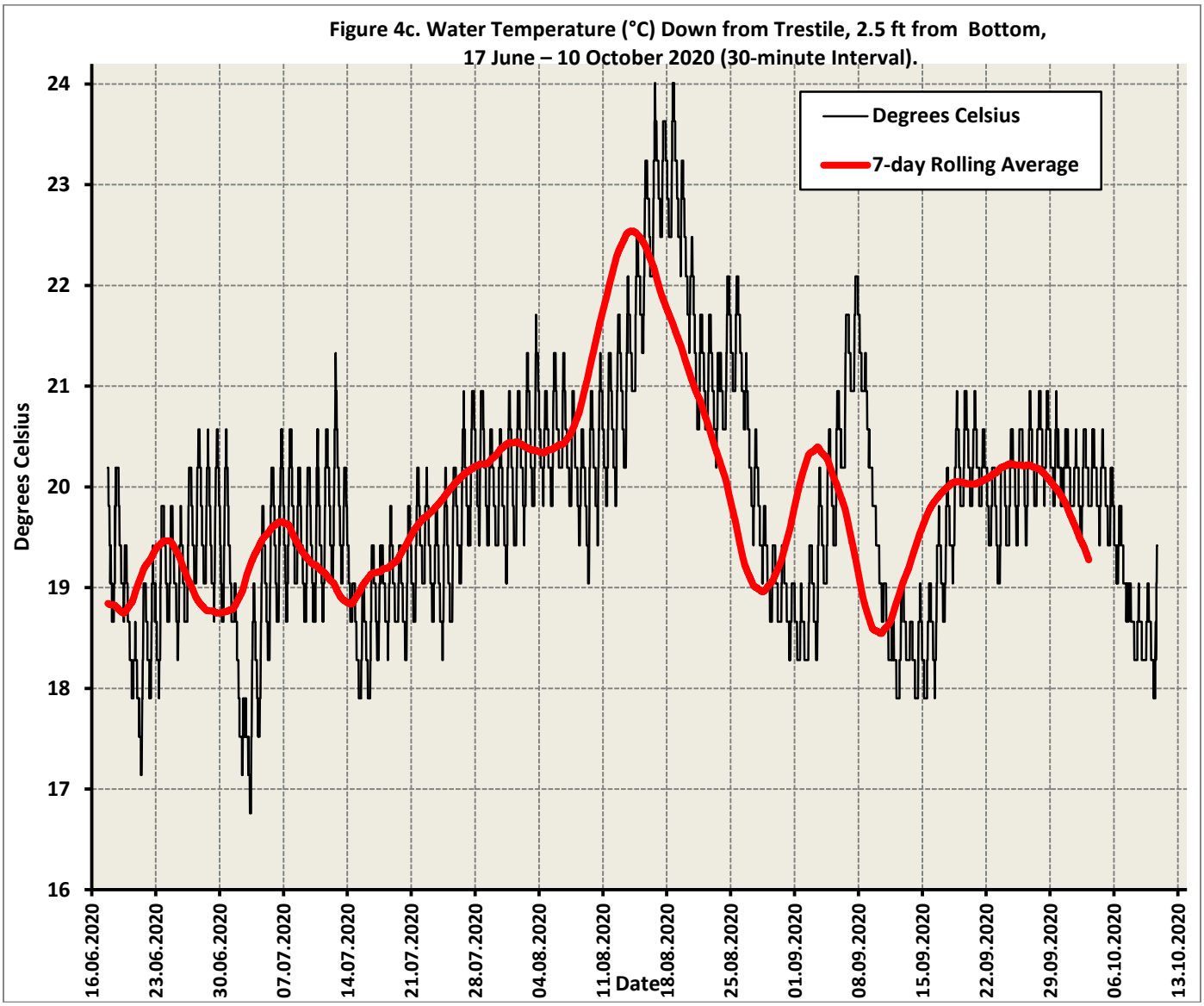


Figure 4c. Water Temperature (°C) Down from Trestle, 2.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

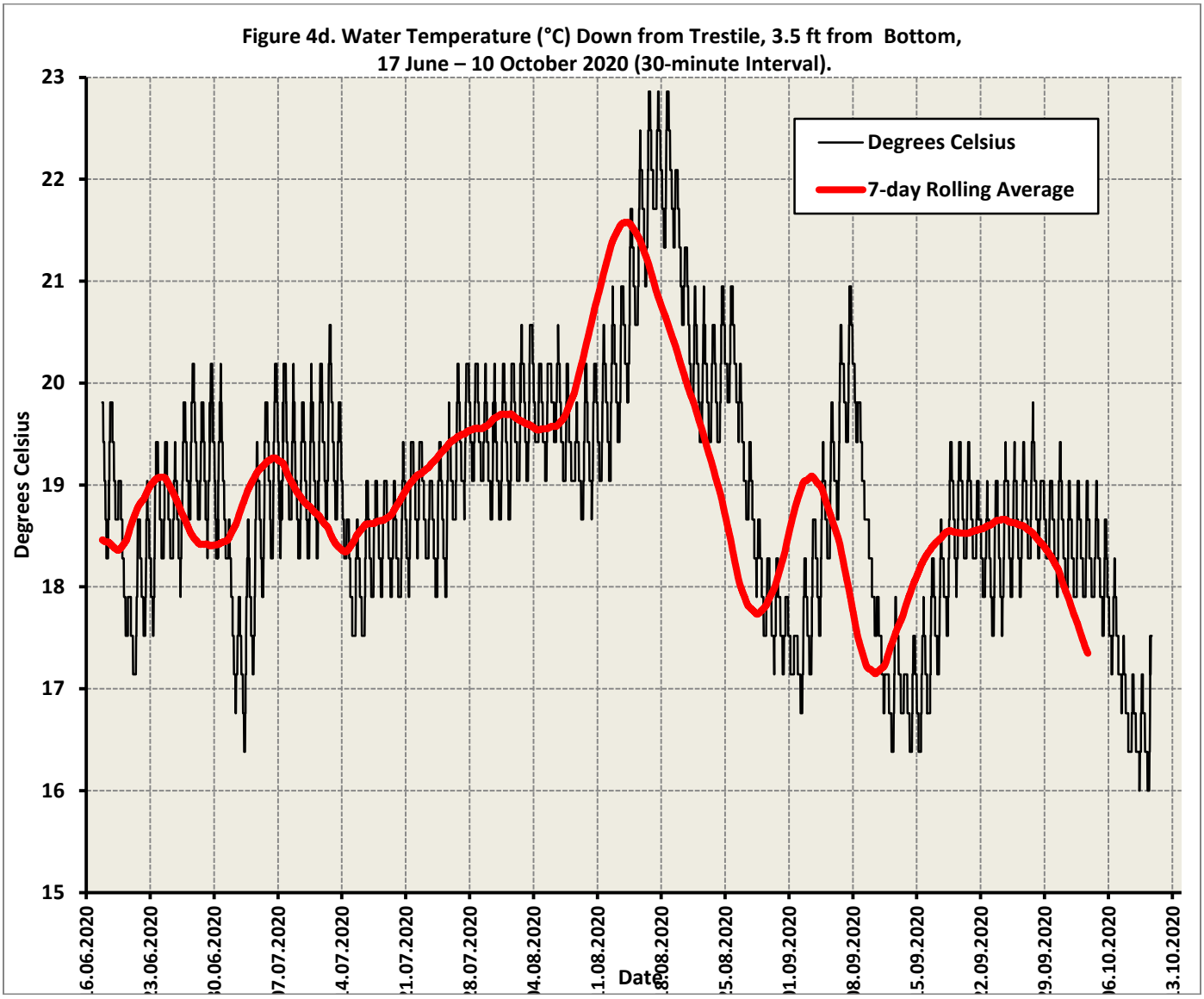


Figure 4d. Water Temperature (°C) Down from Trestle, 3.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

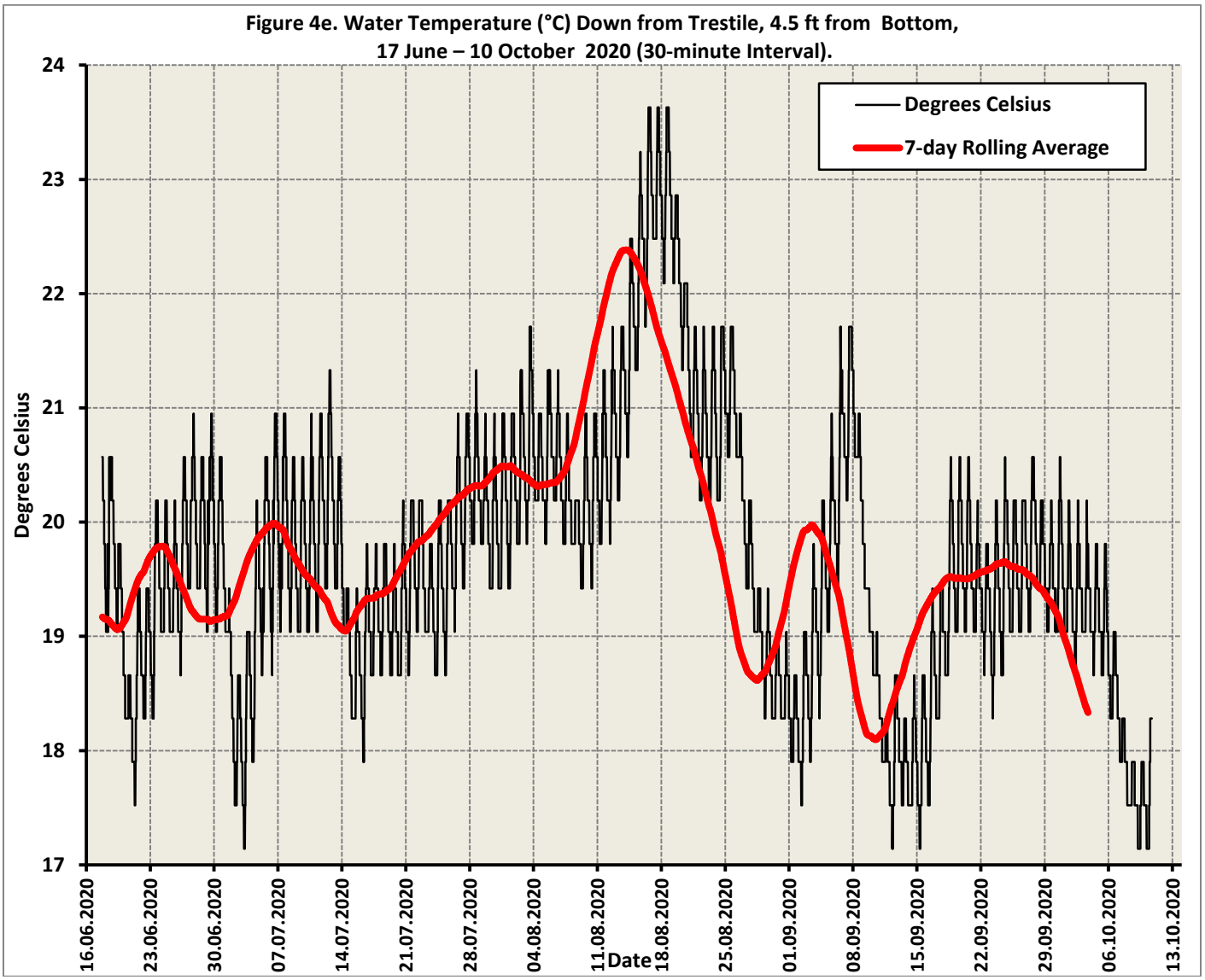


Figure 4e. Water Temperature (°C) Down from Trestle, 4.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

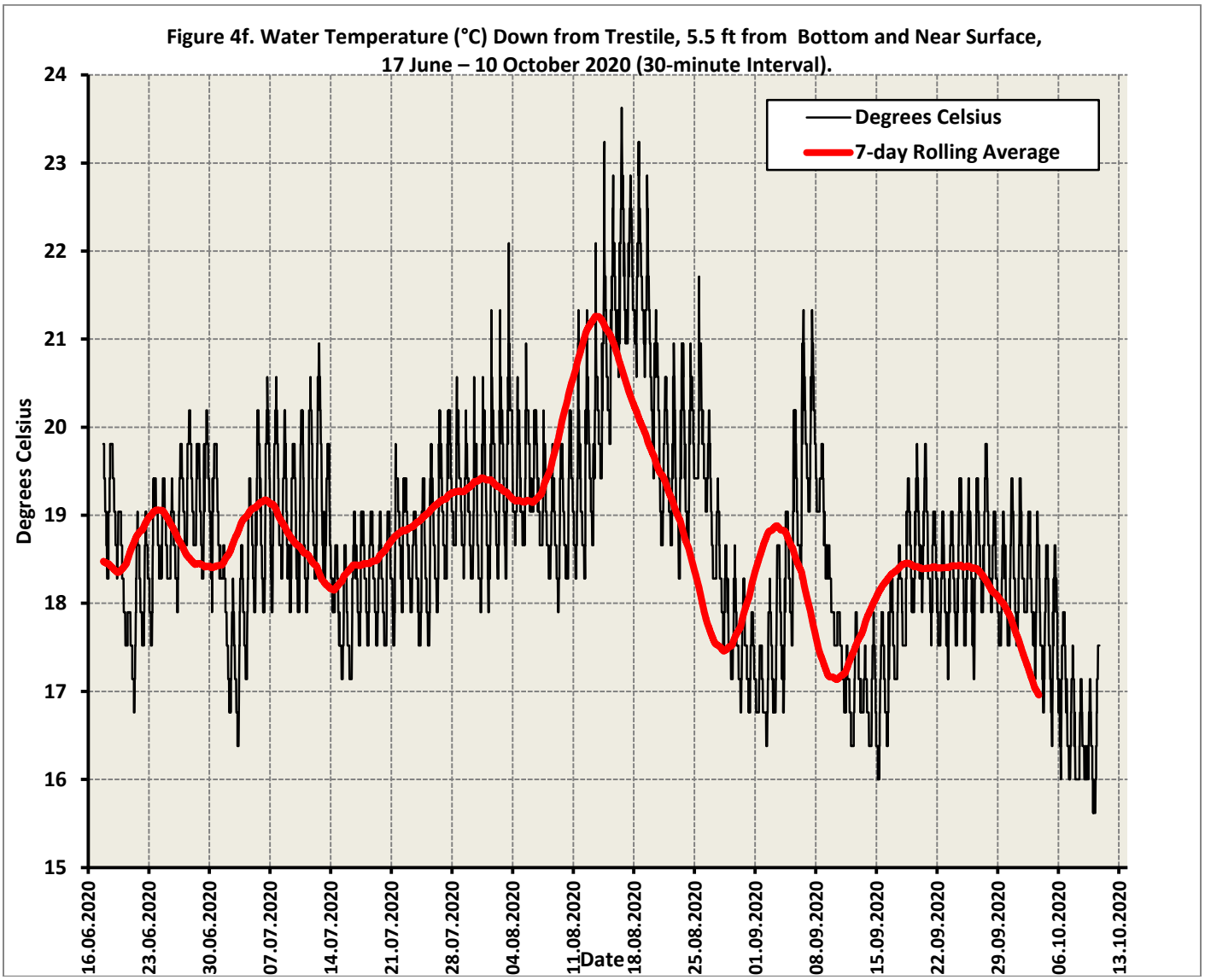


Figure 4f. Water Temperature (°C) Down from Trestle, 5.5 ft from the Bottom, 17 June – 10 October 2020 (30-minute Interval).

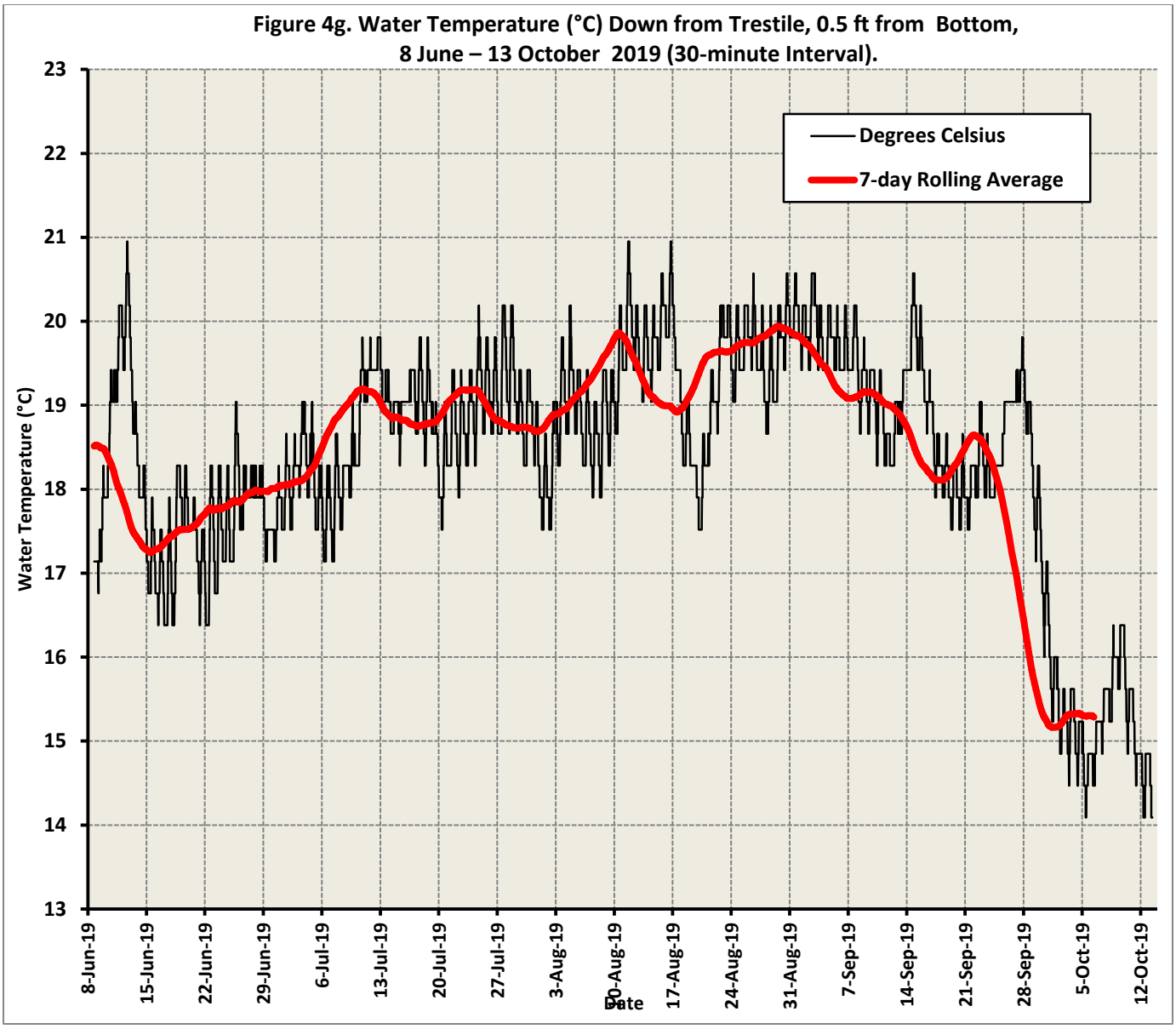


Figure 4g. Water Temperature (°C) Down from Trestle, 0.5 ft from the Bottom, 8 June – 13 October 2019 (30-minute Interval).

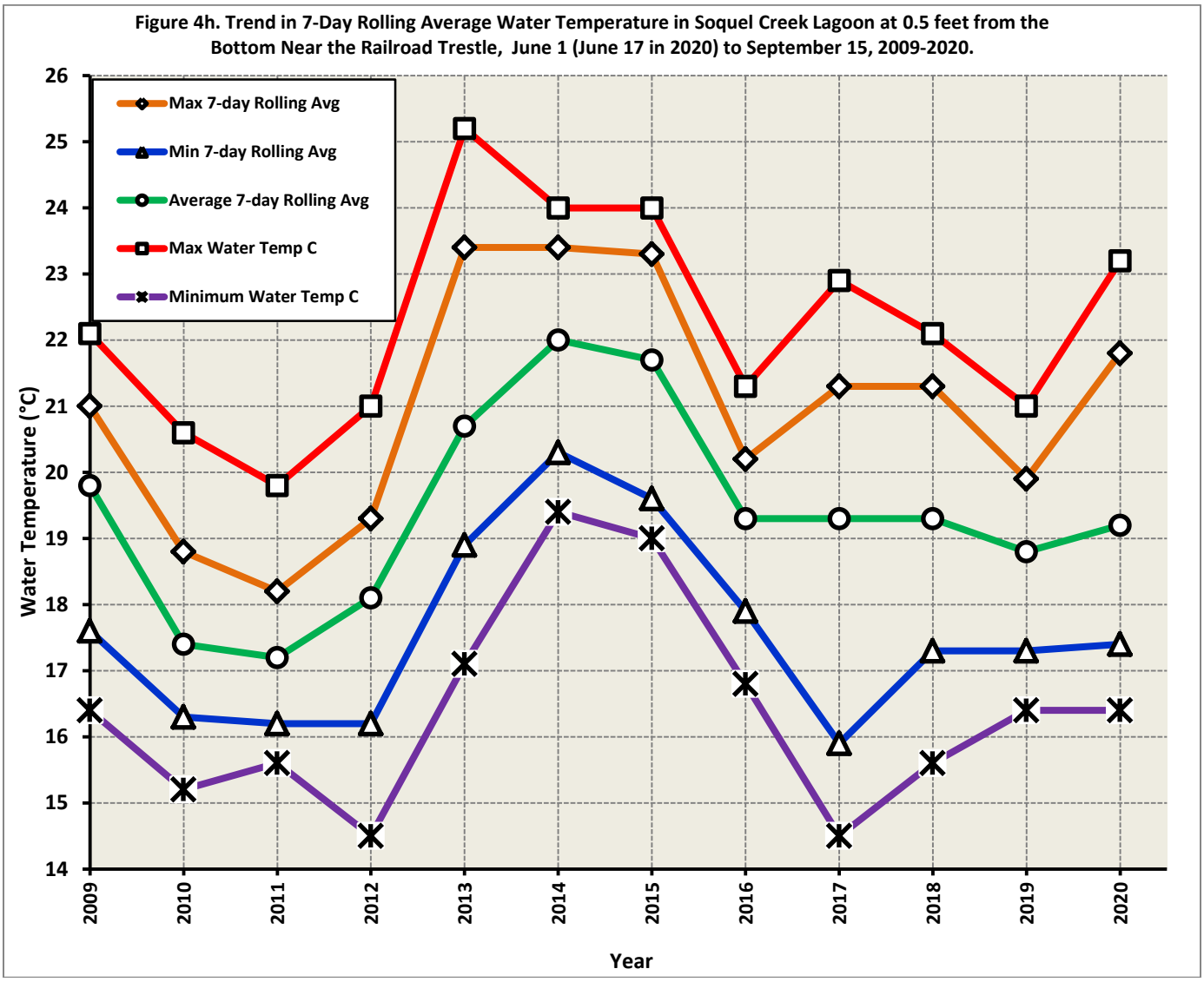


Figure 4h. Trend in 7-day Rolling Average Water Temperature in Soquel Creek Lagoon at 0.5 ft from the Bottom Near the Railroad Trestle, 2009–2020.

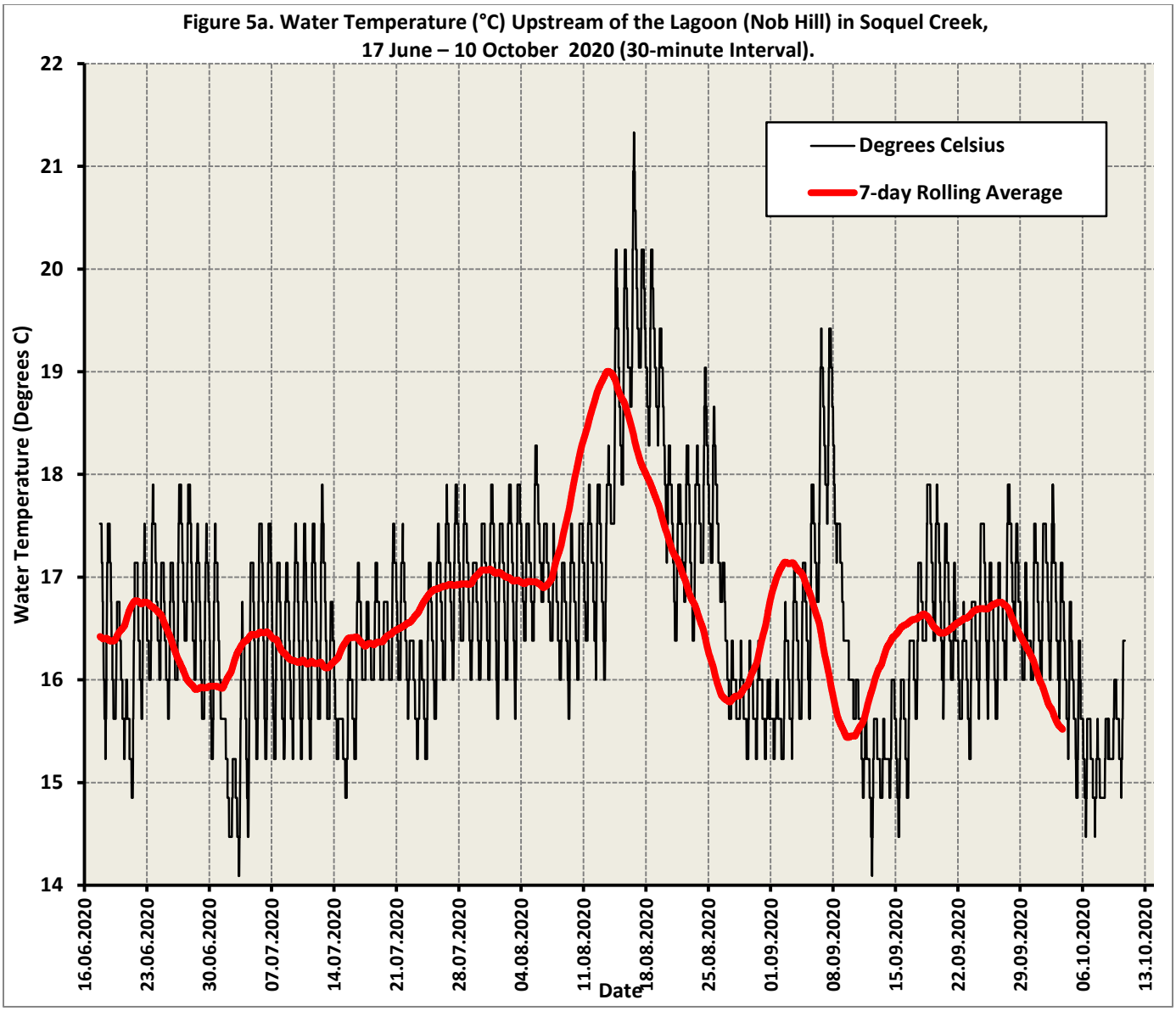


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 17 June – 10 October 2020 (30-minute Interval).

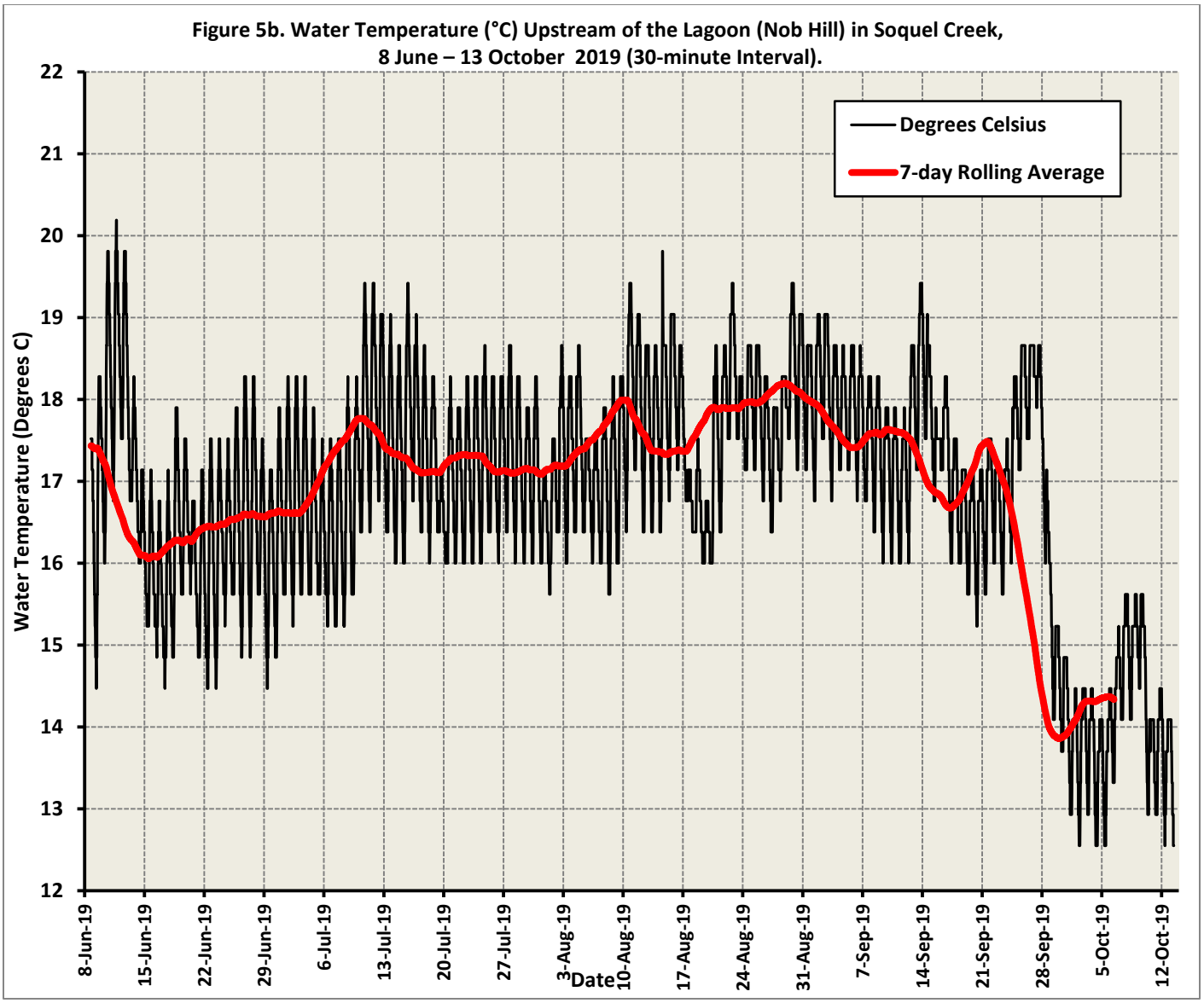


Figure 5b. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June – 13 October 2019 (30-minute Interval).

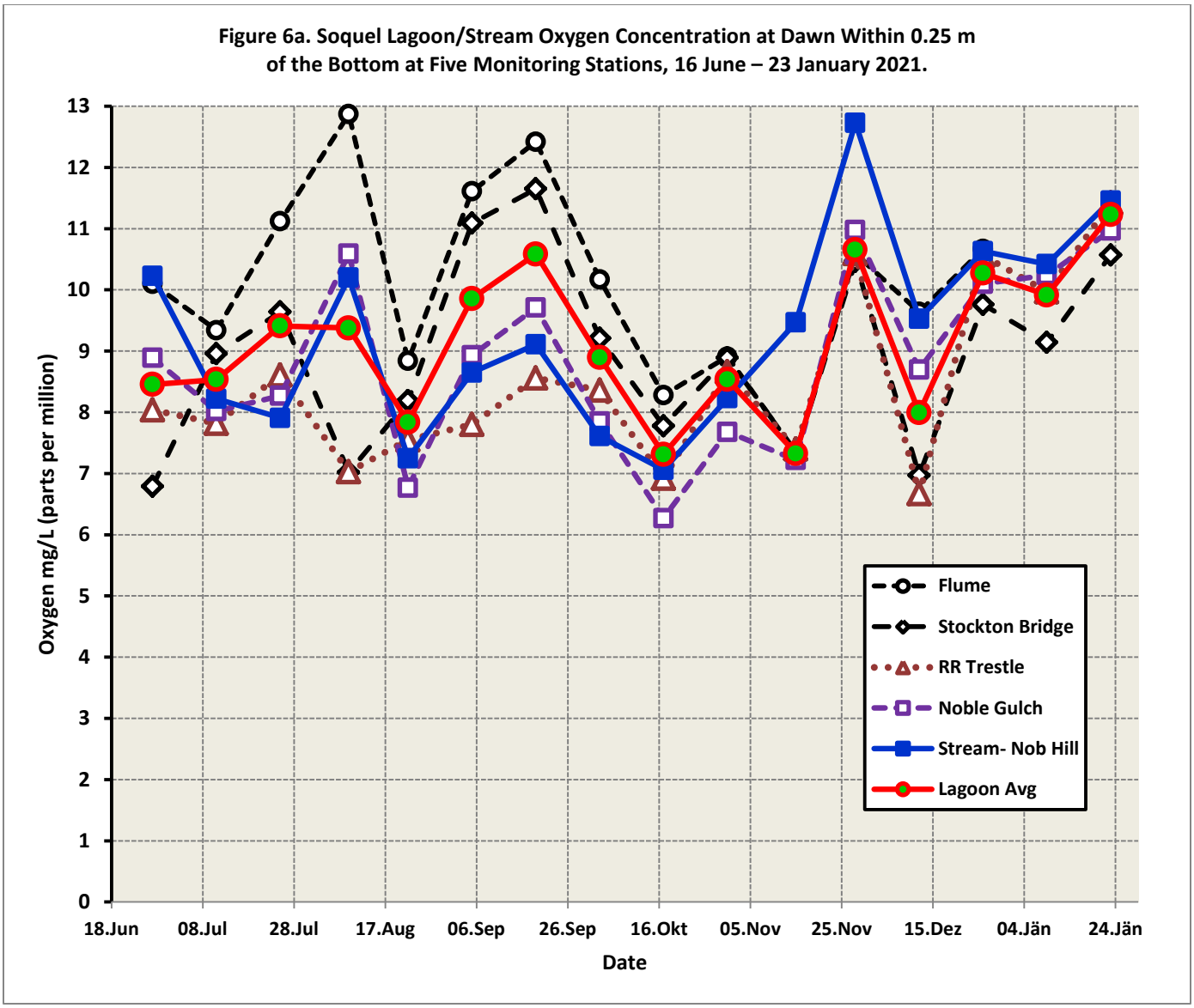


Figure 6a. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 16 June – 23 January 2021.

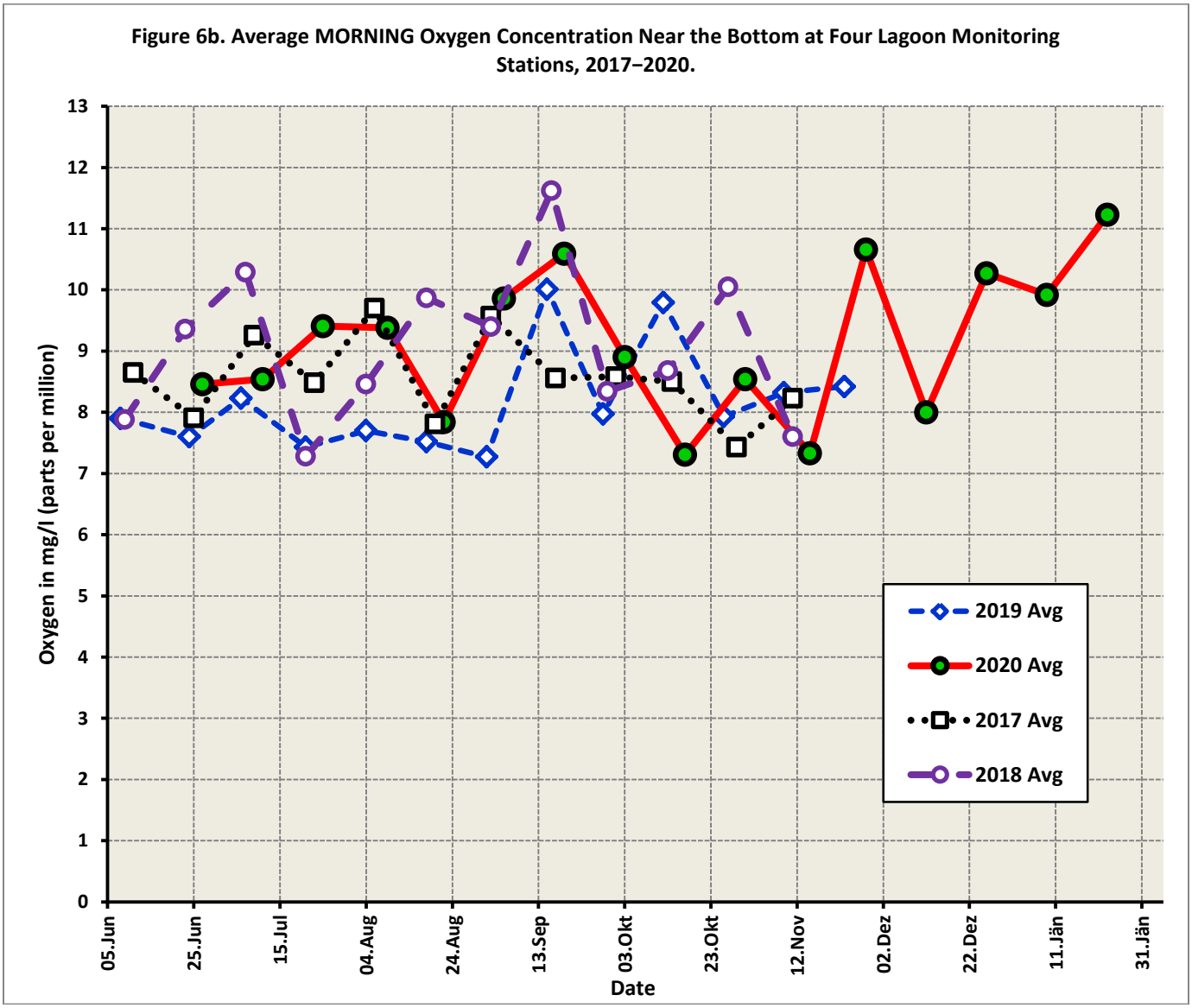


Figure 6b. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2017–2020.

