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SOQUEL CREEK LAGOON MONITORING REPORT, 2006

Prepared by

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aquatic biology

Prepared for

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December 2006 **Project # 106-16**

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ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department with Matt Kotila, heavy equipment operator, in forming and maintaining the lagoon. We thank Mark Sessions and Ed Morrison for helping with seining the fish to relocate them during sandbar construction. Mark has been a positive force in preparing the flume and lagoon for the summer. We are glad that he decided to move back Santa Cruz County. Gary Quail's help in relocating and censusing the fish was greatly appreciated. We appreciate efforts of some of the Begonia Festival participants in avoiding wading in the lagoon during the procession. The Begonia Festival organizers, volunteers and students, under the supervision of Ed Garcia of the City Public Works staff, effectively removed flowers by boat after the Begonia Festival in September. We thank Nels and Susan Westman again for the loan of their boat for fish censusing in October. We appreciate Ed Morrison's daily attention to managing the flume inlet as streamflow lessens through the summer and in preparation for storm events. With a concerted effort, Ed Morrison, Matt Kotila and Ed Garcia were successful in maintaining the sandbar until December 2006.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. Some are Friends of Soquel Creek and include local residents, students and innocent bystanders who happen along. We had considerable public interest in the fish seining on 30 September during the first annual Capitola Water Festival. We thank Barbara Graves, among others, for the Festival and hope that it will become an annual affair. City Council members Bruce Arthur and Mayor Dennis Norton also joined the fish seining in 2006. Volunteers are very welcome to help on normally the first two Sunday mornings in October. Seining usually ends by 1:00 pm, in time for other afternoon activities.

REPORT SUMMARY

Sandbar Construction and Breaching. In 2006, sandbar closure was delayed until mid-June due to high streamflow. Sandbar construction began on 12 June. Three artificial breaches were required. The Creek flowed laterally across the beach at approximately 22 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been partially cleared of sand the previous week. The channel was blocked off to allow rescue of fish. Fourteen seine hauls were made in the lateral channel with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. The overflow from the lagoon ran through a narrow channel cut alongside the flume. Fish captured included 2 yearling or older staghorn sculpins (*Leptocottus armatus*), 3 yearling or older prickly sculpins (*Cottus asper*) and approximately 230 mostly large threespine sticklebacks (*Gasterosteus aculeatus*). Only 3 young-of-the-year sticklebacks were captured, and approximately 80% of the adults were female. No steelhead (*Oncorhynchus mykiss*) or tidewater goby (*Eucyclogobius newberryi*) were detected. Fish were relocated to the main estuary/lagoon. The sandbar was fully constructed and closed for the summer on 14 June.

On Saturday, 9 December 2006, a facilitated breach of the sandbar as required to prevent flooding. The stream flowed through the pre-cut notch due to lagoon filling during the third stormflow event of the winter season (**Figure 19**). The flume was moving water at full capacity at the time of the breach. Stormflow reached approximately 110 cubic feet per second at the USGS gage in Soquel Village overnight after the late afternoon breach (**Figure 20**). The sandbar remained open on 10 December with an approximately 50-foot opening through the sandbar. The mouth of the San Lorenzo River was also open on 10 December. Rain continued into the next week with stormflow on 12 December reaching approximately 36 cfs.

Stream Inflow to the Lagoon. Habitat conditions in the 2006 lagoon followed a winter with numerous storm events, with the highest baseflow since the El Niño winter of 1997-98 (**Table 10; Figures 17 and 18**). Stream inflow on 1 June 2006 was second highest in the last 16 years and third highest on 1 October. The streamflow at the Soquel Village gage on 8 October 2006 was approximately 5.4 cfs. Streamflow just above the lagoon was measured at 2.93 cfs on 8 October 2005 at Nob Hill. The 2006 lagoon was shallower than in 2005 with the seepage under the flume and lower gage heights in 2006, and stream inflow temperatures were warmer in 2006 because of warmer afternoon air temperatures. The lagoon bottom at the thalweg under Stockton Avenue Bridge was approximately 0.35 feet higher in 2006 than 2005, indicating aggradation there. The lagoon bottom at the multiple temperature probe site upstream of the railroad trestle was at approximately the same elevation in both years. However, inflow was greater in 2006 than 2005.

Water Temperature. Lagoon water temperatures (**Figures 4a- 4l**) closely mirrored temperatures in the stream inflow (**Figures 5a-5b**) in 2006, as in the past. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2006 (**Figures 4a-4b, 5a-5b; Alley 2005**). In 2006, daily temperature *maxima* in the stream were similar to that near the lagoon bottom (**Figures 4a-4b, 5a-5b**). Daily temperature *maxima* near

the bottom were warmer in the lagoon than the stream in 1999 and 2001-2004, but were cooler in 2000 and 2005 (**Alley 2005**). Daily stream temperature fluctuated more than daily lagoon temperature.

The 2006 lagoon was shallower than in 2005 with the lower gage heights in 2006. Stream inflow temperatures were warmer in 2006 because of warmer afternoon air temperatures than in 2005 (**Table 4**). However, inflow was even greater in 2006 than 2005. Despite the shallower lagoon and warmer inflow in 2006, with the higher summer inflows in 2006, the early morning and afternoon water temperatures near the bottom at the 4 lagoon stations were generally similar to or cooler than in 2005 except in late July and mid-August (**Figures 3a-3d**). However, at the deeper, continuous temperature monitoring station upstream of the trestle, the shallower 2006 lagoon had generally warmer water temperatures near the bottom than in 2005 (**Figures 4a and 4m**). Daily maxima near the bottom at this deep location were greater in 2006 than 2005 for the latter half of June, the latter half of July, mid-August and most of September.

In 2006, the daily maximum water temperature near the lagoon surface ranged from **15.6°C** (60.1°F) on 29 September - 1 October to **22.9°C** (73.2ºF) on 23 and 25 July (**Figures 4k and 4l**). Near the lagoon bottom, maximum daily water temperature ranged between **15.2°C** (59.4°F) on 1 October and **22.5°C** (72.5°F) on 12 July (**Figures 4a and 4b**).

There was no thermocline in 2006, with complete mixing of the water column each night. Days when lagoon water temperatures exceeded 22ºC (71.6ºF) near the bottom would likely be stressful for juvenile steelhead. In 2006, this occurred on 4days (22-25 July) during the warmest and longest air temperature period of the summer, when maximum air temperature reached 93.5ºF along the San Lorenzo River in Brookdale on 25 July. The 2006 lagoon met the steelhead management goal of early morning minimum temperature less than 20°C near the bottom **(Figure 4a**). The coho management goal of keeping maximum water temperatures below 20ºC (68ºF) in the presence of steelhead was not met 17% of the days measured (19 of 112 days - 19 June- 8 October). However, coho prefer to have temperatures below 16°C (depending on food abundance) (**J. Smith pers. communication**), and the lagoon temperature near the bottom cooled to 16°C in the morning on only 6 days from mid-June to mid-September.

Aquatic Vegetation. Filamentous algae was first noted during monitoring on 30 June 2006 during our second two-week monitoring, 16 days after sandbar closure (**Table 9**); compared to 1 July 2005, 3.0 weeks after sandbar closure in 2005 (**Table 10**). Pondweed was possibly observed on 12 August 2006 in Reach 2, 8 weeks after sandbar closure. However, the identification was uncertain. It was not positively identified after that. Pondweed propagates best on sandy substrate. The lagoon bottom has become progressively coarser each year with more cobbles, thus discouraging pondweed.

In 2006, surface algae was first observed in all reaches on 28 July after a warm month and 5 weeks after sandbar closure (**Table 9**). Surface algae in 2006 varied between 0 and 5% coverage, with the most being present in Reach 3 and near Noble Gulch. By contrast, surface algae in 2005 varied between 0 and 20% coverage of Reach 3, and coverage reached 60% at the mouth of

Noble Gulch. The appearance of surface algae coincided with a period of considerable gray water input from Noble Gulch that presumably contributed nutrients to stimulate plant growth.

Algal mat coverage of the lagoon bottom increased rapidly to 70-80% by mid-July 2006 and varied between 50 and 100% until late October (**Table 9**). Average algal thickness increased to a maximum on 12 August in Reaches 2 and 3 and on 25 August in Reach 1. On these dates, the maximum average algal thickness was estimated at 1.5 feet in Reach 1 (2 ft at most), 3 feet in Reach 2 (4 ft at most), 2 feet in Reach 3 (3 feet at most) and 2 feet at the mouth of Noble Gulch (reaching 3.5 ft at most). Algal abundance did not become thicker in September, as was the case in 2005. The overall average algal thickness and algal coverage of the lagoon bottom for monitorings in July- September were greater in 2005 than 2006 (**Tables 9 and 10**).

Oxygen Levels. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. In 2006, oxygen levels for steelhead were either "fair" or "good" *near the bottom at dawn* at all stations during monitorings (**Table 3, Figure 6a; Appendix A**). Therefore, oxygen concentration stayed above 5 mg/l at all stations throughout the summer at dawn within 0.25 m of the bottom. The percent of early morning monitorings when oxygen concentrations were above 7 mg/l at Stations 1-4 were 86%, 53%, 71% and 64%, respectively (**Figure 6a**). Unlike in 2003-2005, the lowest morning oxygen concentrations near the bottom were often not least near Noble Gulch (Station 4) except in September (**Figure 6e; Appendix A**).

In 2006, oxygen concentrations near the bottom at dawn were lower than in 2005 the majority of the time (**Figures 6a-6J and Appendix A**). Therefore, despite more algae production in 2005 than 2006 and presumably higher plant respiration and oxygen consumption at night in 2005, early morning oxygen levels were higher in 2005. Apparently, more oxygen produced during the day at algal densities in 2005 compensated for more respiration loss of oxygen at night.

On all monitoring days at 2-week intervals, the oxygen concentration was higher in the afternoon than in the morning at all stations, despite higher water temperature, and even on cloudy days (**Figures 6b-6e**). In the afternoon on 8 of 9 monitorings July through October, oxygen concentration increased down the water column at each station except at the very bottom, presumably because oxygen production was highest near the algae, which was growing in the lower water column (**Appendix A**). An exception was 5 October when it was cloudy, windy and slightly turbid after the first fall storm. By November, algae abundance is too low to have the water column effect.

Begonia Festival Observations and Water Quality Findings. The lagoon depth was maintained at a good gage height of 2.25 ft. There were 10 floats in the nautical parade. Unlike in 2005 when none of the floats were propelled by wading, in 2006 there were 4 floats propelled by waders. There were 13 waders in the lagoon, and they disturbed the bottom more than usual. Secchi depth was to the bottom before and after the Begonia Festival. Conductivity increased slightly at Stockton Avenue Bridge from 614 before to 624 umhos after the nautical parade. At the trestle it increased from 608 before to 620 umhos after the nautical parade. This was little

change and not stressful for steelhead. Oxygen concentrations were in the "good" range after the nautical parade. There was no odor of hydrogen sulfide, and no fish mortality was observed.

Fall Steelhead Sampling. Our steelhead population estimate based on mark and recapture for fall 2006 was 992 juveniles +/- 125 compared to 1,454 juveniles +/- 347 in 2005 (**Table 12, Figure 16**) (methods in **Ricker 1971**). This indicated a smaller juvenile population in 2006, but it was sixth highest in 14 years of estimates. It was below the 14-year average of 1,160. We would expect fewer juveniles to use the lagoon in 2006 than 2005 because there were higher adult passage flows late in the spawning season in 2006, encouraging less spawning in the lower creek to seed the lagoon with young-of-the-year steelhead. The only other species captured in Fall 2006 was threespine sticklebacks.

It was concluded from juvenile size distributions that steelhead grew faster in the 2006 summer lagoon than in 2005, consistent with less competition from a smaller juvenile population in 2006. It was the fastest growth rate in the last 9 years. Growth was greater in 2006 despite the delayed lagoon formation that occurred on 14 June 2006 compared to 9 June 2005.

Pollution Sources. The lagoon near the beach was closed to human contact due to bacterial levels above the maximum acceptable level. The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. The use of gull sweeps has been observed to be successful in other locales to prevent gull roosting. All of the refuse cans on the beach were equipped with gull-proof lids in 2006 (**Ed Morrison, pers. comm.**). Refuse containers with gull-proof lids may reduce gull numbers. The City has received funding to deter gull use on restaurant roofs, to redirect restaurant gutter systems away from the lagoon and to provide waste cans with gull-proof lids. Parallel wires were strung over the Paradise Grill Restaurant in 2006, which deterred gull roosting. Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original Management Plan, the trestle could be screened to eliminate roosting areas.

Regarding pollution from urban runoff, 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. The City has obtained grant money to install silt and grease traps on 4 storm drains that empty into the lagoon.

Ideally, all storm drains leading to the lagoon would be re-directed away from the lagoon in summer, including the culvert draining Noble Gulch. Considerable gray water was observed entering the lagoon from Noble Gulch in September, and this pollution coincided with increased algae in the lagoon. As of 2006, summer wash water that collects in the storm drain on the Esplanade is now pumped to the sewer system with a manually operated pump. The City is currently seeking more grant funding to improve the drainage system, repairing broken pipes and

redirecting summer flow where feasible. By minimizing stream inflow from Noble Gulch, there would be reduced nutrients and bacteria entering the lagoon and reduced algal production. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if summer runoff was re-directed into the sewer. It is our understanding that grant money has been obtained to put grease and silt traps on several of these storm drains.

There has been a pollution problem and high flashiness in streamflow in the past after the first small storms of the fall. At times, the lagoon required breaching prematurely because the flume could not accept all of the stormflow, and flooding was imminent. Retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the sources of this problem.

Continuing and New Recommendations and Those Not Yet Implemented

1. 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. (New)

2. Install an automatic switch on the pump in the Esplanade storm drain to better transfer water to the sewer during the dry season. (New)

3. Do not allow wading to propel floats during the Begonia Festival's nautical parade. (New)

4. If the sandbar is in place after November 15, maintain an opening in the flume inlet to allow early spawning adults to pass through the flume from the bay during early storms. (New)

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

6. Look into installing gull sweeps on restaurant roofs. The stringing of wire above roofs as observed over the Paradise Grill Restaurant should continue and be expanded to other restaurants to successfully prevent gull roosting there.

7. Look into screening the railroad trestle to discourage roosting and nesting by rock doves.

8. Repair the cracked flume. Its integrity is jeopardized, and the beach sinkholes created by flume underflow are a safety hazard.

9. As stated in previous reports, if the streamflow in Soquel Creek in the vicinity of Soquel

Village approaches the point of losing surface flow, notify Tiedemann Nursery and the Fish and Game Department so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

10. If participants are allowed to continue wading, recommend that the organizers set a limit of 3 waders per float. Allow passage of these floats in one direction only, presumably downstream, and then to the dismantling location near the Stockton Avenue Bridge.

11. If wading during the Begonia Festival is allowed, continue to perform more detailed water quality monitoring before and after the Begonia Festival to determine the effects of wading. Continue to measure hydrogen sulfide levels.

12. Continue to retain large woody material in the lagoon for fish cover.

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

14. In anticipation of a sandbar breach in the fall, the notch in the sandbar should be cut slightly lower than the piling bolt. *Continue to make the notch a 20-30 foot wide swath across the beach to maximize the possibility of maintaining an estuary with some depth after the breach.* Continue to place secondary berms near the flume exit and entrance to prevent tidal overwash through this swath. 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.

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

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

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

18. The City should continue to fund activities to permanently remove Arundo from lagoon-side residences and other non-native plants in the riparian corridor between Highway 1 and the lagoon.

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

LAGOON AND ESTUARY FORMATION

Results of Fish Seining Prior to Construction Activities

12 June 2006. The Creek flowed laterally across the beach at approximately 22 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been partially cleared of sand the previous week. The channel was blocked off to allow rescue of fish. Fourteen seine hauls were made in the lateral channel with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. Mark Sessions and Ed Morrison of the Capitola Public Works Department assisted Don Alley in the fish relocation, along with volunteer Gary Quail. The overflow from the lagoon ran through a narrow channel cut alongside the flume. Fish captured included 2 yearling or older staghorn sculpins (*Leptocottus armatus*) 3 yearling or older prickly sculpins (*Cottus asper*) and approximately 230 mostly large threespine sticklebacks (*Gasterosteus aculeatus*). Only 3 young-of-the-year sticklebacks were captured, and approximately 80% of the adults were female. No steelhead (*Oncorhynchus mykiss*) or tidewater goby (*Eucyclogobius newberryi*) were detected. Rescued fish were relocated near the Stockton Avenue Bridge in the main lagoon/ estuary. The fish rescue was completed by 1030 hr.

As required in the permit, a fisheries biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our sixteenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 15 years are available at the City (**Alley 1991-2005**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**) and 2004 Soquel Creek Lagoon Management and Enhancement Plan Update (**Alley et al. 2004**), all instream removal of kelp, sea grass and other organic debris was to be accomplished without the use of heavy equipment in the stream channel except within 25 feet of the flume. The bulldozer/tractor could traverse the area adjacent to the flume.

Monitoring of Flume Maintenance and Sandbar Construction

Sandbar construction was delayed this year due to high spring streamflow. Streamflow was measured just above the estuary on 18 May 2006 (37.8 cubic feet per second (cfs)) to compare with the USGS stream gage estimates in Soquel Village (39 cfs). The USGS gage estimate was 1.2 cfs higher than the actual measurement above the estuary. By 12 June 2006, the gage estimate was about 23 cfs, which was judged sufficiently low to be passed through the flume.

12 June 2006. Sandbar construction began this day. Soquel Creek was flowing out to the Monterey Bay in a channel that went laterally across the beach to the jetty. As in most years past, the stream channel flowed laterally along the sea wall east to the jetty. The flume had been mostly cleared of sand the previous week by Public Works staff. A narrow channel was cut through the beach adjacent to the flume to bypass flow after the lateral channel was blocked off for fish rescue. The sand from the auxiliary channel was used to block off the lateral channel.

The lateral channel was blocked off from the estuary at 0720 hr, and the fish were rescued from it before the channel was covered over with sand. Fish were relocated to the main estuary/lagoon. The metal protective sheeting was removed from the ceiling grate on the top of the flume. Flume boards on both sides of the flume inlet were removed beginning at 1120 hr, with the openings fully screened by 1430 hr. The lowermost boards on the eastern restaurant side of the flume inlet were left in place to maintain an underwater, 8-inch x 8-inch adult steelhead passage portal. All but one board had been removed from the flume outlet earlier. The auxiliary channel was blocked off at 1210 hr, and the lagoon began to fill. Matt Kotila, the tractor operator, also constructed a sand berm across the outlet of the lateral channel to prevent water and fish from entering the lateral channel from the surf. The estuary had only partially drained on this day, and the full width of the estuary had remained inundated. The biologist had walked the path up to Noble Gulch to confirm this. The baffle remained inside the flume and was functional. By the end of the day, the lateral channel was covered over with sand down to the jetty. All tractor work was performed above the tidal action and water contact was avoided.

13 June 2006. The sandbar was opened at 0600 hr adjacent to the flume. The lagoon had filled to within 3-4 inches of the top of the flume overnight. The high tide the previous night had been 6.2 feet with no tidal overwash into the lagoon. A cormorant was fishing in the lagoon at 0630 hr and captured a fish. The biologist surveyed upstream at 0830 hr to look for stranded fish in side channel areas. Only 1 juvenile steelhead and one prickly sculpin were observed in a side channel that potentially could become isolated. They could not be captured with a dip net. The estuary was stream-like with considerable cobble 3-5 inches in diameter on the hard streambed. A riffle existed near the trestle. A mid-channel bar existed between the Stockton Avenue Bridge and the railroad trestle. The downed cottonwood remained across from Noble Gulch. Two large redwood stumps were situated in the lagoon, downstream of Noble Gulch. The large Douglas fir stump that had existed further upstream the previous year was gone. The estuary bottom downstream of the Stockton Avenue Bridge consisted of very soft sand in places, indicating recent sedimentation. The thalweg was on the west side with a deep hole and exposed boulders near the Venetian Court wall. Six Public Works staff and the biologist raked kelp and seagrass out of the lower estuary until the sandbar was closed for the day. Another City staff inspected the plumbing under the restaurants for leaks.

The biologist re-surveyed the estuary channel at 1000 hr. That pool where the steelhead and prickly sculpin were previously observed had become isolated and reduced in size. The steelhead was not observed, and 2 sculpins were rescued from this isolated pool. A large isolated pool had formed near the Shadowbrook restaurant that was a maximum of 0.8 feet deep with considerable shade and cover from overhanging willows. Only very small fish were observed there, those possibly being juvenile stickleback or juvenile Sacramento suckers (*Catostomus occidentalis*). This pool was in no danger of drying up and was good habitat. The biologist walked back to the beach, intent on instructing the tractor operator to close the sandbar. A large prickly sculpin that lay along the margin of the main channel was rescued along the way. However, before the biologist reached the beach, the sandbar had already been closed off by Matt Kotila to prevent saltwater incursion and to allow the lagoon to refill at approximately 1030 hr.

14 June 2006. The sandbar was re-opened at 0600 hr. The lagoon had filled to within 4 inches of the top of the flume overnight. Raking began by 2 City staff and the biologist by 0700 hr, with the other 4 City staff joining the work at 0730 hr. The biologist walked upstream to look for stranded fish at 0730 hr. No steelhead were observed. One YOY stickleback and one adult stickleback were relocated from side pools to the main channel. The biologist re-surveyed upstream at 0840 hr. One large stickleback was rescued. No steelhead were observed. A mother merganser and approximately 7 chicks were observed, as well as a great blue heron and a greenback heron. The raking continued in earnest until approximately 1000 hr, at which time preparation of the pad around the flume inlet began. Most of the seagrass was raked out of the lower estuary, downstream of Stockton Avenue Bridge this day. The Venetian side of the lagoon had been graded back to reduce the slope on the west side, and a large log had been moved back along the Venetian wall so as to prevent interference with fish sampling later in the fall. The sandbar was closed for the season between 1030 and 1100 hr.

A layer of filter fabric was laid down with a layer of visquine on top. The plastic sheeting was held in place with sandbags. Sandbags were laid around the flume inlet to prevent water leakage alongside the flume. The visquine was covered with sand. Full screens were placed in the flume inlet on both sides.

The deepest portion of the estuary was under and just downstream of the trestle, adjacent to the bedrock outcrop, as was the case in previous years. The streambed did not appear to have scoured more in this area or under the Stockton Avenue Bridge compared to the previous year. However, the area adjacent to the restaurants near the beach had filled in some, with the thalweg (deepest channel) further to the west than in past years.

15 June 2006. From this day onward until project completion, Ed Morrison, the city staff person in charge of field operations, monitored the beach preparation. Grading work was done along the Venetian Court area to maintain the sand level below the drains in the wall along the walkway. The area long the east side of the lagoon was shored up with another layer of sand. Low-lying areas along the beach were filled to prepare the beach for weekend visitors.

18 June 2006. The fishery biologist placed water temperature sensors in the lagoon and upstream as required by the Fish and Game permit. Water depth at the lagoon temperature monitoring station was approximately the same depth as in 2005. The lagoon gage height was 1.95 on this day. Water quality measurements off the Stockton Avenue Bridge at 1413 hr indicated no saline layer on the bottom of the lagoon. The lagoon was 1.85 meters deep in the thalweg (deepest location) under the bridge. Salinity was also measured in the deep hole adjacent to the Venetian Court wall. No saltwater layer was detected there either.

20 June 2006. Two boards were added to the Venetian Court side of the flume inlet to increase the lagoon water surface elevation. A half screen was placed in the remaining opening. The estimated flow was approximately 20 cfs, based on the USGS estimate in Soquel Village. This is expected to be the finishing day of beach preparation with the tractor work.

21 June 2006. Two boards were added to the restaurant side of the flume inlet to further increase the lagoon water surface elevation. A half screen was placed in the remaining opening.

In conclusion, during the entire sandbar construction and beach preparation, the City's tractor operator paid special attention to avoid working in the waters of the Monterey Bay by grading below the high tide line only after the tide had receded well below the work area.

Effect of Sandbar Construction on Tidewater Gobies in 2006

It was likely that if tidewater gobies were present, they used habitat upstream of the construction area, where there was less tidal fluctuation and salinity. No mortality of tidewater goby was observed during the construction activities. However, artificial water level fluctuations were created during sandbar construction activities. Only 2 sandbar breaches were required during sandbar preparation in 2006, with 3 breaches allowed by the permit without regulatory consultation. In 2006, there was less decomposing kelp and sea grass to remove presumably because of the higher streamflow and the shift to the west of the thalweg position from past years. The 2 breaches closely mimicked normal tidal fluctuations of an estuary. With each lowering of the water in the estuary, tidewater gobies would have to retreat to deeper water as water surface receded in the upper estuary. There were likely few, if any tidewater gobies left in Soquel Creek after the past torrential stormflows of the 1997-98 winter and then again this past winter of 2005-2006. No tidewater gobies were detected during the fall 2005 lagoon sampling. The channel lacked sheltered backwaters for fish to escape high water velocity during high stormflows. However, tidewater gobies have been detected recently in Moran Lake and Aptos Lagoon after years of no detection, and they may repopulate Soquel Lagoon in the future from adjacent populations.

Effect of Sandbar Construction on Steelhead in 2006

No negative impacts to the steelhead population were detected in 2006. Access through the flume was maintained throughout the sandbar construction period. Water quality was diminished in the rake zone during the kelp and sea grass removal. However, shaded habitat under the bridge was not disturbed. In 2006, the only juvenile steelhead observed in the main estuary during sandbar construction was a young-of-the-year (YOY) steelhead observed in a side channel pool upstream of the Shadowbrook Restaurant. When we walked the upper estuary during the 2 daily draw-downs (13-14 June), this was the only steelhead observed. The Creek was surveyed as far upstream as the downstream end of the Rispin parcel. NOAA Fisheries sampled the estuary prior to sandbar closure. However, the results are unavailable at this time.

The seasonal effect of removing organic material and constructing the sandbar is to create good summer rearing habitat for steelhead and tidewater goby. Compared to allowing natural lagoon formation, a lagoon is created with cooler, 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 and sandbar closure create better fish habitat for tidewater goby and steelhead than if the sandbar was allowed to close naturally.

Natural closure would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Under natural sandbar formation, much more saltwater would also be 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. Increased tidal overwash would further elevate water temperature, making the lagoon less hospitable for steelhead.

Recommendations for Lagoon Preparation and Sandbar Construction

1. Closing the sandbar in late May is better than mid-June or later because streamflow is sufficient to rapidly fill the lagoon in most years, and the juvenile steelhead most likely to be present in the lagoon 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 Don Alley and Stafford Lehr (now of CDFG) indicated that a few YOY steelhead were down-migrating in May, but the number greatly increased in June.

2. 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, sandbar construction may be delayed to 4-5 days before the Memorial Day weekend, still satisfying the tradition of lagoon formation by then.

3. Continue to rake as much kelp and sea grass out of the lagoon as possible before final closure, from the Stockton Avenue Bridge downstream, including plant material trapped under the restaurants and in depressions around the bridge piers. It is best to minimize time required to stockpile sand, rake out the decomposing organic material and prepare the flume inlet for fish passage. This will minimize the number of instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to be ready to enter the estuary at the earliest opportunity each day and quickly rake out decomposing kelp and to clear the sand-filled flume. The 2 days of artificial breaching required for sandbar construction in 2006 was 1 day less than is typical.

4. Dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the Fish and Game 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**).

5. To provide cover for juvenile fishes, continue to leave 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.

6. Annually evaluate the structural integrity of the flume and its supports. Repair cracks and supports as necessary. (A grant has been secured for flume repair.)

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

8. 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.

9. Search under the Stockton Avenue Bridge and in Reaches 2 and 3 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.

10. Maintain the underwater portal in the flume intake for out-migration of adult steelhead until June 15, while maintaining a notched top plank for out-migration of smolts until 1 July.

11. Maintain the 1-foot high baffle inside the flume until July 1 for safe entrance of out-migration of smolts into the flume inlet as they enter the Monterey Bay.

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

In 1990, a bolt was set into a wooden piling adjacent to the restaurants at the lagoon. The bolt's elevation was surveyed to coincide with the water surface elevation at which flooding was imminent. The bolt is 1.77 feet above the elevation of the top of the flume inlet. It allowed 1 foot of freeboard at the residence where flooding was identified as a problem. Since then, another low point has been located near the railroad trestle, which will have flooding problems approximately 0.5 feet above the bolt. Another bolt 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.

A tractor is used in the fall to cut a notch in the sandbar adjacent to the flume. 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 facilitates sandbar breaching. A tractor is used to re-cut the sandbar notch so that the 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.

Sandbar Breaching During the 2006-2007 Rainy Season.

9 December 2006. After raining overnight, streamflow had risen to approximately 65 cfs by approximately 0730 hr on this Saturday without the sandbar breaching. A board on either side of the flume inlet had been removed. Streamflow must have mostly entered the ceiling grate to flow through the flume. By 0830 hr, Morrison had removed more boards so that 3 boards were out on the Venetian Court side and 4 boards were out on the restaurant side of the flume inlet. Considerable sand had been lost from the ocean side of the beach by 0830 hr. According to Morrison, tidal overwash had occurred. The possibility of a breach from the ocean side was possible. High tide was to be around 1130 hr and was above 5.0 ft. The biologist arrived at the lagoon at 1500 hr. There was evidence of tidal overwash. The gage height was estimated at 3.40 ft. The lagoon level was above the flume and approximately 10 inches below the piling bolt. The lagoon was within approximately 15 inches of over-topping the bulkhead near the trestle. Water was passing through the flume. Morrison said the berm closest to the lagoon had been compromised by tidal overwash. Wave action had exposed 3 portals on the flume on the ocean side. The wind was blowing and rain was intermittent. A thick cloudbank was approaching from the west. Doppler radar indicated that these clouds were bringing heavy rain with a red color code, according to Jesberg by cell phone. Heavy rain was forecasted for Saturday night. Morrison decided at 1530 hr to use heavy equipment to cut a notch in the sandbar down to the level of the lagoon surface. A small stream channel developed across the beach, which was very flat. Constant rain developed by 1600 hr. The decision seemed prudent to the biologist with breaching appearing imminent within the next 2-3 hours to prevent flooding. Less sand would likely be lost from the beach if the notch were cut at 1530 hr instead of later with a higher lagoon and more head, thus possibly maintaining a deeper estuary after breaching and more fish habitat. The cutting the notch below the elevation of the lowest reference bolt was necessary because stormflows typically reach the beach in a pulse, raising the lagoon water level above the notch elevation quickly before the channel can widen through the beach and pass the stormflow. Therefore, the notch must be at a lower elevation than the reference bolt.

Streamflow at the Soquel gage was measured at 34 cfs at 1415 hr (**Figure 17**). Between 1415 hr and 1815 hr, the streamflow declined to 30 cfs. However, by 1815 hr the flow had increased to 46 cfs at the gage. By 2000 hr, streamflow at the gage had reached 90 cfs. Undoubtedly, this stormflow volume would have overwhelmed the flume and caused flooding around the lagoon without a facilitated breach.

10 December 2006. By 0200 hr, streamflow reached a maximum of 110 cfs at the Soquel Gage before declining to 72 cfs at 0615 hr (**Figure 17**). Notching of the sandbar to the lagoon level may have been done slightly prematurely at 1530 hr. However, it prevented flooding that may have occurred 3-4 hours later if it had not been done. Breaching was inevitably necessary from this storm front. Another storm was forecasted for Sunday-Monday. The City had done a good job of passing 4 smaller stormflows through the flume during the fall season. Our goal has been

to maintain the sandbar until Thanksgiving, if possible, which was accomplished. Usually by Thanksgiving the winter storm pattern has begun to maintain sufficient streamflow to keep the sandbar open.

Recommendations Regarding Sandbar Breaching

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

2. The notch in the sandbar should be cut slightly lower than the piling bolt. *Make the notch at least 20-30 foot wide across the beach to 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.

3. Just as the first storm of the fall season begins, remove boards from each side of the flume if a small storm is anticipated. The number of boards removed will be dictated by the anticipated size of the storm. Remove two boards from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is eventually breached during later, larger storms usually occurring after Thanksgiving. There is now a grated opening on top of the flume inlet. After the stormflow subsides, replace the cover until the next storm.

4. After the first storm of the season with the sandbar still intact, lower the lagoon level to a point where light may penetrate to the lagoon bottom. In doing so, the plant life in the lagoon may continue to photosynthesize and is kept viable. Thus, vegetation mortality and stressfully low oxygen levels are prevented until the water clarity is re-established. Re-install boards to increase lagoon depth after the lagoon clears up.

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

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

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

WATER QUALITY MONITORING IN 2006

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. 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. Water temperatures above 22º C (72º F) (**Table 1**) and oxygen levels below 5 parts per million (mg/L) are thought to stress steelhead. However, steelhead have been found surviving in pools in the Carmel River at 1-2 mg/L for 1-2 hours at dawn. Based on 1988 monitoring, steelhead appear to survive in Soquel Lagoon at water temperatures of 23-25ºC for 1-2 hours toward the end of the day (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-5ºC during a sunny day from a minimum at dawn.

Oxygen levels critical to steelhead 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." 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, being 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.

Locations and Timing of Water Quality Monitoring

As required under the CDFG permit for 2006, 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. Station 1 was at the flume inlet (**Figure 1**). Station 2 was on the downstream side 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 in Soquel Creek near the Nob Hill shopping center, just upstream of where it entered the lagoon. The data at the stream location was used as a point of comparison with lagoon conditions of temperature and oxygen levels in early morning.

In 2006, 6 HOBO temperature loggers were launched on 18 June 2006 just upstream of the railroad trestle in Reach 3 at 1-foot intervals through the water column beginning at 0.5 feet above the bottom and ending 5.5 feet from the bottom, as required by the CDFG permit. This was a deeper portion of the lagoon. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. All 7 loggers were removed on 8 October 2006.

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. If it had, then the shrouds would be placed on the flume inlet to draw the heavier saltwater off the lagoon bottom to hasten the freshwater conversion in the lagoon. In 2006, the CDFG permit required that monitoring occur in the early morning and late afternoon. Prior to 2003, water quality had been measured in the early morning after dawn because the most limiting factor, oxygen concentration, is at a minimum at that time.

Table 1. Temperature Conversions From Degrees Celsius to Degrees Fahrenheit.

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

Table 2. Water Quality Criteria for Measurements Within 0.25 Meters Off the Bottom at Dawn and Gage Height Readings.

MORNING RATING	MORNING TEMPERATURE (Celsius)	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, a management goal for steelhead should be to maintain water temperature below 20ºC (68ºF) at dawn within 0.25 m of the bottom and the afternoon maximum below 22ºC (71.6ºF) near the bottom. This early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). This management goal is somewhat higher than the enhancement goal we established for Soquel Creek, where the goal was to maintain water temperature below 20ºC. Maximum daily water temperature in the lagoon should not reach 26.5ºC (79.5ºF). Although 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, our annual sampling of juvenile steelhead in Soquel Lagoon indicates that growth rate in the lagoon has been greater than in the upstream stream reaches (**Alley 2003**), with nearly all young-of-the-year juveniles in the lagoon reaching smolt size the first summer each year. This indicates that higher water temperature has not prevented relatively rapid growth of juveniles in the lagoon.

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). However, we do not believe that Soquel Creek Lagoon may be cooled sufficiently to support juvenile coho salmon.

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 remains above summer low-flow and juvenile salmonids are feeding and growing rapidly. From June1 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, should not rise above

21ºC (70ºF). 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. 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. According to Moyle (**2002**), regarding temperature optima, "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." 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 (**SYRTAC 2000**), further south of Soquel Creek. 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.

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 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. We do not believe that the mainstem Reaches 1-6, downstream of the Moores Gulch confluence can become sufficiently shaded to reach this goal.

Results of Water Quality Monitoring of the Lagoon After Sandbar Closure

Lagoon Level. **Appendix A** provides detailed data on water quality. **Table 3** rates habitat conditions. **The lagoon level was monitored 14 times in 1 to 2-week intervals from 18 June to 6 December 2006, including September 3, the day of the Begonia Festival.** For 2006, the measurements of lagoon level as measured on the staff gage were rated "good" (**Table 2**) on 4 occasions, "fair" on 5 occasions and "poor" on 4 occasions (**Table 3; Figure 2a**). The fair ratings occurred during June and July. The lagoon level dropped into the poor range in August, prior to the Begonia Festival when streamflow was still high and adjustments were being made with flashboards to accommodate the high, but declining, outflow. Boards were added prior to the Begonia Festival to bring the lagoon level into the good range, which continued through early October. Then a series of small stormflows occurred (**Figure 19**). Lagoon level was dropped in anticipation of the storms and water depth was drawn down after the 26 November storm to maintain light penetration to the bottom. In the cases of these poor lagoon level ratings, flashboards had been removed in anticipation of storms and maintenance of good water quality after these storms. This could not be avoided. For example, on Sunday, November 26, in the morning 4 boards were removed on the Beach House Restaurant side and 3 boards out on Venetian side. Then more boards were removed on the Beach House side and all but 1 board on the Venetian side. At 1800 hr, Garcia of Public Works was called out and the lagoon level was 1 inch over the top of the flume. By 2000 hr, Morrison went to the lagoon and the water level was 8-10 inches above the top of the flume. After 45 minutes, the lagoon level declined and had peaked. The Soquel gage indicated that stormflow had reached 30 cfs for a short time that day (**Figure 19**). By Monday, the flow had receded to the 8-10 cfs. During this storm, any adults intent on entering the lagoon would have easy passage.

