SOQUEL CREEK LAGOON MONITORING REPORT, 2003

Prepared by

D.W. ALLEY & Associates,
aquatic biology

Prepared for

CITY OF CAPITOLA
420 Capitola Avenue
Capitola, California
95010

December, 2003

Project #106-13

330 Old River Lane • P.O. BOX 200 • Brookdale, California 95007 - 0200 • (831) 338-7971 • FAX (831) 338-6045

TABLE OF CONTENTS

List of Tables

List of Figures

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

SOQUEL CREEK LAGOON MONITORING REPORT, 2003

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 Tim Calahan for helping with the fish relocation during sandbar construction (**Photographs, Appendix D**). He has been an important man for many years in accomplishing what is needed during sandbar construction. We always appreciate the humor and honesty he brings to the process. We appreciate the efforts of the Begonia Festival participants to avoid wading in the lagoon during the procession and Nels Westman's efforts to aide a float that temporarily lost control. The Begonia Festival organizers and other volunteers effectively removed flowers 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 of storm events.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. They come mainly from Friends of Soquel Creek and Earth Links, with other interested volunteers and innocent bystanders who join in to lend a hand. We were assisted by two fishery biologists from NOAA Fisheries in this, the thirteenth year of fish sampling, providing a valuable index of steelhead abundance in the lagoon. Volunteers are very welcome to help on the first two Sunday mornings in October. The fun usually ends by 1:00 pm, in time for the 49er game.

REPORT SUMMARY

Sandbar Construction and Breaching. In 2003, the flume had been cleared of sand the week prior to sandbar construction. Sandbar construction began on 20 May and sandbar closure was completed on 22 May. Two artificial breaches were required. When the lateral channel across the beach was sampled before the onset of sandbar construction on 20 May, and water exited the estuary through the flume as the water level increased. Unlike previous years, limited kelp and seagrass were in the lateral channel, allowing seining to be effective. Some kelp was raked out of the channel prior to seining. The fish captured in the lateral channel included approximately 250 staghorn sculpin (*Leptocottus armatus*), approximately 250 threespine stickleback (*Gasterosteus aculeatus*) and 11 juvenile steelhead (*Oncorhynchus mykiss;* 2.5- 3 inches Total Length), 5 juvenile starry flounder (*Platichthys stellatus;* 1-1.5 inches diameter) and 1 striped bass (*Morone saxatilis*; approximately 8 inches Total Length). No tidewater gobies (*Eucyclogobius newberryi*), prickly sculpins (*Cottus asper*) or juvenile Sacramento suckers (*Catostomus occidentalis*) were detected in the estuarine lateral channel. Captured fish were transported from a live car to the main estuary in a water-filled bucket, except for the striped bass. Passage for steelhead smolts was provided during the out-migration season in 2003. On 8 November 2003, the lagoon sandbar breached through the pre-cut notch due to lagoon filling during the first major storm event of the winter season. The flume was moving water at full capacity at the time. The sandbar remained open after that.

Stream Inflow to the Lagoon. Habitat conditions in the 2003 lagoon followed a winter with late storm events, with initial summer baseflow higher than in 2002, but became similar to 2002 flows by late July, based on visual estimates. Lagoon inflow in 2003 was much higher than in drought conditions. Streamflow just above the lagoon was measured at 1.91 cubic feet per second (cfs) in October 2003, compared to 1.28 cfs near the Grange in late September 2002 and 1.58 cfs in late October 2001 near the Grange. Lagoon and stream water temperature was somewhat warmer in 2003 than in 2002, with the lagoon a foot shallower under the Stockton Avenue Bridge and upstream of the railroad trestle. This shallowing was due to sedimentation. No tidal overwash occurred in 2003.

Water Temperature. In analyzing temperature data from the 5 data loggers throughout the water column, results were consistent with temperature data collected at monitoring stations over the past 13 years. There was no thermocline, with complete mixing of the water column. Water temperature warmed somewhat through the water column through the day, with it being coolest near the bottom when no warm saltwater layer was trapped below freshwater in 2003. The daily difference between the maximum daily temperature of the shallowest and deepest probes in 2003 ranged from zero to 1.15°C (2.06°F), as was the case in 2002 (**Tables 4 and 5**). The temperature difference in 2003 through the water column at the minimum daily temperature was much less, ranging from zero to 0.38°C (0.69°F), as was the case in 2002. Juvenile steelhead likely spent most of their time near the bottom, except when feeding on emerging aquatic insects.

Water temperatures in the lagoon closely mirrored temperatures in the stream inflow in 2003. Daily *minima* in the lagoon were consistently warmer than the stream above in 1999-2003. The daily *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2003, but not in 2000. The daily stream temperature fluctuated more in the stream than the lagoon. Lagoon water temperatures were probably stressful for juvenile steelhead in 2003 primarily in early August when maximum daily water temperature near the bottom exceeded 22°C (**Figure 4a**), but less stressful than in 2001 when there had been two tidal overwashes. In 2001 for 14 days, daily temperatures near the bottom fluctuated between approximately 23 and 26°C (73.4- 78.8°F) (**Alley 2003a**).

In the 2003 summer lagoon, 19% of the days failed to meet the management goal of early morning temperatures less than 20°C near the bottom. This was compared to 10% in 2002. A total of 7% of the days in 2003 did not meet the management goal of maximum daily temperatures below 22°C. This was compared to 2% in 2002. The creek site near Nob Hill in 2003, 22 of 127 monitored days (17%; June-early October) failed to meet the management goal of *no more than 4 hours a day at greater than 20°C (68°F).* During the warmest, early August, 10-day period, maximum stream inflow temperature ranged from **20.9°C to 21.7°C (Figure 5g)**, while *near-surface* lagoon temperature ranged between **22.8°C and 23.6°C (Figure 4i)** and the *near-bottom* lagoon temperature was between **21.7°C and 22.5°C (Figure 4e)**.

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. This was the time that oxygen levels were most importantly measured and rated. Filamentous algae was first noted on 7 July 2003, 6 weeks after sandbar closure (**Appendix A**). Pondweed was first noted on 4 August 2003, 10 weeks after sandbar closure (**Photographs, Appendix D**). As in 2000-2003, pondweed became prominent in mid- to late August 2003, and remained so into late October. Pondweed was not noticed until 14 August in 2000 and not until 20 August in 1999. The year, 2003, was unusual with two species of pondweed, one with ovate leaves and one with filamentous leaves.

In 2003, there was the most surface algae sporadically from mid-August on since 1999, particularly near Noble Gulch and later in the dry season. On 27 October, surface algae coverage was 5% in Reach 2, 10% in Reach 3 and 20% around Noble Gulch.

In 2003, oxygen levels for steelhead were either "fair" or "good" near the bottom at all stations during monitorings except at Station 3 (under the railroad trestle) on 18 August, when oxygen concentration fell to 4.80 mg/l (**Table 3, Figure 9a; Appendix A**). Otherwise, oxygen stated above 5 mg/l at all other stations throughout the summer. Morning oxygen concentrations near the bottom were usually least near Noble Gulch (Station 4), followed by the trestle location (Station 3), perhaps due to the higher density of algae and pondweed in those vicinities and more cell respiration through the night to depress oxygen levels. Morning oxygen levels gradually declined through the summer at Station 4 (near Noble Gulch) until October, corresponding to increasing densities of algae and pondweed (**Figures 9a and 9c; Appendix A**). The same

occurred at Station 3 (trestle) from late June to mid-August (**Figure 9a**).

During the two-week monitorings, oxygen levels were most similar in morning and afternoon at all stations during the first two monitorings in June, before filamentous algae and pondweed began to develop. In some cases (Stations 1 and 2), oxygen was slightly less in afternoon in June due to warmer water that has a lower saturation level than cooler water (**Figure 9b; Appendix A**). However, by 7 July when filamentous algae was first observed, oxygen levels were higher in afternoon than in the early morning at all stations and sometimes at supersaturated levels, as exemplified by **Figures 9b and 9c**.

Fall Steelhead Sampling. The 2003 steelhead population estimate, based on mark and recapture was 849 juveniles +/- 198 compared to 1,042 juveniles +/- 84 in 2002 and 454 juveniles +/-27 in 2001 (**Table 5, Figure 16**) (**Ricker 1971**). Other species captured with the 106-foot seine on the two days combined were two starry flounders and abundant threespine sticklebacks. No tidewater gobies were detected in 2003, with the last detection occurring in 1997 before the El Niño storms of 1997-98. The median size for young-of-the-year steelhead was slightly larger in 2003 (110-114 mm Standard Length) compared to 2002, with a similar size distribution in both years (**Figures 10 and 11**). Growth rates and juvenile sizes were greater in 1998-2001 (**Figures 12-15**).

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 in the lagoon. They roost 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. A better method of refuge disposal is needed. Some of the refuge cans situated on the beach had no lids. The gulls had access to refuse that they dragged onto the beach. Refuse containers with lids that are gull-proof and user-friendly may reduce gull numbers.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original Management Plan, to reduce bird pollution the trestle could be screened so that roosting areas are eliminated.

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. 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 increase 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 Recommendations and Those Not Yet Implemented

1. Replace all the open, lid-less refuse containers on the beach with gull-proof lids that are convenient to use. Use enough refuse containers to satisfy the demand for refuse disposal.

2. Look into installing gull sweeps on restaurant roofs.

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

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

5. 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 of the streamflow conditions so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

6. Regarding the Begonia Festival, continue to recommend surfboard paddling for float propulsion rather than wading. If participants choose wading, recommend that the organizers set a limit of 3 waders per float. Allow passage of floats in one direction only, presumably downstream and then to the dismantling location near the Stockton Avenue Bridge.

7. If wading during the Begonia Festival is requested, 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.

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

9. 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.

10. 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.* 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.

11. 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.

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

13. 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.

LAGOON AND ESTUARY FORMATION

Results of Fish Sampling Prior to Sandbar Construction Activities, 2003

Personnel from the City of Capitola Public Works Department assisted Donald Alley in making seine hauls in the lower lateral channel leading southeast from the main estuary across the beach. Two seines with dimensions of 30 feet x 4 feet x 1/8-inch mesh were first used to herd fish from the lateral channel into the main estuary prior to the lateral channel being blocked off. This herding was done to minimize the actual handling of fish. After the lateral channel was blocked off from the main estuary, we continued to remove fish from the lateral channel with the seine and relocated them to the main estuary. The flume had been cleared of sand the previous week, and water exited the estuary through the flume as the water level increased. Unlike previous years, limited kelp and seagrass were in the lateral channel, allowing seining to be effective. Some kelp was raked out of the channel prior to seining. The fish captured in the lateral channel included approximately 250 staghorn sculpin (*Leptocottus armatus*), approximately 250 threespine stickleback (*Gasterosteus aculeatus*) and 11 juvenile steelhead (*Oncorhynchus mykiss;* 2.5- 3 inches Total Length), 5 juvenile starry flounder (*Platichthys stellatus;* 1-1.5 inches diameter) and 1 striped bass (*Morone saxatilis*; approximately 8 inches Total Length). The lateral channel had a flowing stream section at its lower end near the surf where most of the juvenile steelhead were captured. The upper end had a deeper, pooled section where the staghorn sculpins and threespine sticklebacks were captured. A few steelhead were detected in this pooled section. No steelhead mortality was observed in the lateral channel, and no tidewater gobies (*Eucyclogobius newberryi*) were observed in 2003.

Captured fish were transported from a live car to the main estuary in a water-filled bucket, except for the striped bass. It was relocated to the mouth of the lateral channel as it entered the surf. Striped bass would prey heavily on small fish in the summer lagoon. (A very healthy striped bass was captured the previous fall in the summer lagoon.) The lateral channel was observed continually as it became dewatered until no more fish were seen. If tidewater goby had been found, they would have been transported further upstream where cover existed. No tidewater gobies have been captured in the lower lagoon since fall, 1997.

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 the thirteenth year of fishery monitoring and assistance in activities associated with sandbar construction at Soquel Creek Lagoon. Reports for the first 13 years are available at the City (**Alley 1991-2003**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**), 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 could traverse the area adjacent to the flume.

Monitoring of Sandbar Construction

20 May 2003. When we arrived in the morning prior to the fish relocation, sand had been stockpiled along the lateral channel. Kelp was patchy in the lateral channel. There was a shortage of sand on the east side of the beach this year. On the west side of the beach, sand had been moved into the lagoon area by tidal action. The estuary was relatively narrow, with the deep channel (thalweg) next to the restaurants. Sand had been excavated on the Venetian side of the beach above the waterline. Observations up and downstream of the Stockton Avenue Bridge were made. Kelp was present in patches between the Bridge and the railroad trestle. The estuary looked shallower than the previous year. No fish were observed from the bridge or the bulkhead along the lagoon. The flume was open after sand had been flushed out the previous week. The stainless-steel grate was in place on the top of the flume entrance. It looked good. Sewage pipes were being repaired at one of the restaurants as a result of City inspection of restaurant plumbing. Approximately half of the lateral channel was fastwater stream with slightly less than 10 cfs visually estimated. The lateral channel was blocked off this day. Much of it was covered over with sand by the end of the day after fish had been relocated to the main estuary. The sandbar was not artificially breached this day. A notch was cut in the sandbar near the flume. Overflow water passed through the open flume overnight.

21 May 2002. The fisheries biologist arrived at 0700 hr. The lagoon level was within 2-3 inches of the top of the flume. The sandbar was breached at 0800 hr. As the lagoon drained down, one juvenile steelhead, 8 sticklebacks and 3 staghorn sculpins were rescued from puddles formed around pilings under and adjacent to the restaurants. They were relocated under the Stockton Avenue Bridge. As the lagoon drained, the fisheries biologist made two searches upstream past the Shadowbrook Restaurant, looking for potentially stranded fish as was required in the permit. The estuary bottom was very soft and muddy this year. The fisheries biologist's boots sunk into the ooze 2-3 inches with every step (**Photographs; Appendix D**). No shallow side channels or pockets were found along the periphery of the estuary this year to strand fish. The lagoon is narrow, and seldom do side pools form during the lowering of the water level. Unlike the previous year, no fish were visible in the lagoon as the fisheries biologist walked upstream. No mergansers (*Mergus merganser*) were observed.

The wooden baffle inside the flume had been damaged over the winter and was replaced, creating an entry pool to the flume of more than 1 foot with the existing streamflow. As was required by the Fish and Game Agreement, the baffle was V-notched from 12 inches at the outside to 9 inches at the low point. As was required by the Fish and Game Agreement, an 8-inch square portal was cut in the flume inlet boards on the east side for adult steelhead kelt access to the flume. Kelp and sea grass were hand-raked from the lagoon as it drained down. Raking was carried out by 5 Public Works personnel and the fisheries biologist from the Stockton Avenue Bridge to the flume. Most of the plant material downstream of the bridge had been raked out. Considerable kelp remained upstream of the bridge and was left. Water velocities from the bridge upstream were very slow, as was typical. Water velocities adjacent to the restaurants were

higher. More sand was excavated on the Venetian (west) side of the lagoon above the water line before sandbar closure. The effort was to create as deep a lagoon as possible. The sandbar was closed alongside the flume at 1400 hr to prevent saltwater from entering the lagoon.

22 May 2003. The fisheries biologist arrived at 0920 hr. The lagoon was full with the sandbar closed. The sandbar was opened at approximately 1000 hr. The fisheries biologist made two searches for stranded fish upstream past the Shadowbrook Restaurant to the narrow stream habitat. No stranded fish were observed except in a depression formed by the stormdrain runoff on the east side of the lagoon, just upstream of the Stockton Avenue Bridge. Small prickly sculpin were rescued out of this puddle. No fish were visible in the lagoon during the searches. No mergansers were observed. Orange plastic fencing was removed from the lagoon adjacent to the Shadowbrook Restaurant. The lagoon had lowered an estimated 2 to 2.5 feet during the draining, leaving water depth near the trestle an average 2 feet deep. The previous year, with the lagoon at its lowest point during sandbar construction, water depth between Stockton Avenue and the railroad trestle was approximately 5 feet maximum. The pad was prepared around the flume to prevent water seepage alongside the flume once the sandbar was closed. Visquine was spread around the flume on top of filter fabric. Sandbags were used to secure the visquine to the flume. The sandbar was closed at 1300 hr for the season. The top boards on the flume inlet were screened for safety purposes.

23 May 2003. The fishery biologist arrived at the lagoon at 0815 hr. The lagoon was full with a good gage height of 2.26. Water was spilling over the top board at a depth of 2-3 inches, making it easy for juvenile smolt entrance into the flume. The fishery biologist communicated to the heavy equipment operator the importance of building a high berm around the lagoon to prevent tidal overwash. Water quality measurements were taken from the Stockton Avenue Bridge at the east bridge pier and in the thalweg to detect any salinity. No saltwater was detected, indicating that it would be unnecessary to install the flume shrouds. Water temperature was 16.2°C at the surface and 16.1°C at the bottom in the thalweg. The thalweg (water depth = 1.25 m) appeared to be approximately 2 feet shallower under the bridge than the previous summer, indicating significant sedimentation. The sheet metal covers had been installed along the esplanade sidewalk drains to prevent trash from entering the lagoon. The cap had been installed on the storm drain in the street adjacent to the restaurants to prevent water pollution from entering the lagoon.

31 May 2003. Water temperature sensors were placed in the lagoon and upstream of the lagoon as required by the permit. Water depth at the lagoon monitoring station was approximately 1 foot shallower (at 5 feet depth) than in 2002.

3 June 2003. Water quality was again monitored for saltwater at 1658 hr. No saltwater was detected at the Stockton Avenue Bridge Pier or in the thalweg. Water temperature was relatively cool, ranging from 18.2°C at the surface to 17.3°C at the bottom.

9 June 2003. The first lagoon monitoring occurred at 4 stations in early morning and afternoon.

Effects of Sandbar Construction on Tidewater Gobies in 2003

It did not appear that tidewater gobies used the lower estuary in late May. If they were present in the estuary, it was likely that 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 two sandbar breaches were required during sandbar preparation in 2003, with 3 breaches allowed by the permit without regulatory consultation. The estuary receded after the lateral channel had been blocked (20 May) and the new channel was constructed alongside the flume (21 May). This would require tidewater gobies 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. 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.

Effects of Sandbar Construction on Steelhead in 2003

No negative impacts to the steelhead population were detected in 2003. Juveniles were rescued from the lateral channel prior to its being covered over. 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, and water depth near the trestle was approximately 2 feet. Unlike in 2002, the only juvenile steelhead observed in the main estuary during sandbar construction was one smolt near a restaurant piling. When we walked the upper estuary during draw down, no juvenile steelhead were observed as far up as the cut redwood stump past the Shadowbrook Restaurant. No mergansers were present during sandbar construction. Unlike in 2002, no adult steelhead were observed in our initial observations of the lagoon.

The seasonal effect of removing organic material and constructing the sandbar is to create good summer rearing habitat for steelhead and tidewater goby. A lagoon is created with cooler, freshwater conditions with reduced potential for eutrophication and associated increased biological oxygen demand from plant decomposition and night 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. Saltwater would also be trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon 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, 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 young-of-the-year (YOY) steelhead from spawning sites above the lagoon. Small steelhead fry remain in the vicinity of spawning sites before moving down into the lagoon. Our down-migrant trapping on the San Lorenzo River in 1987 and 1988 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, the sandbar construction may be delayed as late as 4-5 days before the Memorial Day weekend and may still satisfy the tradition of lagoon formation before that weekend.

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 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 quickly rake out decomposing kelp and clear the sand-filled flume. The two days of artificial breaching in 2003 required for sandbar construction was quicker than usual.

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 comm.**).

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

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. During daily artificial breaching during sandbar construction, 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.

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. Spend a maximum of 5 days to construct the sandbar.

11. Screen the hose intake for the pump that is used to flush sand from the flume that had been trapped over the winter. This will prevent steelhead from being impinged on the intake fitting.

12. 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.

13. 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.

14. Maintain a depth of 0.7 feet or deeper inside the flume for fish passage until July 1. Placement of planks in the slotted flume outlet may be necessary during drier years.

15. Construct the sandbar berm sufficiently high to reduce the likelihood of tidal overwash during the summer. Creation of a temporary ponding area on the beach may be required.

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

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. The management goal is to pass stormflow through the flume from the first small storm events in the

fall. 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. The wooden cover of the first flume portal may also be removed.

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 2003-2004 Rainy Season.

8 November 2003. The sandbar breached at approximately 2230 hr on Saturday night after it had rained through the afternoon. Ed Morrison of the City had left message with Urquhart of CDFG on 7 November that all efforts would be made to retain the sandbar, but that sandbar breach was likely under sustained storm conditions. Saturday evening at 2100 hr, Morrison contacted Alley. A significant rainstorm was underway. Morrison had just removed 4, 4"x 4" boards on Venetian Court side of flume inlet and 3 such boards on the restaurant side. Wind-blown rain had occurred along coast since 1800 hr. Rain continued harder after 2100 hr, and the sandbar breached on its own and unobserved through wide excavated notch by 2230 hr when Public Works staff returned to the beach. By 2300 hr, the stream channel through the beach was estimated at 20-30 ft wide according to Eddie Ray Garcia of Public Works. Morrison notified Kevan Urquhart of CDFG that sandbar had breached. The sandbar remained open to the date of this report. Prior to breaching, the City had graded a wide swath of sand across the beach to facilitate breaching. The notch in the sandbar was approximately 40 feet wide at the head of the flume and 50-60 feet wide at the surf.

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 one board from each side of the flume if a small storm is anticipated. 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. Clear the sand away from the top of the flume back to the first portal cover. 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 and the opening of the first flume portal behind the flume inlet. The portal must be screened and isolated from human access to prevent a hazard to public safety. 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. Remove the first flume portal cover and screen it if the entrance of the flume cannot handle the volume of the stormflow in October and early November. 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 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, 2003

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 22° C (72° 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 23-25°C for 1-2 hours toward the end of the day (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-5°C 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 20° C were rated "good" while those 20-21.5° C were rated "fair." Temperatures between 21.5 and 23° C were rated "poor," while those greater than 23° 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 2003, 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. The first station was at the flume inlet (**Figure 1; Photographs in Appendix D**). The second station was on the downstream side of the Stockton Avenue Bridge in the deepest thalweg area.

The third was just downstream of the railroad trestle on the east side. The fourth station was at the mouth of Noble Gulch. A fifth station 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 when oxygen levels would be at a minimum.

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 suck the heavier saltwater off the lagoon bottom to hasten the freshwater conversion in the lagoon. In 2003, the CDFG permit required that monitoring occur in the early morning and late afternoon. In the past, 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.

In 2003, a total of 4 water samples were collected before and immediately following the Begonia Festival Procession on 31 August. The two sampling locations were located in Reach 1, approximately 25 feet downstream of the bridge, and in Reach 2, midway between the trestle and the Stockton Avenue Bridge (**Figure 1**). Water samples were taken near the water surface.

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

Degrees Celsius	Degrees Farenheit
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

In 2003, 5 HOBO temperature loggers were placed 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, as required by the CDFG permit. This was a deeper portion of the lagoon. These loggers were launched on 30 May. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. All 6 loggers were removed on 5 October 2003.

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 20°C (68°F) at dawn within 0.25 m of the bottom and the afternoon maximum below 22°C (71.6°F) 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 20°C. Maximum daily water temperature should not reach 26.5°C (79.5°F). Although Coche (**1967, cited in Kubicek and Price 1976**) determined that temperatures between 20 and 24°C 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 2003b**), with nearly all young-of-the-year juveniles in the lagoon reaching smolt size the first summer. This indicates that higher water temperature has not prevented relatively rapid growth of juveniles in the lagoon.

Water temperatures above 20°C (68°F) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and lagoon temperatures below 16°C (60.8°F) 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 20°C (68°F). 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 20°C (68°F) in April and May when baseflow still remains above summer low-flow and juvenile salmonids are feeding and growing rapidly. From Junel to September 1, the water temperature should not rise above 20°C (68°F) more than 4 hours a day (15% of the month) and preferably the maximum daily temperature, averaged weekly, should not rise above 21°C (70°F). 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 15-18°C, 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 15-18°C, 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 16-18°C. 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 20°C average daily temperature and 25°C daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River (**SYRTAC 2000**) further south. The SYRTAC (**2000**) decided that a mean daily temperature of 22°C 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 23°C.

The management goal regarding water temperature prior to re-introduction of coho salmon to Soquel Creek should be that water temperatures in specified reaches meet the criteria that average daily water temperature (averaged weekly) during summer/fall months (June 1 to October 1) be 16.7°C (62°F) or less in the warmest week and that the weekly maximum temperature be 18.0°C (64°F) 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. 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 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 23 May to 27 October 2003, including August 31, the day of the Begonia Festival. For 2003, the measurements of lagoon level as measured on the staff gage were rated "good" (**Table 2**) on all occasions (**Table 3; Figure 2a**). Maintaining the lagoon depth has improved since the pre-1996 summers, particularly late in the dry season (**Figures 2a-c**). In the past, back pressure through the flume has likely dislodged boards to allow leakage through the flume, resulting in reduced water surface elevation. However, there was no indication that this occurred in 2003, with the use of plywood nailed to the boards to hold them together. There was no need for use of the shrouds in 2003. Placement of the grated hole in the top of the flume allowed for better secured flashboards.

No vandalism was detected in 2003. 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, temporary 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 presence of a hole in the top of the flume would alleviate the need for rapid board removal and replacement under some circumstances.

Flume Passability. According to the Management Plan (**1990**), 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 baffle near the flume entrance was replaced in 2003. The flume had been mostly cleared of sand the week prior to the onset of sandbar manipulation to speed the sandbar construction process. Thus, the flume was cleared completely before final sandbar closure, to insure steelhead smolt passage during and after sandbar construction. Sufficient baseflow in 2003 resulted in excellent passage for steelhead smolts and an open flume throughout the dry period (**Table 3**). The sandbar breached on its own through the notched sandbar on 8 November 2003. The flume was flowing at near full capacity and the channel through the beach was 20-30 feet wide within an hour of breaching.

Water Temperature

Results from Bi-monthly Monitoring. In 2003, lagoon water temperature was rated either "good" or "fair" at the four stations throughout the summer within 0.25 meters of the bottom (**Table 3, Figure 3a; Appendix A**). No tidal overwash occurred in 2003, despite significant tidal overwash in adjacent lagoons in October. Of the early morning monitorings, Station 1 at the

flume was rated "good" 67% of the time and "fair" 33% of the time. Station 2 at Stockton Avenue Bridge and Station 3 near the railroad trestle were rated "good" 75% of the time and "fair" 25% of the time. Station 4 at the mouth of Noble Gulch was rated "good" 92% of the time and "fair" 8% of the time. The 2003 temperature ratings were similar to 2002 ratings at Stations 2-4, despite the much shallower conditions in 2003 under the Stockton Avenue Bridge and on the west side, upstream of the trestle. Station 1 at the flume registered warmer temperature in 2003 than 2002 in early to mid-September, with slightly deeper conditions in 2003. Maintaining a deep lagoon for most of the summer helped to minimize water temperature. Water temperatures at the Stockton Avenue Bridge (Station 2) in 2003 were generally cooler than in 2002 in the first half of the summer and at the end (**Figure 3a**). Lagoon water temperatures were generally cooler in the years immediately prior to the drier year 1997, except during the dry year of 1994 (**Figure 3a-c**). There was more tree canopy over the stream prior to a large storm in the 1996-97 winter and the El Niño stormflows of winter 1997-98, allowing cooler stream inflow to the lagoon in the wetter years of 1993, 1995 and 1996.

In 2003, the maximum water temperature increase within 0.25 m of the bottom from morning to afternoon measured at Station 1 (flume) was 2.4°C (4.3°F) on 21 July (**Appendix A**). This was also the case at Stations 2-4, with increases of 2.2, 1.9 and 2°C from morning to afternoon. The afternoon water temperatures measured near the bottom on 7 July at Stations 1-4 were 22.2, 22.0 (**Figure 3d**), 21.5 and 20.3°C (**Figure 3e**), respectively. The warmest afternoon water temperatures measured during two-week intervals was on 4 August. Near the bottom, the afternoon water temperatures at Stations 1-4 for that day were 22.8, 22.6 (**Figure 3d**), 22.3 and 22.0°C (**Figure 3e**), respectively. The afternoon temperatures on 4 August at the surface at Stations 1-4 were 23.5, 23.5, 23.0, and 24.2°C, respectively (**Appendix A**).

Results from Continuous Data Loggers. In analyzing temperature data from the 5 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 13 years. There was no thermocline, with complete mixing of the water column on a diurnal cycle. Water temperature cooled somewhat through the water column through the day, with it being coolest near the bottom as long as no warm saltwater layer was trapped below freshwater, which was avoided throughout the monitoring period of 2003. Each night, water temperature cooled to the bottom, with the surface commonly being cooler than deeper layers at dawn (**Appendix A**). Juvenile steelhead likely spent most of their time near the bottom, except when feeding on emerging aquatic insects at dusk and dawn. This assumption was based on years of underwater observations of salmonids. Therefore, the water temperatures recorded near the lagoon bottom have greatest relevance to assessing habitat quality.

Lagoon water temperatures closely mirrored temperatures in the stream inflow in 2003. Daily temperature *minima* in the lagoon were consistently warmer than the stream above in 1999-2003. Daily temperature *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2003, but not in 2000. The daily stream temperature fluctuated more in the stream than the lagoon.

Lagoon water temperatures were probably stressful for juvenile steelhead in 2003 primarily in early August when maximum daily water temperature near the bottom exceeded 22°C (**Figure 4a**), but less stressful than in 2001 when there had been two tidal overwashes. In 2001 for 14 days, daily temperatures near the bottom fluctuated between approximately 23 and 26°C (73.4-78.8°F) (**Alley 2003a**).

In the 2003 lagoon, 19% of the days measured (24 of 128 day – 31 May- 5 October) failed to meet the management goal of early morning temperatures less than 20°C near the bottom. This was compared to 10% in 2002. A total of 7.1% of the days (9 of 127 days) in 2003 did not meet the management goal of maximum daily temperatures below 22°C. This was compared to 2% in 2002.

From 31 May through 4 October 2003, the daily maximum water temperature of the stream inflow ranged from **14.8°C** (58.7°F) on 12 June to **21.7°C** (71.1°F) on 27 June and 7 August (**Figures 5g and 5h**). The daily maximum water temperature in 2003 near the lagoon surface ranged from **15.3°C** (59.4°F) on June 12 to **23.6°C** (74.6°F) on 12 August (**Figures 4i and 4j**). At the lagoon bottom temperature ranged between **15.3°C** (59.4°F) on 12 June and **22.5°C** (72.5°F) on 7, 8, 11, and 12 August (**Figures 4a and 4b**). The greatest increase in water temperature recorded from morning to afternoon near the bottom in 2003 was 2.7°C during the last week in June (**Figure 4a**). The greatest increase near the lagoon surface was 3.8°C on the same day (**Figure 4i**).

The most significant water temperature differences between days likely resulted from differences in water temperature of the stream inflow on those days and differences in air temperature/ solar insolation. There was a relatively large warming spike the last 4 days in June 2003 and a warm 10-day period from 3 August through 13 August seen in stream water temperature readings above the lagoon (**Figure 5g**), in the lagoon at near the surface (**Figure 4i**) and near the bottom (**Figure 4a**).

On 28 June, *stream* inflow had reached **21.7°C**, with a *near-surface* lagoon temperature of **22.1°C** and a *near-bottom* lagoon temperature of **22.1°C**. During the warmest, early August, 10-day period, maximum stream inflow temperature ranged from **20.9°C to 21.7°C** (**Figure 5g**), while *near-surface* lagoon temperature ranged between **22.8°C and 23.6°C** (**Figure 4i**) and the *near-bottom* lagoon temperature was between **21.7°C and 22.5°C** (**Figure 4e**).

In 2003 there were short, 2-3 day periods of relatively cool stream inflow and lagoon temperatures seen in 10-12 June, 23-25 June, 20-21 July, 30 July- 2 August, and isolated cool days, such as 20 August and 10 September. In late June, maximum *stream* temperature went from **18.2°C** on 25 June to **21.3°C** the next day (**Figure 5g**), an increase of **3.1°C** and the largest of the summer. Maximum lagoon temperatures *near the surface* went from **18.6°C to 20.6°C** (a difference of **2°C**) on those days (**Figure 4i**) and from **18.7° to 19.1°C** *near the bottom* at that time (**Figure 4e**), a difference of **0.4°C**, with a lag time between warm inflow and a warmer lagoon. This may indicate that foggy or overcast days can significantly affect water

temperatures. It may indicate that if fog was lacking at the lagoon and/or the cloud cover burned off early slightly inland, water temperature could increase approximately 2-3°C (3.6-5.4°F) over what it would be with fog and overcast. Therefore, if the summer is generally cool inland, the lagoon may actually be warmer due to the lack of fog and overcast. If the stream and lagoon were more shaded, the warming effect of sunny days would be somewhat mediated.

Water temperature measurements through the water column examined at the 10-day intervals showed the difference between the maximum daily temperatures at 0.5 feet from the bottom and 4.5 feet from the bottom (less than 1 foot from the surface) varied between zero and 1.15°C (2.06°F) of warming from bottom to top (**Table 4**; **Figures 4a-b and 4i-j**), as was the case in 2002 (**Figures 4k-l; Table 5**). The average maximum temperature increase from bottom to top was 0.60°C (1.07°F) for the 14 analyzed days in 2003 (**Table 4**) compared to 0.72°C (1.31°F) in 2002 for the 10 days considered (**Table 5**)

The average temperature difference between maxima near the surface versus near the bottom was less in 2003 than in 2002 probably because data were collected in the cooler June in 2003, and lagoon depth was approximately 1 foot shallower in 2003 at the monitoring location. The minimum daily temperature difference through the water column was much less than the maximum daily temperature difference, ranging from zero to 0.38 °C (0.69°F) in both 2003 and 2002.

The 2003 lagoon was warmer than in 1999-2002 in terms of number of days with near-bottom temperatures above 70°F, with 2000 having the coolest conditions in the last 5 years. In the 2003 lagoon, 29 of 127 days (23%) had maximum temperatures greater than 70° F (21.1° C) near the bottom (**Figure 4b**). Beginning in July in the 2003 lagoon, there were 27 of 96 days (28%) above 70°F near the bottom. In the 2002 lagoon, 14 of 96 days (15%) beginning in July had maximum temperatures greater than 70° F (21.1° C) near the bottom (**Figure 4k**). In the 2001 lagoon with its two tidal overwashes, 22 of 108 days (20%) had temperatures greater than 70° F near the bottom (only 1 day of 80 days (1%) in 2000) (**Alley 2003a**). During those 2 tidal overwashes in 2001, water temperatures were the highest recorded in 5 years, reaching the 77-79°F range for 3-6 day periods, respectively (**Alley 2003a**). In the 2003 lagoon, 75 days (59%) had maximum temperatures above 68° F (20°C) near the bottom, including June (**Figure 4b**). Beginning in July, the 2003 lagoon had 72 days (75%) above 68°F. In the 2002 lagoon, 37 days (38%) had maximum temperatures above 68° F (20°C) near the bottom (**Alley 2003a**). In the 2001 lagoon, 45 days (42%) had temperatures above 68° F (20°C) near the bottom (27 days (34%) in 2000; 31 of 64 days (48%) in 1999.