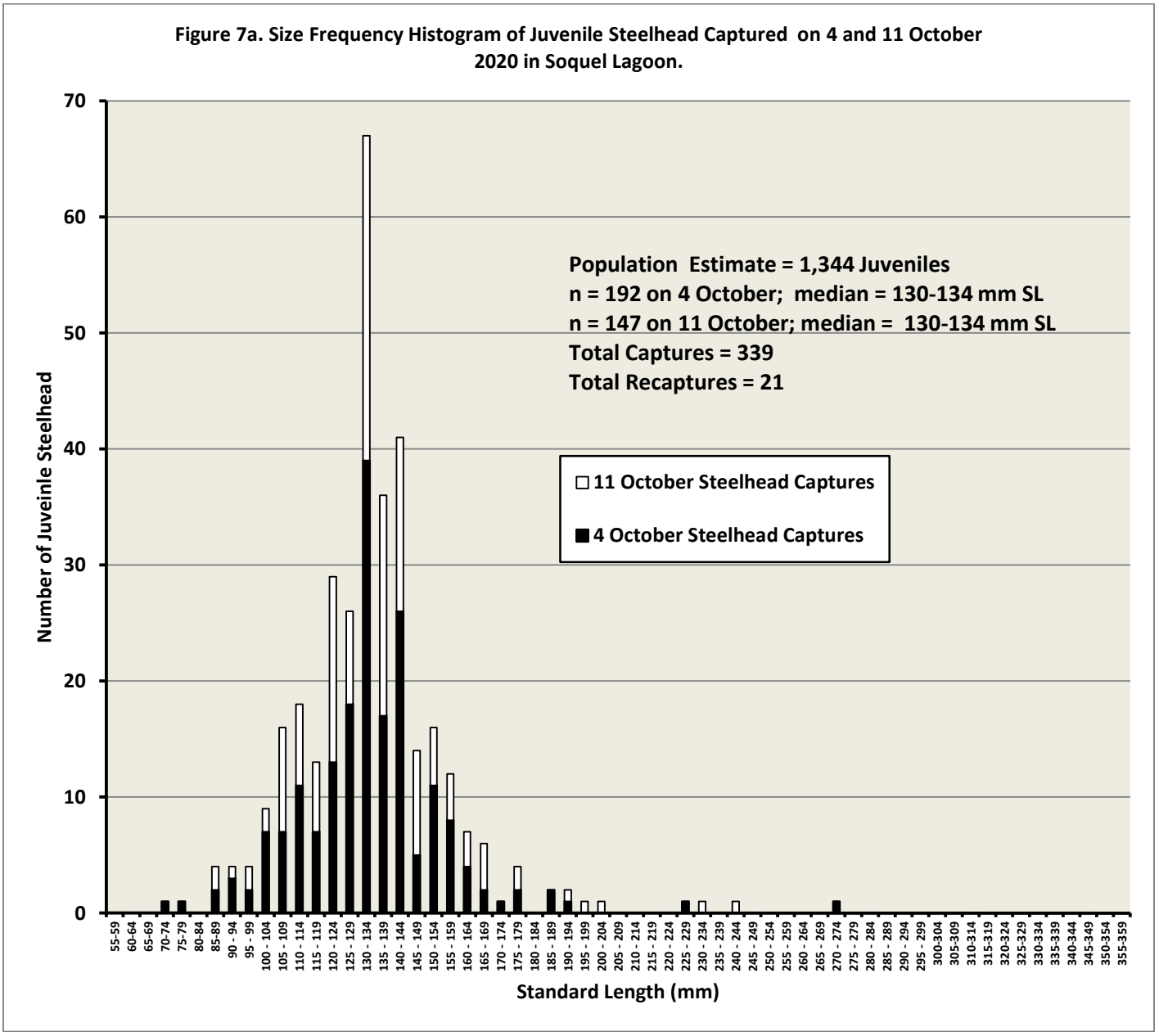


Figure 7a. Size Frequency Histogram of Steelhead Captured on 4 and 11 October 2020 in Soquel Lagoon

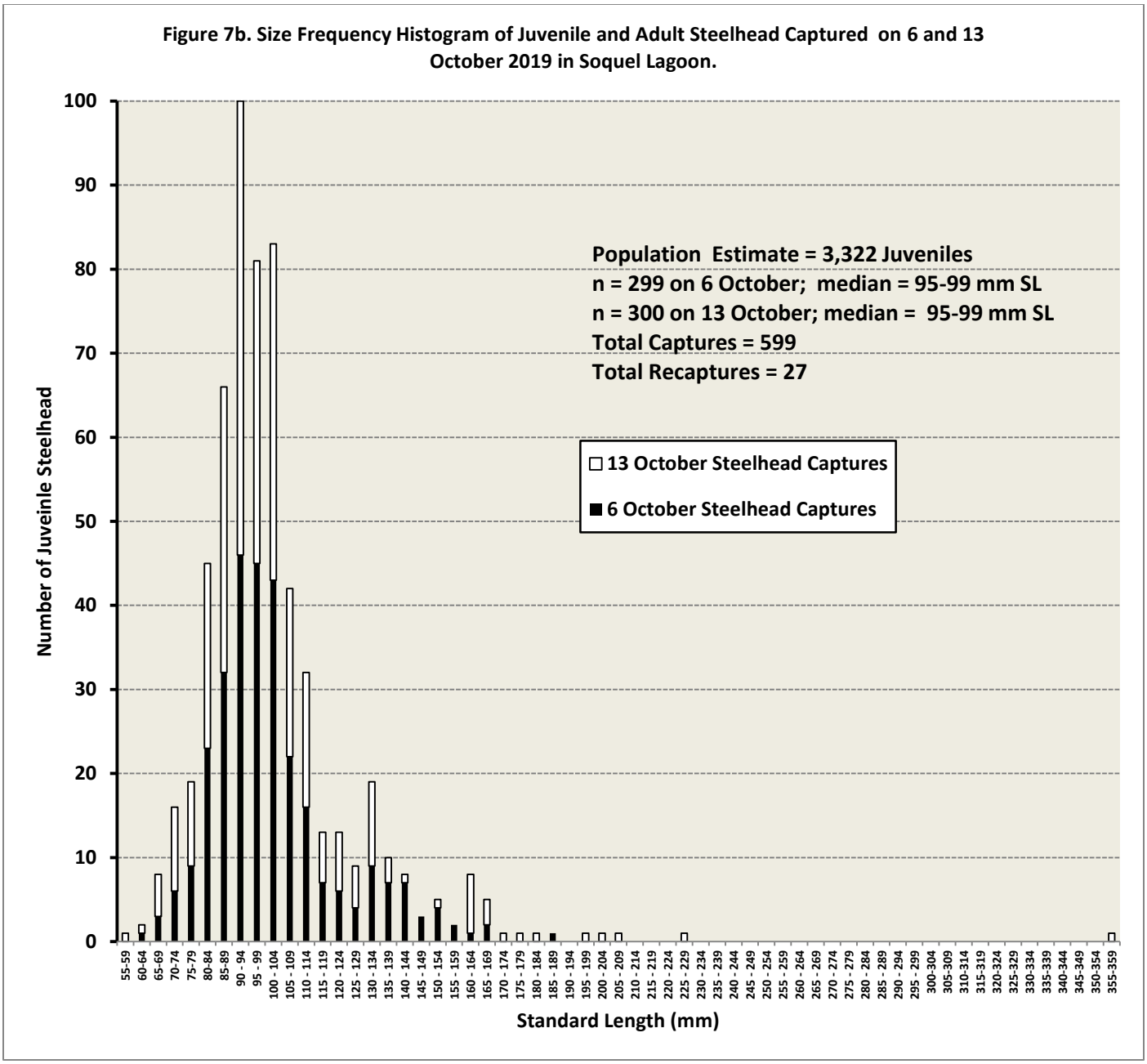


Figure 7b. Size Frequency Histogram of Steelhead Captured on 6 and 13 October 2019 in Soquel Lagoon.

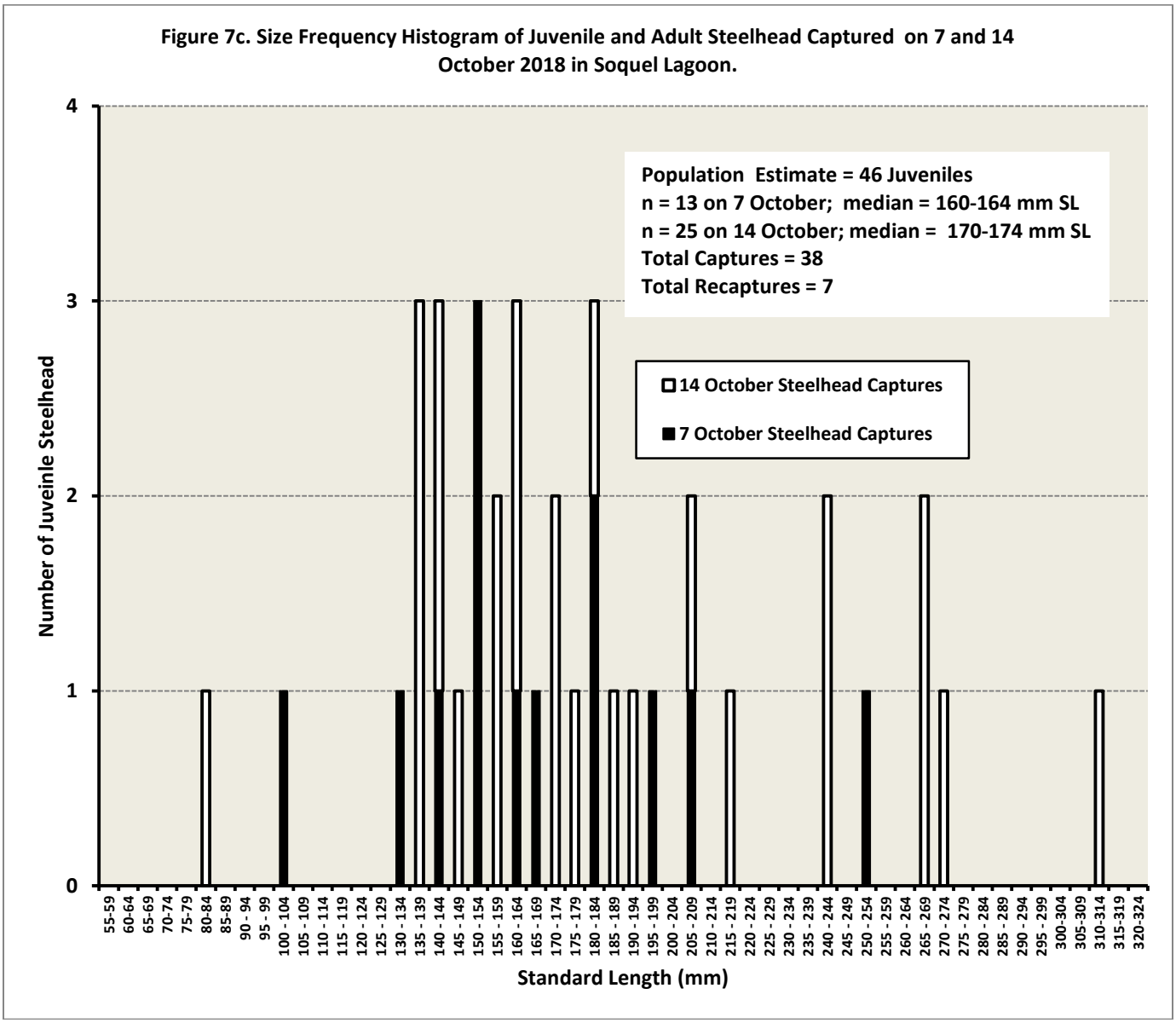


Figure 7c. Size Frequency Histogram of Steelhead Captured on 7 and 14 October 2018 in Soquel Lagoon.

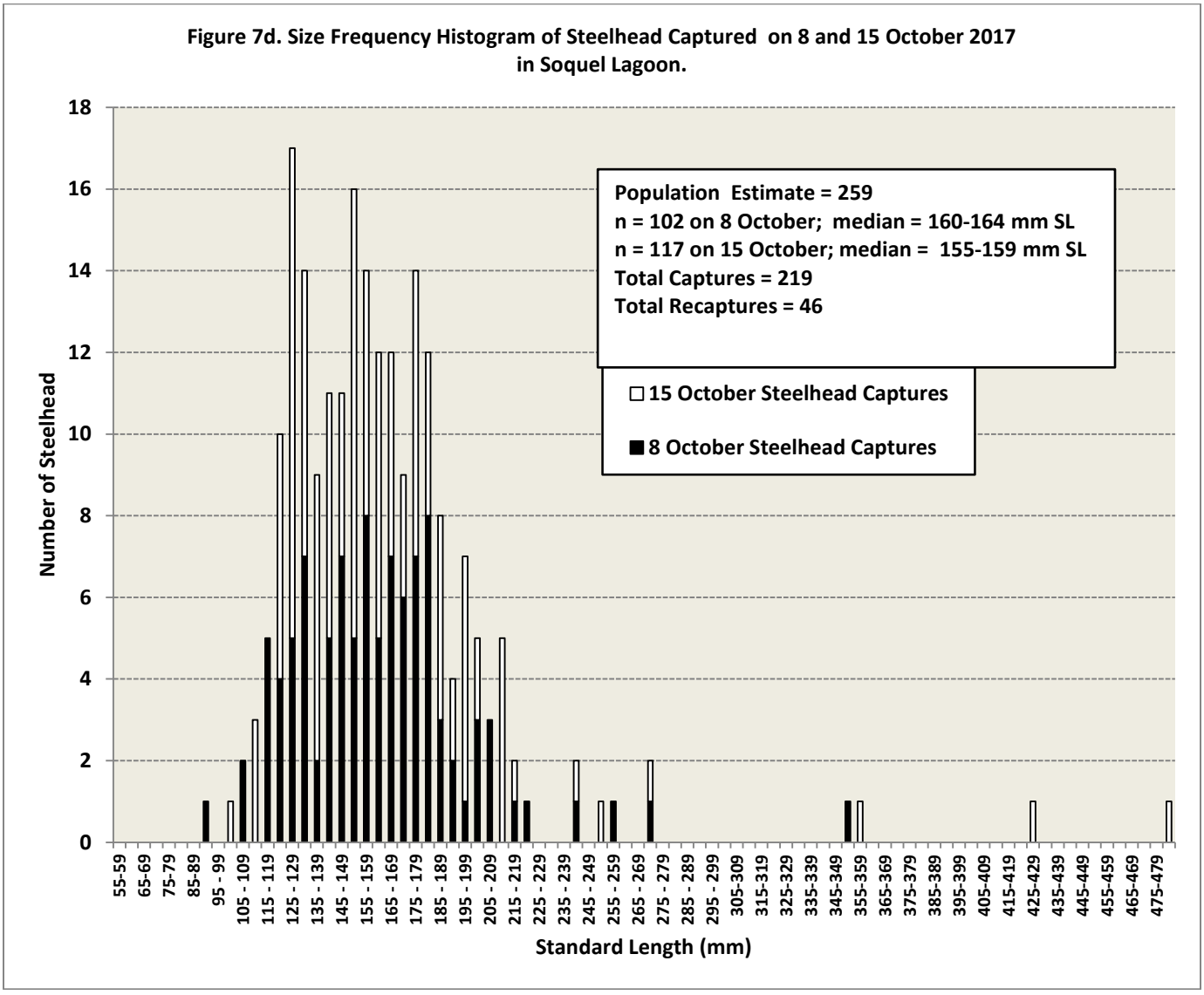


Figure 7d. Size Frequency Histogram of Steelhead Captured on 8 and 15 October 2017 in Soquel Lagoon.

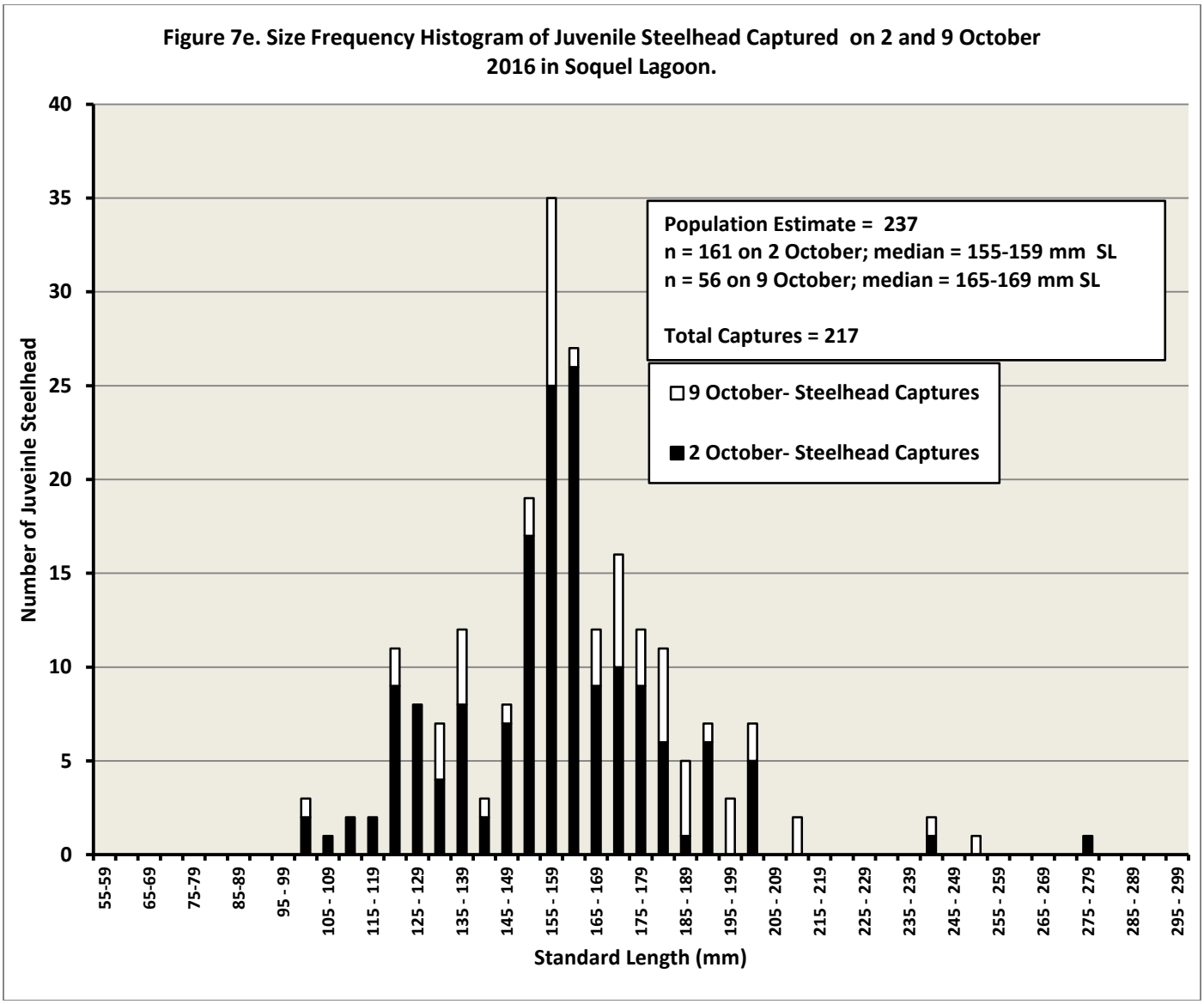


Figure 7e. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 9 October 2016 in Soquel Lagoon.

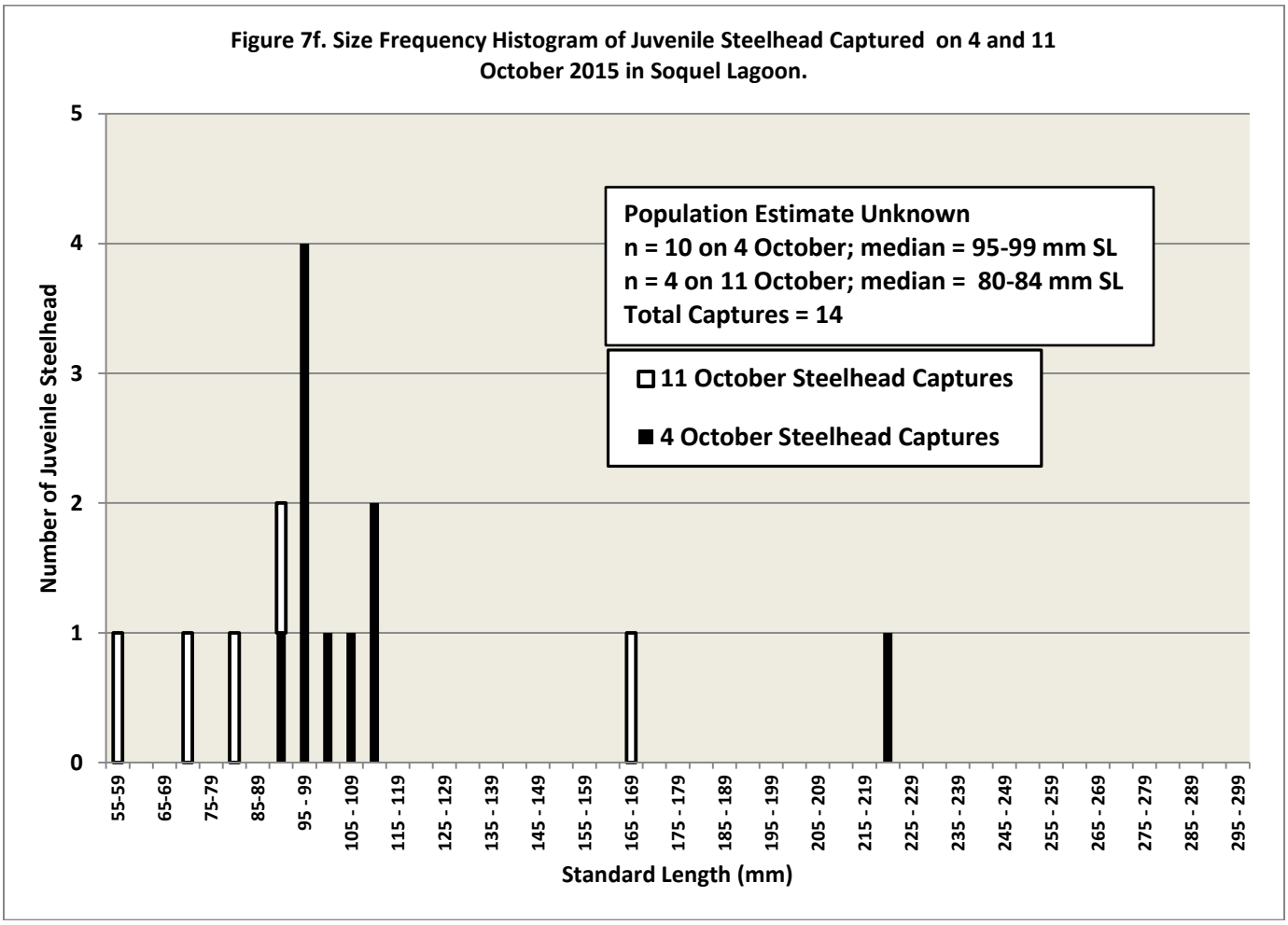


Figure 7f. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2015 in Soquel Lagoon.