Seepage of water through the sandbar under the flume in 2006 increased the difficulty of maintaining a high lagoon level. A concern was that as the lagoon level increased, the hydraulic pressure through the sandbar would be increased, thus increasing the seepage rate. Sand was progressively washed through the sandbar from near the flume inlet, with additional visquine and sandbags placed there to reduce the sand lost. On 14 July, 2x12-inch boards were buried in the beach, under and perpendicular to the flume near the flume exit to inhibit sand migration to the bay from under the flume during lagoon seepage. It worked somewhat. However, sinkholes continued to develop in the beach above the flume once a series of especially low tides occurred. On 19 July, the flume was exposed midway through the sandbar. 2x12-inch boards were nailed parallel and below the flume on either side. Straw bales were inserted next to the boards to encourage the seepage to stay beneath the flume. No work was done in the lagoon.

Maintenance of lagoon gage height declined in 2006 compared to the 2 previous years (**Figure 2**). With no saltwater trapped in the lagoon in 2006, the shrouds were not needed. There was no tidal overwash. Presence of the grated hole in the top of the flume for the 4th year allowed for more secured flashboards than previously.

No vandalism of the flume inlet was detected in 2006. The plywood protected against both back-

pressure and vandalism. Wedges were used to secure the top boards, as well. A better method is still needed to secure the flashboards against vandalism on the one hand, while allowing convenient adjustment or removal of boards by City staff when necessary. While the wedges discourage all but the most determined vandals, they do not allow easy removal of boards when surface algae and debris near the flume needs to be drained out or when sandbar breaching is to be prevented by increasing the volume through the flume. The grated hole in the top of the flume alleviates the need for rapid board removal and replacement during small stormflows.

Flume Passability. According to the Management Plans (**1990; 2004**), fish passage is to be maintained until July 1. A flume depth of 12 inches or deeper was desired at the entrance until that time. The flume was cleared of sand prior to sandbar construction in 2006. Thus, steelhead smolt passage was insured during and after sandbar construction. Sufficient baseflow in 2006 resulted in excellent passage for steelhead smolts throughout the lagoon's existence in 2005 (**Table 3**). The baffle near the flume inlet remained from 2005. The 8x8-inch adult portal was installed in the flume inlet at the time of sandbar construction for adult emigration out of the lagoon. This portal remained until just prior to the Begonia Festival, at which time plywood was nailed to the flashboards to bring the lagoon level up.

On Wednesday, 29 November, notched boards were installed as top boards in the flume inlet, providing 5.5 inches of vertical height and 8 inches horizontal width for adult passage through the flume. On 6 December, a 6.5-inch gap was provided at the top of the flashboards on the Venetian Court side of the flume inlet. No screens were in place. This was deemed adequate for adult passage, assuming that early immigrants would be small male adults (jacks).

On 9 December 2006, a facilitated breach of the sandbar was required to prevent flooding. This was the fourth stormflow of the season and the third in November (**Figure 19**). The stream flowed through the pre-cut notch due to lagoon filling. The flume was moving water at full capacity at the time of the breach. Stormflow reached approximately 110 cubic feet per second at the USGS gage in Soquel Village overnight after the late afternoon breach (**Figure 20**). The sandbar remained open on 10 December with an approximately 50-foot opening through the sandbar. The mouth of the San Lorenzo River was also open on 10 December. Storms continued into the next week.

Table 3. Morning Water Quality Ratings in Soquel Creek Lagoon, 2006, Within 0.25 M of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
18June06	open	1.95 fair	- good - -	- good - -	- good - -	
30June06	open	2.08 fair	good*	fair fair good good	good	18 cfs
14July06	open	1.92 fair	good	good fair fair good	good	16 cfs
28July06	open	1.98 fair	fair fair good good	good fair fair fair	good	10-12 cfs
12Aug06	open	1.78 poor	good	good fair fair fair	good	8 cfs
25Aug06	open	1.63 poor	good fair fair fair	good fair fair fair	good	7 cfs
03Sep06 Begonia Festival (morning)	open	2.25 good	good	good good good fair	good	
03Sep06 (afternoon)	open	2.25 good	- good good -	- good good -	- good good -	
10Sep06	open	2.24 good	good	good fair good fair	good	7 cfs
23Sep06	open	2.14 good	good	good	good	7 cfs
05Oct06	open	2.21 good	good	good good good fair	good	6 cfs
26Oct06	open	2.03 fair	good	good	good	5.5 cfs
09Nov06	open	1.80 poor	good	fair fair good good	good	7 cfs
22Nov06	open	1.66 poor	good	good	good	
06Dec06	open	2.24 good	good	good	good	5 cfs at USGS gage

* Four ratings refer to Monitoring Sites 1-4. One rating represents all sites.

Water Temperature Results from Two-Week Monitoring. In 2006, the lagoon was consistently cooler near the bottom in morning and afternoon than in 2005 except in late July and mid-August, with water temperature rated either "good" (< 20°C at dawn) or "fair" (<21.5°C at dawn) at all four stations throughout the summer within 0.25 meters of the bottom (**Table 3, Figures 3a-d; Appendix A**). This occurred despite the consistently shallower lagoon, warmer air temperature and warmer inflow in July- September 2006 compared to 2005 (**Table 4; Figures 2 and 3e**). The two cooling effects may have been cooler average minimum daily air temperature in July and September 2006 (**Table 4**) and the increased water circulation through the lagoon resulting from higher inflow in 2006 (**Table 10**). Maintenance of a deep lagoon for most of the summer without tidal overwash usually helps to minimize water temperature near the bottom.

As in 2005, the 2006 water temperature at dawn within 0.25 m of the bottom of the lagoon became warmer as the monitoring stations progressed down the lagoon to the flume (**Figure 3f**). Water temperature of the stream inflow was cooler in the morning than the lagoon with 2-week fluctuations in lagoon inflow temperature mirrored in early-morning lagoon temperatures. In the afternoon near the lagoon bottom, Station 1 at the flume was often the warmest, and Station 4 at the mouth of Noble Gulch was usually the coolest (**Figure 3g**). However, in mid-August, Station 1 was the coolest in the afternoon near the bottom on a day that was overcast in the morning and partly cloudy and breezy in the afternoon. From late July through August, Station 2 was the warmest at the surface in the morning and afternoon. In September, Station 4 was the warmest at the surface in the afternoon (**Appendix A**). Station 4 often showed the greatest temperature drop down through the water column in the afternoon, presumably due to cool inflow from Noble Gulch. The warmest water temperatures observed near the bottom at the 4 stations during 2-week intervals occurred on 28 July with readings of 20.4, 20.1, 19.7 and 18.8°C in the morning and 20.5, 20.3, 20.3 and 20.0°C in the afternoon at Stations 1-4, respectively (**Figures 3f-g; Appendix A**).

Results from Continuous Temperature Data Loggers. In analyzing temperature data from the 6 data loggers throughout the water column just upstream of the railroad trestle, results were consistent with temperature data collected through the water column at monitoring stations over the past 16 years. However, the following analysis pertains to the vicinity of these data loggers only. Bare in mind that our 2-week monitoring at the 4 sites indicated that Station 4 near the mouth of Noble Gulch had cooler water temperatures near the bottom than Site 3 near the trestle (**Figures 3f-g**).

Juvenile steelhead likely spend most of their time near the bottom, except when feeding on emerging aquatic insects at dusk and dawn. This assumption is based on years of underwater observations of salmonids. Therefore, the water temperature recorded near the lagoon bottom (within 0.25 m) has greatest relevance to assessing habitat quality.

Table 4. Monthly Statistics for Air Temperature in Capitola and at the Watsonville Airport in July through September in 2005 and 2006.

Month/ Year	Max. Temp. ° F Capitola	Avg. Daily Max. Temp. ° F Watsonville	Avg. Temp. ° F Capitola	Min. Temp. ° F Capitola	Avg. Daily Min. Temp. ° F Watsonville
July, 2005	77.4	72	59.3	51.4	54
July, 2006	86.3	75	61.1	48.3	53
August, 2005	76.1	71	58.5	49.3	53
August, 2006	91.8	76	60.5	51.0	53
Sept., 2005	79.0	71	58.0	47.5	50
Sept., 2006	83.6	76	58.9	45.2	52

Lagoon water temperatures (**Figures 4a- 4l**) closely mirrored temperatures in the stream inflow (**Figures 5a-b**) in 2006, as in past years. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2006 (**Figures 4a-b, 5a-b; Alley 2005**). Daily temperature *maxima* near the bottom were warmer in the lagoon than the stream in 1999 and 2001-2004, but were cooler in 2000 and 2005 (**Alley 2005**). In 2006, the daily temperature *maxima* in the stream were similar to that near the lagoon bottom (**Figures 4a-b, 5a-b**). The daily stream temperature fluctuated more than the daily lagoon temperature.

As in past years, no thermocline was detected by the data loggers or at any of the 4 monitoring stations during the summer in 2006, with complete mixing of the water column on a diurnal cycle. The lagoon was likely 7-8 feet deep at most and subject to daily inland breezes. Water temperature was somewhat cooler at depth compared to nearer the surface by afternoon, being coolest near the bottom in the afternoon in 2006. Each night, water temperature cooled to the bottom, with the surface sometimes being slightly cooler than deeper layers at dawn (particularly for August), and as indicated on 5 occasions for comparisons at 10-day intervals, beginning in late July (**Table 5; Figures 4a-b, 4k-l**).

In 2006, the daily maximum water temperature near the lagoon surface ranged from **15.6°C** (60.1°F) on 29 September - 1 October to **22.9°C** (73.2ºF) on 23 and 25 July (**Figures 4k and 4l**). The daily maximum water temperature in 2005 near the lagoon surface ranged from **16.0°C** (60.8°F) on 8 October to **22.9°C** on 12 July (**Figures 4k and 4l**). Daily maxima near the surface

were higher in 2006 compared to 2005 only in late June, the latter half of July, a short period around 10 August and early September. Near the lagoon bottom, maximum daily water temperature ranged between **15.2°C** (59.4°F) on 1 October and **22.5°C** (72.5°F) on 12 July (**Figures 4a and 4b**). In 2005, maximum daily water temperature at the lagoon bottom ranged between **15.2°C** (59.4°F) on 6 October and **21.3°C** (70.4°F) on 12 July (**Figures 4a and 4b**). The shallower 2006 lagoon had generally warmer water temperatures near the bottom than in 2005.Daily maxima near the bottom were greater in 2006 than 2005 for the latter half of June, the latter half of July, mid-August and most of September.

The greatest increase in water temperature recorded from morning to afternoon near the bottom in 2006 was **3.4°C** (6.2°F) on 22 July (**Figures 4a-b**). The greatest increase near the lagoon surface was **3.8°C** (6.9°F) on the same day (**Figures 4k-l**).

From 18 June through 8 October 2006, the daily maximum water temperature of the stream inflow ranged from a minimum of **16.8°C** (62.2°F) on 8 September to a maximum of **22.5°C** (72.5°F) on 23 July (**Figures 5a-b**). The temperature sensor was found at the water surface on 8 October, and water temperature readings appeared unreliable after 12 September. In 2005 from 10 June through 8 October, the daily maximum water temperature of the stream inflow ranged from a minimum of **14.1°C** (57.4°F) on 4, 5 and 8 October to a maximum of **21.3°C** (70.4°F) on 9, 11 and 12 July (**Alley 2005**). In 2004 the maximum water temperature ranged from **15.2ºC** (59.4ºF) on 20 September to **22.1ºC** (71.8ºF) on 20 July (**Alley 2005**).

Days when lagoon water temperatures exceeded 22ºC (71.6ºF) near the bottom would likely be stressful for juvenile steelhead. In 2006, this occurred on 4days (22-25 July) during the warmest and longest air temperature period of the summer, when maximum air temperature reached 93.5ºF along the San Lorenzo River in Brookdale on 25 July. In 2005, water temperature near the bottom never reached this threshold. It only went above 22°C once (12 July) at the surface (**Alley 2005**). In 2004, the goal near the bottom was not met for 5 days after tidal overwash on 19 July, 4 days in August (2 days at a time in early and late August) and 2 days in early September (8.8% of the days (11 of 125 days) (**Alley 2005**). But conditions were more stressful in 2001 when there had been two major tidal overwashes. In 2001, daily temperatures near the bottom fluctuated between approximately 23 and 26ºC (73.4- 78.8ºF) for 14 days (**Alley 2003c**).

The 2006 lagoon met the steelhead management goal of early morning minimum temperature of less than 20°C near the bottom (**Figure 4a**), as it did in 2005 (**Figure 4m**). In the 2004 lagoon, 27% of the days measured (34 of 125 days; 1 June – 3 October) failed to meet the management goal partially due to tidal overwash. This was compared to 19% in 2003 and 10% in 2002. The coho management goal of keeping maximum water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met 17% of the days measured (19 of 112 days; 19 June- 8 October). However, coho prefer to have temperatures below 16°C (depending on food abundance) (**J. Smith pers. communication**), and the lagoon temperature near the bottom cooled to 16°C in the morning on only 6 days from mid-June to mid-September.

Detailed water temperature measurements expressed at 10-day intervals showed that the

difference between maximum daily temperatures in the late afternoon at 0.5 feet from the bottom and 5.5 feet from the bottom (less than 0.5 feet from the surface) varied between –1.14°C (2.05° F) and 1.90ºC (3.42ºF) from bottom to top (**Table 5**; **Figures 4a-b and 4k-l**). The negative difference, indicating warmer conditions on the bottom than the surface presumably resulted from unusually cool air temperature that cooled surface water without complete mixing with water near the bottom for a short period in mid-August. There must have been an absence of wind action. In 2006, the average maximum temperature difference from bottom to top was **0.59°C** (1.06°F) for 13 days analyzed (**Table 5**). In 2005, the average maximum temperature difference from bottom to top was **0.58°C** (1.06°F) for 14 days analyzed (**Table 6**). In 2004 the average difference was **0.41ºC** (0.74ºF) for the 14 days analyzed in 2004 (**Table 7**), compared to 0.60ºC (1.07ºF) for the 14 analyzed days in 2003 (**Table 8)** and **0.72ºC** (1.31ºF) for the 10 days considered in 2002 (**Table 9**).

In 2006, the difference in minimum daily temperatures in the morning from bottom to top of the water column was more than the maximum daily temperature difference through the column, ranging from –3.44°C (6.19°F) to 2.07 ºC (3.73ºF) (**Table 5**). The negative difference resulted from very cool nights followed by very warm days.

At the creek site near Nob Hill in 2006, water temperature failed to meet the management goal of *no more than 4 hours a day at greater than 20ºC (68ºF)* on 14 of 112 monitored days (**12%**; 19 June- 8 October) (**Figure 5a**). This included the assumption that water temperature did not go above 20°C from 12 September to 8 October, as was indicated by data with the sensor on the surface except for one day. At the creek site near Nob Hill in 2005, water temperature failed to meet the management goal of *no more than 4 hours a day at greater than 20ºC (68ºF)* on 6 of 120 monitored days (**5%**; 10 June- 8 October) (**Alley 2005**). In 2004, 9 of 125 monitored days (**7%**; June-early October) did not meet the goal. September was unusually cool in 2004 and 2005 (**Alley 2005**). At the Creek site near Nob Hill in 2003, 22 of 127 monitored days (**17%**; June-early October) failed to meet the management goal (**Alley 2005**).

With a water temperature goal of having the average weekly temperature of 16.7º C (62º F) or cooler for coho salmon, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

Water temperatures in the lagoon closely mirrored temperatures in the stream inflow in 2003-2006. Daily *minima* in the lagoon near the bottom were consistently warmer than the stream above in 1999-2006 (**Figures 4a, 5a and Alley 2005**). The daily *maxima* near the bottom of the lagoon were similar to the stream in 2006 (**Figures 4a-4b and 5a-5b**). The daily stream temperature fluctuated more than the lagoon.

Table 5. 2006 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 Feet and 5.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>		Max/Min Temp ºC(ºF)/ ºC(ºF) **5.5 ft**				Max/Min Temp ºC(ºF)/ ºC(ºF) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 5.5 to 0.5 ft from Bottom **ºC(ºF) / ºC(ºF)**
20 June		19.04 (66.28)/ 16.00 (60.80)				18.66 (65.59)/ 15.62 (60.11)	0.38 (0.68)/ 0.38 (0.68)
30 June		20.18 (68.33)/ 17.90 (64.21)				19.80 (67.65)/ 17.52 (63.54)	0.38 (0.68)/ 0.38 (0.68)
9 July		19.42 (66.96)/ 17.14 (62.85)				19.04 (66.28)/ 16.76 (62.17)	0.38 (0.68)/ 0.38 (0.68)
19 July		21.71 (71.08)/ 19.04 (66.28)				21.33 (70.39)/ 18.66 (65.59)	0.38 (0.68)/ 0.38 (0.68)
29 July		21.33 (70.39)/ 18.28 (64.91)				20.95 (69.71)/ 19.04 (66.28)	0.38 (0.68) -0.76 (-1.37)
8 August		19.80 (67.65)/ 17.14/ (62.85)				19.80 (67.65)/ 17.52 (63.54)	0 (0)/ -0.38 (-0.68)
18 August		17.90 (64.22)/ 16.38 (61.48)				19.04 (66.28)/ 17.14 (62.85)	-1.14 (-2.06)/ -0.76 (-1.37)
28 August		19.04 (66.28)/ 14.85 (58.73)				18.66 (65.59)/ 16.76 (62.17)	0.38 (0.68)/ -1.91 (-3.44)
7 September		17.9 (64.22)/ 17.14 (62.85)				17.90 (64.22)/ 16.76 (62.17)	0 (0)/ 0.38 (0.68)
17 September		17.9 (64.22)/ 16.0 (60.8)				16.00 (60.8)/ 14.85 (58.73)	1.9 (3.42) 1.15 (2.07)
27 September		17.52 (63.54)/ 14.85 (58.73)				16.38 (61.48)/ 15.23 (59.42)	1.14 (2.06)/ -0.38 (-0.69)
2 October		16.0 (60.80)/ 14.08 (57.35)				15.61 (60.11)/ 14.08 (57.35)	0.39 (0.69)/ 0 (0)
7 October		16.0 (60.8)/14.35 (58.73)				15.23 (59.42/13.70 (56.66)	0.77 (1.38)/0.65 (2.07)

Table 6. 2005 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 Feet and 5.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>		Max/Min Temp ºC(ºF)/ ºC(ºF) **5.5 ft**				Max/Min Temp ºC(ºF)/ ºC(ºF) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 5.5 to 0.5 ft from Bottom **ºC(ºF) / ºC(ºF)**
11 June		18.28 (64.91)/ 15.23 (59.42)				18.66 (65.59)/ 16.0 (60.82)	-0.58 (-0.78)/ -0.77 (-1.38)
20 June		19.42 (66.96)/ 14.09 (57.35)				18.66 (65.59)/ 16.0 (60.8)	0.76 (1.37)/ -1.91 (-3.45)
30 June		19.42 (66.96)/ 18.28 (64.91)				19.42 (66.96)/ 17.52 (63.54)	0 (0)/ 0.76 (1.37)
9 July		20.57 (69.02)/ 18.28 (64.91)				20.95 (69.71)/ 18.28 (64.91)	-0.38 (-0.69)/ 0 (0)
19 July		20.95 (69.71)/ 19.04 (66.28)				19.81 (67.65)/ 18.66 (65.59)	1.14 (2.06)/ 0.38 (0.69)
29 July		20.19 (68.33)/ 18.66 (65.59)				19.04 (66.28)/ 18.28 (64.91)	1.15 (2.05) 0.38 (0.68)
8 August		19.81 (67.65)/ 18.66 (65.59)				18.66 (65.59)/ 18.28 (64.91)	1.15 (2.06)/ 0.38 (0.68)
18 August		18.28 (64.91)/ 17.14 (62.85)				17.9 (64.22)/ 17.14 (62.85)	0.38 (0.69)/ 0 (0)
28 August		19.81 (67.65)/ 17.9 (64.22)				18.66 (65.59)/ 17.9 (64.22)	1.15 (2.06)/ 0 (0)
7 September		17.9 (64.22)/ 17.14 (62.85)				17.52 (63.54)/ 16.76 (62.17)	0.38 (0.68)/ 0.38 (0.68)
17 September		17.9 (64.22)/ 16.0 (60.8)				16.76 (62.17)/ 15.62 (60.11)	1.14 (2.05)/ 0.38 (0.69)
27 September		17.52 (63.54)/ 15.62 (60.11)				16.38 (61.48)/ 16.04 (60.8)	1.14 (2.06)/ -0.38 (-0.69)
2 October		17.9 (64.22)/ 16.76 (62.17)				17.52 (63.54)/ 16.38 (61.48)	0.38 (0.68)/ 0.38 (0.69)
8 October		16.0 (60.8)/14.35 (58.73)				16.0 (60.8)/14.85 (58.73)	0 (0)/0 (0)

Table 7. 2004 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 Feet and 5.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>		Max/Min Temp ºC(ºF)/ ºC(ºF) **5.5 ft**				Max/Min Temp ºC(ºF)/ ºC(ºF) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 5.5 to 05 ft from Bottom **ºC(ºF) / ºC(ºF)**
1 June		20.19 (68.33)/ 18.28 (64.91)				19.04 (66.28)/ 17.9 (64.22)	1.15 (2.05)/ 0.38 (0.69)
10 June		20.57 (69.02)/ 18.66 (65.59)				19.42 (66.96)/ 18.66 (65.59)	1.15 (2.06)/ 0 (0)
20 June		20.57 (69.02)/ 18.28 (64.91)				20.19 (68.33)/ 18.28 (64.91)	0.38 (0.69)/ 0 (0)
30 June		20.57 (69.02)/ 19.04 (66.28)				19.81 (67.65)/ 18.66 (65.59)	0.76 (1.37)/ 0.38 (0.69)
9 July		19.42 (66.96)/ 17.9 (64.22)				18.66 (65.59)/ 17.14 (62.85)	0.76 (1.38)/ 0.76 (1.37)
19 July		23.63 (74.53)/ 21.71 (71.08)				22.86 (73.15)/ 21.71 (71.08)	0.77 (1.38) 0 (0)
29 July		20.57 (69.02)/ 19.42 (66.96)				20.59 (69.02)/ 18.66 (65.59)	0 (0)/ 0.76 (1.37)
8 August		22.09 (71.77)/ 20.57 (69.02)				22.09 (71.77)/ 20.57 (69.02)	0 (0)/ 0 (0)
18 August		21.33 (70.39)/ 20.57 (69.02)				21.33 (70.39)/ 20.57 (69.02)	0 (0)/ 0 (0)
28 August		21.71 (71.08)/ 20.95 (69.71)				21.71 (71.08)/ 20.95 (69.71)	0 (0)/ 0 (0)
7 September		22.48 (72.46)/ 20.57 (69.02)				22.09 (71.77)/ 20.57 (69.02)	0.38 (0.69)/ 0 (0)
17 September		19.42 (66.96)/ 19.04 (66.28)				19.42 (66.96)/ 19.04 (66.28)	0 (0)/ 0 (0)
27 September		18.66 (65.59)/ 17.52 (63.54)				18.66 (65.59)/ 17.52 (63.54)	0 (0)/ 0 (0)
2 October		17.9 (64.22)/16.38 (61.48)				17.52 (63.54)/16.38 (61.48)	0.38 (0.68)/0 (0)

Table 8. 2003 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 feet and 4.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>	Max/Min Temp ºC(ºF)/ ºC(ºF) **4.5 ft**	Max/Min Temp ºC(ºF)/ ºC(ºF) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 4.5 and 0.5 ft from Bottom **ºC(ºF) / ºC(ºF)**
1 June	18.66 (65.59)/ 16.38 (61.48)	18.66 (65.59)/ 16.38 (61.48)	0 (0)/ 0 (0)
10 June	16.76 (62.17)/ 15.62 (60.11)	16.76 (62.17)/ 15.62 (60.11)	0 (0)/ 0 (0)
20 June	19.81 (67.65)/ 16.76 (62.17)	18.66 (65.59)/ 16.76 (62.17)	1.15 (2.06)/ 0 (0)
30 June	20.95 (69.71)/ 18.66 (65.59)	20.57 (69.02)/ 18.66 (65.59)	0.38 (0.69)/ 0 (0)
9 July	20.95 (69.71)/ 18.28 (64.91)	20.19 (68.33)/ 18.28 (64.91)	0.76 (1.38)/ 0 (0)
19 July	19.81 (67.65)/ 19.04 (66.28)	19.42 (66.96)/ 18.66 (65.59)	0.39 (0.69) 0.38 (0.69)
29 July	20.95 (69.71)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	0 (0)/ 0 (0)
8 August	23.24 (73.84)/ 20.95 (69.71)	22.09 (71.77)/ 20.57 (69.02)	1.15 (2.07)/ 0 (0)
18 August	21.71 (71.08)/ 19.81 (67.65)	20.95 (69.71)/ 19.81 (67.65)	0.76 (1.37)/ 0 (0)
28 August	21.71 (71.08)/ 20.19 (68.33)	20.95 (69.71)/ 19.81 (67.25)	0.76 (1.37)/ 0.38 (0.69)
7 September	20.95 (69.71)/ 19.04 (66.28)	20.19 (68.33)/ 18.66 (65.59)	0.76 (1.38)/ 0.38 (0.69)
17 September	20.95 (69.71)/ 19.04 (66.28)	19.81 (67.65)/ 18.66 (65.59)	1.14 (2.06)/ 0.38 (0.69)
27 September	18.66 (65.59)/ 17.90 (64.22)	18.28 (64.91)/ 17.52 (63.54)	0.38 (0.68)/ 0.38 (0.68)
4 October	18.66 (65.59)/17.14 (62.85)	18.28 (64.91)/17.14 (62.85)	0.38 (0.68)/0 (0)

Creek conditions in 1999-2006 had been much cooler than in 1998, despite the much higher baseflow in 1998. In 1998, there was a 20-day period in which water temperature rose above 21º C (69.8º F) for several hours each day in the stream above the lagoon, with a maximum of approximately 23.5º C (74.3º F) on 3 August 1998 (**Alley 2005**). Daily maxima were still approaching 21ºC on 4 September 1998. Considerable riparian vegetation had been removed by El Niño stormflows the previous winter. Despite the warm stream temperatures, lagoon water temperatures in 1998 were relatively cool compared to other years (**Alley 2003**).

Aquatic Vegetation. Filamentous algae was first noted during monitoring on 30 June 2006 during our first two-week monitoring, 16 days after sandbar closure (**Appendix A**); compared to 1 July 2005, 3.0 weeks after sandbar closure in 2005 (**Alley 2005**); compared to 27 June 2004, 4.5 weeks after sandbar closure in 2004 (**Alley 2004**); and compared to 7 July 2003, 6 weeks after sandbar closure in 2003 (**Alley 2003**).

Pondweed was possibly observed on 12 August 2006 in Reach 2, 8 weeks after sandbar closure. However, the identification was uncertain. It was not positively identified after that. Pondweed propagates best on sandy substrate. The lagoon bottom has become progressively coarser each year with more cobbles, thus discouraging pondweed. Pondweed was first noted on 10 September 2005, 13 weeks after sandbar closure (although it may have gone unnoticed earlier due to its initial scarcity); compared to 6 August 2004, 10 weeks after sandbar closure; compared to 4 August 2003, 10.5 weeks after sandbar closure in 2003. In most years, the pondweed became most abundant in September and continued into October.

In 2006, surface algae was first observed in all reaches on 28 July after a warm month and 5 weeks after sandbar closure (**Table 9**). In 2005, surface algae was observed 4.5 weeks after sandbar closure on 15 July (**Table 10**). In 2004, surface algae occurred 4 weeks after sandbar closure (**Alley 2004**). Surface algae in 2006 varied between 0 and 5% coverage, with the most being present in Reach 3 and near Noble Gulch. By contrast, surface algae in 2005 varied between 0 and 20% coverage of Reach 3, with very little in the lower 2 reaches (maximum was 2%). The most extensive surface algae in 2006 was observed on 10 September when it was absent in Reach 1, 2% in Reach 2 and 5% in Reach 3 and at the mouth of Noble Gulch.

At the mouth of Noble Gulch, surface algae in 2006 ranged from 0 to 5% through 10 September and was last observed on 23 September (**Table 9**). It had been more prominent in 2005 when on 25 September it covered 60% of the surface within 50 feet of the mouth (**Table 10**). The appearance of surface algae coincided with a period of considerable gray water input from Noble Gulch that presumably contributed nutrients to stimulate plant growth.

Algae mat coverage of the lagoon bottom increased rapidly to 70-80% by mid-July 2006, and varied between 50 and 100% until late October (**Table 9**). Average algal thickness increased to a maximum on 12 August in Reaches 2 and 3 and on 25 August in Reach 1. At those times, the maximum average algal thickness was estimated at 1.5 feet in Reach 1 (reaching 2 ft at most), 3 feet in Reach 2 (reaching 4 ft at most), 2 feet in Reach 3 (reaching 3 feet at most) and 2 feet at the mouth of Noble Gulch (reaching 3.5 ft at most). Algal abundance did not become thicker in

September, as had occurred in 2005 (**Table 10**). The average thickness of bottom algae for July-September was greater in 2005 than 2006 for Reaches 1 and 3 and at the mouth of Noble Gulch (**Tables 9 and 10**). The average algal coverage of the lagoon bottom was greater in 2005 than 2006 in all 3 reaches and at Noble Gulch for July- September.

Table 9. Visually Estimated Algae Coverage and Thickness in the 2006 Lagoon.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month-Day	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover
6-18	0	0	0	-	-	-	-	-	-	-	-	-
6-30	0.3	20	0	0.3	20	0	0.3	10	0	0.3	5	0
7-14	0.3	80	0	0.3	80	0	0.2	70	0	0.2	60	0
7-28	0.5	95	3	0.4	95	5	0.5	95	1	0.8	95	5
8-12	0.8	70	0	3.0	90	0	2.0	90	0	1.0	100	3
8-25	1.5	50	0	1.0	50	0	0.8	35	5	1.5	100	5
9-10	**0.2**	**100**	**0**	**0.8**	**90**	**2**	**1.0**	**90**	**5**	**2.0**	**60**	**5**
9-23	1.0	50	<1	1.5	-	2	1.3	-	5	1.0	60	1
10-5	Brown turbidity	-	0	Brown turbidity	-	0	Brown turbidity	-	1	Brown turbidity	-	0
10-26	0.4	70	<1	0.3	70	0	0.6	90	<1	0.4	Gray turbidity	0
11-09	-	-	0	-	-	0	-	-	0	-	-	0
11-22	<0.2	-	0	-	-	0	0.15	-	0	-	-	0
Avg-6-30 to 9-23	0.4	65		1.0	70		0.9	65		1.0	70	

Table 10. Visually Estimated Algae Coverage and Thickness in the 2005 Lagoon.

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month-Day	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover
6-19	0	0	0	0	0	0	0	0	0	0	0	0
7-01	0.33	80	0	0.33	100	0	0.7	100	0	0.25	100	0
7-15	-	-	0	0.5	100	0	0.5	100	5	0.5	90	3
7-29	1.0	80	0	1.0	90	0	0.5	80	10	0.4	60	<1
8-14	-	-	0	-	85	0	-	60	0	2.0	95	0
8-27	1.0	35	0	1.0	95	0	1.5	100	0	4.0	100	0
9-10	-	-	0	1.5	100	<1	2.5	99	<1	2.0	60	2
9-25	**2.0**	**100**	**2**	**2.0**	**100**	**2**	**3.0**	**99**	**20**	**3.0**	**60**	**60**
10-8	-	-	0	-	-	<1	-	-	<1	3.0	100	20
10-18	-	-	0	-	-	10	-	-	15	0.5	50	3
11-03	-	-	0	-	-	0	-	-	0	-	-	0
11-17	0.15	100	0	0.3	70	0	-	-	0	0.15	60	0
Avg-7-01 to 9-25	1.1	75		1.0	95		1.4	90		1.7	80	

Dissolved Oxygen. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. This was the time that oxygen levels were most importantly measured and rated. In 2006, oxygen levels for steelhead were either "fair" or "good" *near the bottom at dawn* at all stations during monitorings (**Table 3, Figure 6a; Appendix A**). Therefore, oxygen concentration stayed above 5 mg/l at all stations throughout the summer at dawn within 0.25 m of the bottom. Of the early morning monitorings, Station 1 at the flume was rated "good" (greater than 7 mg/l) 86% of the time (12 of 14 monitorings) (**Figure 6b**). Station 2 at Stockton Avenue Bridge was rated "good" 53% (8 of 15 monitorings) and "fair" (between 5 and 7 mg/l) 47% of the time (**Figure 6c**). Station 3 near the railroad trestle was rated "good" 71% of the time (10 of 14 monitorings) and "fair" 29% of the time (**Figure 6d**). Station 4 at the mouth of Noble Gulch was rated "good" 64% of the time (9 of 14 monitorings) and "fair" 36% of the time (**Figure 6e**). Unlike in 2003-2005, the lowest morning oxygen concentrations near the bottom were often not least near Noble Gulch (Station 4), such as in most of July and August when it was lowest at the bridge or the trestle. In September, the lowest oxygen concentration was near Noble Gulch (**Figure 6e; Appendix A**). Lower oxygen concentration at dawn is usually associated with more algae present. In 2006, there was less algae near the Gulch than in previous years. The flume station generally had the highest oxygen concentration at dawn of the 4 lagoon locations and higher concentrations than the stream station on 5 of 11 monitorings through November. On 6 of the 11 monitorings, the stream site had higher oxygen concentrations than any of the lagoon stations near dawn through November. Station 3 under the trestle is subject to pigeon droppings that encourage algae production and decomposition that lead to greater oxygen depletion at night.

In 2006, oxygen concentrations near the bottom at dawn were lower than in 2005 the majority of the time (**Figures 6a-6j and Appendix A**). For 9 monitorings over 4 months, beginning at approximately 1 July and continuing through late October, oxygen concentrations were lower in 2006 for 5 of 9 monitoring days at Station 1, 8 of 9 monitorings at Station 2, 6 of 9 monitorings at Station 3 and 9 of 9 monitorings at Station 4. Therefore, in 2005 with thicker algae production than 2006, early morning oxygen levels were higher even though oxygen consumption at night from plant respiration was presumably higher. Apparently, greater oxygen production during the day at these algal densities more than compensated for the respiration loss of oxygen overnight.

On all monitoring days, the oxygen concentration was higher in the afternoon than in the morning at all stations, despite higher water temperature, and even on cloudy days (**Figures 6b-6e**). In the afternoon on 8 of 9 monitorings through October, oxygen concentration increased down the water column at each station except at the very bottom, presumably because oxygen production was highest near the algae that was growing in the lower water column (**Appendix A**). An exception was on 5 October when it was both cloudy and windy after the first fall storm. By November, algae abundance is too low to have this effect.

Salinity. Only salinities of 0.4 parts per thousand or less were detected after sandbar construction in 2006 (**Appendix A**). Therefore, all stations were rated "good" throughout the lagoon period (**Table 3**).

Conductivity. Conductivity remained low throughout 2006, remaining in the 570-670 umhos range the entire summer/fall (**Appendix A**). Stream conductivity was always slightly lower than in the lagoon. The highest lagoon conductivity in 2006 was 671 umhos at the bottom at the mouth of Noble Gulch on 28 July. The highest conductivity detected in the creek in 2006 was 602 umhos on the same morning. On 3 September, the day of the Begonia Festival, conductivity increased slightly at Stockton Avenue Bridge from 614 before to 624 umhos after the procession. At the trestle it increased from 608 before to 620 umhos after the procession. This was little change and not stressful to steelhead.

Stream In-Flow to the Lagoon. The lagoon water quality is generally best when more summer baseflow occurs. When tidal overwash occurs or saltwater back-flushes into the lagoon, with more summer baseflow that passes through the lagoon, the more quickly that saltwater is flushed out of the lagoon to reduce lagoon heating. The year 2001 was most affected by tidal overwash in the last 7 years. In recent years, the sandbar around the periphery of the lagoon has been maintained at a higher elevation to prevent tidal overwash. With proper flume management and the new grated flume ceiling installed in 2003, it should be easier to maintain lagoon depth and prevent fluctuations in lagoon level when the summer begins with high baseflow. To maximize summer baseflow, water percolation into the aquifer must be maximized and surface runoff must be minimized during the rainy season. 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.

Habitat conditions in the 2006 lagoon followed a winter with numerous storm events, with the highest baseflow since the El Niño winter of 1997-98, which had been substantially more than any other of the last 16 years of monitoring (**Table 11; Figures 17 and 18**). The early summer inflow as of 1 June 2006 (28 cfs) was 48% that of 1998 (58 cfs). By July 1 the 2006 flow (17 cfs) was 77% of the 1998 flow (22 cfs). Stream inflow to the lagoon on 1 June 2006 was second highest in the last 16 years and third highest on 1 October. The streamflow at the Soquel gage on 8 October 2006 was approximately 5.4 cfs. Streamflow just above the lagoon was measured at 2.93 cfs on 8 October 2005 at Nob Hill, compared to 1.33 cubic feet per second (cfs) on 1 October 2004, 1.92 cfs there in 2003, 1.28 cfs near the Grange in 2002 and 1.58 cfs in 2001 near the Grange.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon. The 6 restaurants contiguous with the Soquel Creek Lagoon that had accessible plumbing systems were tested for leaks and deficiencies in plumbing connections and repaired as necessary. Confirmation is contained in **Appendix B**.