The creek site near Nob Hill in 2003, 22 of 127 monitored days (17%; June-early October) failed to meet the management goal of *no more than 4 hours a day at greater than 20°C (68°F)* (**Figures 5 g-h**). For comparisons with 2002, beginning in July 2003, 16 of 96 days (17%) of the days failed to meet the management goal of no more than 4 hours a day at greater than 20°C (**Figures 5e-f**), indicating warmer stream water temperatures than in 2002. At the 2002 creek site for the same 96 days, only 4 days (4%) failed to meet the management goal.

In 2003 at the creek site near Nob Hill Shopping Center, 10 days from June onward (8%) reached temperatures greater than 70°F. In 2003 at the creek site, 7 days (continuous in early August) from July through early October (7%) had temperatures greater than 70°F compared to one day (1%) in 2002 for the same period. At the 2001 creek site, 11 of 108 days (10%) had temperatures greater than 70° F (**Figures 5c-d**) (41 days (51%) in 2000 (**Figures 5a-b**); 26 days (41%) in 1999 (**Figures 6a-b**)). At the 2003 stream site, 37 days (June-October 4) and 33 days (34%) from July to October 4 had days with water temperature above 68°F, making the stream warmer in 2003 compared to 2002, when 11 days (11%) had temperatures above 68°F from July onward. At the 2001 stream site, 25 days (23%) had temperatures above 68°F (45 days (56%) in 2000). Interestingly, the warmest stream temperatures in the past 5 years were in 2000, the year when lagoon water temperatures were the coolest.

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

Table 3. Morning Water Quality Ratings in Soquel Creek Lagoon, 2003, Within 0.25 M of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
23 May03	open	2.26 good	- good - -		- good - -	
03June03	open		good good - -		good good - -	
09June03	open	2.37 good	good*	good	good	10-12 cfs
23June03	open	2.33 good	good	good	good	
07July03	open	2.20 good	good	good	good	5-6 cfs
21July03	open	2.55 good	good	good	good	2.25 cfs
04Aug03	open	2.53 good	fair	good good good fair	good	1.5- 1.75 cfs
18Aug03	open	2.50 good	fair fair fair good	good good poor fair	good	1.5- 1.75 cfs
31Aug03 Begonia Festival	open	2.48 good	good	good good fair fair	good	
31Aug03 (afternoon)	open	2.48 good	- - - -	-	- - - -	
01Sept03	open	2.53 good	fair good good good	good good fair fair	good	1.5- 1.75 cfs
15Sept03	open	2.41 good	fair fair fair good	good good good fair	good	1.25- 1.5 cfs
28Sept03	open	2.50 good	good	good good good fair	good	1.25- 1.5 cfs
12Oct03	open	2.42 good	good	good	good	1.91 cfs (measured by flowmeter on 30ct03)
27Oct03	open	2.38 good	good	good	good	
05Nov03	open		good	fair	good	
08Nov03	Sandbar breached.					

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

Table 4. Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 feet and 4.5 feet from the Bottom in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon, 2003.

Depth Above Bottom>>>>		Max/Min Temp °C(°F)/ °C(°F) **4.5 ft**				Max/Min Temp °C(°F)/ °C(°F) **0.5 ft**	Temp. Difference of Max/ Min Temp. for 0.5 to 4.5 ft from Bottom **°C(°F) / °C(°F)**
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)

Table 5. Maximum and Minimum Water Temperatures at One Foot Intervals Through the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon, 2002.

Depth Above Bottom>>>>	Max/Min Temp °C(°F)/ °C(°F) **5.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **4.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **3.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **2.5 ft**	Max/Min Temp °C(°F) /°C(°F) **1.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **0.5 ft**	Temp. Diff. of Max/ Min Temp. for 0.5 to 5.5 ft from Bottom **°C(°F) / °C(°F)**
3 July					20.57 (69.71)/ 19.04 (66.28)	20.19 (68.33)/ 19.04 (66.28)	
10 July	22.48 (72.46)/ 20.19 (68.33)	22.48 (72.46)/ 20.19 (68.33)	22.48 (72.46)/ 20.19 (68.33)	22.09 (71.77)/ 20.19 (68.33)	22.68 (73.15)/ 20.19 (68.33)	22.09 (71.77)/ 20.19 (68.33)	0.39 (0.69)/ 0 (0)
20 July	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 17.9 (64.22)	19.42 (66.96)/ 17.9 (64.22)	0 (0)/ 0.38 (0.69)
30 July	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	0.38 (0.68)/ 0 (0)
9 August	21.71 (71.08)/ 19.42 (66.96)	21.71 (71.08)/ 19.42 (66.96)	21.71 (71.08)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	0.76 (1.37)/ 0 (0)
19 August	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 17.9 (64.22)	18.66 (65.59)/ 17.9 (64.22)	18.66 (65.59)/ 17.9 (64.22)	0.76 (1.37)/ 0.38 (0.69)
29 August	19.04 (66.28)/ 18.28 (64.91)	19.04 (66.28)/ 18.28 (64.91)	19.04 (66.28)/ 18.28 (64.91)	18.66 (65.59)/ 18.28 (64.91)	18.28 (64.91)/ 17.9 (64.22)	18.28 (64.91)/ 17.9 (64.22)	0.76 (1.37)/ 0.38 (0.69)
8 September	20.19 (68.33)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.42 (66.91)/ 18.28 (64.91)	19.42 (66.91)/ 18.28 (64.91)	0.77 (1.42)/ 0 (0)
18 September	20.19 (68.33)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.04 (66.28)/ 17.9 (64.22)	19.04 (66.28)/ 17.9 (64.22)	1.15 (2.05)/ 0.38 (0.69)
28 September	18.28 (64.91)/ 16.76 (62.17)	18.28 (64.91)/ 16.76 (62.17)	17.52 (63.54)/ 16.76 (62.17)	17.52 (63.54)/ 16.76 (62.17)	17.14 (62.85)/ 16.76 (62.17)	17.14 (62.85)/ 16.76 (62.17)	1.14 (2.06)/ 0 (0)
5 October	17.9 (64.22)/16.0 (60.8)	17.52 (63.54)/16.0 (60.8)	17.14 (62.86)/16.0 (60.8)	16.76 (62.17)/16.0 (60.8)	16.76 (62.17)/15.62 (60.11)	16.76 (62.17)/15.62 (60.11)	1.14 (2.05)/0.38 (0.69)

Stream conditions in 1999-2003 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 21° C (69.8° F) for several hours each day in the stream above the lagoon, with a maximum of approximately 23.5° C (74.3° F) on 3 August 1998 (**Figure 6c**). Daily maxima were still approaching 21°C 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 (**Figure 3b**).

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. Filamentous algae was first noted on 7 July 2003, 6 weeks after sandbar closure (**Appendix A**). Pondweed was first noted on 4 August 2003, 10 weeks after sandbar closure. As in 2000-2003, pondweed became prominent in mid- to late August 2003, and remained so into late October (**Photographs; Appendix D**). Pondweed was not noticed until 14 August in 2000 and not until 20 August in 1999. The year, 2003, was unusual in that two species of pondweed were detected, one with ovate leaves and one with filamentous leaves.

In 2003, there was the most surface algae sporadically from mid-August on since 1999, particularly near Noble Gulch and later in the dry season. On 18 August there was as much as 5% surface coverage in Reaches 2 and 3 (**Appendix A**). There was 5% surface coverage near Noble Gulch on 28 September. On 12 October, there was 3-5% surface coverage in Reaches 2 and 3 and 15% surface coverage around Noble Gulch. On 27 October, surface algae coverage was 5% in Reach 2, 10% in Reach 3 and 20% around Noble Gulch. At other monitorings, surface algae was usually 1% or less surface coverage. It covered 1-2% of the surface at Noble Gulch in mid-July and late August (**Appendix A**). In 2002 the most surface algae coverage was 5% of the surface in Reaches 2 and 3 just before the Begonia Festival on 1 September and in those Reaches and at Noble Gulch in mid-September. Surface algae never really developed in 2001, with only 1-2% coverage appearing in September after the Begonia Festival. In 2000 the most coverage was 15% in Reach 3 in mid-August. In 1999, surface algae had reached a maximum during the two July monitorings, with as much as 25% of certain reaches being covered.

In 2003, oxygen levels for steelhead were either "fair" or "good" near the bottom at all stations during monitorings except at Station 3 (under the railroad trestle) on 18 August, when oxygen concentration fell to 4.80 mg/l (**Table 3, Figure 9a; Appendix A**). Otherwise, oxygen stated above 5 mg/l at all other stations throughout the summer. Morning oxygen concentrations near the bottom were usually least near Noble Gulch (Station 4), followed by the trestle location (Station 3), perhaps due to the higher density of algae and pondweed in those vicinities and more cell respiration through the night to depress oxygen levels. Morning oxygen levels gradually declined through the summer at Station 4 (near Noble Gulch) until October, corresponding to

increasing densities of algae and pondweed (**Figures 9a and 9c; Appendix A**). The same occurred at Station 3 (trestle) from late June to mid-August (**Figure 9a**). In 2002, oxygen was rated "fair" or "good" near the bottom (**Figure 8**). In 2001 they had been rated "good" near the bottom on all monitorings except at the railroad trestle in October (**Figure 7**). Oxygen concentration in the stream above the lagoon (Station 5) in the morning was generally higher than most lagoon stations until 1 September, after which time at least 2 lagoon stations had higher morning oxygen levels (**Figure 9a; Appendix A**).

During the two-week monitorings, oxygen levels were most similar in morning and afternoon at all stations during the first two monitorings in June, before filamentous algae and pondweed began to develop. In some cases (Stations 1 and 2), oxygen was slightly less in afternoon in June due to warmer water that has a lower saturation level than cooler water (**Figure 9b; Appendix A**). However, by 7 July when filamentous algae was first observed, oxygen levels were higher in afternoon than in the early morning at all stations and sometimes at supersaturated levels, as exemplified by **Figures 9b and 9c**. The dip in afternoon oxygen concentration detected on 15 September coincided with a decline in water temperature, indicating perhaps longer cloud cover on that day than during other monitoring times (**Figures 4a-4j**).

Salinity. Salinity was not an issue in summer, 2003. No saltwater was detected in the lagoon in 2003, even after 26 October, when there was massive overwash of other local lagoons.

Conductivity. Conductivity remained low throughout the summer/fall in 2003 (**Appendix A**). registered as stressful at Station 2 under the Stockton Avenue Bridge on 30 May 2002 (**Appendix A**). The highest lagoon conductivity was detected on 4 August at the flume, 750 umhos at the bottom. The highest conductivity detected in the stream was on 780 umhos on the morning of 15 September, which was higher than any lagoon readings.

Stream In-Flow to the Lagoon. Inflow to the lagoon ranged from 1.91 cubic feet per second (cfs)(measured by flowmeter) on 12 October (compared to 1.28 cfs near the Grange on 22 September 2002) to 10-12 cfs on 9 June (**Table 3**). Streamflows appeared to start off at higher levels in the early dry season than in 2002, but dropped rapidly to similar levels as in 2002 by the end of July. Streamflow was measured at 1.58 cfs near the Grange in Soquel Village on 21 October 2001. On 23 October 2000, 2.32 cfs was measured at the Grange. Streamflow was somewhat higher in 1999, when 3.7 cfs was measured on 24 October 1999 (**Alley 2000**). By comparison, on 17 June and 29 June 1998, streamflow was measured at Nob Hill to be 31.2 cfs and 22.6 cfs, respectively. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cfs (**Alley 1999**). Water quality worsens at the end of the dry season in most years, when stream inflow is at a minimum. The lowest visually estimated summer baseflows in 1995, 1996 and 1997 had been 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, lagoon in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September.

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 the saltwater is flushed out of the lagoon more quickly to reduce lagoon heating (**Figure 3b; 1997 was the driest year and 1998 was the wettest**). The year 2001 was most affected by tidal overwash in the last 5 years. With proper flume management and the new grated flume ceiling, it should be easier to maintain lagoon depth and prevent fluctuations with more 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.

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

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 culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch until 2001 (**Alley 1995; 1996b; 1997-2000**). In 2001 and 2002, no gray water was observed during monitorings, but in 2003, on 2 of 12 monitorings the water was murky. In 2000, gray water plumes were observed on 5 of the 7 monitorings. 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 has been consistently greater at the mouth of Noble Gulch in 2002 and 2003 (**Figures 8 and 9a**) and other years, although oxygen concentration was in the good range throughout 2001 (**Figure 7**) and 2002. Adjacent to Noble Gulch in 2003, the oxygen rating in the morning was "good" 6 times and "fair" 6 times (**Table 3**). 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. 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 be reduced, then the gull population would probably decline and pollution would be reduced at Soquel Lagoon. Better refuge disposal is needed. Some of the refuge cans currently on the beach have no lids. The gulls have excellent access and commonly drag refuge out of these cans. Refuse containers with lids that were gull-proof and user-friendly to beach-goers may reduce gull numbers. Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls. Gull sweeps are an effective option.

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.

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

1. Replace the open, lid-less refuse cans on the beach with those with gull-proof lids and convenience in use. Use enough refuse cans 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 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 on the other side after June 1, close the underwater portal for adults. Close the adult portal by July 1 in any event. If adult steelhead are seen in the lagoon after June 1 and the adult portal has been closed, then open the hole for a week, allowing them to out-migrate.

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 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

11. 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.

12. "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**).

13. Regarding the Begonia Festival, we recommend that float propulsion by surfboard paddling or row boat or electric outboard motor continue to be encouraged rather than 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.

14. If wading during the Begonia Festival is requested, 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.

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

16. 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.

FISH CENSUSING

Steelhead Plantings in Soquel Creek

As in 2001 and 2002, no steelhead were planted in Soquel Creek in 2003. It appears that CDFG allowed planting in streams where the juvenile's parents were captured in those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured in Soquel Creek. Therefore, no juveniles were planted.

Results of Fish Sampling in Soquel Creek Lagoon

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. Tidal overwash has not been an issue since 2001, and lagoon water temperature was not elevated in 2003 overwash. However, due to 2 tidal overwashes in July 2001, daily water temperature fluctuated between approximately 23 and 26°C 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 the metabolic rate of fishes, possibly reducing growth rate in 2001.

Fall sampling for steelhead occurred on 5 and 12 October 2003, 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. On 5 and 12 October, a total of 204 unclipped juvenile steelhead (compared to 509 in 2002) ranging from 65 to 199 mm Standard Length (SL). A total of 109 juveniles from 5 effective seine hauls were marked on 5 October (**Figure 9**). The median size of steelhead captured was 110- 114 mm in 2003 compared to 105-109 mm SL in 2002 and 125-129 mm SL in 2001 (**Figures 10-12**). In 2000, the median size increment was 135-139 mm SL (**Figure 13**). In 1999 it had been 120-125 mm SL (**Figure 14**). In 1998, the most popular size increment was 115-119 mm SL (**Figure 15**). Comparison of size distributions and the median size in each of the last 6 years, young-of-the-year growth rate was similar in 2002 and 2003, with faster growth rates in 1998-2001.

Much fewer juveniles were captured and marked on the first weekend in 2003 compared to 1998-2002, although the 2003 lagoon population estimate of 849 juveniles was similar to the estimate in 1999 and 2000 and greater than in 1998 and 2001. A possible explanation was that more submerged vegetation was present in 2003, particularly clumped pondweed. This more

dense "forest" may have provided more cover for juveniles and reduced the necessity to use the shade under the bridge for escape cover. Also, the lagoon was a foot shallower in 2003 under the bridge, making it less attractive for cover than in 2002. It would follow that fewer individuals were under the bridge to be captured in 2003.

Our steelhead population estimate based on mark and recapture for fall 2003 was 849 juveniles +/- 198 compared to 1,042 juveniles +/- 84 in 2002 and 454 juveniles +/-27 in 2001 (**Table 6, Figure 16**) (**Ricker 1971**). Other species captured with the 106-foot seine on the two days combined were two starry flounders and abundant threespine sticklebacks.

Our sampling of lower Soquel Creek in fall, 2003, indicated one of the lowest juvenile densities since 1997, unlike in 2002 when densities were the highest since 1997 (**Alley 2003b**), though densities of juvenile steelhead in the lower 2 miles of stream habitat above the lagoon are generally low (**Alley 2001; 2002; 2003b**). 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, when lagoon production reached 2,800 fish, it likely represented as much as 10% of the smolt production in the entire 16.6 miles of steelhead habitat in the mainstem, East and West Branches. Thus, the lagoon provides valuable habitat through proper management.

On 5 and 12 October 2003, a total of five 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. This was adjacent to Venetian Court, around to the flume and between the flume and the restaurants. 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.

Table 6. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2003.

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 (95% confidence interval.) 1,046 fish marked from two seine hauls.
1994-	1,140 +/- 368 (95% confidence interval.) 76 fish were marked from two seine hauls.
1995-	360 +/- 60 (95% confidence interval.) 59 fish were marked from 4 seine hauls.
1996-	255 +/- 20 (95% confidence interval). 105 fish were marked from 3 seine hauls.
1997-	560 +/- 182 (95% confidence interval). 53 fish were marked from 3 effective seine hauls.
1998-	671 +/- 74 (95% confidence interval). 164 fish were marked from 3 effective and one snagged seine haul.
1999-	928 +/- 55 (95% confidence interval). 397 fish were marked from 4 effective seine hauls.
2000-	875 +/- 156 (95% confidence interval). 185 fish were marked from 4 effective seine hauls.
2001-	454 +/- 27 (95% confidence interval). 186 fish were marked from 4 effective seine hauls.
2002-	1,042 +/- 84 (95% confidence interval). 363 fish were marked from 4 effective seine hauls.
2003-	849 +/- 198 (95% confidence interval). 109 fish were marked from 5 effective seine hauls.

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 with higher streamflow into the lagoon in summer (known as summer baseflow). However, City Public Works in the past has an easier time of maximizing water depth in years with intermediate streamflows, such as 1999-2002, rather than 1998, with the previous inlet design to the flume. 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 vandals intent on draining the lagoon and against tidal back-pressure that may dislodge the boards.

The 2003 addition of the grated ceiling opening on the flume entrance allows greater ability 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. Maintenance of the lagoon in the fall after the first small storms is important. Minimizing pollutant input from early fall storms is also important to avoid fish kills.

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 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.

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.

LITERATURE CITED

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

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

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

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

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

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

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

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

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

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

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

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

LITERATURE CITED (continued)

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

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

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

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

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

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

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

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

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

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

LITERATURE CITED (continued)

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

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

Smith, J.J. 1999. Personal Communication. San Jose State University.

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

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

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

FIGURES

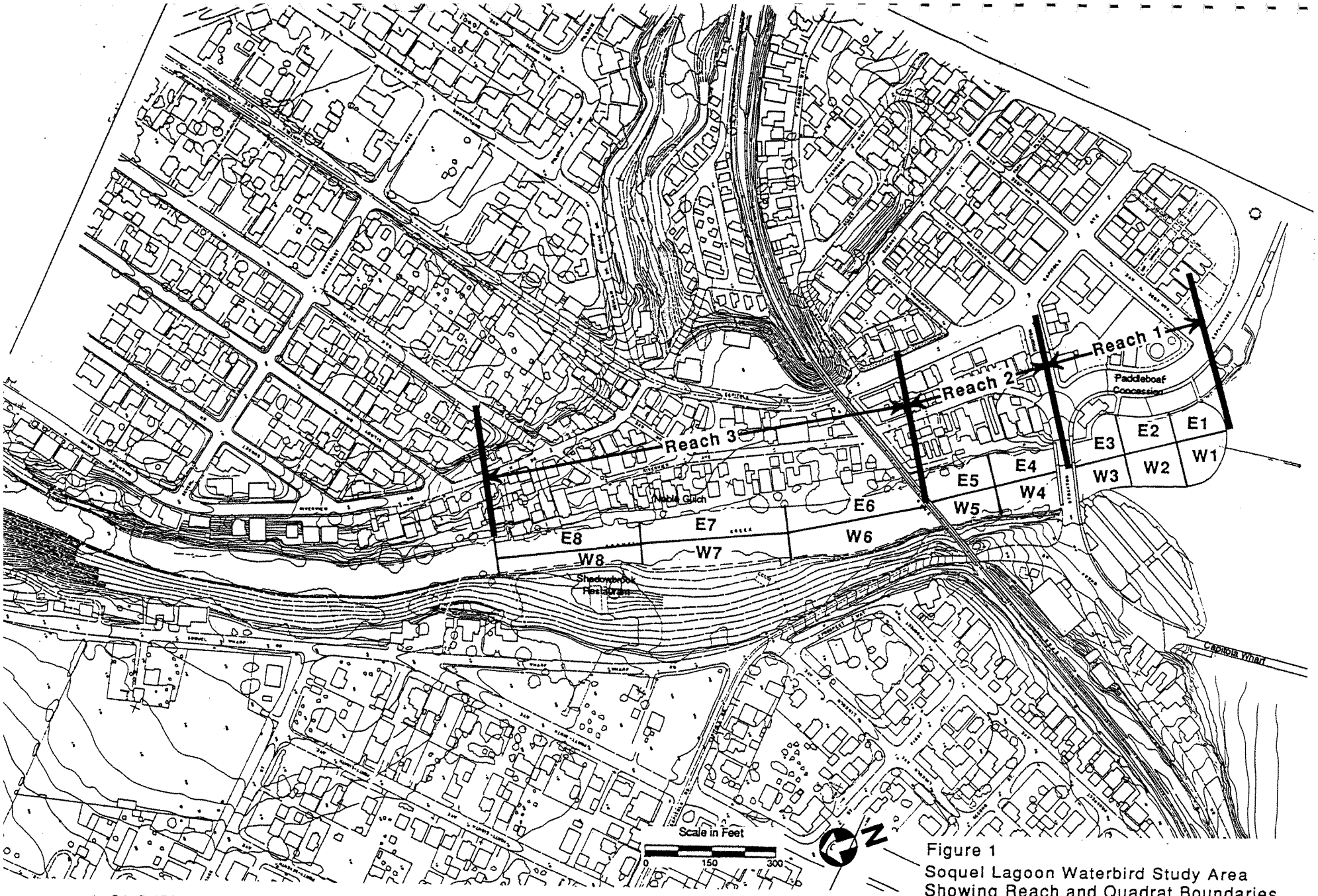


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.

Figure 1	SOQUEL LAGOON Management & Enhancement Plan	May 1990

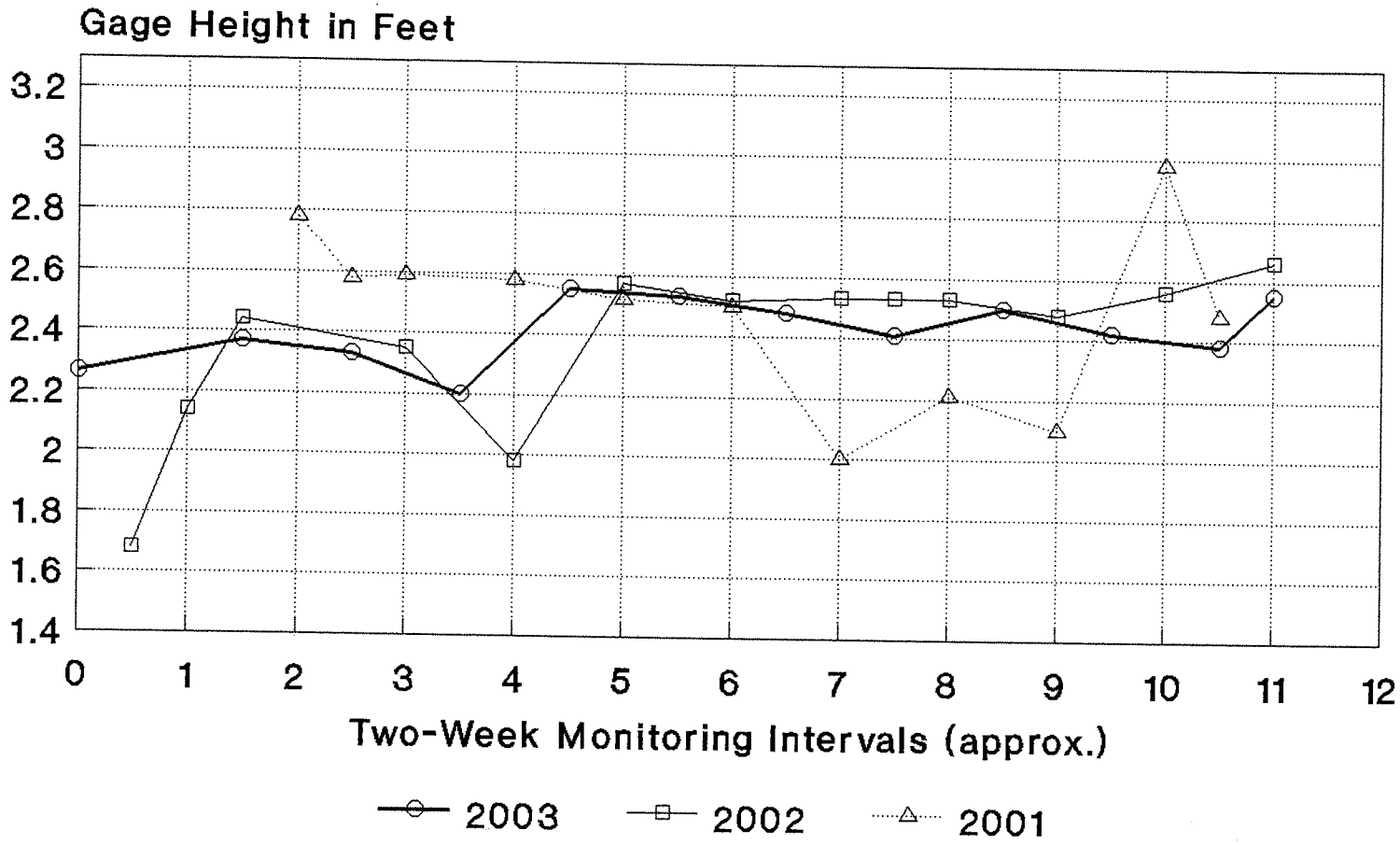


Figure 2a. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 2001-2003.

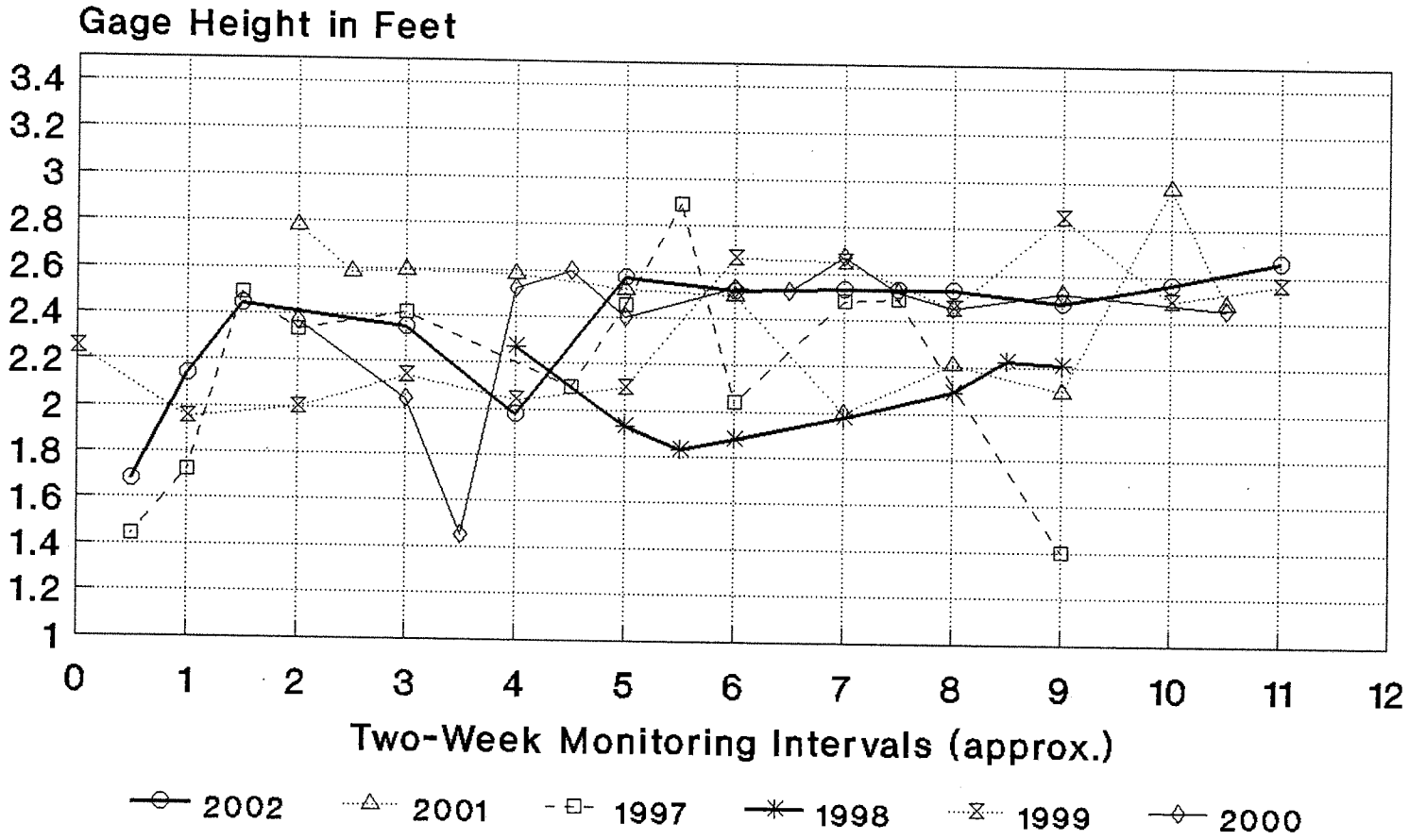


Figure 2b. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 1997-2002.

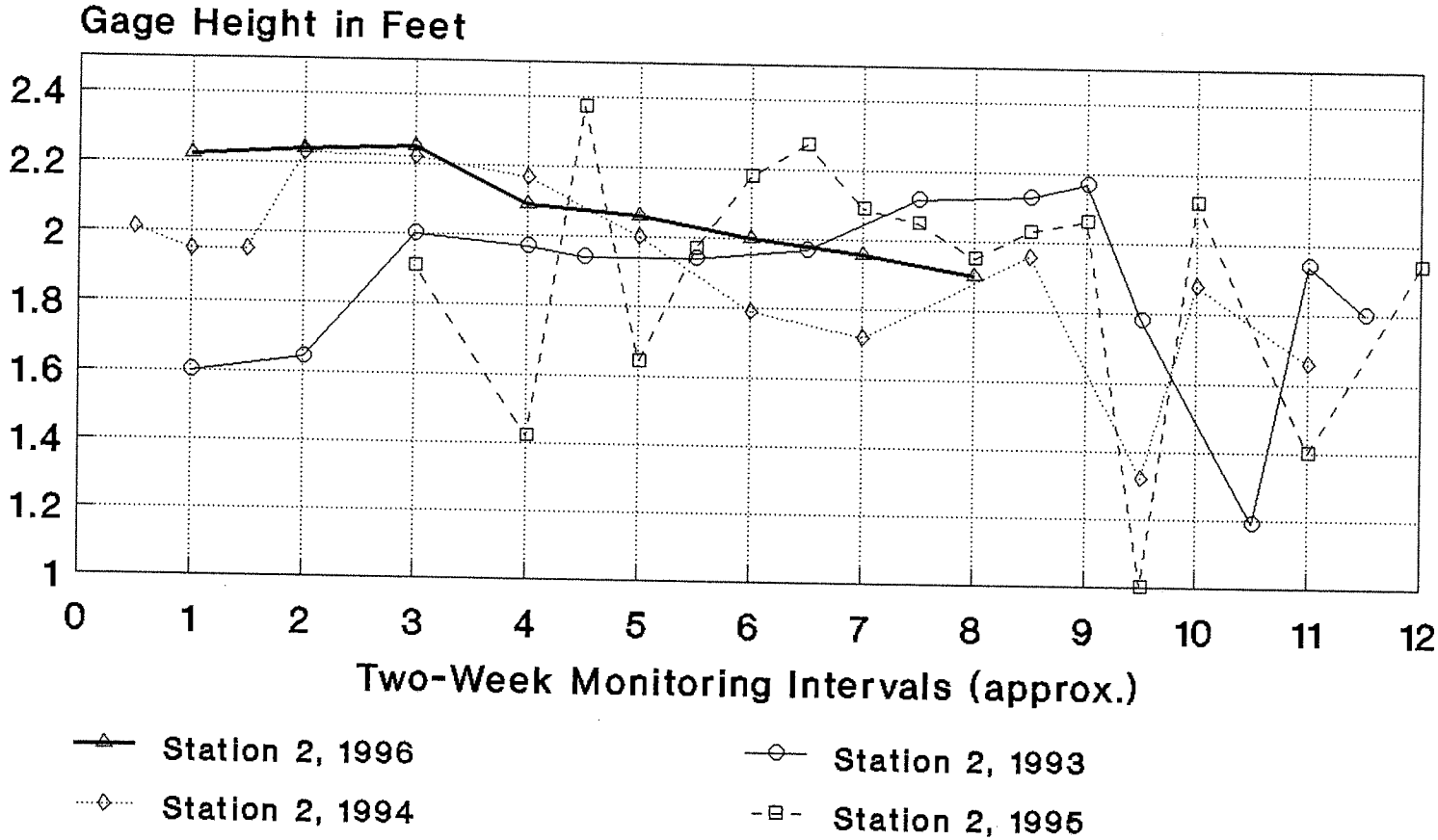


Figure 2c. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Late May to Late October, 1993-96.

Soquel Lagoon Water Temperature
Reach 1 & 2 Boundary-Stockton Ave Bridge
Within 0.25 M of Bottom, 2001-2003.