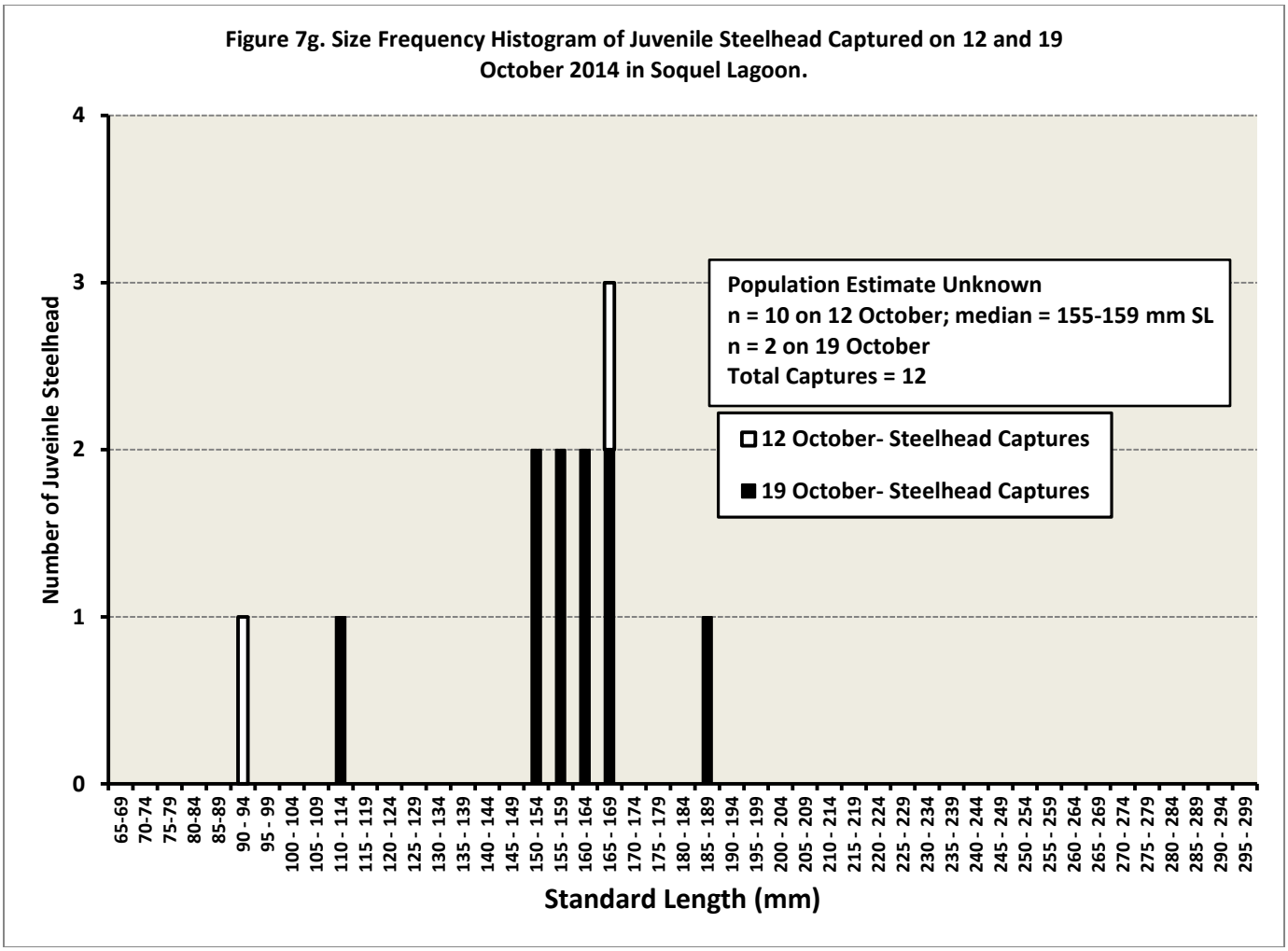


Figure 7g. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

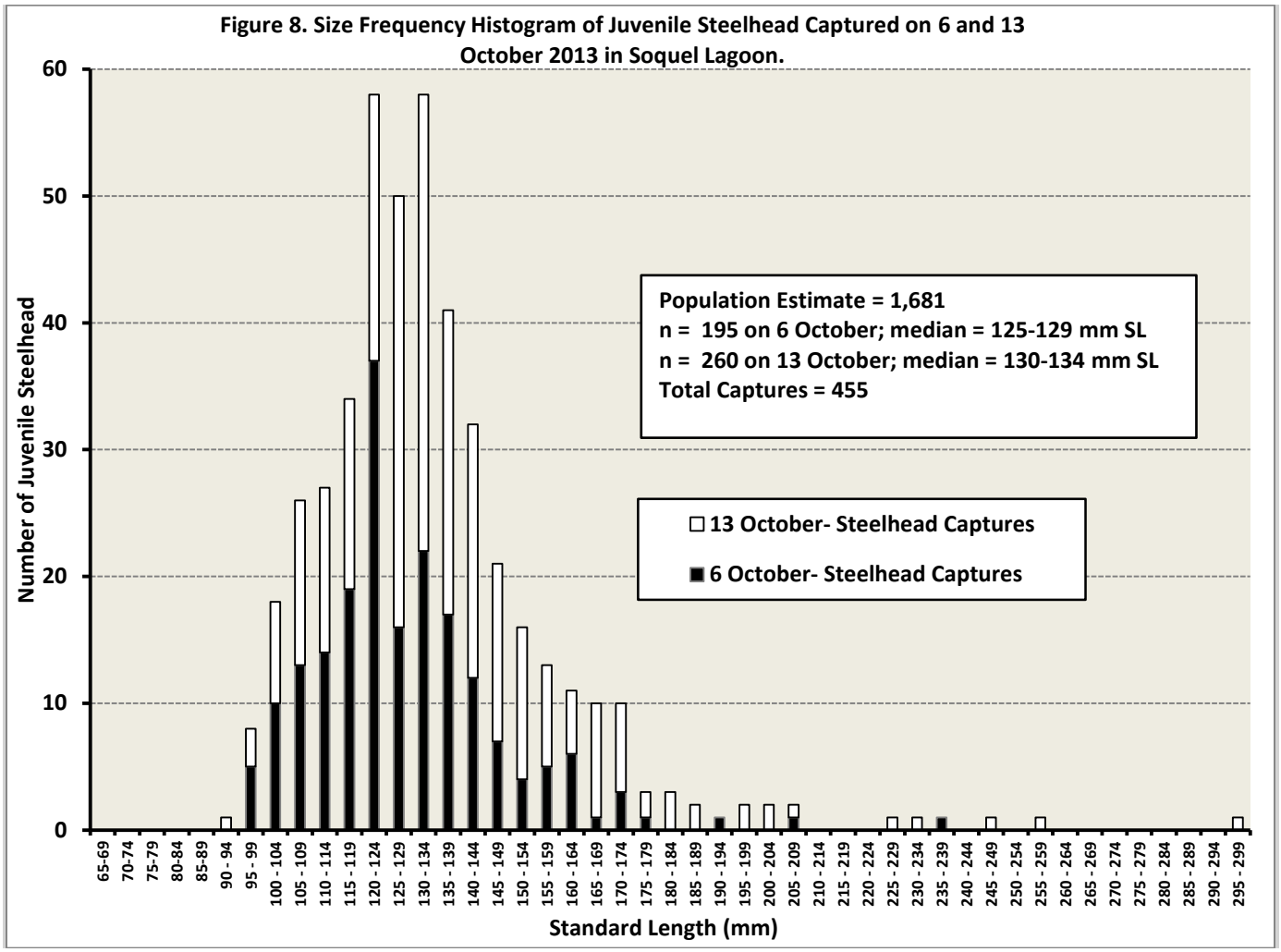


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

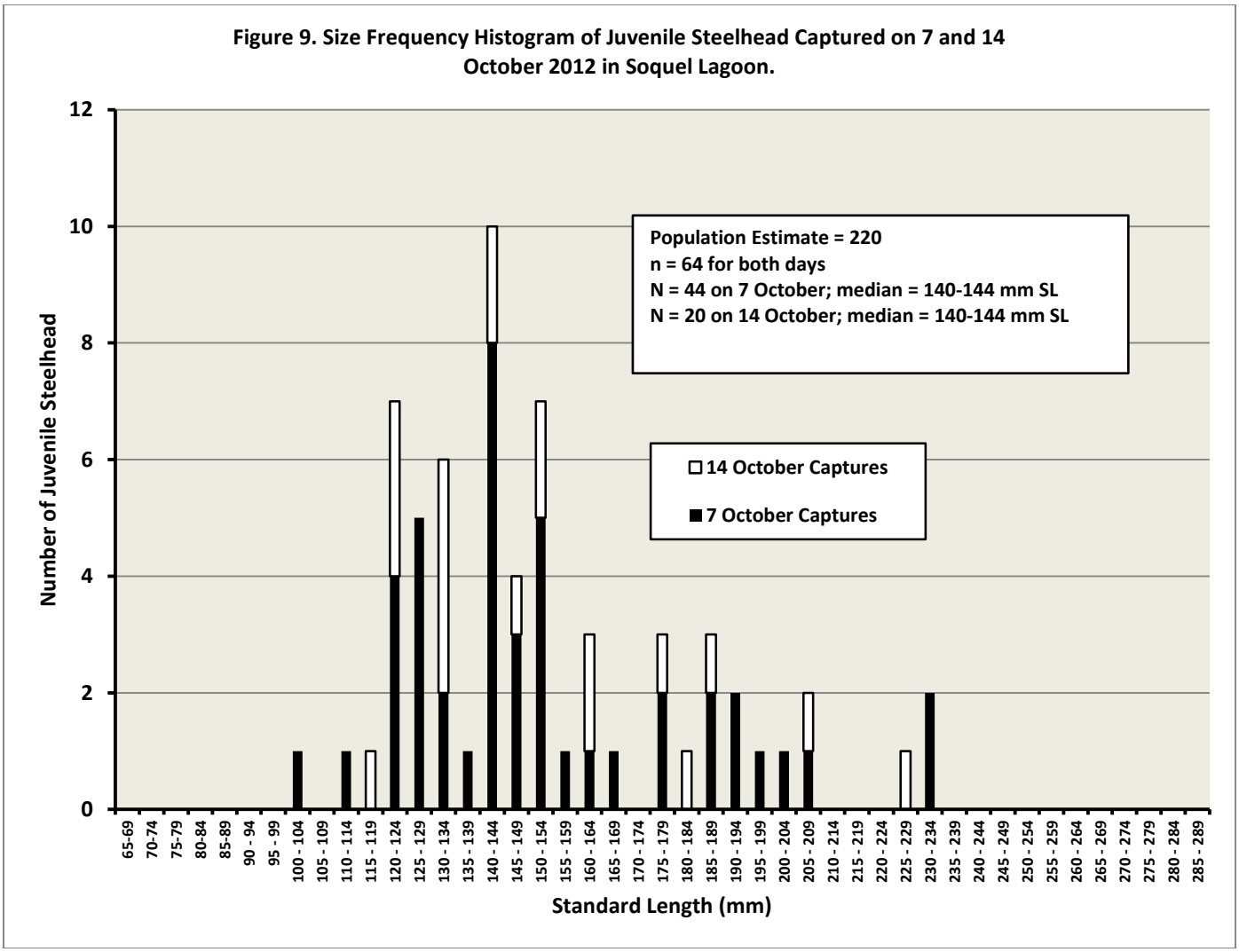


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

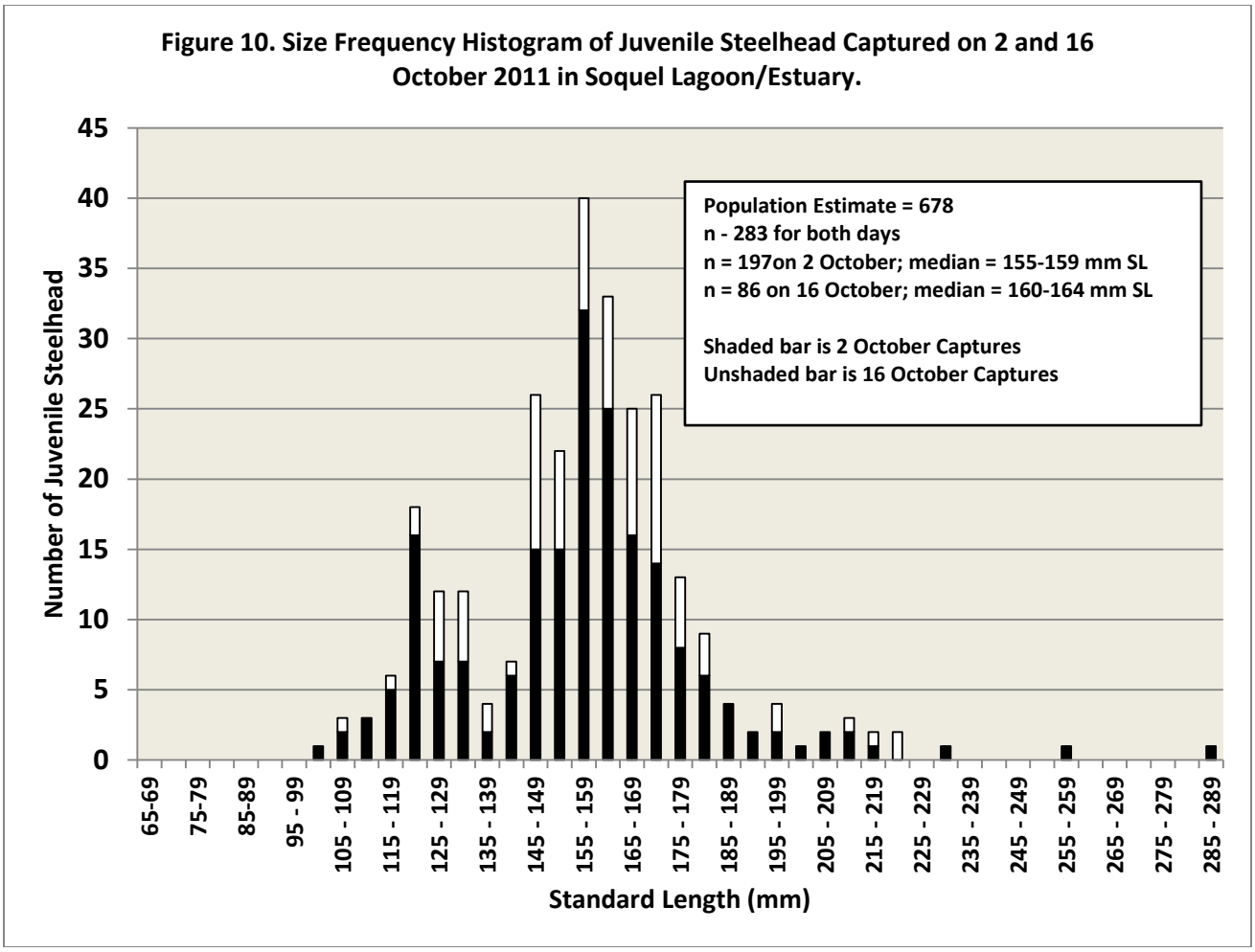


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

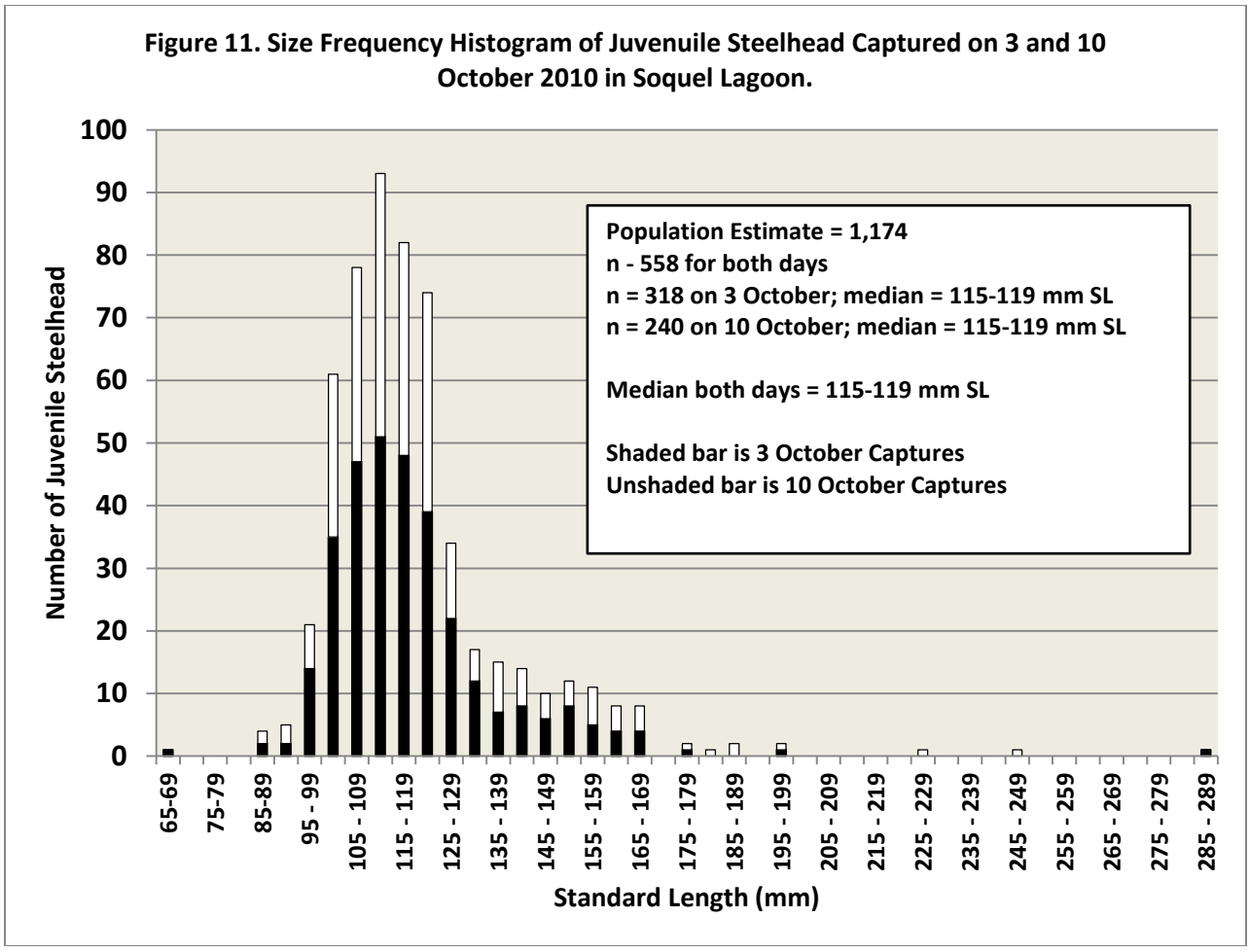


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

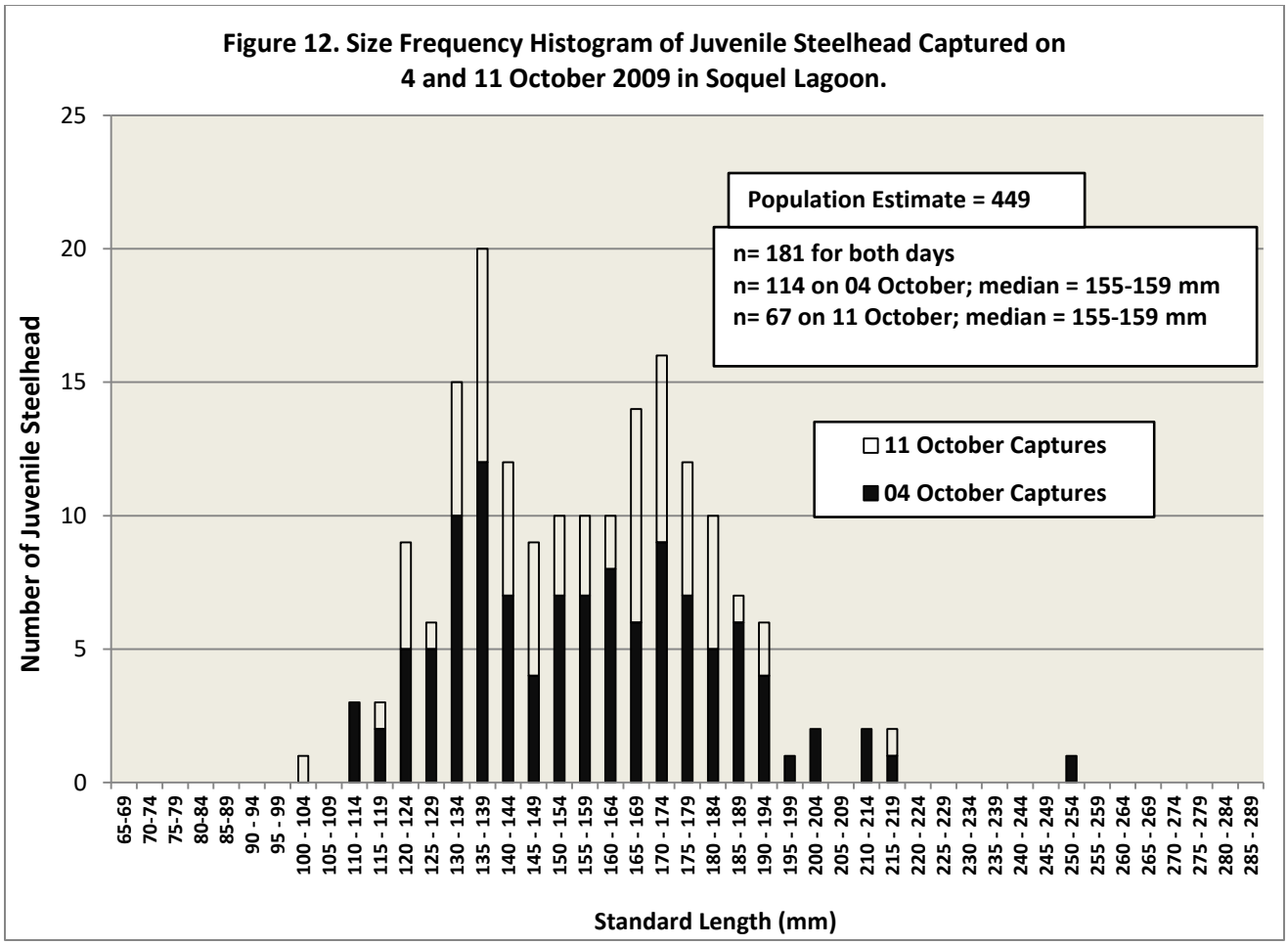


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

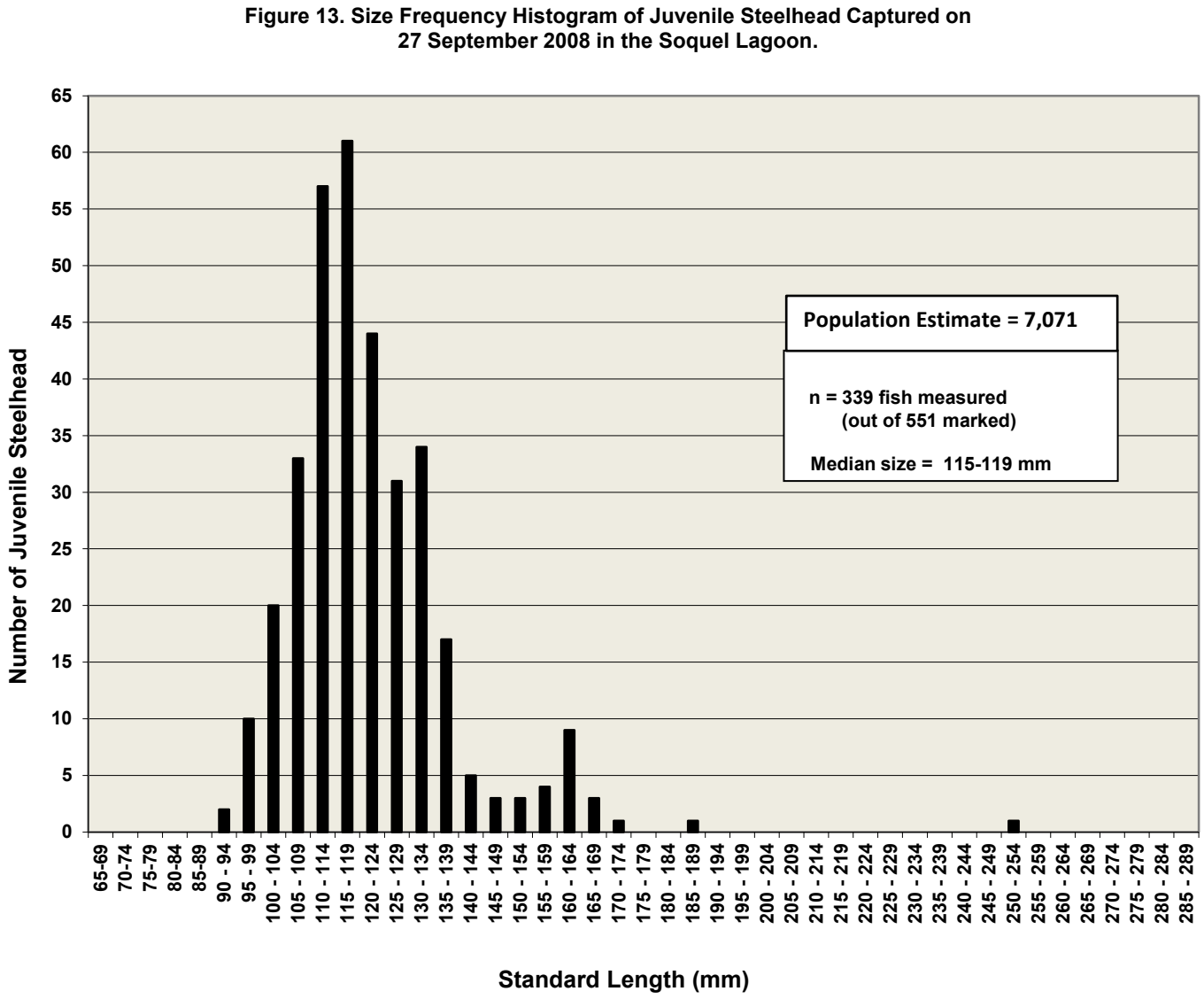


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

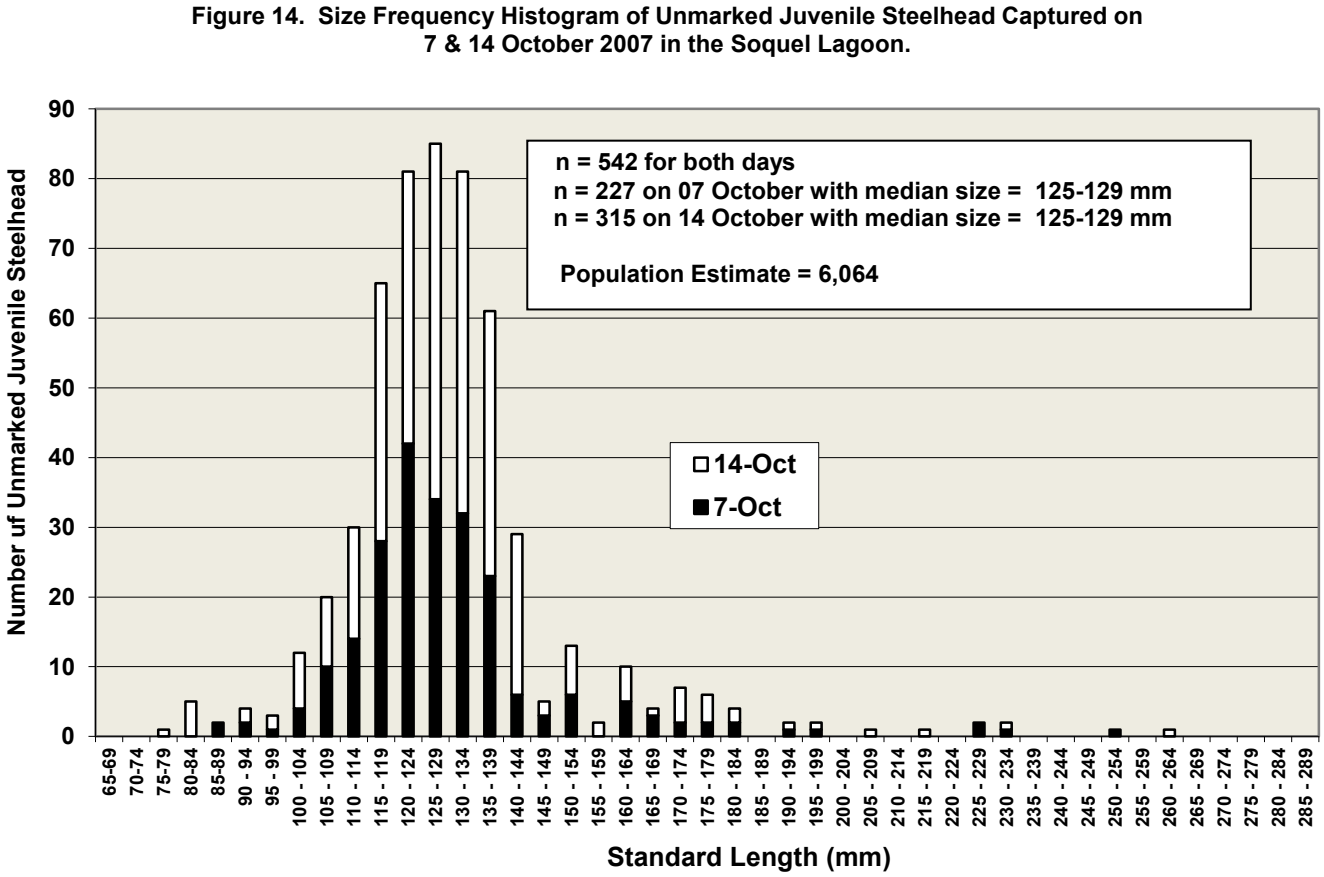


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

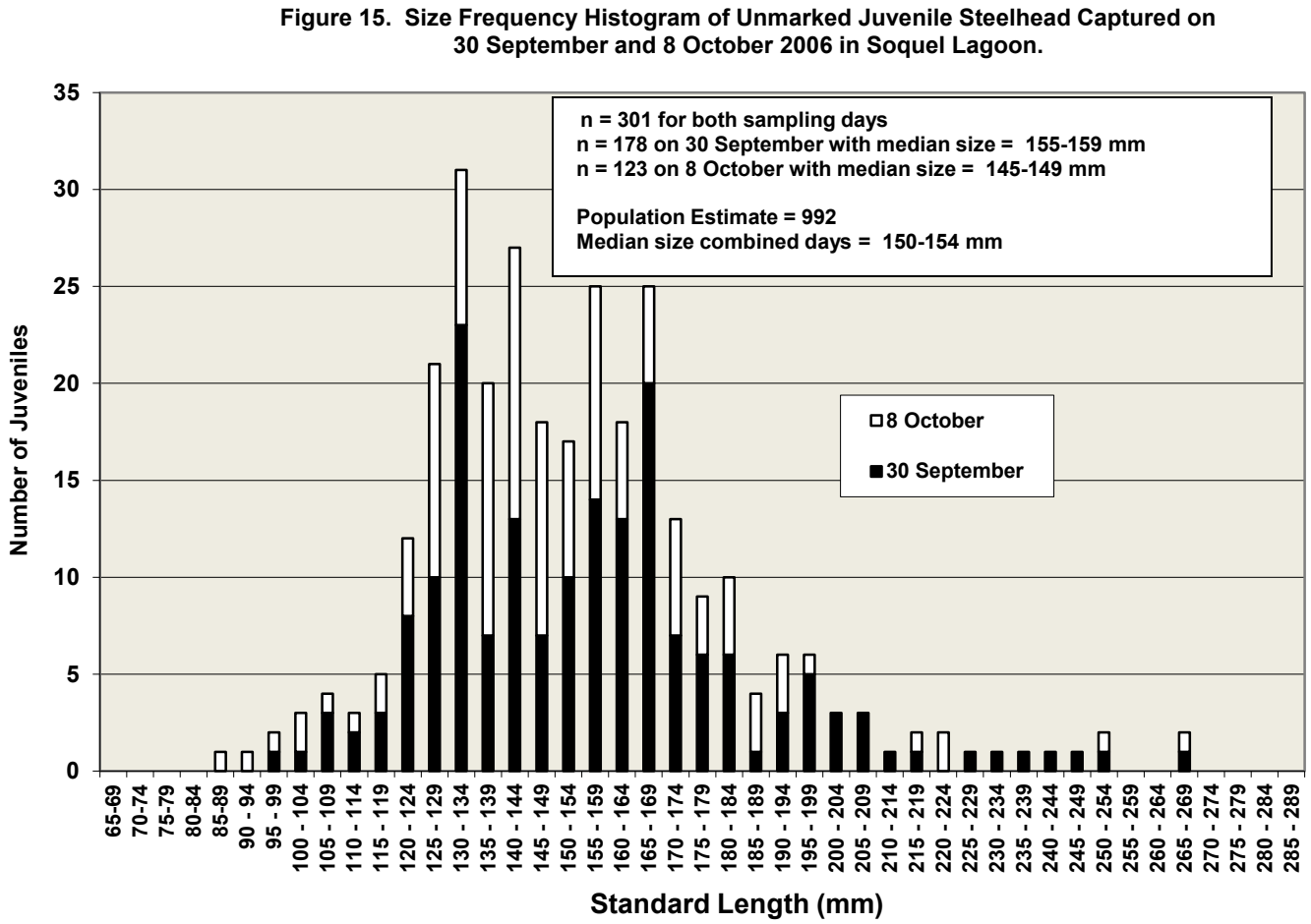


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

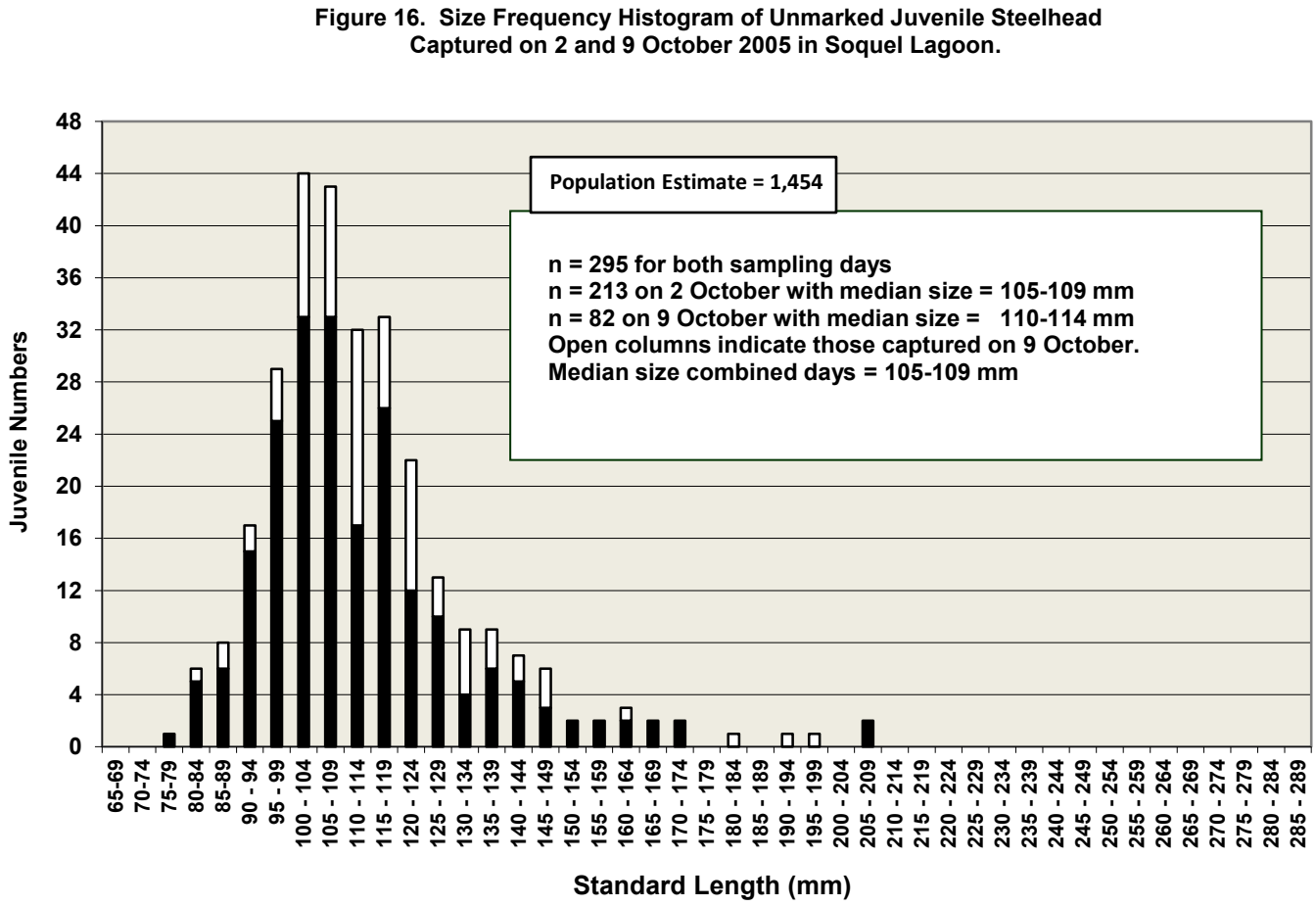


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

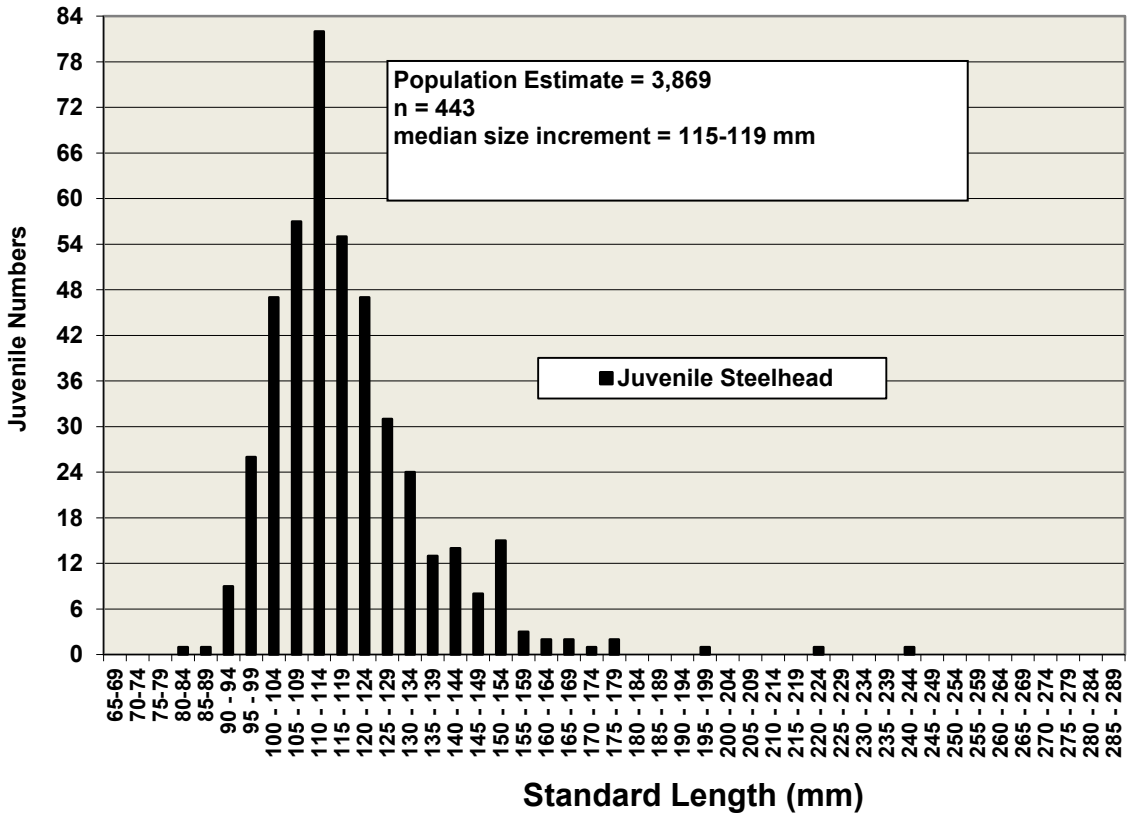


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

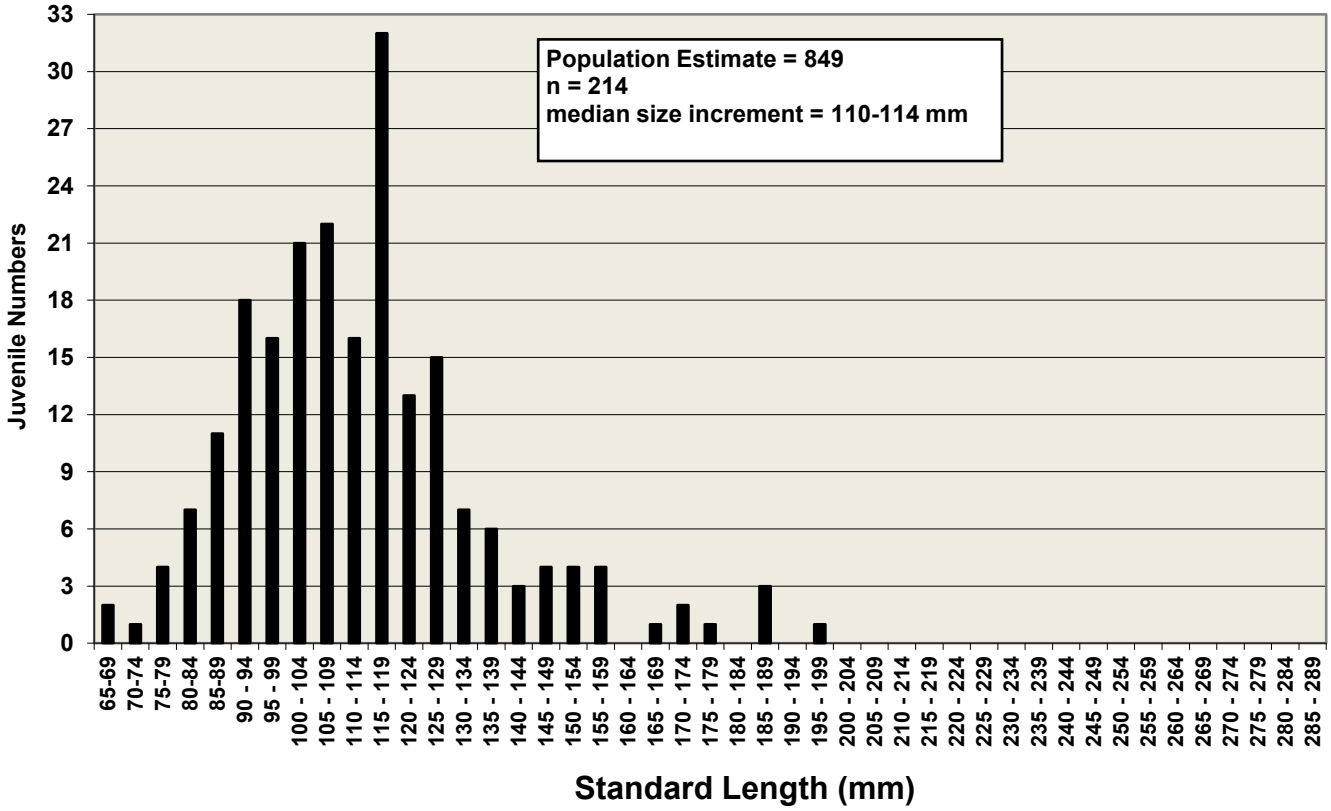


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

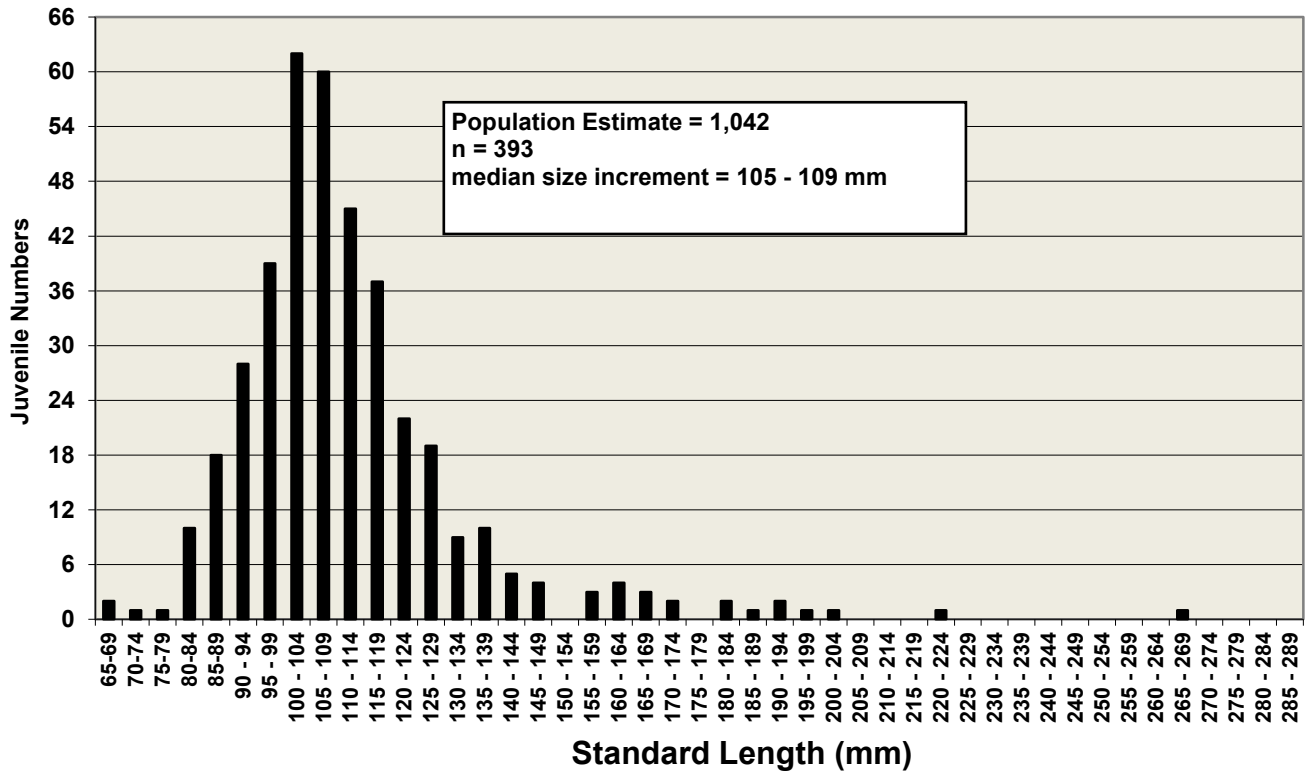


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

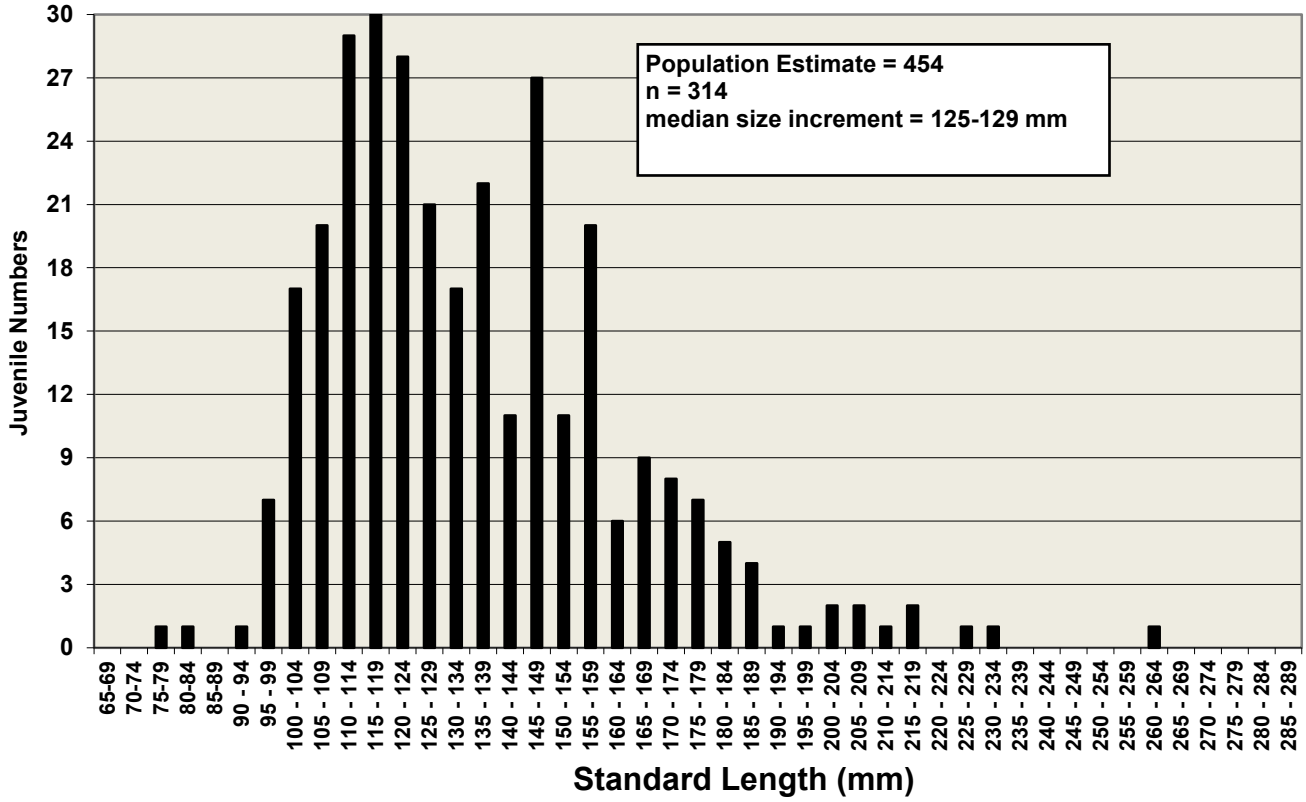


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

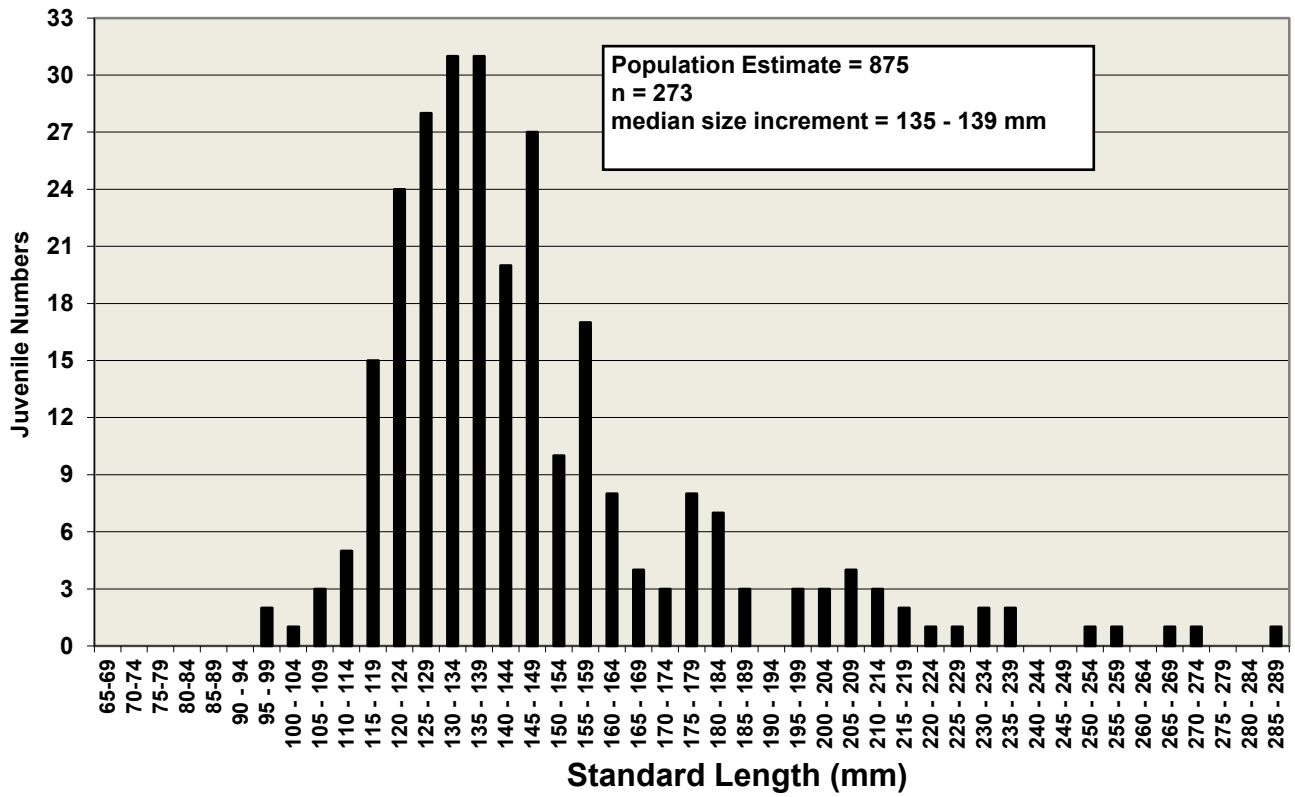


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

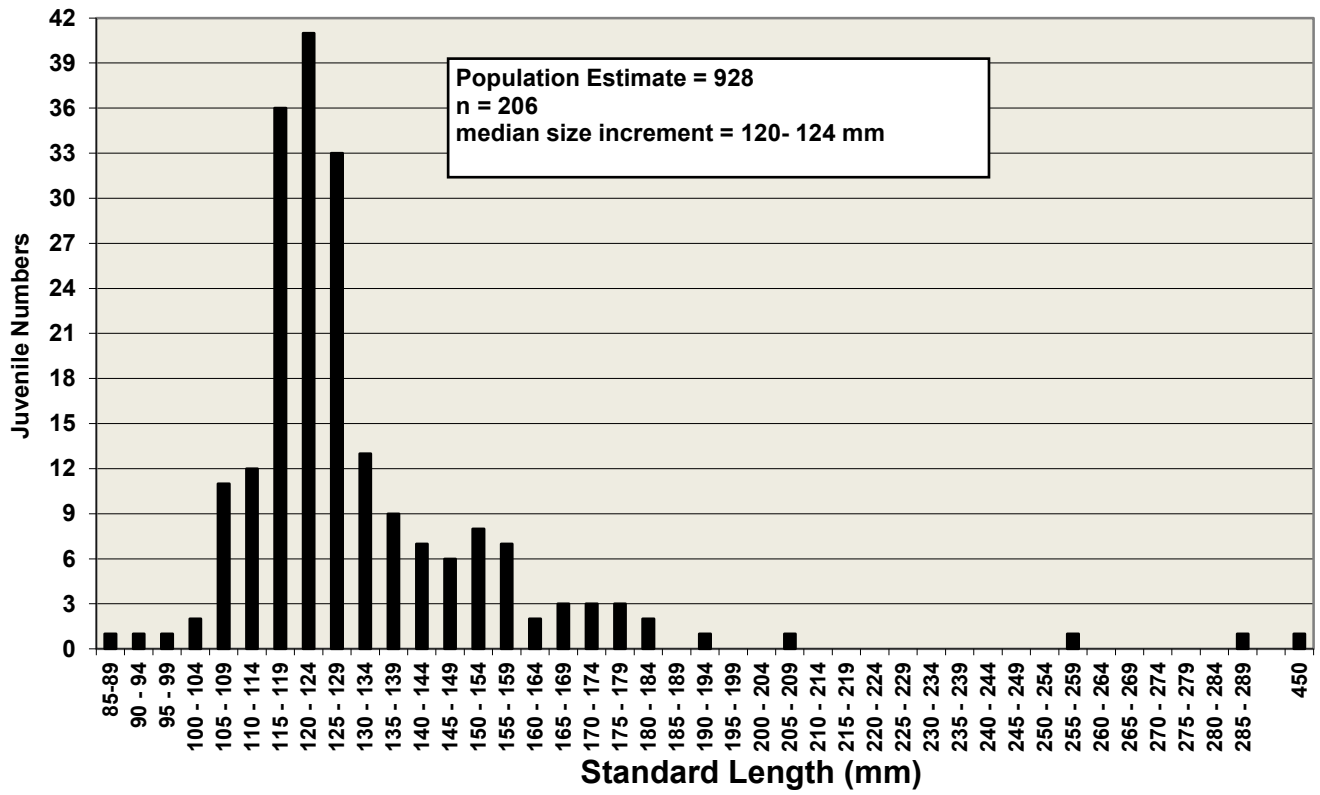


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.

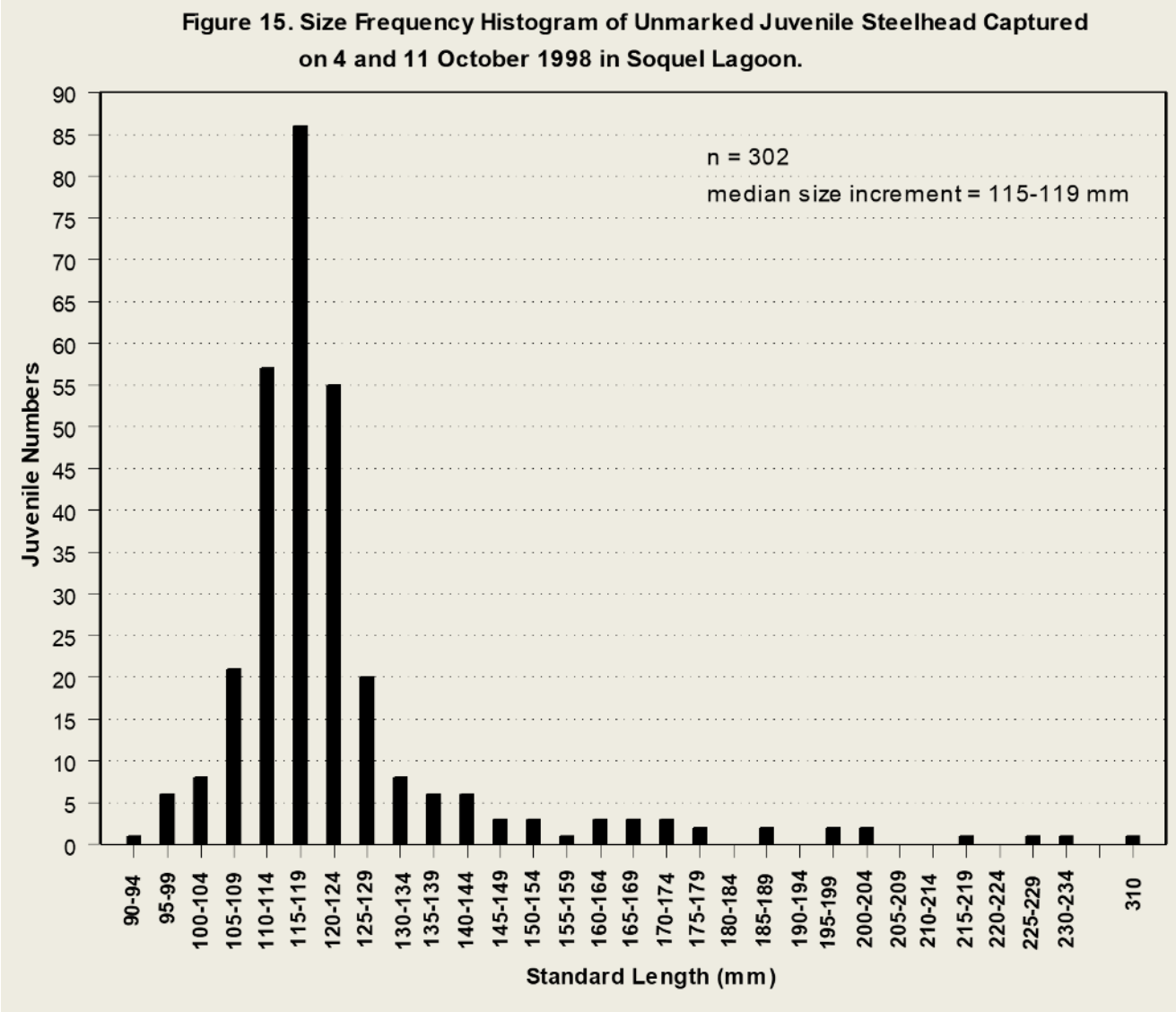


Figure 23. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

Population Estimate = 671.

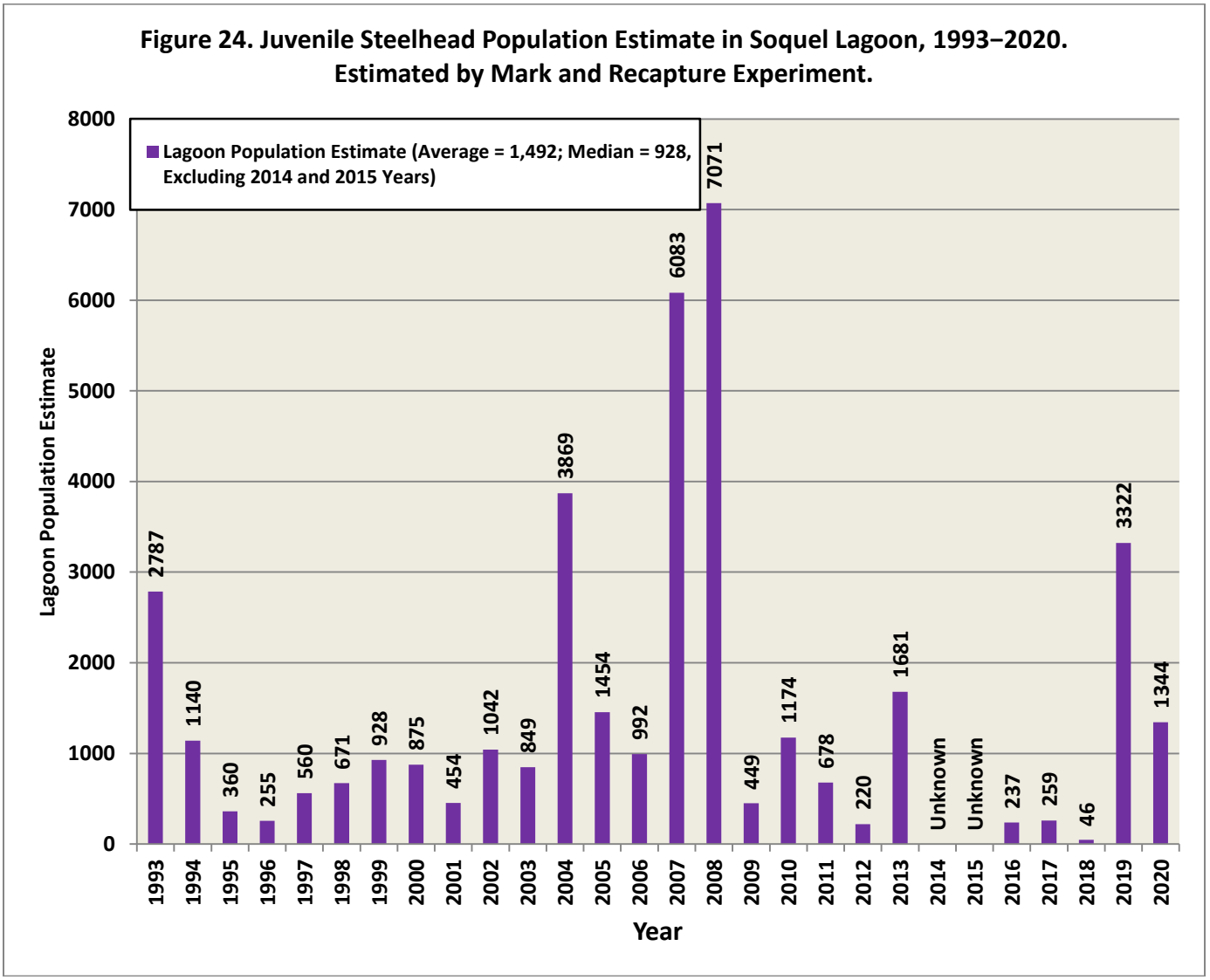


Figure 24. Steelhead Population Estimate in Soquel Lagoon, 1993−2020.

Figure 25. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2020.

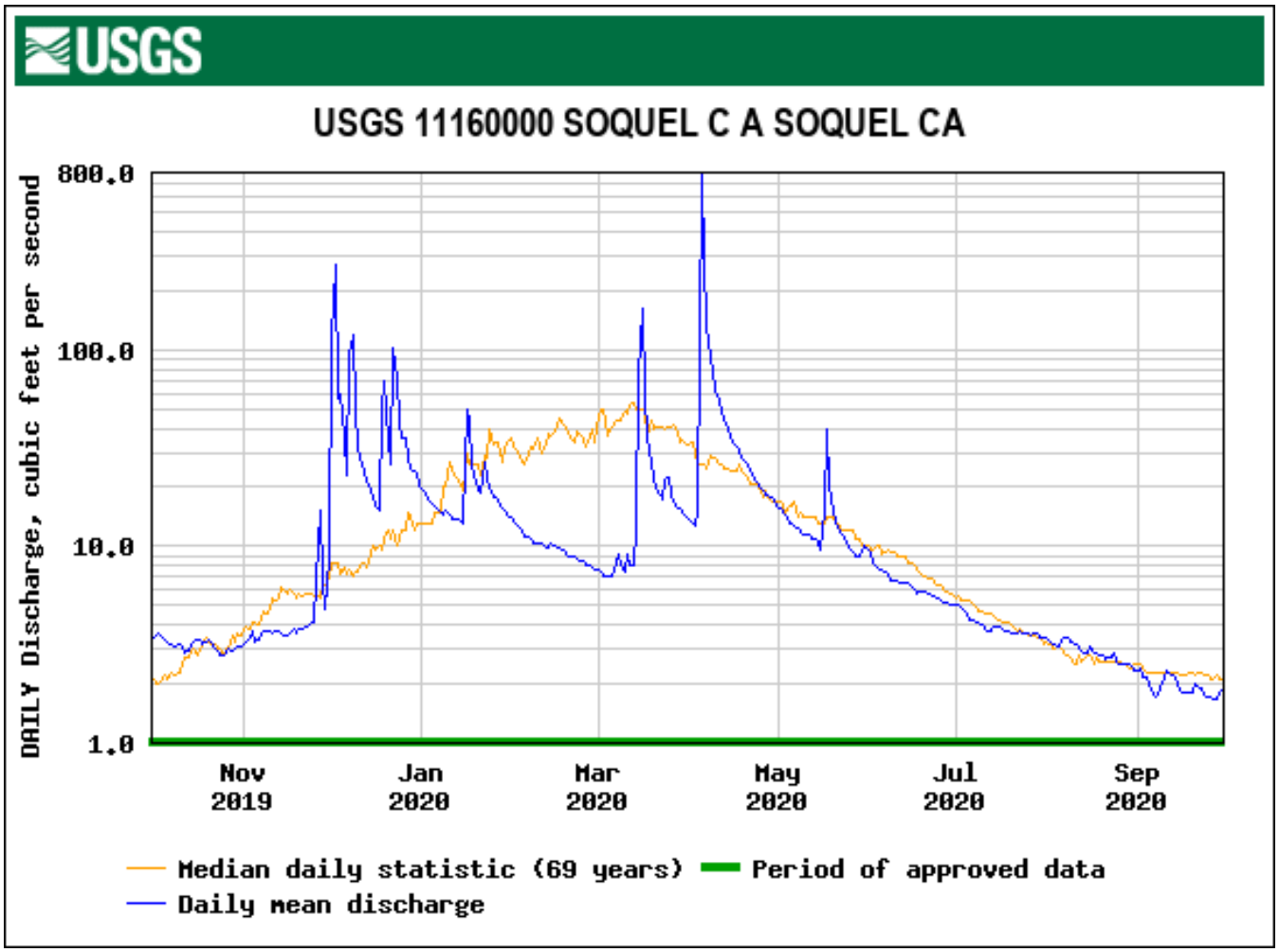


Figure 26. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2020 to 1 February 2021.

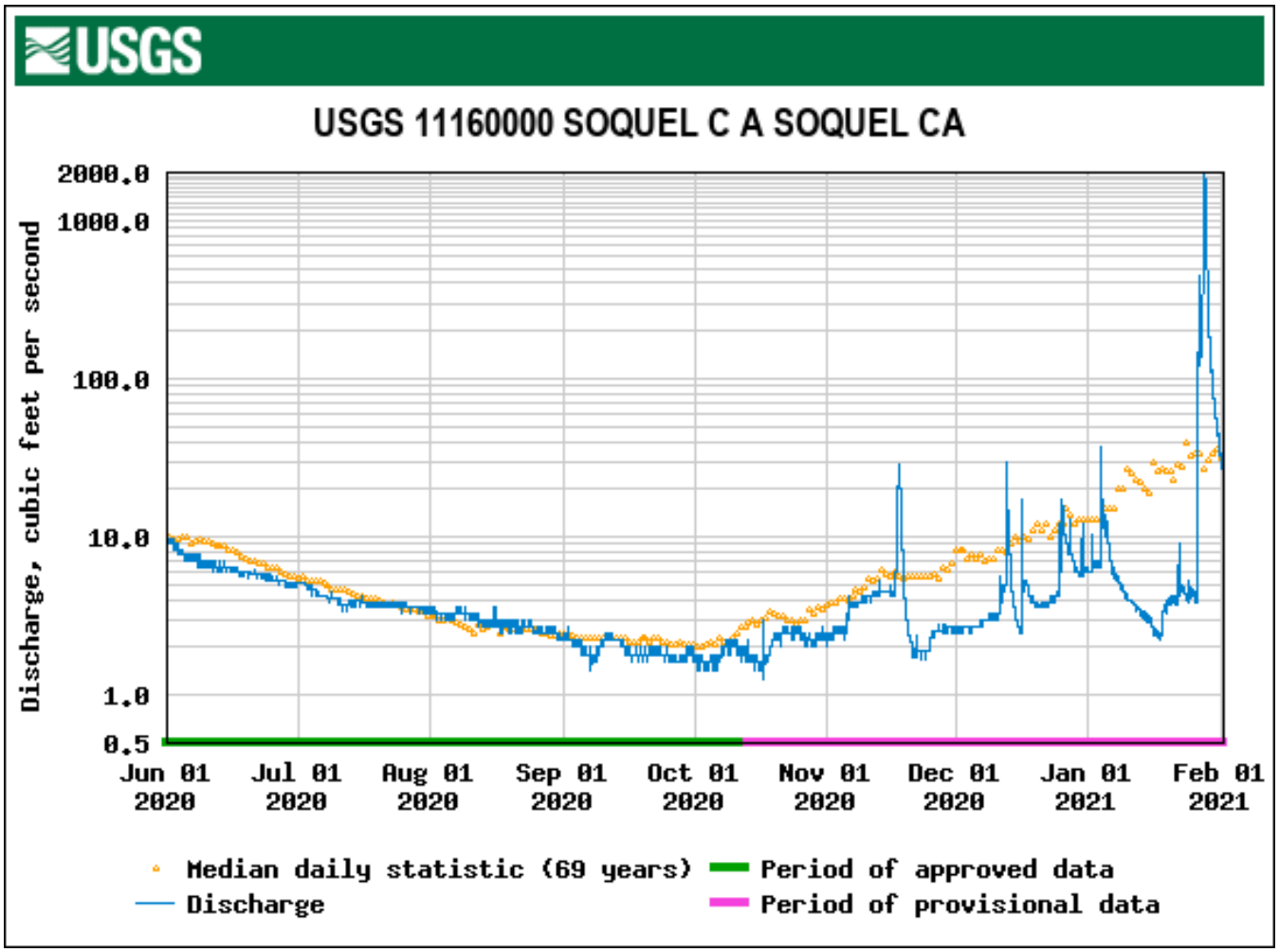


Figure 27. Maximum Visual Gull Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2016–2020.

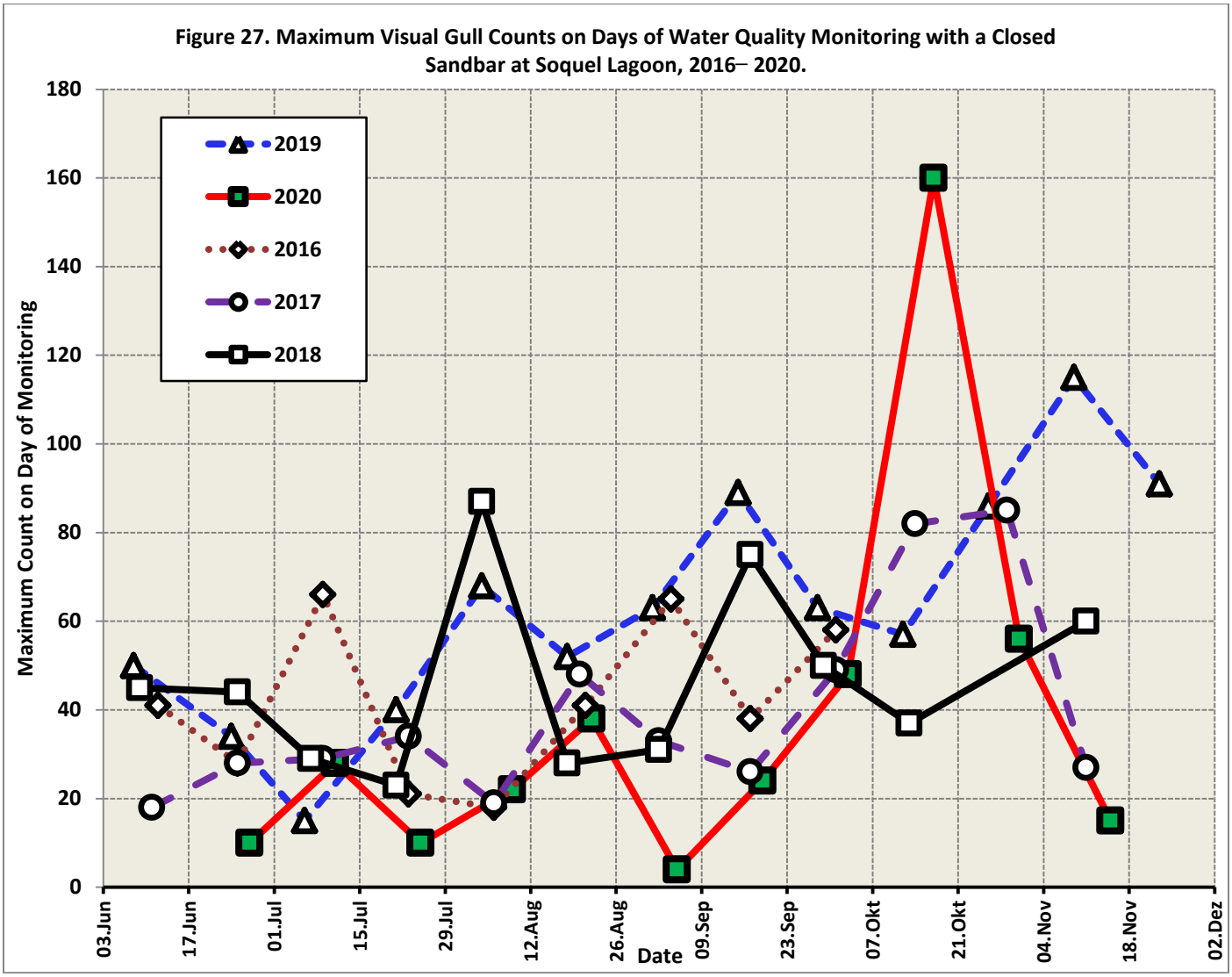
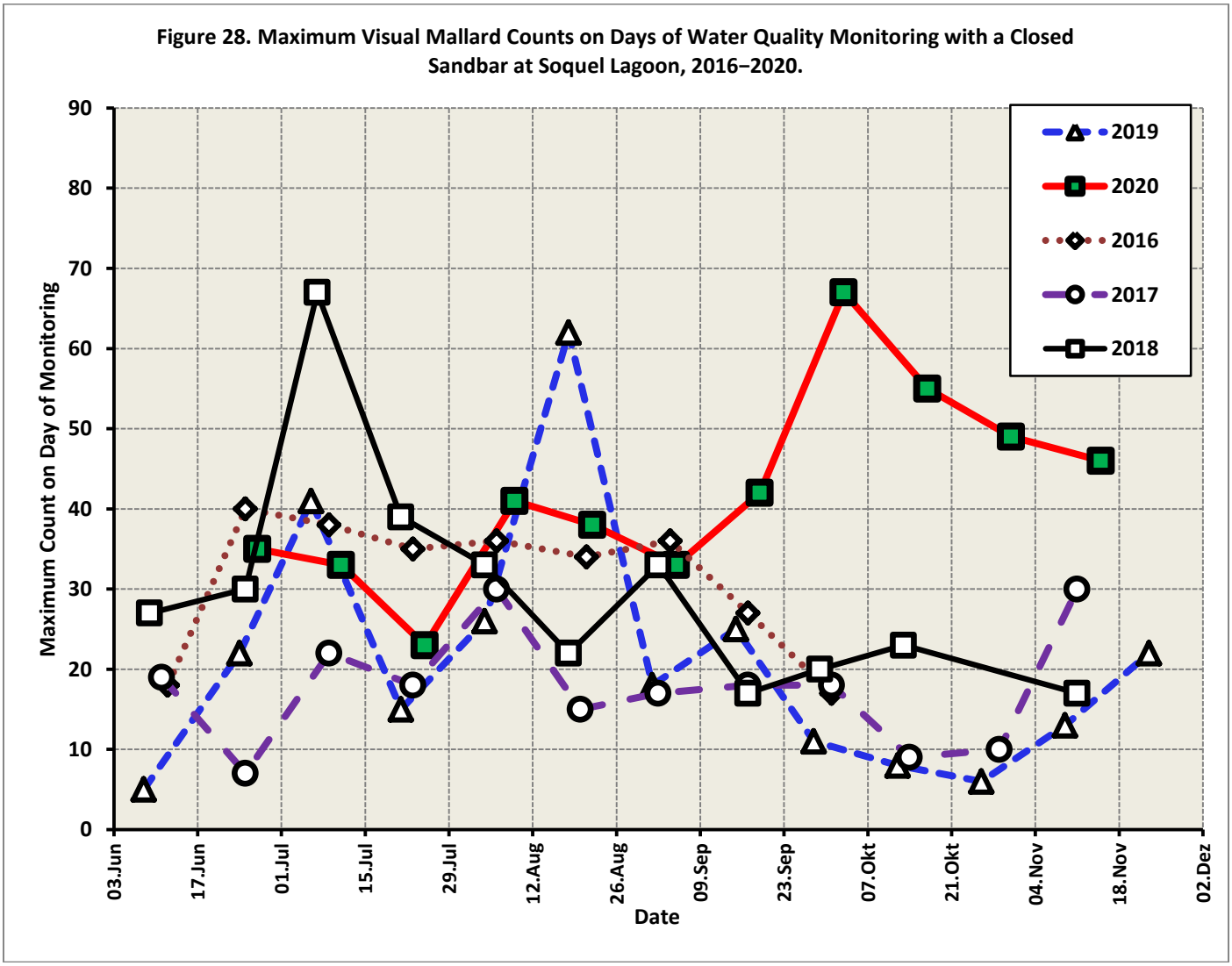


Figure 28. Maximum Visual Mallard Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2016–2020.



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

16 June 2020– 28 January 2021.

16 June 2020. The sandbar had been closed since 11 June. Sandbar construction was delayed in 2020 due to a delay in the decision by the City council to create a lagoon. A berm had been completed around the entire lagoon periphery to prevent tidal overwash on 12 June. The lagoon was full with a functioning flume on 13 June, with a gage height of 2.60. An underwater portal was present for adult out-migrants. Gage height was 2.70 on 16 June. Saltwater was not detected at the Venetian Court wall or adjacent the Stockton Bridge abutments. The biologist recommended that the shroud would be unnecessary on the flume inlet. 6.1 cfs at Soquel Village.

			16 June 2020				
	Venetian Court Wall 1320 hr Air temp. 18.9°C						