Begonia Festival Observations and Water Quality Findings. The City's fishery biologist was present during and after the Begonia Festival. The day of the Festival, 3 September, was initially overcast and became sunny by 1215 hr. The lagoon depth was maintained at a good gage height of 2.25 ft. There were 10 floats in the nautical parade. Unlike in 2005 when none of the floats were propelled by wading, in 2006 there were 4 floats propelled by waders. There were 13

waders in the lagoon, with 5 waders propelling the Cinderella float alone. The lagoon bottom was disturbed more than usual by all of these waders. Despite light turbidity caused by the wading, secchi depth was to the bottom before and after the nautical parade. Conductivity increased slightly at Stockton Avenue Bridge from 614 before to 624 umhos after the nautical parade. At the trestle it increased from 608 before to 620 umhos after the nautical parade. This was little change. There was no odor of hydrogen sulfide, and no fish mortality was observed.

Oxygen concentrations were lower after the nautical parade at Stations 2 and 3 than previously (25 August) and after (10 September) (**Figures 6a-6e**). This also occurred in 2005 (**Figures 6f-6j**). Lower oxygen levels on the day of the Begonia Festival may have resulted from slight turbidity (though secchi depth was to the bottom) and because measurements were taken about 1 hour earlier in the afternoon than normal monitorings in order to detect any immediate conductivity changes. Later in the afternoon, oxygen levels increase with additional photosynthesis. Despite the lower than usually oxygen readings on 3 September measured after the nautical procession, oxygen levels in the afternoon were rated "good" (above 7mg/l) for steelhead at the two stations measured. Oxygen levels in the morning had been rated "good" at 3 of 4 stations and "fair" at one station.

Floats were dismantled on 4 September, and flowers were gathered from the lagoon on 5 September, using a boat. More than 90% of the petals were retrieved.

Water quality measurements and observations on 10 September detected no oxygen depletion resulting from decomposing begonias or trampled aquatic vegetation.

Table 11. Streamflow Recorded at the USGS Stream Gage in Soquel Village, Approximately One Mile Upstream of the Lagoon and Estimated from the Graphical Representation.

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

Discussion of Options to Improve Water Quality

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included in these is the culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch until 2001, and now again in 2005 and 2006 (**Alley 1995; 1996b; 1997-2000; 2005**). Gray water plumes were observed in 2006 on 8 of 12, 2-week monitorings. The first 3 monitorings had no gray water. Gray water was observed in August- November, becoming clear in early December. In 2005, gray water plumes and sometimes oil slicks were observed on 7 of 13, 2-week monitorings. The gray water problem occurred particularly in late September and October in 2005 and was correlated with the highest surface algae estimates. By contrast, gray water plumes were observed in 2004 on only 1 of 11, 2-week monitorings. As further history of the problem, in 2001 and 2002, no gray water was observed during monitorings, but in 2003, the water was murky on 2 of 12 monitorings. In 2000, gray water plumes were observed on 5 of the 7 monitorings. Sewer lines along River View Road, parallel to the lagoon, were repaired in 2006. Hopefully, this will have a positive effect on cleaning up water coming from Noble Gulch.

Stimulation of algal growth has annually occurred at the mouth of Noble Gulch, with consistently greater growth there compared to elsewhere in the lagoon in most years except 2001. Increased algal growth indicates elevated nutrient inputs probably associated with bacteria. Oxygen depletion noted at dawn has been consistently greater at the mouth of Noble Gulch in 2002-2005 and other years, with usually lower oxygen readings at that station (**Alley 2005**). However, in 2006 oxygen depletion at dawn was not consistently greatest at the mouth of Noble Gulch (**Figure 6a**).

Usually, when cloudy water enters the lagoon from Noble Gulch, the water is clear upstream in Noble Gulch at the park beyond Bay Street. This indicates that pollutants enter Noble Gulch from the lower village near Soquel Creek. There are ducks living at the mobile home park up that drainage that could be removed to reduce nutrient influxes and coliform bacterial inputs. A flashboard dam could be constructed in Noble Gulch at Bay Street to impound water to be pumped out for irrigation purposes, provided that lagoon depth is being adequately maintained. Coliform counts greater than 200/ 100 ml are considered a hazard to human health.

By minimizing the stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced. Algae production may be reduced. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if summer runoff was re-directed into the sewer.

The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe in the lagoon. They roost on the buildings surrounding the lagoon. Restaurant goers and others feed them. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. It is likely that the gull population is artificially high because of the artificial food source and artificial roosting

areas. If these were reduced, then the gull population would probably decline, and pollution would be reduced at Soquel Lagoon. All of the refuse cans on the beach were equipped with gull-proof lids in 2006 (**Ed Morrison, pers. comm.**). Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls. Gull sweeps are an effective option. Parallel wires covered the roof of the Paradise Grill in 2006 and were effective in keeping gulls off. The remainder of the restaurants would benefit from this application.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over the lagoon. As stated in the original management plan, the trestle could be screened so that roosting areas were eliminated and bird pollution reduced.

Regarding urban runoff, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petrochemicals. All existing and new drainage systems from new development and parking lots should include installation of effective traps and percolation basins to increase percolation of storm runoff.

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

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

1. 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.

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

3. Re-install the 12-inch high wooden baffle inside the flume prior to directing water through the flume, if it was destroyed during the previous winter.

4. Do not allow the pedal boat operator to dictate lagoon level.

5. Maximize lagoon depth throughout the dry season, while maintaining passage through the flume for adult steelhead until June 1 and for steelhead smolts until July 1. If the lagoon level begins to drop below the notch for steelhead smolts on one side of the flume because of the hole for adult steelhead after June 1, close the underwater portal for adults. If there is plenty of flow to maintain lagoon depth with the adult portal open, leave it open throughout the summer. If adult steelhead are seen in the lagoon after June 1 and the adult portal has been closed, then open the portal for a week to allow out-migration.

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

7. Secure the flume boards to prevent their lifting by vandals to drain the lagoon.

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

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

10. Do not reduce the lagoon level for the Begonia Festival's nautical parade.

11. Do not allow wading to propel floats during the Begonia Festival's nautical parade.

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

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

14. Install an automatic switch on the pump in the Esplanade storm drain to transfer water to the sewer during the dry season.

15. Regarding the nautical parade during the Begonia Festival, we 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. If wading is allowed, set a limit of 3 waders per float. Allow float passage in one direction only, presumably downstream, before dismantling near the Stockton Avenue Bridge. In the past, floats were taken down the lagoon and then back up before dismantling back at the bridge.

16. If wading during the nautical parade is allowed, continue to perform more detailed water quality monitoring before and after the nautical parade to determine the effects of wading. Continue to measure hydrogen sulfide levels.

17. 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.

18. 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.

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

FISH CENSUSING

Steelhead Plantings in Soquel Creek

No steelhead were planted in Soquel Creek in 2006, as was the case in 2003- 2005. It appears that CDFG allowed planting only in streams where the juveniles' parents were captured in those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured from Soquel Creek for the hatchery. Therefore, no juveniles were planted.

Results of Fish Sampling in Soquel Creek Lagoon

Our steelhead population estimate based on mark and recapture for fall 2006 was 992 juveniles +/- 125 compared to 1,454 juveniles +/- 347 in 2005 (**Table 12, Figure 16**) (methods in **Ricker 1971**). This was below our 14-year average of 1,160 juveniles. The only other species captured in Fall 2006 was threespine sticklebacks. No PIT-tagged juveniles from 2005 NOAA Fisheries tagging were captured on either sampling day in 2006.

Even with a freshwater lagoon created by the City of Capitola, the water temperature sometimes approaches the upper tolerance limit of steelhead for 1-2 hours per day when morning fog is absent and stream inflow is warm. If sufficient saltwater were present in the lagoon, water temperatures could become lethal for steelhead. Although tidal overwash occurred in 2001 and 2004, it was prevented in 2006. In 2004, lagoon water temperature reached 24ºC (75.2ºF) on 20 July after tidal overwash on 19 July. However, the elevated condition lasted only 4 days with quick flume management. The shroud was installed on the flume inlet and the adult portal was opened to encourage draining of saltwater from the lagoon. However, due to 2 tidal overwashes in July 2001, daily water temperature fluctuated between approximately 23 and 26ºC for 14 days near the bottom in Reaches 1-3. This likely forced juveniles higher in the water column or further upstream where water depth was less. This would increase vulnerability to predation. Also, the increased temperature increased fish metabolic rate, possibly reducing growth rate in 2001.

Fall sampling for steelhead occurred on 30 September and 8 October 2006, from just upstream of the Stockton Avenue Bridge, downstream. A bag-seine with dimensions 106-foot long by 6- feet

high by 5/16-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and just upstream of it. Juvenile steelhead congregate in the shade under the bridge. The seine was pulled to the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. A total of 300 unclipped juvenile steelhead were captured on the 2 days (compared to 294 in 2005, 447 in 2004, 204 in 2003 and 509 in 2002) ranging from 85 to 269 cm Standard Length (SL). A total of 178 juveniles from 5 effective seine hauls were marked on 30 September. On 8 October, 122 unmarked (unclipped) steelhead and 54 marked (clipped) steelhead were captured from 5 effective seine hauls. One adult steelhead was captured that day, measuring 470 mm SL and 535 mm Fork Length. The median size of juvenile steelhead captured the first day was 155-159 mm SL. The median size for unclipped juvenile steelhead captured on the second day was 145-149 mm SL. Time was not budgeted to measure lengths of the marked fish on the second day, which would have given a measure of growth over the week. However, the methods were those used in previous years.

We concluded from the size distributions of juveniles captured that steelhead grew at a faster rate in the 2006 summer lagoon than in the 2005 lagoon, consistent with less competition from a smaller juvenile population in 2006. It was the fastest growth rate in the last 9 years. Growth was greater in 2006 despite the delayed lagoon formation that occurred on 14 June 2006 compared to 9 June 2005. The median size for unclipped fish on both days was 150-154 mm SL in 2006 compared to 105-109 mm SL in 2005, 115-119 mm SL in 2004, 110-114 mm SL in 2003, 105-109 mm SL in 2002 and 125-129 mm SL in 2001 (**Figures 10-15**). In 2000, the median size increment was 135-139 mm SL (**Figure 16**). In 1999 it had been 120-125 mm SL (**Figure 17**). In 1998, the most popular size increment was 115-119 mm SL (**Figure 18**). Comparison of size distributions and the median size in each of the last 8 years, young-of-the-year growth rate was similar in 2002-2005, with faster growth rates in 1998-2001 and 2006.

Our lagoon population estimate in Fall 2006 indicated a smaller juvenile steelhead population compared to 2005, but it was sixth highest in 14 years of estimates. We would expect fewer juveniles to use the lagoon in 2006 than 2005 because there were higher adult passage flows late in the spawning season in 2006, encouraging less spawning in the lower creek to seed the lagoon with young-of-the-year steelhead. Past calculations indicated that lagoon 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 smolt production in the 16.6 miles of steelhead habitat in the mainstem, East and West Branches. The 2004 production estimate of 3,900 fish represented an estimated 47% of the smolt production for the 16.6 miles of habitat. The lagoon provides valuable habitat through proper management.

On 30 September 2006, 3 seine hauls were made for tidewater gobies with a 30-foot x 4-foot x 1/8-inch mesh beach seine in lower Soquel Lagoon near the beach. On 8 October, another 2 seine hauls were made. The sampling was adjacent to Venetian Court, around to the flume. The sheer drop off at the lagoon margin prevented more seining. This is the only location where a seine could be adequately beached to capture tidewater gobies. Threespine sticklebacks were abundant with no tidewater gobies captured. The last capture of tidewater gobies was one in fall,

1997. The low number captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98, probably indicated a lack of backwater areas to be used as refuges during high winter stormflows. This species was plentiful in Soquel Lagoon during the last drought of the late 1980's and early 1990's. Tidewater gobies have been recently reported in adjacent lagoons (Moran Lake and Aptos) by Jerry Smith (**pers. communication**). They may re-populate Soquel Lagoon in the future from these sources.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. Stream shading must be increased to provide cooler stream inflow. The City must maintain the water level as high as possible throughout the summer until sandbar breaching, without large fluctuations. It is potentially easier to maintain good water quality and water depth when there is higher streamflow into the lagoon in summer (known as summer baseflow). The ceiling grate constructed in 2003 makes it easier to maximize lagoon depth because a portion of the flow can spill over the boards into the ceiling opening with all of the flashboards in place. However, even with the grate, it was difficult to maximize lagoon depth in 2006 because of the seepage of water and sand under the flume (**Figure 2**).

If the lagoon becomes too shallow, steelhead habitat in the upper lagoon is lost. This is another reason to keep the lagoon as deep as possible during summer. The flume's flashboards must be secured against vandal's intent on draining the lagoon and against tidal backpressure that may dislodge the boards.

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. Minimizing pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

Table 12. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2006.

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 and one with rope tangled around one pole.

2006- 992 +/- 125 (standard error). 178 fish were marked in 5 effective seine hauls.

Recommendations Regarding Fish Management

1. 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 Game Department of the streamflow conditions so that direct water diversion of surface flow 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. Complete loss of surface flow should be avoided.

2. Maximize lagoon depth by maximizing the number of flashboards in the flume inlet as streamflow declines and by sealing the boards with visquine and/or plywood, as was done in the past.

3. Secure the flume boards so that vandals cannot pry them up and drain the lagoon. This will prevent tidal surges through the flume from doing the same thing. Installation of a louver system on one side of the flume inlet would eliminate the need to deal with boards all summer. The design and installation of a louver system is recommended.

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

5. Do not remove flume boards for the Begonia Festival's nautical parade or prior to taking fall vacation time.

6. Remove flume boards as the first small storms begin in fall and replace the boards after the stormflow has subsided. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches. Many forecasts for rain and storm intensities are incorrect in the early fall. It is harmful to steelhead to drop the lagoon level in anticipation of a storm that fails to develop and then fail re-install the flume board afterwards.

7. Maintain the lagoon in fall until streamflow has increased enough (20-25 cfs) to prevent stranding of spawning adult steelhead or coho salmon and to prevent osmotic stress to lagoon- inhabiting steelhead. If necessary, install a perimeter fence with 2"x 4" mesh with 6-foot panels around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. The goal should be to maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar. By this time, the winter storm pattern has usually developed to keep the sandbar open.

8. If sufficient turbidity occurs after the first storm of the season to prevent light from penetrating to the bottom of the intact lagoon for more than one day, reduce

lagoon depth temporarily to insure that light reaches the bottom. This will prevent death of aquatic vegetation and increased biological oxygen demand, with the associated loss of oxygen production that would have occurred from photosynthesis. Thus, anoxic conditions will be prevented. When the lagoon clears up, re-establish the maximum lagoon depth.

9. If the sandbar is still in place after November 15, maintain an opening in the flume inlet to allow early spawning adults to pass through the flume from the bay.

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

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FIGURES

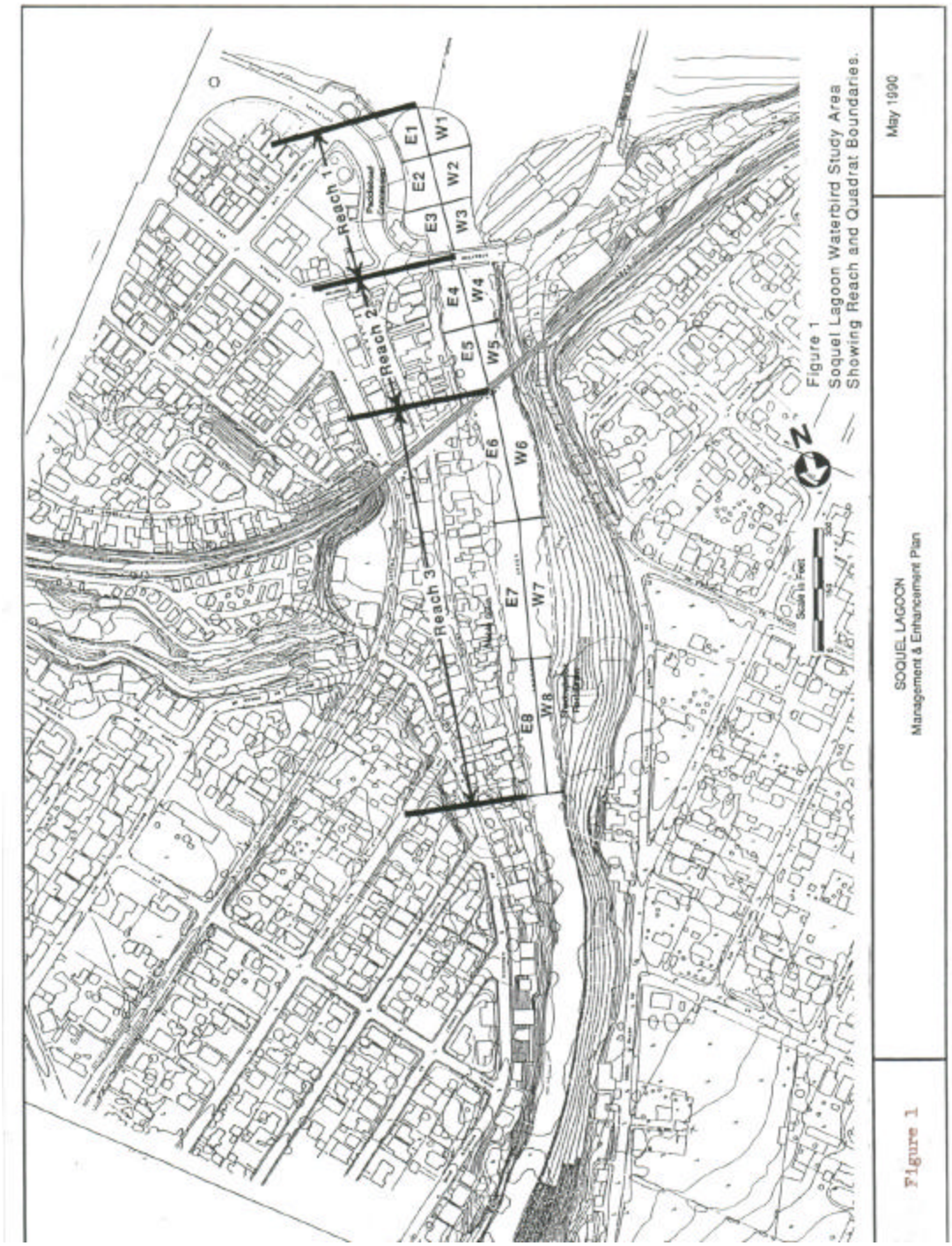
Reach 1
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Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.
May 1990
SOQUEL LAGOON
Management & Enhancement Plan
Figure 1

Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Approximately 27 May to 6 December 2004- 2006.

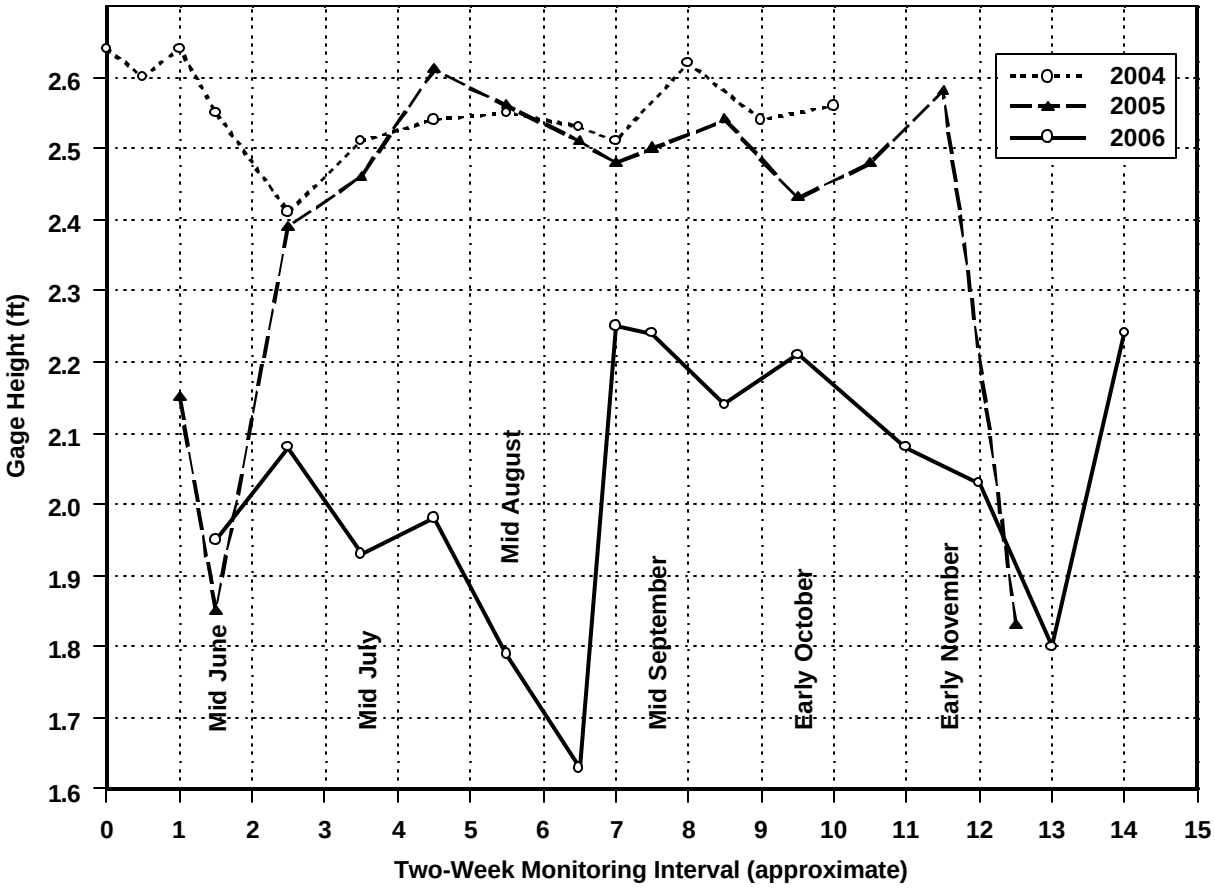


Figure 3a. 2005 and 2006 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr from 19 June to 6 December.

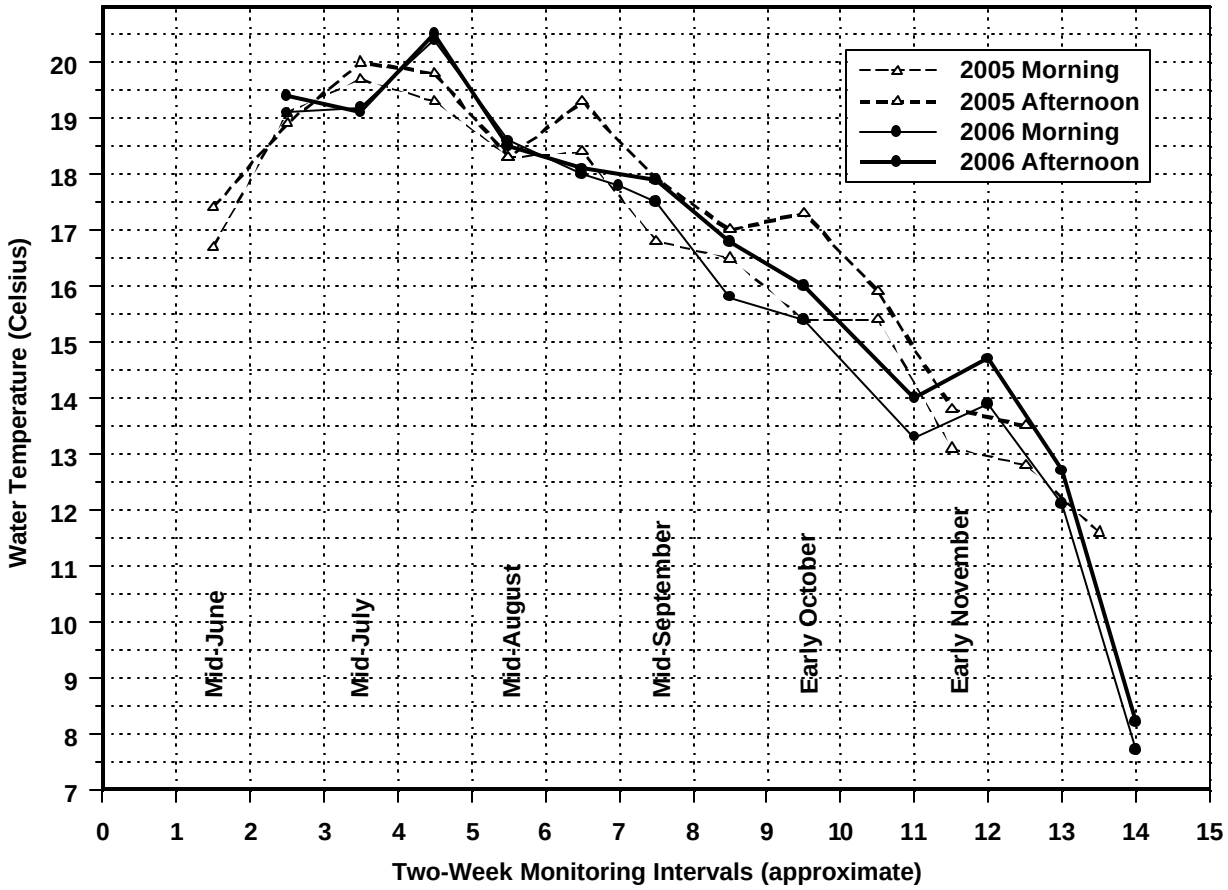


Figure 3b. 2005 and 2006 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr from 18 June to 6 December.

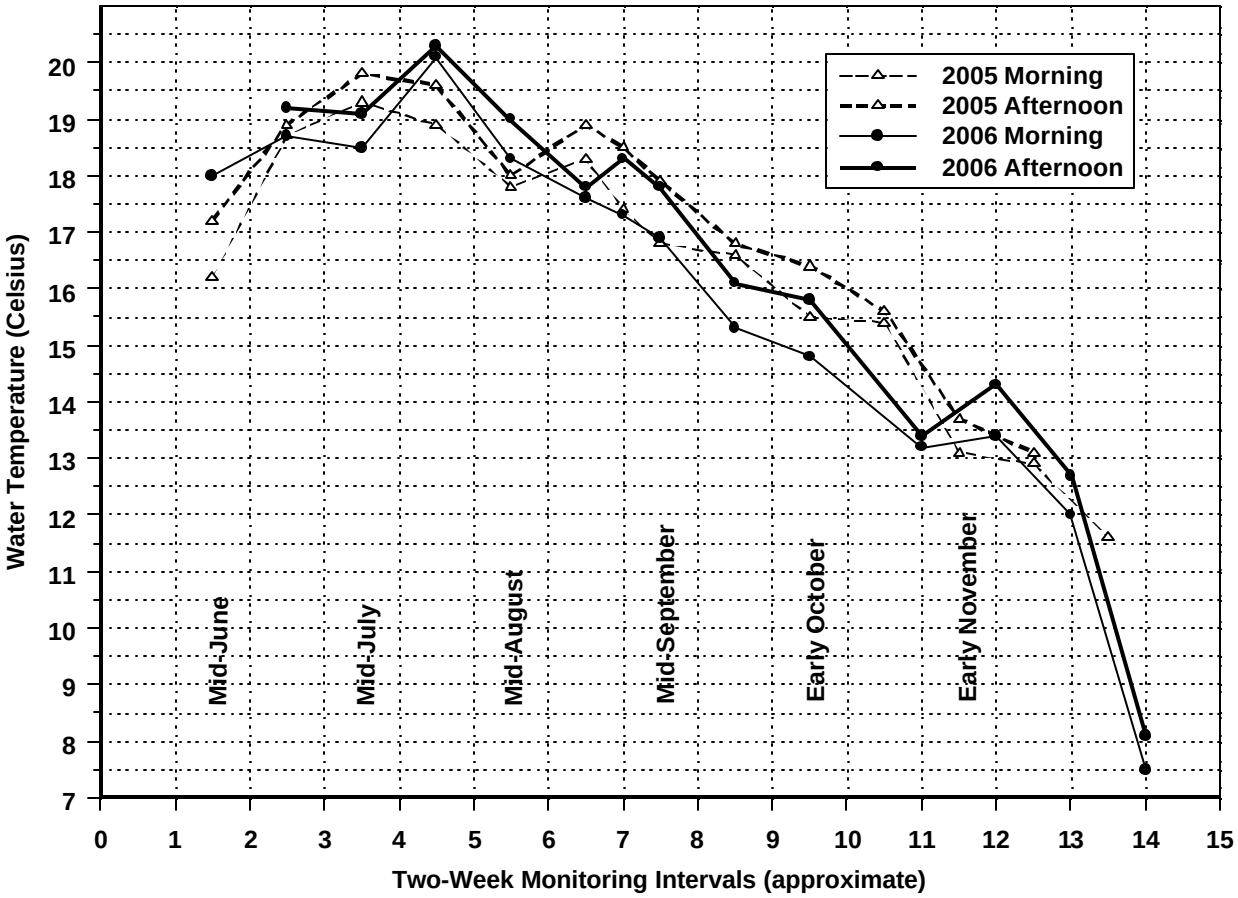


Figure 3c. 2005 and 2006 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr from Approximately 18 June to 6 December.

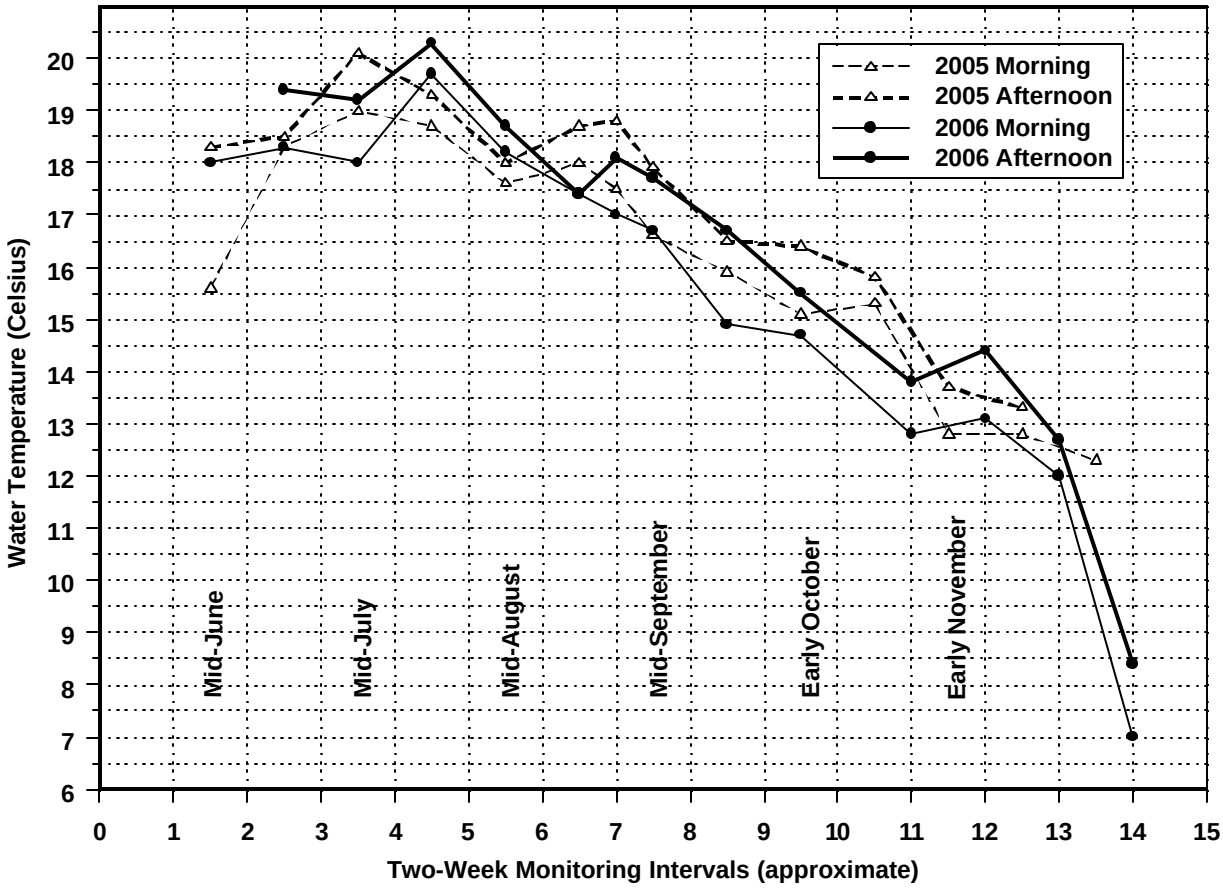


Figure 3d. 2005-2006 Soquel Lagoon Water Temperature at the Mouth of Noble Gulch Near the Bottom at Dawn and in the Afternoon after 1500 hr from 19 June to 6 December.

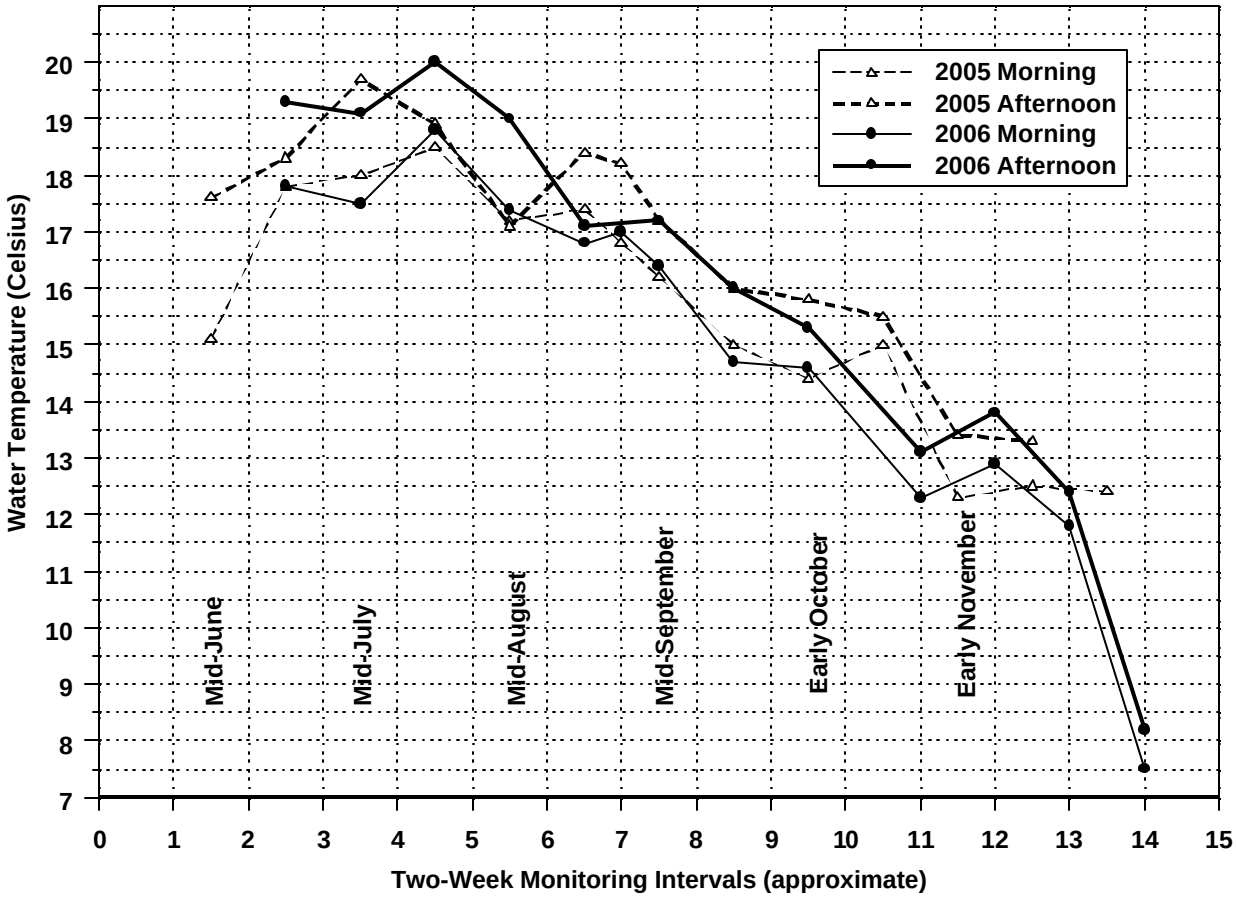


Figure 3e. 2005 and 2006 Soquel Creek Water Temperature at Nob Hill Above the Lagoon Measured Between 0800 hr and 0930 hr From Approximately 19 June to 6 December.