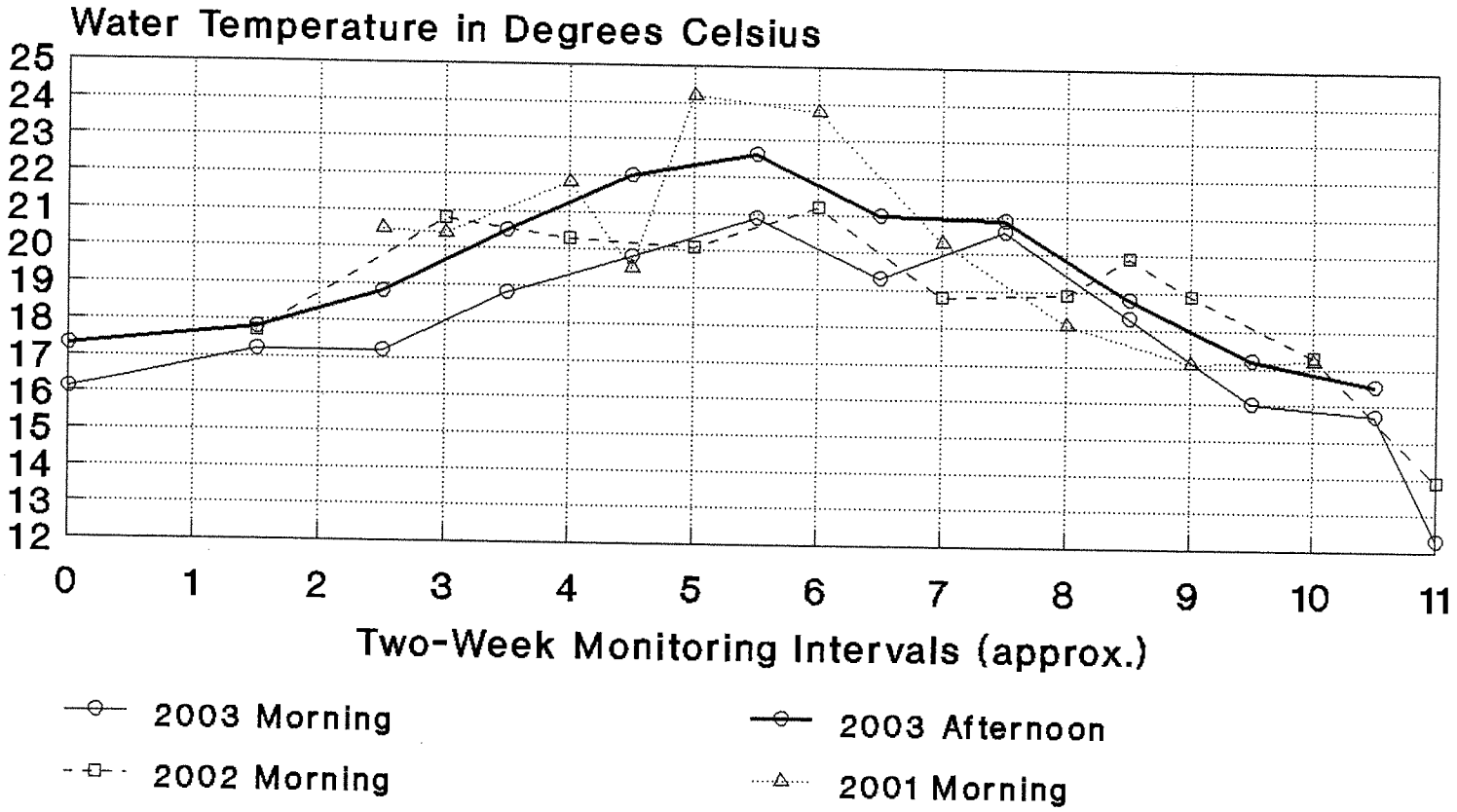


Figure 3a.Soquel Lagoon Water Temp. Near Bottom at Dawn and Late Afternoon; Stockton Ave Bridge, Summer 2001-2003.

Soquel Lagoon Water Temperature
Reach 1 & 2 Boundary-Stockton Ave Bridge
Within 0.25 M of Bottom, 1997-2002.

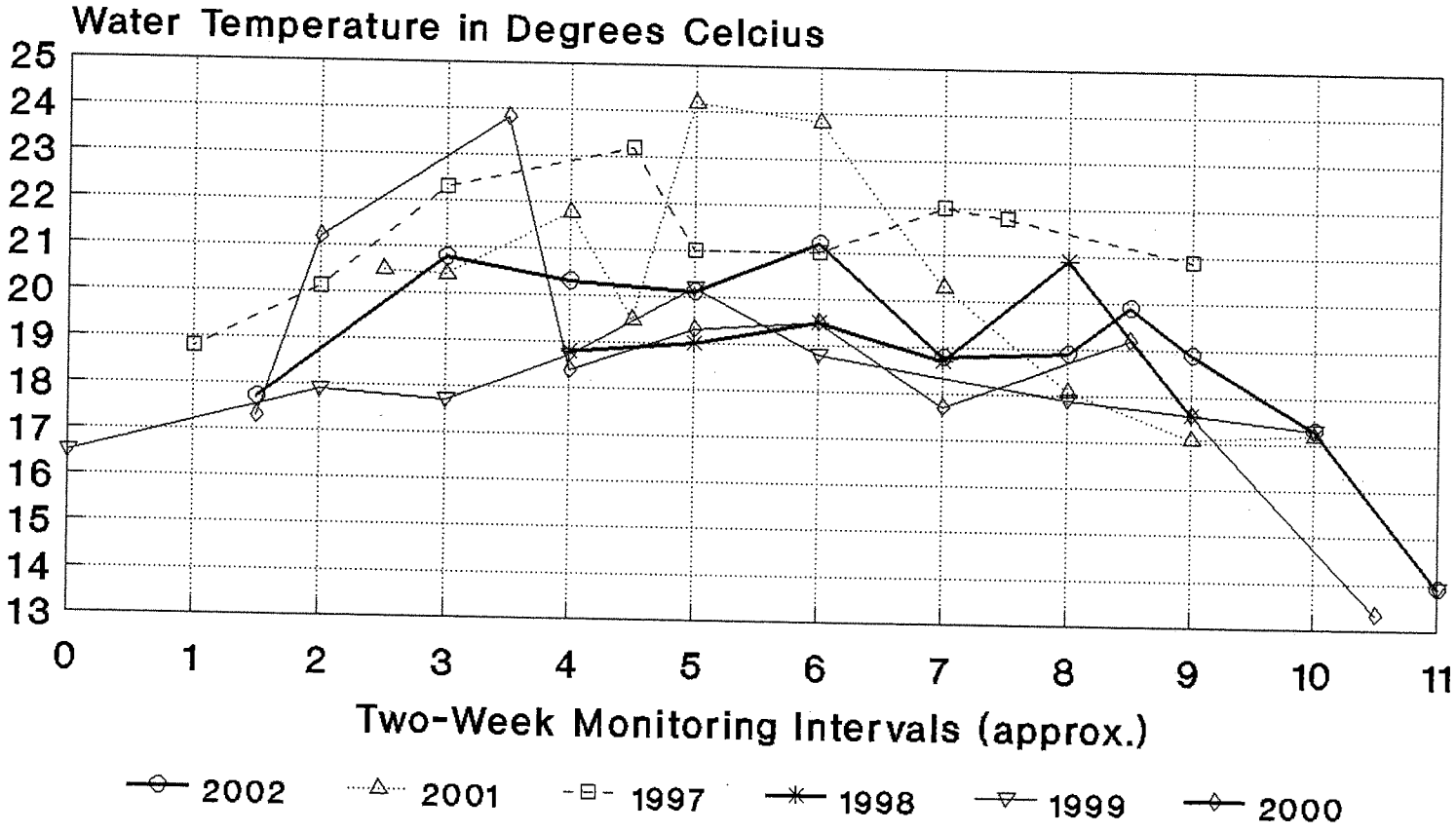


Figure 3b.Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Mid-May to Late October 1997-2002.

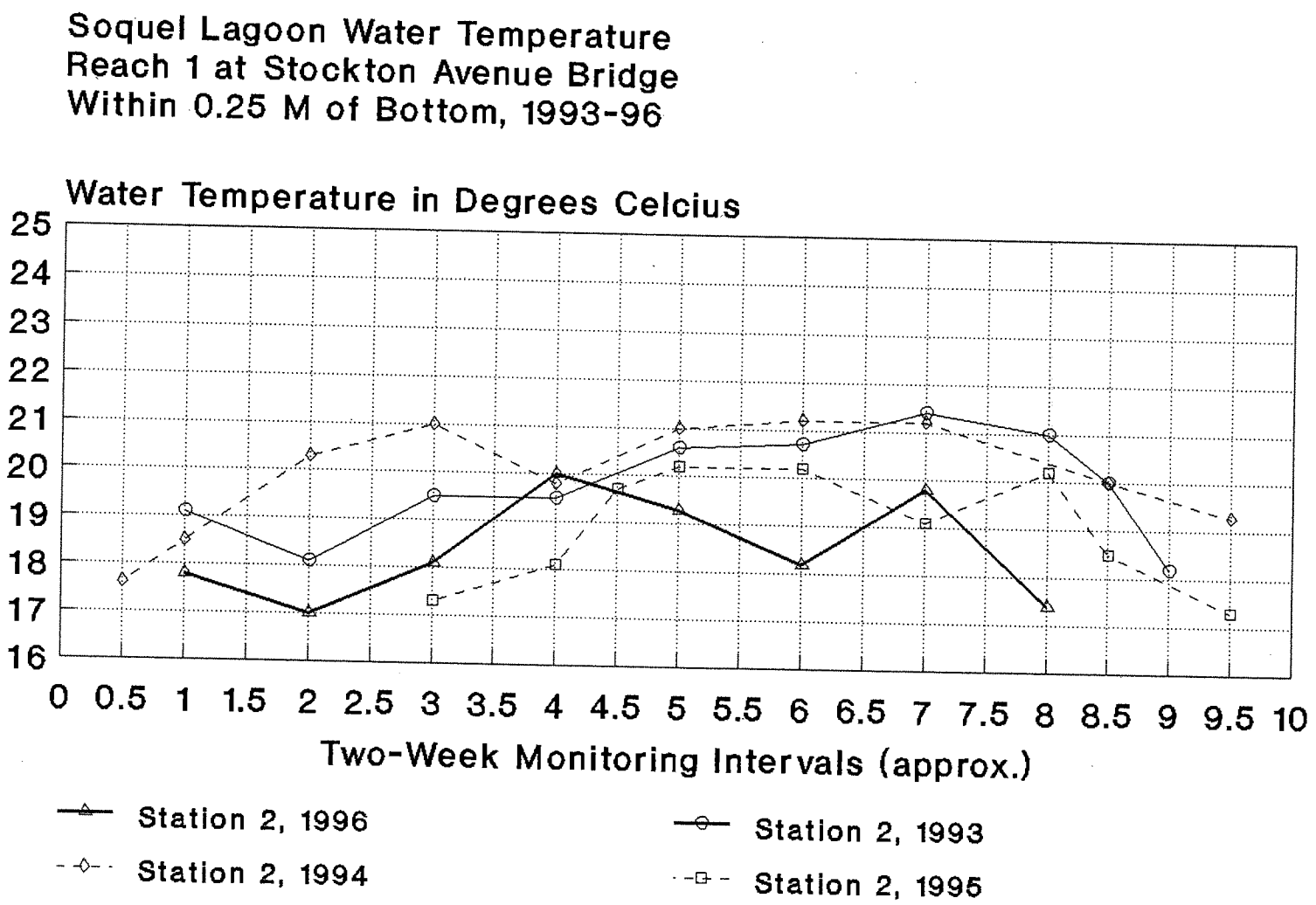


Figure 3c.Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Late May to Late September 1993-96.

Figure 3d. Soquel Lagoon Water Temperature in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 2, Stockton Avenue Bridge.

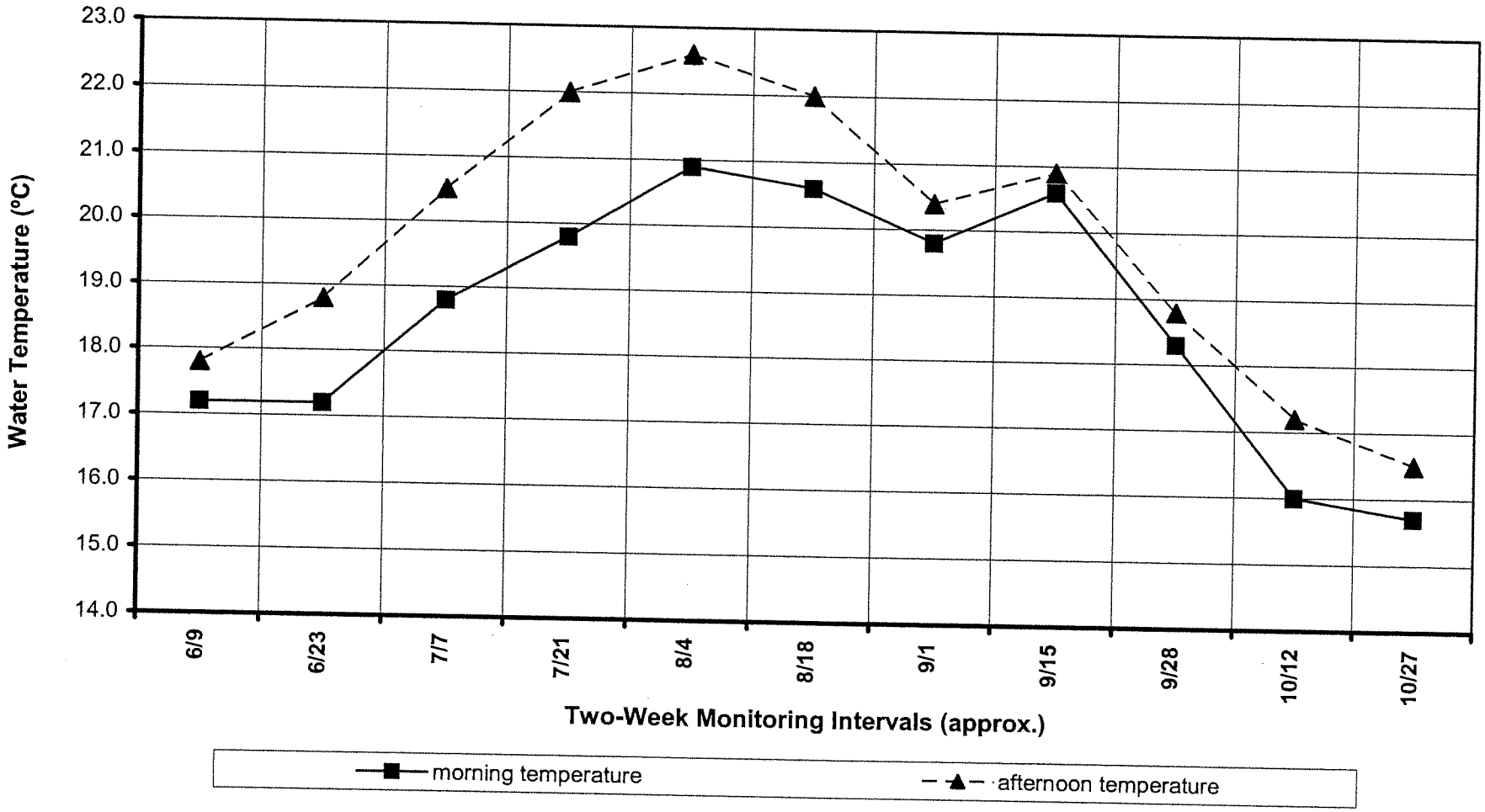
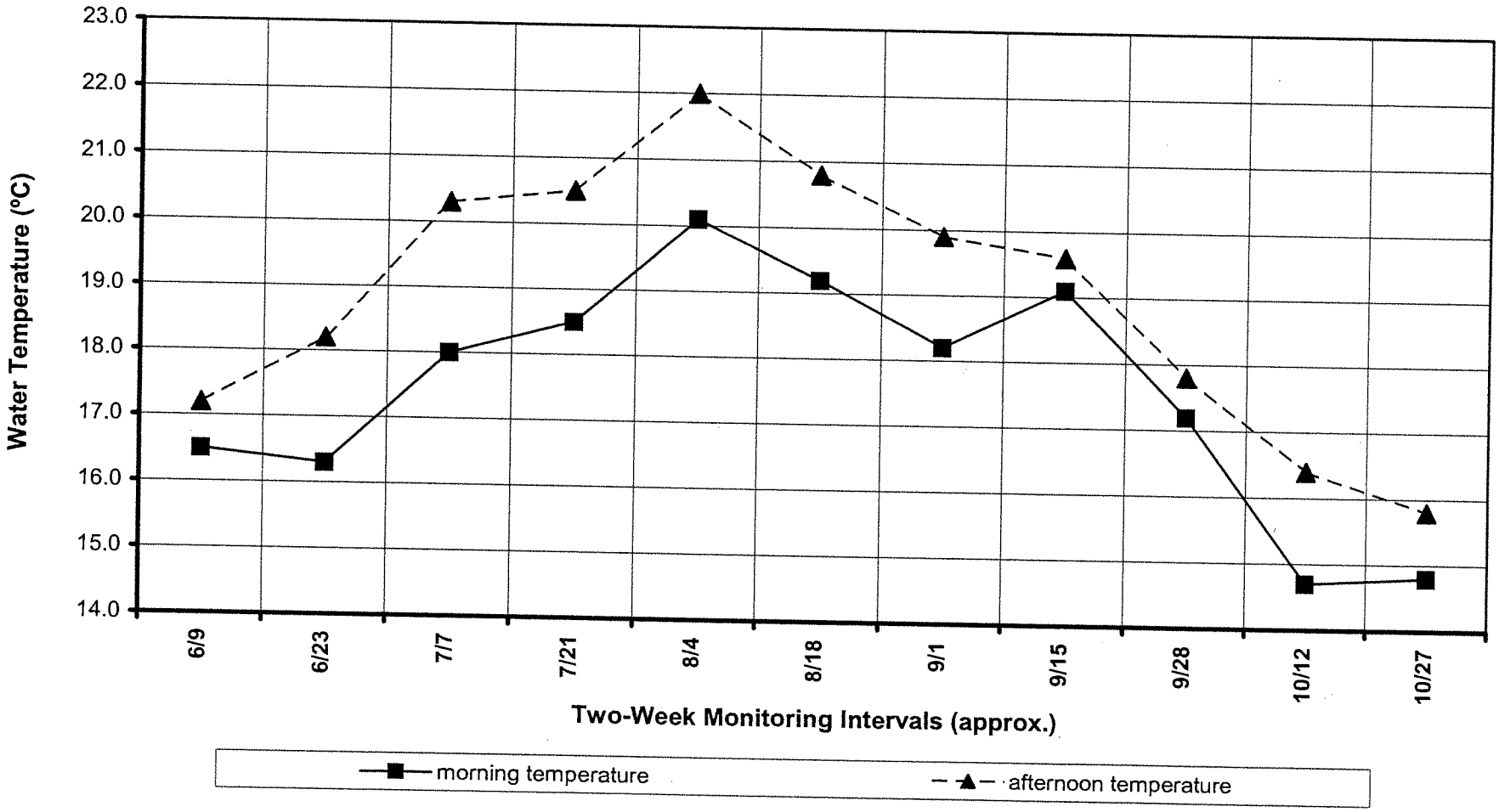


Figure 3e. Soquel Lagoon Water Temperature in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 4, Mouth of Noble Gulch.



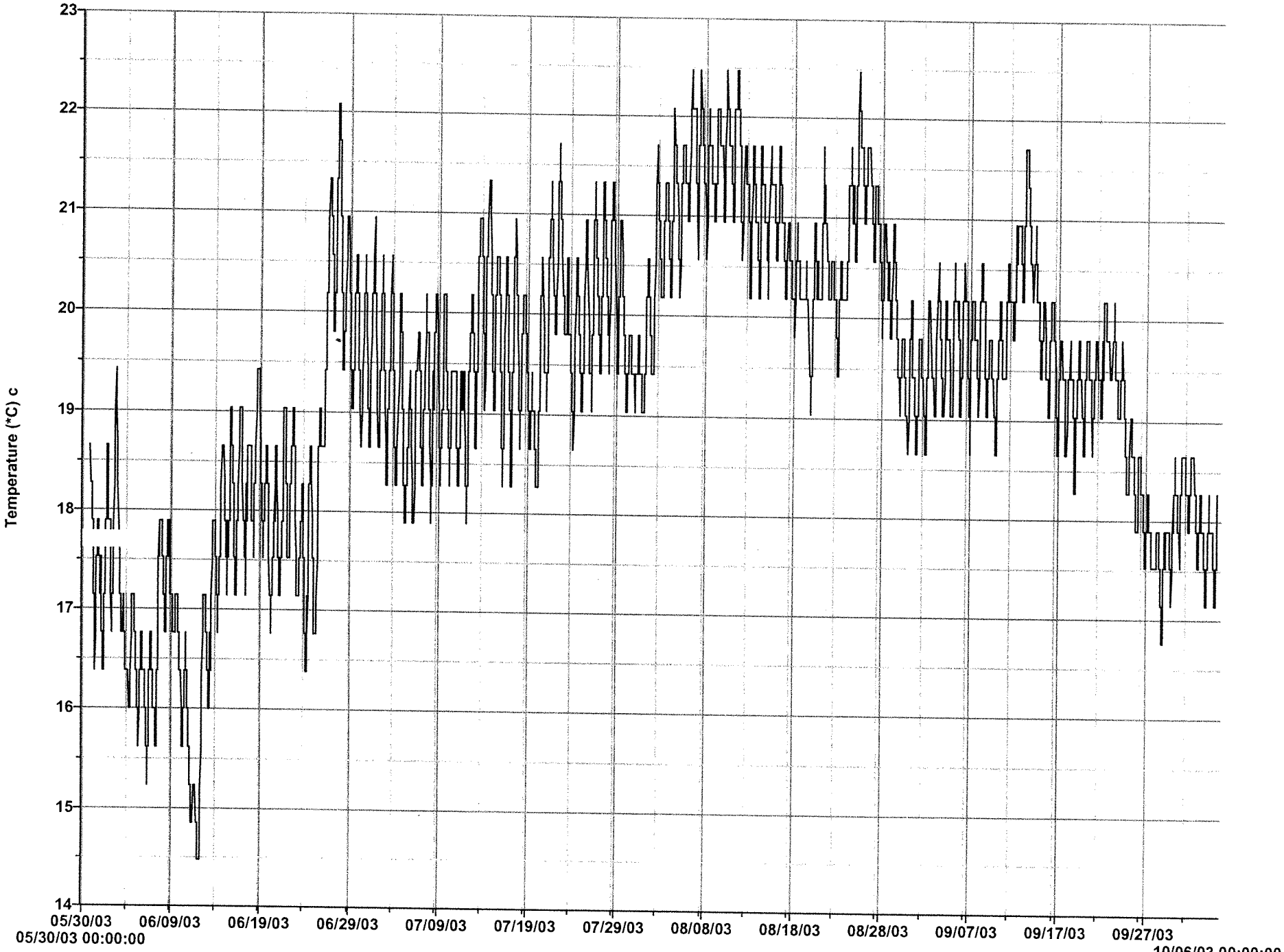


Figure 4a. Water Temp. (*C) Above Trestle 0.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

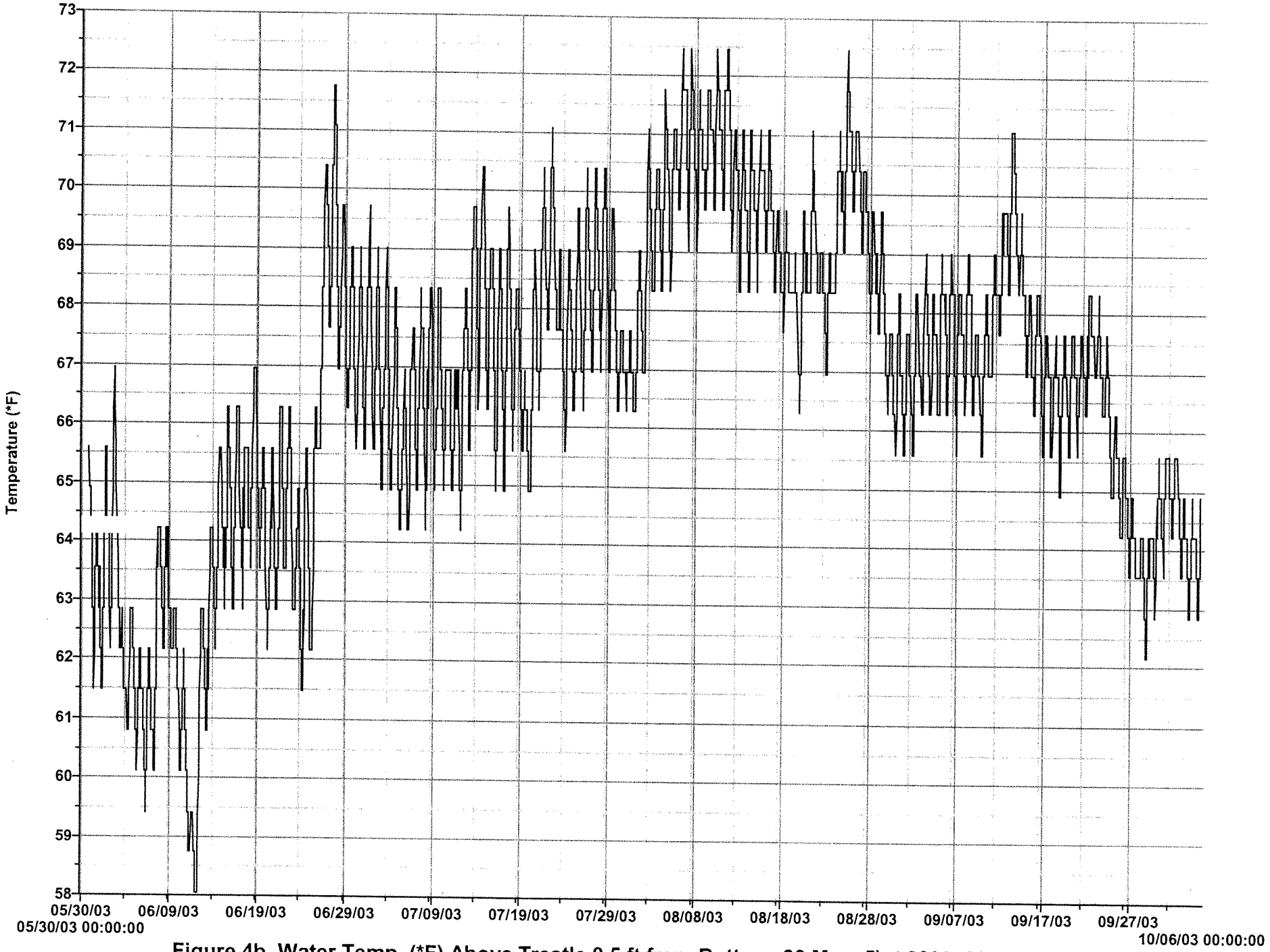


Figure 4b. Water Temp. (*F) Above Trestle 0.5 ft from Bottom, 30 May- 5)ct 2003, 30-min Interval

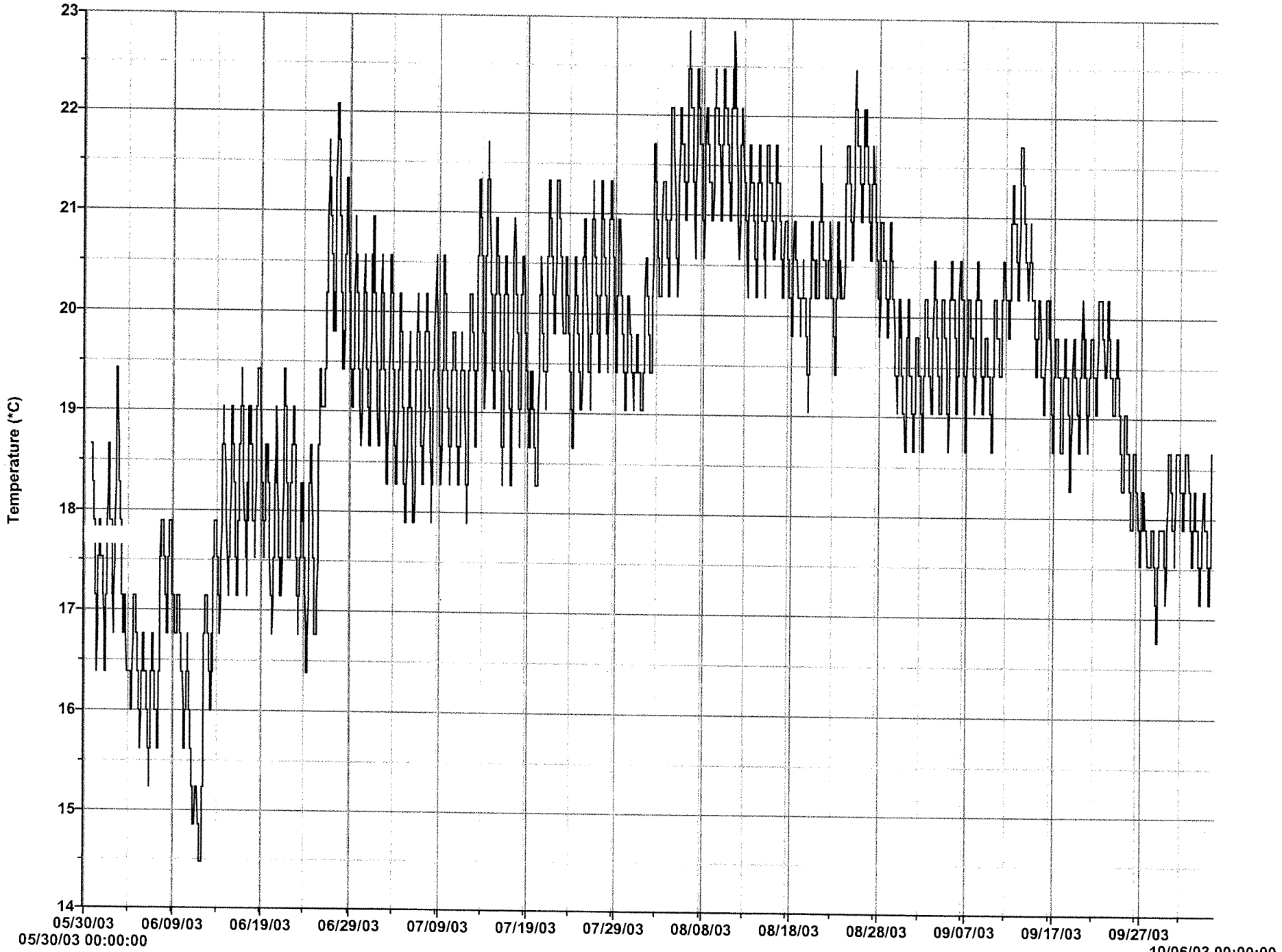


Figure 4c. Water Temp. (*C) Above Trestle 1.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

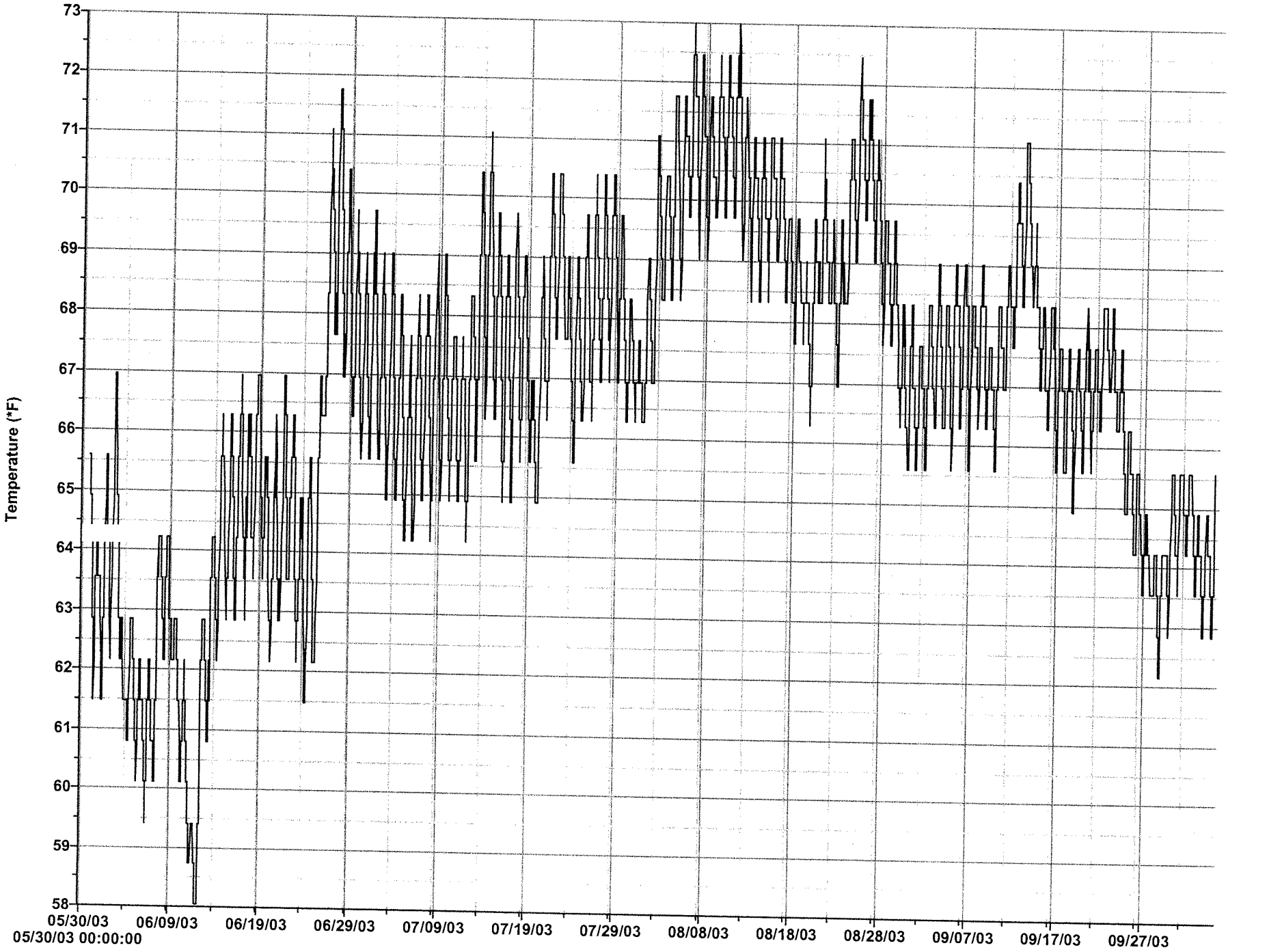


Figure 4d. Water Temp. (*F) Above Trestle 1.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