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**
0.00	20.6	0.4	9.75	754				
0.25	20.4	0.4	9.85	753				
0.50	20.0	0.4	9.81	740				
0.75	19.8	0.4	9.72	736				
1.00	19.6	0.4	9.96	726				
1.25	19.6	0.4	9.83	726				
1.50	19.6	0.4	10.28	732				
1.75	19.5	0.4	10.32 (113)	738				
2.00 b	19.6	0.4	0.53	754				

17 June 2020. Temperature probes were launched in the lagoon and upstream.

27 June 2020. The first complete water quality monitoring of the season was accomplished after the sandbar had been closed on 11 June. Temperature probes were launched on 17 June in the lagoon and upstream. Gage height was 2.62. Flume inlet 1.1 ft; Flume outlet 0.5 ft. Sky overcast and misty. Air temperature 14.7°C. Oxygen was 74-102% full saturation in the morning near the bottom and fair to good. Inflow oxygen in the morning was good at Nob Hill. Water temperature ranged 18.6-19.7 ° C in the morning in the lagoon and good, about 1°C warmer than in the high baseflow 2019. No surface algae. Secchi depth to the bottom.

			27 June 2020					
	Flume		0712 hr		**Stockton Avenue Bridge**			0737 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	19.6	0.4	10.38	682	19.5	0.4	10.55	693
0.25	19.7	0.4	10.27	692	19.7	0.4	10.53	694
0.50	19.7	0.4	10.23	693	19.7	0.4	10.48	694
0.75	19.7	0.4	10.10 (110)	693	19.7	0.4	10.30	695
0.90bott	19.7	0.4	9.25	693				
1.00					19.7	0.4	9.81	696
1.25					19.6	0.4	9.03	699
1.50					19.6	0.4	7.45	705
1.75					19.6	0.4	6.79 (74)	709
1.85bott					19.6	0.4	6.05	715
	Railroad Trestle			0755 hr	**Mouth of Noble Gulch**			0815 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	19.4	0.4	10.67	685	18.9	0.4	10.45	670
0.25	19.4	0.4	10.63	687	19.0	0.4	10.41	671
0.50	19.4	0.4	10.58	687	19.0	0.4	10.33	671
0.75	19.4	0.4	10.50	687	18.9	0.4	10.28	670
1.00	19.4	0.4	9.80	687	18.6	0.4	8.89 (95)	676
1.25b	19.0	0.4	8.04 (86)	688	18.5	0.4	9.63 (102)	667
1.50b	19.0	0.4	0.19	686				
	Nob Hill			0917 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	10.23	619				

Station 1: Flume at 0712 hr- Air temp. 14.7°C. no surface algae and yes, a planktonic algal bloom. Reach 1- 10 gulls bathing; 7 mallards (mother and 5 large chicks).
Station 2: Stockton Avenue Bridge at 0737- hr- No surface algae. Light plankton bloom. Secchi depth to bottom. Reach 2 mallards on trestle abutment. 6 mallards from Reach 1
Station 3: Railroad Trestle at 0755 hr- no surface algae. Reach 3- 6 mallards from Reach 1 being fed near trestle. 14 mallards (5 were YOY).
Station 4: Mouth of Noble Gulch at 0815 hr. No surface algae. No gray water plume.
Station 5: Nob Hill at 0917 hr- Water temp. 1.5-2° C cooler than lagoon near the bottom in morning Oxygen 1-3 mg/l more than in lagoon in the morning. Streamflow – 4.7 cfs at Soquel Village gage.

11 July 2020. Gage height was 2.60. Flume inlet 1.2 ft. Flume outlet 0.7 ft. Sky overcast and misty. Air temp. 13.5°C. Underwater portal removed. Oxygen was 85-96% full saturation in the morning near the bottom and good. Inflow oxygen in the morning was good at Nob Hill. Water temperature ranged 18.6-19. ° C in the morning in the lagoon and good near the bottom, about 1-1.5°C warmer than in the high baseflow 2019. No surface algae. Secchi depth to the bottom.