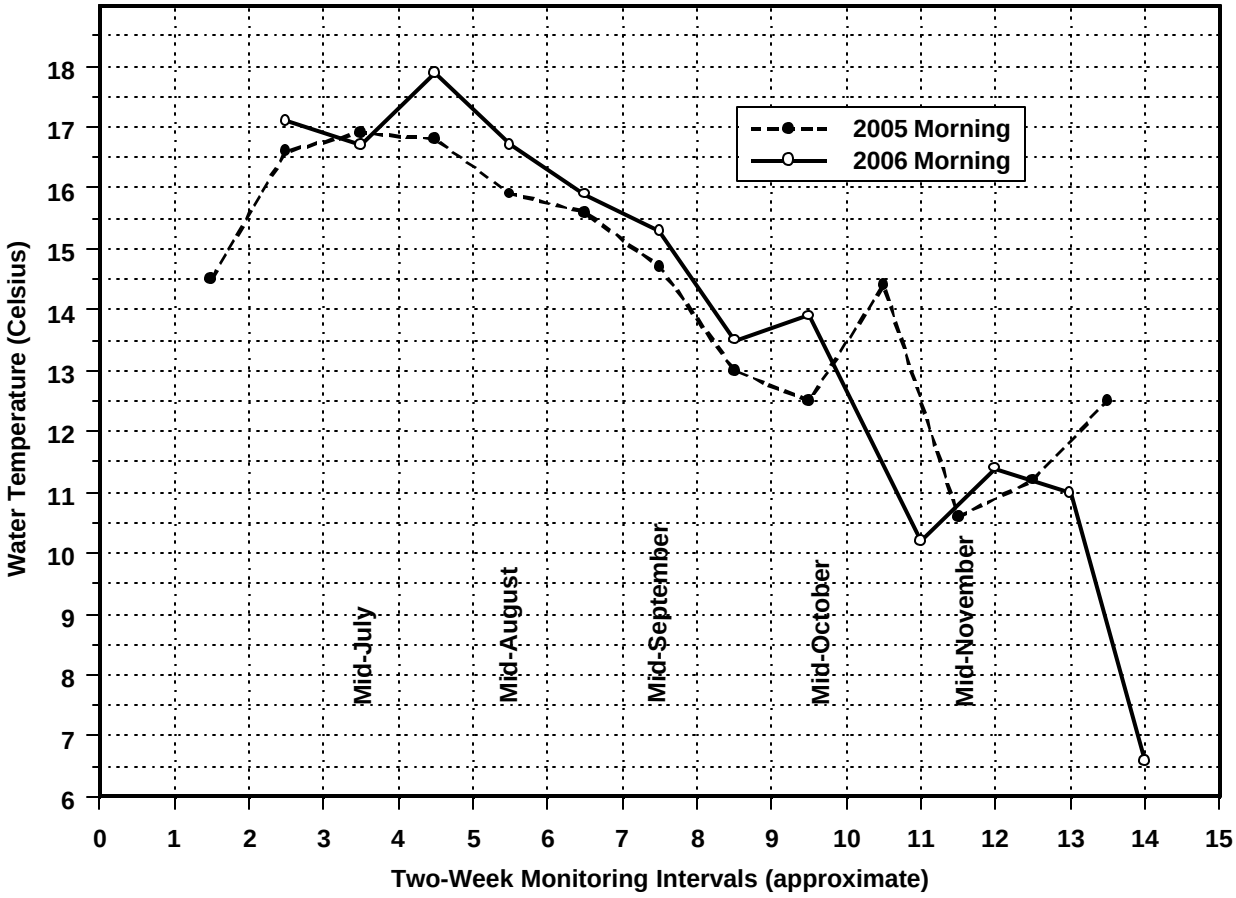


Figure 3f. Water Temperature at Four Lagoon Stations Near the Bottom and Upstream in Soquel Creek at Dawn from 30 June to 6 December 2006.

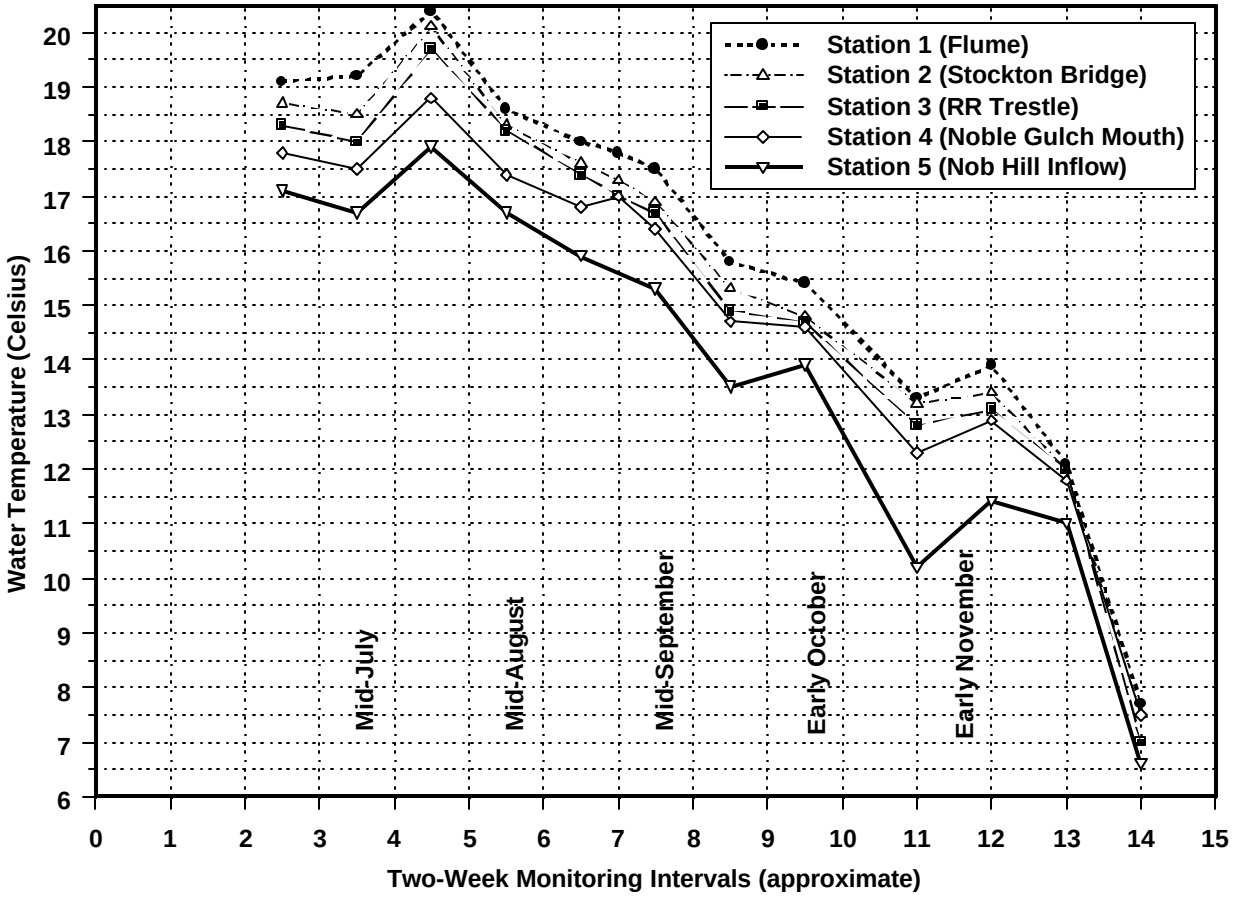


Figure 3g. Water Temperature at Four Lagoon Stations Near the Bottom Between 1500 and 1630 hr in the Afternoon from 30 June to 6 December 2006.

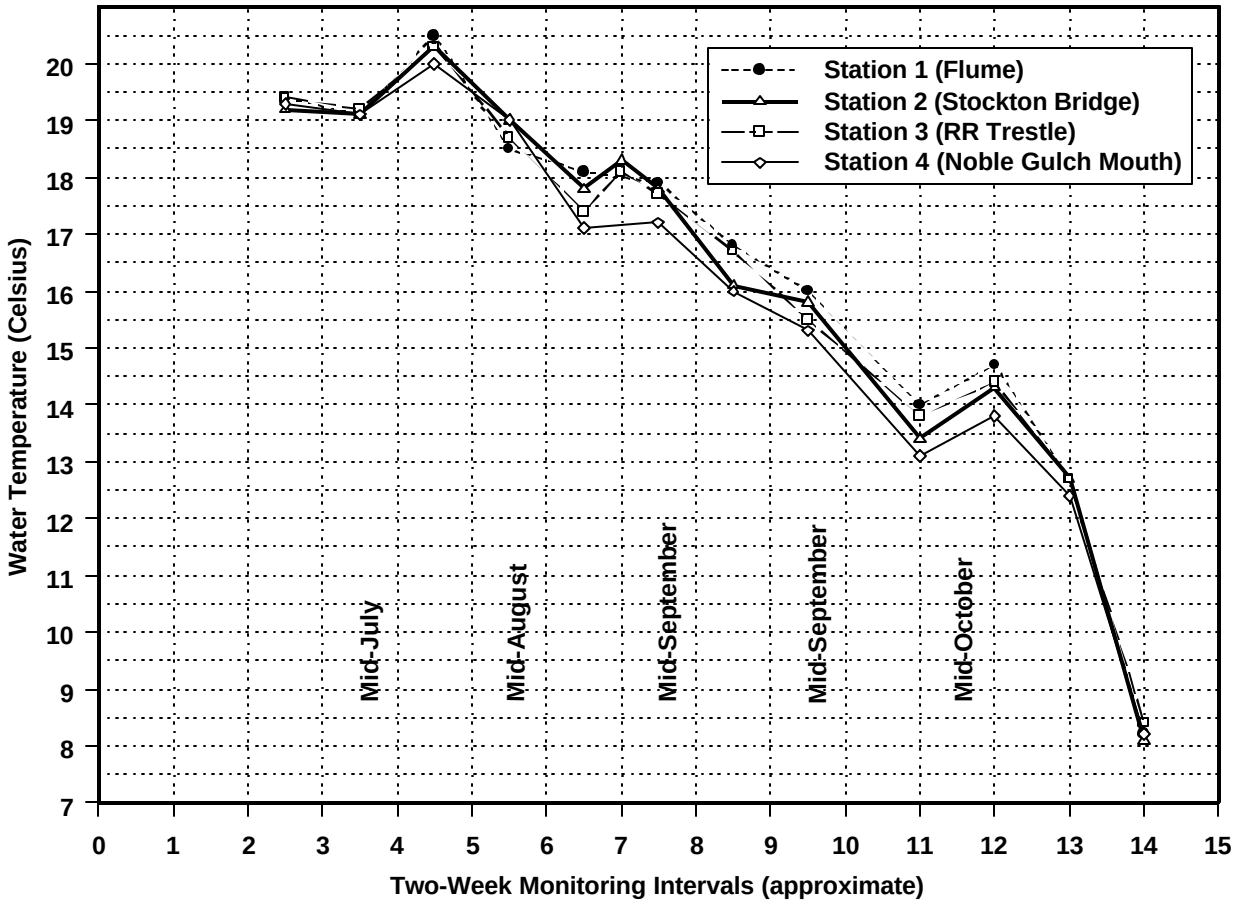


Figure 4a. Water Temperature (*C) Above Trestle, 0.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

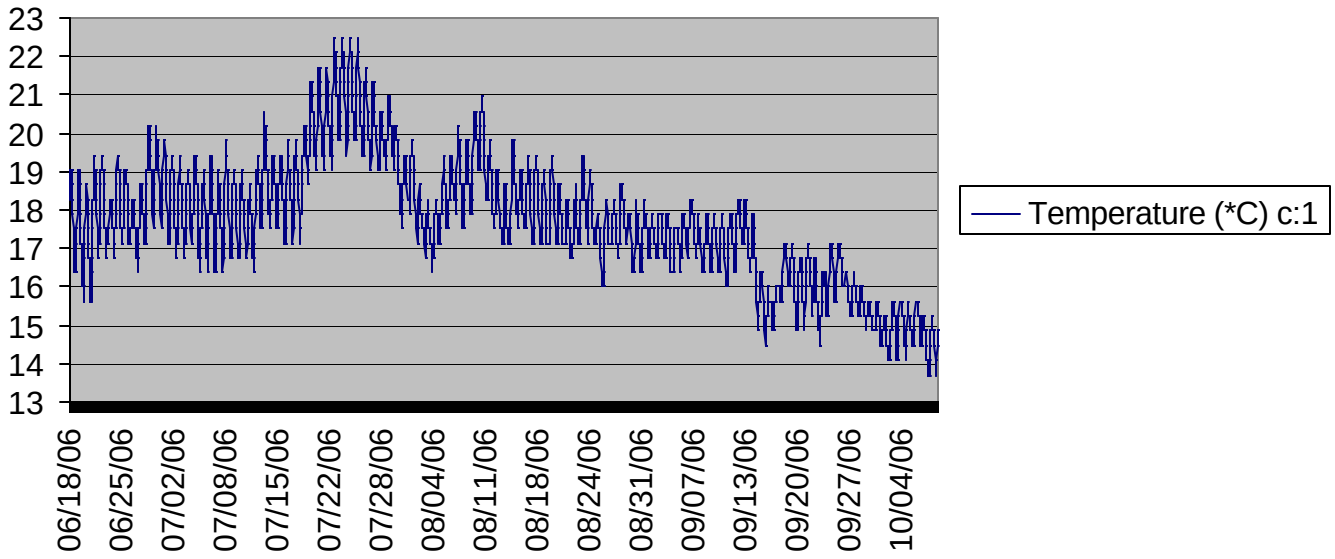


Figure 4b. Water Temperature (*F) Above Trestle, 0.5 ft from Bottom, 18 June-8 October 2006 (30 minute interval).

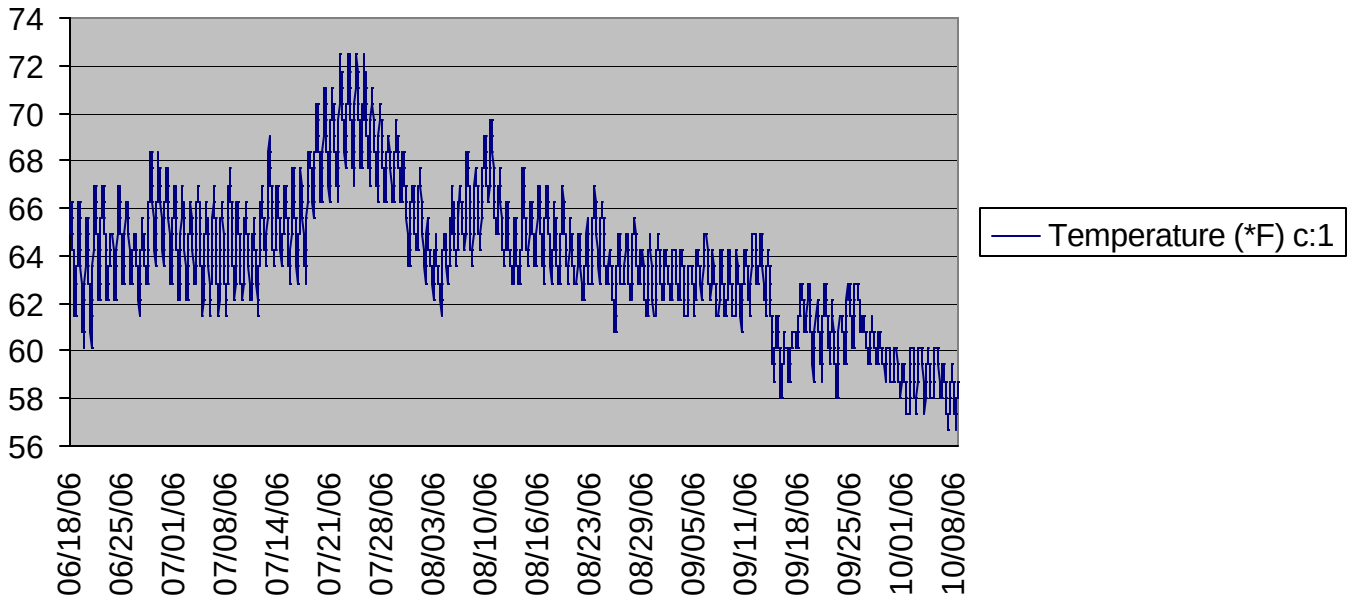


Figure 4c. Water Temperature (*C) Above Trestle, 1.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

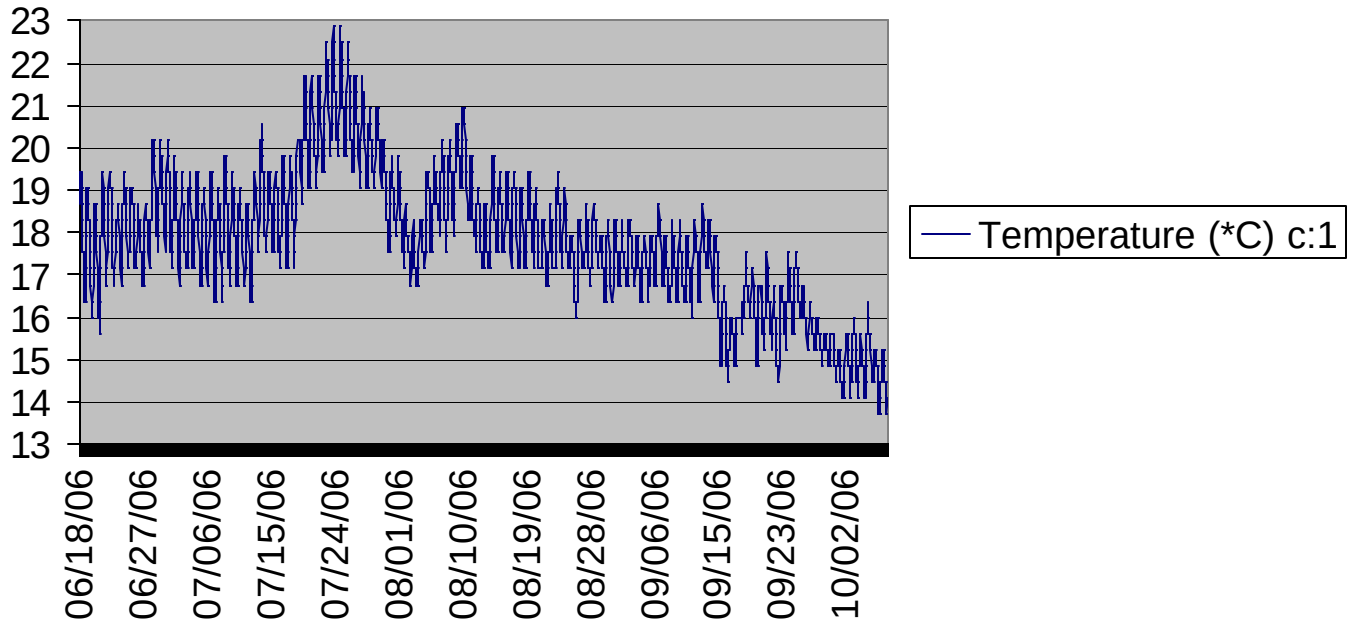


Figure 4d. Water Temperature (*F) Above Trestle, 1.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

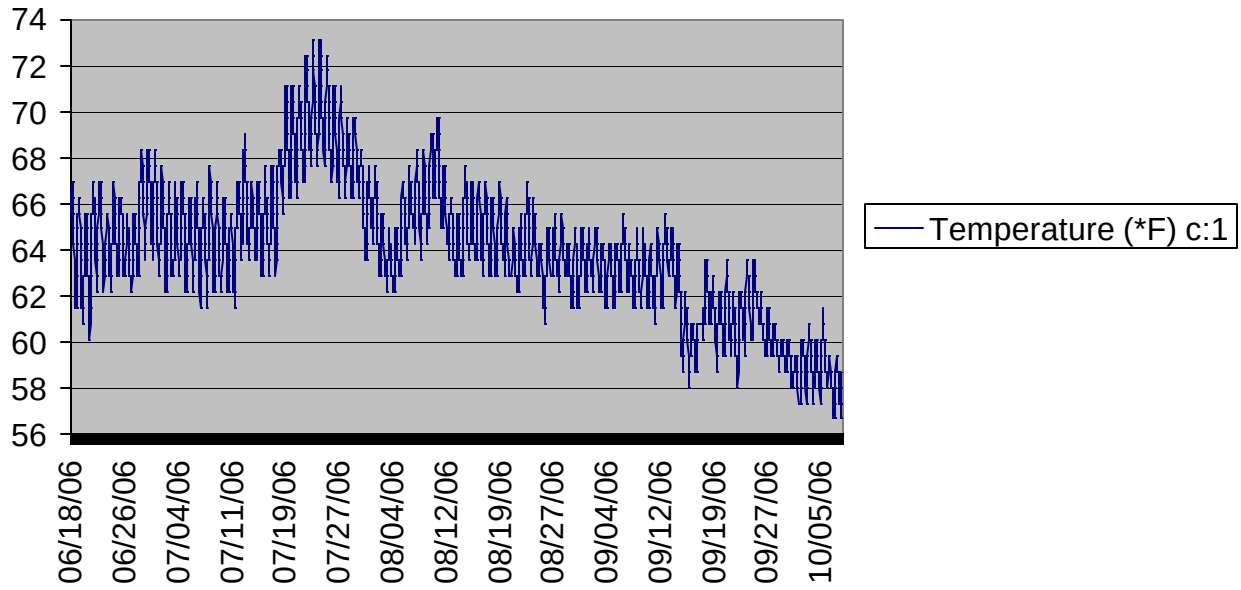


Figure 4e. Water Temperature (*C) Above Trestle, 2.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

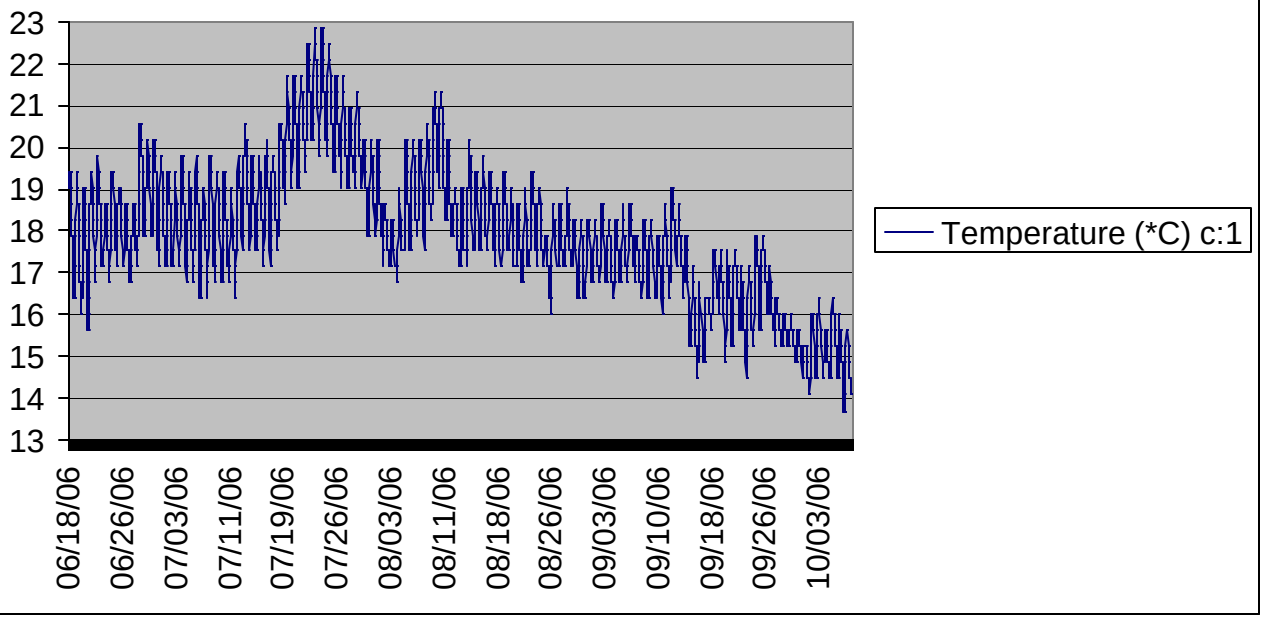


Figure 4f. Water Temperature (*F) Above Trestle, 2.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

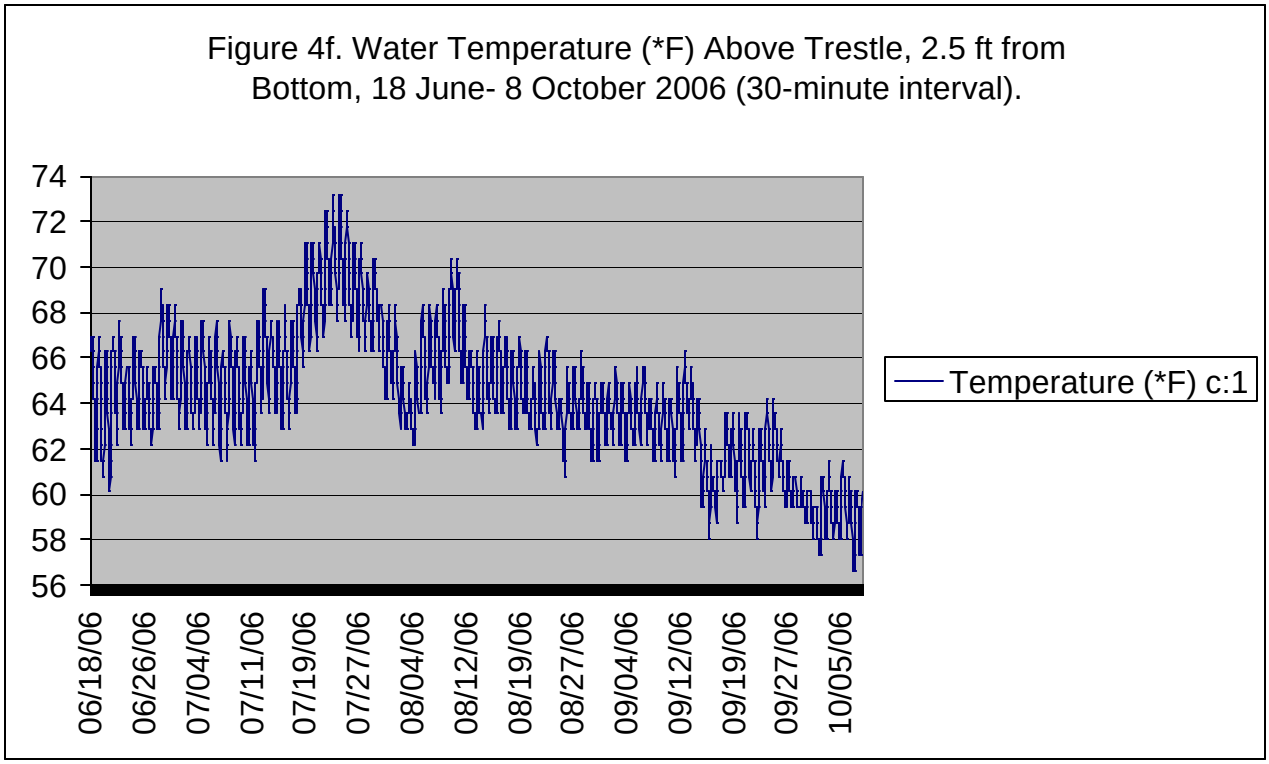


Figure 4g. Water Temperature (*C) Above Trestle, 3.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

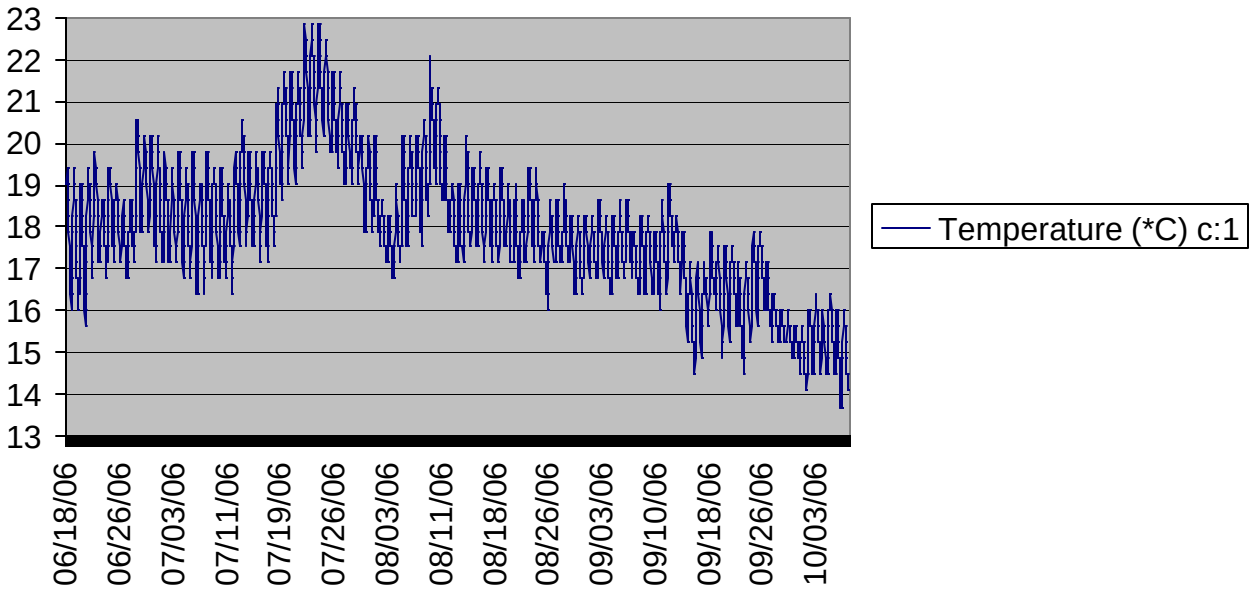


Figure 4h. Water Temperature (*F) Above Trestle, 3.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

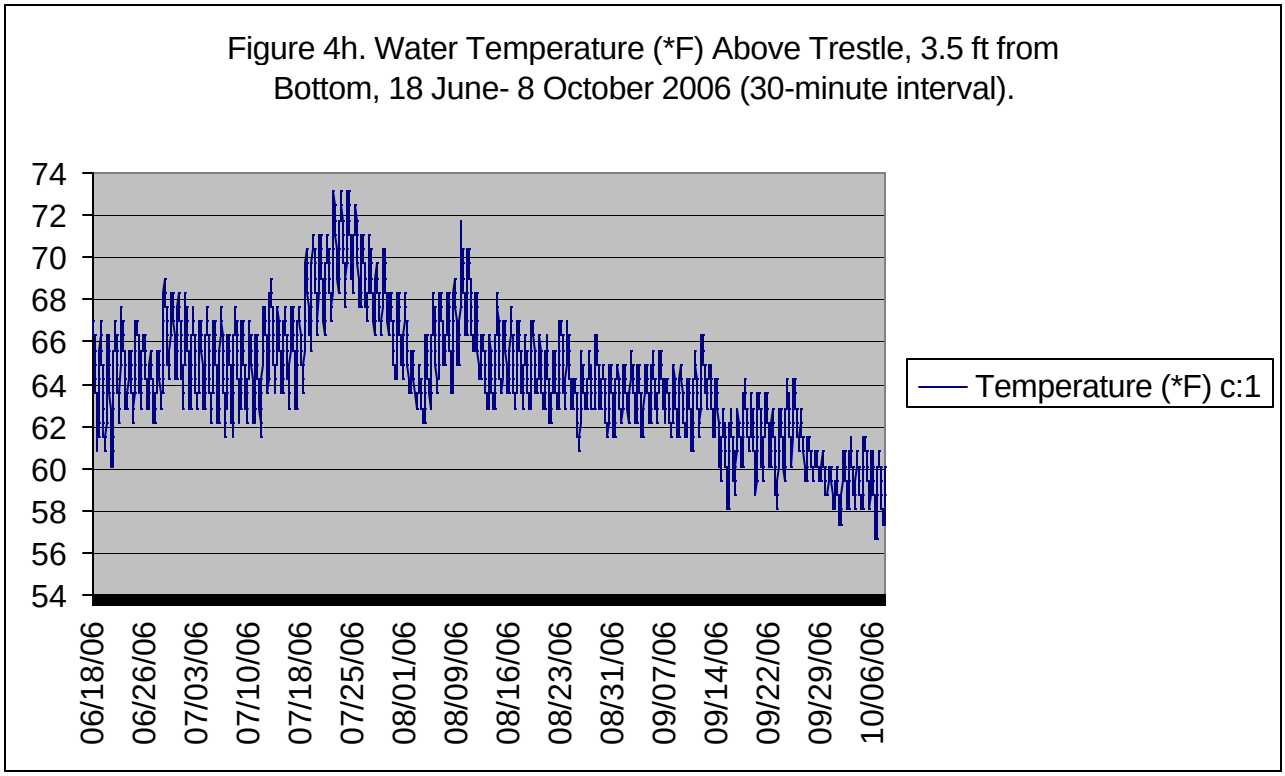


Figure 4i. Water Temperature (*C) Above Trestle, 4.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

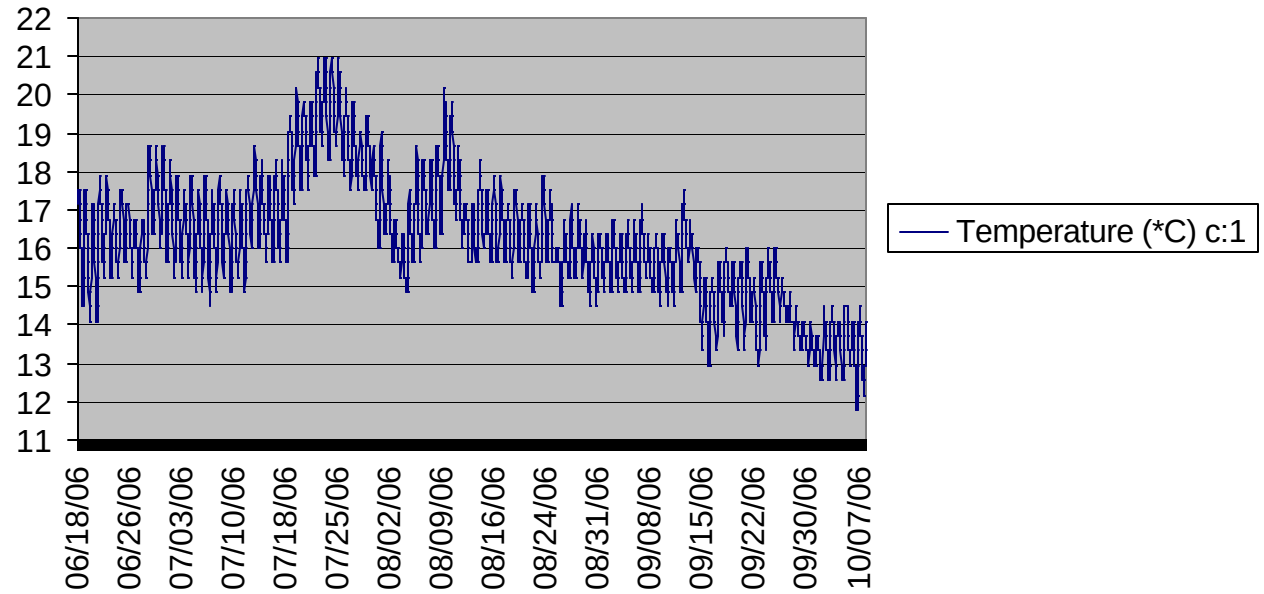


Figure 4j. Water Temperature (*F) Above Trestle, 4.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

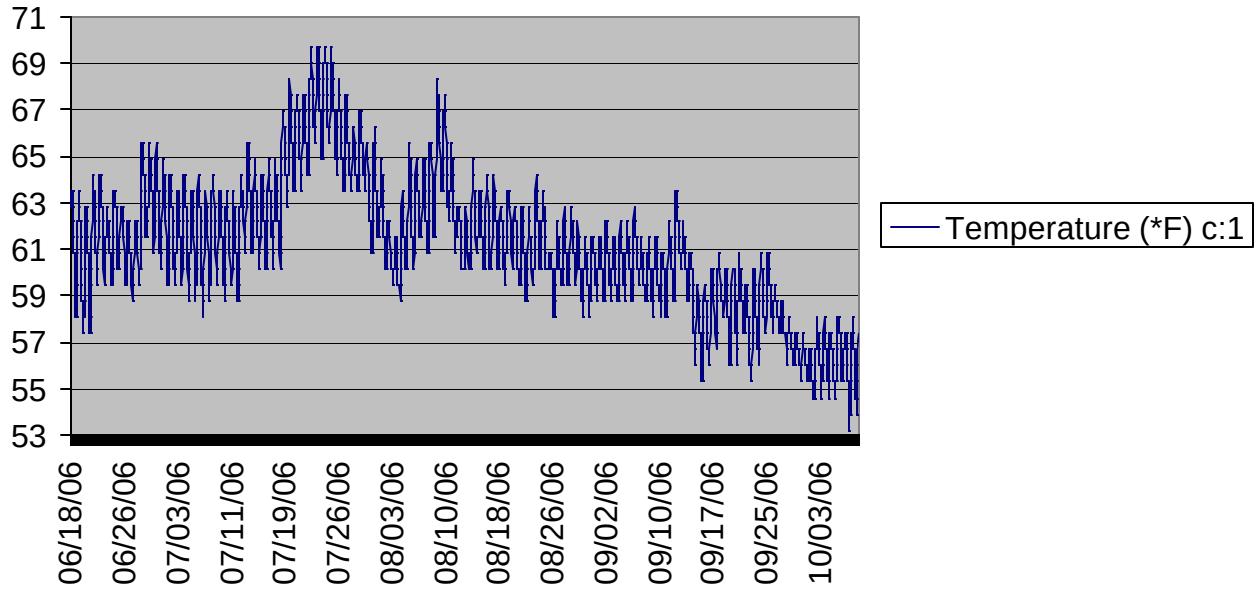


Figure 4k. Water Temperature (*C) Above Trestle, 5.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

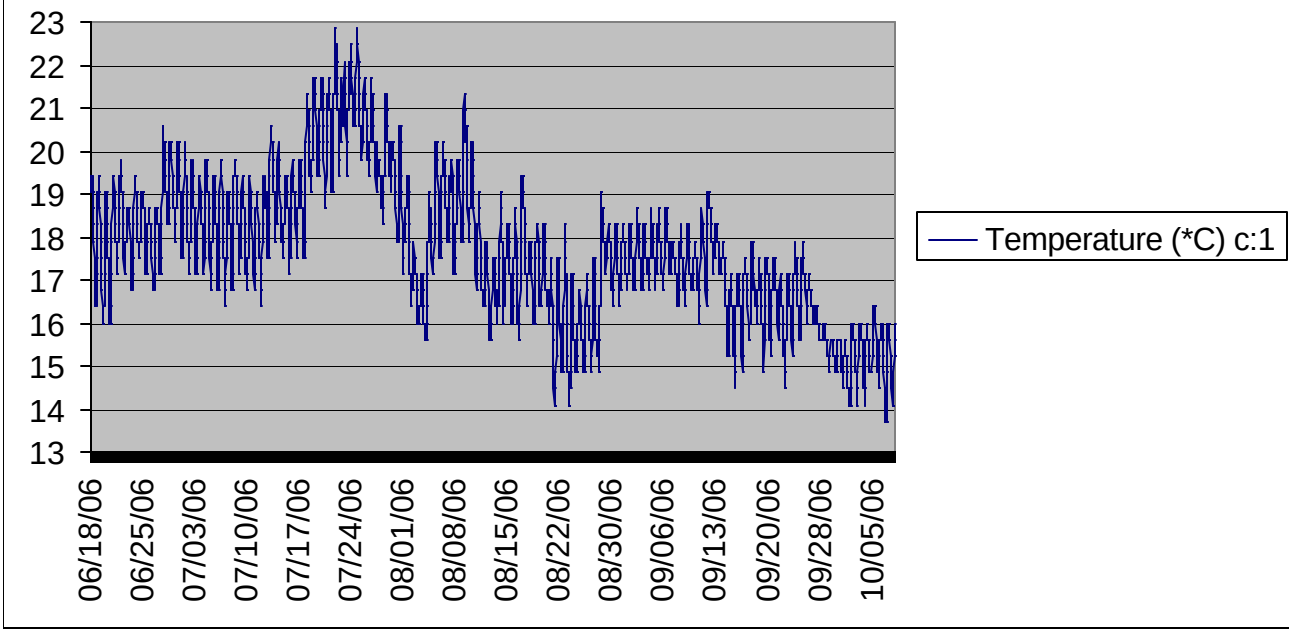


Figure 4l. Water Temperature (*F) Above Trestle, 5.5 ft from Bottom, 18 June- 8 October 2006 (30-minute interval).