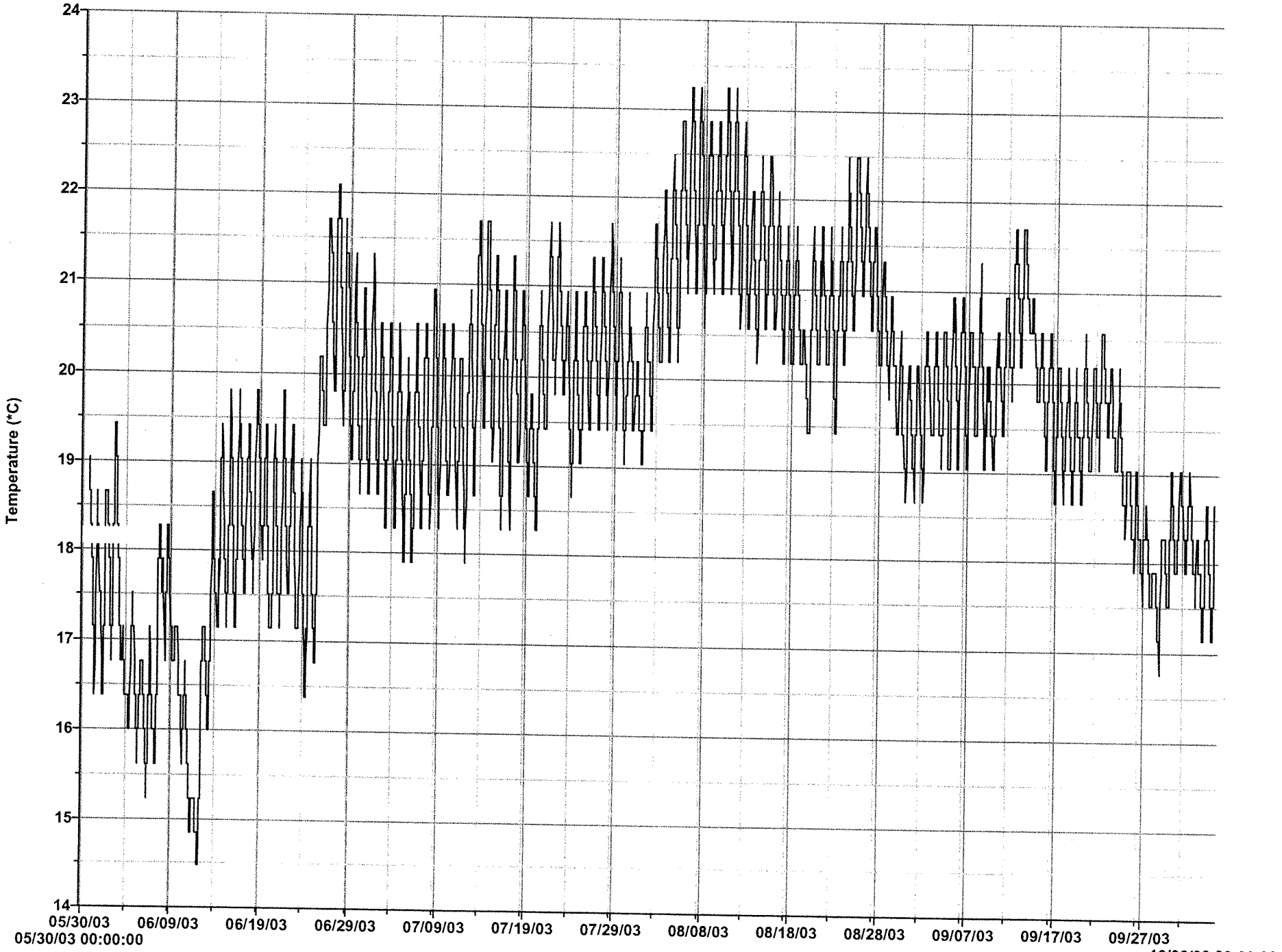


Figure 4e. Water Temp. (C*) Above Trestle 2.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

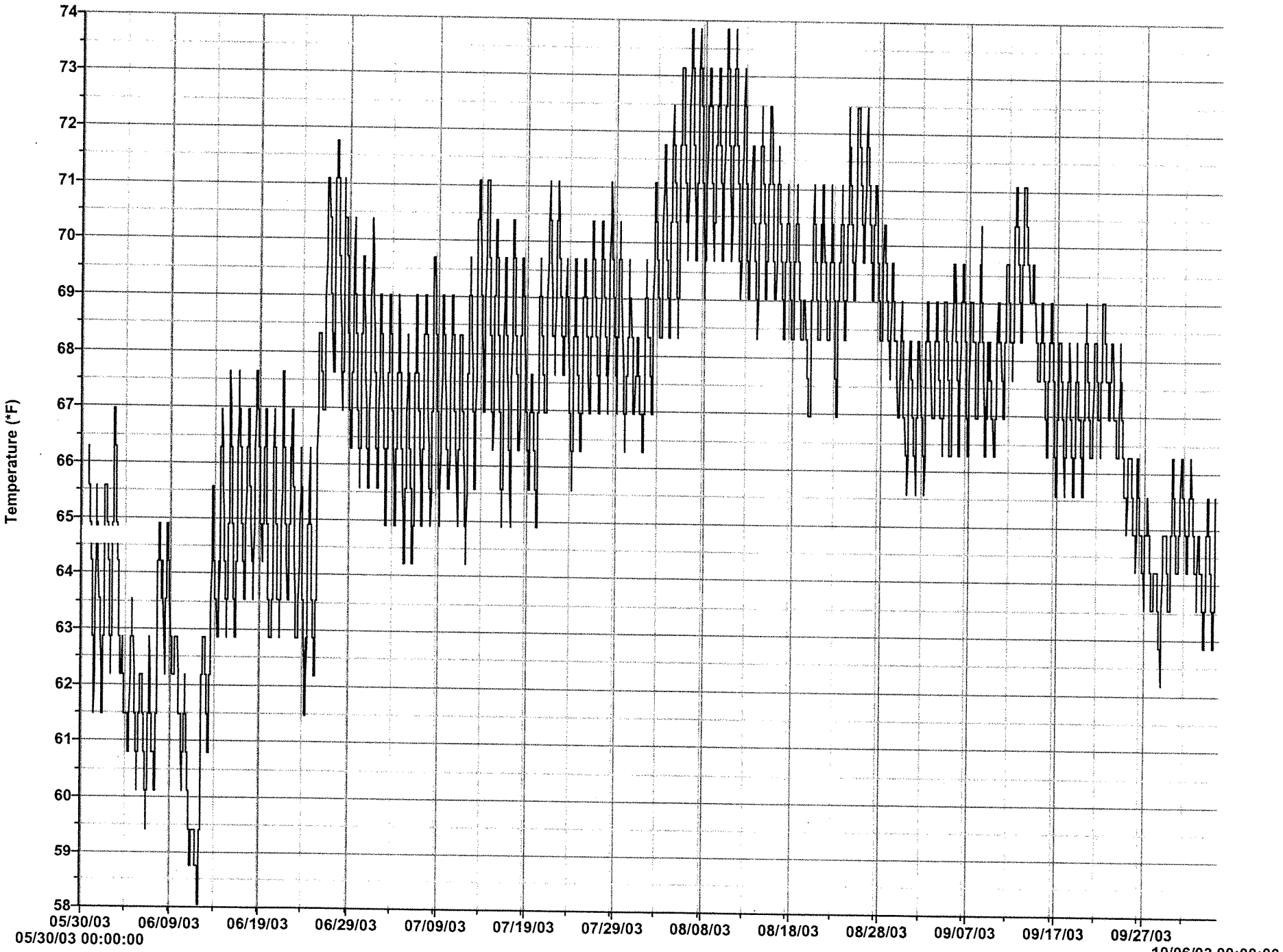


Figure 4f. Water Temp. (*F) Above Trestle 2.5 ft from Bottom, 30 May- 5 Oct 2003, 30 min Interval

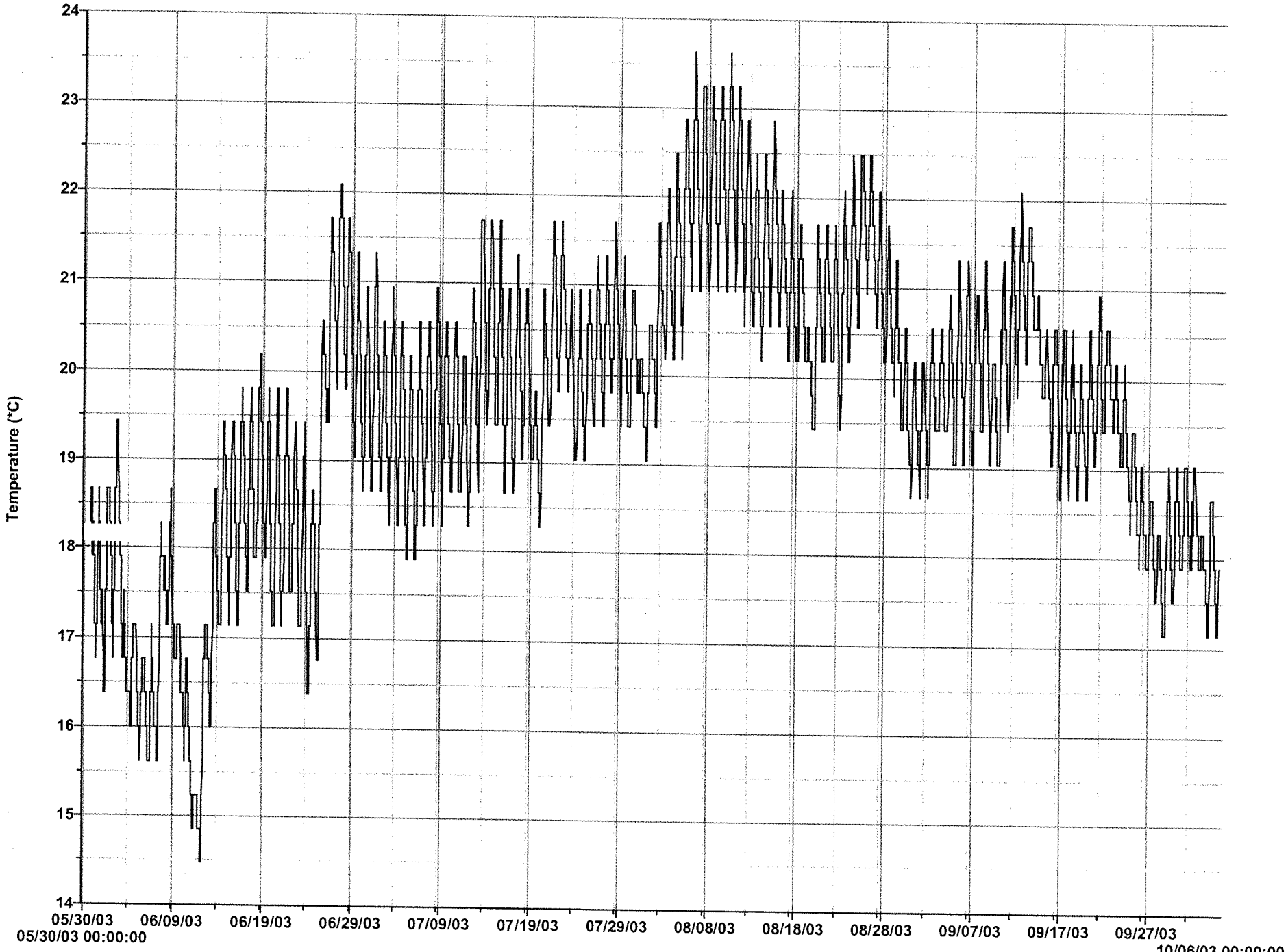


Figure 4g. Water Temp. (*C) Above Trestle 3.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

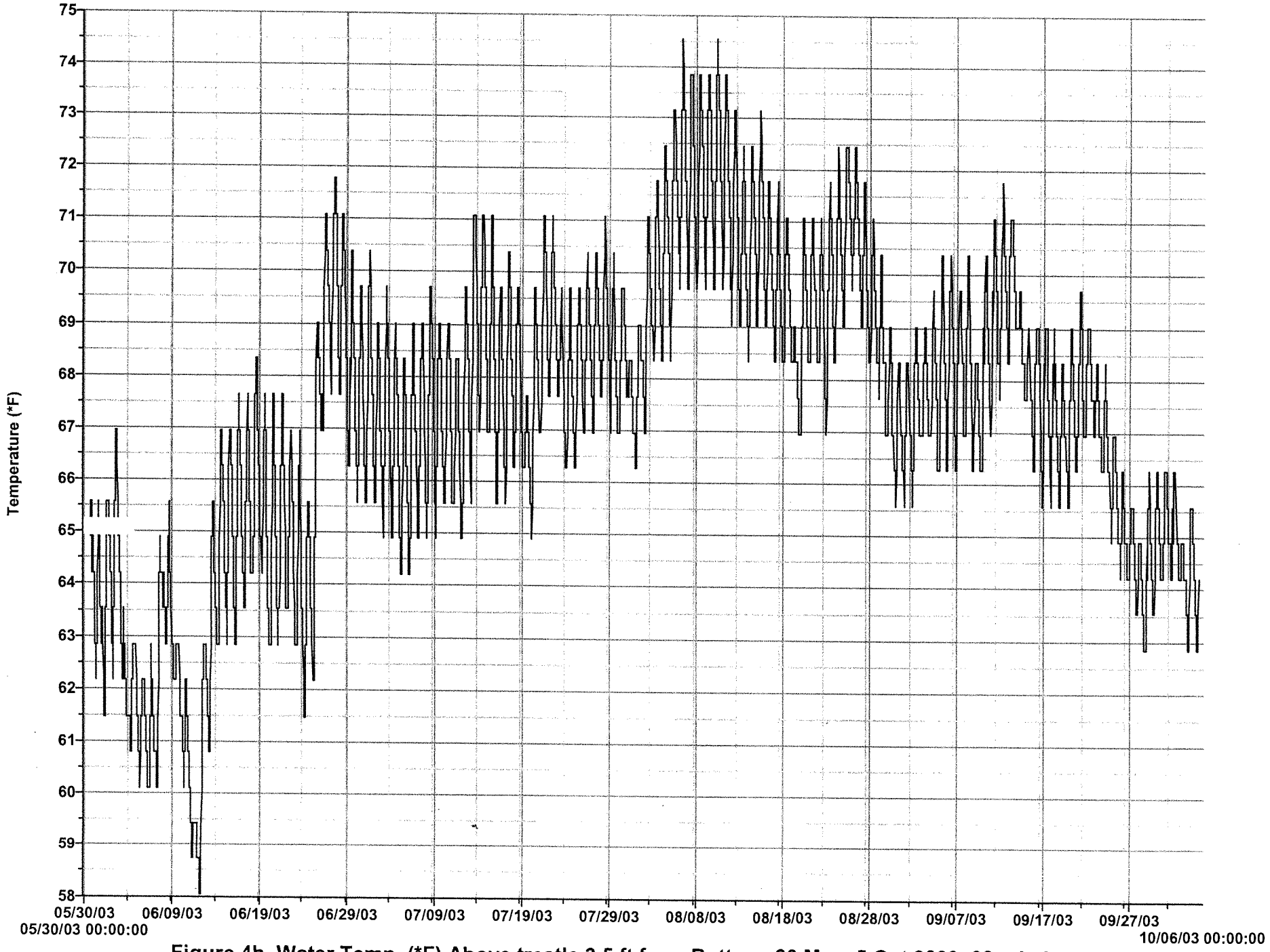


Figure 4h. Water Temp. (*F) Above trestle 3.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

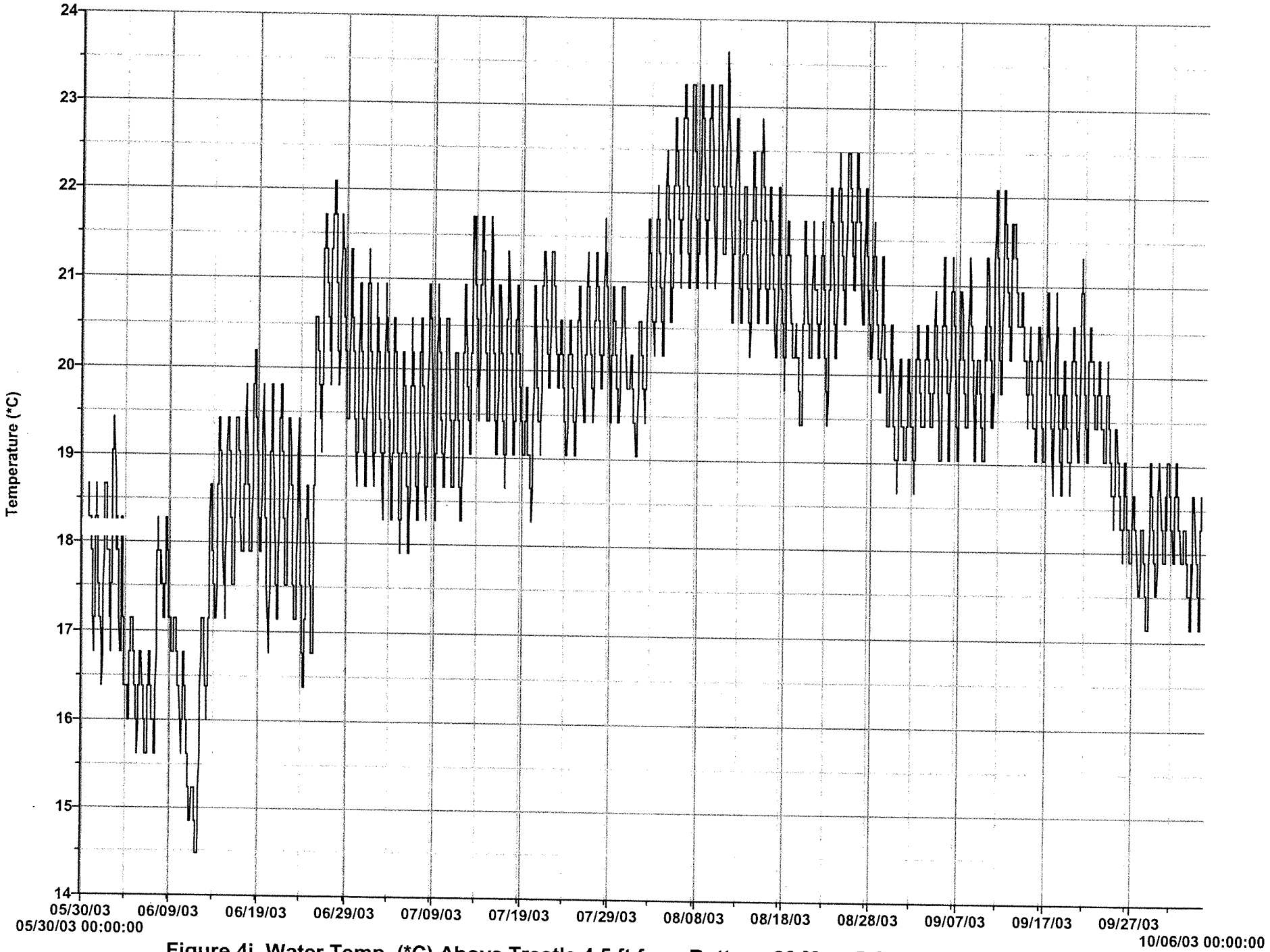


Figure 4i. Water Temp. (*C) Above Trestle 4.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

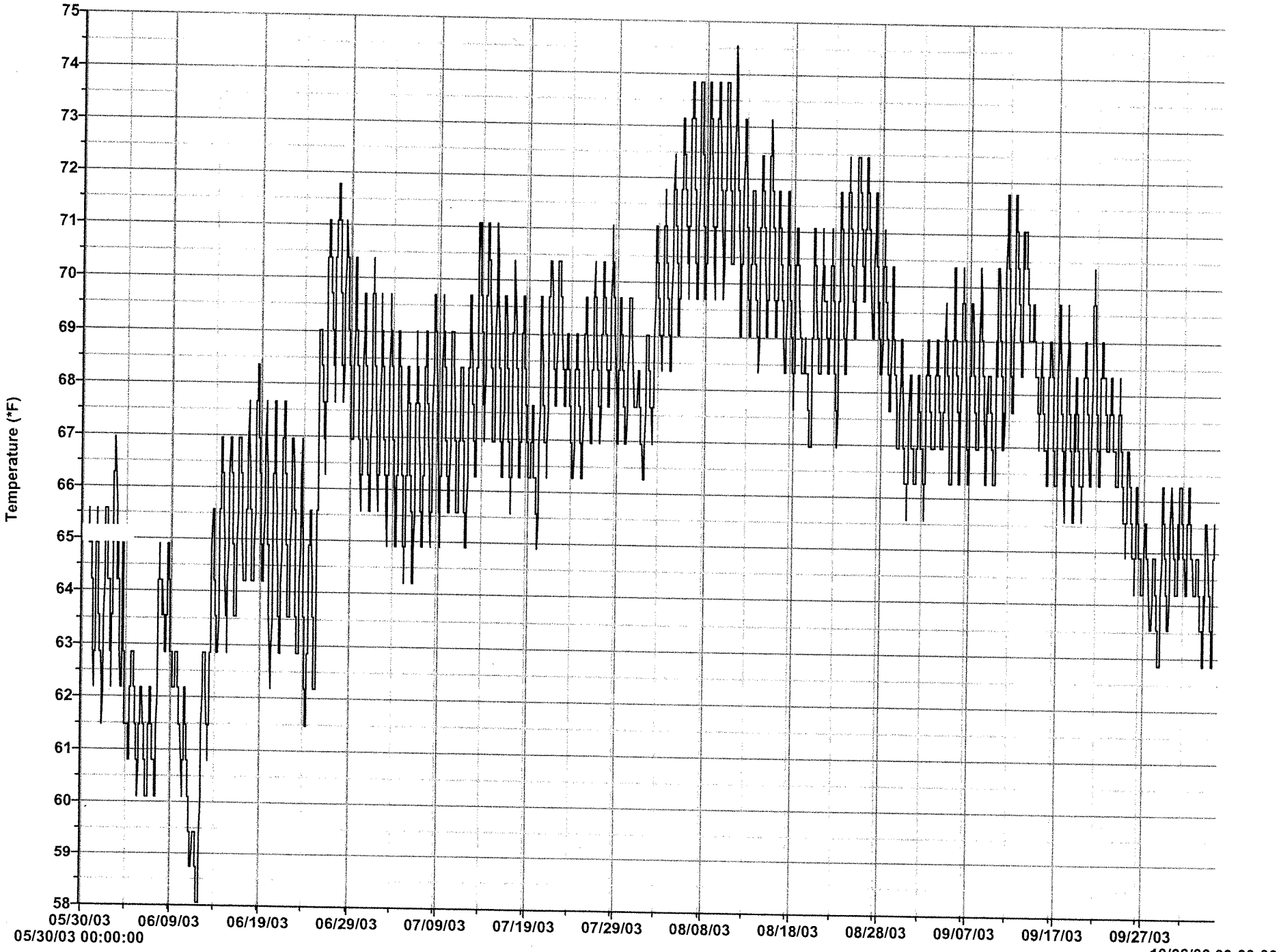


Figure 4j. Water Temp. (*F) Above Trestle 4.5 ft from Bottom, 30 May- 5 Oct 2003, 30-min Interval

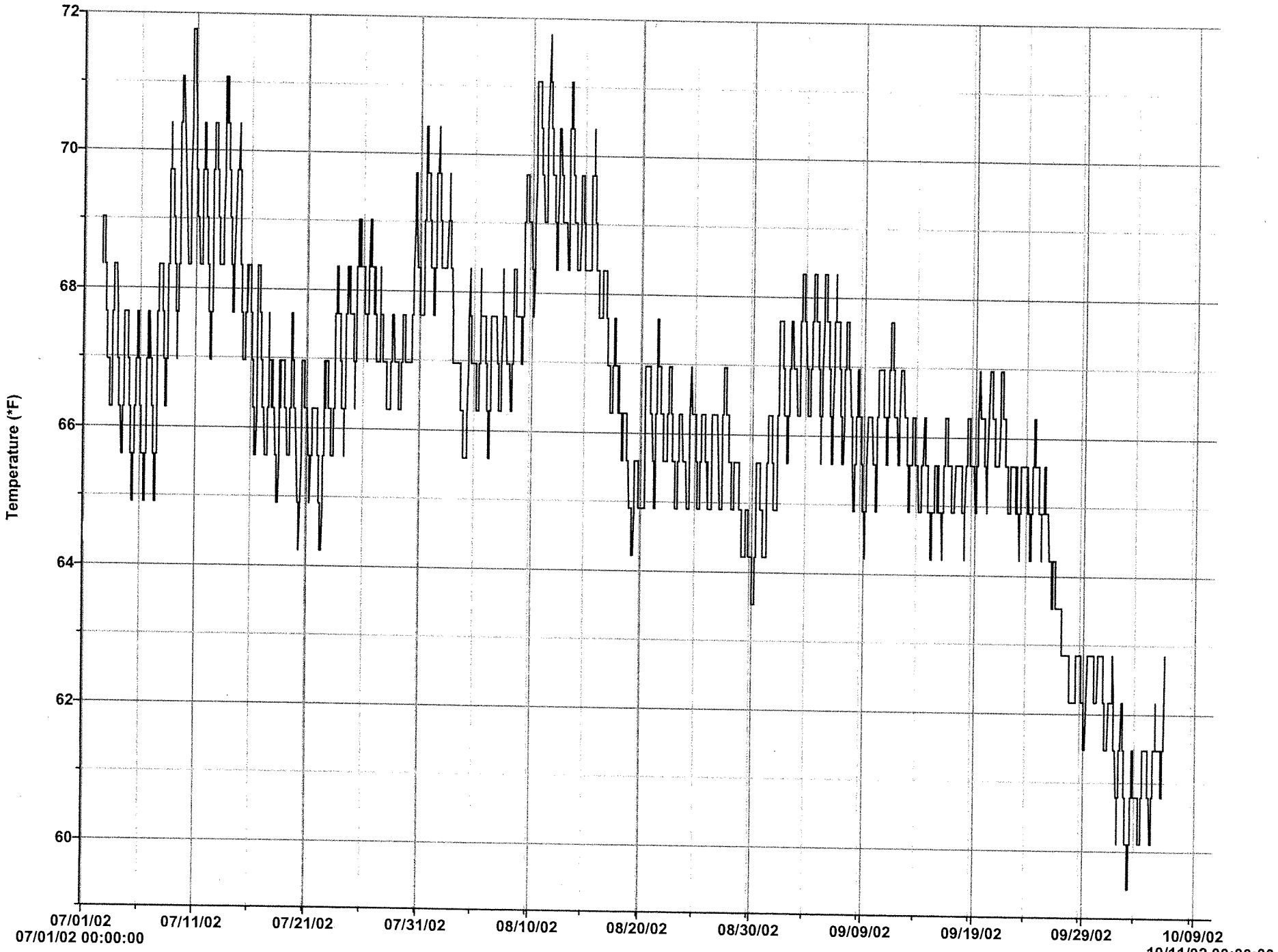


Figure 4k. Water Temp. (*F) Above Trestle 0.5 ft From Bottom, 9 Jul-6 Oct 2002, 30-min Interval

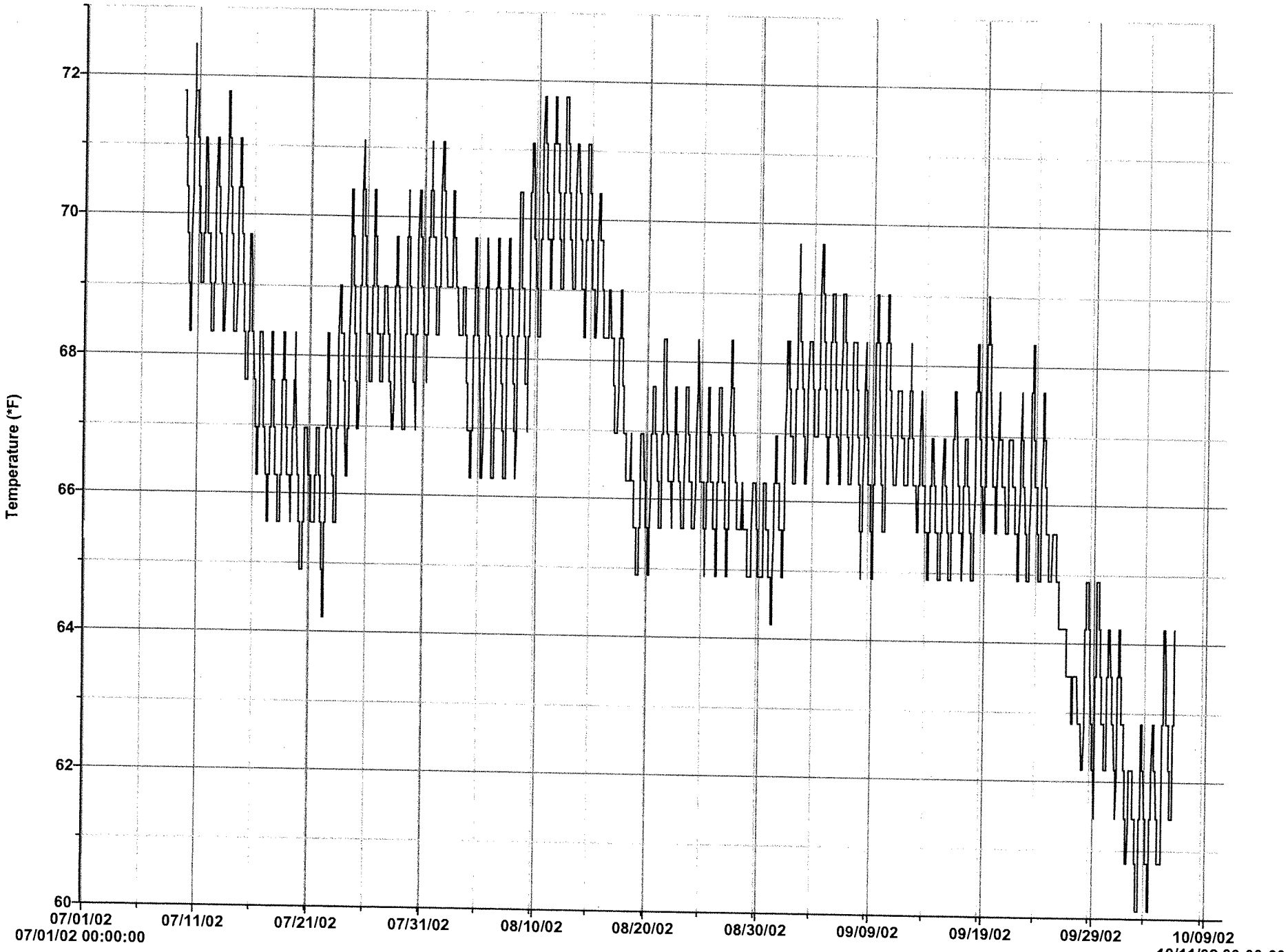


Figure 4l. Water Temp. (*F) Above Trestle 5.5 ft From Bottom, 9 Jul-6 Oct 2002, 30-min Interval

Figure 5a. Water Temperature (Degrees Centigrade) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

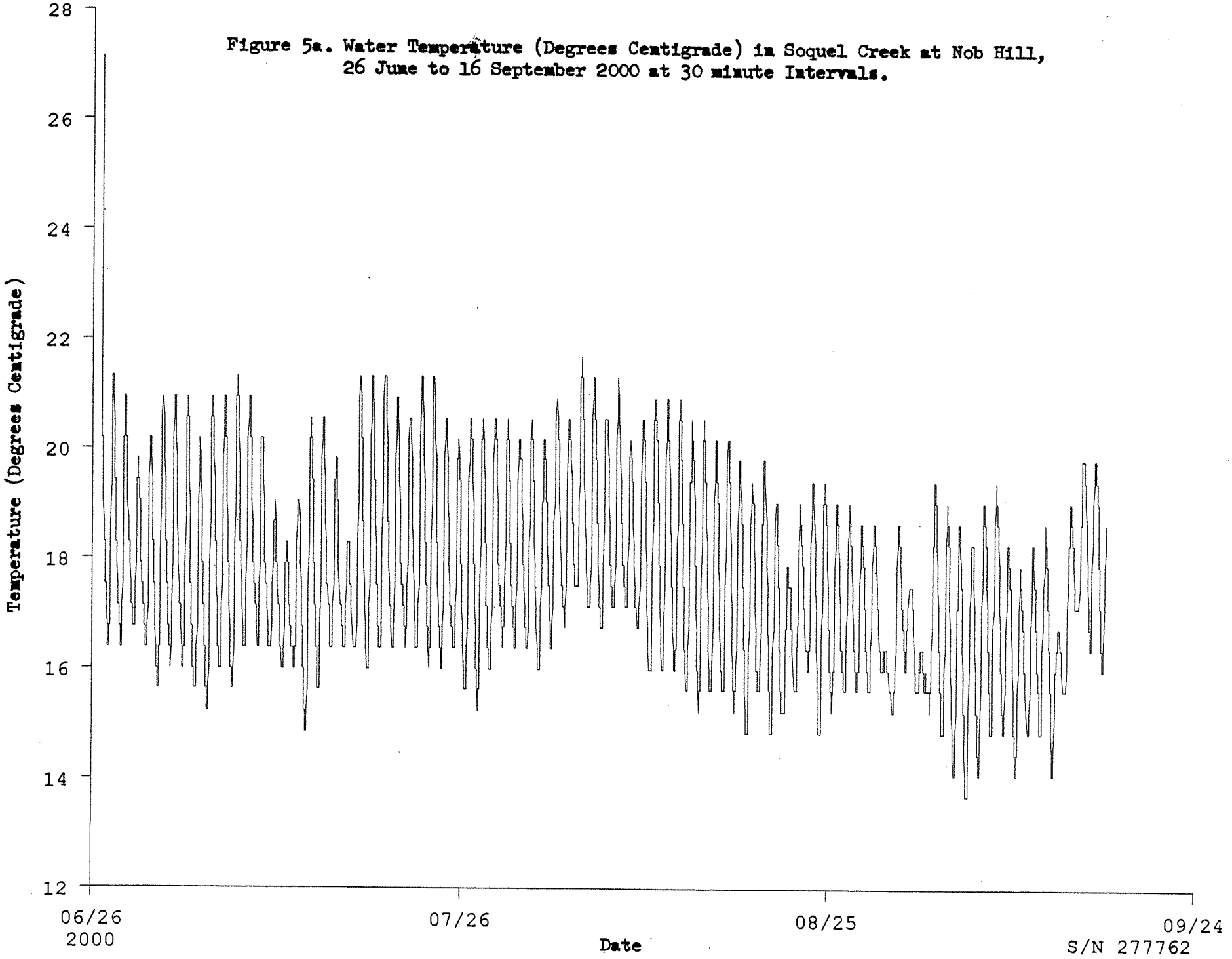


Figure 5b. Water temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

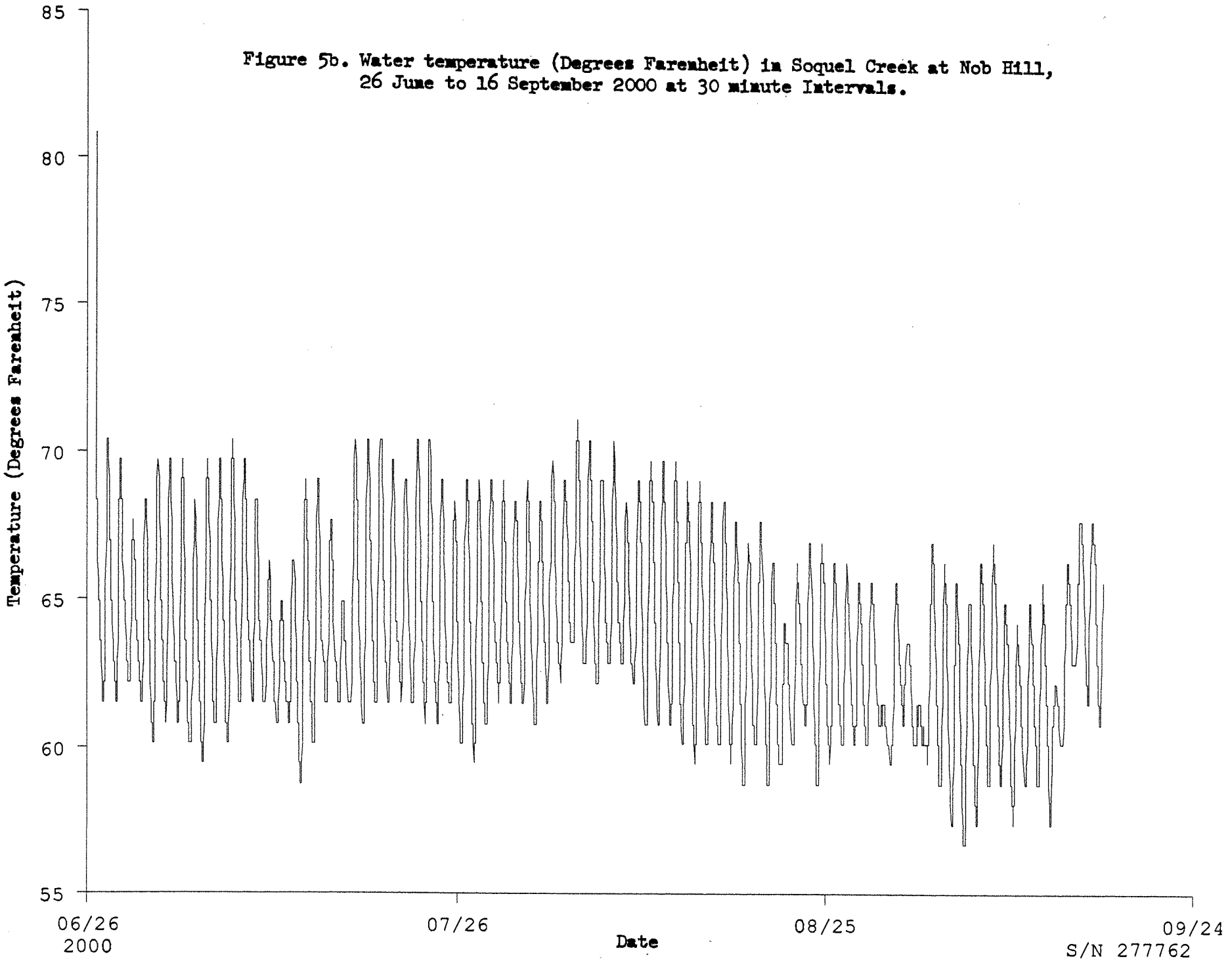


Figure 5c. Water Temperature (Degrees Celsius) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.