			11-July 2020					
	Flume		0711 hr		**Stockton Avenue Bridge**			0727 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	19.2	0.4	9.34	698	19.4	0.4	9.13	699
0.25	19.2	0.4	9.38	700	19.4	0.4	9.13	703
0.50	19.2	0.4	9.32	699	19.4	0.4	9.12	703
0.75	19.2	0.4	9.34 (96)	699	19.4	0.4	9.06	704
0.87b	19.2	0.4	9.03	699				
1.00					19.4	0.4	9.11	704
1.25					19.4	0.4	9.09	704
1.50					19.4	0.4	9.17 (95)	703
1.75					19.4	0.4	8.96 (88)	704
1.80b					19.4	0.4	8.72	704
	Railroad Trestle			0746 hr	**Mouth of Noble Gulch**			0803 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	19.1	0.4	8.72	696	18.6	0.4	8.52	
0.25	19.1	0.4	8.64	698	18.6	0.4	8.42	
0.50	19.1	0.4	8.65	698	18.6	0.4	8.36	
0.75	19.1	0.4	8.65	698	18.6	0.4	8.24	
1.00	19.1	0.4	8.38	698	18.6	0.4	8.02 (86)	
1.25b	19.1	0.4	7.82 (85)	696	18.1	0.4	6.51	
1.32b	19.1	0.4	6.04	695				
	Nob Hill			0848 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**
	16.4	**0.4**	**8.22 (84%)**	**611**				

Station 1: Flume at 0711 hr- Air temp. 13.5 C. no surface algae. Reach 1- 28 gulls bathing California and Hermann's; 9 mallards in Margaritaville Cove. Flume inlet 1.2 ft deep. Outlet 0.7 ft deep.
Station 2: Stockton Avenue Bridge at 0727- hr- No surface algae. Secchi depth to bottom. Reach 2- 4 mallards in water, 2 mallards on trestle abutment.
Station 3: Railroad Trestle at 0746 hr- no surface algae. Reach 3- 18 mallards in water. 2 mallards roosting on branches adjacent Golino property. 3 Kayakers in Reach 3.
Station 4: Mouth of Noble Gulch at 0803 hr. No surface algae. No gray water plume.
Station 5: Nob Hill at 0848 hr- Water temp. 2-3° C cooler than lagoon near the bottom in morning. Oxygen similar to or less than in lagoon near the bottom in the morning. Streamflow – 3.4 cfs at Soquel Village gage.

25 July 2020. Gage height of 2.62 in morning. Flume inlet 1.0 ft. Flume outlet 0.7 ft. Overcast and misty at 0700 hr. Air temperature of 14.4 C Morning oxygen levels were good (88% – 104+ super saturation), oxygen higher than 2 weeks previous with similar water temperatures in the good range. Secchi depth to bottom.

			25-July-2020					
	Flume			0700 hr	**Stockton Avenue Bridge**			0719 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.2	0.4	11.19	700	19.2	0.4	10.10	699
0.25	19.2	0.4	11.10	700	19.2	0.4	10.02	706
0.50	19.2	0.4	11.11	701	19.2	0.4	10.02	707
0.75	19.2	0.4	11.12	701	19.2	0.4	9.78	707
0.85b	19.2	0.4	10.61	702				
1.00					19.2	0.4	9.54	709
1.25					19.2	0.4	9.13	708
1.50					19.2	0.4	9.55	709
1.75					19.2	0.4	9.64 (104)	708
1.87b					19.2	0.4	9.42	708
2.00								
	Railroad Trestle			0741 hr	**Mouth of Noble Gulch**			0802 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	18.8	0.4	9.44	698	17.4	0.4	9.32	
0.25	18.8	0.4	9.44	699	18.3	0.4	8.67	
0.50	18.9	0.4	9.56	699	18.3	0.4	8.72	
0.75	18.8	0.4	9.43	699	18.3	0.4	8.50	
1.00	18.7	0.4	8.72	697	18.2	0.4	8.27 (88)	
1.25b	18.7	0.4	8.61	696	17.8	0.4	5.53	
1.50b	18.8	0.4	3.74	694				
	Nob Hill			0841 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**
	16.7	0.4	7.91	620				

Station 1: Flume 0700 hr. Reach 1- 10 gulls bathing. No surface algae.
Station 2: Stockton Bridge 0731 hr. Reach 2-no waterfowl. No surface algae.
Station 3: Railroad trestle 0821 hr. Reach 3- 1 female adult mallard and 4 YOY near trestle and 1 female and 2 YOY at Noble Gulch exit. 14 mallards in water near Shadowbrook Restaurant. No surface algae
Station 4: Noble Gulch 0837 hr. No surface algae or gray water.
Station 5: Nob Hill at 08412 hr. 0.4° C warmer water temperature than 2 weeks previous and 1.5-2.5°C cooler than lagoon near bottom. Streamflow− 3.6 cfs at Soquel Village gage.

9 August 2020. Gage height of 2.58 in morning. Flume inlet 1.0 ft. Flume outlet 0.6 ft. Overcast at 0717 hr. Air temperature of 14.9°C and similar to 2 weeks previously. Morning oxygen levels were good (76% – 142% super saturation), oxygen levels higher than 2 weeks previous, with warmer water temperatures in the fair to good range. Secchi depth to bottom.

			9 August 2020					
	Flume			0717 hr	**Stockton Avenue Bridge**			0735 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	12.99	725	20.0	0.4	12.43	720
0.25	20.2	0.4	13.04	727	20.0	0.4	12.37	724
0.50	20.2	0.4	12.97	727	20.0	0.4	12.38	726
0.75	20.2	0.4	12.87 (142)	727	20.0	0.4	11.53	727
0.80b	20.2	0.4	12.46	727				
1.00					2.00	0.4	10.90	727
1.25					2.00	0.4	10.63	729
1.50					19.8	0.4	9.02 (94)	730
1.75b					19.7	0.4	8.07	729
2.00								
	Railroad Trestle			0750 hr	**Mouth of Noble Gulch**			0807 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	19.8	0.4	11.67	721	18.9	0.4	11.42	699
0.25	19.9	0.4	11.79	725	19.0	0.4	11.24	706
0.50	19.9	0.4	11.87	726	18.9	0.4	10.95	701
0.75	19.9	0.4	11.82	726	18.8	0.4	10.67	694
1.00	19.6	0.4	6.80	727	18.8	0.4	10.59	687
1.20b					18.5	0.4	8.47	672
1.25	19.2	0.4	7.03	721				
1.37b	19.2	0.4	4.80	719				
	Nob Hill			0850 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**
	17.1	0.4	10.20 (106)	622				

Station 1: Flume 0717 hr. Reach 1- 22 gulls bathing. 24 mallards in Margaritaville cove, 1 pied-billed grebe. 5 mallards roosting on wood under Stockton Bridge. No surface algae.
Station 2: Stockton Bridge 0735 hr. Reach 2- 3 mergansers hunting. No surface algae.
Station 3: Railroad trestle 0750 hr. Reach 3- 19 mallards with some from Reach 1. 17 steelhead surface hits/ minute above trestle at 0822 hr. No surface algae
Station 4: Noble Gulch 0807 hr. 80% bottom algal 1.0 – 2.0 ft thick, avg 1.2 ft. No surface algae. No gray water. 41 mallards counted through all reaches combined on way back to truck.
Station 5: Nob Hill at 0850 hr. Water temperature 2-3°C cooler than lagoon near the bottom. 3.3 cfs at Soquel Village.

22 August 2020. Gage height of 2.51 in morning. Flume inlet 1.0 ft. Flume outlet 0.5 ft. Overcast at 0714 hr. Air temperature of 17.1°C and 2°C warmer than 2 weeks previously. Morning oxygen levels were in the fair to good range (78% –97% super saturation); oxygen levels lower than 2 weeks previous, with warmer water temperatures in the fair to good range. Secchi depth to bottom.

			22 August 2020					
	Flume			0714 hr	**Stockton Avenue Bridge**			0732 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	8.80	747	20.5	0.4	8.23	759
0.25	20.4	0.4	8.86	754	20.5	0.4	8.10	756
0.50	20.4	0.4	8.84	754	20.6	0.4	8.06	766
0.75b	20.4	0.4	8.52	755	20.5	0.4	8.15	765
1.00					20.6	0.4	8.02	765
1.25					20.5	0.4	8.10	765
1.50					20.5	0.4	8.19	765
1.75b					20.5	0.4	7.98	764
2.00								
	Railroad Trestle			0747 hr	**Mouth of Noble Gulch**			0802 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	20.3	0.4	7.65	755	19.8	0.4	7.71	734
0.25	20.3	0.4	7.50	758	19.8	0.4	7.35	741
0.50	20.3	0.4	7.56	758	19.8	0.4	7.20	740
0.75	20.3	0.4	7.59	758	19.8	0.4	7.12	736
1.00	20.3	0.4	7.55 (84)	759	19.4	0.4	6.77 (74)	712
1.15b								
1.25	20.3	0.4	4.11	787	19.3	0.4	3.66	686
	Nob Hill			0847 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**
	17.8	0.4	7.25 (76)	630				

Station 1: Flume 0714 hr. Reach 1- 34 gulls bathing; 37 mallards in or near Margaritaville cove. No surface algae.
Station 2: Stockton Bridge 0732 hr. Reach 2- 1 mallard; 2 mergansers hunting- one caught a steelhead. No surface algae.
Station 3: Railroad trestle 0747 hr. Reach 3- 7 mallards, 1 pied-billed grebe. 10% surface algae.
Station 4: Noble Gulch 0802 hr. 20% surface algae. No gray water. The 2 mergansers from Reach 2 perched on barge above Noble Gulch in Reach 3.
Station 5: Nob Hill at 0847 hr. Water temperature 1.5– 2.5°C cooler than lagoon sites. Oxygen was lower than 3 of 4 lagoon sites near the bottom. Kingfisher observed. Streamflow- 2.5 cfs at Soquel Village gage.

5 September 2020. Gage height of 2.57 in morning. Flume inlet 1.0 ft. Flume outlet 0.4 ft. Sky clear at 0714 hr. Air temperature of 14.6°C and 2.5°C cooler than 2 weeks previously. Morning oxygen levels were good (84% – super saturation); oxygen levels higher than 2 weeks previous, with cooler water temperatures in the good range. 1 in X 4 in board added to inlet, as recommended, to raise lagoon depth. Secchi depth to bottom.

			5 September 2020					
	Flume			0714 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	18.8	0.4	11.57	714	19.1	0.4	11.11	714
0.25	18.8	0.4	11.58	714	19.1	0.4	10.99	722
0.50	18.8	0.4	11.61	715	19.1	0.4	11.07	722
0.75b	18.9	0.4	11.49	715	19.1	0.4	11.15	722
1.00					19.1	0.4	11.04	722
1.25					19.1	0.4	11.02	722
1.50					19.1	0.4	11.09	722
1.75b					19.2	0.4	10.44	723
	Railroad Trestle			0748 hr	**Mouth of Noble Gulch**			0803 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	0.4	8.58	731	18.3	0.4	8.93	674
0.25	18.9	0.4	8.29	731	18.3	0.4	8.64	684
0.50	18.9	0.4	8.09	732	18.2	0.4	8.83	683
0.75	18.9	0.4	8.07	732	18.2	0.4	8.93	688
1.00	18.9	0.4	8.08	732	18.1	0.4	8.93	661
1.20b					18.3	0.4	2.25	706
1.25	18.9	0.4	7.80 (84)	731				
1.37b	18.9	0.4	7.32	732				
	Nob Hill			0844 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**
	16.7	0.4	8.65	614				

Station 1: Flume at 0714 hr. Reach 1- 0 and later 4 gulls bathing; 32 mallards in Margaritaville cove. No surface algae.
Station 2: Stockton Avenue Bridge at 0730 hr. Secchi depth to bottom. Reach 2- 1% surface algae. 2 mallards from Reach 1.
Station 3: Railroad Trestle at 0748 hr. Reach 3- 20% surface algae. 1mallards in water;
Station 4: Mouth of Noble Gulch at 0803 hr. 20% surface algae. No gray water. Barge moored to Arthurs' dock.
Station 5: Nob Hill at 0844 hr. Water temperature 1.4–2.4°C cooler than the lagoon near bottom. Streamflow – 1.8 cfs at Soquel Village gage.

19 September 2020. Gage height of 2.60 in morning. Flume inlet 1.0 ft. Flume outlet 0.4 ft. Sky overcast at 0719 hr. Air temperature of 15.1°C and 0.5°C warmer than 2 weeks previously. Morning oxygen levels were good (92% – 126% super saturation); oxygen levels higher than 2 weeks previous, with slightly warmer water temperatures in the good range. Secchi depth to bottom.

			19 September 2020					
	Flume 0719 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 (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	18.7	0.4	12.53	722	18.9	0.4	11.91	722
0.25	18.7	0.4	12.23	725	19.0	0.4	11.82	734
0.50	18.7	0.4	12.42	725	19.0	0.4	11.78	732
0.75b	18.7	0.4	11.56	725	19.0	0.4	11.58	732
1.00					19.0	0.4	11.65	731
1.25					19.1	0.4	11.69	732
1.50					19.0	0.4	11.65	733
1.75b					19.0	0.4	11.13	732
	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 (% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	18.7	0.4	9.58	716	18.7	0.4	10.04	704
0.25	18.9	0.4	9.23	729	18.7	0.4	9.82	705
0.50	18.9	0.4	9.13	730	18.7	0.4	9.78	705
0.75	18.9	0.4	9.19	730	18.7	0.4	9.81	704
1.00	18.9	0.4	9.23	730	18.7	0.4	9.71	703
1.20b					18.7	0.4	3.21	687
1.25	18.9	0.4	8.56 (92)	730				
1.37b	18.9	0.4	7.64	731				
1.50								
	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**
	16.7	0.3	9.11 (94)	598				

Station 1: Flume at 0710 hr. Reach 1- 12 gulls bathing. No surface algae.
Station 2: Stockton Avenue Bridge at 0725 hr. Reach 2- 4 mallards. Family feeding ducks at Stockton Bridge at 0800 hr. No surface algae.
Station 3: Railroad Trestle at 0743 hr. Reach 3- 11 mallards; 1 coot in water. No surface algae.
Station 4: Mouth of Noble Gulch at 0756 hr. no gray water.
Station 5: Nob Hill at 0826 hr. Water temperature 1.3 – 1.8 C cooler than lagoon. Streamflow- 1.6 cfs at Soquel Village gage.

3 October 2020. Gage height of 2.60 in morning. Flume inlet 1.0 ft. Flume outlet 0.4 ft. Sky foggy at 0730 hr and overcast later. Air temperature of 14.8°C and 0.3°C cooler than 2 weeks previously. Morning oxygen levels were good (82% – 99% full saturation); oxygen levels lower than 2 weeks previous, with slightly cooler water temperatures in the good range. Secchi depth to bottom.

			3 October 2020					
	Flume 0730 hr				**Stockton Ave Bridge** 0748 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	18.6	0.4	9.96	736	18.8	0.4	9.21	740
0.25	18.6	0.4	10.04	735	18.8	0.4	9.33	743
0.50	18.6	0.4	10.17	736	18.9	0.4	9.23	744
0.75b	18.5	0.4	9.22	736	19.0	0.4	8.44	744
1.00					18.9	0.4	8.73	745
1.25					18.9	0.4	8.34	744
1.50					18.9	0.4	9.21 (94)	743
1.75b					18.9	0.4	8.45	735
	Railroad Trestle 0810 hr				**Mouth of Noble Gulch** 0831 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	18.7	0.4	8.50	743	18.2	0.4	8.12	716
0.25	18.8	0.4	8.55	748	18.3	0.4	7.96	718
0.50	18.8	0.4	8.48	748	18.3	0.4	7.76	717
0.75	18.8	0.4	8.41	748	18.3	0.4	7.73	717
1.00	18.8	0.4	8.35	749	18.2	0.4	7.85	718
1.25b	18.8	0.4	8.36 (90)	749	17.6	0.4	6.67	654
1.43b	18.8	0.4	7.73	749				
	Nob Hill			0910 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**
	16.2	0.4	7.61 (77)	597				

Station 1: Flume at 0730 hr. Reach 1- 48 gulls; 62 mallards in water, 2 mallards roosting on wood under Stockton Bridge. No surface algae.
Station 2: Stockton Avenue Bridge at 0748 hr. Secchi depth to bottom. Reach 2- 14 mallards from Reach 1. No surface algae.
Station 3: Railroad Trestle at 0810 hr. Reach 3- No surface algae. 5 mallards, 19 coots, 1 pied-billed grebes
Station 4: Mouth of Noble Gulch at 0831 hr. No surface algae. No gray water.
Station 5: Nob Hill at 0910 hr. Water temperature 2 – 2.5°C cooler than lagoon. 1.6 cfs at Soquel Village gage.

4 October 2020. Gage height of 2.60 in morning. Fish sampling day. Sky slightly overcast at 0846 hr. Air temperature of 15.2°C. Morning oxygen level was good (88% saturation). Secchi depth to the bottom.

			4-October 2020					
	Above Stockton Bridge			0846 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)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**umhos**
0.00	18.7	0.4	8.10					
0.25	18.7	0.4	8.10					
0.50	18.7	0.4	8.09					
0.75	18.7	0.4	8.13					
1.00	18.7	0.4	8.17 (88%)					
1.10b	18.8	0.4	7.43					
1.50								
1.75								
2.00								
2.15								

11 October 2020. Fish sampling day. Sky clear at 0843 hr. Air temperature of 15.0°C. Morning oxygen level was good and higher than on 4 October. Secchi depth to the bottom.

			11-October 2020					
	Above Stockton Bridge			0846 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)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**umhos**
0.00	17.6	0.4	8.76	732				
0.25	17.6	0.4	8.72	720				
0.50	17.6	0.4	8.73	719				
0.75	17.6	0.4	8.62	719				
1.00	17.6	0.4	8.51	719				
1.15b	17.6	0.4	6.23	720				
1.50								
1.75								
2.00								
2.15								

17 October 2020. Gage height of 2.65 in morning. Flume inlet 1.0 ft. Flume outlet 0.7 ft during an incoming tide. Sky clear at 0734 hr. Air temperature of 13.3°C and 1.8°C cooler than 2 weeks previously. Morning oxygen levels fair to good (66% – 82+% saturation); oxygen levels lower than 2 weeks previously, 1.5°C cooler water temperatures in the good range. Secchi depth to bottom.

			17 October 2020					
	Flume 0734 hr				**Stockton Avenue Bridge** 0751 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**Umhos**
0.00	17.2	0.4	8.13	698	17.5	0.4	8.05	699
0.25	17.2	0.4	8.22	699	17.5	0.4	8.13	705
0.50	17.1	0.4	828	698	17.5	0.4	7.90	705
0.75b	17.2	0.4	7.28	699	17.6	0.4	7.19	706
1.00					17.6	0.4	7.84	707
1.25					17.6	0.4	7.88	706
1.50					17.6	0.4	7.83	706
1.75					17.6	0.4	7.78 (82%)	706
1.80b					17.6	0.4	7.11	706
	Railroad Trestle 0816 hr				**Mouth of Noble Gulch** 0832 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**umhos**
0.00	17.5	0.4	7.29	704	17.5	0.4	6.81	693
0.25	17.6	0.4	7.06	705	17.5	0.4	6.57	696
0.50	17.7	0.4	7.02	705	17.5	0.4	6.47	700
0.75	17.7	0.4	7.03	705	17.5	0.4	6.37	695
1.00	17.7	0.4	6.97	705	17.5	0.4	6.27 (66%)	701
1.25b	17.7	0.4	6.92 (73%)	705	17.8	0.4	3.24	889
1.40b	17.7	0.4	4.73	704				
	Nob Hill			0906 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**
	15.8	0.4	7.06 (71%)	590				

Station 1: Flume at 0734 hr. Reach 1- 160 gulls bathing; 42 mallards in water mostly in Margaritaville cove. 2 domestic, larger gray ducks also there. 3 mallards roosting on wood under Stockton Bridge. No surface algae

Station 2: Stockton Avenue Bridge at 0751 hr. Reach 2- 6 mallards from Reach 1. 28 coots. 1% surface algae.

Station 3: Railroad trestle at 0816 hr. Reach 3- No surface algae. 20 mallards (maybe 10 from Reach 1); 46 coots. 1 electric motor powered boat.

Station 4: Mouth of Noble Gulch at 0832 hr. No surface algae. No gray water.

Station 5: Nob Hill at 1632 hr. Water temperature 1.3 – 1.9°C cooler than lagoon and 0.4 C cooler than 2 weeks earlier. 1.4 cfs at Soquel Village gage.

31 October 2020. Gage height of 2.62 in morning. Halloween and full moon. Flume inlet 1.0 ft. Flume outlet 0.5 ft. Sky clear at 0738 hr at sunrise. Air temperature of 7.4°C and 6.1°C cooler than 2 weeks previously. Morning oxygen levels good (72% – 86% saturation); oxygen levels higher than 2 weeks previously, 4°C cooler water temperatures in the good range. Secchi depth to bottom.

			31 October 2020					
	Flume 0738 hr				**Stockton Avenue Bridge** 0755 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat,)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**
0.00	13.3	0.4	8.71	638	13.7	0.4	8.93	636
0.25	13.3	0.4	8.98	637	13.7	0.4	9.05	641
0.50	13.4	0.4	8.91 (85%)	637	13.7	0.4	9.04	642
0.75b	13.3	0.4	8.23	636	13.8	0.4	8.94	643
1.00					13.8	0.4	9.00	643
1.25					13.8	0.4	8.98	643
1.50					13.8	0.4	8.89 (86%)	643
1.75b					13.8	0.4	7.92	643
	Railroad Trestle 0815 hr				**Mouth of Noble Gulch** 0830 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)(% sat.)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)(% sat.)**	**Cond 4 umhos**
0.00	13.3	0.4	8.67	637	12.7	0.4	8.34	588
0.25	13.5	0.4	8.64	639	13.0	0.4	7.90	612
0.50	13.5	0.4	8.60	640	12.9	0.4	7.52	627
0.75	13.5	0.4	8.67	640	12.9	0.4	7.68	628
1.00	13.5	0.4	8.68	640	12.9	0.4	7.68 (72%)	626
1.25b	13.5	0.4	8.66 (83%)	639	13.0	0.4	3.46	633
1.40b	13.5	0.4	8.46	639				
	Nob Hill			0917 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**
	11.4	0.4	8.23 (75%)	537				

Station 1: Flume at 0738 hr. Reach 1- In water 56 gulls bathing, 33 mallards mostly in Margaritaville, 27 Coots, 1 gray duck. No surface algae.
Station 2: Stockton Avenue Bridge at 0755 hr. Secchi depth to the bottom. Reach 2- 12 mallards from Reach 1. 2 mallards from Reach 3, 10 coots. 1% surface algae.
Station 3: Railroad trestle at 0830 hr. Reach 3- 10 mallards; 1 pied-billed grebe, 14 coots. 22. No surface algae.
Station 4: Mouth of Noble Gulch at 0830 hr. No surface algae. No gray water.
Station 5: Nob Hill at 0917 hr. Water temperature 4.4°C cooler than 2 weeks earlier and 1.5-2.4°C cooler than lagoon. 2.5 cfs at Soquel Village gage and 1.1 cfs higher than 2 weeks previously. (May be inaccurate due to leaf dam below the gage.)

15 November 2020. Gage height of 2.46 in morning. Small stormflow of 6 cfs on 13 November. One 4 in X 4 in board removed from each side of inlet. Flume inlet 1.8 ft. Flume outlet 1.2 ft during high tide and back flushing. Sky clear at 0736 hr at just before sunrise. Air temperature of 7.4°C and the same as 2 weeks previously. Morning oxygen levels good (65% – 68% saturation); oxygen lower higher than 2 weeks previously, 1.1−2.4°C cooler water temperatures in the good range. Secchi depth just to bottom barely.

			15 November 2020					
	Flume 0736 hr				**Stockton Avenue Bridge** 0756 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	1.1	0.4	7.39	590	11.4	0.4	7.87	591
0.25	11.1	0.4	7.37	588	11.4	0.4	7.81	591
0.50	11.2	0.4	7.33	588	11.4	0.4	7.55	591
0.71b	11.2	0.4	6.78	588				
0.75					11.4	0.4	7.58	590
1.00					11.4	0.4	7.52	590
1.25					11.4	0.4	7.47	591
1.50					11.4	0.4	7.35 (68%)	591
1.75b					11.4	0.4	6.74	591
	Railroad Trestle 0817 hr				**Mouth of Noble Gulch** 0837 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	11.1	0.4	7.35	582	10.8	0.4	7.34	546
0.25	11.2	0.4	7.37	583	10.8	0.4	7.10	543
0.50	11.2	0.4	7.34	582	10.8	0.4	7.22	545
0.75	11.2	0.4	7.44	582	10.8	0.4	7.23	544
1.00	11.2	0.4	7.40	581	10.8	0.4	7.22 (65%)	544
1.20b					10.8	0.4	6.57	547
1.25b	11.2	0.4	6.84	579				
	Nob Hill			0917 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**
	10.6	0.4	9.47 (85)	535				

Station 1: Flume at 0736 hr. Reach 1- 15gulls bathing, 36 mallards in Margaritaville cover, 30 coots. Secchi depth just to bottom barely. 1% floating pondweed.
Station 2: Stockton Avenue Bridge at 0756 hr. Reach 2- No surface algae. 4 mallards in water from Reach 3.
Station 3: Railroad trestle at 1521 hr. Reach 3- 1% floating pondweed Reach 2− 7 mallards from Reach 1, 3 mallards roosting on trestle abutment, 9 coots, 12 common goldeneye ducks.
Station 4: Mouth of Noble Gulch at 0837 hr. No surface algae. 6 mallards in water, 1 mallard perched on willow, 22 coots, and 8 goldeneye ducks.
Station 5: Nob Hill at 0917 hr. Water temperature 0.2 – 0.8°C cooler than the lagoon near bottom and 0.8°C cooler than 2 weeks earlier. 4.5 cfs at Soquel Village gage.

28 November 2020. Gage height of 2.46 in morning. Small stormflow of 28 cfs maximum on 17-18 November. Notch established across beach prior to stormflow. Additional board removed on Venetian side of inlet on 19 November. Additional board removed from Zelda's side of inlet on 20 November after checking secchi depth. Therefore, 2 boards out on either side. One board added back on either side when water clarity improved. 1 board out on either side of inlet on 28 November. Flume inlet 1.8 ft. Flume outlet 1.5+ ft during high tide and back flushing. Sky clear at 0754 hr at just after sunrise. Air temperature of 5.1°C and 2.3°C cooler than 2 weeks previously. Morning oxygen levels good (91% – 93% saturation); oxygen higher than 2 weeks previously, 2.5- 2.9°C cooler water temperatures in the good range. Secchi depth to bottom.

			28 November 2020					
	Flume 0754 hr				**Stockton Avenue Bridge** 0815 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	8.5	0.4	10.70	600	8.9	0.4	10.67	593
0.25	8.7	0.4	10.57	592	8.9	0.4	10.62	597
0.50	8.7	0.4	10.59	593	9.0	0.4	10.79	597
0.75b	8.7	0.4	10.29	593	8.9	0.4	10.63	596
1.00					8.9	0.4	10.53	597
1.25					8.9	0.4	10.47	597
1.50					8.9	0.4	10.46	597
1.75b					8.9	0.4	9.80	597
	Railroad Trestle 0835 hr				**Mouth of Noble Gulch** 0854 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	8.6	0.4	10.72	589	8.3	0.4	10.75	569
0.25	8.7	0.4	10.60	590	8.2	0.4	10.92	567
0.50	8.6	0.4	10.64	590	8.1	0.4	11.03	565
0.75	8.6	0.4	10.65	590	8.1	0.4	11.04	565
1.00	8.6	0.4	10.67	590	8.1	0.4	10.98	566
1.12b					8.2	0.4	9.29	570
1.25	8.6	0.4	10.59 (91%)	590				
1.45b	8.6	0.4	9.47	589				
	Nob Hill			0929 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**
	7.5	0.4	12.73	527				

Station 1: Flume at 0754 hr. Reach 1- 21 gulls; 55 mallards, 36 coots, 1 gray duck. No surface algae.
Station 2: Stockton Avenue Bridge at 0815 hr. Reach 2- 10 coots, 3 goldeneye ducks. No surface algae.
Station 3: Railroad trestle at 0835 hr. Reach 3-7 mallards, 31 coots, 14 goldeneye, 1 pied-billed grebe. No surface algae.
Station 4: Mouth of Noble Gulch at 0854 hr. No surface algae or gray water.
Station 5: Nob Hill at 0929 hr. Water temperature 0.7° C cooler than 2 weeks earlier, 1.8 – 2.8° C cooler than the lagoon near the bottom. 2.1° C cooler than 2 weeks previously. 0.6 – 1.2°C cooler than lagoon. Estimated streamflow = 2.5 cfs at Soquel Village gage and 2 cfs less than 2 weeks ago.

8 December 2020. Tidal overwash occurred into the lagoon at Venetian wall. Lower 1 foot of lagoon was below secchi depth without light penetration. Alley requested that 2 additional boards be removed from

inlet and berm be re-established at Venetian wall. Only one additional board was removed on Zelda's side of the flume inlet instead of one due to miscommunication. Berm was re-established at Venetian wall.

12 December 2020. Gage height of 2.56 in morning. Light rain occurred on 11 December with 5.6 cfs maximum stormflow. Still 1 board out on either side of inlet. Sky cloudy at 0733 hr. Air temperature of 14.5°C and 9.4°C warmer than 2 weeks previously. Morning oxygen levels fair to good near the bottom; oxygen lower than 2 weeks previously, 0.6- 1.7°C warmer water temperatures and in the good range. Secchi depth 3.6 ft with total depth 5.5.ft under bridge. Recommended that 2 additional boards be removed from the flume inlet. Did not confirm that this was done but assumed it was.

			12 December 2020					
	Flume 0733 hr				**Stockton Avenue Bridge** 0757 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	9.4	0.4	10.46	577	9.3	0.4	10.54	605
0.25	9.4	0.4	10.26	586	9.3	0.4	10.14	621
0.50	9.4	0.4	9.64	626	9.3	0.5	9.90	649
0.75b	9.4	0.5	8.47	700	9.4	0.6	9.12	867
1.00					9.5	0.9	8.60	1237
1.25					9.5	1.3	7.87	1712
1.50					9.5	1.5	6.47	2083
1.75b					9.9	2.4	2.66	3241
	Railroad Trestle 0829 hr				**Mouth of Noble Gulch** 0908 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	9.4	0.3	10.22	452	10.3	0.3	10.25	409
0.25	9.3	0.4	9.52	634	9.9	0.4	9.68	547
0.50	9.3	0.5	8.87	767	9.6	0.6	9.09	782
0.75	9.5	0.7	8.05	987	9.6	0.7	9.05	966
1.00	9.6	0.8	8.39	1157	9.8	0.8	8.70	1157
1.25b	9.7	1.1	6.67	1541	10.1	1.0	6.23	1343
1.37b	9.9	1.4	4.89	1929				
	Nob Hill			1022 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**
	10.0	0.3	9.53	477				

Station 1: Flume at 0733 hr. Reach 1- 8 gulls; 33 mallards in Margaritaville cove, 7 goldeneye, 9 coots in water, 29 coots and 1 snowy egret standing on Venetian Court margin. No surface algae.
Station 2: Stockton Avenue Bridge at 0757 hr. Reach 2- 17 mallards, 19 coots, 5 goldeneye, 1 cormorant roosting on wood adjacent wooden flood wall. No surface algae.
Station 3: Railroad trestle at 0829 hr. Reach 3- 31 coots, 12 goldeneye, 3 pied-billed grebes, 1 gray duck. No surface algae.
Station 4: Mouth of Noble Gulch at 0908 hr. No surface algae. No gray water.
Station 5: Nob Hill at 1022 hr. Water temperature 0.2 – 0.6 C warmer than lagoon near the bottom in the afternoon. 2.5°C warmer than 2 weeks previously. 4.9 cfs at Soquel Village gage.

26 December 2020. Stormflow maximum of 30 cfs on 13 December. Stormflow maximum of 17.4 cfs on 17 December. Stormflow overnight 26 December (approx. 17 cfs) with rain over by monitoring time. Gage height of 2.55. 2 boards out on Zelda's side and 1 board out on Venetian side of flume inlet. Secchi depth to bottom. Sky foggy at 0745 hr. Flume inlet 2.0 ft with frequent back-flush. Flume outlet 2 - 2.5 ft. Air temperature of 11.0°C and 3.5°C cooler than 2 weeks previously. Morning oxygen levels good near the bottom (84% to 92% full saturation); oxygen higher than 2 weeks previously, 0.6- 0.9°C cooler water temperatures and in the good range.

			26 December 2020					
	Flume			0745 hr	**Stockton Avenue Bridge**			0809 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	8.9	0.4	11.19	568	9.1	0.4	11.08	552
0.25	8.9	0.4	10.89	568	9.1	0.4	10.97	552
0.50	8.8	0.4	10.67 (92%)	576	9.0	0.4	10.74	554
0.75b	8.7	0.4	10.35	584	8.9	0.4	10.15	567
1.00					8.8	0.4	10.12	584
1.25					8.8	0.4	9.82	587
1.50					8.8	0.4	9.76 (84%)	588
1.75b					8.8	0.4	9.54	588
	Railroad Trestle			0831 hr	**Mouth of Noble Gulch**			0846 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	9.1	0.4	10.85	564	9.6	0.4	10.54	562
0.25	9.0	0.4	10.75	562	9.3	0.4	10.59	553
0.50	9.0	0.4	10.63	585	9.1	0.4	10.57	560
0.75	9.0	0.4	10.56	566	9.0	0.4	10.62	564
1.00	9.0	0.4	10.50 (91%)	567	8.9	0.4	10.10 (87%)	578
1.25b	8.9	0.4	5.53	572	9.0	0.5	7.23	634
	Nob Hill			0935 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**
	9.6	0.4	10.63	542				

Station 1: Flume at 0745hr- Reach 1- 3 gulls bathing, 3mallards, 11 goldeneye, 1 merganser, 19 coots in water, 6 coots standing on Venetian margin. No surface algae.
Station 2: Stockton Avenue Bridge at 0809 hr- Reach 2 – 7 mallards, 4 coots, 1 merganser from Reach 1, brown duck on concrete under Stockton Bridge. No surface algae.
Station 3: Railroad trestle at 0831 hr- Reach 3- 21 mallards, 16 coots, 12 goldeneye. No surface algae.
Station 4: Mouth of Noble Gulch at 0846 hr- No surface algae. No gray plume at mouth.
Station 5: Nob Hill at 0935 hr. Water temperature 0.4°C cooler than 2 weeks earlier in the morning. 1.9 - 2.6° C cooler than lagoon near the bottom in the morning and 0.6 – 0.8 C warmer than the lagoon. Stormflow maximum of 17.4 cfs on 26 December at Soquel Village gage at 1045 hr.

			9-Jan-2021					
	Flume			0805 hr	**Stockton Avenue Bridge**			0826 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	9.2	0.4	10.64	603	9.3	0.4	10.39	608
0.25	9.2	0.4	10.40	602	9.3	0.4	10.29	604
0.50	9.2	0.4	10.21	601	9.3	0.4	10.16	602
0.70b	9.2	0.4	10.10	601				
0.75					9.3	0.4	10.15	601
1.00					9.3	0.4	10.11	604
1.25					9.4	0.4	9.68 (84)	636
1.50					9.5	0.4	9.14 (80)	683
1.75b					9.9	0.6	4.43	892
	Railroad Trestle			0850 hr	**Mouth of Noble Gulch**			0906 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	9.2	0.4	10.10	602	9.4	0.4	10.61	561
0.25	9.2	0.4	9.86	602	9.1	0.4	10.37	561
0.50	9.2	0.4	9.95	602	9.1	0.4	10.38	561
0.75	9.2	0.4	9.96	602	9.1	0.4	10.34 (90)	561
1.00	9.2	0.4	9.97 (87)	603	9.1	0.4	10.24 (89)	562
1.13b					9.1	0.4	8.23	575
1.25b	9.2	0.4	4.38	610				
	Nob Hill			0940 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**
	8.8	0.4	10.42 (90)	549				

9 January 2021. Gage height of 2.32, clear, breezy. Air temperature of 9.9˚ C at 0805 hr. Flume inlet 2.0 ft with back-flush; flume exit 2.0+ ft. 2 flashboards out on restaurant side and 1 board out on Venetian side of flume inlet. Inner and outer berms in place on beach. Secchi depth to bottom. Previous small stormflows since last monitoring- Dec 28 (approx. 13 cfs); Dec 31 (approx. 13 cfs); Jan 2 (approx. 11 cfs); Jan 4 (approx. 36 cfs). All streamflows estimated from hydrograph at Soquel Village gage.
Station 1: Flume at 0805 hr- Reach 1- No gulls bathing. No surface algae in lagoon. Reach 1 in water- 14 mallards and 1 gray duck not concentrated in Margaritaville cover, 6 coots, 6 coots on Venetian margin. 3 mallards roosting on wood under bridge.
Station 2: Stockton Avenue Bridge at 0826 hr- Reach 2 in water- 4 coots, 2 mallards on wood stump. No surface algae. 1 black-crowned night heron in overhanging willows. 2 coots on lagoon-side lawn.
Station 3: Railroad trestle at 0850 hr- Reach 3 in water- 13 mallards dabbling, 14 coots, 13 goldeneye.
Station 4: Mouth of Noble Gulch at 0906 hr- No surf. algae. No gray water plume at NG mouth.
Station 5: Nob Hill at 0940 hr- Water temperature at 8.8 C was 0.8°C cooler in morning than 2 weeks previous. 5 cfs at Soquel Village.