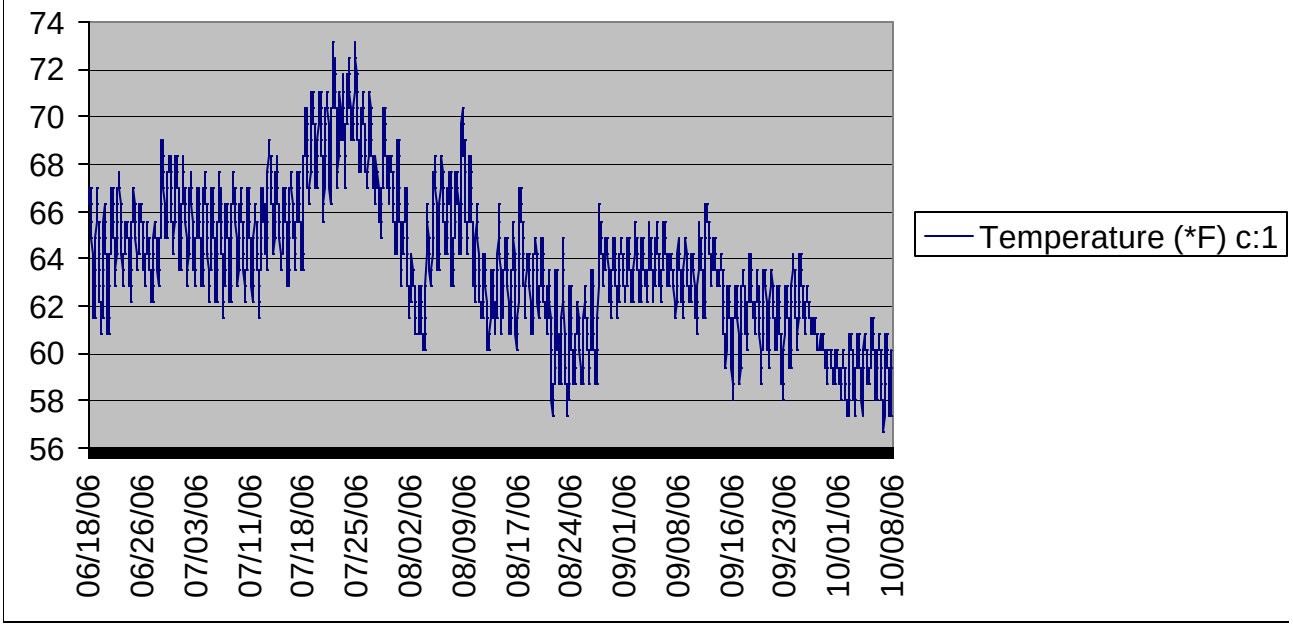


Figure 4m. Water Temperature (*C) Above the Trestle 0.5 ft from the Bottom, 10 June - 9 October 2005 (30-minute interval).

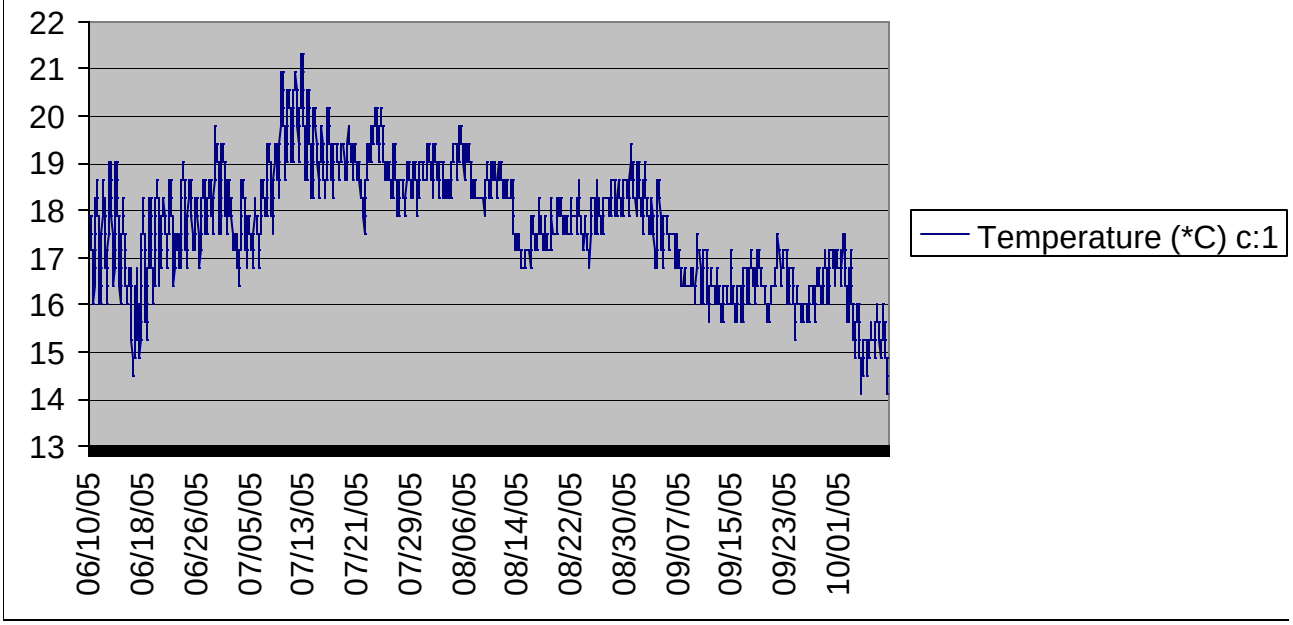


Figure 5a. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June- 12 September 2006 (30-minute interval).

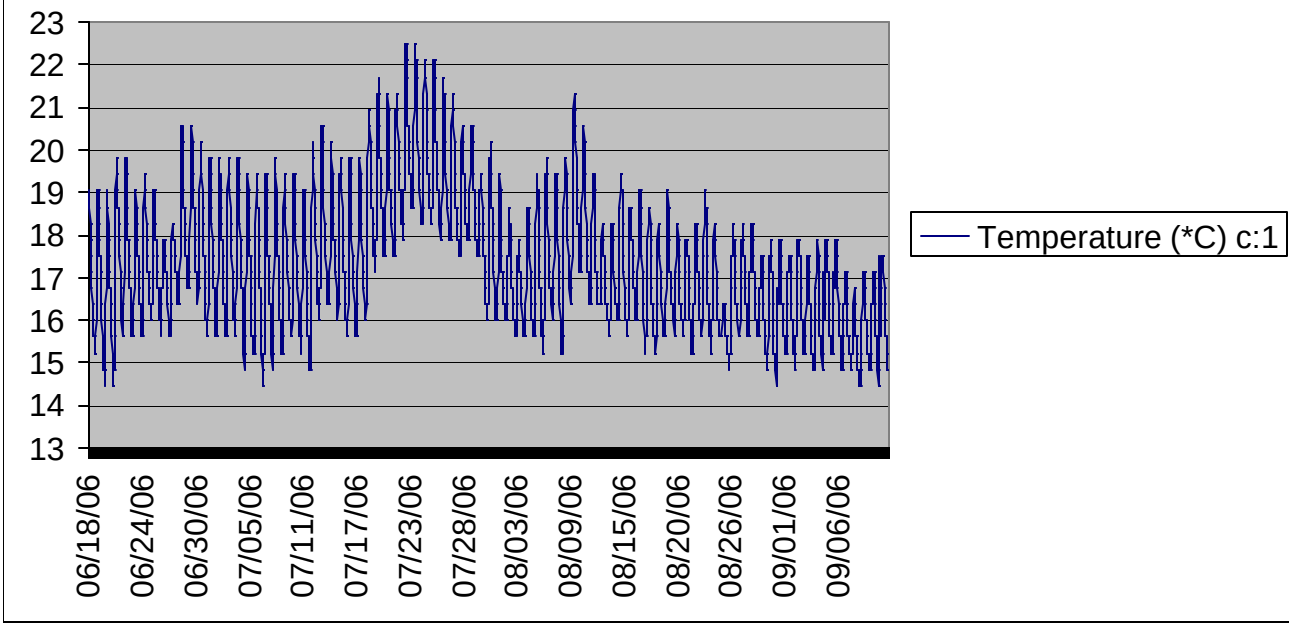


Figure 5b. Water Temperature (*F) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June- 12 September 2006 (30-minute interval).

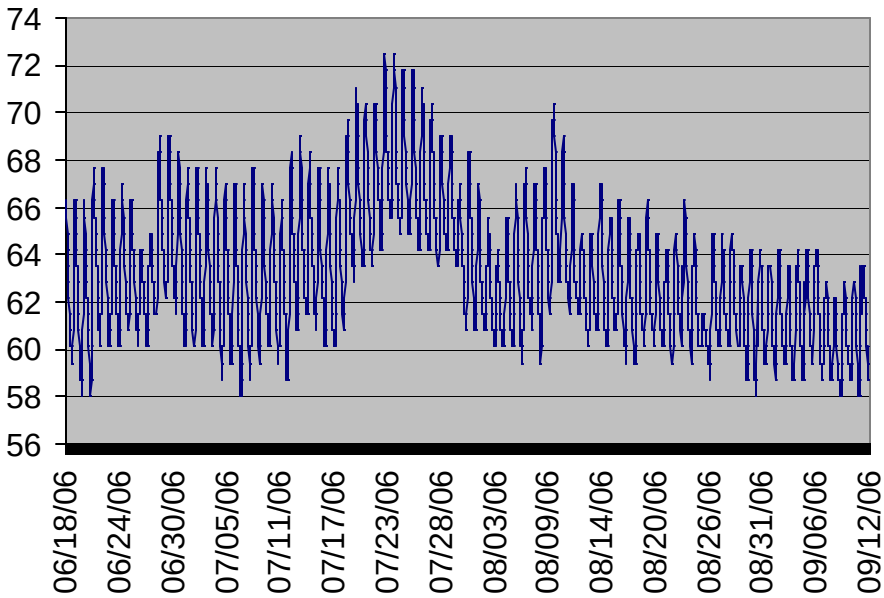


Figure 5c. Water Temperature (*C) in Soquel Creek at Nob Hill, 10 June to 9 October 2005 (30-minute interval).

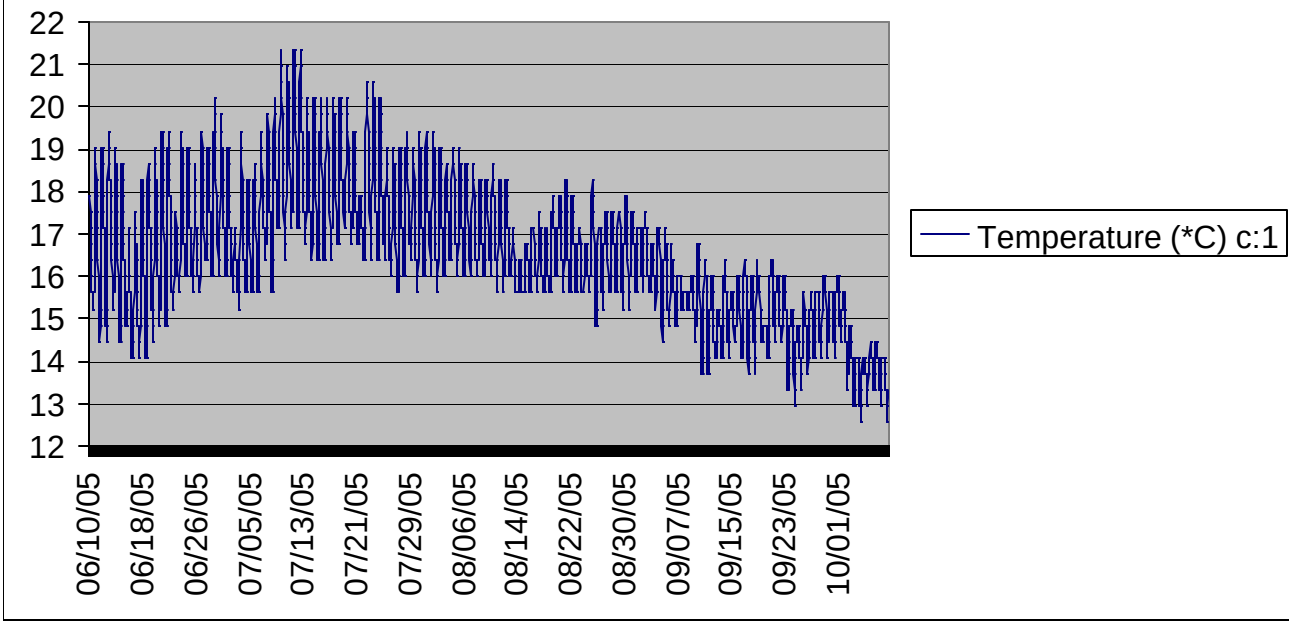


Figure 6a. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at 5 Stations, 30 June - 6 December 2006

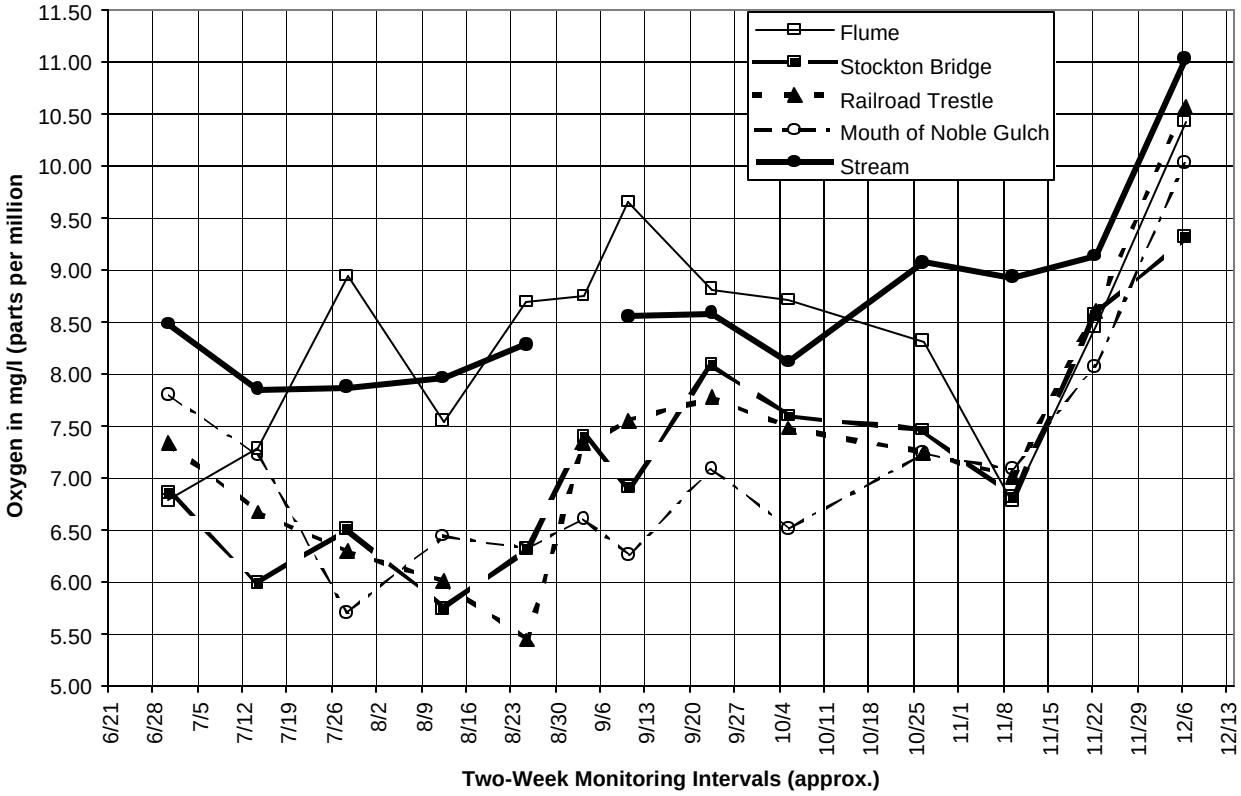


Figure 6b. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 1, the Flume, 30 June - 6 December 2006.

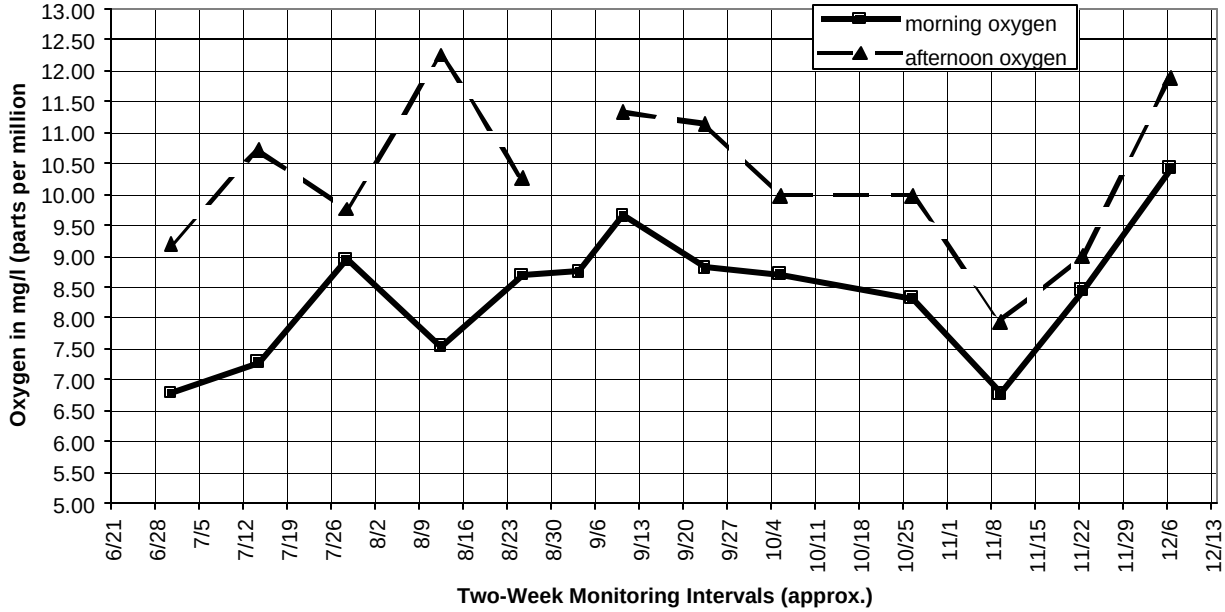


Figure 6c. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge, 30 June - 6 December 2006.

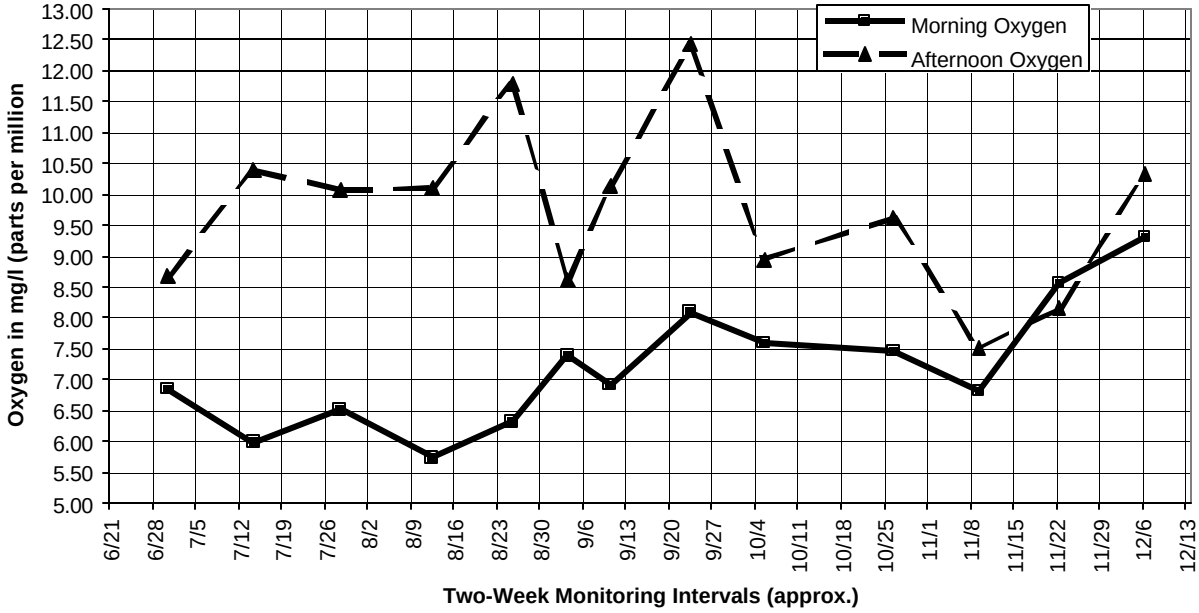


Figure 6d. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 meters of the Bottom at Station 3, the Railroad Trestle, 30 June - 6 December 2006.

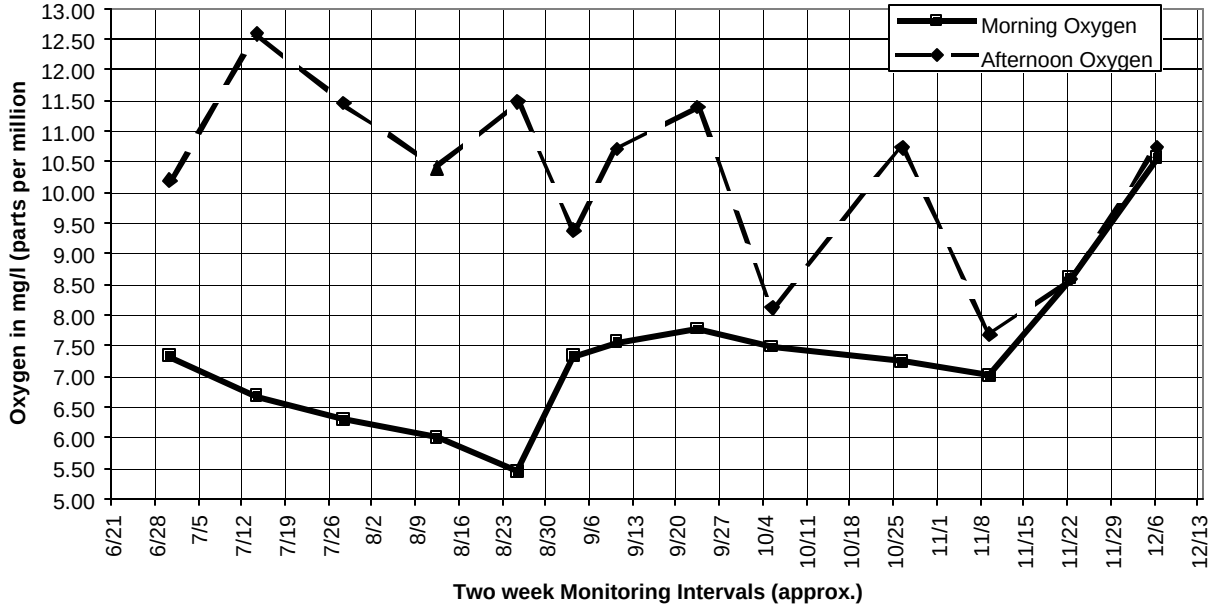


Figure 6e. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 4, the Mouth of Noble Gulch, 30 June - 6 December 2006.

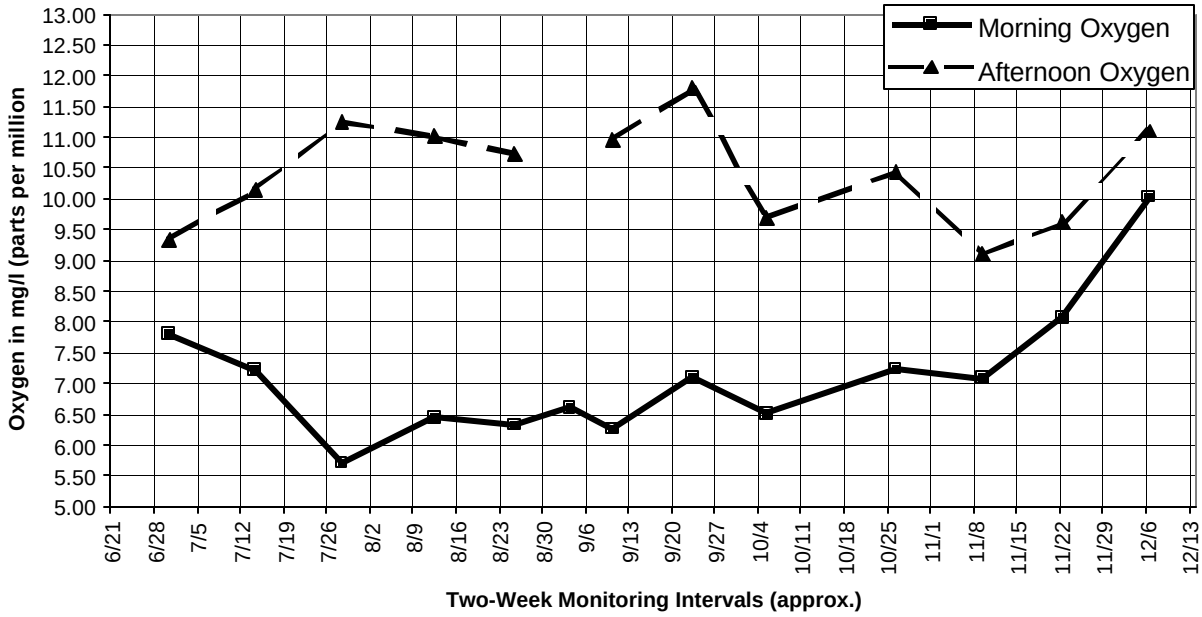


Figure 6f. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at 5 Stations, 19 June - 1 December 2005.

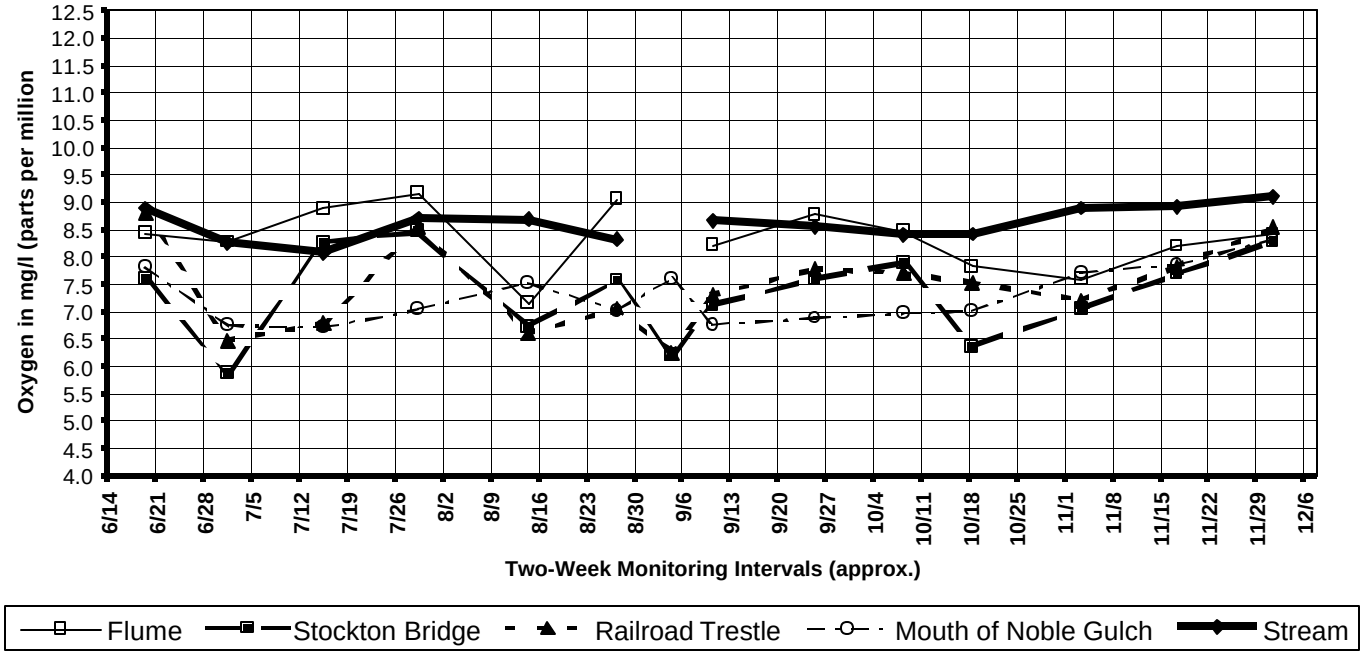


Figure 6g. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 1, the Flume, 19 June - 1 December 2005.

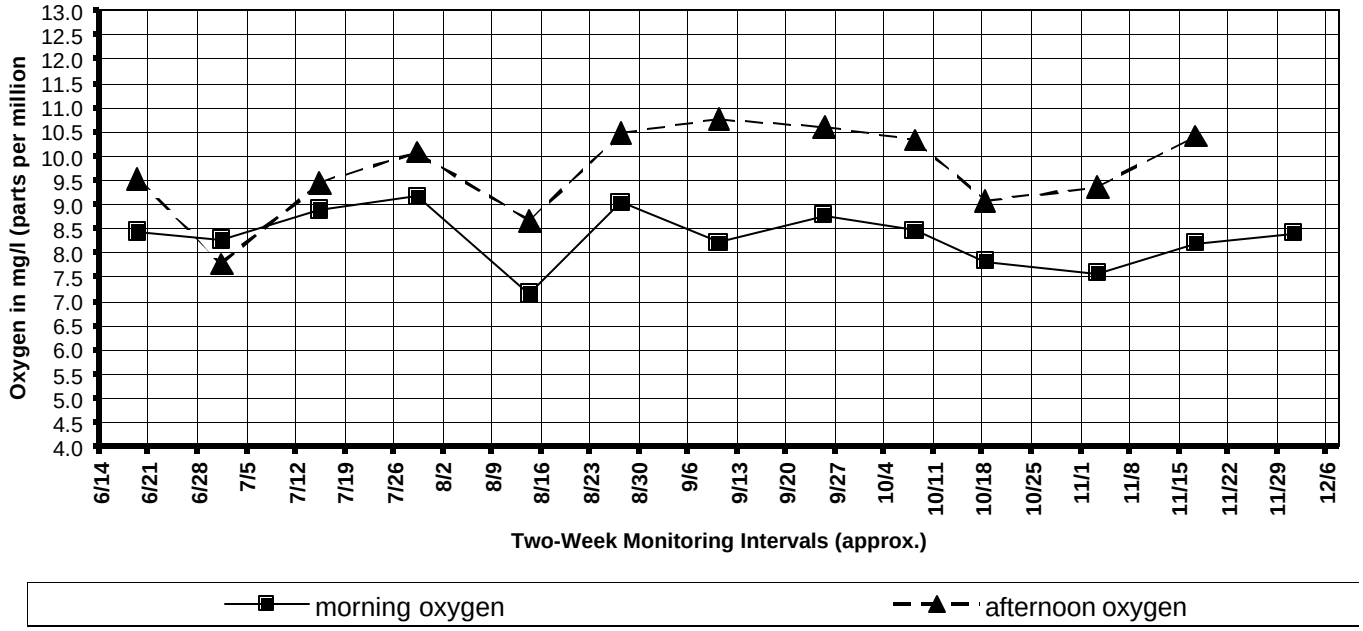


Figure 6h. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 2, Stockton Avenue Bridge, 19 June - 1 December 2005.

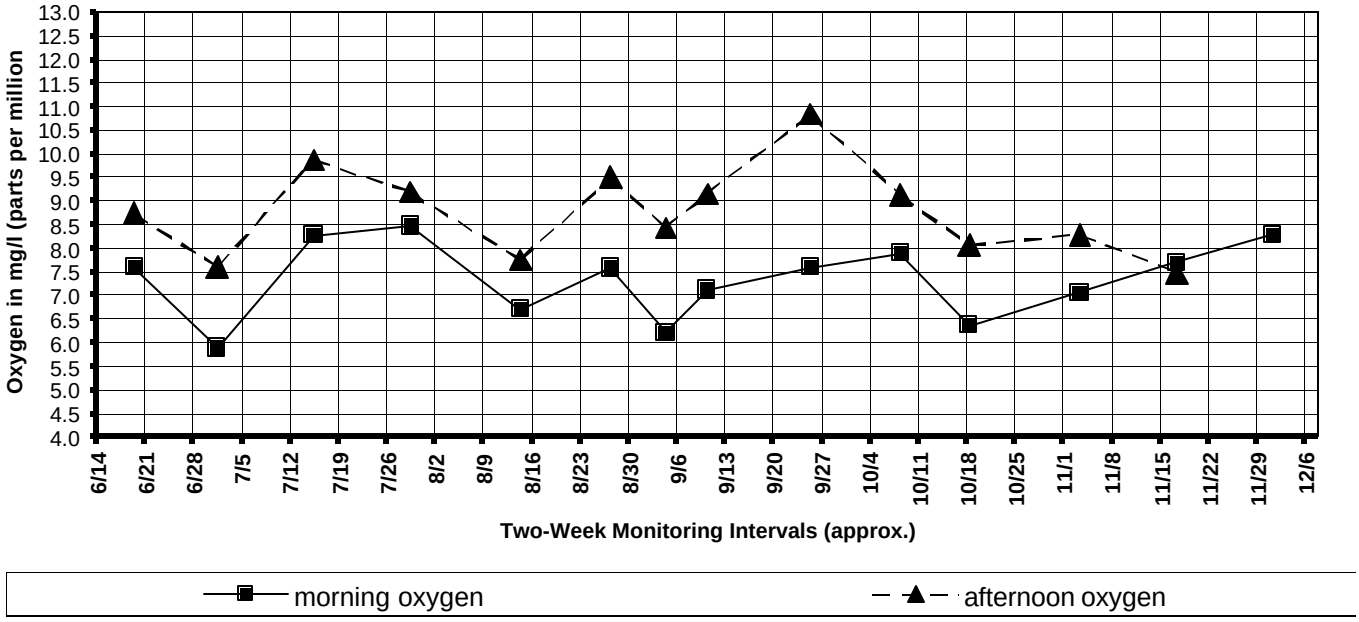


Figure 6i. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 19 June - 1 December 2005.