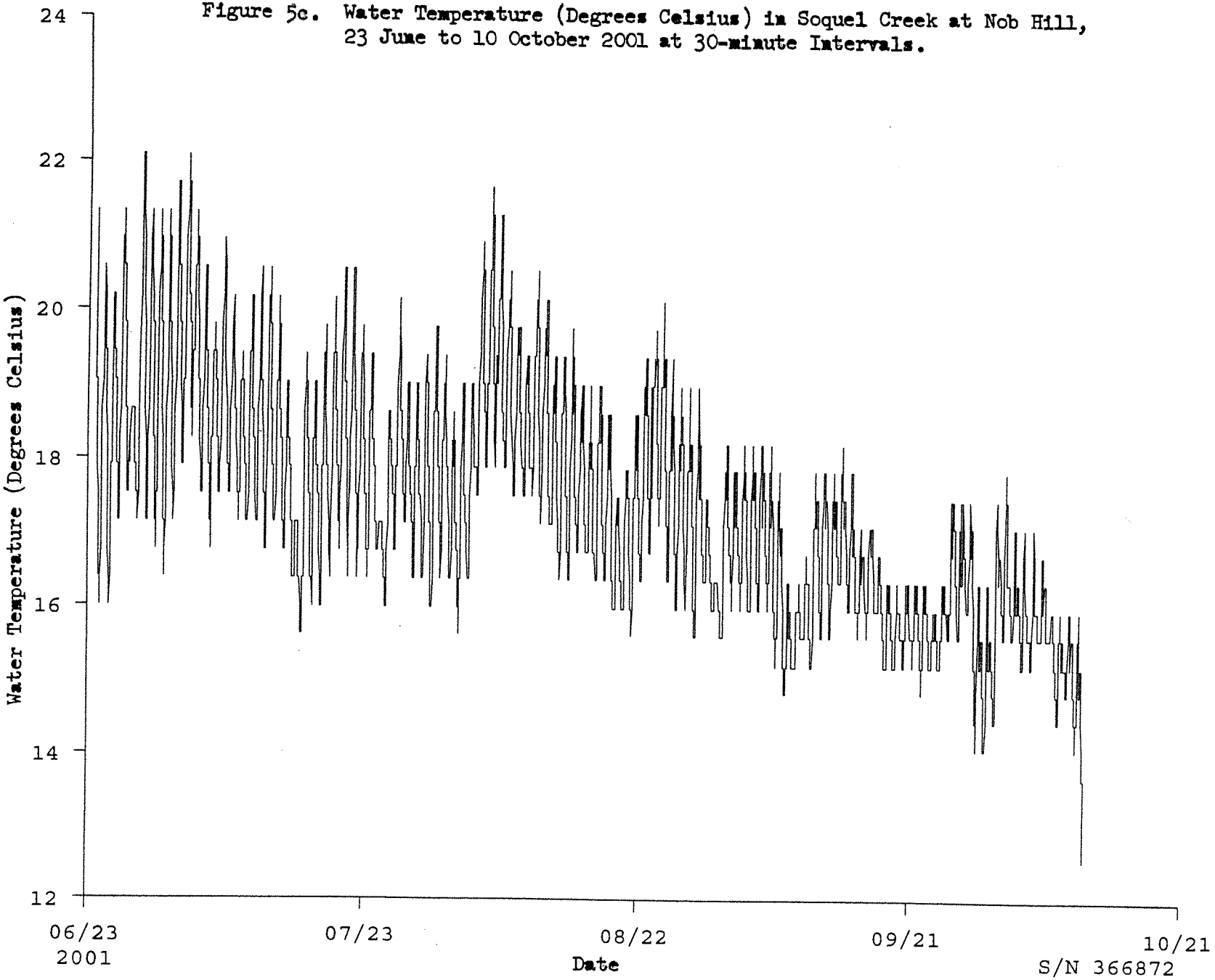
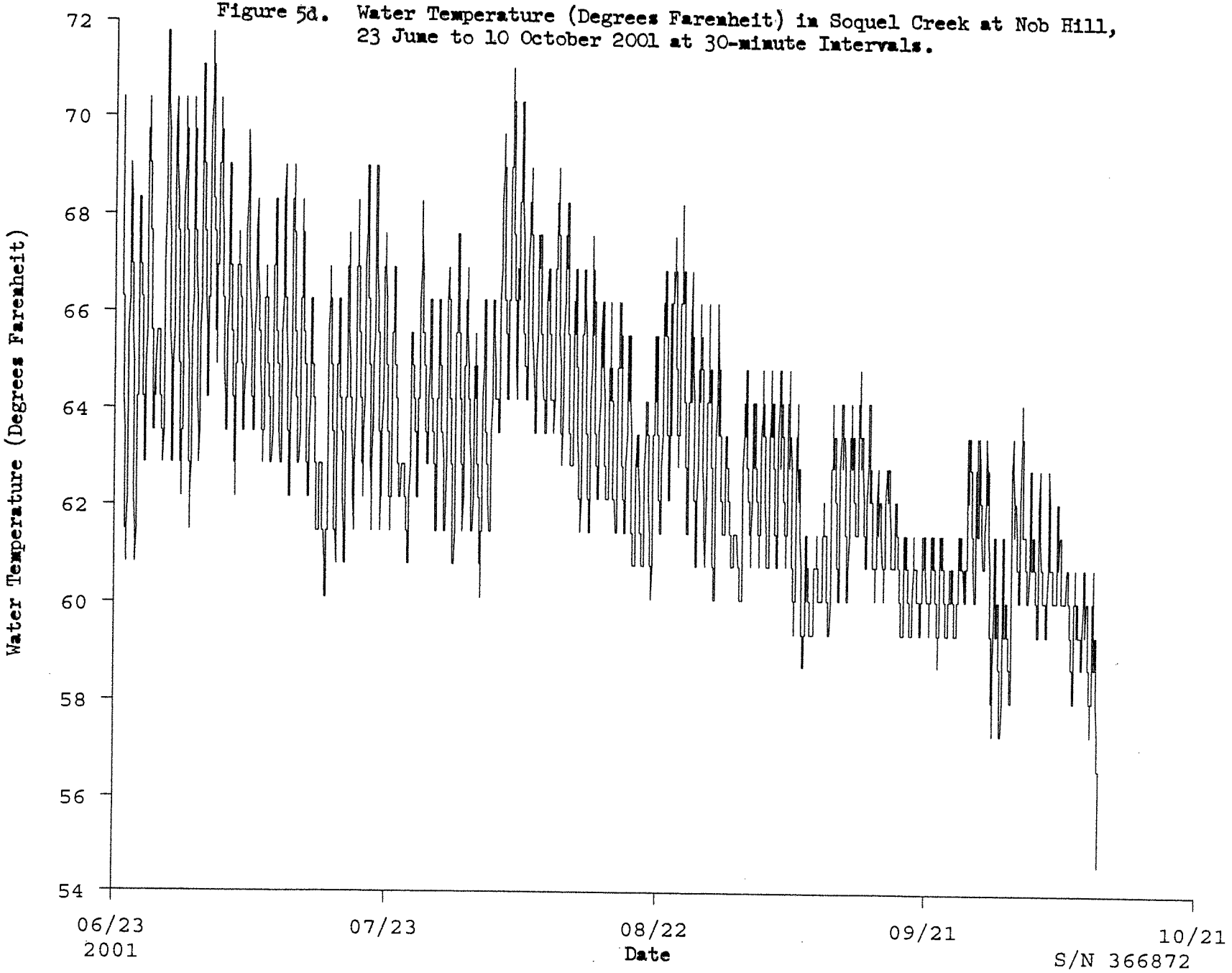


Figure 5d. Water Temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.



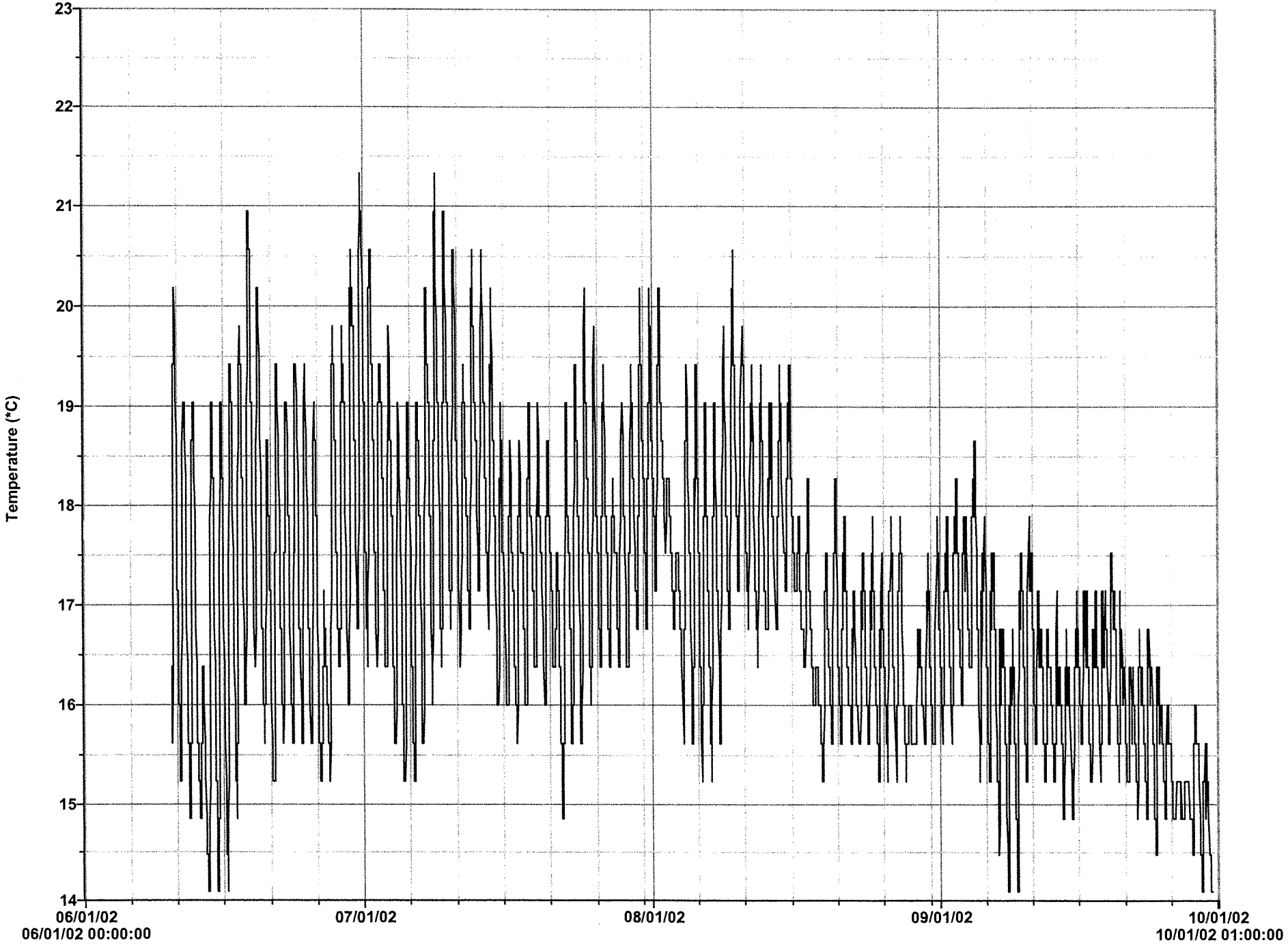


Figure 5e. Water Temp. (*C) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

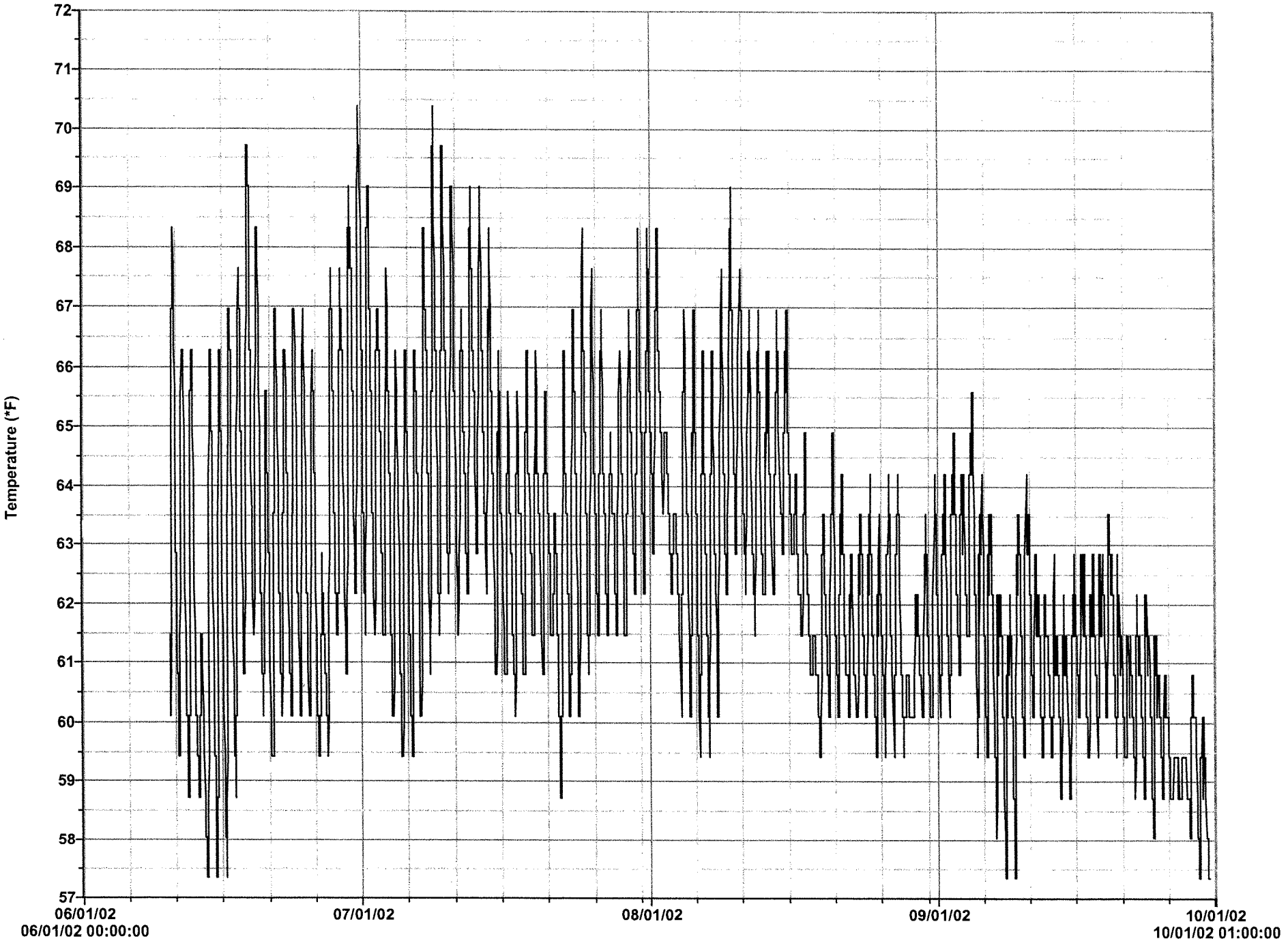


Figure 5f. Water Temp. (*F) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

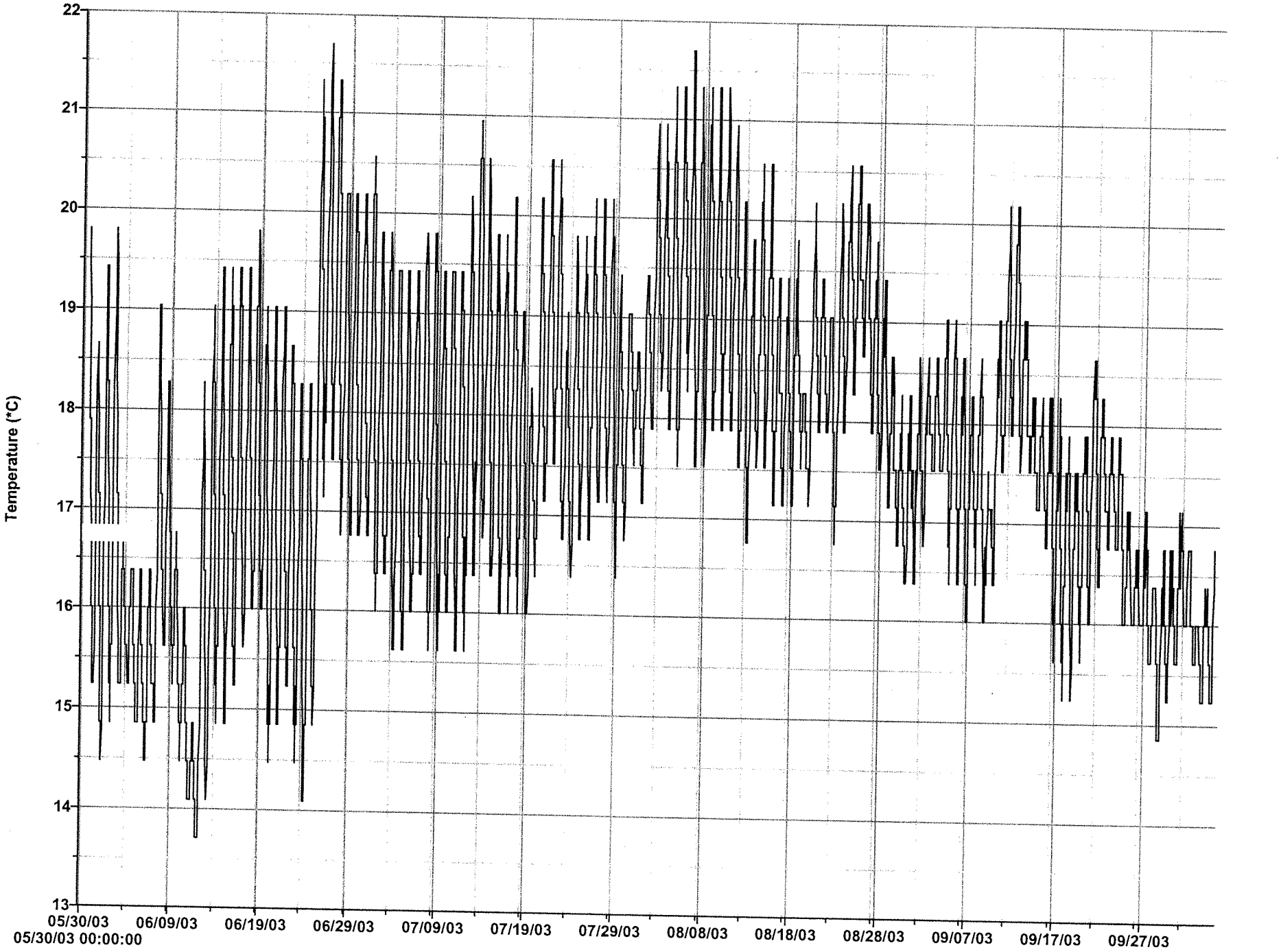


Figure 5g. Water Temp. (*C) Above Lagoon (Nob Hill), 30 May- 5 Oct 2003, 30 -min Interval

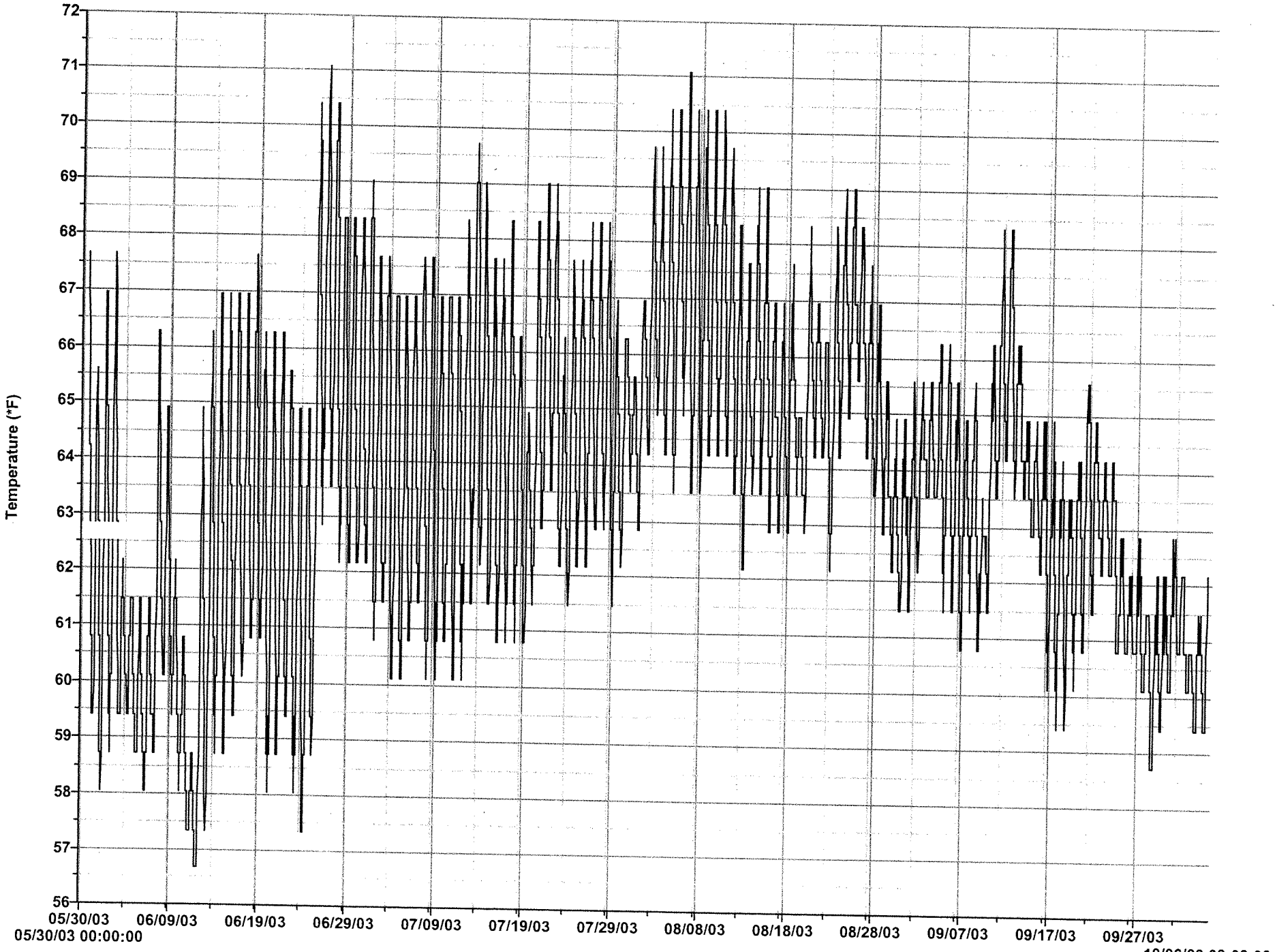


Figure 5h. Water Temp. (*F) Above Lagoon (Nob Hill), 30 May- 5 Oct 2003, 30-min Interval

Figure 6a. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek Lagoon, 16 July to 18 September 1999.

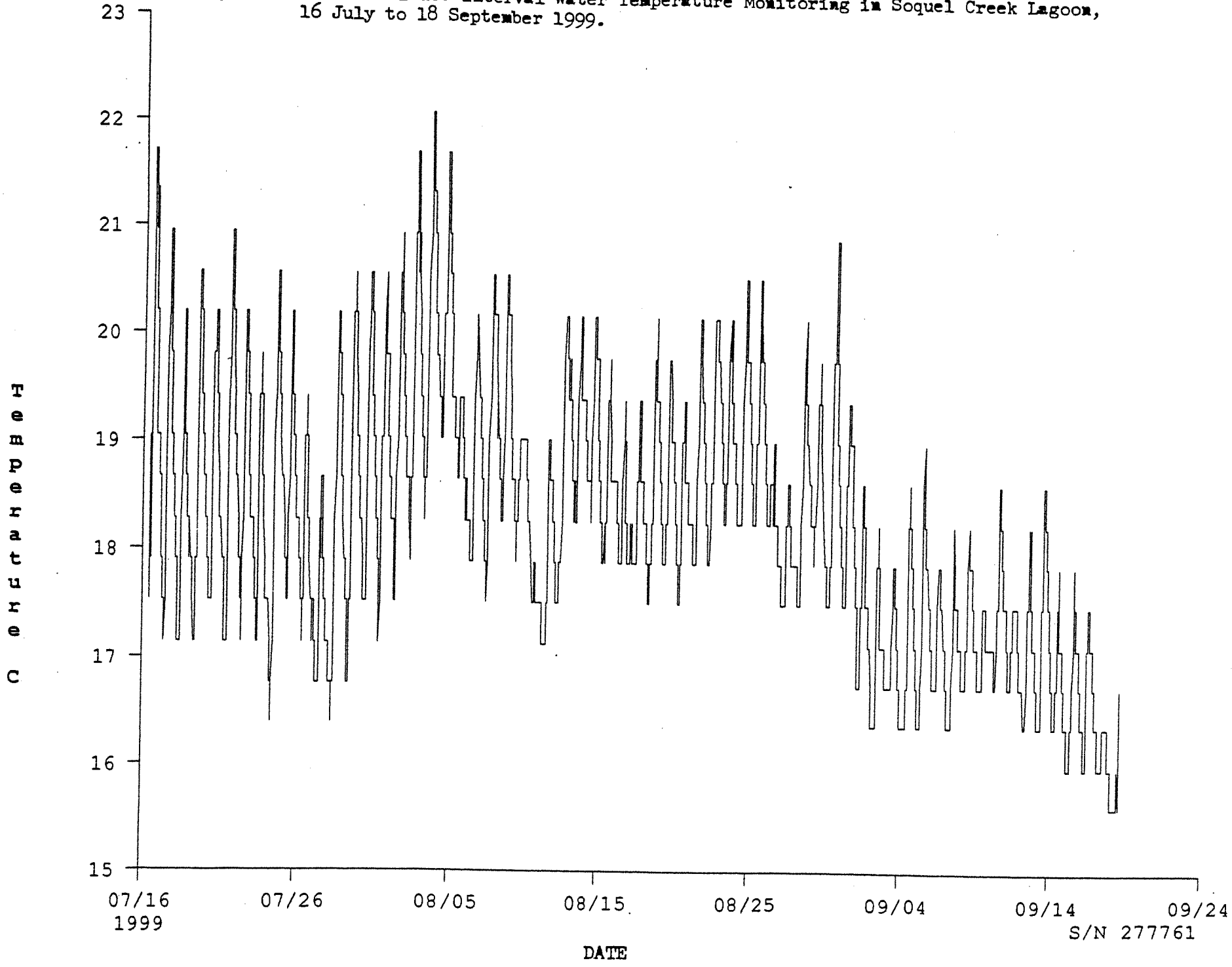


Figure 6b. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek at Nob Hill, 16 July to 18 September 1999.

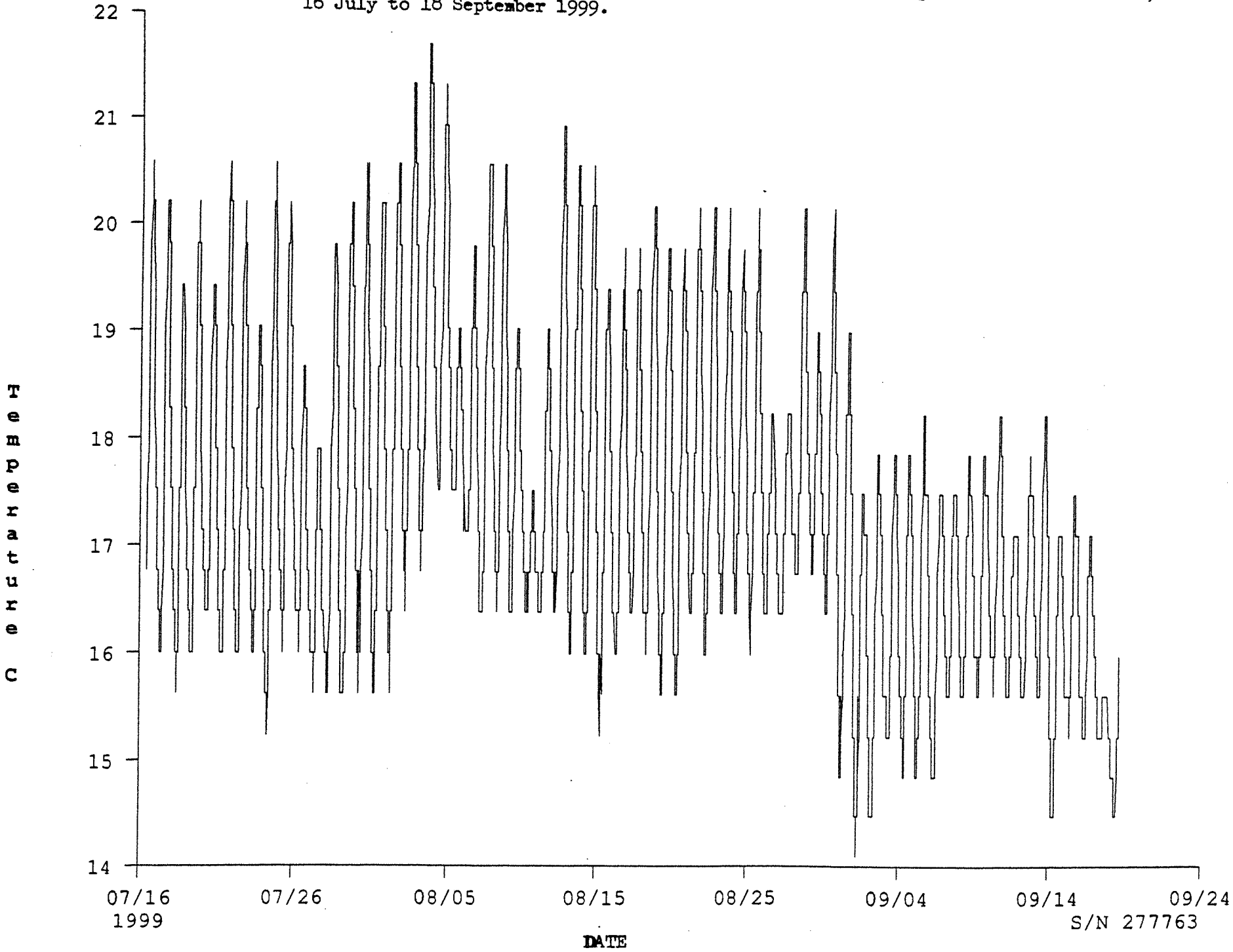


Figure 6c, Hourly Water Temperature Monitoring at Nob Hill on Soquel Creek, July 23 - September 4, 1998.