			23-Jan-2021					
	Flume			0805 hr	**Stockton Avenue Bridge**			0821 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	9.3	0.5	12.01	653	9.5	0.4	11.98	624
0.25	9.4	0.5	12.00 (103)	652	9.5	0.4	11.83	625
0.50	9.4	0.5	11.96	654	9.5	0.4	11.74	627
0.67b	9.4	0.5	11.74	657				
0.75					9.5	0.4	11.53	641
1.00					9.6	0.5	11.36	685
1.25					10.6	1.0	10.34 (94)	1395
1.50					11.0	1.4	10.57 (97)	1951
1.75b					11.5	1.9	8.07	2659
	Railroad Trestle			0846 hr	**Mouth of Noble Gulch**			0905 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	9.2	0.4	11.37	593	9.0	0.3	11.04	491
0.25	9.3	0.4	11.25	595	9.2	0.4	10.95	564
0.50	9.2	0.4	11.24	954	9.4	0.4	10.91	622
0.75	9.6	0.5	11.18	729	10.4	0.6	10.66	898
1.00	10.2	0.7	11.42 (102)	1023	10.6	0.7	10.97 (99)	957
1.12b								
1.45b	10.8	0.9	9.03	1347	11.1	0.8	7.26	1156
	Nob Hill			1000 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**
	8.9	0.4	11.46 (99)	532				

23 January 2021. Gage height of 2.32, clear, cool. Small stormflow on previous day 22 Jan (approx. 9 cfs). Air temperature of 9.4˚ C at 0805 hr. Flume inlet 1.8 ft; flume exit approximately 1.5 ft. 2 flashboards out on restaurant side and 1 board out on Venetian side of flume inlet. Inner and outer berms in place on beach. Secchi depth 2.6 feet with lagoon depth of 5.5 feet off the Stockton Bridge at center. Recommended to Public Works to remove another board from restaurant side of flume inlet to make 3 boards out on that side and one board out on Venetian side.

Station 1: Flume at 0805 hr- Reach 1- No gulls bathing. No surface algae in lagoon. Reach 1 in water- 15 coots, 4 goldeneye ducks, 2 coots roosting on wood under bridge.

Station 2: Stockton Avenue Bridge at 0824 hr- Reach 2 in water- 17 coots, 4 goldeneye; 10 mallards and 1 coot roosting on trestle abutment. 2 fishermen at Stockton Ave Bridge east side. Caught juvenile steelhead previous weekend. No surface algae.

Station 3: Railroad trestle at 0848 hr- Reach 3 in water- 4 mallards dabbling, 13 coots, 9 common goldeneye, 1 pied-billed grebe near Noble Gulch mouth. 3 coots on lagoon-side lawn.

Station 4: Mouth of Noble Gulch at 0905 hr- No surf. algae. No gray water plume at NG mouth.

Station 5: Nob Hill at 1000 hr- Water temperature at 8.9 C was 0.1°C warmer in morning than 2 weeks 5 cfs at Soquel Village and equal to 2 weeks ago.

26 January 2021. In preparation for first major storm forecasted in the winter season, outer and inner berms were reduced in height to minimize hydraulic the head on lagoon at the time of sandbar opening to minimize estuary evacuation and minimize water velocity during expected sandbar opening. Public Works added 2 flashboards to restaurant side of flume inlet, leaving one board out on either side to prevent wood from jamming flume inlet during stormflow. Gage readings at Soquel Village began elevating rapidly after about 1130 pm. Morrison traveled to lagoon and arrived at approximately midnight to observe sandbar conditions. The sandbar had breached a few minutes before his arrival, and the stream was flowing through the cut notch, approximately 10 feet wide and 0.5 ft as it passed across the beach. The streamflow estimate at the Soquel Village gage was approximately 23 cfs at midnight, and rainfall was heavy in Capitola at the time. Streamflow at the beach was likely more than 30 cfs at the time of the sandbar opening with contributions from Noble Gulch and urban surface runoff in Capitola. The biologist, who lives in the Santa Cruz Mountains where heavy rainfall and wind were occurring, decided it unsafe to travel to the lagoon at the time of sandbar opening because roads may soon close if trees blew down, which in fact occurred overnight. However, Morrison was present at the creekmouth just as the creek was exiting across the beach and observed no fish mortality. Morrison observed that the estuary water surface elevation increased to within 0.5 feet of the piling bolt that indicated the elevation of flooding conditions along the lagoon bulkhead before it began to recede. Thus, flooding was prevented.

27 January 2021. The streamflow increased through the night to a maximum estimate of approximately 450 cfs by 0800 hr at the Soquel Village gage.

28 January 2021. Another storm on 28 January increased stormflow to approximately 2,000 cfs at Soquel Village.

APPENDIX B. 2020 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2020 Drain Line Test for Restaurants Contiguous With Soquel Creek						
Restaurant	Initial Contact	Test Date	Comments	Sign Off	Contact	ph#
My Thai Beach 207 Esplanade	Mr. Rooter	5/19/2020	Passed	Cat Thasher Building Inspector		
Bay Bar 209-B Esplanade	Unable to contact business personnel					
Pizza My Heart 209-A Esplanade	Bellows	6/4/2020	Passed	Cat Thasher Building Inspector	Kaitlyn	831-265-3049
Sand Bar 211 Esplanade	Mr. Rooter	5/7/2020	Passed	Cat Thasher Building Inspector		
Paradise Bar & Grill 215 Esplanade	Business closed/for sale					
Zelda's 203 Esplanade	Amer/Anytime	6/1/2020	Passed	Cat Thasher Building Inspector	Josh	831-345-2666

APPENDIX C. Hydrographs for USGS 11160000 Soquel Creek Stream Gage at Soquel, CA; Water Years 2007−2019.

Figure 1. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

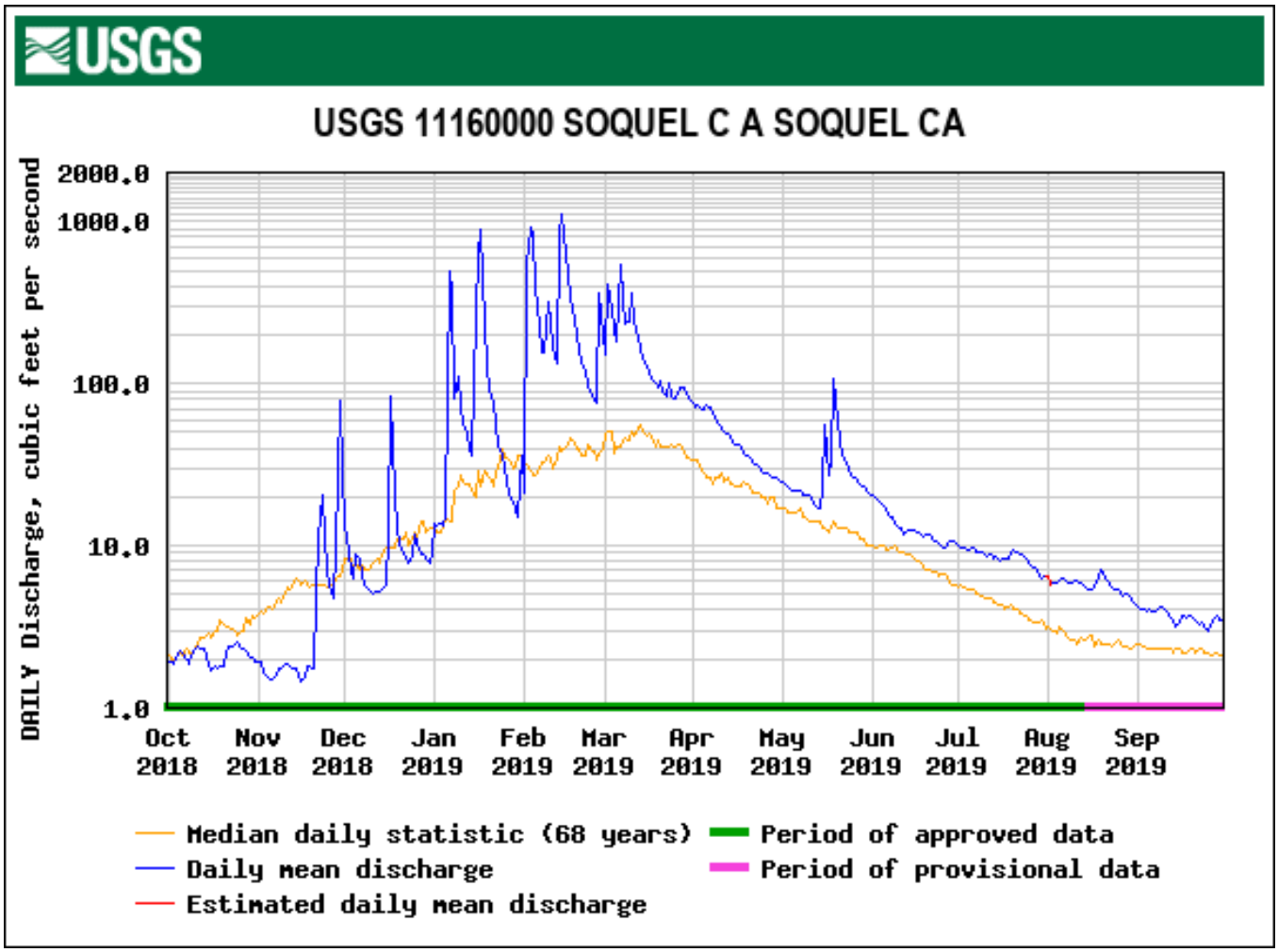


Figure 2. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

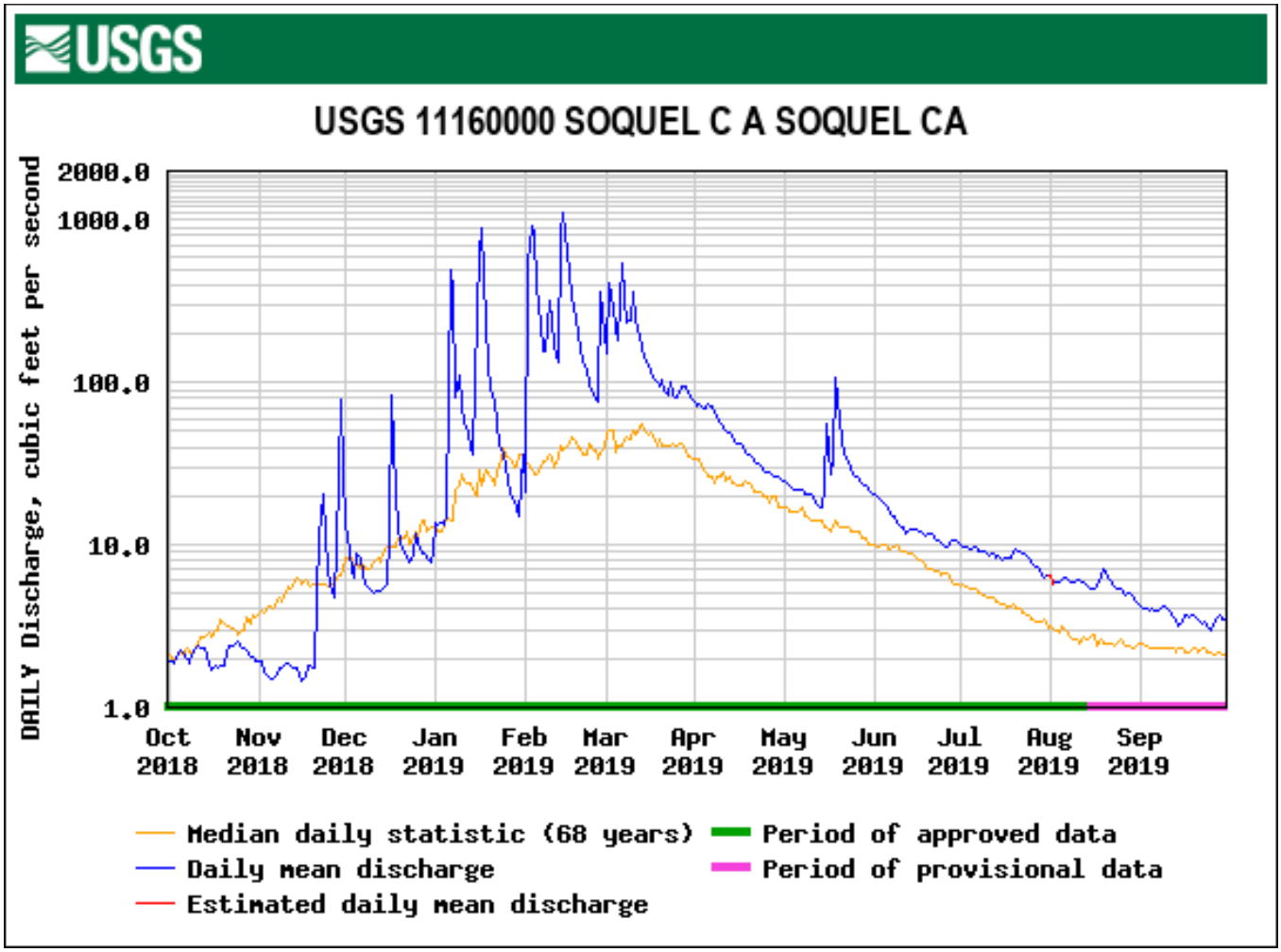


Figure 3. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

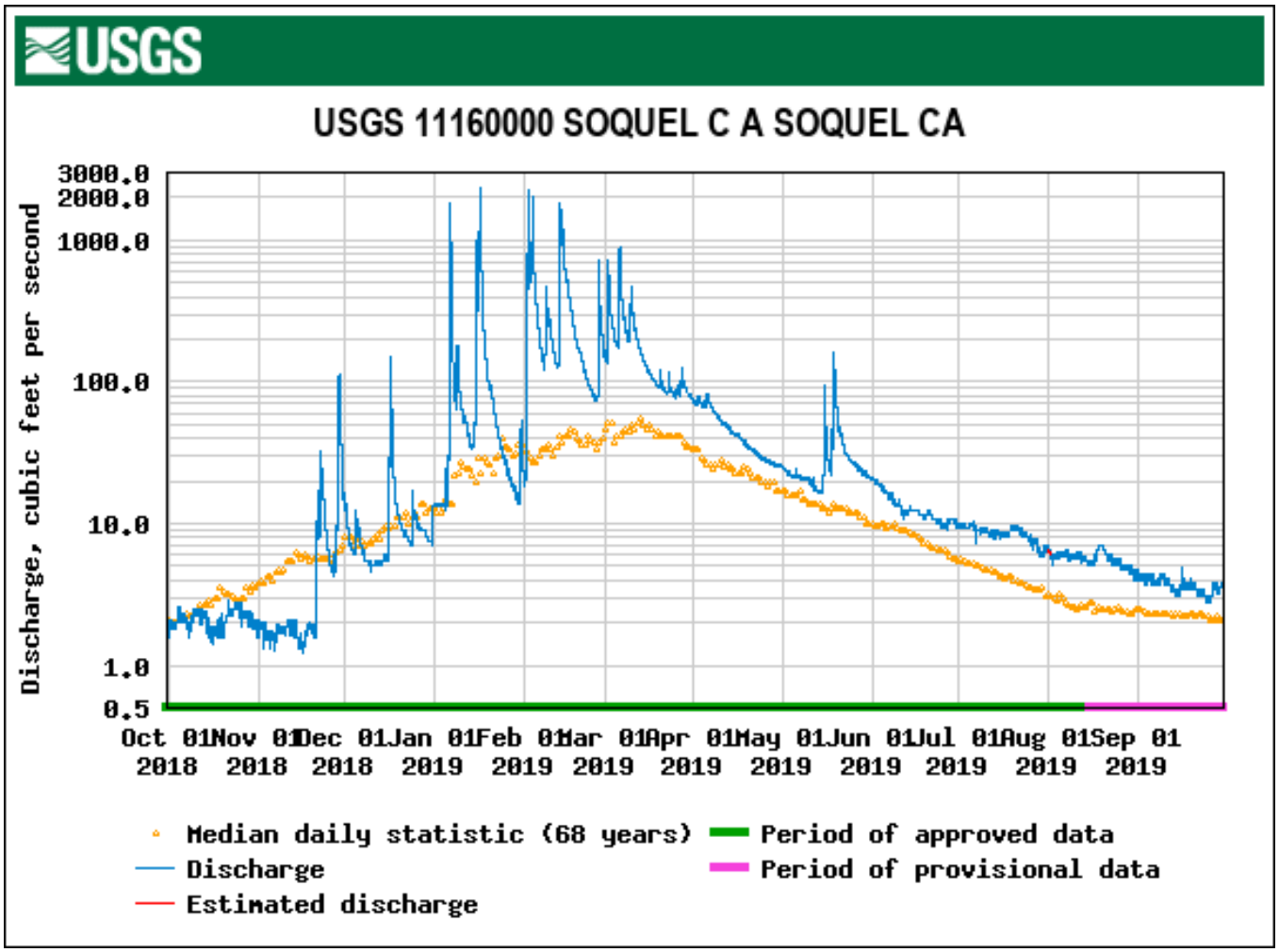


Figure 4. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May – 9 December 2019.

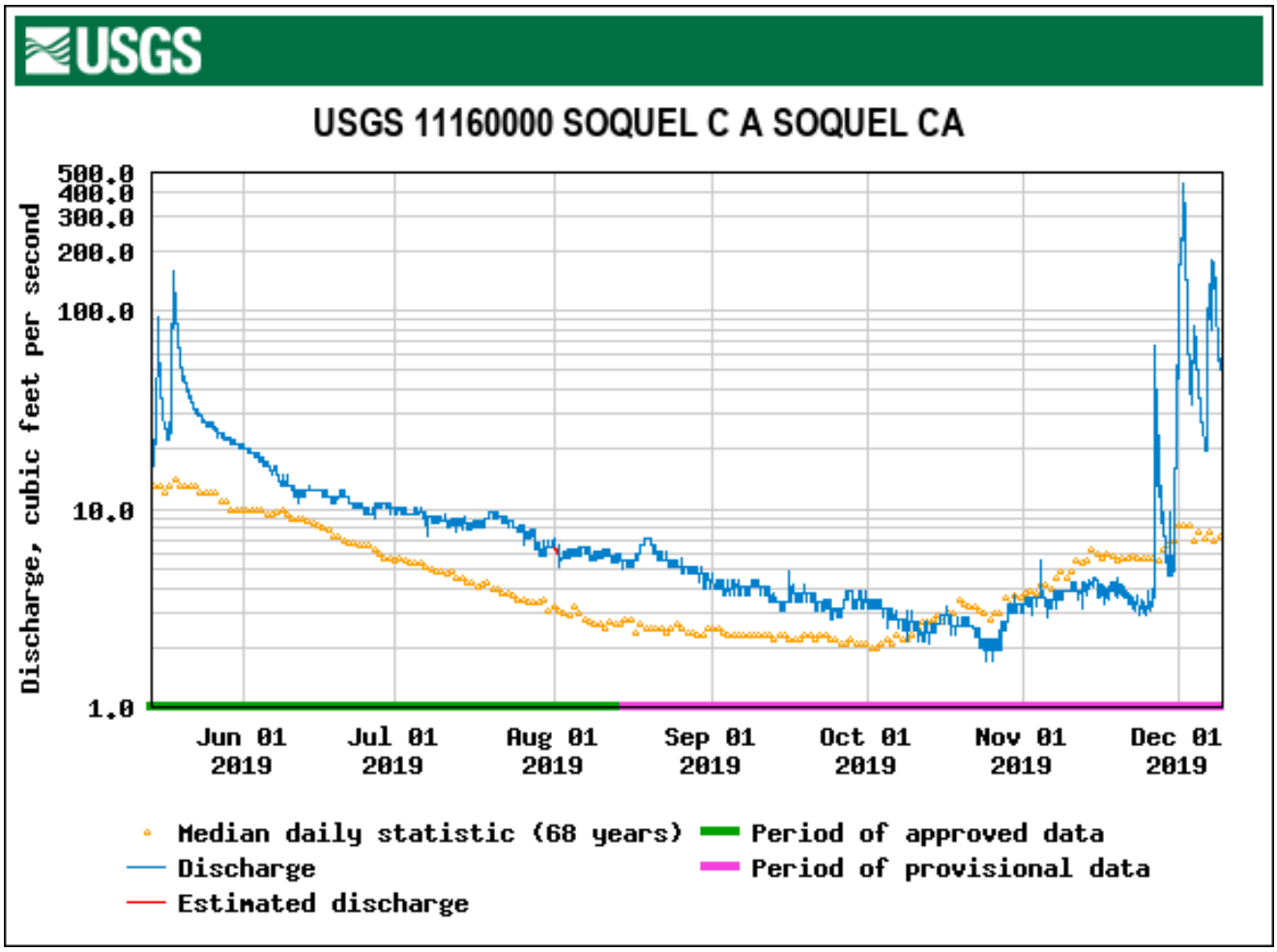


Figure 5. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

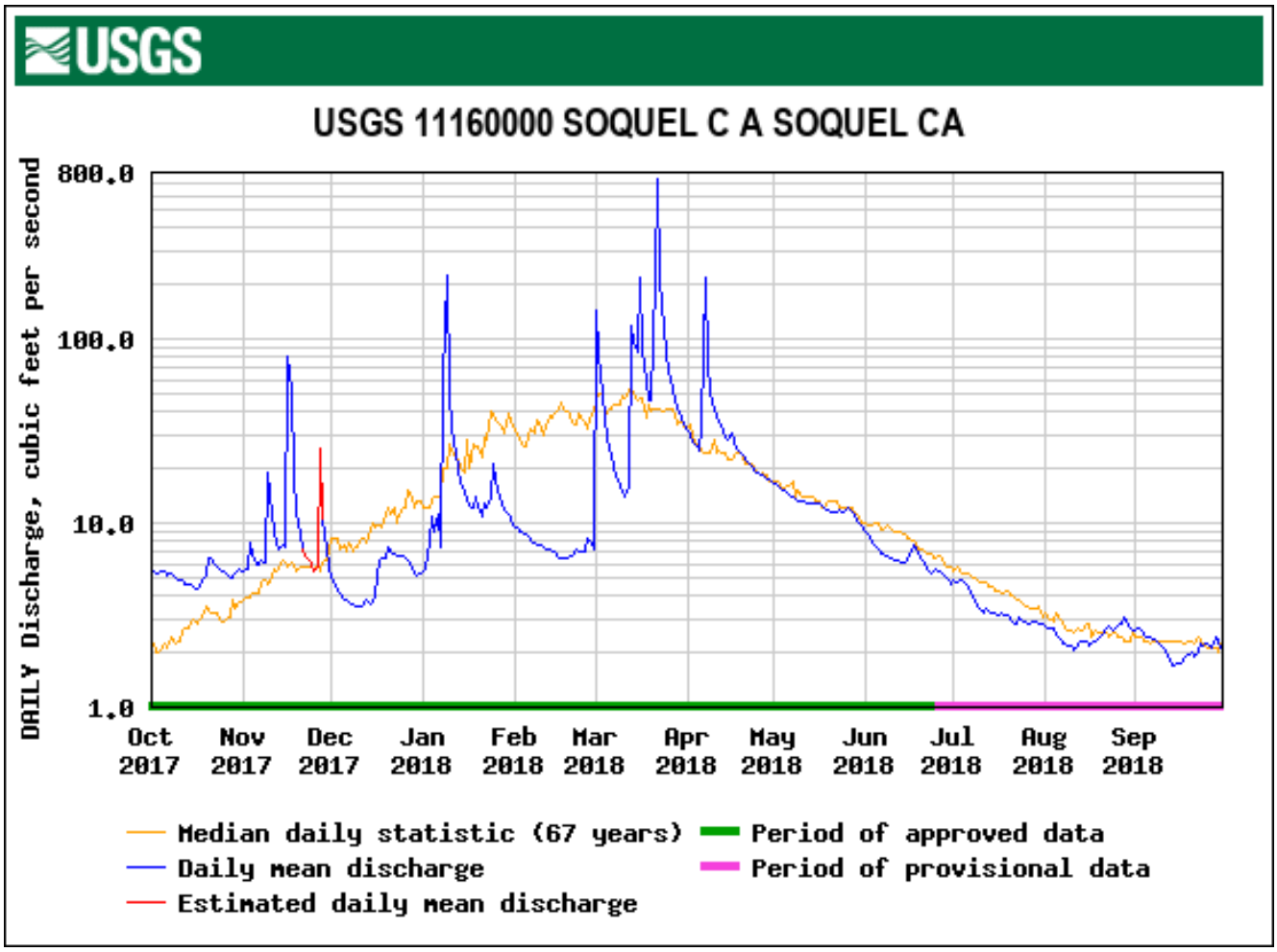


Figure 6. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

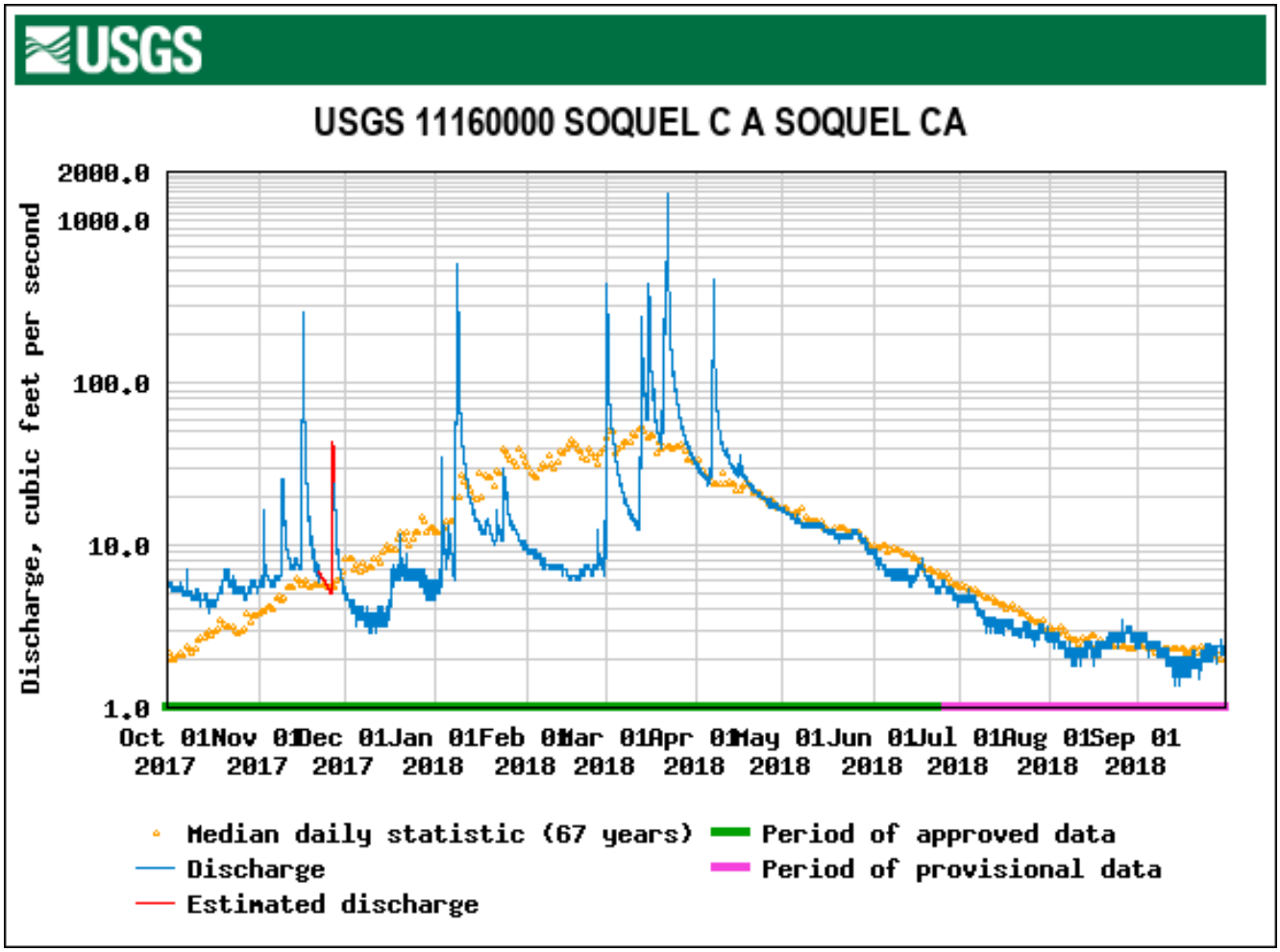


Figure 7. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 1 December 2018.

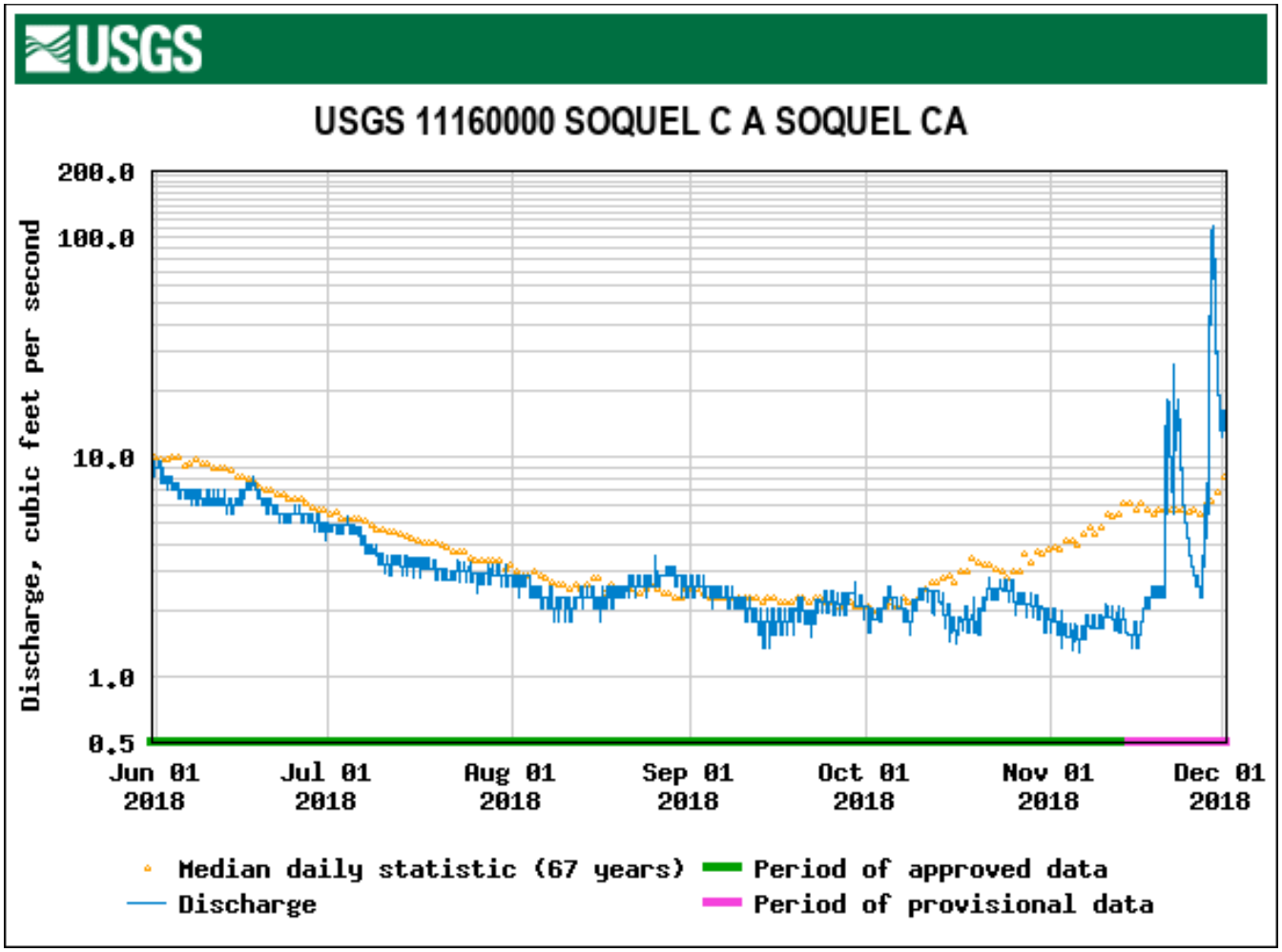


Figure 8 Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

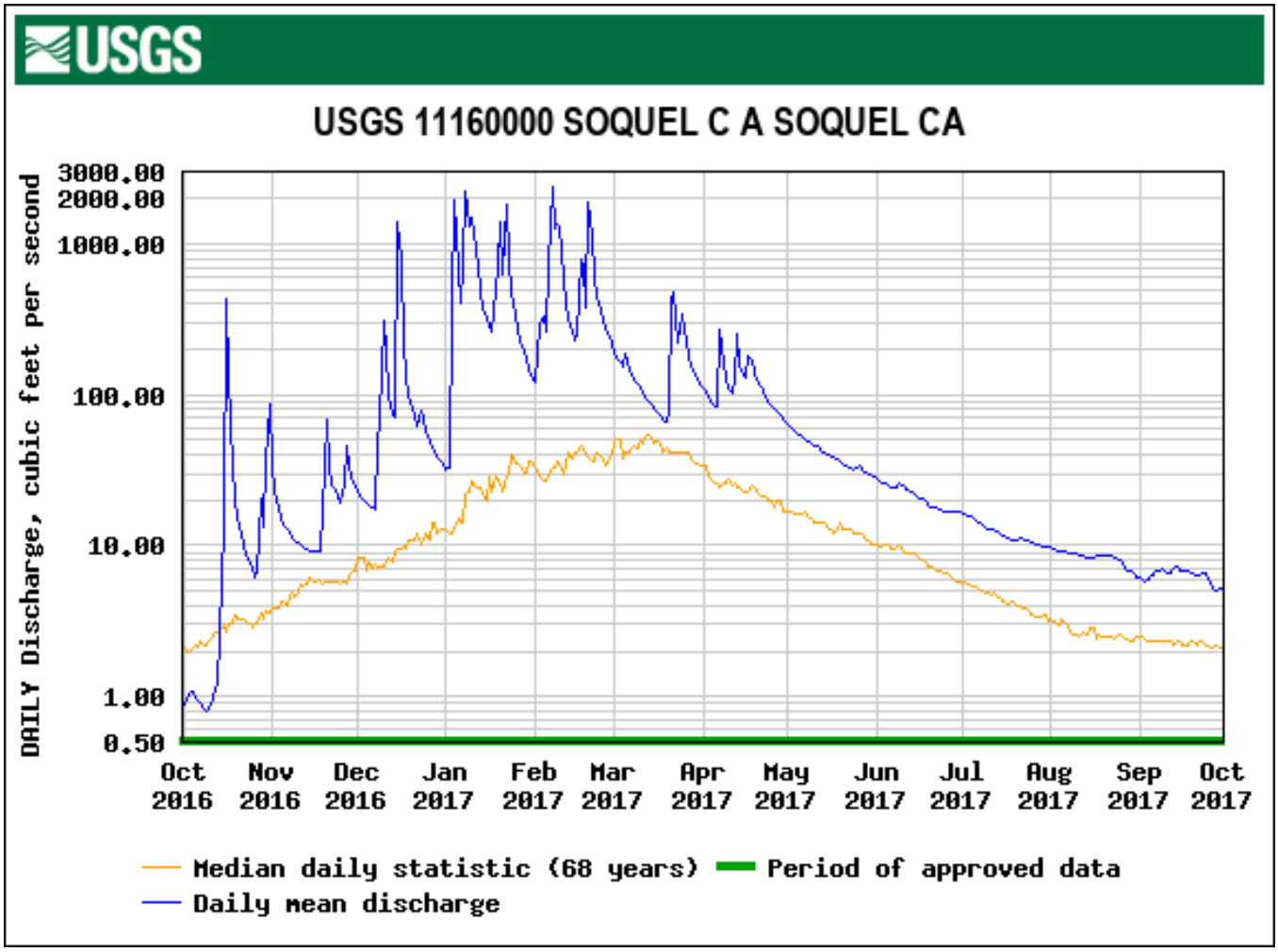


Figure 9. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

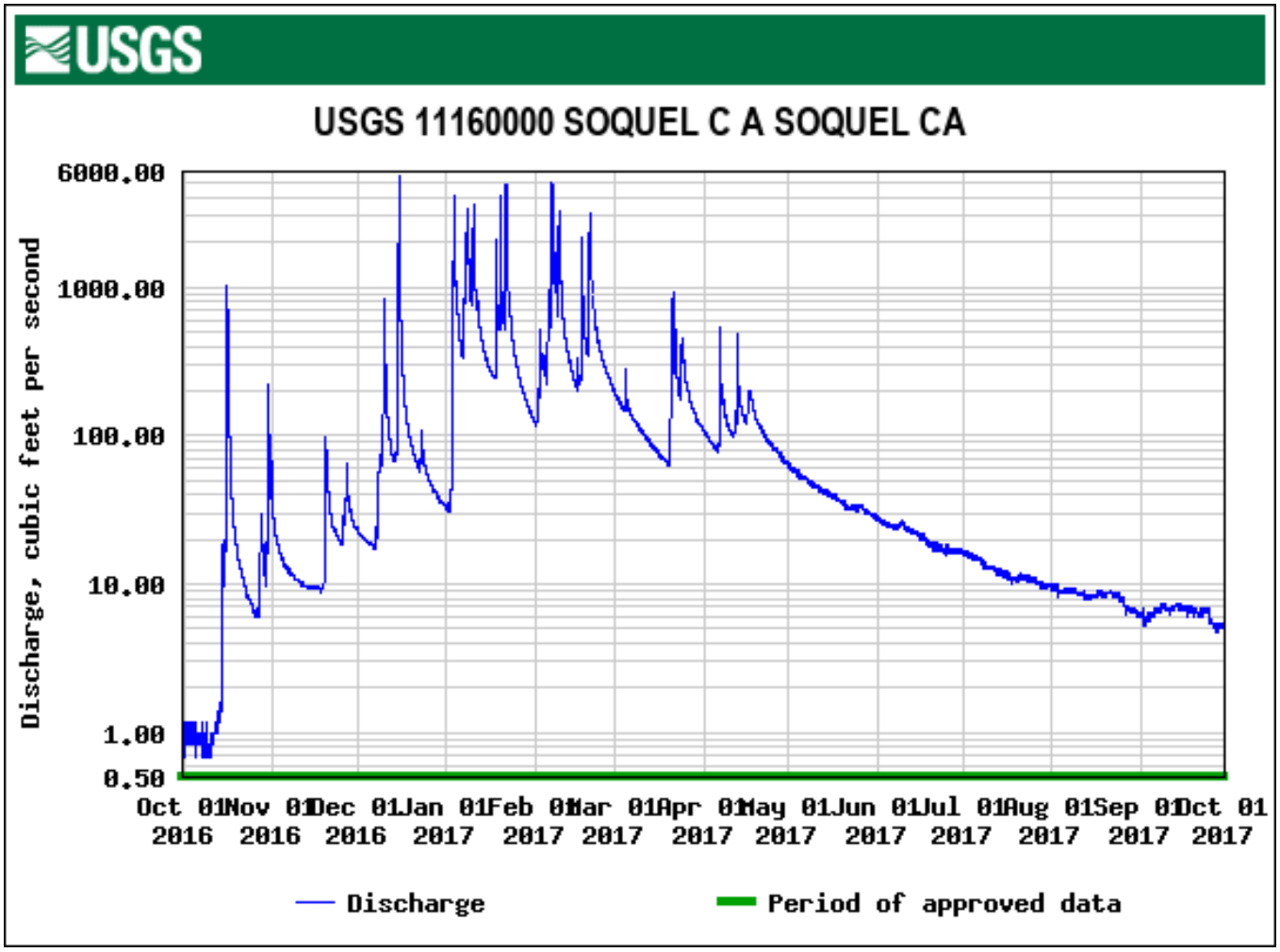


Figure 10. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 20 November 2017.