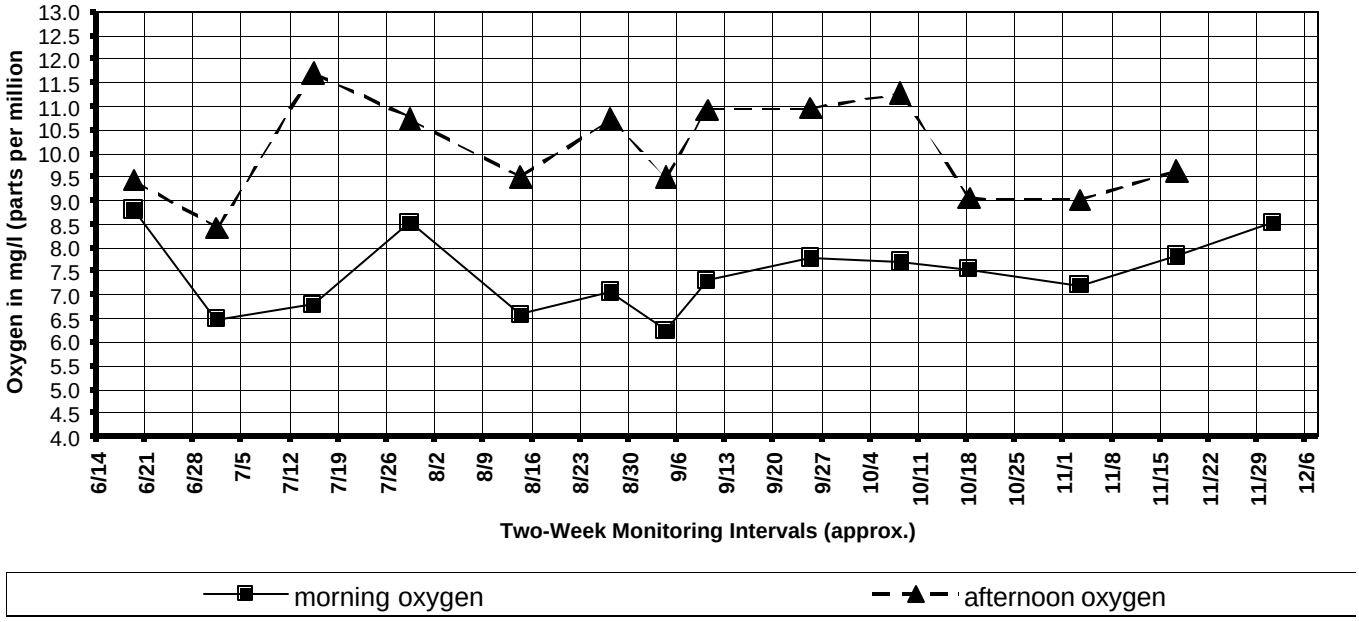


Figure 6j. Soquel Lagoon Oxygen Concentrations in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 4, Mouth of Noble Gulch, 19 June - 1 December 2005.

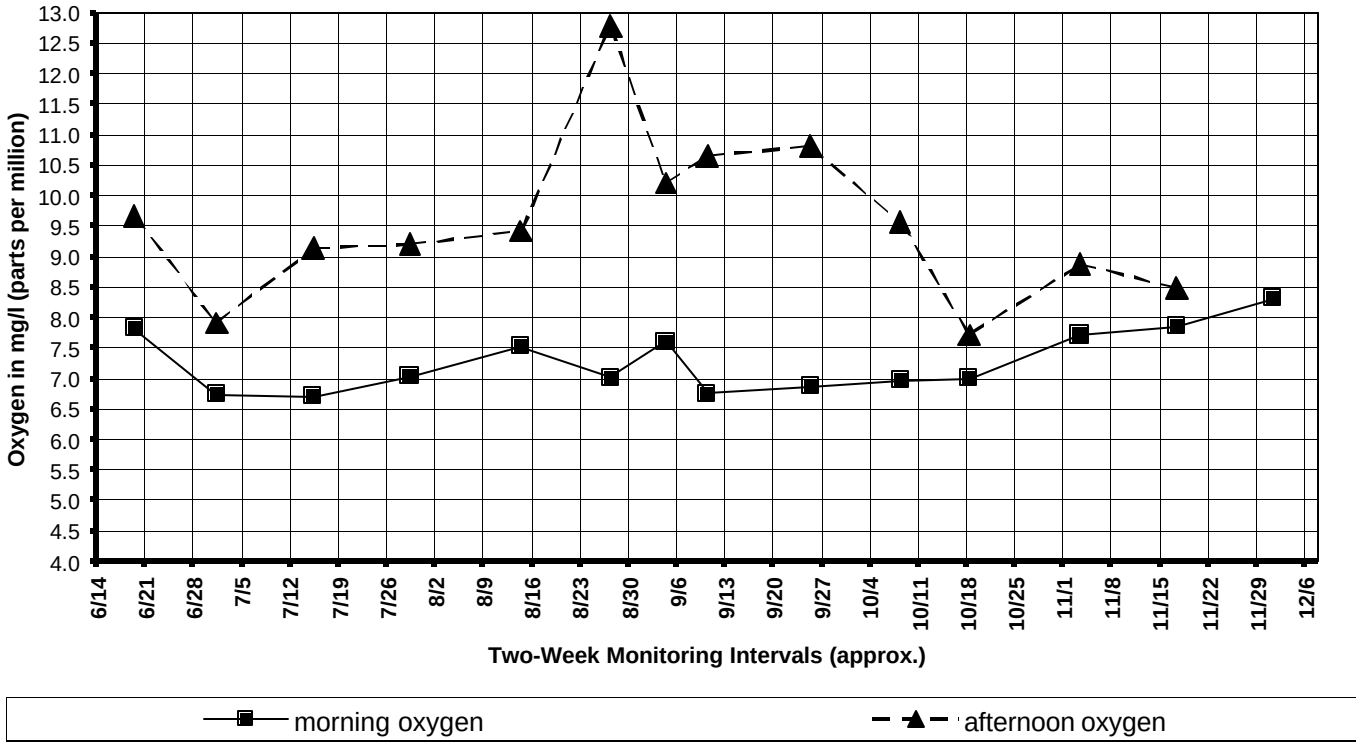


Figure 7. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

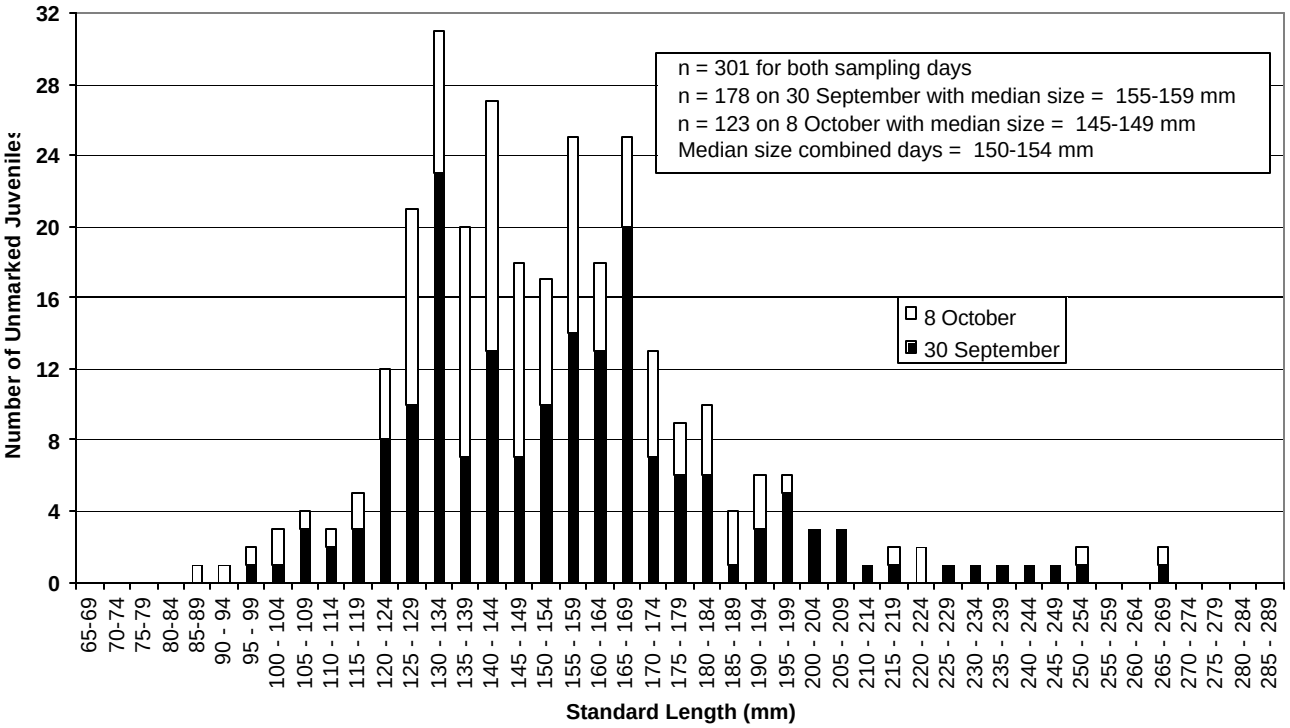


Figure 8. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

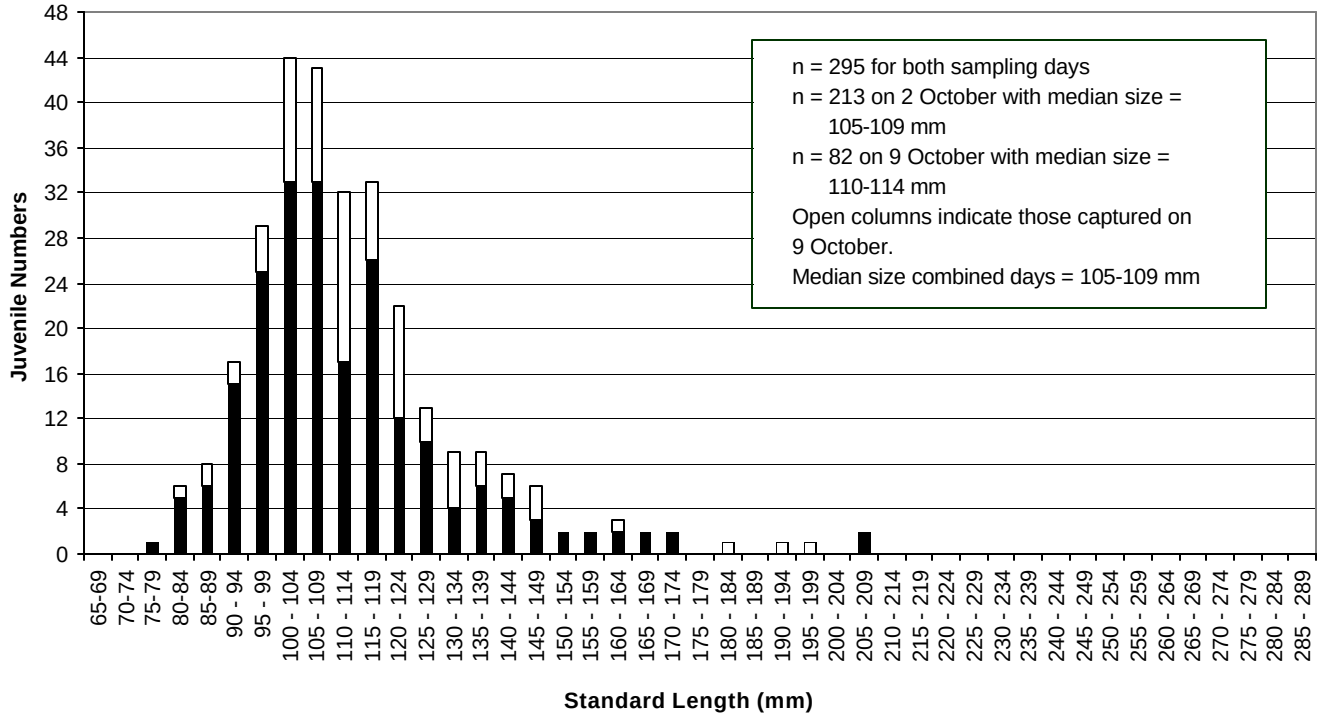


Figure 9 Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

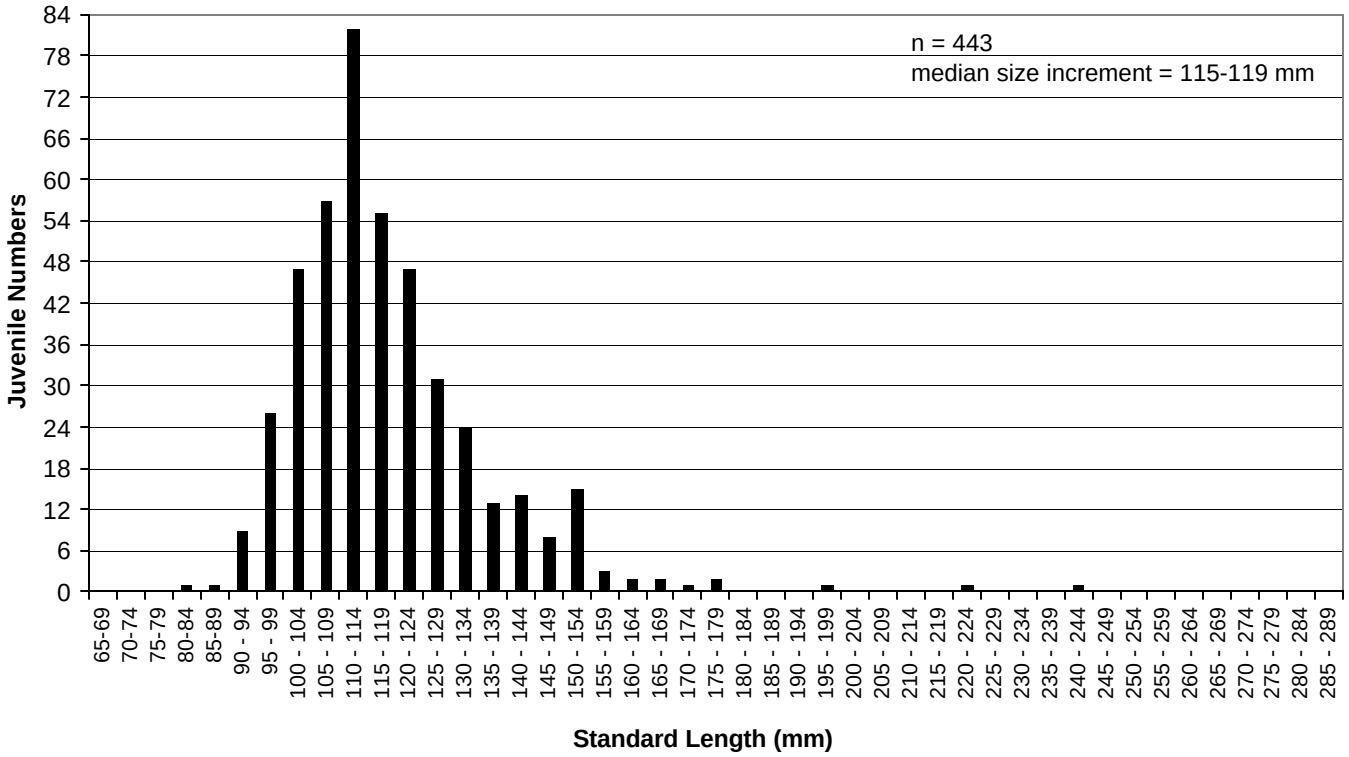


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

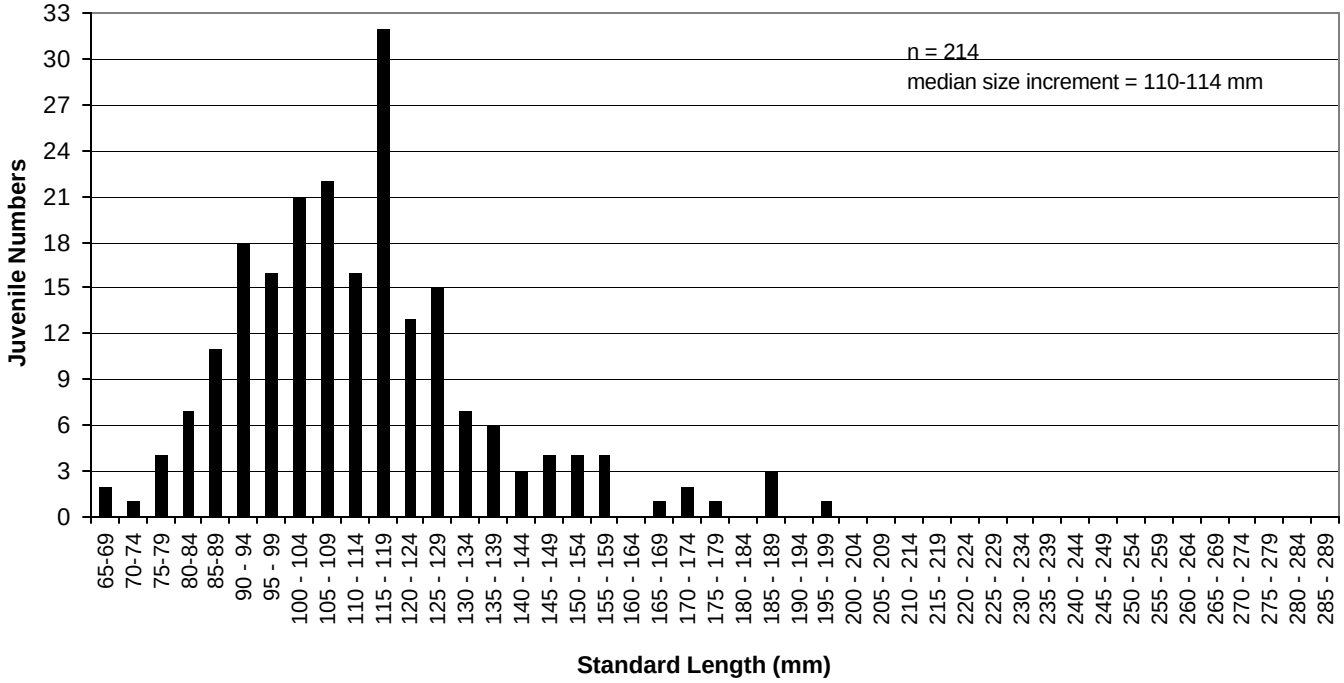


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 and 13 October 2002 in Soquel Lagoon.

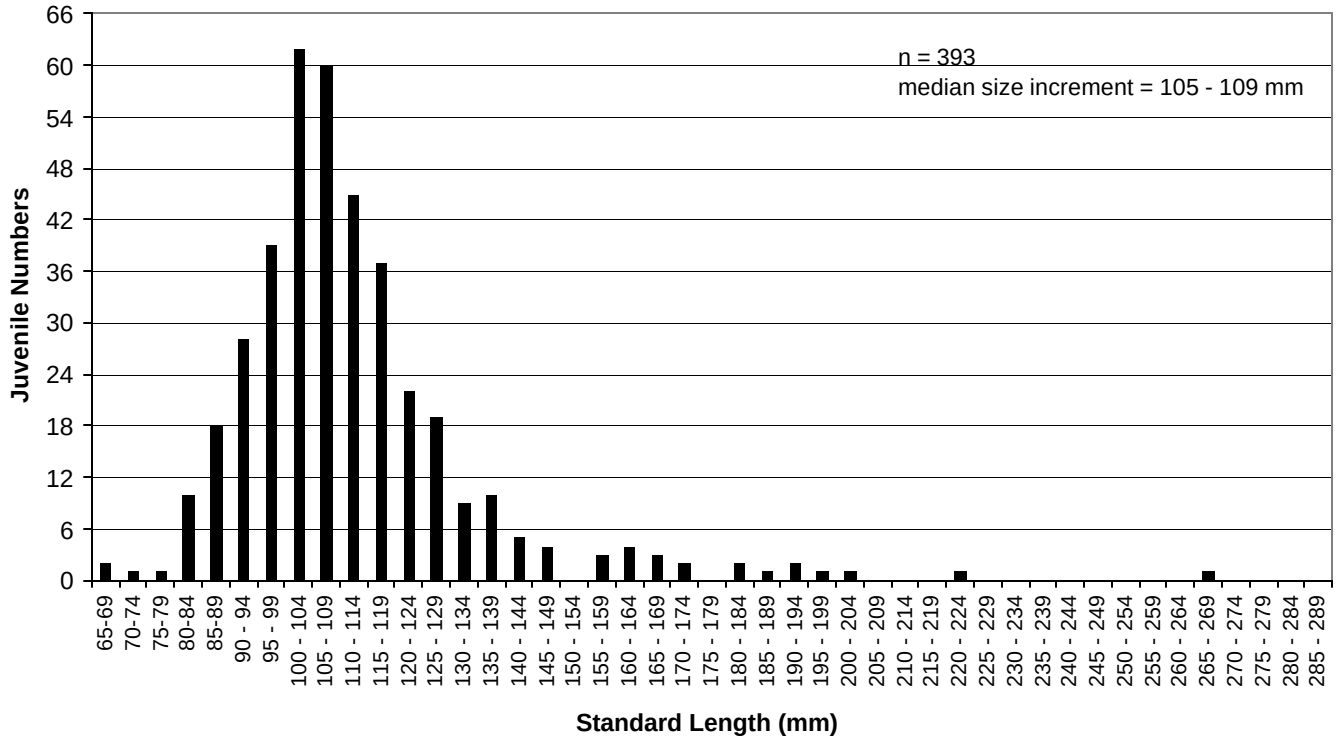


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

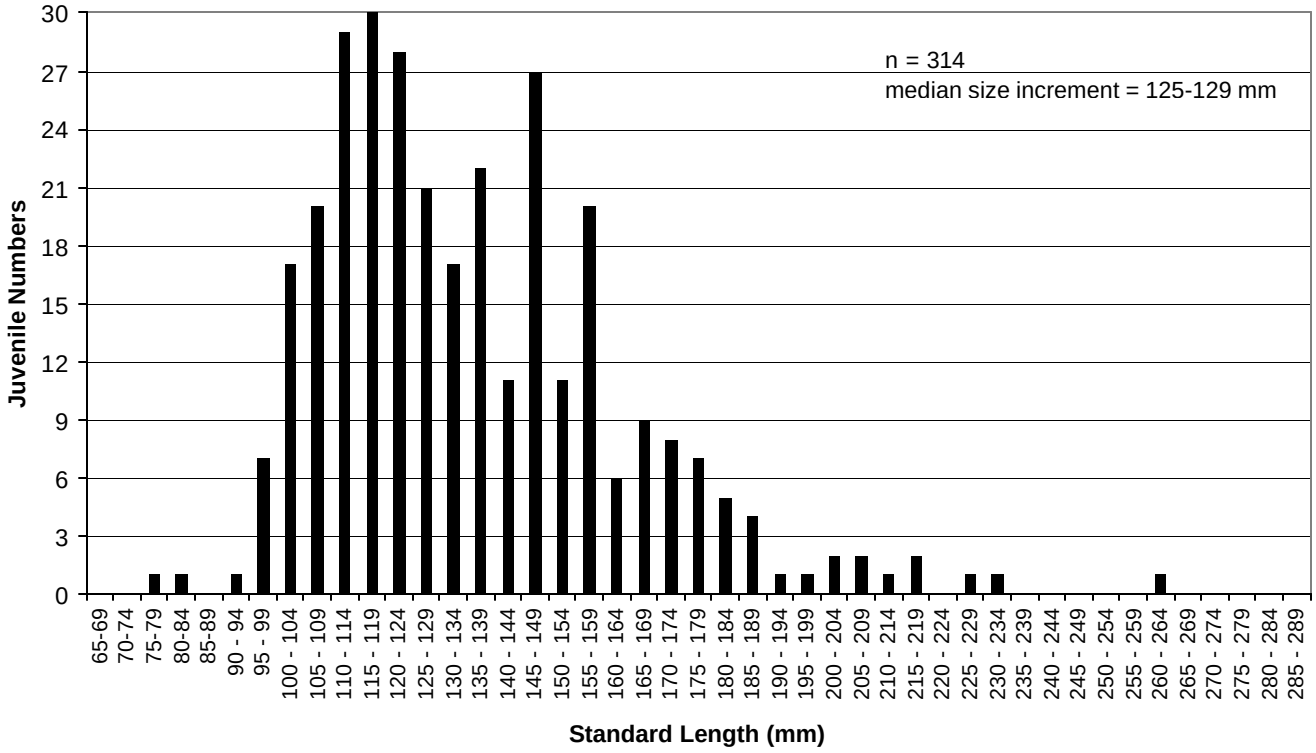


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

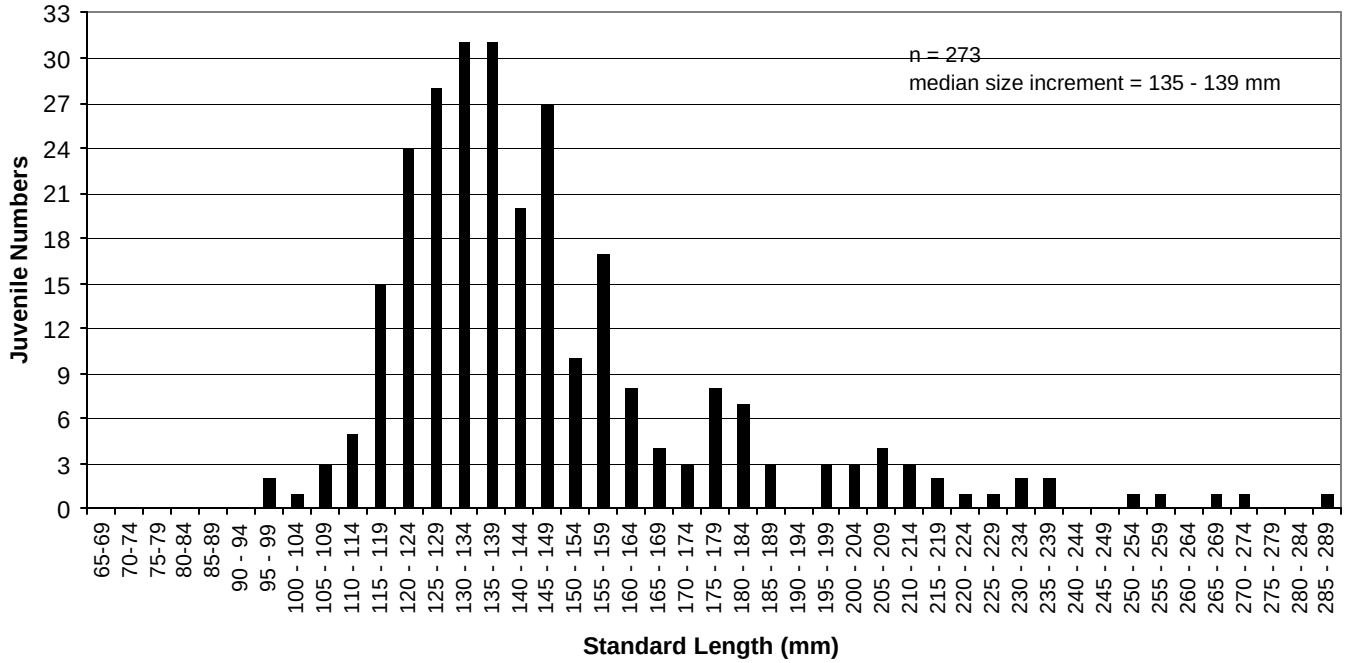


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999 (only) in Soquel Lagoon.

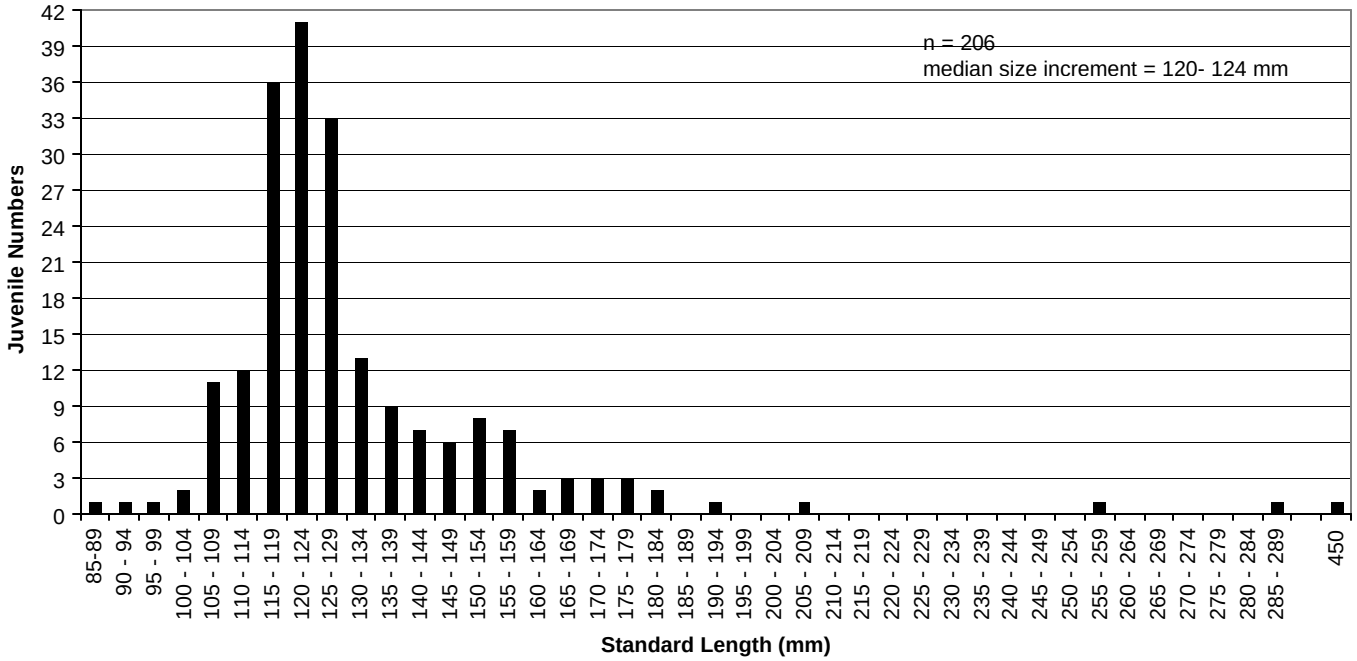


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

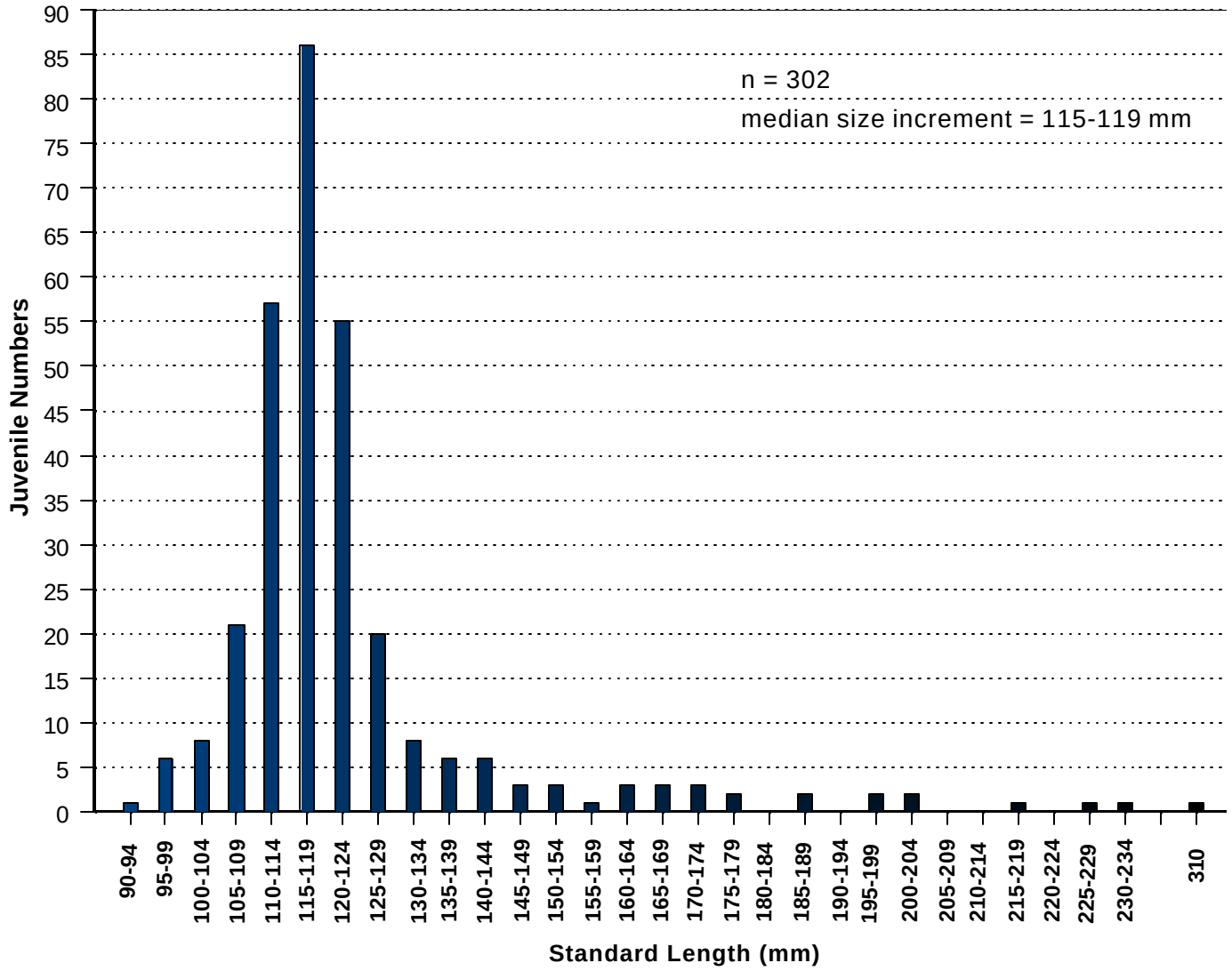


Figure 16. Juvenile Steelhead Production in Soquel Creek Lagoon, 1993-2006, Estimated by Mark and Recapture Experiment.

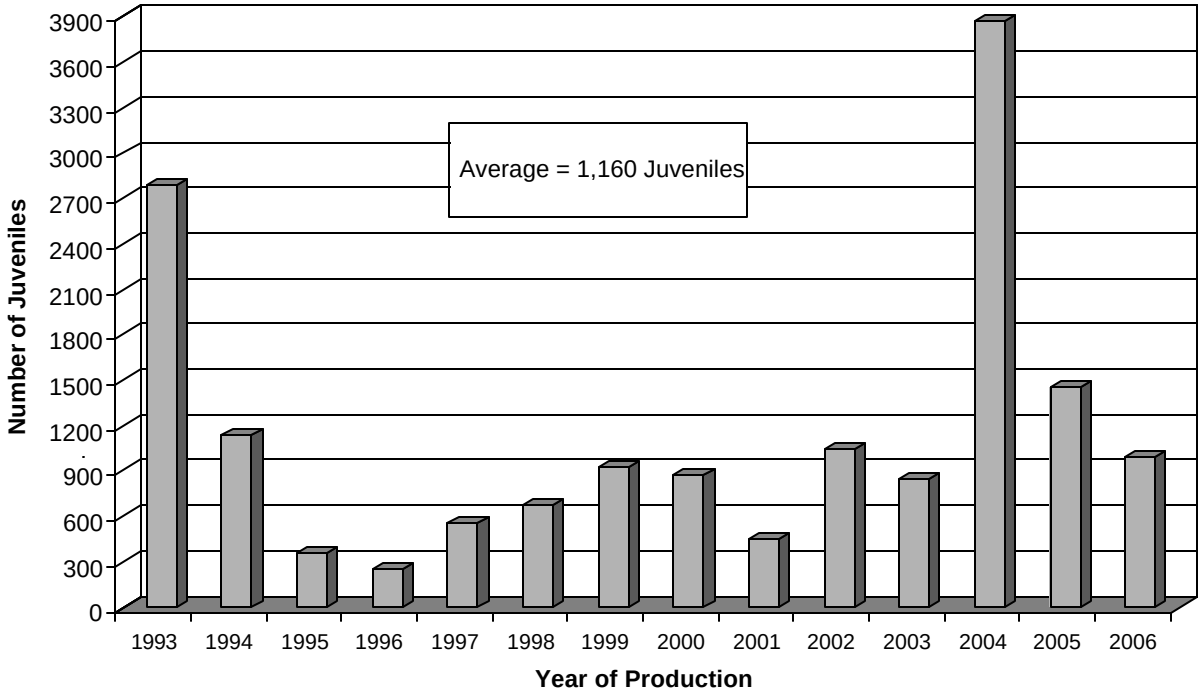


Figure 17. Soquel Creek Streamflow Data for the USGS Gage in Soquel, CA, 1 October 2005 – 1 July 2006.