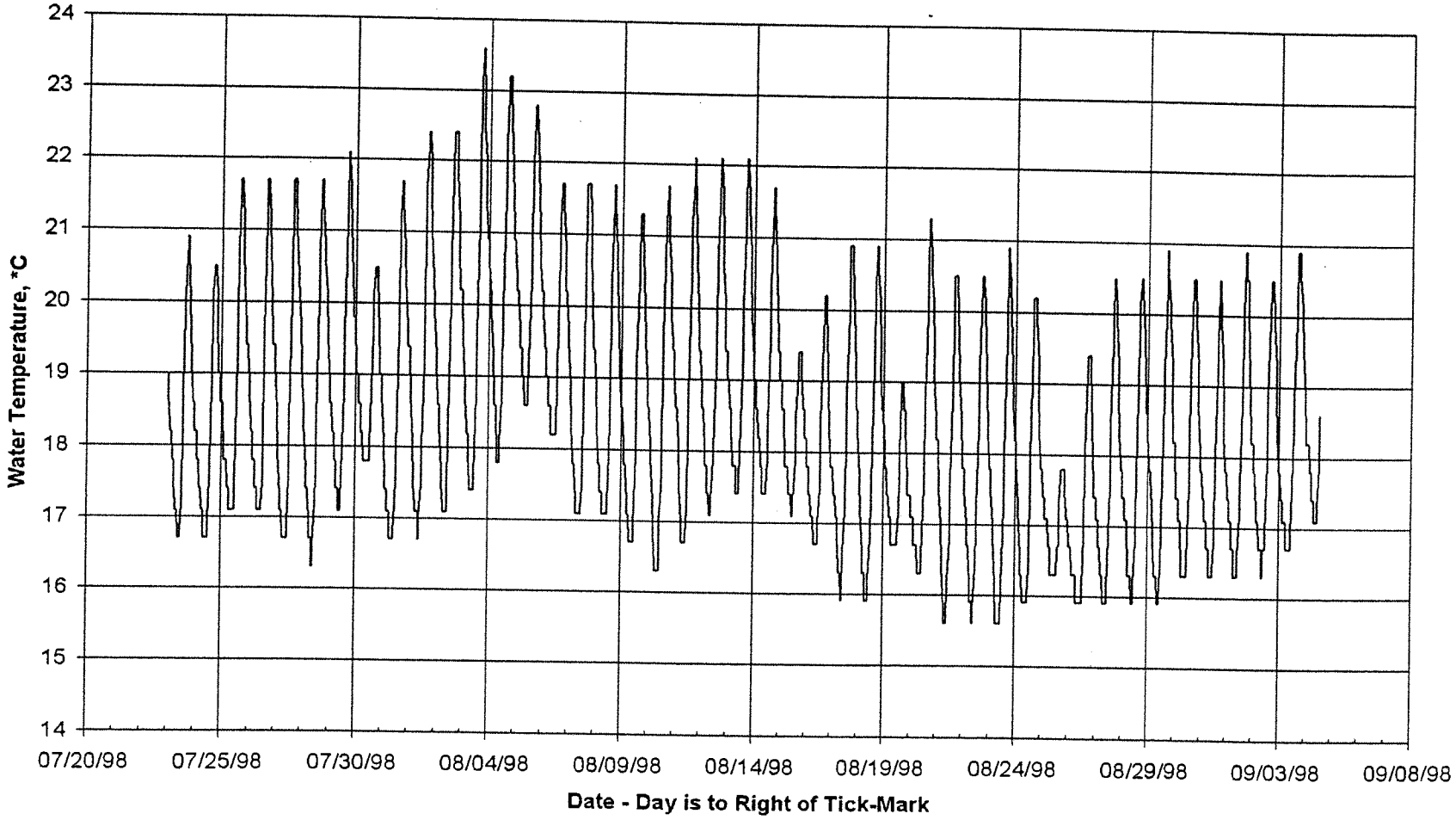


Figure 7. Soquel Lagoon Oxygen Concentration at Dawn, 29 June - 8 October 2001, Within 0.25 Meters of the Bottom at 4 Stations.

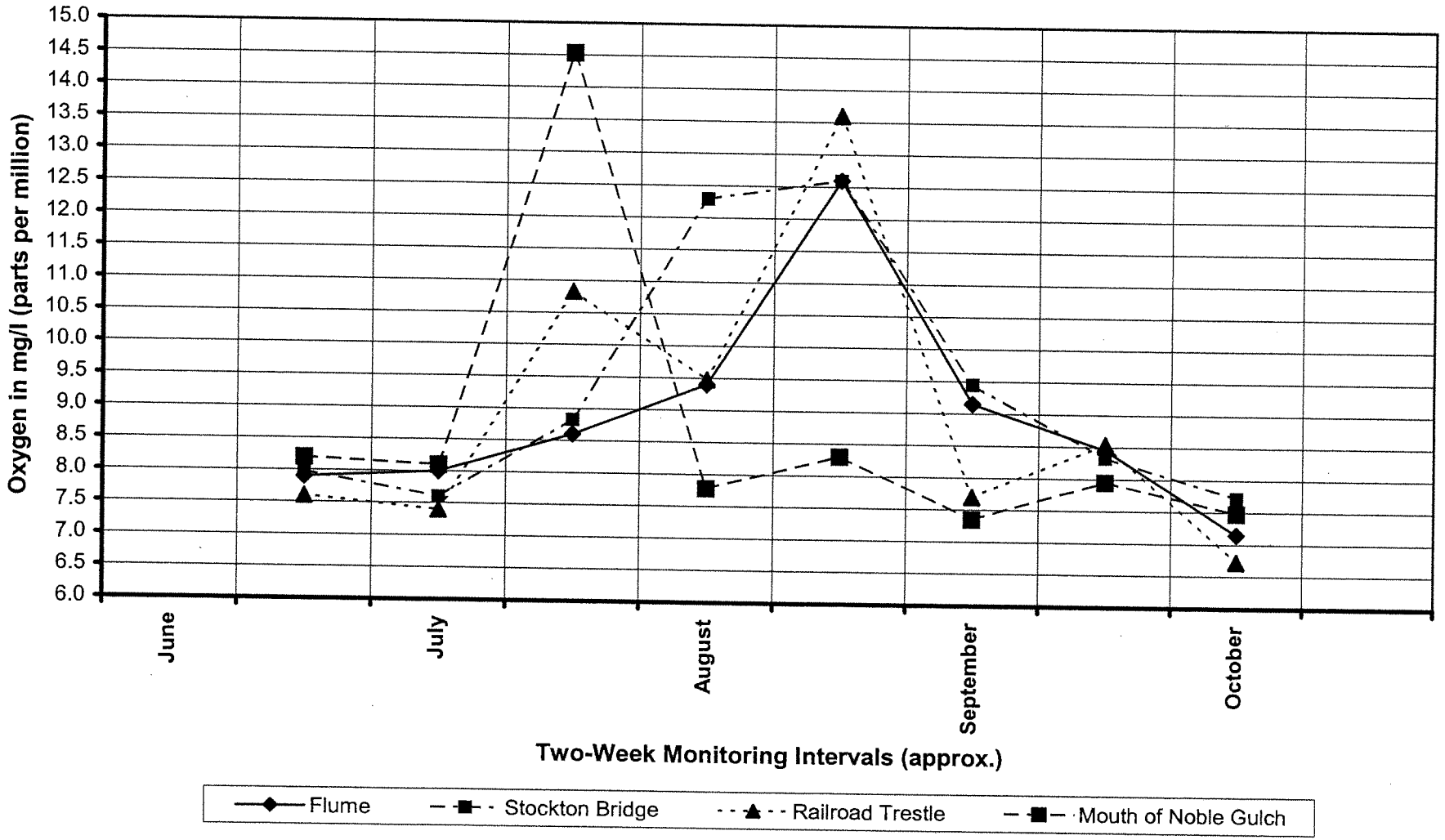


Figure 8. Soquel Lagoon Oxygen Concentration at Dawn, 10 June - 25 October 2002, Within 0.25 Meters of the Bottom at 4 Stations.

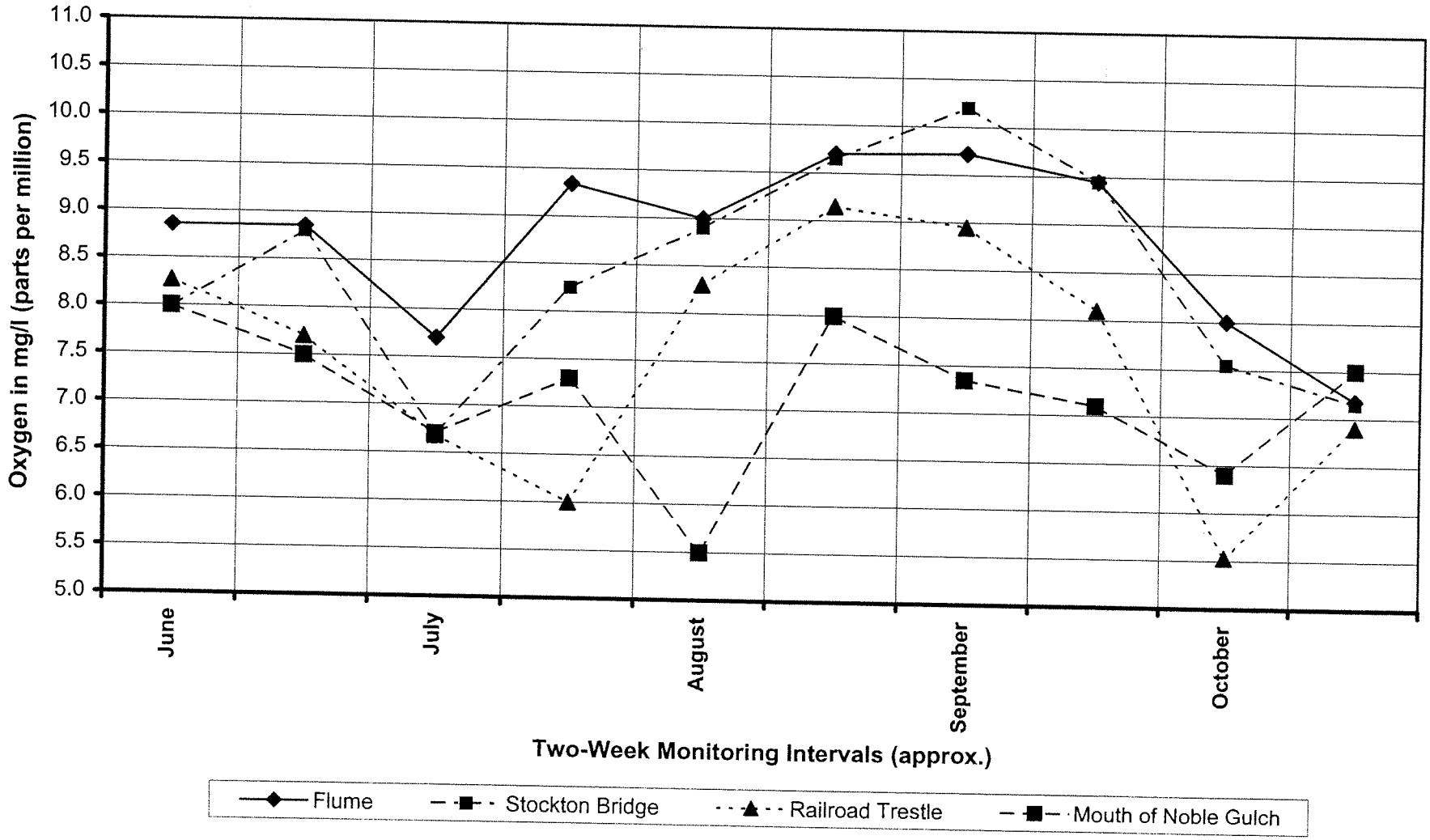


Figure 9a. Soquel Lagoon/Stream Oxygen Concentration at Dawn, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom at 5 Stations.

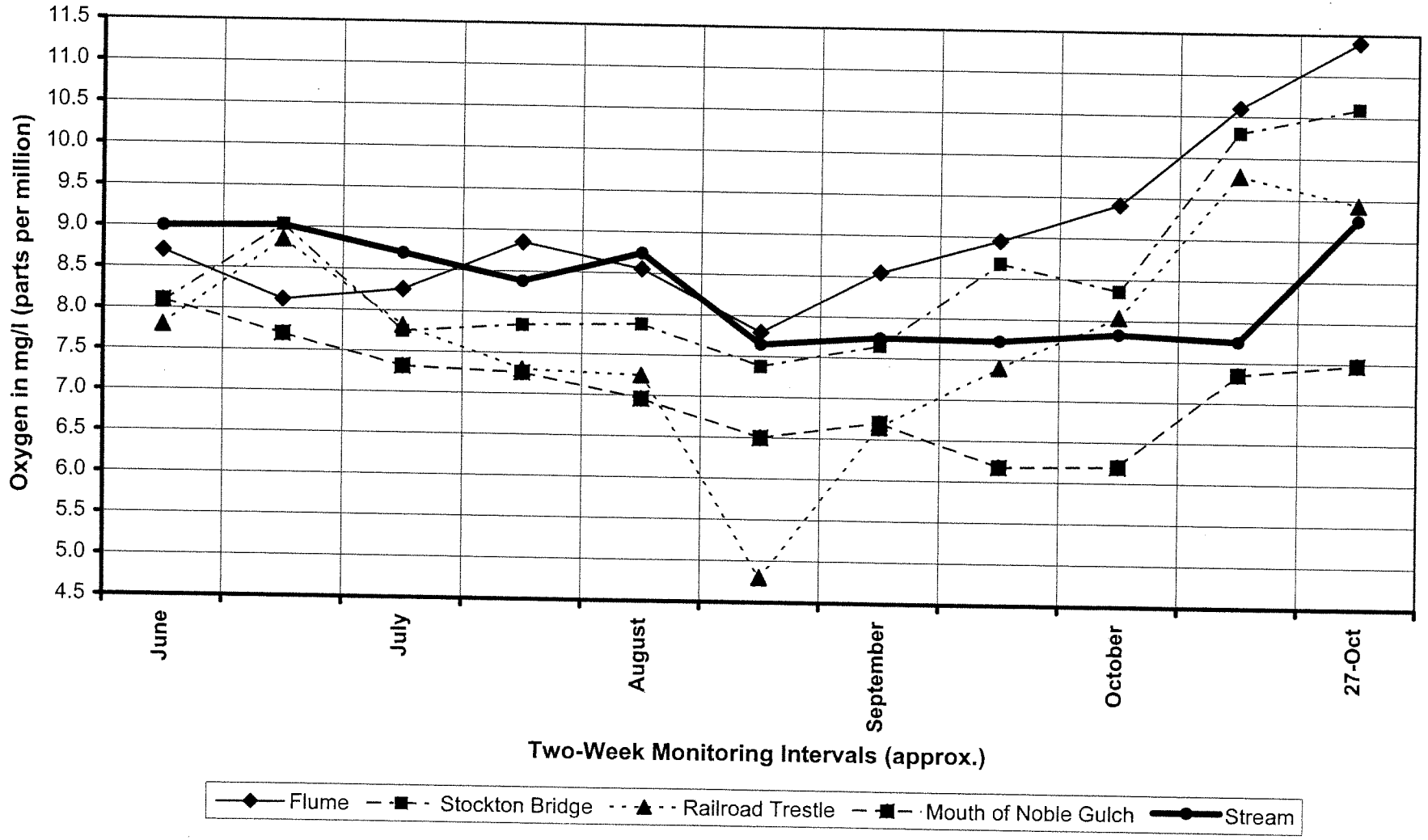


Figure 9b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 2, Stockton Avenue Bridge.

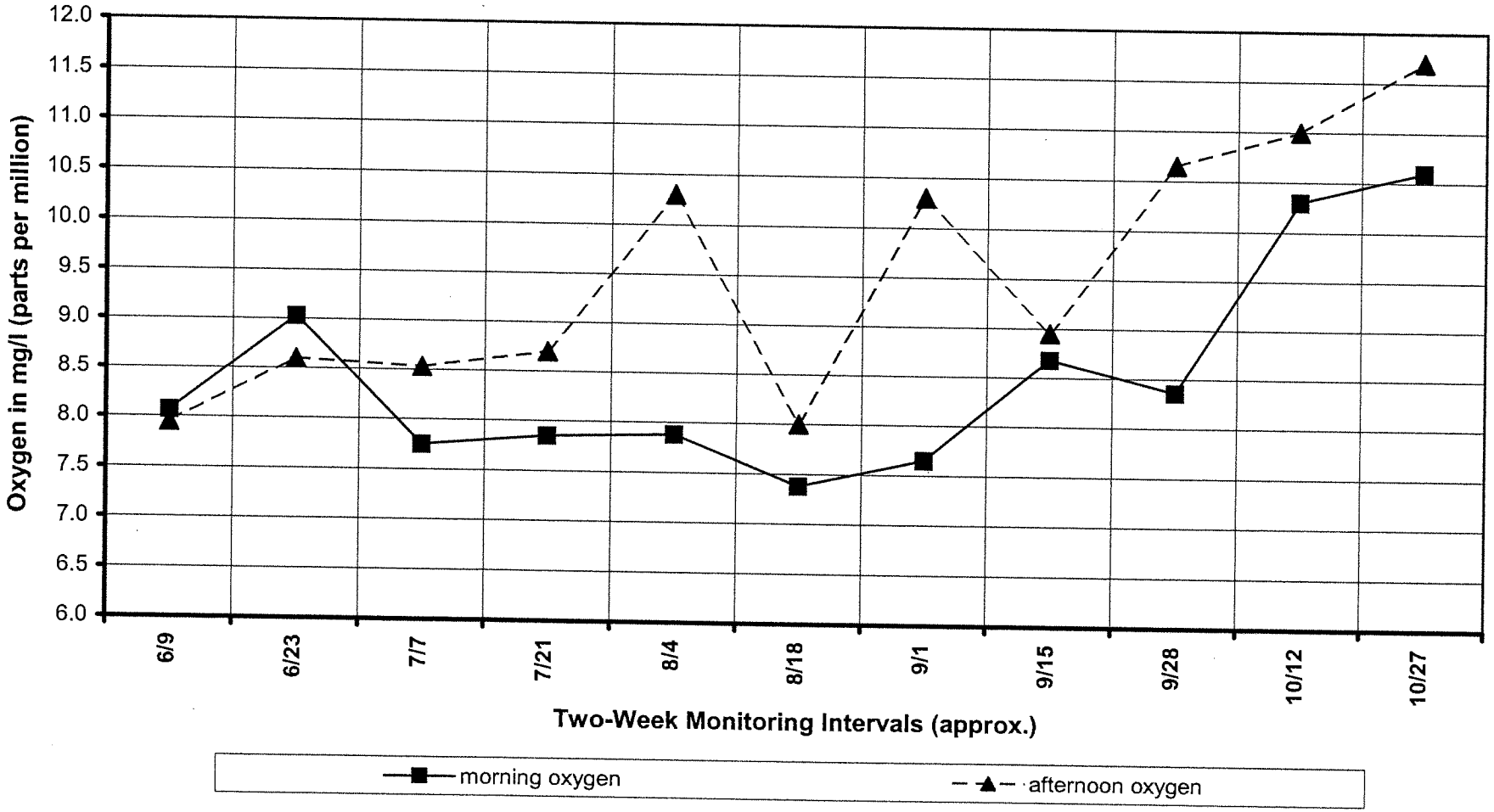


Figure 9c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 4, Mouth of Noble Gulch.

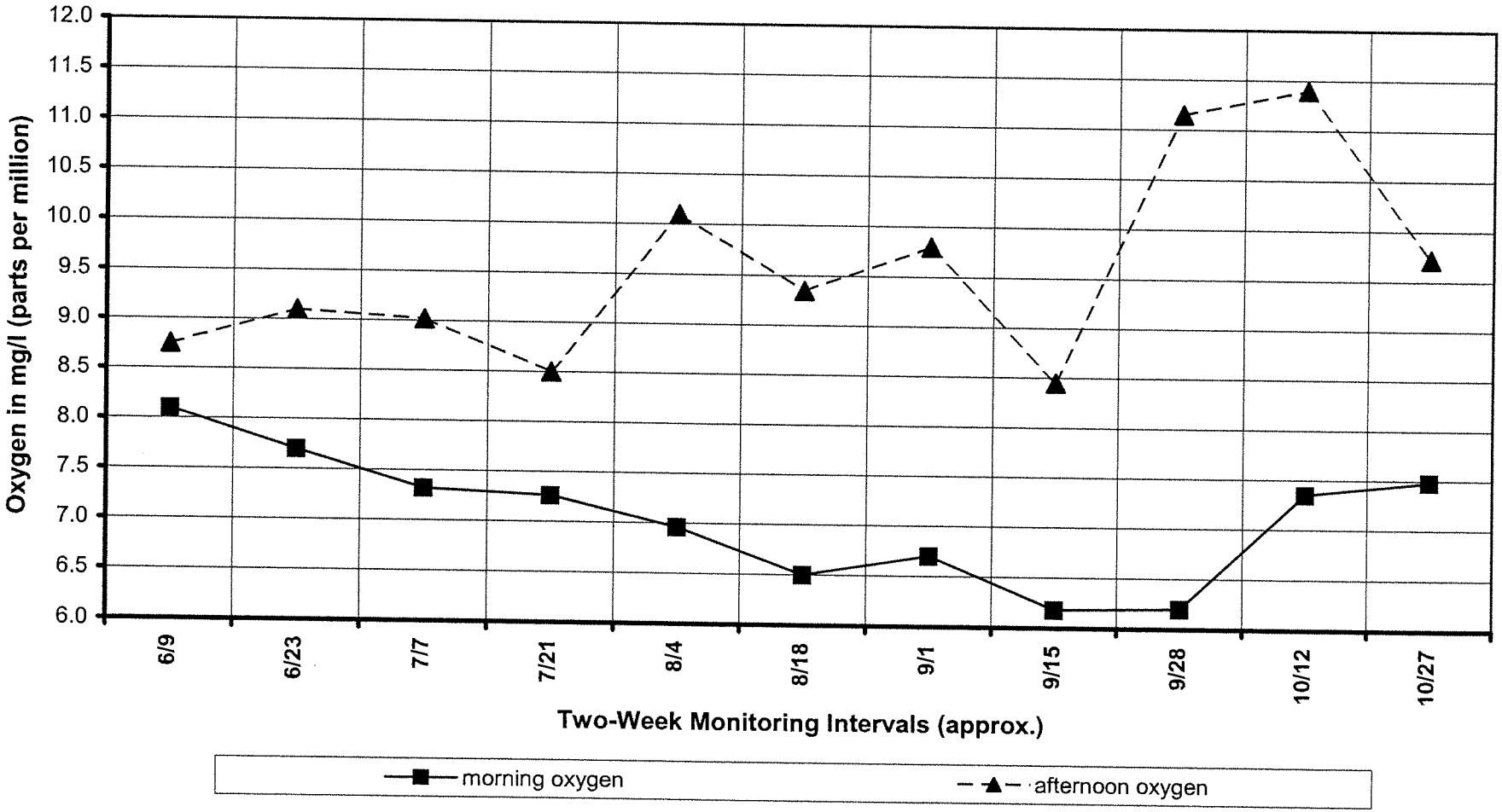


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

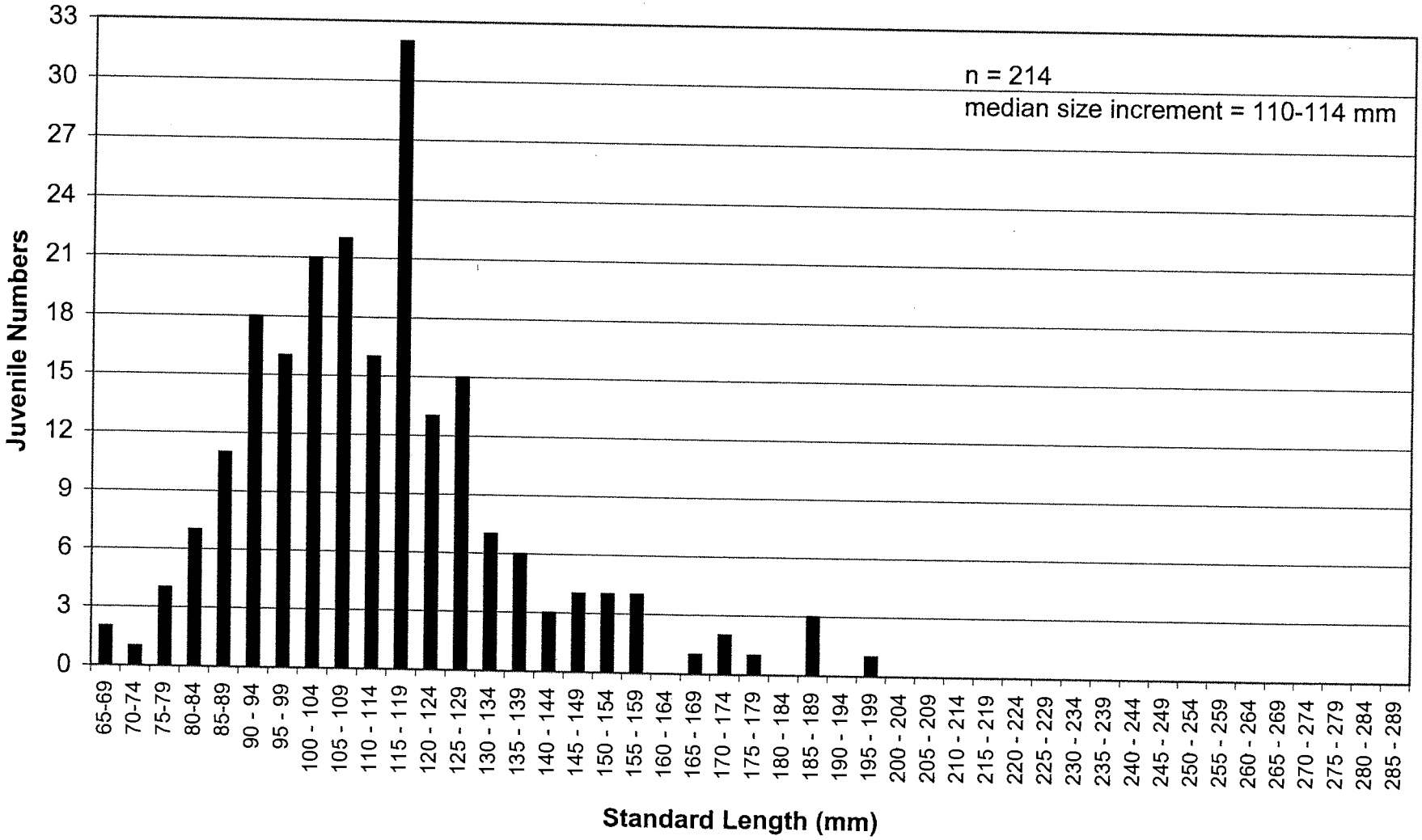


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

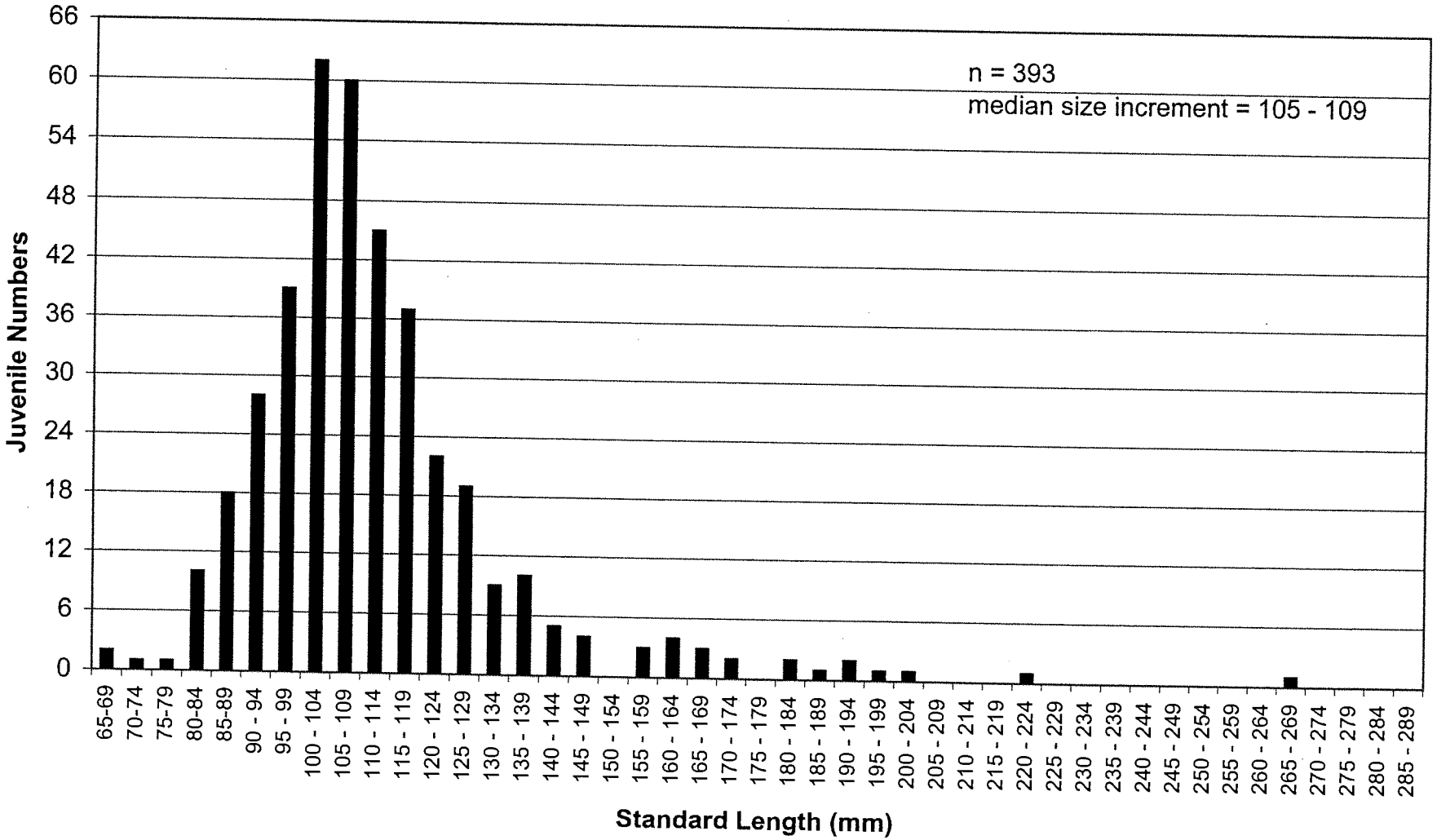


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

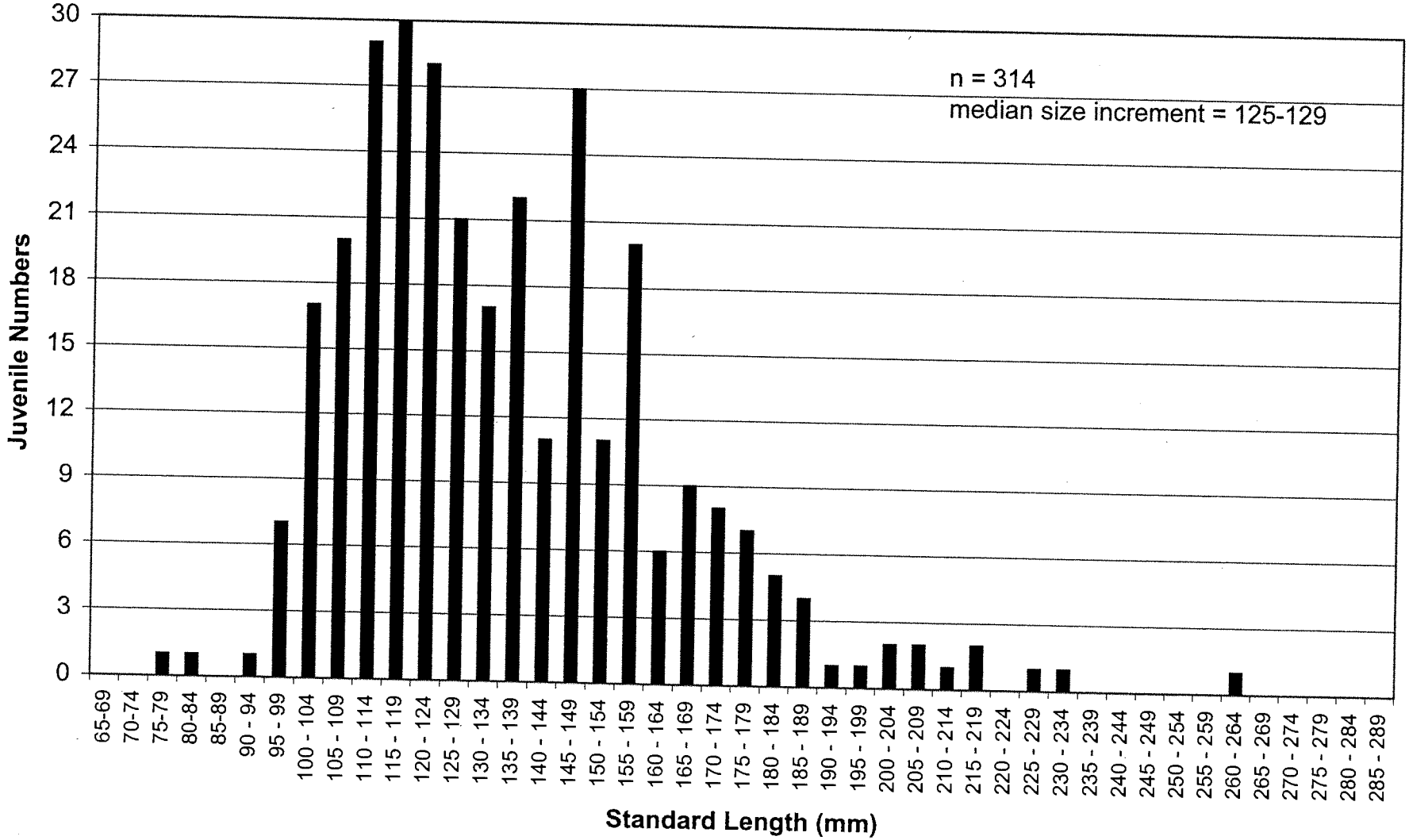


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

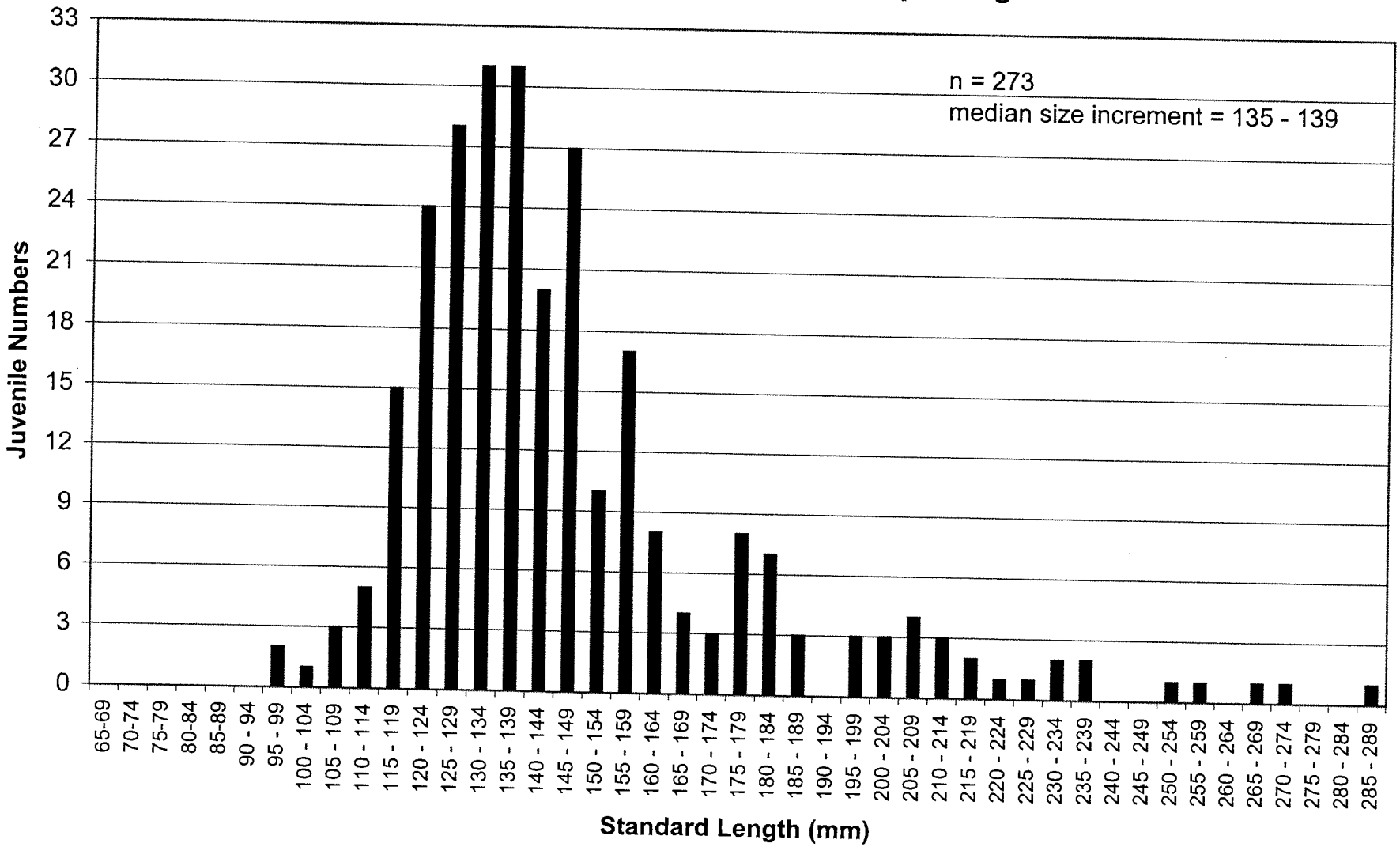


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.