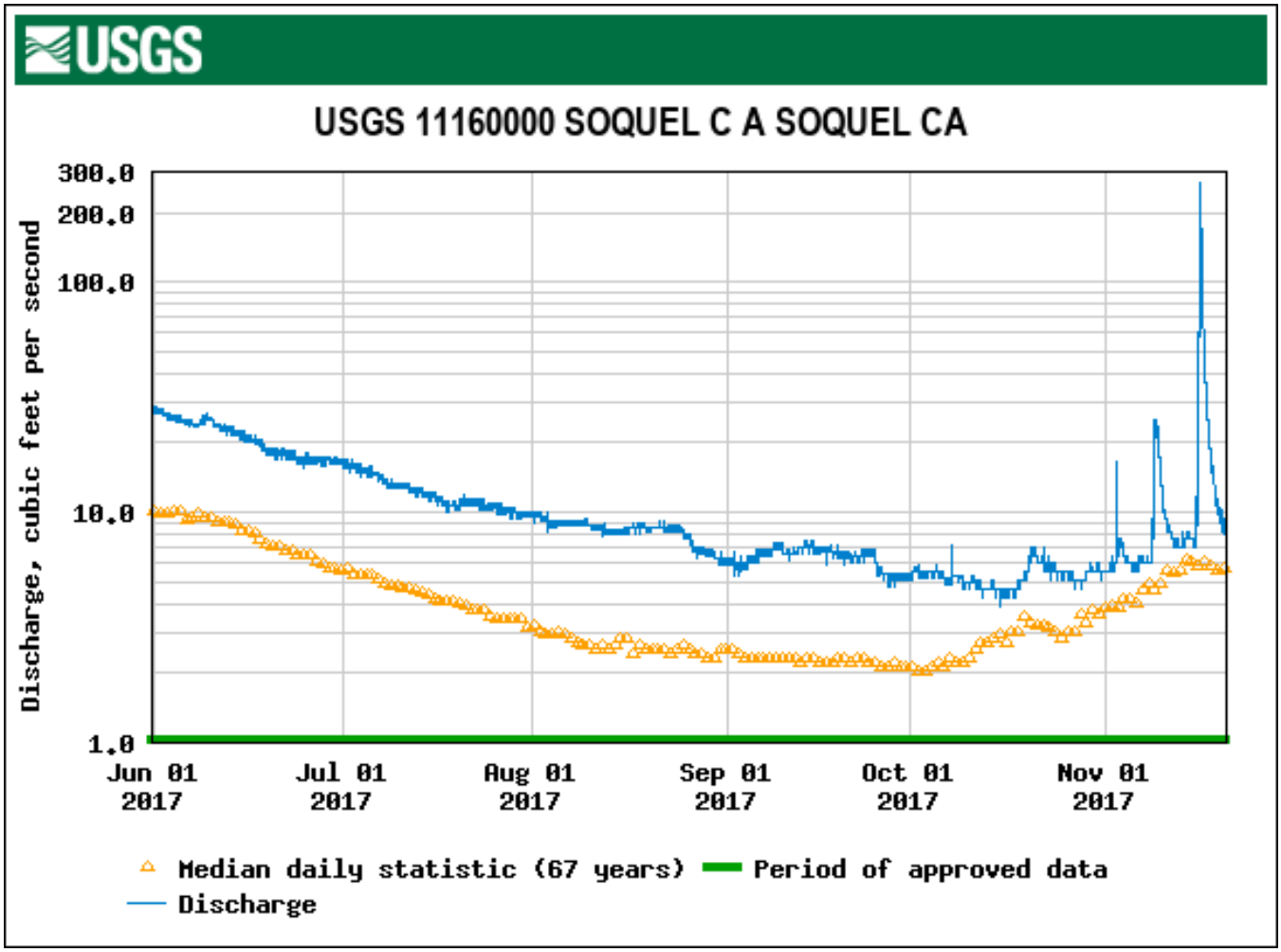


Figure 11. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016

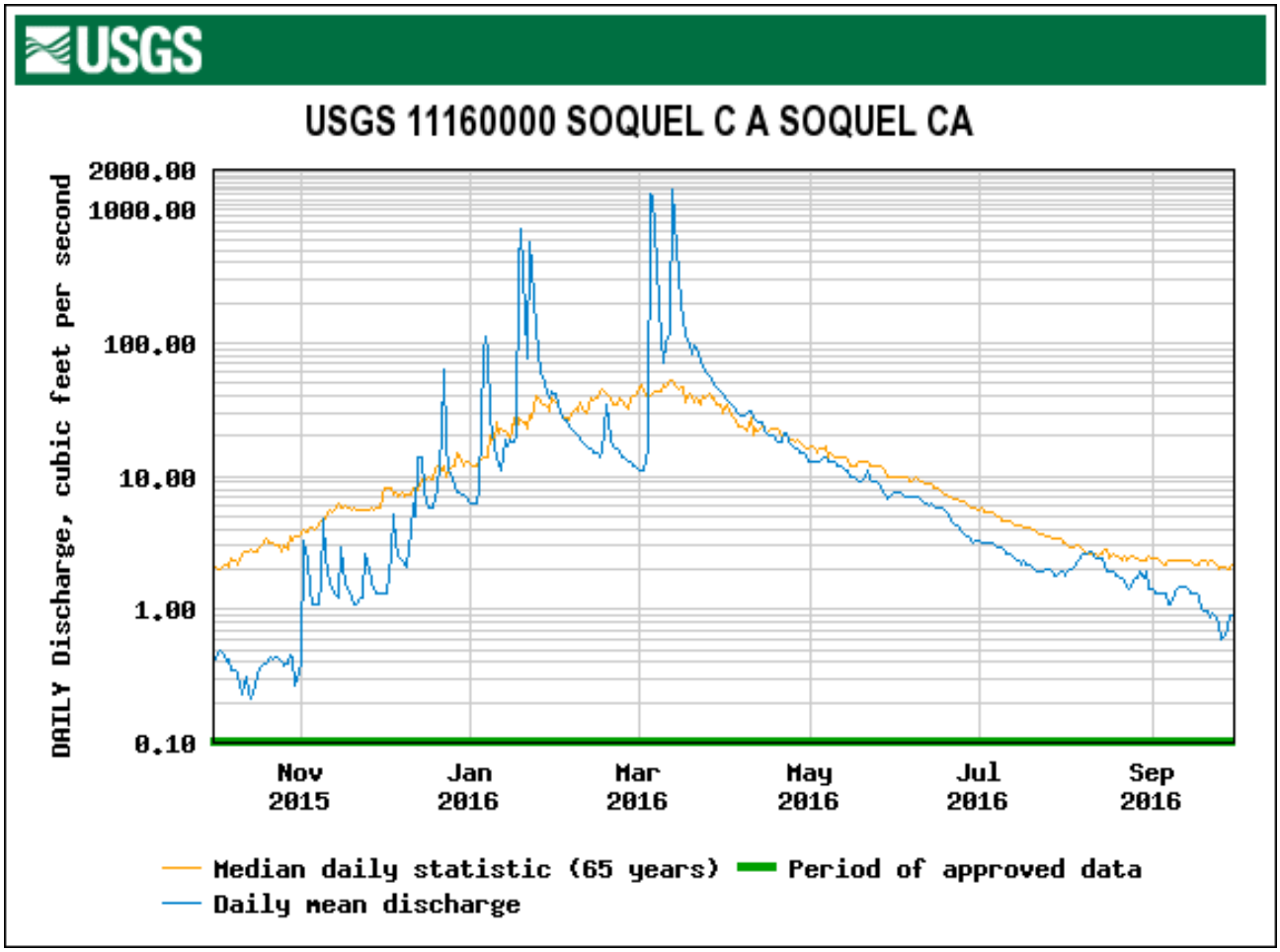


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Figure 12. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016.

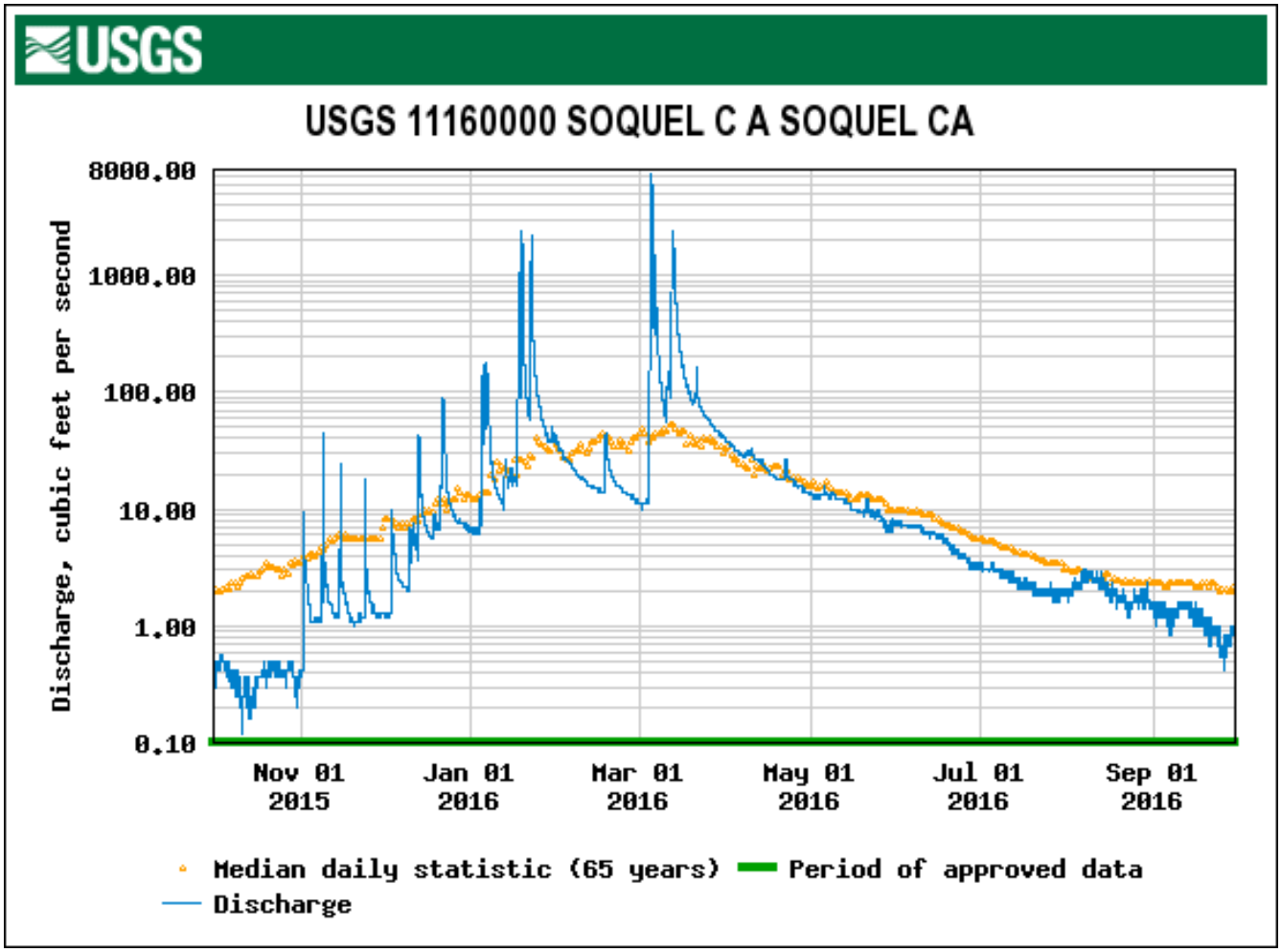

Figure 13. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2016 – 11 October 2016.

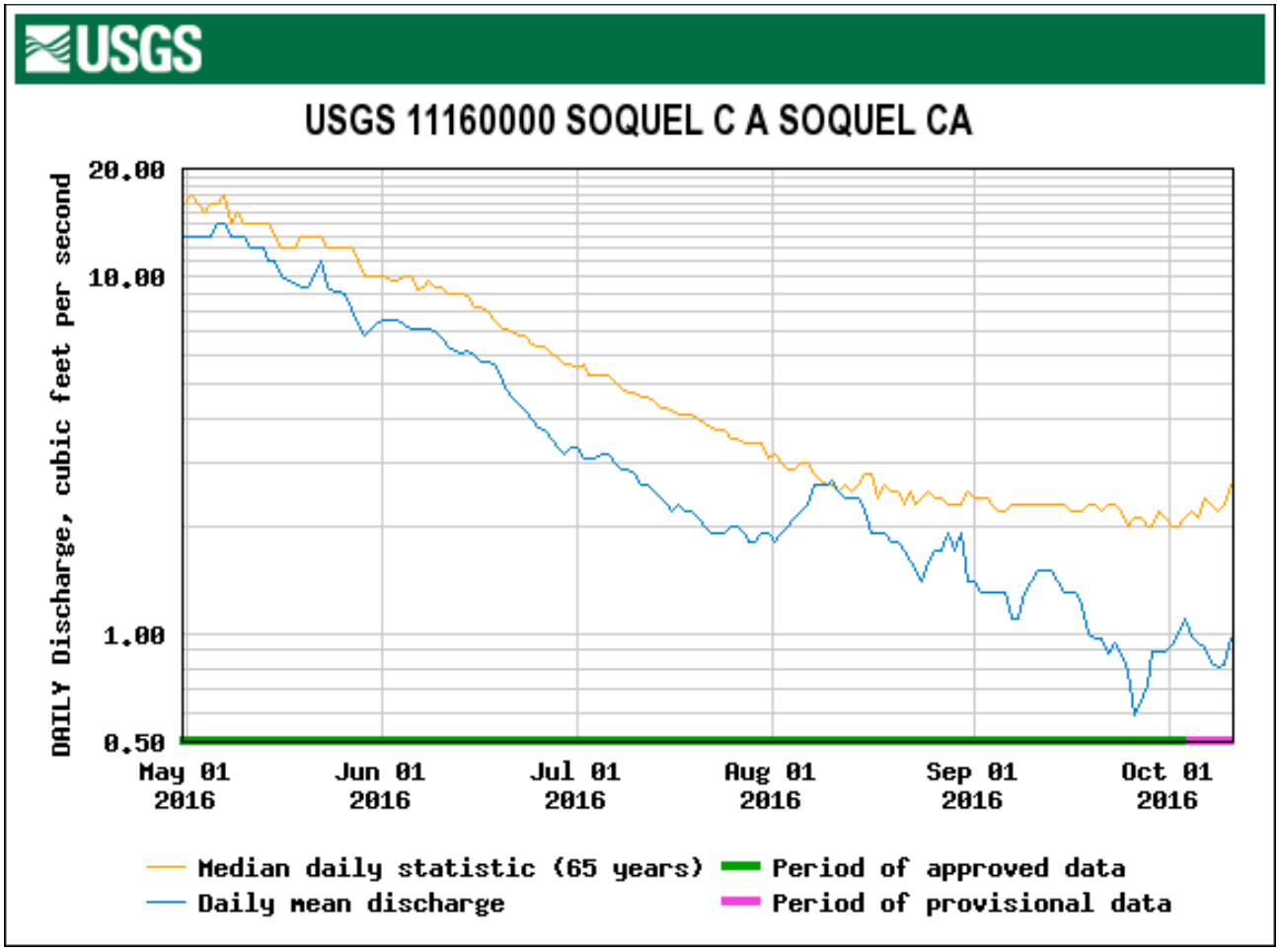

Figure 14. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

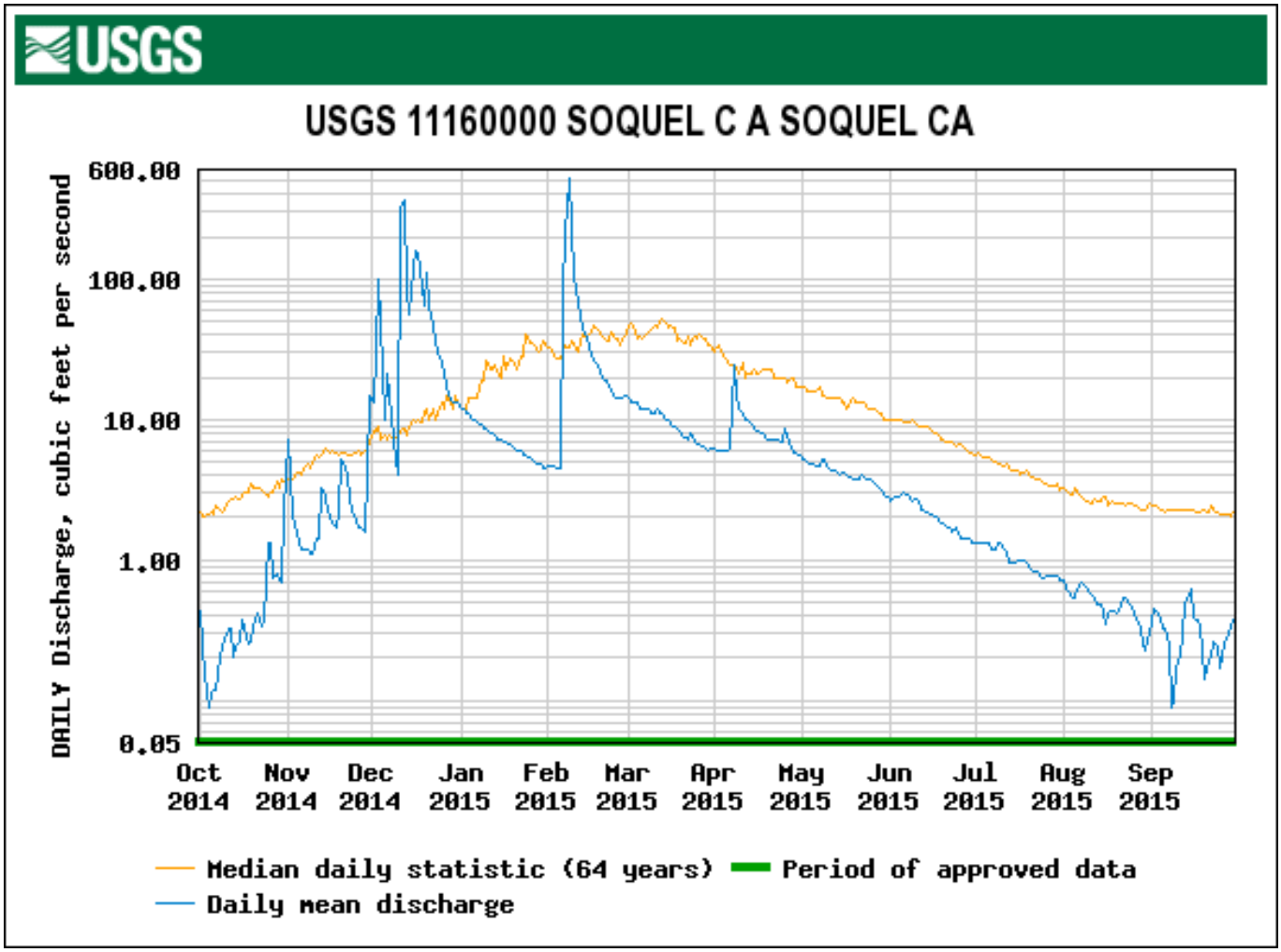

Figure 15. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

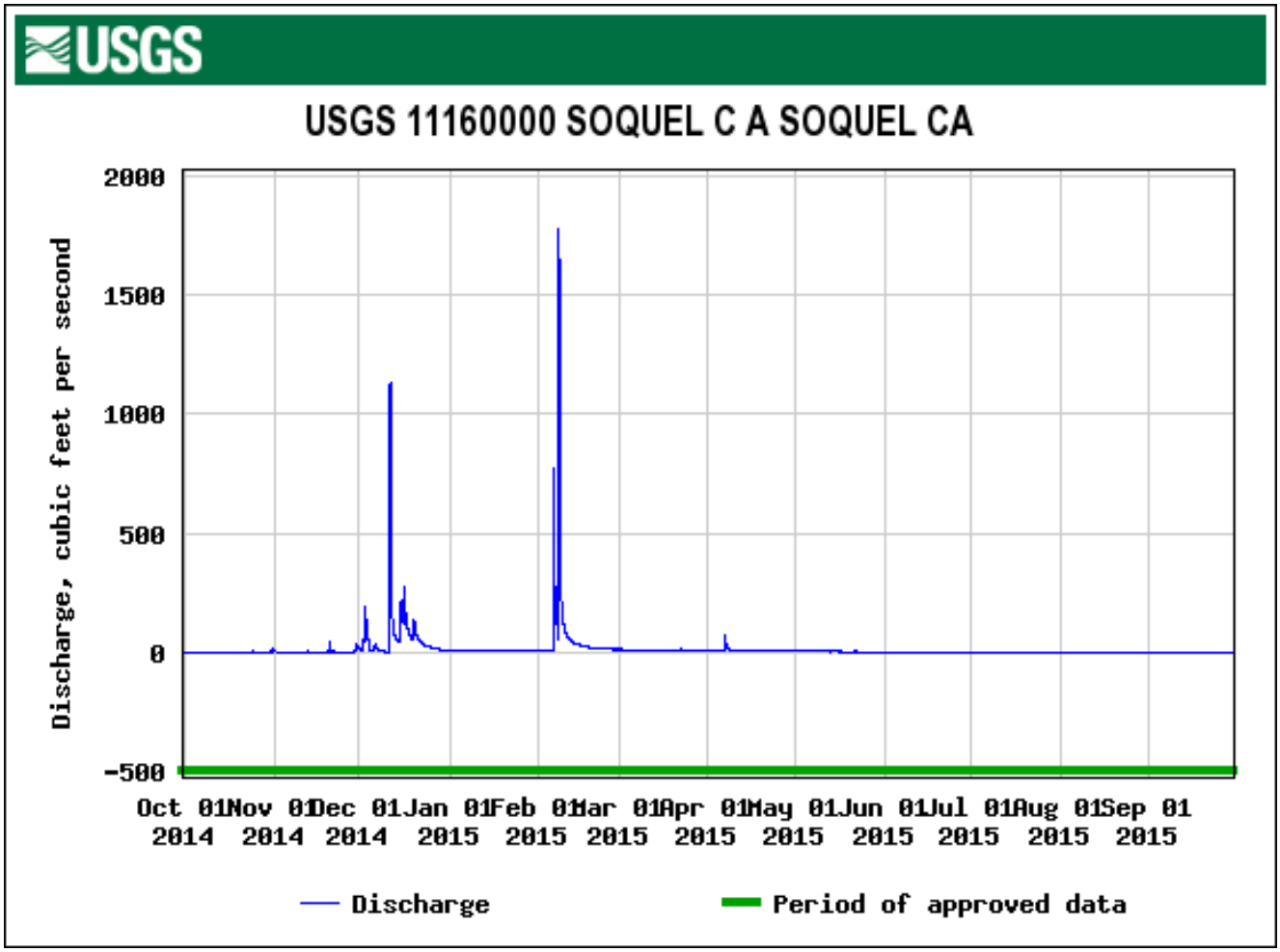

Figure 16. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2015 – 15 November 2015.