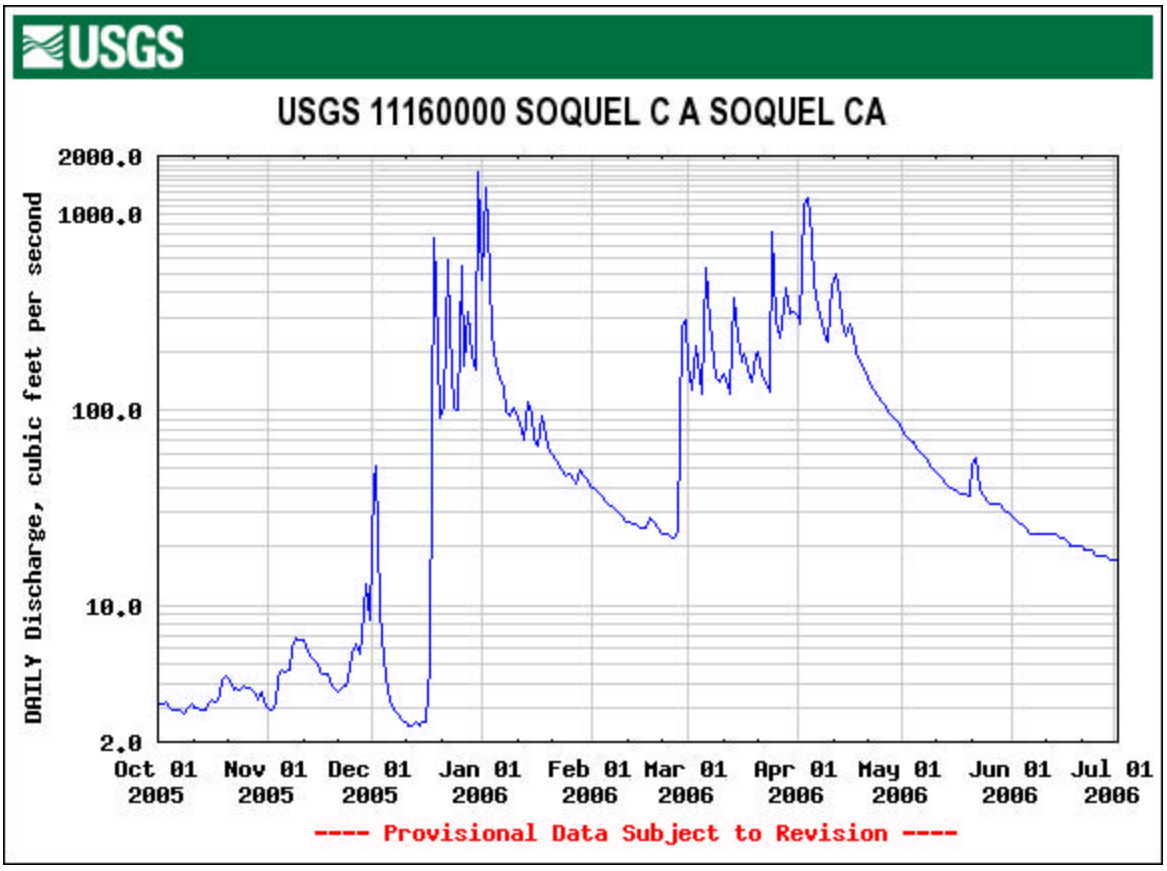


Figure 18. Soquel Creek Mean Daily Streamflow Data for the USGS Gage at Soquel, CA, 1 June – 10 December 2006.

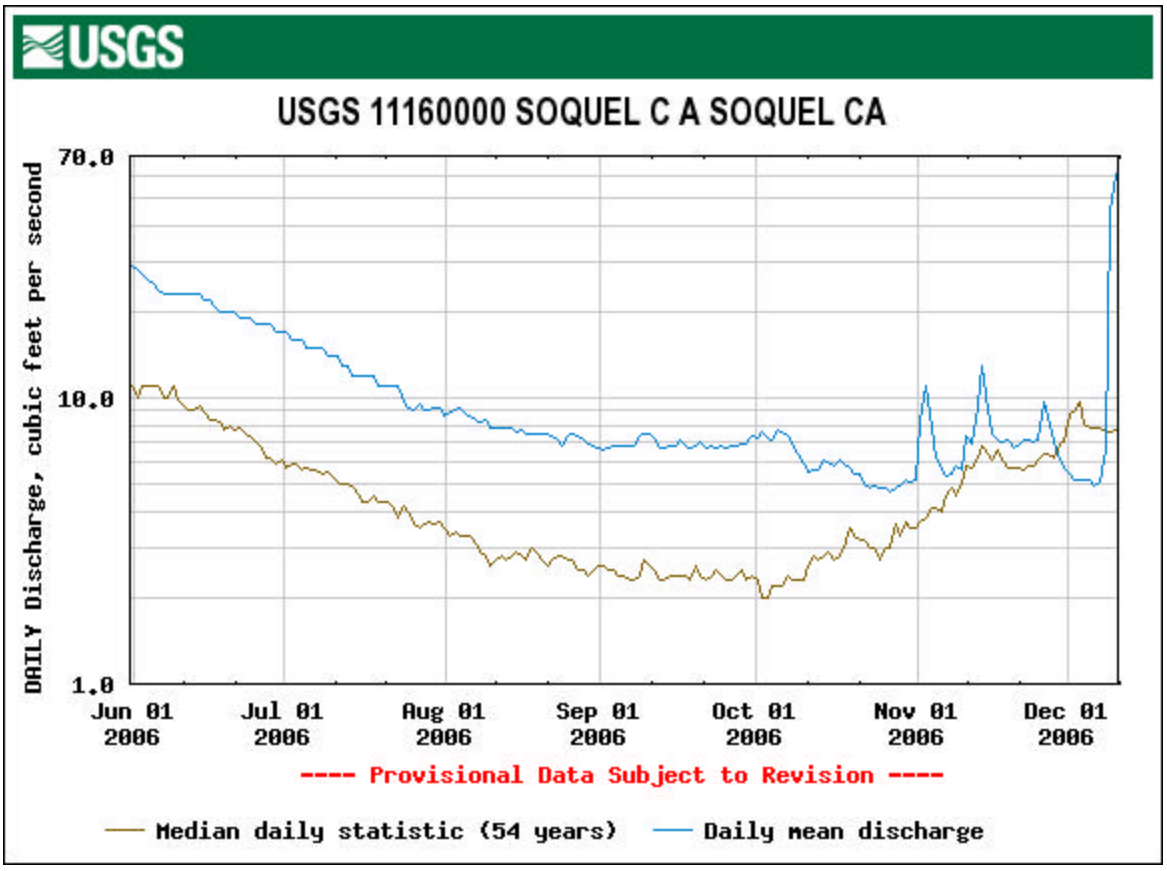


Figure 19. Soquel Creek Real-Time Streamflow at the Gage in Soquel, CA, 10 November – 10 December 2006.

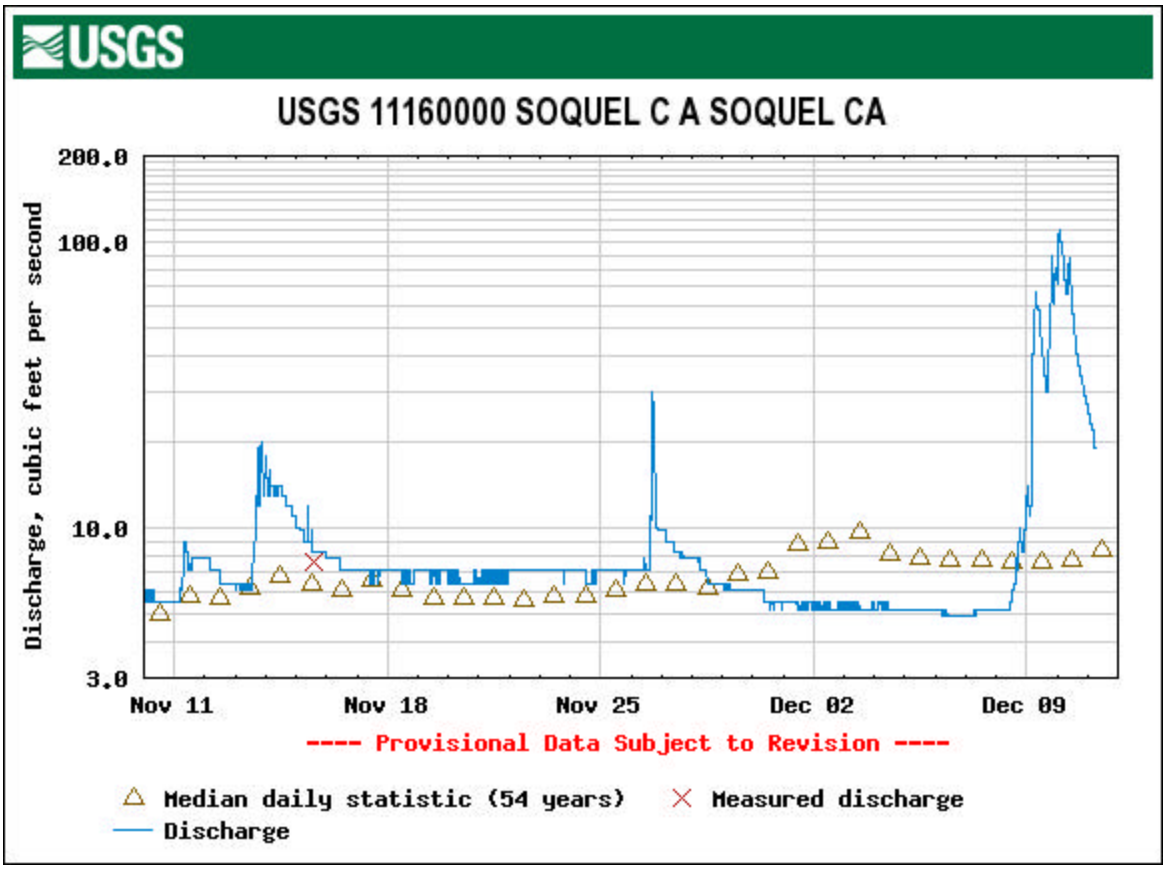
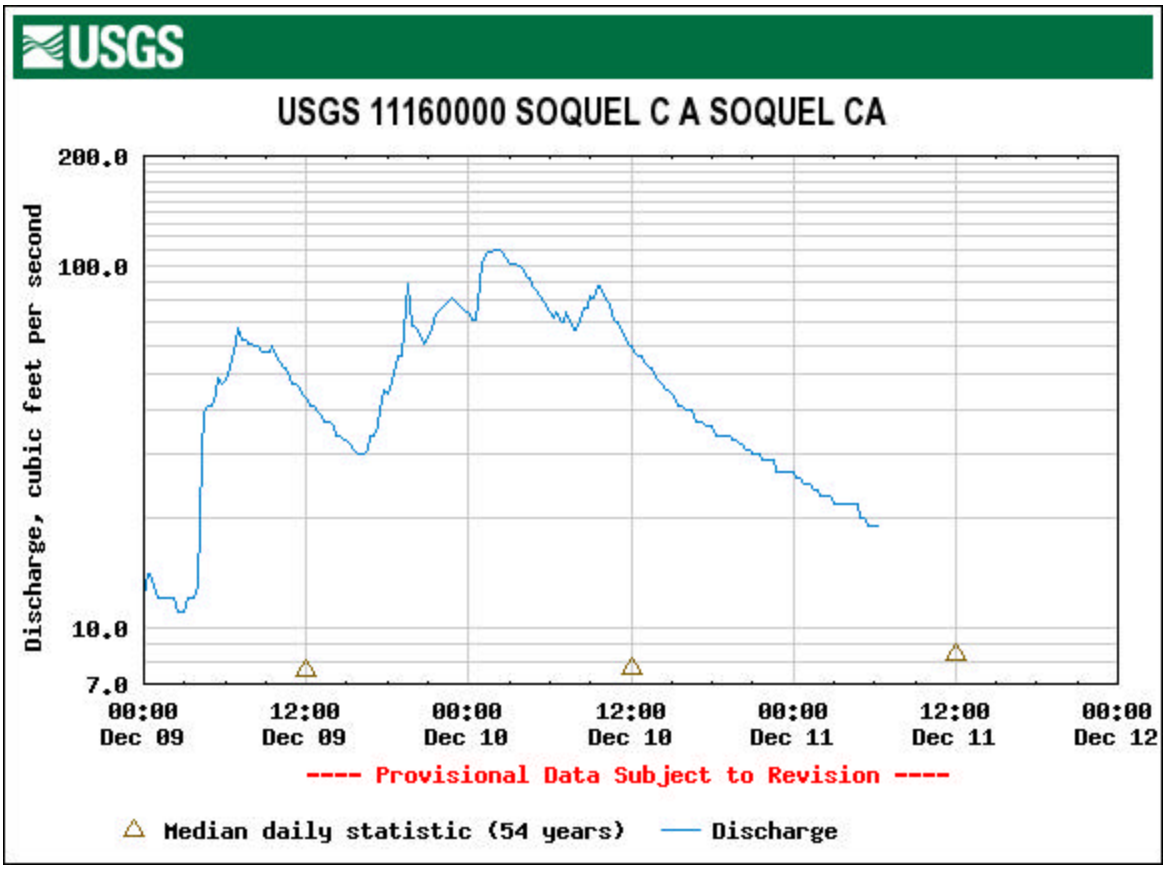


Figure 20. Soquel Creek Real-Time Streamflow Data for the USGS Gage at Soquel, CA, 9 December – 10 December 2006.



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION
18 JUNE – 10 DECEMBER 2006.

18 June 2006. Launched temperature probes in the lagoon and upstream. The sandbar had bee closed for the summer on 14 June.

18-June-06									
	Flume Inlet				**Stockton Ave Bridge Thalweg**				1413 hr
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 Umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00					18.8	0.3	8.03	644	
0.25					18.8	0.3	8.24	644	
0.50					18.7	0.3	8.16	644	
0.75					18.6	0.3	7.90	644	
1.00					18.5	0.3	7.95	643	
1.25					18.4	0.3	8.35	642	
1.50					18.4	0.3	8.46	643	
1.75					18.0	0.3	9.06	641	
1.85					18.0	0.3	6.70	641	

	Railroad Trestle				**Mouth of Noble Gulch**			
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								
0.25								
0.50								
0.75								
1.00								
1.25								
1.50								

18 June 2006. Gage height 1.95. Measurements were taken at the deepest thalweg under Stockton Bridge and in a deep hole adjacent to the Venetian Courts. No saltwater was detected.

30-June-06									
	Flume Inlet 0652 hr				**Stockton Ave Bridge Thalweg** 0705 hr				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 Umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	19.1	0.3	7.68	589	19.0	0.3	7.23	585	
0.25	19.2	0.3	7.18	589	19.1	0.3	7.14	585	
0.50	19.2	0.3	7.34	589	19.1	0.3	6.96	585	
0.75	19.1	0.3	6.93	589	19.1	0.3	6.97	585	
1.00	19.1	0.3	6.78	589	18.9	0.3	6.87	585	
Bottom1.25	19.1	0.3	5.04	589	18.8	0.3	6.66	583	
1.50					18.7	0.3	6.85	582	
Bottom1.70					18.7	0.3	4.19	581	

	Railroad Trestle 0729 hr				**Mouth of Noble Gulch** 0740 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	18.3	0.3	7.39	578	17.9	0.3	7.79	571
0.25	18.4	0.3	7.30	578	17.9	0.3	7.71	571
0.50	18.3	0.3	7.34	578	17.9	0.3	7.71	571
0.75	18.3	0.3	7.29	577	17.8	0.3	7.74	573
1.00	18.3	0.3	7.33	578	17.8	0.3	7.80	574
Bottom1.25	18.4	0.3	4.01	577	17.8	0.3	4.19	577
1.50								

30 June 2006. Gage height 2.08. Weather overcast. Air temperature 14.5 C at 0652 hr. Half screen in flume on Venetian side and quarter screen on restaurant side of flume inlet. Water pouring 10 inches over upper board on Venetian side with half screen and 5 inches over upper board on restaurant side with quarter screen. Flume outlet greater than 2 feet deep. There was a problem with water seepage under the flume through the beach with sink holes on the beach. The beach was flagged above the buried flume.Sheet metal was in place under sidewalk grates on the Esplanade except one in front of Zelda's and one in front of Beach House, both of which were full of cigarette butts. The storm drain was plugged and dry on the Esplanade.

Station 2: Stockton Avenue Bridge at 0705 hr. Secchi depth to bottom. One mallard near the bridge.

Station 3: Railroad Trestle at 0729 hr. 10 mallards near the trestle.

Station 4: Mouth of Noble Gulch at 0740 hr. No gray water observed from Noble Gulch.

Station 5: Nob Hill at 0807 hr. Water temperature 17.1^{o}C. Conductivity 560 umhos. Oxygen 8.48 mg/l. Visible streamflow estimate of 18 cfs.

				30-Jun-06						
	Flume			1555 hr	**Stockton Avenue Bridge**			1530 hr		
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**		
0.00	19.9	0.3	8.08	597	20.4	0.3	7.87	602		
0.25	19.8	0.3	8.49	596	20.3	0.3	7.80	601		
0.50	19.6	0.3	8.66	592	20.1	0.3	7.72	599		
0.75	19.4	0.3	9.19	591	19.9	0.3	7.74	595		
1.00 b	19.5	0.3	8.49	589	19.6	0.3	8.86	592		
1.25					19.4	0.3	8.88	591		
1.50					19.2	0.3	8.68	590		
1.70 b					19.2	0.3	3.92	590		
2.00										
2.25										

	Railroad Trestle			1515 hr	**Mouth of Noble Gulch**			1451 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	20.7	0.3	8.32	607	20.6	0.3	8.75	604		
0.25	20.4	0.3	8.53	603	20.0	0.3	8.90	595		
0.50	20.2	0.3	8.64	599	19.7	0.3	8.92	594		
0.75	19.8	0.3	8.68	592	19.4	0.3	9.15	591		
1.00	19.4	0.3	10.2	590	19.3	0.3	9.34	592		
1.05 b					19.4	0.3	6.24	593		
1.25 b	19.2	0.3	3.83	590						
1.50										
1.75										

30 June 2006. Gage height of 2.06 in afternoon. Sunny. Flume inlet greater than 2 feet depth. Flume exit between 1.5 and 2 feet depth. Air temperature 20.4 C at 1549 hr at the flume.
Station 1: Flume at 1549 hr. Reach 1- no surface, 20% of the bottom with algal tufts 0.3 feet thick. 77 gulls bathing. Gulls avoiding to roost on Paradise Beach Restaurant because it was covered with wires.
Station 2: Stockton Avenue Bridge at 1529 hr. Secchi depth to bottom. Reach 2- no surface, 20% of the bottom covered with algal tufts 0.3 feet thick. Green phytoplankton present.
Station 3: Railroad Trestle at 1515 hr. Reach 3- no surface, 10% of bottom with algal tufts. Pea-green phytoplankton present.
Station 4: Mouth of Noble Gulch at 1457 hr. No surface, 5% of the bottom covered with algae on submerged branches. Gray water plume extended 20 feet out from mouth of Gulch.

				14-July-06						
	Flume			0710 hr	**Stockton Avenue Bridge**			0725 hr		
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**		
0.00	19.1	0.3	7.67	603	18.9	0.3	7.25	601		
0.25	19.2	0.3	7.77	603	19.0	0.3	6.99	600		
0.50	19.3	0.3	7.66	603	19.0	0.3	7.14	600		
0.75	19.2	0.3	7.38	603	19.0	0.3	7.10	600		
1.00	19.2	0.3	7.28	603	18.9	0.3	6.76	598		
1.10 b	19.2	0.3	5.55	602	18.6	0.3	6.14	595		
1.50					18.5	0.3	5.99	594		
1.60 b					18.5	0.3	3.16	594		
1.75										
2.00										

	Railroad Trestle			0740 hr	**Mouth of Noble Gulch**			0750 hr		
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**		
0.00	18.4	0.3	6.76	594	17.5	0.3	7.27	583		
0.25	18.5	0.3	6.60	595	17.5	0.3	7.24	582		
0.50	18.4	0.3	6.42	592	17.5	0.3	7.11	582		
0.75	18.1	0.3	6.68	589	17.5	0.3	7.21	583		
1.00 b	18.0	0.3	6.67	590	17.5	0.3	3.39	585		
1.25 b	18.1	0.3	3.39	590						

14 July 2006. Gage height of 1.92 in morning. Overcast, light fog. Air temperature of 14.0°C at 0710 hr. Boards were buried in the beach near the flume exit, perpendicular to the flume. The purpose was to slow sand migration to the bay from under the flume due to seepage. It appeared to work without no especially low tides to increase the gradient.

Station 5: Nob Hill at 0835 hr. Water temperature 16.7°C. Conductivity 572 umhos. Salinity 0.3 ppt. Oxygen 7.85 mg/l. Streamflow visually estimated at 16 cfs. Saw a greenback heron.

				14 July-06					
	Flume			1450 hr	**Stockton Avenue Bridge**			1530 hr	
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**	
0.00	19.7	0.3	9.67	610	20.0	0.3	8.77	616	
0.25	19.6	0.3	9.73	604	20.0	0.3	8.79	615	
0.50	19.5	0.3	9.77	604	19.8	0.3	8.76	615	
0.75	19.2	0.3	10.55	602	19.7	0.3	8.59	612	
1.00	19.1	0.3	10.72	602	19.7	0.3	8.72	611	
1.25 b	19.2	0.3	7.30	602	19.2	0.3	10.16	608	
1.50					19.1	0.3	10.39	604	
1.60 b					19.0	0.3	5.15	602	
1.75									
2.00									

	Railroad Trestle			1515 hr	**Mouth of Noble Gulch**			1500 hr	
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**	
0.00	20.4	0.3	8.84	616	19.7	0.3	9.53	609	
0.25	20.0	0.3	9.05	613	19.7	0.3	9.83	608	
0.50	19.8	0.3	9.20	611	19.3	0.3	10.23	604	
0.75	19.4	0.3	11.45	601	19.1	0.3	10.14	602	
1.00 b	19.2	0.3	12.60	601	19.4	0.3	8.24	606	
1.25 b	19.0	0.3	5.65	600					
1.50									

14 July 2006. Gage height of 1.93 in afternoon. Sunny. Air temperature of 24.6°C at 1458 hr. Flume inlet approx. 1.7 ft depth. Flume exit depth 1.5 ft on both sides.

Station 1: Flume at 1450 hr. Reach 1- no surface algae, 80% of bottom from film to 1.0 ft, averaging 0.3 feet. 59 gulls bathing in Reach 1 in afternoon.

Station 2: Stockton Avenue Bridge at 1530 hr. Secchi depth to bottom. Reach 2- no surface algae, 80% of bottom covered with algae 0.1-1.0 ft thick, averaging 0.3 ft.

Station 3: Railroad Trestle at 1515 hr. Reach 3- no surface algae, 70% of bottom from 0.1 to 1.0 ft, averaging 0.2 ft.

Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae, 60% of bottom from 0.1 to 1.2 ft thick, averaging 0.2 ft. No gray water was entering lagoon from Noble Gulch.

19 July 2006. Biologist observed installation of boards along an excavated portion the flume and straw bails beside the boards. The boards and straw bails were on placed on either side of the flume to confine water seepage to under the flume.

0707hr					28-Jul-06					0717hr
	Flume					**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**		**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	20.1	0.3	9.64	634		20.3	0.3	9.30	632	
0.25	20.4	0.3	9.39	634		20.4	0.3	9.18	632	
0.50	20.4	0.3	9.33	635		20.4	0.3	9.01	634	
0.75	20.4	0.3	9.35	633		20.4	0.3	9.05	634	
1.00	20.4	0.3	8.94	633		20.1	0.3	6.62	634	
1.15 b	20.4	0.3	7.32	631						
1.25						20.1	0.3	6.41	634	
1.50						20.1	0.3	6.51	634	
1.65						20.1	0.3	3.15	634	
1.75										

0740hr					28-Jul-06					0750hr
	Railroad Trestle					**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**		**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**	
0.00	19.7	0.3	6.13	634		18.8	0.3	6.61	620	
0.25	19.7	0.3	6.33	633		18.8	0.3	6.54	620	
0.50	19.7	0.3	6.32	634		18.8	0.3	6.56	618	
0.75	19.7	0.3	6.33	634		18.8	0.3	6.63	620	
1.00	19.7	0.3	6.29	634		18.8	0.3	5.70	624	
1.03 b						18.8	0.3	1.76	671	
1.25 b	19.9	0.3	2.74	634						
1.50										

28 July 2006. Gage height of 1.98 morning. Air temperature of 15.8°C at 0707 hr.
Station 1: Flume at 0707 hr. Reach 1- 3% surface algae. 5 mallards (2 domestic), 1 goose and 26 gulls in water.
Station 2: Stockton Avenue Bridge at 0717 hr. Secchi depth to bottom. Reach 2- 5% surface algae.
Station 3: Railroad Trestle at 0740 hr. Reach 3- 1% surface algae in morning between trestle and Shadowbrook Restaurant.
Station 4: Mouth of Noble Gulch at 0750 hr. 2% surface algae. 6 mallards swimming near Shadowbrook restaurant. No gray water coming from Gulch.

Station 5: Nob Hill at 0816 hr. Water temperature 17.9°C. Conductivity 602 umhos. Oxygen 7.87 mg/l. Streamflow visually estimated at 12 cfs. Greenback heron observed near Nob Hill.

1600 hr					28-Jul-06				1539 hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	21.0	0.3	9.11	645	21.2	0.3	8.25	648	
0.25	21.1	0.3	9.05	644	21.2	0.3	8.16	648	
0.50	20.7	0.3	9.64	641	21.1	0.3	8.26	646	
0.75	20.6	0.3	9.98	638	21.0	0.3	8.41	644	
1.00	20.5	0.3	9.76	638	20.9	0.3	8.76	637	
1.05 b	20.6	0.3	6.05	636					
1.25					20.3	0.3	10.97	6.34	
1.50					20.3	0.3	10.06	631	
1.60 b					20.4	0.3	2.52	633	
1.75									

1535hr					28 Jul-06				1507hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	20.9	0.3	9.09	645	20.6	0.3	10.06	636	
0.25	21.0	0.3	9.11	645	20.4	0.3	10.27	633	
0.50	20.9	0.3	9.28	642	20.2	0.3	10.60	628	
0.75	20.3	0.3	11.45	632	20.0	0.3	11.25	628	
1.00 b	20.3	0.3	11.46	628	19.6	0.3	7.27	636	
1.25 b	20.1	0.3	6.45	629					
1.50									

28 July 2006. Gage height of 1.95 at 1539 hr. Sunny. Air temperature of 20.0°C at 1600 hr. Flume inlet 1.3 ft. Flume outlet 1.5 ft.

Station 1: Flume at 1600 hr. Reach 1- 52 gulls bathing. No surface algae. 95% of the bottom with algae 0.4-2 feet thick, averaging 0.5 ft.

Station 2: Stockton Avenue Bridge at 1539 hr. Secchi depth to bottom. Reach 2- No surface algae. 95% bottom algae 0.2- 2 ft thick, averaging 0.4 ft.

Station 3: Railroad Trestle at 1535 hr. Reach 3- 1% surface algae blown to margin, 95% bottom algae 0.3- 2 ft thick, averaging 0.5 ft.

Station 4: Mouth of Noble Gulch at 1507 hr. 5% surface algae, 95% bottom algae 0.3-3.0 ft thick, averaging 0.8 ft. 20 ducks (mostly mallards with some domestic) in Reach 3 downstream of Noble Gulch and near Gulch. 4 ducks, 1 goose, 1 turtle on cottonwood log across from Gulch. No gray water from Gulch.

0707 hr					12-Aug-06				0722 hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**	
0.00	18.7	0.3	8.87	622	18.9	0.3	9.59	623	
0.25	18.7	0.3	8.75	622	18.9	0.3	9.09	623	
0.50	18.8	0.3	8.59	620	19.0	0.3	9.16	622	
0.75	18.8	0.3	8.58	620	18.9	0.3	8.32	622	
1.00	18.6	0.3	7.54	620	18.5	0.3	6.50	619	
1.25 b	18.6	0.3	4.40	620	18.3	0.3	5.99	618	
1.50					18.3	0.3	5.74	618	
1.60 b					18.3	0.3	2.76	619	
1.75									

0755hr					12-Aug-06				0805 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**	
0.00	18.6	0.3	7.84	619	17.4	0.3	6.54	606	
0.25	18.3	0.3	7.23	619	17.5	0.3	6.31	606	
0.50	18.3	0.3	6.26	617	17.4	0.3	6.42	606	
0.75	18.2	0.3	6.06	617	17.4	0.3	6.44	607	
1.00 b	18.2	0.3	6.00	618	17.5	0.3	2.33	608	
1.13 b	18.3	0.3	2.08	618					
1.25									

12 August 2006. Gage height of 1.78 (morning) and 1.79 (afternoon). Overcast and misty at 0707 hr with air temperature at 15.3°C. Air temperature 16.7ºC at 1510 hr with it cool, clear and breezy. Flume entrance approximately 1.2 ft. Flume exit at 1.5-2 ft with incoming tide in afternoon. One exit plate in place.

Station 1: Flume at 0707 hr. Reach 1- 17 gulls bathing with 1 goose and 1 mallard.
Station 2: Stockton Avenue Bridge at 0722 hr. Secchi depth to the bottom probably. Reach 2- 2 mallards in water.
Station 3: Railroad trestle at 0755 hr. Reach 3- 3% surface algae. 3 mallards and 1 pied-billed grebe.
Station 4: Mouth of Noble Gulch at 0805 hr. 5% surface algae. 1 mallard roosting on cottonwood log.
Station 5: Nob Hill at 0834 hr. Water temperature at 16.7°C. Conductivity 581 umhos, Oxygen 7.96 mg/l. Visually estimated flow of 8 cfs.

1558 hr					12-Aug-06				1536 hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	19.4	0.3	9.95	629	19.4	0.3	9.11	630	
0.25	19.4	0.3	9.97	631	19.4	0.3	8.63	630	
0.50	19.3	0.3	10.12	628	19.4	0.3	8.43	630	
0.75	19.0	0.3	10.68	622	19.3	0.3	8.34	629	
1.00	19.0	0.3	11.01	621	19.3	0.3	8.51	625	
1.25 b	19.0	0.3	6.05	622	19.2	0.3	9.18	623	
1.50					19.0	0.3	10.10	622	
1.65 b					19.0	0.3	7.97	622	
1.75									

1524hr					12-Aug-06				1510 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**	
0.00	19.3	0.3	9.95	625	18.8	0.3	10.62	615	
0.25	19.2	0.3	9.77	624	18.7	0.3	10.49	614	
0.50	18.9	0.3	11.43	620	18.5	0.3	11.36	612	
0.75	18.9	0.3	11.98	616	18.5	0.3	12.25	612	
1.00 b	18.7	0.3	10.40	617	18.5	0.3	6.68	615	
1.25 b	18.6	0.3	5.36	617					
1.50 b									

Station 1: Flume at 1510. Reach 1- no surface algae. Could not see lagoon bottom very well. Estimated about 50% bottom covered with algae 0.6-3 ft thick, averaging 1.0 ft. Film elsewhere. Pondweed may be present.
Station 2: Stockton Avenue Bridge at 1536 hr. Secchi depth to the bottom. Reach 2- No surface algae. 90% of bottom covered by algae 1.0- 4.0 ft thick, averaging 3 ft. Possibly pondweed present.
Station 3: Railroad trestle at 1524 hr. Reach 3- no surface algae. 90% of bottom covered by algae 0.5- 3 ft thick, averaging 2 ft. 5 ducks roosting on redwood stump just downstream of trestle.
Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae. 70% of bottom covered by algae 0.6-4 ft thick, averaging 0.8 ft. 13 ducks (mostly mallards) and a goose swimming near Gulch.

0712hr					25-Aug-06					0727 hr
	Flume					**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**		**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**	
0.00	18.2	0.3	9.43	617		18.2	0.3	9.63	613	
0.25	18.1	0.3	9.05	617		18.2	0.3	9.62	615	
0.50	18.1	0.3	9.21	616		18.2	0.3	9.62	615	
0.75	18.0	0.3	8.69	615		18.2	0.3	9.22	613	
0.88 b	18.0	0.3	5.82	615						
1.00						17.8		8.06	612	
1.25						17.6	0.3	6.78	612	
1.50						17.6	0.3	6.32	612	
1.65 b						17.6	0.3	2.66	613	
1.75										

0742hr					25-Aug-06					0805hr
	Railroad Trestle					**Mouth of Noble Gulch**				
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	17.7	0.3	8.85	612		16.9	0.4	6.67	602	
0.25	17.8	0.3	8.17	613		16.8	0.4	6.71	601	
0.50	17.4	0.3	5.49	611		16.8	0.4	6.27	601	
0.75	17.4	0.3	5.48	611		16.8	0.4	6.32	602	
1.00 b	17.4	0.3	5.44	611		17.0	0.4	0.51	615	
1.20 b	17.5	0.3	1.16	613						
1.50										

25 August 2006. Gage height of 1.63 (morning) and 1.63 (afternoon). Overcast in morning and likely all day. Air temperature of 14.7ºC at 0712 hr and 18.2ºC at 1610 hr. Flume inlet at 1.0 ft. Flume outlet at 1.2 feet.

Station 1: Flume at 0712 hr. Reach 1- 12 gulls bathing, 4 mallards and 1 pelican in water. 35 steelhead hits/ minute near Stockton bridge at 0719 hr. No surface algae. Flume at 1546 hr. Reach 1- No surface algae. 50% of bottom with algae 1-2 ft thick, averaging 1.5 ft thick and film over remainder. 95 gulls bathing with none on the restaurant roofs. 2 mallards dabbling. 1 merganser on shore at beach.
Station 2: Stockton Avenue Bridge at 0727 hr. No surface algae except 2 x 4 ft clump near redwood stump near the trestle. 3 mallards in the water. Reach 2 at 1519 hr. No surface algae. 50% of bottom covered with algae 0.5- 2 ft thick, averaging 1 ft. Remainder 0.1 ft thick. Secchi depth to bottom. 4 ducks roosting on redwood stump.
Station 3: Railroad trestle at 0742 hr. Reach 3- 5% surface algae. 1 pied-billed grebe. At 1502 hr, 7 mallards and 1 merganser roosting on redwood stump in Reach 3 above trestle. 35% of bottom covered with algae 0.5- 2.0 ft thick, averaging 0.8 ft. Remainder 0.1 ft thick, some of which bright green.
Station 4: Mouth of Noble Gulch at 0805 hr. 5% surface algae. Thick brown plume with oil slick trailing 40 ft downstream of Gulch mouth, 8-12 ft wide and preventing view of the lagoon bottom. At 1449 hr,

murky plume present, white-green color, 10 x 20 ft dimensions. 2% surface algae. 30% of bottom with algae 1- 3.5 ft thick. Remainder of bottom with 0.1 ft thick algal mat. 1 goose, 1 mallard and 2 turtles on cottonwood log.

Station 5: Nob Hill at 0825 hr. Water temperature 15.9°C. Oxygen 8.28 mg/l. Conductivity 586 umhos. Salinity 0.3 ppt. Visually estimated streamflow of 7 cfs.