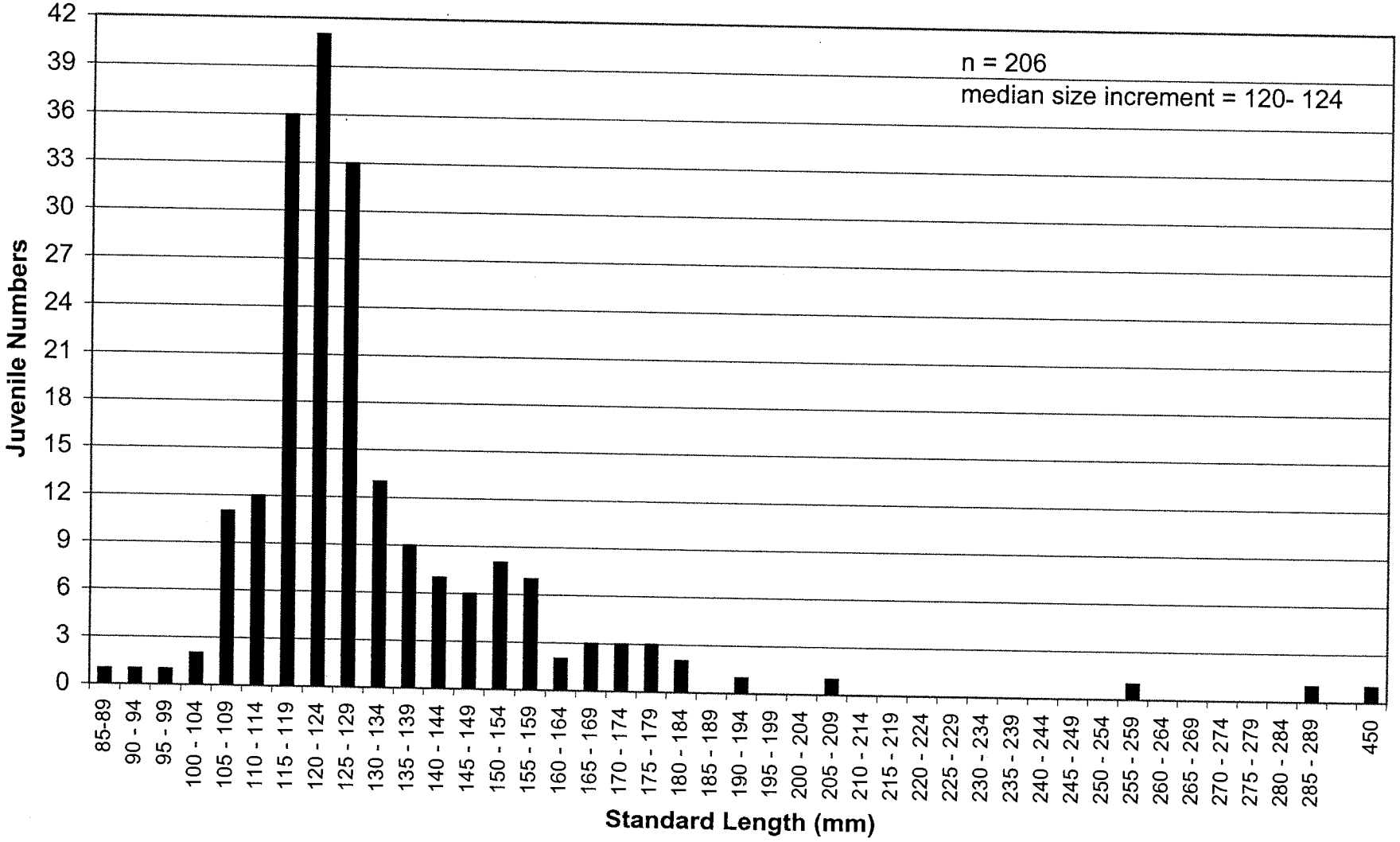


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

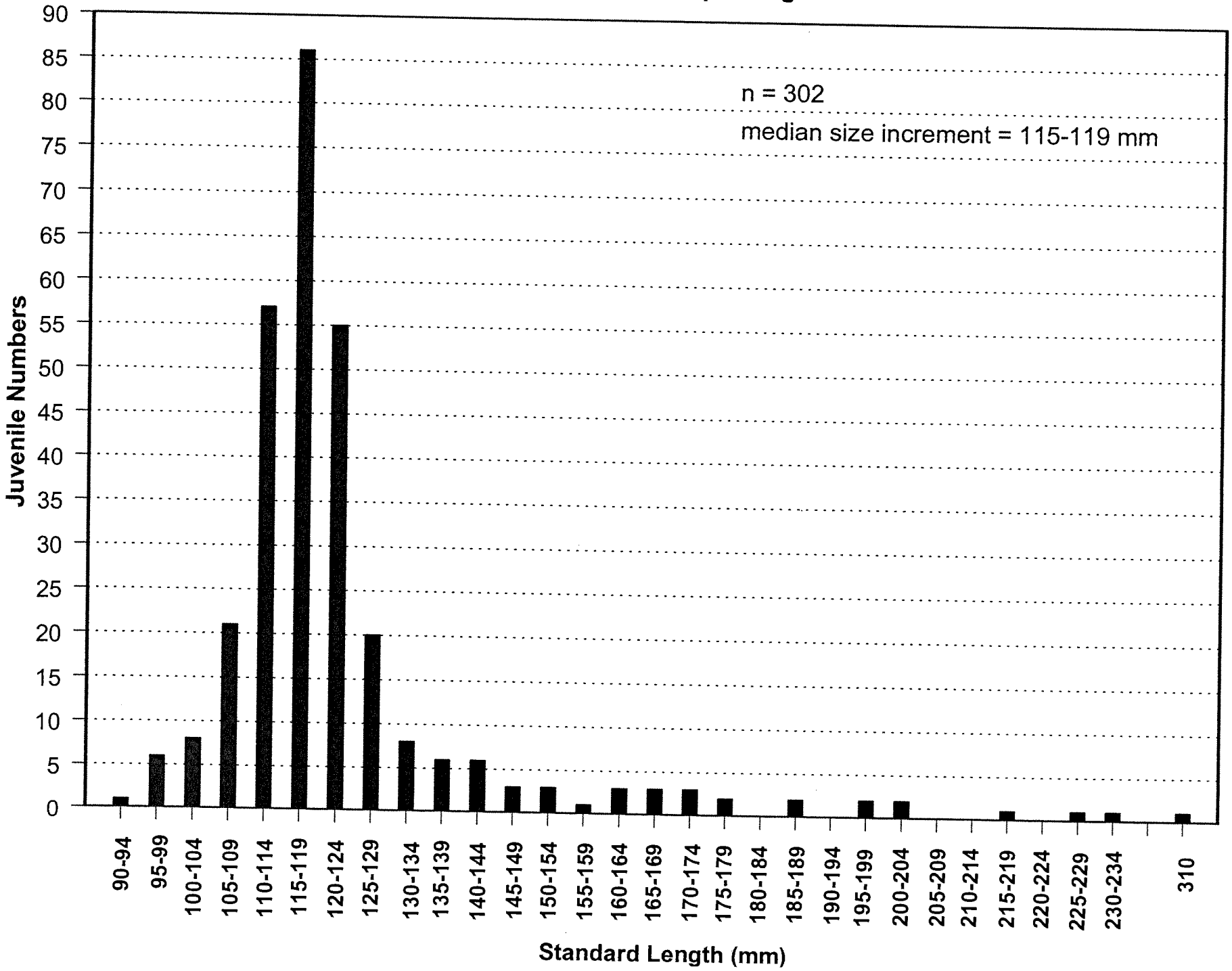
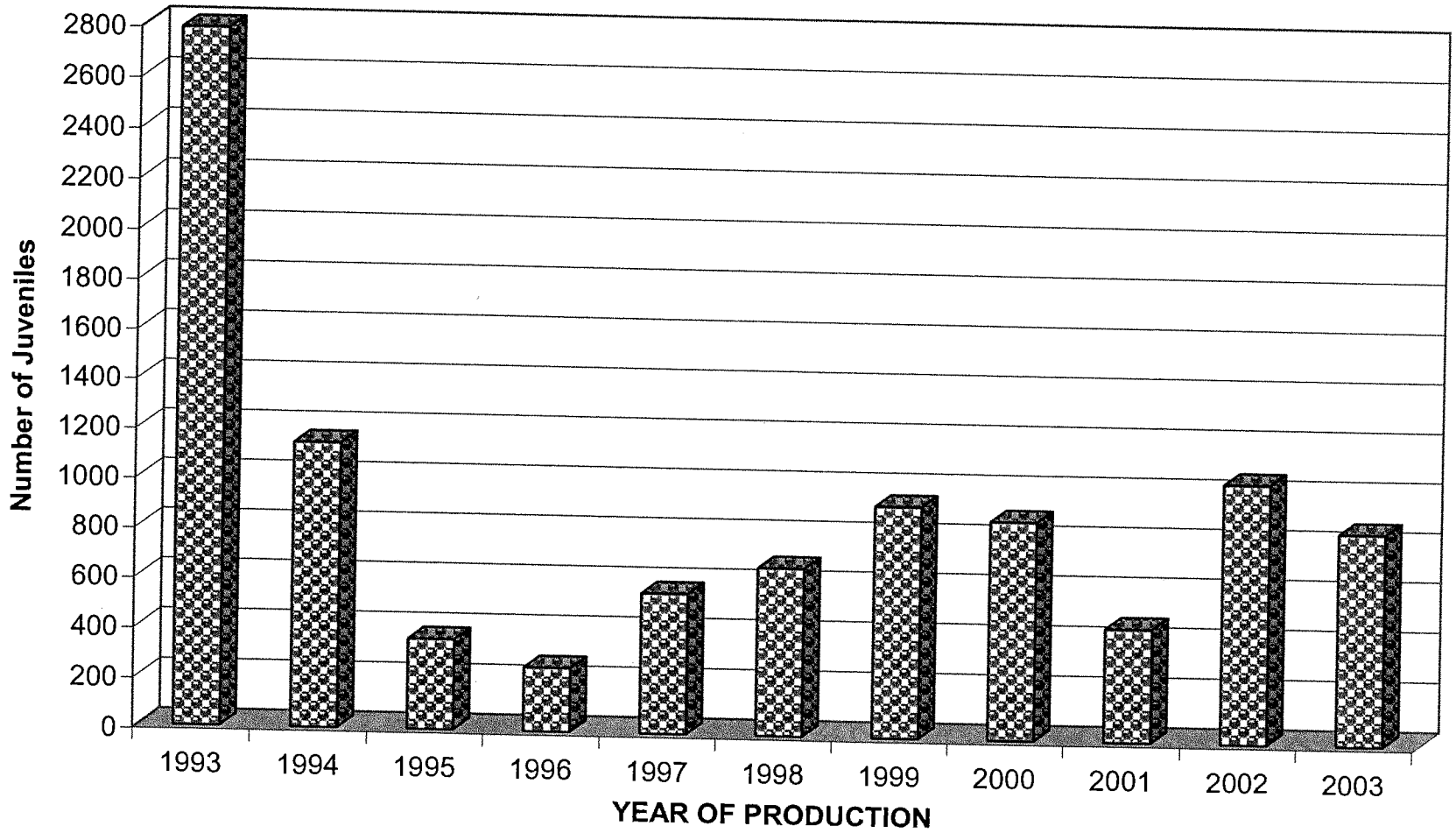


Figure 16. Juvenile Steelhead Production in Soquel Creek Lagoon, Estimated by Mark and Recapture for 1993-2003.



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION, 23 MAY – 5 NOVEMBER 2003.

	23-May-03							
	Near Bridge Abutment			0832hr	Stockton Ave Bridge Thalweg			0850hr
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	16.0	0		500	16.2	0.0		480
0.25	15.8	0		500	16.2	0.0		480
0.50	15.8	0		500	16.2	0.0		480
0.75	15.8	0		500	16.1	0.0		480
1.00	15.8	0		500	16.1	0.0		480
1.25	15.8	0		500	16.1	0.1		480
1.50	15.8	0		520				
1.75								
Bottom2.00								

	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								

23 May 2003. Gage height of 2.26. Sidewalk grates cleaned and covered. Storm drain on Esplanade capped.

			3-Jun-03					1658hr
	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	0.0		590
0.25					18.6	0.0		590
0.50					18.5	0.0		580
0.75					18.2	0.0		560
1.00					17.7	0.0		560
1.25					17.6	0.0		560
1.50					17.4	0.0		560
1.75					17.4	0.0		560
2.00					17.4	0.0		560
2.25					17.8	0.0		560

	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								

Water temperature sensors installed in lagoon and creek on 5-29-03.

0720hr					09-Jun-03				0740hr
	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	0.0	8.70	540	17.0	0.0	8.25	550	
0.25	17.2	0.0	8.70	540	17.0	0.0	8.10	550	
0.50	17.2	0.0	8.75	540	17.2	0.0	8.05	550	
0.75	17.3	0.0	8.75	540	17.2	0.0	8.05	550	
1.00	17.5	0.0	8.65	540	17.2	0.0	8.07	550	
1.25	17.6	0.0	8.70	540	17.2	0.0	3.35	550	
1.40	17.5	0.0	4.10	540					
1.75									
2.00									

0805hr					09-Jun-03				0825hr
	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	17.0	0.0	7.90	530	16.5	0.0	8.10	520	
0.25	17.2	0.0	7.85	530	16.5	0.0	8.05	520	
0.50	17.2	0.0	7.75	530	16.5	0.0	8.05	520	
0.75	17.2	0.0	7.85	530	16.5	0.0	8.03	520	
1.00	17.2	0.0	7.73	530	16.5	0.0	8.10	520	
1.25/1.10	17.2	0.0	7.80	530	16.5	0.0	6.60	520	
1.40	17.2	0.0	5.30	530					

09 June 2003. Gage height of 2.37. Cloudy, overcast. Air temperature of 13.8°C. Flume grate installed during winter; outlet 1.5 feet deep.

Station 1: Flume at 0720 hr. Reach 1- no surface algae, phytoplankton bloom in all three reaches. Contaminated water sign up.

Station 2: Stockton Avenue Bridge at 0740 hr. Secchi depth to bottom. Reach 2- no surface algae, film on bottom.

Station 3: Railroad Trestle at 0805 hr. Reach 3- no surface algae, film on bottom.

Station 4: Mouth of Noble Gulch at 0825 hr. No surface algae, layer of leaves and detritus on bottom.

Station 5: Nob Hill at 0908 hr. Water temperature 15.6°C. Conductivity 550 umhos. Oxygen

9.00 mg/l.

1510hr			09-Jun-03				1525hr
	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		8.30		18.0		8.22	
0.25	18.2		8.25		18.2		8.15	
0.50	18.1		8.12		18.0		8.10	
0.75	17.8		8.10		18.0		8.10	
1.00	17.8		8.15		17.8		7.95	
1.25	17.8		8.15		17.8		1.50	
1.40	17.8		6.85					
1.75								
2.00								

1545hr			09-Jun-03				1600hr
	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	17.6		8.73		17.3		8.80	
0.25	17.7		8.45		17.2		8.75	
0.50	17.6		8.56		17.2		8.80	
0.75	17.6		8.50		17.2		8.85	
1.00	17.4		8.52		17.2		8.75	
1.25/1.10	17.4		8.52		17.2		6.42	
1.37	17.4		6.30					

0705hr			23-Jun-03				0733hr
	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	16.8	0.0	9.10	560	16.9	0.0	9.10	550
0.25	17.1	0.0	9.10	570	17.2	0.0	9.05	550
0.50	17.1	0.0	9.10	570	17.2	0.0	9.02	550
0.75	17.1	0.0	9.10	570	17.2	0.0	9.10	550
1.00	17.2	0.0	8.85	570	17.2	0.0	9.03	550
1.25/1.05	17.5	0.0	7.64	570	17.4	0.0	6.03	560
1.35	17.6	0.0		580				

0754hr						23-Jul-03				0810hr
	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	16.8	0.0	8.94	550		16.2	0.0	7.38	560	
0.25	17.1	0.0	9.00	550		16.4	0.0	7.25	560	
0.50	17.2	0.0	8.98	550		16.6	0.0	7.30	560	
0.75	17.2	0.0	8.90	550		16.5	0.0	7.30	560	
1.00	17.2	0.0	8.90	550		16.3	0.0	7.70	560	
1.25/1.10	17.2	0.0	8.85	550		16.3	0.0	6.10	570	
1.37	17.2	0.0	5.95	560						

23 June 2003. Gage height of 2.33 morning and afternoon. Overcast/ clouds breaking up by 0900 hr. Air temperature of 11.2°C at 0705 hr. Flume inlet 2 ft, outlet at 1.2 ft depth. 0.25 ft above top board. Someone ran water down Esplanade drain. Garbage cans with lids on beach.

Station 1: Flume at 1640 hr. No surface algae. Reach 1- 50% bottom 2-6 inch thick algae.

Station 2: Stockton Avenue Bridge at 1606 hr. Reach 2- Greener soup of phytoplankton than previously. Film on bottom.

Station 3: Railroad Trestle at 1555 hr. Reach 3- no surface algae. Film on bottom.

Station 4: Mouth of Noble Gulch at 1535 hr. No surface algae. Film on bottom.

Station 5: Nob Hill at 0858 hr. Water temperature 14.8 °C. Conductivity 520 umhos. Oxygen 9.02 mg/l.

1640hr						23-Jun-03				1606hr
	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	19.5		8.75			19.8		8.70		
0.25	19.4		8.75			20.0		8.65		
0.50	19.2		8.65			19.6		8.40		
0.75	19.0		8.65			19.0		8.75		
1.00	18.9		8.50			18.8		8.60		
1.25	18.9		8.63			18.7		7.60		
1.35	18.8		7.03							

1555hr				23-Jul-03				1535hr
	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	19.8		8.80		20.0		8.20	
0.25	19.9		8.61		19.6		8.25	
0.50	19.8		8.50		19.2		8.23	
0.75	19.5		8.45		18.5		8.65	
1.00	18.8		9.25		18.2		9.10	
1.25/1.12	18.5		9.34		18.2		6.72	
1.37	18.5		7.50					

0708 hr					07-Jul-03					0730 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	19.2	0.0	8.30	610		18.8	0.0	8.22	610	
0.25	19.3	0.0	8.35	610		18.8	0.0	7.98	610	
0.50	19.3	0.0	8.30	610		18.8	0.0	7.98	610	
0.75	19.3	0.0	8.33	610		18.8	0.0	7.98	610	
1.00	19.3	0.0	8.26	610		18.8	0.0	7.75	610	
1.20	19.3	0.0	7.35	620		18.8	0.0	4.98	610	
1.25										
1.50										
1.75										

0750hr					07-Jul-03					0804 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	18.5	0.0	8.03	620		17.8	0.0	7.05	640	
0.25	18.6	0.0	7.88	620		18.0	0.0	6.95	650	
0.50	18.6	0.0	7.76	620		18.2	0.0	6.88	650	
0.75	18.5	0.0	7.73	620		18.2	0.0	6.90	620	
1.00	18.5	0.0	7.82	620		18.0	0.0	7.32	600	
1.25	18.5	0.0	4.45	620		17.8	0.0	4.92	620	

07 July 2003. Gage height of 2.20 (morning) and 2.22 (afternoon). Overcast. Air temperature at 13.8 °C at 0708 hr. Flume entrance greater than 1.0 ft. Flume exit at 1.0 ft. Plywood nailed to flashboards on Venetian side to reduce leakage between boards and maintain lagoon height.

Station 1: Flume at 1640 hr. Reach 1- no surface algae. 15% of bottom covered by algae 0.2-0.5 ft thick. 7 mallards in morning. 42 gulls bathing in afternoon.

Station 2: Stockton Avenue Bridge at 1615 hr. Secchi depth to the bottom. Reach 2- no surface algae. 20% of bottom covered by algae 0.2- 1.0 ft thick; remainder film on bottom. 15 mergansers feeding under bridge.

Station 3: Railroad trestle at 1558 hr. Reach 3- no surface algae. 25% of bottom covered by algae 0.2- 0.6 ft thick; remainder film. 21 mallards in Reach 3 in morning. One was white

Station 4: Mouth of Noble Gulch at 1533 hr. No surface algae. 50% of bottom covered by algae 0.2-0.5 ft thick. 12 mergansers roosting on fallen cottonwood and disturbed by boaters.

Station 5: Nob Hill at 0928 hr. Water temperature at 17.0°C. Conductivity 630 umhos, Oxygen 8.70 mg/l. Estimated streamflow approximately 5-6 cfs.

1640 hr	07-Jul-03				1615 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	21.8	0.0	8.65	620	21.8	0.0	8.80	650
0.25	21.6	0.0	8.65	620	21.5	0.0	8.70	640
0.50	21.5	0.0	8.78	620	21.2	0.0	8.67	640
0.75	21.2	0.0	8.95	620	20.8	0.0	8.65	640
1.00	21.1	0.0	9.05	620	20.5	0.0	8.53	640
1.20	21.0	0.0	6.85	620				
1.25					20.4	0.0	6.53	640
1.50								
1.75								

1558hr	07-Jul-03				1533 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	21.3	0.0	9.05	620	22.2	0.0	8.40	630
0.25	21.2	0.0	9.10	620	21.6	0.0	8.05	630
0.50	21.2	0.0	8.88	620	21.1	0.0	7.95	630
0.75	21.1	0.0	9.08	620	20.5	0.0	8.68	630
1.00	21.0	0.0	10.30	620	20.3	0.0	9.02	610
1.25	20.7	0.0	10.10	620	20.3	0.0	6.60	600
1.30	20.7	0.0	7.65	620				

0703hr					21-Jul-03				0737hr
	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	19.8	0.0	8.55	630	19.8	0.0	8.38	630	
0.25	19.7	0.0	8.85	630	19.8	0.0	8.13	630	
0.50	19.7	0.0	8.90	630	19.8	0.0	8.04	630	
0.75	19.8	0.0	8.90	630	19.8	0.0	7.98	630	
1.00	19.8	0.0	8.90	630	19.8	0.0	7.95	630	
1.25	19.8	0.0	8.85	630	19.8	0.0	7.85	630	
1.35	19.8	0.0	5.76	630					
1.50					19.9	0.0	4.26	640	
1.75									

0800hr					21-Jul-03				0820hr
	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	0.0	7.48	630	18.8	0.0	7.70	620	
0.25	19.5	0.0	7.35	630	18.9	0.0	7.57	620	
0.50	19.5	0.0	7.48	630	18.9	0.0	7.45	620	
0.75	19.6	0.0	7.40	630	19.0	0.0	7.35	620	
1.00	19.6	0.0	7.35	630	18.5	0.0	7.26	620	
1.25	19.6	0.0	7.26	630	18.2	0.0	4.78	630	
1.45	19.6	0.0	4.78	630					

21 July 2003. Gage height of 2.55 (morning) and 2.56 (afternoon). Partly cloudy. Air temperature of 15.5°C at 0703 hr and 20.8°C at 1630 hr. Flume inlet at 1.6 ft. Flume outlet at 0.9 feet. Water surface about 0.1 ft above top of flume. Notch cut in top board. Man feeding ducks and gulls at trestle in morning with bag of bread pieces. Saw no mergansers. However, a resident saw 12 mergansers on 20 July.

Station 1: Flume at 1630 hr. Reach 1- 1% surface algae. 30% of bottom covered with algae 0.5- 1.0 ft thick, averaging 0.8 ft; remainder thick film. Phytoplankton bloom in process.

Station 2: Stockton Avenue Bridge at 1606 hr. Secchi depth to bottom. Reach 2- no surface algae. 25% of bottom covered with algae 0.5-2 ft thick; remainder has film.

Station 3: Railroad Trestle at 1550 hr. Reach 3- no surface algae. 25% of bottom covered with algae 0.3- 1.5 ft thick, averaging 0.6 ft. 54 mallards counted in Reach 3.

Station 4: Mouth of Noble Gulch at 1526 hr. No surface algae. 70% of bottom covered by algae 0.5- 2 ft thick, averaging 1.0 ft. 14 of the 54 mallards were roosting on downed cottonwood with 1 pond turtle.

Station 5: Nob Hill at 0900 hr. Water temperature 17.8 °C. Conductivity 600 umhos, Oxygen 8.38 mg/l. Estimated streamflow of 2.25 cfs.

1630hr					21-Jul-03				1606hr
	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	22.5	0.0	8.70	570	22.3	0.0	9.00	660	
0.25	22.3	0.0	8.70	570	22.3	0.0	8.86	660	
0.50	22.2	0.0	8.90	570	22.3	0.0	8.81	660	
0.75	22.2	0.0	9.20	570	22.2	0.0	8.70	660	
1.00	22.2	0.0	9.30	560	22.0	0.0	8.70	660	
1.25	22.1	0.0	8.37	560	22.0	0.0	1.15	660	
1.50									

1550hr					21-Jul-03				1526hr
	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	21.8	0.0	9.50	660	22.8	0.0	8.78	620	
0.25	21.8	0.0	9.35	660	22.2	0.0	8.60	620	
0.50	21.8	0.0	9.10	660	22.0	0.0	8.40	620	
0.75	21.8	0.0	9.10	660	20.8	0.0	8.40	620	
1.00	21.7	0.0	9.77	660	20.5	0.0	8.50	620	
1.13					20.3	0.0	5.85	620	
1.25	21.5	0.0	9.70	660					
1.45	21.5	0.0	3.05	660					

0710 hr					04-Aug-03					0732hr
	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	20.5	0.0	8.60	650		20.6	0.0	9.20	680	
0.25	20.6	0.0	8.90	650		20.8	0.0	9.10	680	
0.50	20.7	0.0	8.62	650		20.8	0.0	9.10	680	
0.75	20.7	0.0	8.45	650		20.8	0.0	9.10	680	
1.00	20.7	0.0	8.55	650		20.9	0.0	9.05	680	
1.25	20.6	0.0	5.55	660		20.6	0.0	5.55	660	

0755 hr					04-Aug-03					0810hr
	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	20.6	0.0	8.30	630		20.0	0.0	7.05	630	
0.25	20.6	0.0	8.35	630		20.1	0.0	6.76	630	
0.50	20.7	0.0	8.10	630		20.1	0.0	6.60	630	
0.75	20.8	0.0	7.82	630		20.1	0.0	6.55	630	
1.00	20.8	0.0	7.50	630		20.1	0.0	6.96	630	
1.20						19.5	0.0	4.48	610	
1.25	20.8	0.0	7.25	630						
1.45	20.8	0.0	4.26	630						

04 August 2003. Gage height of 2.53. Clear then slightly overcast. Air temperature of 16.0 °C at 0710 hr and 29.5°C at 1625 hr. Flume entrance at 1.7 ft. Flume outlet at 0.8 feet. 2 women feeding gulls with 2 bags of bread fragments at Venetian Court in afternoon.

Station 1: Flume at 1625 hr. Reach 1- <1% surface algae. 25% of bottom covered by algae 1-3 ft thick; 40% of bottom covered with algae and pondwood 0.5- 1.0 ft thick and averaging 0.8 ft; remainder film. 2 red-breasted mergansers. One could not swallow a small flounder.

Station 2: Stockton Avenue Bridge at 1605 hr. Reach 2- <1% surface algae. 85% of bottom covered by algae 1-1.5 ft, averaging 1.3 ft thick, and 15% algae and pondweed 1.5- 4 ft averaging 2.0 ft thick.

Station 3: Railroad Trestle at 1543 hr. Reach 3- <1% surface algae. 90% of bottom covered by algae 0.5-1.0 ft, averaging 0.8 ft thick, and 10% algae and pondweed 1.5-4 ft thick.

Station 4: Mouth of Noble Gulch at 1525 hr. 2% surface algae. 80% of bottom covered by algae 0.3-2 ft thick, averaging 0.7 ft. 20% film. 5% surface algae. 5 mergansers adjacent

Shadowbrook Restaurant in morning with 27 mallards, steelhead hitting surface.
Station 5: Nob Hill at 0853 hr. Water temperature of 18.2 °C. Conductivity of 720 umhos. Oxygen 8.74 mg/l. Estimated streamflow of 1.5- 1.75 cfs.

1625 hr					04-Aug-03				1605hr
	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	23.5	0.0	9.30	740	23.5	0.0	9.95	680	
0.25	23.5	0.0	9.50	740	23.5	0.0	10.40	680	
0.50	23.5	0.0	9.70	740	23.2	0.0	10.25	680	
0.75	23.0	0.0	9.80	730	23.1	0.0	10.10	680	
1.00	22.8	0.0	10.30	730	22.6	0.0	10.30	680	
1.25	22.8	0.0	7.45	750	22.5	0.0	7.80	680	

1543 hr					04-Aug-03				1525hr
	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	23.0	0.0	9.05	680	24.2	0.0	9.23	680	
0.25	23.0	0.0	9.95	680	23.4	0.0	9.20	680	
0.50	22.8	0.0	9.82	680	22.8	0.0	9.20	680	
0.75	22.8	0.0	9.65	670	22.0	0.0	10.1	670	
1.00	22.6	0.0	9.65	670	22.0	0.0	10.1	660	
1.20					21.5	0.0	9.05	650	
1.25	22.3	0.0	9.40	670					
1.45	22.3	0.0	7.80	680					

0720 hr					18-Aug-03				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	20.5	0.0	7.90	650	20.2	0.0	7.52	640	
0.25	20.6	0.0	7.90	650	20.5	0.0	7.30	640	
0.50	20.7	0.0	7.90	650	20.6	0.0	7.27	640	
0.75	20.7	0.0	7.88	620	20.6	0.0	7.33	640	
1.00	20.7	0.0	7.83	620	20.6	0.0	7.38	650	
1.25	20.9	0.0	7.80	620	20.6	0.0	4.23	650	
1.40	20.5	0.0	4.96	630					

0802hr					18-Aug-03				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	20.0	0.0	9.25	620	19.5	0.0	6.62	630	
0.25	20.2	0.0	9.18	620	19.7	0.0	6.28	630	
0.50	20.3	0.0	9.18	620	19.7	0.0	6.23	630	
0.75	20.5	0.0	9.20	620	19.6	0.0	6.20	620	
1.00	20.4	0.0	9.20	620	19.2	0.0	6.50	600	
1.20					18.9	0.0	3.26	590	
1.25	20.4	0.0	9.15	620					
1.45	20.4	0.0	5.90	620					

18 August 2003. Gage height 2.50. Overcast morning, sunny afternoon. Air temperature of 14.8 °C at 0720 hr; 23°C at 1540 hr. Flume inlet at 1.3 ft. Flume outlet at 1.0 ft, tide in-coming in afternoon.

Station 1: Fume in at 1647 hr. Reach 1- no surface algae. 15% bottom covered by algae 0.2-04. ft thick, 15% algae and pondweed 2-4 ft thick, averaging 3 ft. 70% thick film in shallows. 5 mergansers feeding near restaurants.

Station 2: Stockton Avenue Bridge at 1630 hr. Secchi depth to bottom. Reach 2- 5% surface algae. 20% of bottom covered by algae 0.2-1 ft thick, averaging 0.5 ft. 40% of bottom with algae and pondweed 2-5 ft thick. 40% of bottom with algal film. Common merganser feeding in pondweed under trestle.

Station 3: Railroad Trestle at 1605 hr. Reach 3- 5% surface algae. 20% bottom covered by algae 0.6-1 ft thick, averaging 0.8 ft. 30% algae and pondweed 2-5 ft thick. Remainder of bottom with thick algal film. 4 mallards and 3 geese moved had moved upstream.

Station 4: Mouth of Noble Gulch at 1539 hr. 2% surface algae. Bottom covered by 60% algae 0.3-1.5 ft thick, averaging 0.7 ft. 30% algae and pondweed 2-4 ft thick, averaging 3 ft. 10% of bottom with film. 2 mergansers roosting on cottonwood. 1 goose, 2 sandpiper-like birds observed. 2 other geese from 2002 did not survive winter.

Station 5 Nob Hill at 0903 hr. Water temperature 17.7°C. Conductivity 620 umhos, Oxygen 7.65 mg/l. Estimated streamflow 1.5-1.75 cfs.