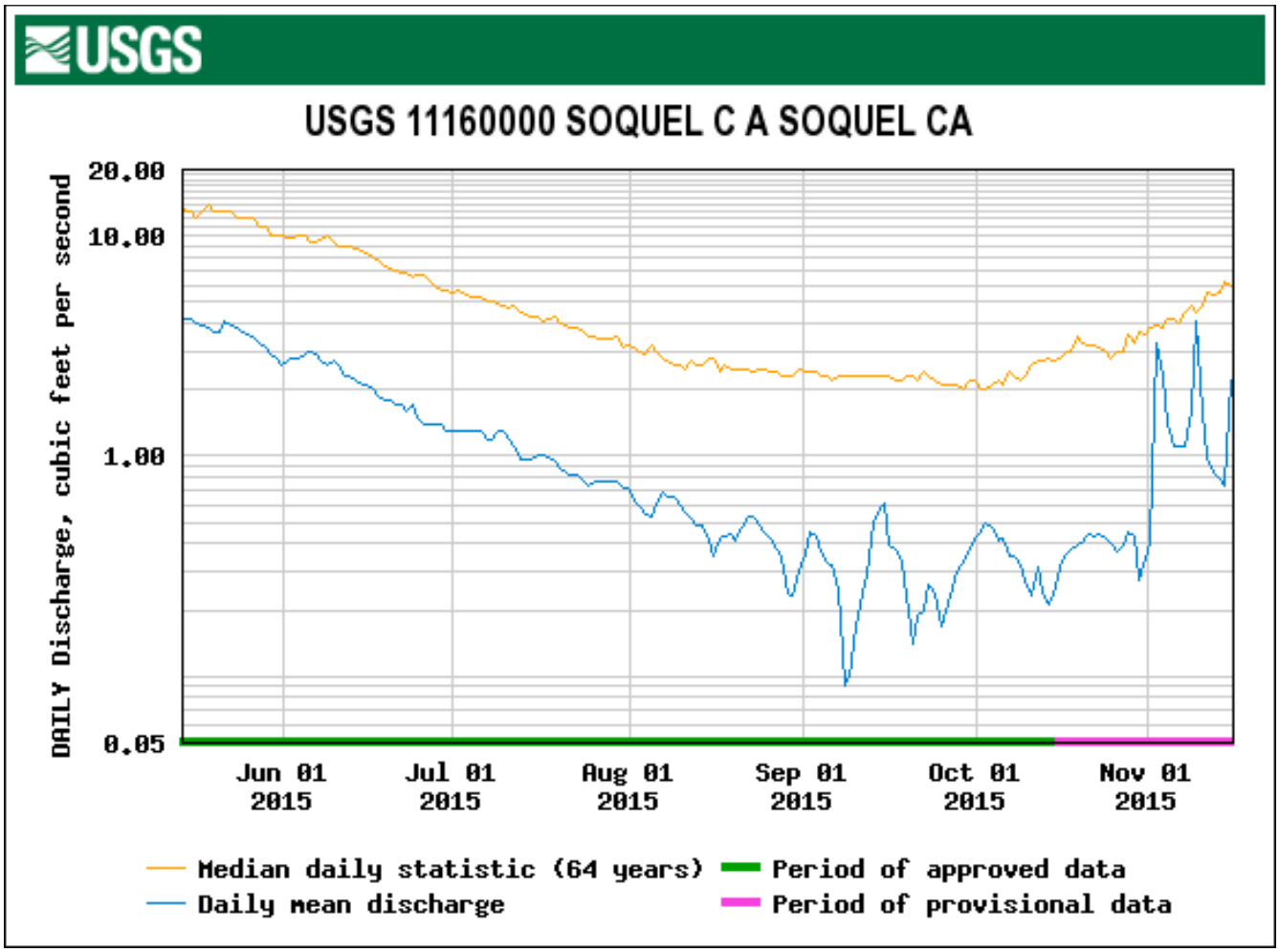

Figure 17. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

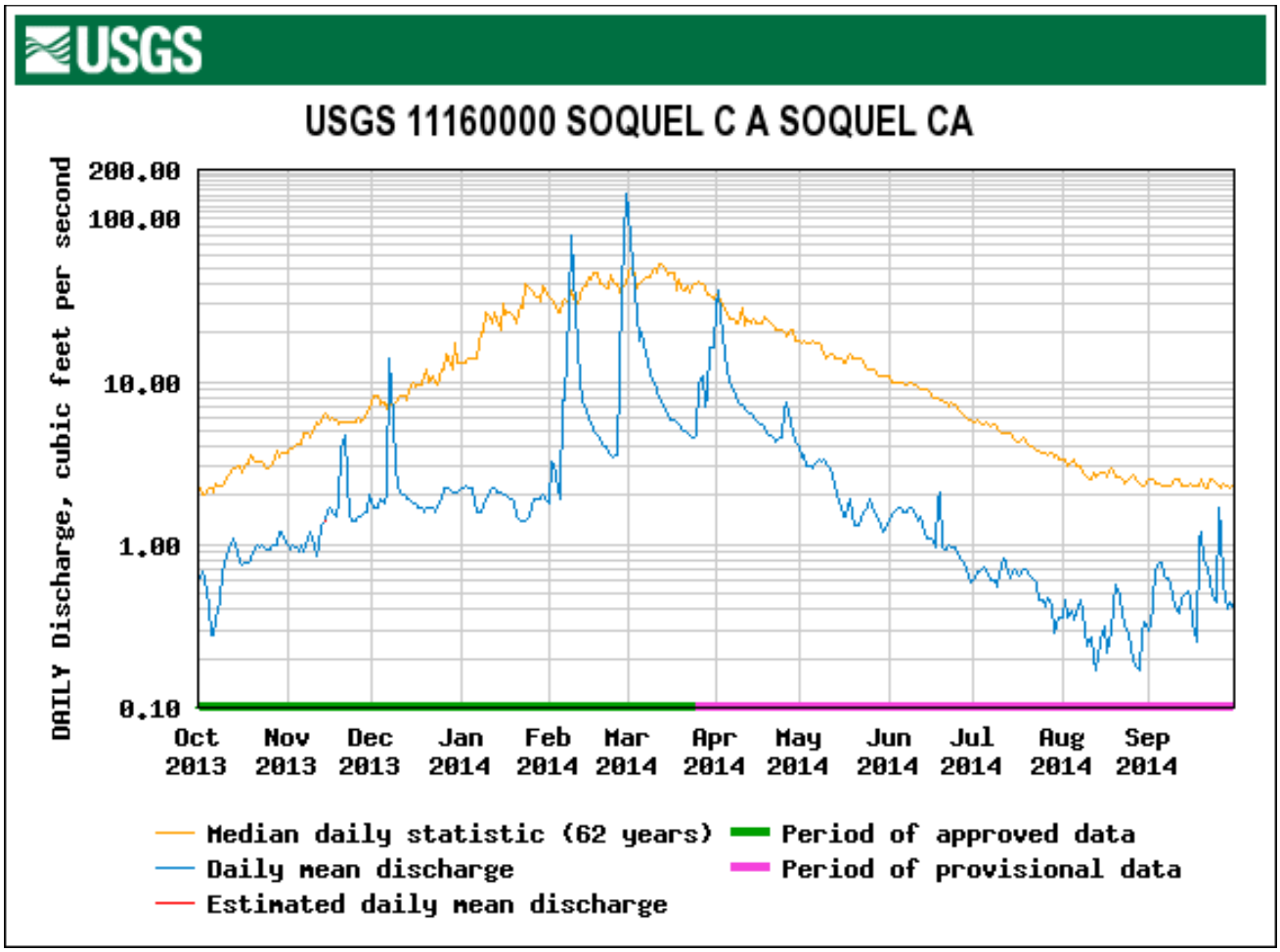

Figure 18. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

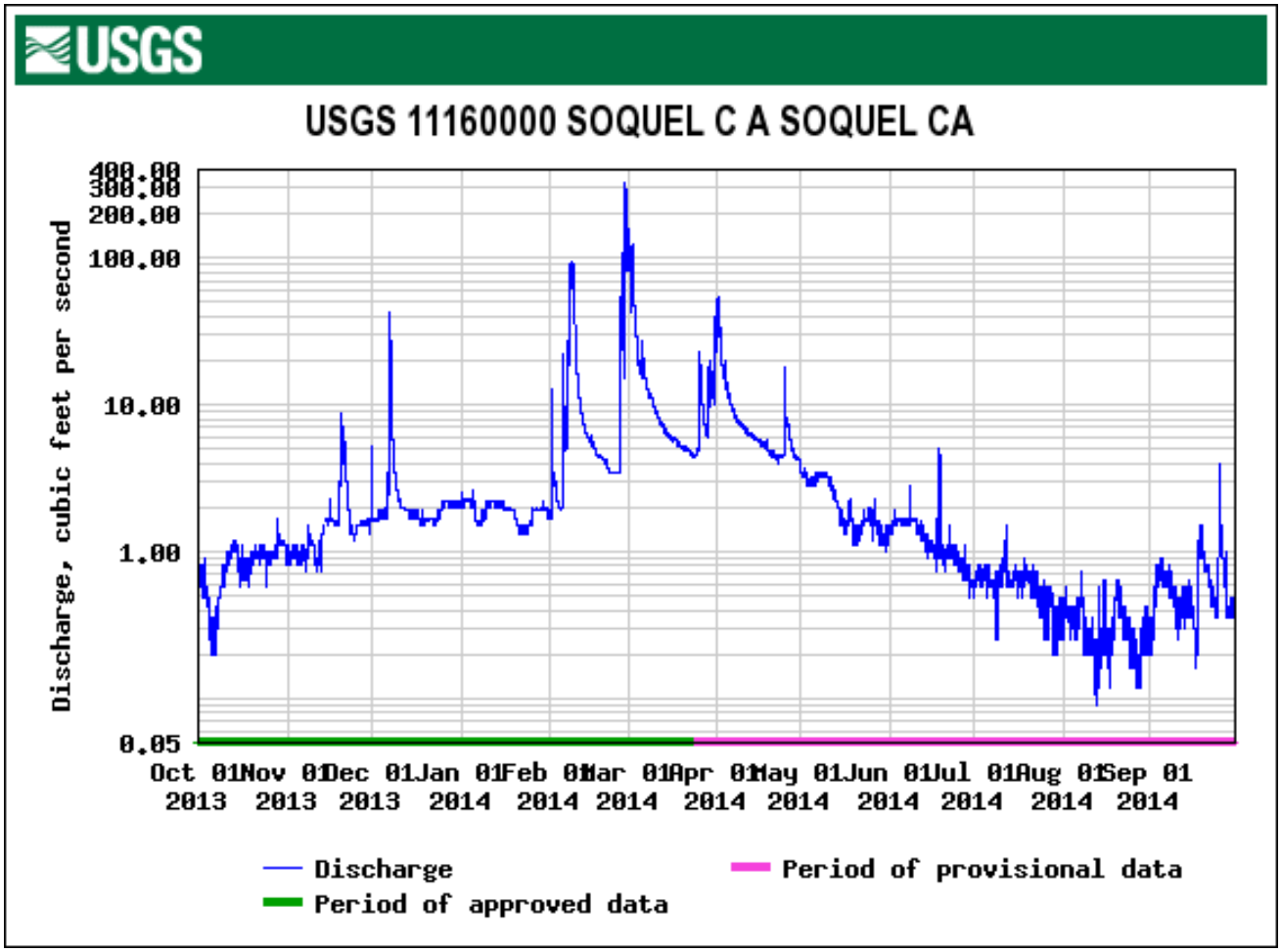

Figure 19. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

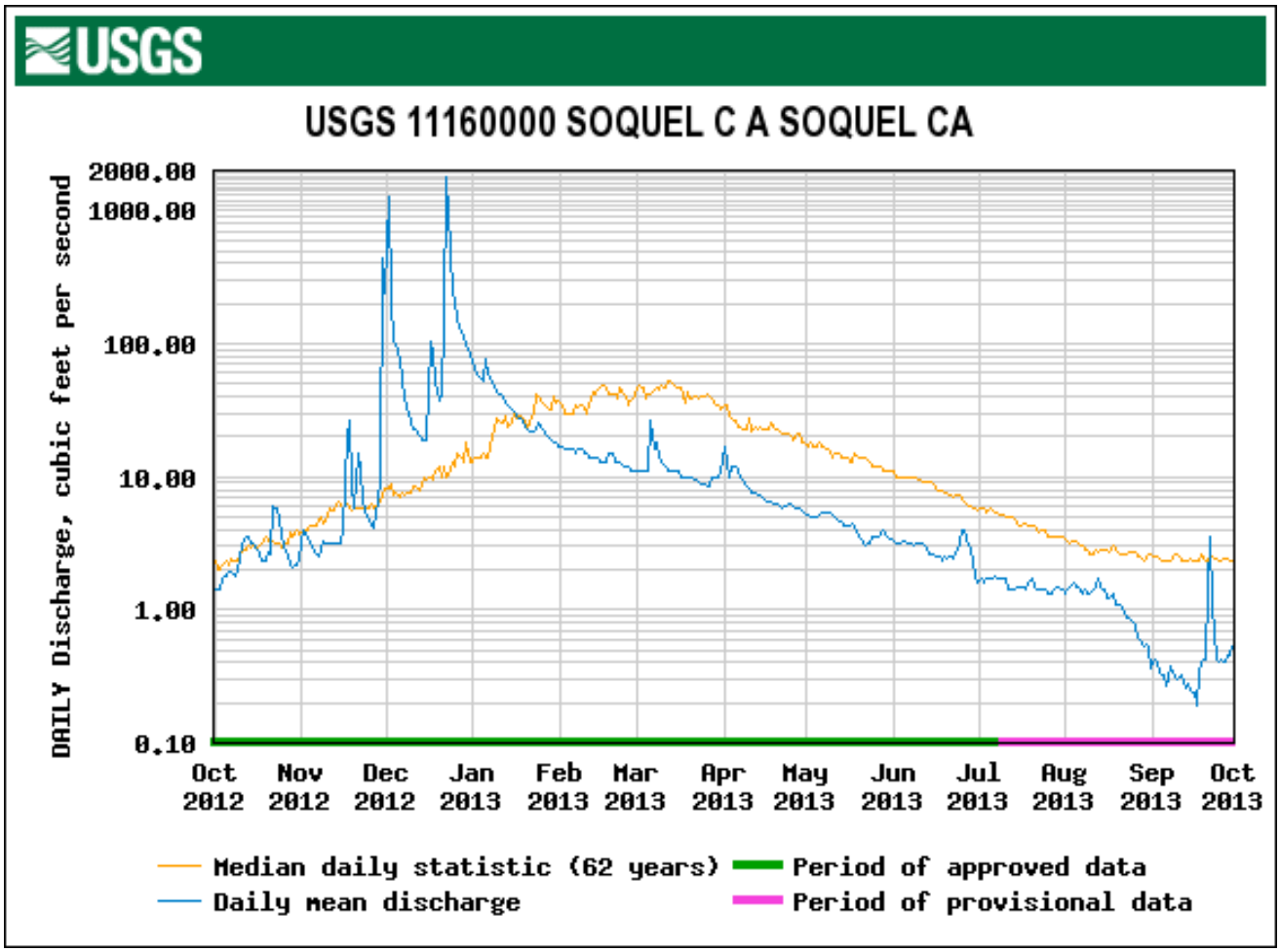

Figure 20. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

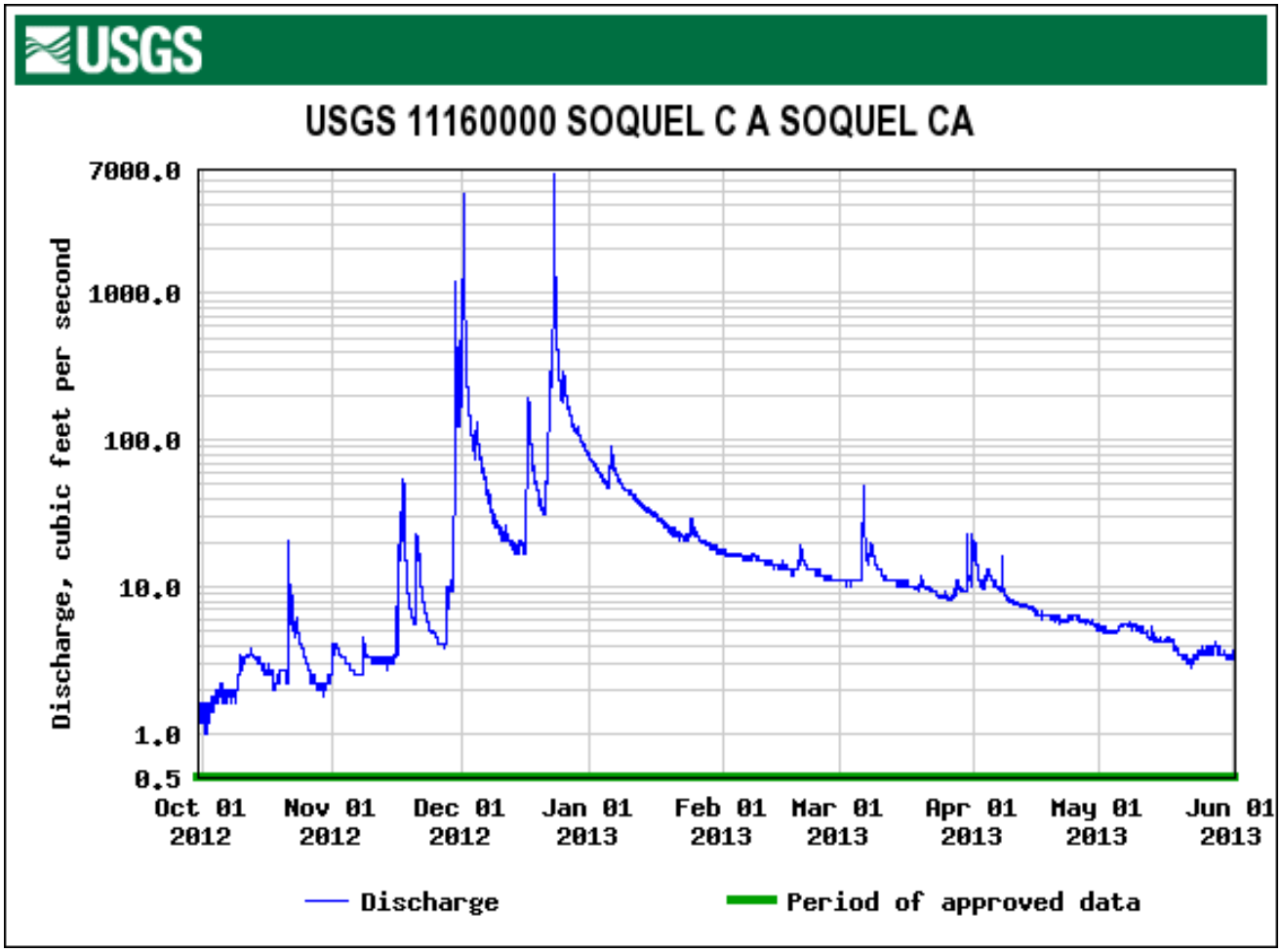

Figure 21. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

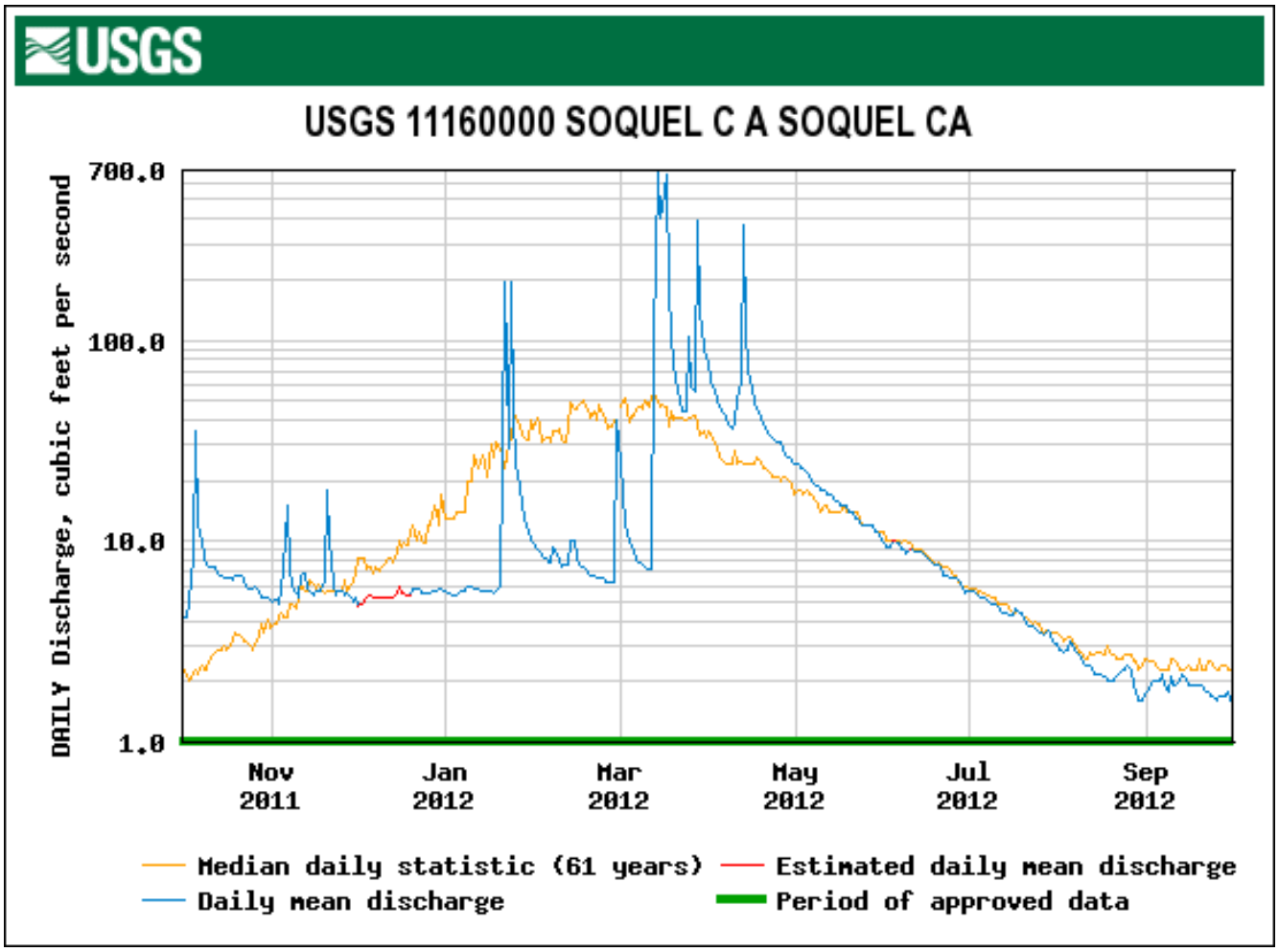

Figure 22. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

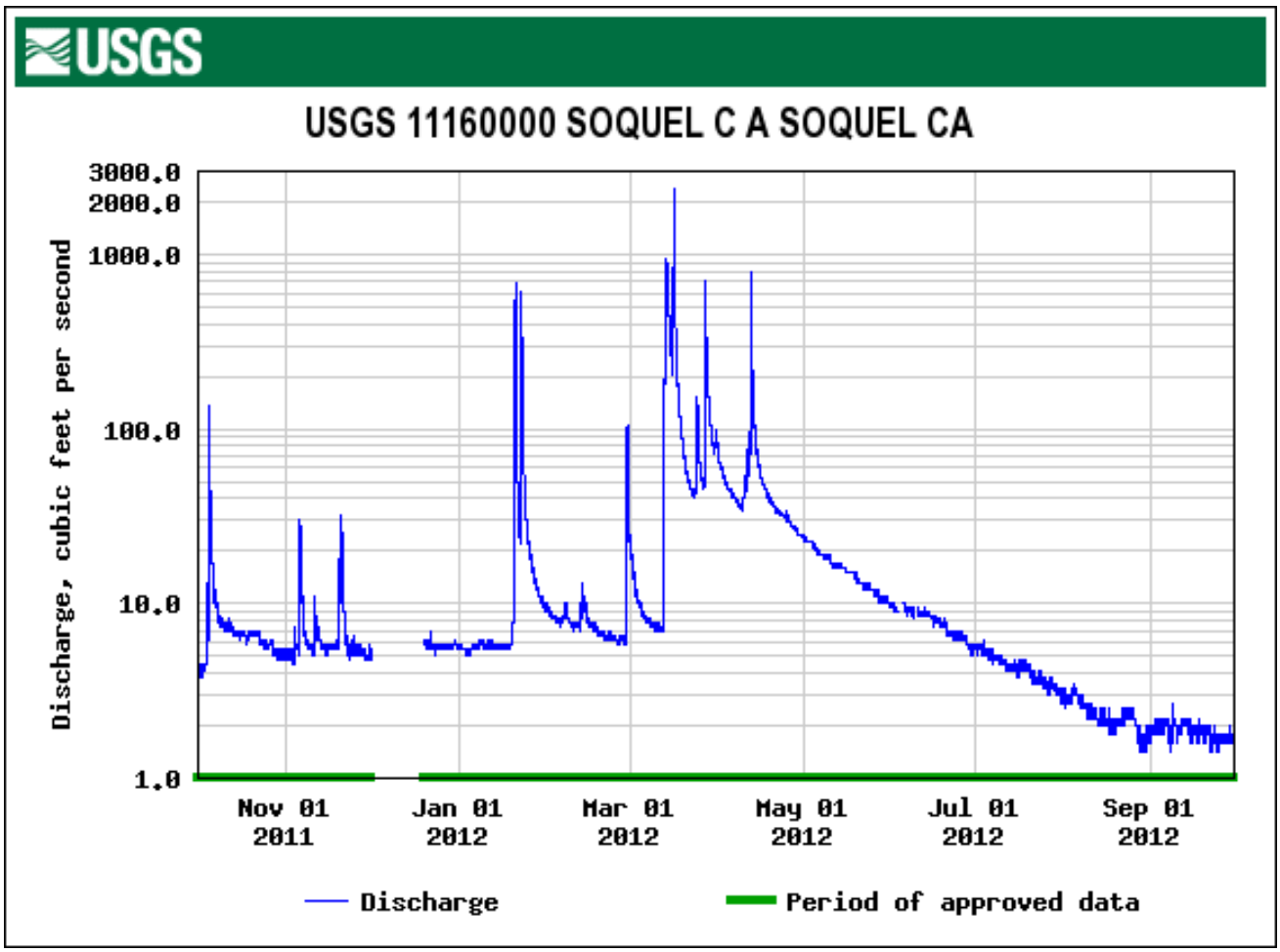

Figure 23. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

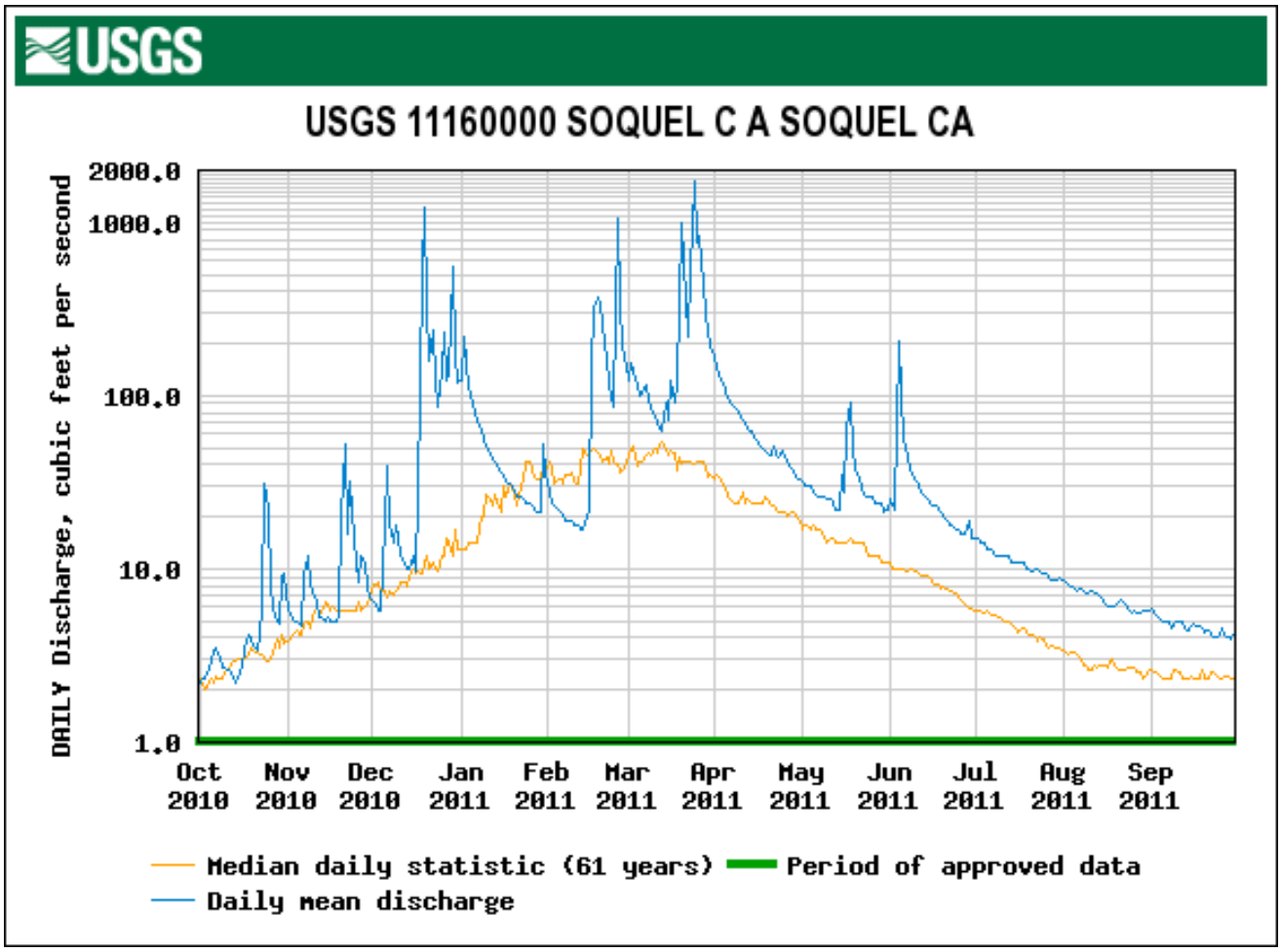

Figure 24. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

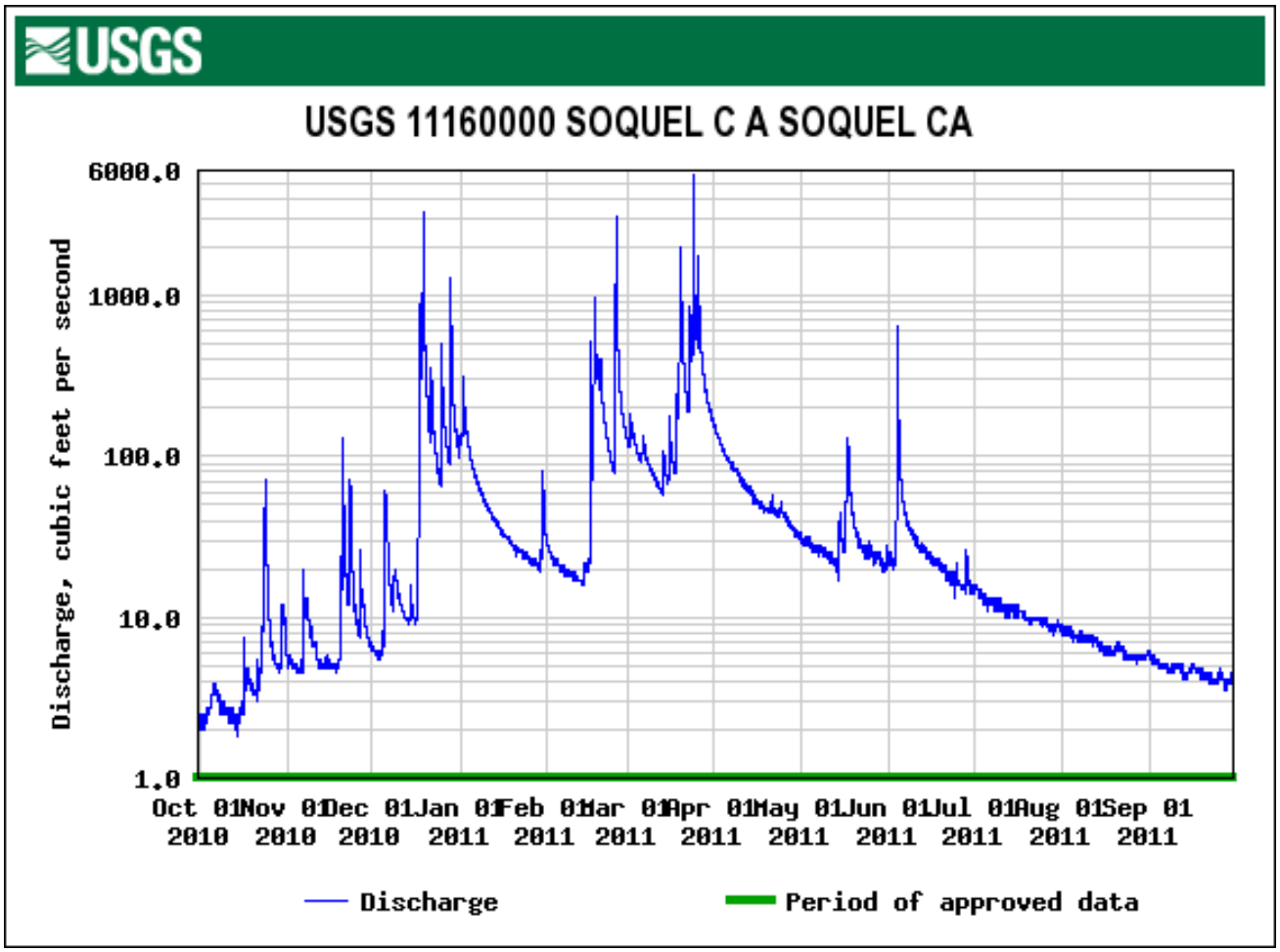

Figure 25. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

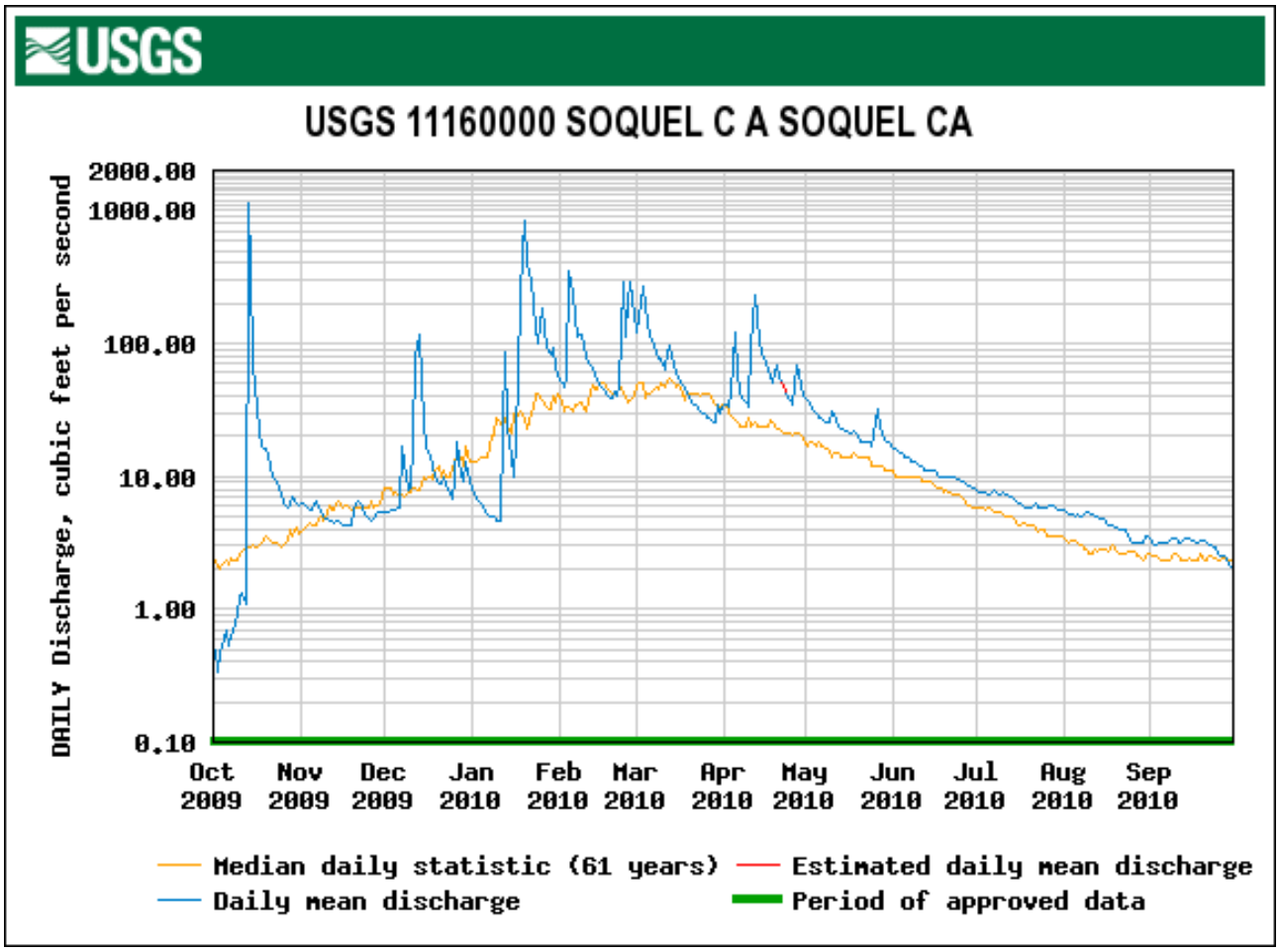

Figure 26. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

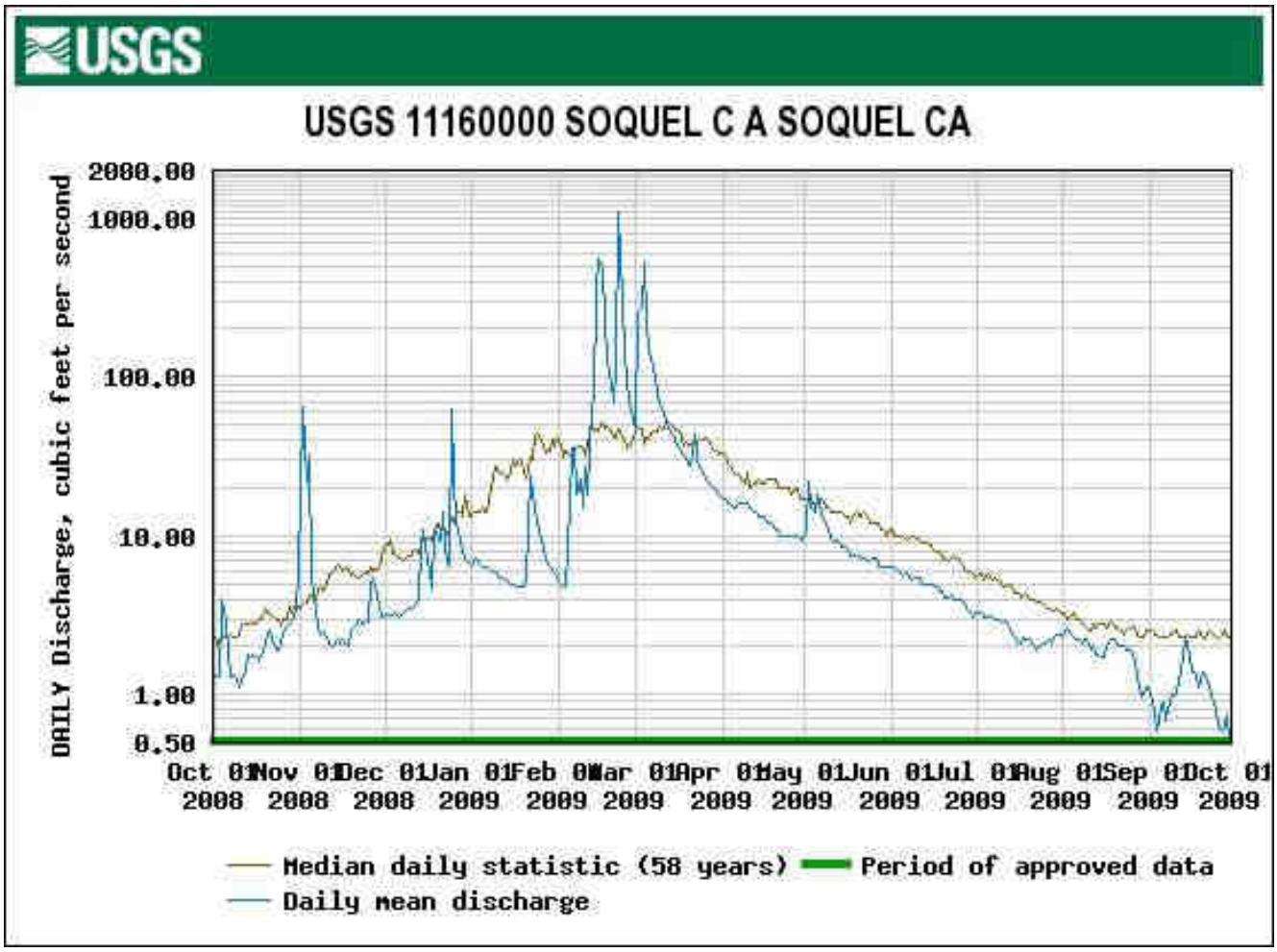

Figure 27. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

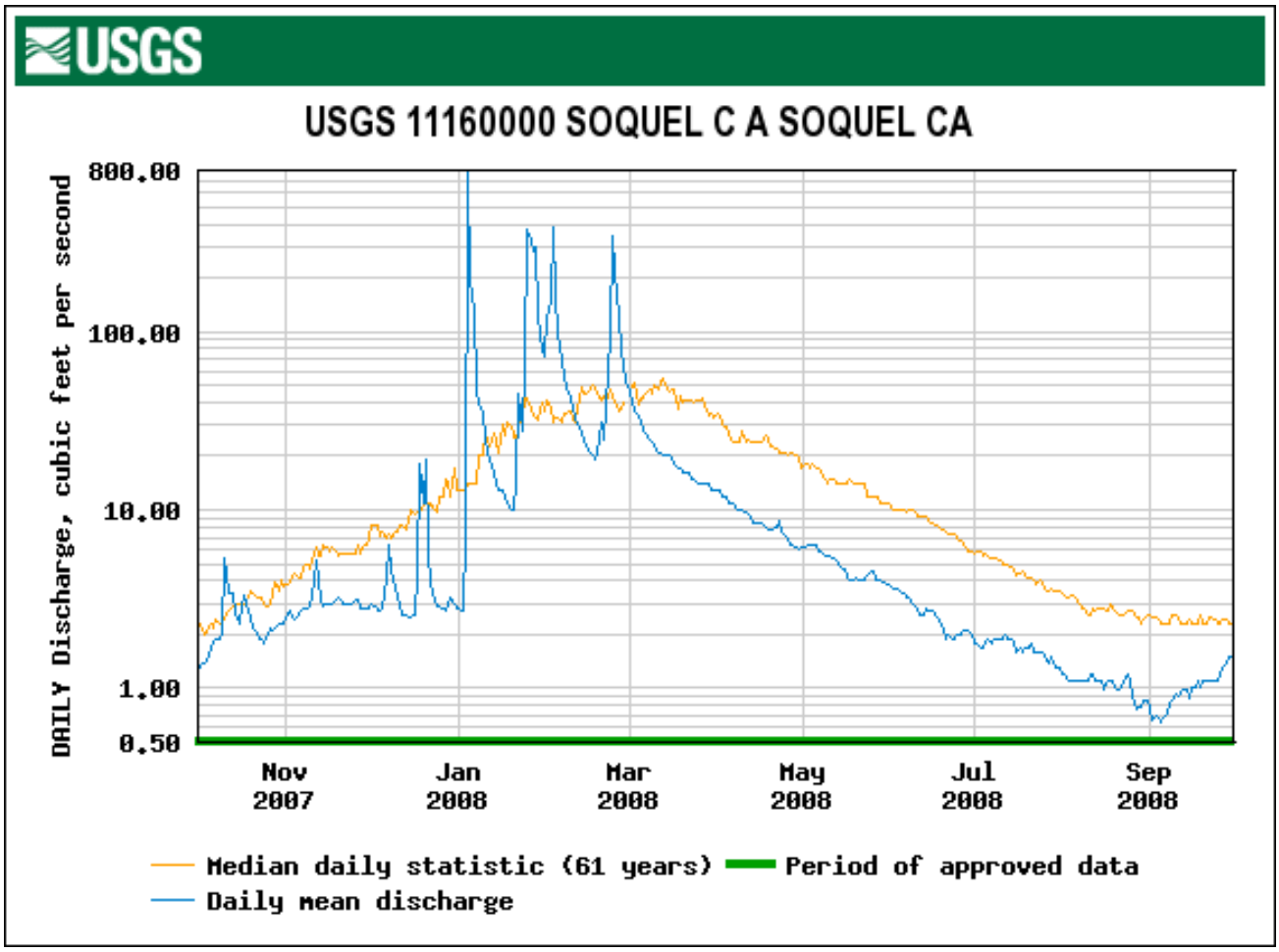

Figure 28. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.