1546hr					25-Aug-06				1519hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**	
0.00	18.5	0.3	8.79	622	18.3	0.3	8.67	620	
0.25	18.5	0.3	8.73	620	18.3	0.3	8.68	620	
0.50	18.3	0.3	8.68	618	18.3	0.3	8.72	620	
0.75	18.1	0.3	10.25	616	18.3	0.3	8.59	619	
0.88	18.3	0.3	5.70	616					
1.00					18.2	0.3	8.44	618	
1.25 b					18.0	0.3	9.79	613	
1.50					17.8	0.3	11.79	610	
1.65 b					18.1	0.3	6.52	610	
1.75									

1502hr					25-Aug-06				1449hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**	
0.00	18.1	0.3	9.62	615	17.3	0.3	10.60	602	
0.25	18.0	0.3	9.55	611	17.2	0.3	10.48	601	
0.50	17.6	0.3	9.87	607	17.1	0.3	10.82	600	
0.75	17.5	0.3	11.26	604	17.1	0.3	10.72	600	
0.95 b					17.1	0.3	8.63	601	
1.00	17.4	0.3	11.49	604					
1.20 b	17.5	0.3	9.82	604					
1.50									
1.75									

0733hr					03-Sep-06				0744hr
	Flume				**Stockton Avenue Bridge**				
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	17.7	0.3	8.81	614	17.7	0.4	8.93	615	
0.25	17.8	0.3	8.82	614	17.7	0.4	9.24	615	
0.50	17.8	0.3	8.74	614	17.7	0.4	8.62	615	
0.75	17.8	0.3	8.75	615	17.8	0.4	8.84	615	
1.00 b	17.8	0.3	6.69	615	17.8	0.4	8.44	614	
1.25					17.5	0.4	9.04	611	
1.50					17.3	0.4	7.39	612	
1.75 b					17.4	0.4	2.70	613	
0804 hr					03-Sep-06				0817hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	17.3	0.4	9.05	609	17.0	0.4	6.64	608	
0.25	17.2	0.4	8.82	608	17.0	0.4	6.61	609	
0.50	17.1	0.4	7.94	608	17.0	0.4	6.62	608	
0.75	17.0	0.4	7.80	607	17.0	0.4	6.65	609	
1.00	17.0	0.4	7.33	608	17.0	0.4	6.60	611	
1.25 b	17.0	0.4	3.54	608	16.9	0.4	2.16	621	

					03-Sep-06				1418hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00					18.3	0.4	8.56	625	
0.25					18.3	0.4	8.94	624	
0.50					18.3	0.4	8.56	624	
0.75					18.3	0.4	8.53	624	
1.00					18.3	0.4	8.42	624	
1.25					18.3	0.4	8.54	624	
1.50					18.3	0.4	8.62	624	
1.75 b					18.3	0.4	7.61	624	
1435 hr					03-Sep-06				0817hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**	
0.00	18.2	0.4	9.24	620					
0.25	18.1	0.4	9.34	621					
0.50	18.1	0.4	9.43	620					

0.75	18.1	0.4	9.54	621
1.00	18.1	0.4	9.38	620
1.25 b	18.1	0.4	4.70	620

03 September 2006. Begonia Festival Day. Gage height of 2.25 (morning) and 2.25 (afternoon). Overcast in morning with sunny conditions by 1212 hr. It appeared that sandbags were added to the lagoon bottom around the flume inlet to slow seepage under the flume. 15 gulls were bathing in the lagoon in the early morning. 3 mallards were dabbling near the trestle then. 6 mallards and 1 domestic duck swimming near the cottonwood log across from Noble Gulch then. 1 pied-billed grebe and 1 coot also swimming nearby. 1 goose and 1 mallard were roosting on the cottonwood log at 0817 hr. 3 mergansers observed hunting near Noble Gulch at 1020 hr. Around 10 floats were floated down the lagoon. A total of 13 waders were used to propel 4 of the floats. One float used 5 waders by itself. Another used 4 waders and 2 surfboard paddlers. Turbidity was caused by the wading. However, secchi depth was to the bottom at Stockton Avenue Bridge, immediately after the procession. Hydrogen sulfide measurements were discontinued after 2005 because city staff assumed that there would be no more waders during the Begonia Festival, as was the case in 2005. This was not the case. The City recommends that people not wade in the lagoon to move the floats, but does not forbid it. Flower petals were collected on Tuesday by Begonia Festival staff.

0725 hr					10-Sep-06				0737 hr
	Flume				**Stockton Avenue Bridge**				
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	17.4	0.4	9.66	612	17.4	0.4	9.56	609	
0.25	17.4	0.4	9.65	613	17.4	0.4	9.54	609	
0.50	17.5	0.4	9.59	613	17.4	0.4	9.64	609	
0.75	17.5	0.4	9.65	613	17.5	0.4	9.37	609	
1.00	17.5	0.4	9.65	613	17.4	0.4	9.24	609	
1.05 b	17.5	0.4	8.48						
1.25					17.1	0.4	7.65	609	
1.50					16.9	0.4	6.91	608	
1.75 b					16.9	0.4	2.79	608	

0835 hr					10-Sep-06				0850 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	16.9	0.4	9.16	607	16.4	0.4	7.02	634	
0.25	16.9	0.4	8.95	606	16.4	0.4	7.18	633	
0.50	16.8	0.4	8.97	604	16.4	0.4	6.99	632	
0.75	16.8	0.4	9.35	604	16.4	0.4	6.89	632	
1.00	16.7	0.4	7.55	604	16.4	0.4	6.75	632	
1.15 b					16.5	0.4	2.47	606	
1.25 b	16.7	0.4	2.00	606	16.2	0.4	2.93	634	
1.50									

10 September 2006. Gage height of 2.24 (morning) and 2.21 (afternoon). Overcast and misty in the morning and sunny and breezy in afternoon. Air temperature of 13.8°C at 0725 hr and 16.5ºC at 1558 hr. Flume entrance at 1.0 ft. Flume outlet at 1.2 feet.

Station 1: Flume at 0725 hr. Reach 1- No surface algae. Great blue heron on beach.
Station 2: Stockton Avenue Bridge at 0737 hr. Reach 2- 2% surface algae.
Station 3: Railroad Trestle at 0835 hr. Reach 3- 5% surface algae. Batteries dead in meter. No begonias observed.
Station 4: Mouth of Noble Gulch at 0850 hr. Gray-green plume from Gulch, 12 ft diameter. 5 ducks roosting on cottonwood log.
Station 5: Nob Hill at 0920 hr. Water temperature of 15.3°C. Conductivity of 584 umhos. Oxygen 8.55 mg/l. Visually estimated streamflow 7.0 cfs.

1558 hr					10-Sep-06				1525 hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	18.1	0.4	11.47	619	18.2	0.4	9.42	624	
0.25	18.1	0.4	11.38	619	18.2	0.4	9.49	624	
0.50	18.0	0.4	11.31	618	18.1	0.4	9.38	623	
0.75	18.0	0.4	11.13	618	18.2	0.4	9.25	623	
1.00	17.9	0.4	11.32	618	18.1	0.4	9.33	622	
1.08 b	17.9	0.4	10.28	615					
1.25					17.9	0.4	9.86	618	
1.50					17.8	0.4	10.12	617	
1.75 b					17.7	0.4	5.82	617	

1510 hr					10-Sep-06				1458 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**	
0.00	18.2	0.4	10.02	622	18.4	0.4	9.10	625	
0.25	18.1	0.4	9.80	622	18.2	0.4	9.45	620	
0.50	18.0	0.4	9.74	621	17.9	0.4	9.47	614	
0.75	17.8	0.4	9.94	618	17.3	0.3	10.38	608	
1.00	17.7	0.4	10.71	615	17.2	0.3	10.96	607	
					17.4	0.3	6.58	607	
1.25 b	17.5	0.4	3.71	613					
1.50									

10 September 2006.

Station 1: Flume at 1558 hr. Reach 1- No surface algae. 100% of bottom coverd by algae 0.1- 2 ft, averaging 0.2 ft. 76 gulls bathing. 2 people feeding birds at Stockton Ave park.

Station 2: Stockton Avenue Bridge at 1525 hr. Reach 2- No surface algae. 90% of bottom covered by algae 0.5-3.0 ft, averaging 0.8 ft thick. Algae shortest on east side. No begonias observed.

Station 3: Railroad Trestle at 1510 hr. Reach 3- 90% of bottom covered by algae 0.2- 4.5 ft, averaging 1.0 ft thick. Algae shortest in center. No begonias observed.

Station 4: Mouth of Noble Gulch at 1458 hr. 5% surface algae. 60% of bottom covered by algae 0.3-3.5 ft thick, averaging 2.0 ft. Planktonic algae present.

0714 hr					23-Sep-06					0727 hr
	Flume					**Stockton Avenue Bridge**				
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	15.7	0.4	9.11	599		15.8	0.4	9.06	601	
0.25	15.8	0.4	9.04	599		15.8	0.4	8.95	601	
0.50	15.8	0.4	9.08	599		15.8	0.4	8.91	601	
0.75	15.8	0.4	8.98	599		15.8	0.4	8.75	600	
1.00	15.8	0.4	8.81	599		15.7	0.4	8.57	599	
1.05 b	15.8	0.4	5.61	599						
1.25						15.5	0.4	8.36	597	
1.50						15.3	0.4	8.09	594	
1.75 b						15.3	0.4	4.13	594	
0745 hr					23-Sep-06					0803 hr
	Railroad Trestle					**Mouth of Noble Gulch**				
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	15.0	0.4	7.73	590		14.7	0.4	7.19	587	
0.25	15.0	0.4	7.80	589		14.7	0.4	7.32	587	
0.50	14.9	0.4	7.91	589		14.7	0.4	7.21	587	
0.75	14.9	0.4	7.85	589		14.7	0.4	7.15	587	
1.00	14.9	0.4	7.77	589		14.7	0.4	7.09	587	
1.13 b						14.7	0.4	1.87	589	
1.25 b	14.9	0.4	2.82	592						
1.50										

23 September 2006. Gage height of 2.14 (morning) and 2.14 (afternoon). Clear and cool in morning. Sunny in afternoon. Air temperature of 11.6°C at 0714 hr and 17.8°C at 1553 hr. Flume inlet 1.0 ft deep. Flume outlet 1.2 ft.

Station 1: Flume at 0714 hr. Reach 1- No surface algae. 1 cormorant, 1 pied-billed grebe, 19 gulls bathing.

Station 2: Stockton Avenue Bridge at 0727 hr. Reach 2- <1% surface algae and cormorant moved upstream.

Station 3: Railroad Trestle at 0745 hr. Reach 3- 6 mallards, 3 coots, 1 pied-billed grebe.

Station 4: Mouth of Noble Gulch at 0803 hr. Gray water plume 15 ft diameter from Gulch. Oil sheen on surface. 4 mallards and 1 goose on cottonwood log. 2 pied-billed grebes in water beside log. Dead pine removed at end of path.

Station 5: Nob Hill at 0832 hr. Water temperature of 13.5°C. Conductivity of 563 umhos. Oxygen 8.58 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 7 cfs.

1553 hr					23-Sep-06				1535 hr
	Flume				**Stockton Avenue Bridge**				
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	17.2	0.4	11.23	615	17.6	0.4	9.98	623	
0.25	17.1	0.4	11.35	616	17.5	0.4	9.57	623	
0.50	17.0	0.4	10.92	616	17.4	0.4	10.15	620	
0.75	17.0	0.4	10.78	613	17.2	0.4	10.27	613	
1.00	16.8	0.4	11.13	610	16.6	0.4	12.12	605	
1.05	16.7	0.4	8.90	609					
1.25					16.2	0.4	11.78	602	
1.50					16.1	0.4	12.42	600	
1.75					16.0	0.4	6.13	601	
1515 hr					23-Sep-06				1450 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	17.5	0.4	10.22	623	18.3	0.4	9.48	643	
0.25	17.5	0.4	10.31	623	17.6	0.4	8.41	639	
0.50	17.4	0.4	10.21	622	16.5	0.4	8.79	622	
0.75	17.3	0.4	10.02	618	16.1	0.4	10.85	594	
1.00	16.7	0.4	11.40	608	16.0	0.4	11.79	604	
1.13 b					16.2	0.4	8.92	604	
1.25 b	16.6	0.4	5.71	609					
1.50									

23 September 2006.

Station 1: Flume at 1553 hr. Reach 1- <<1% surface algae. 50% bottom algae 0.3-2 ft, averaging 1 ft. 56 gulls bathing. People feeding gulls from Venetian Court and Margaritaville. Gulls not using Paradise Grill roof.

Station 2: Stockton Avenue Bridge at 1535 hr in Reach 2- 2% surface algae. Bottom 100% covered by algae 0.2-5.0 ft, averaging 1.5 ft thick.

Station 3: Railroad Trestle at 1515 hr- Reach 3- 5% surface algae; 100% bottom algae 0.3- 5 ft, averaging 1.3 ft. 6 mallards, 3 coots, 1 pied-billed grebe.

Station 4: Mouth of Noble Gulch at 1450 hr- Cloudy plume at Gulch mouth. 1% surface algae. 60% of bottom covered by algae 0.2- 4 ft thick, averaging 1.0 ft. 1 cormorant, 1 goose and 2 turtles on the cottonwood log.

0746 hr			5-Oct-06				0755 hr
	Flume				**Stockton Avenue Bridge**		
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	15.3	0.4	9.39	599	15.4	0.4	9.00	600
0.25	15.4	0.4	9.28	600	15.4	0.4	9.09	600
0.50	15.4	0.4	9.35	600	15.4	0.4	8.86	600
0.75	15.4	0.4	9.42	599	15.4	0.4	8.79	599
1.00	15.4	0.4	8.71	599	15.2	0.4	8.25	596
1.05 b	15.4	0.4	8.63	600	14.9	0.4	8.17	593
1.25								
1.50					14.8	0.4	7.59	592
1.75					14.7	0.4	3.87	592

0815 hr			5-Oct-06				0829 hr
	Railroad Trestle				**Mouth of Noble Gulch**		
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	15.0	0.4	9.03	594	14.7	0.4	6.63	583
0.25	15.0	0.4	8.87	593	14.6	0.4	6.58	585
0.50	14.9	0.4	7.75	590	14.6	0.4	6.56	585
0.75	14.7	0.4	7.63	590	14.6	0.4	6.55	585
1.00	14.7	0.4	7.54	589	14.6	0.4	6.51	586
1.20 b					14.8	0.4	2.23	591
1.25	14.7	0.4	7.48	590				
1.30 b	14.7	0.4	3.32	590				
1.50								

5 October 2006. Gage height of 2.21 (morning) and 2.20 (afternoon). Cloudy in morning and rained overnight. Sunny and windy in afternoon with clouds in mountains. Air temperature of 13.0°C at 0746 hr, 16.2ºC at Flume at 1543 hr.

Station 2: Stockton Avenue Bridge at 0755 hr. Reach 2- No surface algae.
Station 3: Railroad Trestle at 0815 hr. Reach 3- 1% surface algae. 10 coots upstream of trestle. 1 pied-billed grebe.
Station 4: Mouth of Noble Gulch at 0829 hr. Gray water at mouth. Construction on sewer line out in street. No surface algae and no birds on cottonwood log.
Station 5: Nob Hill at 0903 hr. Water temperature of 13.9°C. Conductivity of 575 umhos. Oxygen 8.11 mg/l. Salinity 0.4 ppt. Streamflow visually estimated at 6 cfs.

1543 hr					5-Oct-2006				1526 hr
	Flume				**Stockton Avenue Bridge**				
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	16.3	0.4	9.53	612	16.6	0.4	9.29	619	
0.25	16.3	0.4	9.55	607	16.8	0.4	8.80	619	
0.50	16.3	0.4	9.44	607	16.7	0.4	8.82	617	
0.75	16.0	0.4	9.47	607	16.6	0.4	8.71	615	
1.00	16.0	0.4	8.98	604	16.5	0.4	8.64	613	
1.15 b	15.9	0.4	7.15	605					
1.25					16.3	0.4	8.51	602	
1.50					15.8	0.4	8.93	599	
1.75 b					15.7	0.4	4.26	600	
1512 hr					5-Oct-2006				1457 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	17.2	0.4	8.62	616	17.9	0.4	7.57	616	
0.25	16.7	0.4	8.51	608	17.6	0.4	7.63	611	
0.50	16.5	0.4	8.46	605	17.0	0.4	7.63	595	
0.75	16.2	0.4	8.29	597	15.6	0.4	9.77	589	
1.00	15.8	0.4	8.24	593	15.3	0.4	9.69	589	
1.25 b	15.5	0.4	8.12	592	15.4	0.4	5.01	590	
1.30 b	15.5	0.4	2.65	592					

5 October 2006.

Station 1: Flume at 1543 hr. Reach 1- No surface algae. Could not see bottom due to turbidity. 73 gulls bathing.

Station 2: Stockton Avenue Bridge at 1526 hr. Reach 2- <1% surface algae. Could not see bottom. No birds observed.

Station 3: Railroad Trestle at 1512 hr. Reach 3- 2% surface algae. Could not see the bottom. 10 coots upstream of trestle.

Station 4: Mouth of Noble Gulch at 1457 hr. Brown water emanating from Noble Gulch. No surface algae at Gulch. Could not see bottom. 9 ducks and 1 goose roosting on cottonwood log.

0750 hr					26-Oct-2006				0805 hr
	Flume				**Stockton Avenue Bridge**				
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	13.1	0.4	8.34	578	13.1	0.4	8.03	578	
0.25	13.2	0.4	8.38	578	13.2	0.4	8.08	578	
0.50	13.3	0.4	8.33	578	13.2	0.4	7.92	578	
0.75	13.3	0.4	8.34	578	13.2	0.4	8.04	578	
1.00	13.3	0.4	8.31	578	13.2	0.4	7.58	578	
1.25 b	13.2	0.4	6.18	577	13.2	0.4	7.74	578	
1.50					13.2	0.4	7.46	578	
1.70 b					13.2	0.4	4.34	578	

0825 hr					26-Oct-2006				0840 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	12.8	0.4	7.30	572	12.3	0.4	7.45	565	
0.25	12.8	0.4	7.24	572	12.4	0.4	7.34	565	
0.50	12.8	0.4	7.31	572	12.4	0.4	7.34	565	
0.75	12.8	0.4	7.21	572	12.4	0.4	7.31	565	
1.00	12.8	0.4	7.24	572	12.3	0.4	7.23	566	
1.05 b					12.6	0.4	3.27	569	
1.20 b	12.8	0.4	3.09	573					
1.25									

26 October 2006. Gage height of 2.03 (morning) and 2.08 (afternoon). Clear and breezy in morning and sunny in afternoon. Air temperature of 7.2°C at 0750 hr and 18.8ºC at 1532 hr. Flume inlet 1 ft, flume outlet 1.5 ft with tide incoming in afternoon.

Station 1: Flume at 0750 hr. Reach 1- No birds in water. No gulls on beach. Pigeons foraging in sand near walkway between restaurants.

Station 2: Stockton Avenue Bridge at 0825 hr. Reach 2- 19 coots and 2 mallards.

Station 3: Railroad Trestle at 0825 hr. Reach 3- 63 coots upstream of trestle.

Station 4: Mouth of Noble Gulch at 0840 hr. Gray water emanating from Gulch. 1 coot roosting on cottonwood log. 1 goose in water.

Station 5: Nob Hill at 0908 hr. Water temperature of 10.2°C. Conductivity of 534 umhos. Oxygen 9.07 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 5.5 cfs. Approximately 15 mallards congregated near Nob Hill instead of being in the lagoon.

1532 hr			26-Oct-2006				1510 hr
	Flume				**Stockton Avenue Bridge**		
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	14.5	0.4	9.84	592	14.8	0.4	9.64	597
0.25	14.4	0.4	9.84	592	14.1	0.4	9.36	596
0.50	14.3	0.4	9.76	587	14.4	0.4	9.23	592
0.75	14.0	0.4	9.84	586	14.2	0.4	9.09	590
1.00	14.0	0.4	9.98	586	14.0	0.4	9.27	586
1.25 b	13.9	0.4	5.86	586	13.6	0.4	9.63	583
1.50					13.4	0.4	9.62	579
1.70 b					13.4	0.4	5.02	579
1.75								

1456 hr			26-Oct-2006				1442 hr
	Railroad Trestle				**Mouth of Noble Gulch**		
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	15.2	0.4	9.34	606	15.2	0.4	9.05	586
0.25	14.7	0.4	9.12	598	14.7	0.4	9.03	576
0.50	13.7	0.4	9.00	593	13.7	0.4	10.78	564
0.75	13.2	0.4	10.42	593	13.2	0.4	10.58	577
1.00	13.1	0.4	10.74	582	13.1	0.4	10.43	578
1.05 b					13.4	0.4	6.48	580
1.25 b	13.4	0.4	6.00	582				
1.50								

26 October 2006.

Station 1: Flume at 1532 hr in Reach 1, gulls bathing earlier but none now. Gulls rafting in bay just beyond surf. <1% surface algae and bottom algae 70% coverage 0.2- 1.0 ft, averaging 0.4 ft. Remainder of bottom covered with algal film.

Station 2: Stockton Avenue Bridge at 1510 hr in Reach 2, no surface algae and bottom 70% covered with algae 0.2- 4 ft, averaging 0.3 ft. 3 coots.

Station 3: Railroad Trestle at 1456 hr. Reach 3- <1% surface algae and bottom 90% covered with algae 0.2- 4 ft, averaging 0.6 ft. 50 coots and 2 mallards between trestle and Shadowbrook restaurant.

Station 4: Mouth of Noble Gulch at 1442 hr, No surface algae and bottom covered with algae 0.1- 1 foot thick, averaging 0.4 ft. 1 goose, 1 turtle and 6 ducks on cottonwood log. Gray plume 20 ft diameter and extending 20 ft downstream of plume. Cannot see bottom within plume.

3 November 2006. Observed lagoon between storms. Lagoon level to top of flume. Recommended that 2 boards be pulled on Venetian Court side of flume inlet and 1 board from restaurant side. Had half screen on one side and quarter screen on other side. Submersible pump in storm drain on Esplanade was insufficient to pump water out of storm drain to sewer.

0735 hr				09-Nov-06					0751 hr
	Flume				**Stockton Avenue Bridge**				
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	13.9	0.4	6.89	599	13.7	0.4	6.84	597	
0.25	13.9	0.4	6.82	599	13.8	0.4	6.74	598	
0.50	13.9	0.4	6.80	599	13.8	0.4	6.79	597	
0.75	13.9	0.4	6.77	599	13.7	0.4	6.76	597	
0.87 b	13.9	0.4	6.27	598	13.6	0.4	6.85	595	
1.00									
1.25					13.5	0.4	6.87	594	
1.50					13.4	0.4	6.81	594	
1.63 b					13.5	0.4	4.38	593	
1.75									

0810 hr				09-Nov-06					0825 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	13.1	0.4	6.91	588	12.9	0.4	7.05	587	
0.25	13.1	0.4	6.97	588	13.0	0.4	7.03	587	
0.50	13.1	0.4	6.94	588	12.9	0.4	7.03	587	
0.75	13.1	0.4	6.95	588	12.9	0.4	7.08	587	
1.00 b	13.1	0.4	7.01	588	13.0	0.4	2.25	589	
1.13 b	13.1	0.4	3.46	588					
1.25									
1.50									

09 November 2006. Gage height of 1.80 (morning) and 2.03 (afternoon). Sunny, cool and calm in morning and sunny and wind gusts in afternoon. Air temperature of 12.0°C at 0735 hr and 14.1ºC at 1530 hr. Notch freshly cut in beach with 2 berms, one near lagoon and one near surf.. In afternoon, flume inlet 1.0 ft and outlet 1.5 ft deep with incoming tide. Looked like ¼ quarter screens on either side of inlet with boards put back in after small storm, with screen frames to top of flume openings. One metal plate in place at flume outlet. One board in base of outlet.

Station 1: Flume at 0735 hr. Reach 1- No surface algae. 1 cormorant, 74 coots and 30 gulls. **Station 2:** Stockton Avenue Bridge at 0751hr. Reach 2- 19 coots.

Station 3: Railroad Trestle at 0810 hr. Reach 3- 14 coots, 1 pied-billed grebe and 5 mallards between trestle and redwood stump 120 meters upstream. 4 mallards roosting stump.

Station 4: Mouth of Noble Gulch at 0825 hr. Gray water from Gulch. 1 goose on cottonwood log. 1 great blue heron roosting in downed tree lying across cottonwood log, hiding in the branches.

Station 5: Nob Hill at 0850 hr. Water temperature of 11.4°C. Conductivity of 560 umhos. Oxygen 8.93 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 7.0 cfs.

1530 hr					09-Nov-06					1515 hr
	Flume					**Stockton Avenue Bridge**				
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	14.6	0.4	7.92	610		14.4	0.4	7.81	606	
0.25	14.7	0.4	7.85	610		14.4	0.4	7.78	606	
0.50	14.7	0.4	7.87	610		14.4	0.4	7.77	606	
0.75	14.7	0.4	7.93	610		14.3	0.4	7.60	605	
1.00 b	14.7	0.4	7.65	608		14.3	0.4	7.66	604	
1.25						14.3	0.4	7.67	604	
1.50						14.3	0.4	7.50	604	
1.75 b						14.2	0.4	4.27	604	
2.00										

1500 hr					09Nov-06					1444 hr
	Railroad Trestle					**Mouth of Noble Gulch**				
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	14.5	0.4	8.01	606		14.1	0.4	9.16	595	
0.25	14.5	0.4	7.97	606		14.1	0.4	9.13	597	
0.50	14.5	0.4	7.91	606		13.9	0.4	9.14	598	
0.75	14.4	0.4	7.90	607		13.8	0.4	9.09	597	
1.00 b	14.4	0.4	7.68	607		13.8	0.4	2.41	600	
1.25 b	14.4	0.4	4.77	607						
1.50										

09 November 2006.

Station 1: Flume at 1530 hr. Reach 1- No surface algae. Could not observe lagoon bottom due to low sun angle and shade. 35 gulls, 32 coots.

Station 2: Stockton Avenue Bridge at 1515 hr, secchi depth to bottom. Reach 2- No surface algae. Could not see bottom. 30 coots.

Station 3: Railroad Trestle at 1500 hr. Reach 3- No surface algae. Could not see bottom. 1 male merganser, 1 cormorant, 1 goose, 2 pied-billed grebes, 50 coots and 38 mallards. Coots and mallards were attracted to man and child feeding bread fragments at dock just downstream of Noble Gulch.

Station 4: Mouth of Noble Gulch at 1444 hr. Gray water present from Gulch.

0746 hr					22-Nov-06					0802 hr
	Flume					**Stockton Avenue Bridge**				
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	12.0	0.4	8.65	572		11.9	0.4	8.55	571	
0.25	12.0	0.4	8.55	572		11.9	0.4	8.63	571	
0.50	12.1	0.4	8.47	572		11.9	0.4	8.54	572	
0.75	12.1	0.4	8.41	572		12.0	0.4	8.39	572	
1.00	12.1	0.4	8.45	572		12.0	0.4	8.57	572	
1.05 b	12.1	0.4	7.67	572						
1.25						12.0	0.4	8.56	572	
1.45						12.0	0.4	5.30	572	
1.50										
1.75										
2.00										

0820 hr					22-Nov-06					0833 hr
	Railroad Trestle					**Mouth of Noble Gulch**				
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	11.9	0.4	7.75	571		12.1	0.4	8.10	571	
0.25	11.9	0.4	7.78	571		11.9	0.4	8.10	571	
0.50	11.9	0.4	7.76	571		11.8	0.4	7.98	571	
0.75	11.9	0.4	7.78	571		11.8	0.4	8.07	571	
1.00b	12.0	0.4	7.81	571		11.8	0.4	1.80	571	
1.13b	12.0	0.4	4.73	571						
1.25										
1.50										

22 November 2006. Gage height of 1.66 (morning) and 1.80 (afternoon). High cloud cover. A depression has formed in front of flume inlet. Air temperature of 9.5°C at 0746 hr and 13.4ºC at 1616 hr. In afternoon, flume inlet 1.0 ft and outlet 0.5-1.0 ft deep from side to side.

Station 1: Flume at 0746 hr. Reach 1- No surface algae. 70 gulls bathing with 4 coots. At 1616 hr, Reach 1- No surface algae. Bottom not visible except near edges. None there thicker than 0.2 ft. 8 gulls bathing, 13 coots and 1 pied-billed grebe.

Station 2: Stockton Avenue Bridge at 0802 hr. Reach 2- No surface algae. Secchi depth to bottom. 3 coots. At 1603 hr, Reach 2- No surface algae. 11 coots. Near bridge- Maximum algal thickness 0.2 ft.

Station 3: Railroad Trestle at 0820 hr. Reach 3- No surface algae. 11 coots, 1 gull, 5 horned grebes (one captured a stickleback), 14 mallards in water, 4 mallards roosting on submerged willow. Pied billed grebes propel with feet underwater, probing algae and debris on bottom with bill. At 1603 hr. Reach 3- No surface algae. Too dark to see bottom. 5 mallards roosting on redwood stump above trestle, 19 coots in water.

Station 4: Mouth of Noble Gulch at 0833 hr. No surface algae and gray water present. 1 snowy egret on cottonwood log across lagoon. Leaves accumulated on bottom near Gulch mouth. At 1532 hr, no surface algae. Bottom algae 0.1-0.2 ft thick. Gray water present. 1 goose on cottonwood log.

Station 5: Nob Hill at 0902 hr. Water temperature of 11.0°C. Conductivity of 551 umhos. Oxygen 9.13 mg/l. Salinity 0.4 ppt. Streamflow not estimated.

1616 hr					22-Nov-06				1603 hr
	Flume				**Stockton Avenue Bridge**				
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	12.7	0.4	9.30	581	12.8	0.4	8.78	583	
0.25	12.7	0.4	9.32	581	12.8	0.4	8.95	582	
0.50	12.7	0.4	9.15	581	12.8	0.4	8.86	582	
0.75	12.7	0.4	9.07	581	12.7	0.4	8.76	582	
1.00	12.7	0.4	9.00	581	12.7	0.4	8.69	582	
1.20b	12.7	0.4	9.02	581					
1.25					12.7	0.4	8.54	582	
1.50					12.7	0.4	8.16	581	
1.60					12.7	0.4	4.37	581	
1.75									
2.00									

1550 hr					22-Nov-06				1532 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
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	12.8	0.4	8.87	580	12.8	0.4	9.69	572	
0.25	12.8	0.4	8.85	582	12.6	0.4	9.42	575	
0.50	12.7	0.4	8.77	581	12.5	0.4	9.53	576	
0.75	12.7	0.4	8.78	582	12.4	0.4	9.61	576	
1.00b	12.7	0.4	8.59	584	12.3	0.4	4.65	577	
1.25b	12.7	0.4	0.50	585					
1.50									

0731 hr				06-Dec-06					0742 hr
	Flume					**Stockton Avenue Bridge**			
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	7.6	0.4	10.62	512		7.5	0.4	9.97	505
0.25	7.6	0.4	10.51	512		7.5	0.4	10.07	505
0.50	7.7	0.4	10.46	512		7.6	0.4	9.98	505
0.75	7.7	0.4	10.42	512		7.6	0.4	9.95	505
1.00 b	7.6	0.4	8.48	512		7.5	0.4	9.91	505
1.25						7.5	0.4	9.91	505
1.50						7.5	0.4	9.77	505
1.75						7.5	0.4	9.31	505
1.80b						7.5	0.4	7.05	505

0805 hr				06-Dec-06					0820 hr
	Railroad Trestle					**Mouth of Noble Gulch**			
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	7.0	0.4	10.76	498		7.5	0.4	10.09	505
0.25	7.0	0.4	10.70	498		7.5	0.4	10.03	506
0.50	7.0	0.4	10.61	498		7.5	0.4	10.04	506
0.75	7.1	0.4	10.59	498		7.5	0.4	10.06	506
1.00	7.1	0.4	10.58	499		7.5	0.4	10.03	506
1.13b						7.6	0.4	3.52	507
1.25	7.0	0.4	10.56	499					
1.30b	7.1	0.4	5.65	499					

6 December 2006. Gage height of 2.28 (morning). Clear and cool. Air temperature of 4.9°C at 0731 hr.
Station 1: Flume at 0738 hr. Reach 1- No surface algae. Bottom invisible. Reach 1 with 1 cormorant, 19 gulls, 15 coots. Sandbags added in front of flume to replace sand lost.
Station 2: Stockton Avenue Bridge at 0742 hr. Reach 2- No surface algae. Bottom invisible. Secchi depth to bottom. 5 coots in water and 3 coots roosting on redwood stump. 1 horned grebe.
Station 3: Railroad Trestle at 0805 hr. Reach 3- No surface algae. Lagoon bottom invisible. 16 coots and 1 Barrow's goldeneye duck (*Bucephala islandica*).
Station 4: Mouth of Noble Gulch at 0820 hr. No surface algae and no gray water. Bottom invisible. 1 goose and the cormorant were roosting on cottonwood log.
Station 5: Nob Hill at 0850 hr. Water temperature of 6.6°C. Conductivity of 490 umhos. Oxygen 11.03 mg/l. Salinity 0.4 ppt. Visually estimated streamflow at 8-9 cfs. 29 mallards and 6 coots in creek in vicinity of Nob Hill.

1550 hr			06-Dec-06				1530 hr
	Flume				**Stockton Avenue Bridge**		
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	9.1	0.4	11.29	525	8.7	0.4	10.79	528
0.25	8.7	0.4	11.29	521	8.7	0.4	10.51	525
0.50	8.5	0.4	11.52	519	8.6	0.4	10.55	523
0.75	8.2	0.4	11.87	517	8.5	0.4	10.46	522
1.00 b	8.1	0.4	11.63	517	8.5	0.4	10.44	519
1.25					8.3	0.4	10.26	518
1.50					8.1	0.4	10.33	517
1.75					8.0	0.4	6.13	517

1515 hr			06-Dec-06				1500 hr
	Railroad Trestle				**Mouth of Noble Gulch**		
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	9.1	0.4	10.91	528	9.0	0.4	10.86	521
0.25	8.9	0.4	10.68	527	8.8	0.4	10.95	520
0.50	8.6	0.4	10.69	524	8.4	0.4	11.18	519
0.75	8.6	0.4	10.78	522	8.3	0.4	11.06	519
1.00	8.4	0.4	10.74	519	8.2	0.4	11.10	519
1.13b					8.2	0.4	5.73	520
1.25	8.1	0.4	4.60	519				

6 December 2006. Gage height of 2.24 (afternoon). Clear and calm. Air temperature of 11.6 °C at 1550 hr. Too shaded to see entire bottom. No screens over flume inlet. 6.5 inch clearance on Venetian side for adult steelhead passage at top of boards.
Station 1: Flume at 1550 hr. Reach 1- No surface algae. Lagoon bottom around flume without algae. Reach 1 with 3 mergansers (one male), 11 gulls, 11 coots, 2 pied-billed grebes.
Station 2: Stockton Avenue Bridge at 1530 hr. Reach 2- No surface algae. Secchi depth to bottom. 4 coots and 2 mallards.
Station 3: Railroad Trestle at 1515 hr. Reach 3- No surface algae. Lagoon bottom under trestle with 10% algae coverage -.1-0.2 ft thick. Reach 3- 19 coots, 5 mallards, 1 pied-billed grebe, 1 gull, 1 goose. 1 coot roosting on redwood stump and one coot roosting on cottonwood log.
Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae and slight gray water. Bottom invisible.

9 December 2006. A facilitated breach of the sandbar was required to prevent flooding. This was the fourth stormflow of the season and the third in November. The stream flowed through the pre-cut notch due to lagoon filling. The flume was moving water at full capacity at the time of the breach. After raining overnight, streamflow had risen to approximately 65 cfs by approximately 0730 hr on this Saturday without the sandbar breaching. A board on either side of the flume inlet had been removed. Streamflow must have mostly entered the ceiling grate to flow through the flume. By 0830 hr, Morrison had removed more boards so that 3 boards were out on the Venetian Court side and 4 boards were out on the restaurant

side of the flume inlet. Considerable sand had been lost from the ocean side of the beach by 0830 hr. According to Morrison, tidal overwash had occurred. The possibility of a breach from the ocean side was possible. High tide was to be around 1130 hr and was above 5.0 ft. The biologist arrived at the lagoon at 1500 hr. There was considerable evidence of tidal overwash. The gage height was estimated at 3.40 ft. The lagoon level was above the flume and approximately 10 inches below the piling bolt. The lagoon was within approximately 15 inches of over-topping the bulkhead near the trestle. Water was passing through the flume. Morrison said the berm closest to the lagoon had been compromised by tidal overwash. Three portals were exposed on the flume at the ocean side. A small stream channel developed across the beach, which was very flat out to the surf. The wind was blowing and rain was intermittent. A thick cloud bank was approaching from the west. Doppler radar indicated that these clouds were bringing heavy rain with a red color code, according to Jesberg by cell phone. Heavy rain was in the forecast for Saturday night. Morrison made the decision at 1530 hr to use heavy equipment to cut a notch in the sandbar down to the level of the lagoon surface. Constant rain developed by 1600 hr.

Streamflow at the Soquel gage was measured at 34 cfs at 1415 hr. Between 1415 hr and 1815 hr, the streamflow declined to 30 cfs. However, by 1815 hr the flow had increased to 46 cfs at the gage. By 2000 hr, streamflow at the gage had reached 90 cfs.

10 December 2006. By 0200 hr, streamflow reached a maximum of 110 cfs at the Soquel Gage before declining to 72 cfs at 0615 hr. Another storm was forecasted for Sunday-Monday. Rain continued into the next week with stormflow reaching approximately 36 cfs on 12 December.

APPENDIX B.

2006 DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK-2006				
RESTAURANT	**INITIAL CONTACT**	**TEST DATE**	**COMMENTS**	**SIGN OFF**
BEACH HOUSE 207 ESPLANADE	5/11/2006 J. ANDERSON 475-5846	25-May-06	NEGATIVE SLOPE LEAKAGE AT CAPS	16-Jun-06
BAY BAR & GRILL 209 ESPLANADE	5/11/2006 ANNE ELYSE SMITH 477-0749	25-May-06		25-May-06
PIZZA MY HEART 209-A ESPLANDE	5/11/2006 KELLY PATTERSON 475-5714	16-May-06	BROKEN FLOOR JOIST SECURE & SLOPE ISSUES	21-Jun-06
FOG BANK 211 ESPLANDE	5/11/2006 KIMBERLY SPENCE 462-1881	16-May-06 5/25/2006	SLOPE ISSUES SECURE CLEANOUT	21-Jun-06
PARADISE BAR & GRILL 215 ESPLANADE	5/11/2006 NICOLE COPE 476-4900	16-May-06	SLOPE ISSUES	8-Jun-06
ZELDA'S 203 ESPLANADE	5/11/2006 ED LEIPELT 475-4900	16-May-06		16-May-06