1647 hr			18-Aug-03					1630 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	22.8	0.0	9.00	670	22.6	0.0	9.20	640
0.25	22.8	0.0	9.30	670	22.7	0.0	8.90	640
0.50	22.8	0.0	9.35	670	22.5	0.0	8.35	640
0.75	22.3	0.0	9.50	670	22.2	0.0	8.30	640
1.00	22.3	0.0	9.45	670	22.0	0.0	8.00	650
1.25	22.0	0.0	9.40	670	21.7	0.0	4.80	650
1.40	22.0	0.0	7.32	680				

1605hr			18-Aug-03					1539 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	22.8	0.0	10.20	660	23.0	0.0	8.85	680
0.25	22.8	0.0	9.02	660	22.6	0.0	8.10	680
0.50	22.5	0.0	8.53	650	21.8	0.0	7.70	660
0.75	22.2	0.0	8.38	650	20.8	0.0	9.30	660
1.00	21.8	0.0	8.94	650	20.8	0.0	9.35	660
1.20					20.6	0.0	6.80	660
1.25	21.8	0.0	9.18	650				
1.45	21.9	0.0	5.21	640				

0745 hr			31-Aug-03					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	19.3	0.0	8.40	620	18.8	0.0	8.40	650
0.25	19.3	0.0	8.60	620	19.2	0.0	8.05	650
0.50	19.3	0.0	8.53	620	19.3	0.0	7.80	650
0.75	19.3	0.0	8.43	620	19.3	0.0	7.71	650
1.00	19.5	0.0	8.32	620	19.3	0.0	7.50	650
1.20					19.3	0.0	3.90	650
1.25	19.8	0.0	8.15	620				
1.45	19.8	0.0	5.38	620				

0825 hr			31-Aug-03				0843 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	18.8	0.0	6.90	630	17.8	0.0	6.20	620
0.25	18.8	0.0	6.60	630	17.8	0.0	6.00	620
0.50	19.1	0.0	6.55	630	18.0	0.0	6.03	620
0.75	19.2	0.0	6.56	630	18.0	0.0	6.00	620
1.00	19.2	0.0	6.60	630	18.0	0.0	6.10	610
1.12					18.0	0.0	3.40	610
1.25	19.2	0.0	6.25	630				
1.38	19.2	0.0	3.72	630				

31 August 2003. Begonia Festival Day. Gage height of 2.48. Morning overcast with drizzle. Afternoon sunny. Air temperature of 13.5 °C at 0745 hr.

Station 1: Flume at 0745 hr. Reach 1- 30% of bottom with algae and pondweed 3-4 ft thick and pondweed focused on restaurant side. Remaining 70% algae carpet about 0.6 ft thick. No surface algae.

Station 2: Stockton Avenue Bridge at 0805 hr. Secchi depth to bottom. Reach 2- no surface algae except one 1 ft diameter clump. 70% bottom covered by algae 0.5-1 ft thick, and 30% algae and pondweed clumps 3-4 ft thick – hedge cropped by mallards. Congregation of 47 mallards and one gull.

Station 3: Railroad Trestle at 0825 hr. Reach 3- no surface algae. 60% of bottom covered by algae and pondweed carpet 0.5-1 ft thick, and 40% algae and pondweed in circular clumps 2.5-4 ft thick.

Station 4: Mouth of Noble Gulch at 0843 hr. No surface algae. Pondweed missing within 25 ft periphery of Noble Gulch outlet except near dock to south. Within periphery was a carpet of algae 0.5-1 ft thick. Outside periphery, bottom 90% covered with algae and pondweed 2-3 ft thick. 20 mallards observed, one white in color.

	31-Aug-03							1555 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	0.0		640
0.25					21.0	0.0		650
0.50					21.0	0.0		650
0.75					21.0	0.0		650
1.00					21.0	0.0		660
1.25					20.8	0.0		660

31 August 2003. After the Begonia Festival. Gage height of 2.48. Sunny and windy.

Station 2: Stockton Avenue Bridge at 1555 hr. Secchi depth to bottom. Water samples indicated no detectable hydrogen sulfide in the water immediately after Begonia Festival. Six floats participated with the use of 12 boats and electrically powered propellers to move floats. One float used 2 waders to pull it. A white material sprayed into the lagoon from the tail pipe of a float's car. A larger float lost control with only an electric motor.

0735 hr	1-Sep-03							0754 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	19.8	0.0	9.03	620	19.3	0.0	8.03	625
0.25	19.9	0.0	8.88	620	19.5	0.0	7.95	625
0.50	19.9	0.0	8.73	620	19.8	0.0	7.75	625
0.75	20.0	0.0	8.65	620	19.8	0.0	7.60	625
1.00	20.1	0.0	8.55	620	19.8	0.0	7.65	625
1.20					19.8	0.0	4.45	625
1.25	20.2	0.0	8.55	620				
1.45	19.8	0.0	5.95	640				

0814 hr					1-Sep-03				0830 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	18.9	0.0	6.86	610	17.9	0.0	6.70	600	
0.25	19.2	0.0	7.03	610	18.0	0.0	6.82	600	
0.50	19.2	0.0	6.98	610	18.1	0.0	6.85	600	
0.75	19.2	0.0	6.88	610	18.2	0.0	6.77	600	
1.00	19.3	0.0	6.83	610	18.2	0.0	6.70	600	
1.12					18.2	0.0	4.70	610	
1.25	19.3	0.0	6.65	610					
1.38	19.3	0.0	4.44	620					

1 September 2003. Gage height of 2.48. Foggy. Air temperature of 14.8 °C at 0735 hr and 28.8°Cat 1534 hr.

Station 1: Flume at 1630 hr. Reach 1- 40% of bottom with algae and pondweed 3-4 ft thick and pondweed focused on restaurant side. Remaining 30% algae carpet about 0.5-1 ft thick. 1% surface algae.

Station 2: Stockton Avenue Bridge at 1611 hr. Secchi depth to bottom. Reach 2- 1% surface algae. 60% bottom covered by algae 0.5-1 ft thick, and 40% algae and pondweed clumps 3-4 ft thick. No evidence of Begonia Festival on lagoon bottom.

Station 3: Railroad Trestle at 1556 hr. Reach 3- no surface algae. 60% of bottom covered by algae and pondweed carpet 0.5-1 ft thick, and 40% algae and pondweed in circular clumps 3-5 ft thick. No evidence of Begonia Festival on lagoon bottom.

Station 4: Mouth of Noble Gulch at 1534 hr. No observations made.

Station 5 Nob Hill at 0912r. Water temperature 17.2°C. Conductivity 580 umhos, Oxygen 7.75 mg/l. Estimated streamflow 1.5-1.75 cfs.

1630 hr			1-Sep-03				1611 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	0.0	9.90	640	21.2	0.0	10.7	650
0.25	21.0	0.0	10.2	640	21.2	0.0	10.6	650
0.50	21.0	0.0	10.2	640	21.2	0.0	10.7	650
0.75	20.8	0.0	10.3	640	21.0	0.0	10.4	650
1.00	20.5	0.0	10.3	620	20.4	0.0	10.3	640
1.25	20.3	0.0	10.4	640	20.3	0.0	5.84	640
1.40	20.3	0.0	4.65	660				

1556 hr			1-Sep-03				1534 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	20.6	0.0	10.2	630	21.0	0.0	9.52	600
0.25	20.8	0.0	9.36	630	20.5	0.0	9.55	610
0.50	20.8	0.0	9.30	630	20.2	0.0	9.80	610
0.75	20.8	0.0	9.15	630	20.2	0.0	9.75	610
1.00	20.3	0.0	9.45	630	19.9	0.0	9.80	610
1.12					19.8	0.0	7.78	620
1.25	20.2	0.0	9.14	630				
1.45	20.1	0.0	5.45	630				

0725 hr			15-Sep-03				0750 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	20.8	0.0	9.35	630	20.2	0.0	9.36	620
0.25	21.0	0.0	9.45	630	20.2	0.0	9.10	620
0.50	21.0	0.0	9.35	630	20.5	0.0	8.82	620
0.75	21.0	0.0	9.10	630	20.5	0.0	8.80	620
1.00	21.0	0.0	9.10	630	20.6	0.0	8.68	620
1.25	21.0	0.0	8.95	630	20.7	0.0	4.60	630
1.45	20.8	0.0	6.85	640				

0816hr									0830hr
	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	20.0	0.0	8.20	630	19.0	0.0	6.50	610	
0.25	20.2	0.0	8.18	630	19.1	0.0	6.33	610	
0.50	20.2	0.0	7.92	630	19.1	0.0	6.20	620	
0.75	20.3	0.0	7.50	630	19.2	0.0	6.18	620	
1.00	20.3	0.0	7.45	630	19.1	0.0	6.18	580	
1.05					19.0	0.0	4.97	600	
1.25	20.3	0.0	7.40	630					
1.37	20.3	0.0	4.83	630					

15 September 2003. Gage height of 2.41 in morning and 2.42 in afternoon with incoming tide. 2.50 to top of flume. Overcast. Air temperature of 16.7°C at 0725 hr and 24.2°C at 1534 hr. Flume inlet at 1.3 ft and afternoon outlet at 1.0 ft. No evidence of previous Begonia Festival- no flowers or bottom disturbance observed.

Station 1: Flume at 1630 hr. Reach 1- 1% surface algae. 75% bottom covered by algae 2-4 ft thick with spires, 25% algae and pondweed 3-5 ft thick, in clumps of 3-6 ft in diameter.

Station 2: Stockton Avenue Bridge at 1607 hr. Secchi depth to bottom. Reach 2- 1% surface algae. 65% bottom covered by algae 0.5-2 ft thick with occasional pondweed, 35% algae and pondweed 3.5-5 ft thick with some reaching surface, and in clumps 6-8 ft in diameter.

Station 3: Railroad Trestle at 1550 hr. Reach 3- 1% surface algae. 55% bottom covered by algae 1-2 ft thick with occasional pondweed, 45% algae and pondweed 3.5-5 ft thick in clumps of 6-8 ft in diameter. Appeared that ocean fisher had dumped a dead striped bass 10 inches long and a 1.2 ft long dead shark under the trestle.

Station 4: Mouth of Noble Gulch at 1535 hr. 2% surface algae along margins. 40% bottom covered by algae 1-2 ft thick, and 60% algae and pondweed 3-4 ft thick. 25 Mallards, 1 white and brown duck, 1 goose, 2 Pied-billed grebes, 1 Western grebe, 1 black-crowned night heron perched on downed cottonwood across from the Gulch. Water murky at Gulch outlet in morning.

Station 5: Nob Hill at 0910 hr. Water temperature 17.8°C. Conductivity 780 umhos, Oxygen 7.73 mg/l. Estimated streamflow 1.25-1.5 cfs. Green-back heron observed.

1630 hr					15-Sep-03				1607 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	22.0	0.0	9.60	640	21.7	0.0	10.5	630	
0.25	21.8	0.0	10.45	640	21.6	0.0	9.60	630	
0.50	21.8	0.0	10.45	640	21.4	0.0	9.05	630	
0.75	21.7	0.0	10.10	640	21.2	0.0	9.00	630	
1.00	21.6	0.0	11.0	640	20.9	0.0	8.95	640	
120					20.9	0.0	5.30	650	
1.25	21.6	0.0	10.9	650					
1.45	21.3	0.0	7.10	650					

1550 hr					15-Sep-03				1525 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	21.0	0.0	9.35	660	21.5	0.0	8.21	630	
0.25	21.0	0.0	9.50	660	20.6	0.0	8.35	630	
0.50	21.0	0.0	9.20	660	20.2	0.0	8.28	630	
0.75	21.0	0.0	9.20	660	20.2	0.0	8.20	630	
1.00	20.6	0.0	10.10	660	19.6	0.0	8.45	580	
1.12					19.4	0.0	6.60	620	
1.25	20.5	0.0	8.70	660					
1.45	20.5	0.0	5.35	660					

0759 hr					28-Sep-03					0819 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	18.3	0.0	9.28	590		17.8	0.0	8.50	580	
0.25	18.3	0.0	9.75	590		17.9	0.0	8.75	590	
0.50	18.5	0.0	9.75	590		18.1	0.0	8.62	590	
0.75	18.5	0.0	9.62	590		18.1	0.0	8.62	590	
1.00	18.5	0.0	9.48	590		18.2	0.0	8.48	590	
1.25	18.7	0.0	9.41	600		18.3	0.0	8.36	590	
1.30						18.2	0.0	4.61	600	
1.50	18.2	0.0	5.75	600						

0845 hr					28-Sep-03					0853 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	17.8	0.0	8.50	580		17.1	0.0	6.84	570	
0.25	17.8	0.0	8.23	580		17.2	0.0	6.60	570	
0.50	17.8	0.0	8.23	580		17.2	0.0	6.88	570	
0.75	17.8	0.0	8.05	580		17.2	0.0	6.49	570	
1.00	17.9	0.0	7.98	580		17.2	0.0	6.20	570	
1.12						17.1	0.0	3.46	570	
1.25	17.9	0.0	8.04	580						
1.32	17.9	0.0	4.67	590						

28 September 2003. Upper board on restaurant side of flume previously inserted to raise water surface as discussed between Morrison and Alley. Gage height of 2.50 in the morning and 2.52 in the afternoon. Overcast in the morning and sunny in afternoon. Air temperature of 16.5°C at 0759 hr and 19.6°C at 1615 hr. Flume inlet 1.3 ft. Flume outlet 0.6 ft deep.

Station 1: Flume at 1647 hr. Reach 1- no surface algae. 90% of bottom with algae 2.0 ft thick; 10% of bottom with pondweed and algae 3-4.5 ft thick, averaging 4 ft.

Station 2: Stockton Avenue Bridge at 1630 hr. Secchi depth to bottom. Reach 2- less than 1% surface algae. 40% bottom covered by algae and pondweed clumps 3-4.5 ft thick; remaining 60% mostly algae 2 ft thick with 30% of that with non-clumped pondweed 2.5 ft thick. There are two species of pondweed (*Potamogeton spp.*), one with submerged broad leaves and one with filamentous leaves.

Station 3: Railroad Trestle at 1609 hr. Reach 3- less than 1% surface algae. 70% of bottom

covered by algae 2 ft thick with one type of pondweed interspersed to 2.5 ft thick, and 30% clumped pondweed and algae 3-4.5 ft thick.

Station 4: Mouth of Noble Gulch at 1547 hr. 5% surface algae. 20-25 ft diameter perimeter around Gulch outlet with algae 0.5-1 ft thick. Beyond perimeter- 90% clumped pondweed and algae 2-4 ft thick, averaging 3 ft. Only 2 mallards roosting on downed cottonwood during morning monitoring.

Station 5: Nob Hill at 0925 hr. Water temperature 16.2°C . Conductivity 580 umhos, Oxygen 7.83 mg/l. Estimated streamflow 1.25- 1.5 cfs.

1647 hr	28-Sep-03				1630 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	20.2	0.0	11.15	600	19.9	0.0	12.1	590
0.25	19.2	0.0	11.4	600	19.8	0.0	11.8	590
0.50	19.8	0.0	11.7	590	19.3	0.0	11.52	580
0.75	19.6	0.0	11.65	590	19.0	0.0	11.0	580
1.00	19.4	0.0	13.2	590	18.8	0.0	10.65	580
1.25	19.4	0.0	13.4	590	18.4	0.0	5.80	590
1.50	19.4	0.0	8.90	620				

1609 hr	28-Sep-03				1547 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	19.8	0.0	12.5	600	19.7	0.0	11.6	570
0.25	19.7	0.0	11.35	605	19.0	0.0	11.2	570
0.50	19.5	0.0	11.4	580	18.2	0.0	10.95	570
0.75	18.8	0.0	10.6	580	18.0	0.0	10.5	570
1.00	18.7	0.0	10.8	580	17.8	0.0	11.15	570
1.12					17.8	0.0	5.37	570
1.25	18.6	0.0	11.8	580				
1.45	18.6	0.0	6.80	600				

0717 hr					12-Oct-03				0738 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	0.0	11.7	560	15.3	0.0	11.0	560	
0.25	15.6	0.0	11.6	560	15.7	0.0	11.6	560	
0.50	15.8	0.0	10.9	560	15.9	0.0	11.1	560	
0.75	15.8	0.0	10.8	560	16.0	0.0	10.8	560	
1.00	15.8	0.0	10.8	560	16.0	0.0	10.3	560	
1.25	16.0	0.0	10.6	560	16.1	0.0	5.32	560	
1.50	15.6	0.0	7.76	560					
1.75									

0756 hr					12-Oct-03				0812 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	0.0	11.0	550	14.4	0.0	7.48	540	
0.25	15.3	0.0	10.6	550	14.6	0.0	7.29	540	
0.50	15.5	0.0	10.4	550	14.7	0.0	7.40	540	
0.75	15.5	0.0	10.1	550	14.7	0.0	7.35	540	
1.00	15.6	0.0	10.1	550	14.7	0.0	7.35	540	
1.12					14.6	0.0	4.68	540	
1.25	15.7	0.0	9.78	550					
1.40	15.7	0.0	6.69	560					

12 October 2003. Gage height 2.42. Sunny all day. Air temperature 10.2°C at 0700 hr and 23.8°C at 1607 hr.

Station 1: Flume at 1607 hr. Reach 1- 1% surface algae. 20% of bottom with clumped pondweed and algae 2.5- 4 ft thick; 60% of bottom with algae 0.5-2 ft thick; 20% of the bottom sandy.

Station 2: Stockton Avenue Bridge at 1545 hr. Secchi depth to bottom. Reach 2- 5% surface algae. 60% of bottom covered by algae and clumped pondweed 3- 5 ft thick; 30% of bottom with algae 0.5-3 ft thick; 10% of bottom exposed sand. Coots present at the lagoon. They came later than usual this year.

Station 3: Railroad Trestle at 1528 hr. Reach 3- 3% surface algae. 65% of bottom covered by algae and clumped pondweed 3- 5 ft thick; 35% algae 0.5-2 ft thick. 1 kingfisher and 3 pied-billed grebes observed in afternoon.

Station 4: Mouth of Noble Gulch at 1503 hr. 15% surface algae. 70% of bottom with cluped pondweed and algae 2-3 ft thick; 20% of bottom with algae 0.3-1.5 ft thick; 10% of bottom sandy. Water murky in afternoon. 1 black-crowned night heron and 1 greenback heron observed in the morning.

Station 5: Nob Hill at 0700 hr. Water temperature 12.7°C. Conductivity 530 umhos, Oxygen 7.76 mg/l. Streamflow measured to be 1.91 cfs on 3 October 2003.

1607 hr					12-Oct-03				1545 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	18.3	0.0	13.7	580	18.4	0.0	12.8	580	
0.25	18.2	0.0	14.2	580	18.3	0.0	12.3	580	
0.50	18.2	0.0	14.3	580	18.2	0.0	11.5	580	
0.75	17.9	0.0	14.3	580	17.4	0.0	11.2	580	
1.00	17.7	0.0	15.1	580	17.2	0.0	11.0	580	
1.25	17.7	0.0	15.4	580	16.8	0.0	6.84	580	
1.45	17.5	0.0	10.7	580					
1.75									

1528 hr					12-Oct-03				1503 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	18.5	0.0	14.2	600	19.7	0.0	12.5	580	
0.25	18.0	0.0	14.4	580	18.3	0.0	11.9	580	
0.50	17.5	0.0	14.7	580	17.3	0.0	11.2	580	
0.75	17.2	0.0	14.6	580	16.6	0.0	11.9	580	
1.00	16.8	0.0	15.0	580	16.4	0.0	11.4	580	
1.12					16.3	0.0	5.63	580	
1.25	16.5	0.0	14.3	580					
1.40	16.5	0.0	8.50	580					

0710 hr					27-Oct-03				0725 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	15.5	0.0	12.1	530	15.5	0.0	10.6	530	
0.25	15.5	0.0	11.8	530	15.6	0.0	11.2	530	
0.50	15.5	0.0	11.8	530	15.6	0.0	11.7	530	
0.75	15.5	0.0	11.8	530	15.7	0.0	10.5	530	
1.00	15.5	0.0	11.8	540	15.7	0.0	10.6	530	
1.20					15.6	0.0	6.53	530	
1.25	15.5	0.0	11.4	540					
1.40	15.2	0.0	7.82	550					

0756 hr					27-Oct-03				0810 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	0.0	9.98	540	14.8	0.0	7.80	530	
0.25	15.3	0.0	10.6	540	14.8	0.0	7.50	530	
0.50	15.3	0.0	10.4	540	14.8	0.0	7.42	530	
0.75	15.3	0.0	10.3	540	14.8	0.0	7.48	530	
1.00	15.3	0.0	10.2	540	14.8	0.0	7.48	530	
1.05					14.7	0.0	4.83	530	
1.25	15.3	0.0	9.44	540					
1.33	15.3	0.0	4.76	550					

27 October 2003. Gage height 2.38 in the morning and 2.42 in the afternoon. Sunny all day. Air temperature 15.0°C at 0710 hr and 25.0°C at 1516 hr. Secchi depth to bottom. Warmest afternoon monitored all summer. Other lagoons had massive tidal overwash of saltwater the previous weekend, including San Lorenzo River. None occurred in Soquel Lagoon.

Station 1: Flume at 1610 hr. Reach 1- Surface algae not noted. 50% of bottom with clumped pondweed and algae 3- 4 ft thick; could not observe the bottom. 100+ gulls bathing.

Station 2: Stockton Avenue Bridge at 1556 hr. Secchi depth to bottom. Reach 2- 5% surface algae. 70% of bottom covered by algae and clumped pondweed 3.5- 5 ft thick; 30% of bottom with algae 2 ft thick. More coots present at the lagoon.

Station 3: Railroad Trestle at 1536 hr. Reach 3- 10-15% surface algae. 65% of bottom covered by algae and clumped pondweed 3.5- 5 ft thick; 35% algae 1.5-2 ft thick. Cottonwoods' leaves turning yellow.

Station 4: Mouth of Noble Gulch at 1510 hr. 20% surface algae. 80% of bottom with clumped pondweed and algae 3-3.5 ft thick. Could not see bottom to evaluate algae carpet. 2 mergansers roosting on downed cottonwood.

Station 5: Nob Hill at 0845 hr. Water temperature 14.2°C. Conductivity 530 umhos, Oxygen 9.25 mg/l.

1610 hr					27-Oct-03				1556 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	17.8	0.0	15.1	540	17.8	0.0	15.1	540	
0.25	17.7	0.0	15.7	540	17.7	0.0	15.8	550	
0.50	17.7	0.0	15.3	540	17.6	0.0	15.2	550	
0.75	17.3	0.0	14.8	540	16.8	0.0	12.8	550	
1.00	16.8	0.0	14.4	540	16.5	0.0	11.7	550	
1.25	16.8	0.0	14.2	540	16.2	0.0	6.24	560	
1.50	16.7	0.0	8.70	550					

1536 hr					27-Oct-03				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	18.7	0.0	14.4	560	20.2	0.0	12.0	570	
0.25	17.3	0.0	14.5	560	18.5	0.0	11.2	570	
0.50	16.7	0.0	14.1	550	16.8	0.0	10.6	540	
0.75	16.3	0.0	12.8	540	16.0	0.0	10.1	560	
1.00	16.1	0.0	12.6	540	15.8	0.0	9.72	560	
1.08					15.8	0.0	4.70	550	
1.25	16.0	0.0	9.36	540					
1.37	16.0	0.0	5.12	560					

31 October 2003. Friday at 1630 hr. Gage Height 2.55. Rain the previous night. Water was black with pondweed visible. Could not see bottom. Lagoon had risen 6-8 inches above present level during storm. Morrison stated that there was a problem with algae clogging the new grate on the top of the flume inlet. Morrison had removed 2"x 4" board prior to the storm.

3 November 2003. After discussion between Morrison and Alley, two 4"x 4" boards were removed on either side of flume to allow light to penetrate to the bottom so that photosynthesis may continue to prevent aquatic vegetation death and anoxia.

5-Nov-03								1220 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					12.5	0.0	6.18	420
0.25					12.3	0.0	6.05	420
0.50					12.3	0.0	6.03	420
0.75					12.3	0.0	6.35	450
1.00					10.8	0.0	4.83	460

5 November 2003. Secchi depth just to the bottom. Oxygen depletion detected, but levels sufficient for steelhead. Morrison agreed with Alley to leave boards out to allow light to penetrate to the bottom, promoting photosynthesis and preventing anoxia. Rain forecasted for 6 November.

7 November 2003. Morrison left message with Urquhart of CDFG that all efforts would be made to retain the sandbar, but that sandbar breach was likely under sustained storm conditions.

8 November 2003. Saturday evening at 2100 hr. Morrison contacted Alley. Rainstorm underway. Raining steadily in Brookdale. Morrison had just removed 4, 4"x 4" boards on Venetian Court side of flume inlet and 3 such boards on the restaurant side. Wind-blown rain along coast since 1800 hr. Rain continued harder, and sandbar breached on its own through wide excavated notch by 2230 hr. By 2300 hr, stream channel through the beach was estimated 20-30 ft wide through the beach according to Public Works staff, Ed Garcia. Morrison notified Urquhart of CDFG that the sandbar had breached. Sandbar remained open for the winter.

APPENDIX B.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 2003.

DRAIN LINE TEST FOR RESTAURANTS
CONTIGUOUS WITH SOQUEL CREEK

RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS	SIGN OFF
BEACH HOUSE 207 ESPLANADE MAUREEN WILKS (831) 475-5846	5/13/2003 JANET	5/14/2003 OK DJK		5/14/2003 OK DJK
RIC'S 209 ESPLANADE LAURIE & MARCIE (831) 768-9220	5/13/2003 TIFFANY	5/14/2003 OK DJK		5/14/2003 OK DJK
PIZZA MY HEART 209-A ESPLANDE CHUCK HAMMER (831) 426-2511	5/13/2003 HILBERTO	5/14/2003 OK DJK		5/14/2003 OK DJK
FOG BANK 211 ESPLANDE LINDA BENNENT (831) 462-1881	5/13/2003 JESSE	5/14/2003 OK DJK		5/14/2003 OK DJK
PARADISE BAR & GRILL 215 ESPLANADE STEVE YATES (831) 425-2625	5/13/2003 DAVID	5/21/2003 OK MW		5/21/2003 OK MW
ZELDA'S 203 ESPLANADE ED (831) 475-4900	5/13/2003 ED	5/14/2003 OK DJK		5/14/2003 OK DJK

Appendix C. Water Quality Testing Results for Hydrogen Sulfide in the Lagoon Immediately Following the Begonia Festival.

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

Tel: 831 724-5422
FAX: 831 724-3188

175931-8-4013

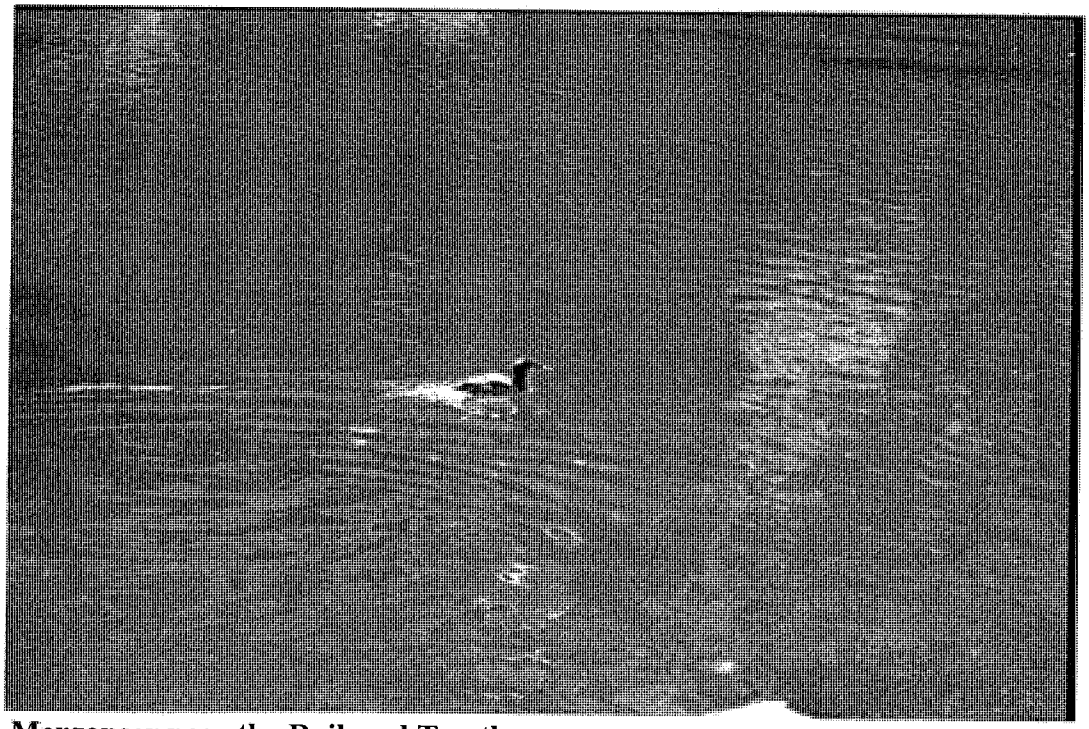
D.W. Alley Associates
P.O. Box 200
Brookdale CA 95007

5 SEPT 03

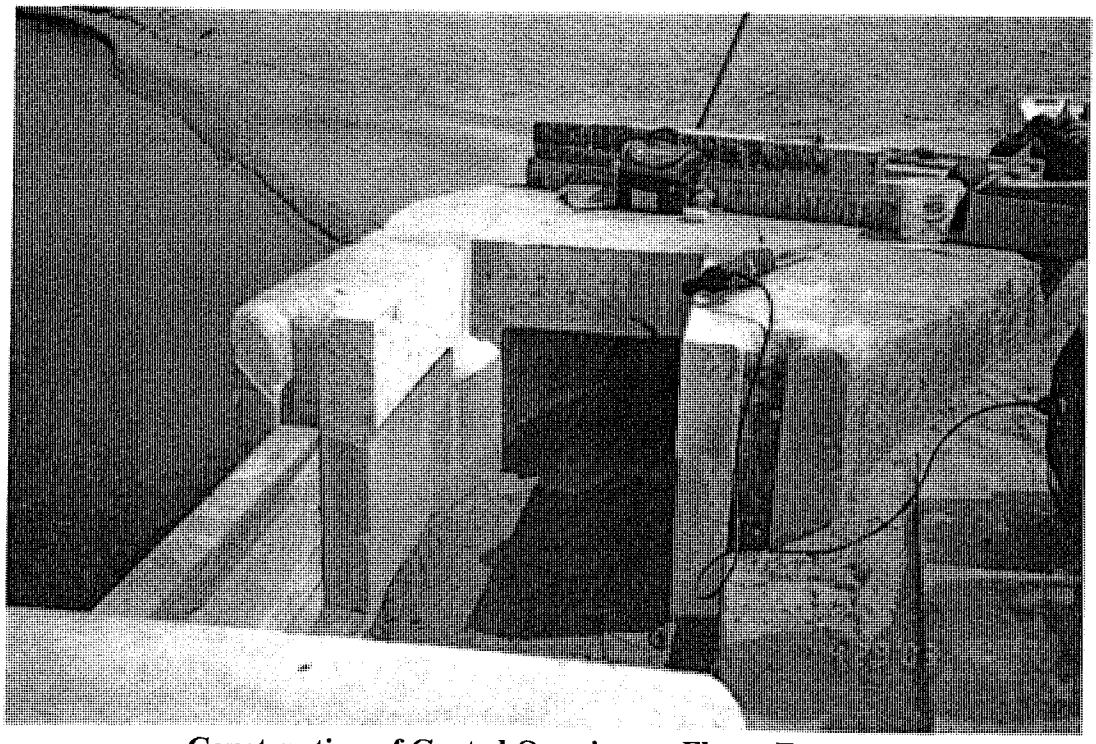
MATERIAL: Water samples received 02 September 2003
IDENTIFICATION: Samples collected 8/31/03
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):

Sample Identification	Dissolved Sulfide
R-1B Before (1000)	< 0.1
R-1D After (1500)	< 0.1
R-2B Before (0950)	< 0.1
R-2D After (1455)	< 0.1

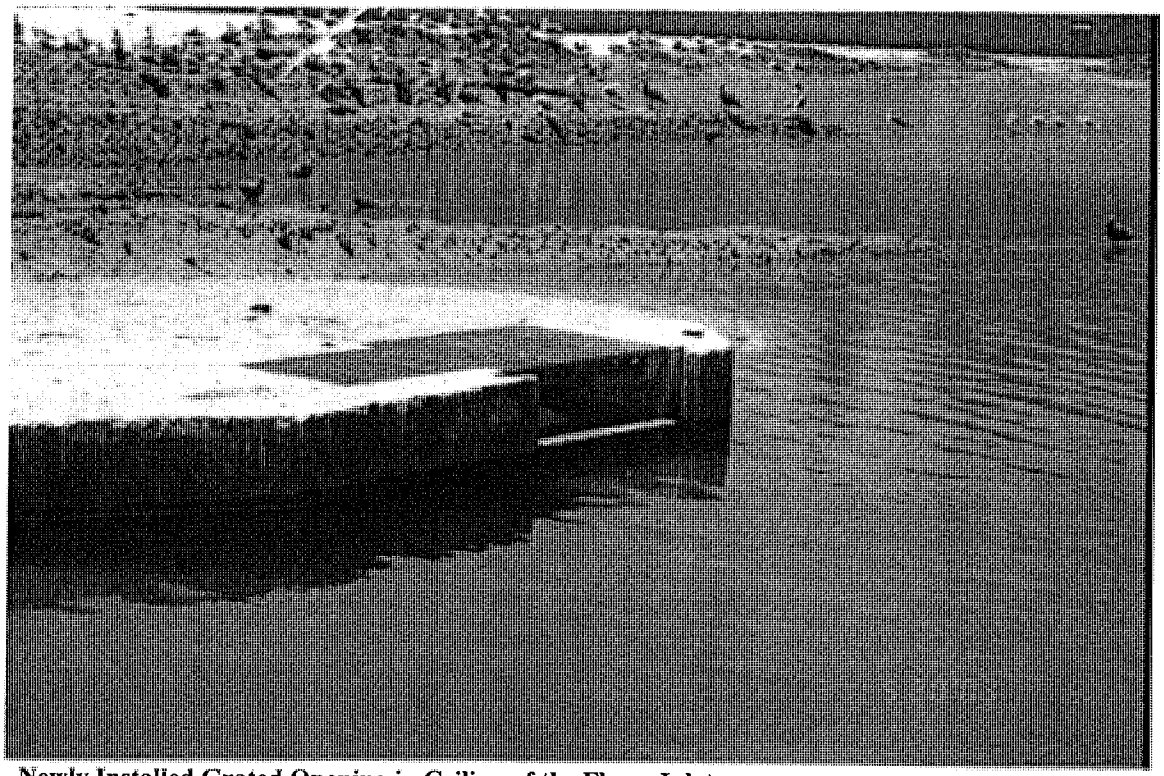
APPENDIX D. PHOTOGRAPHS.



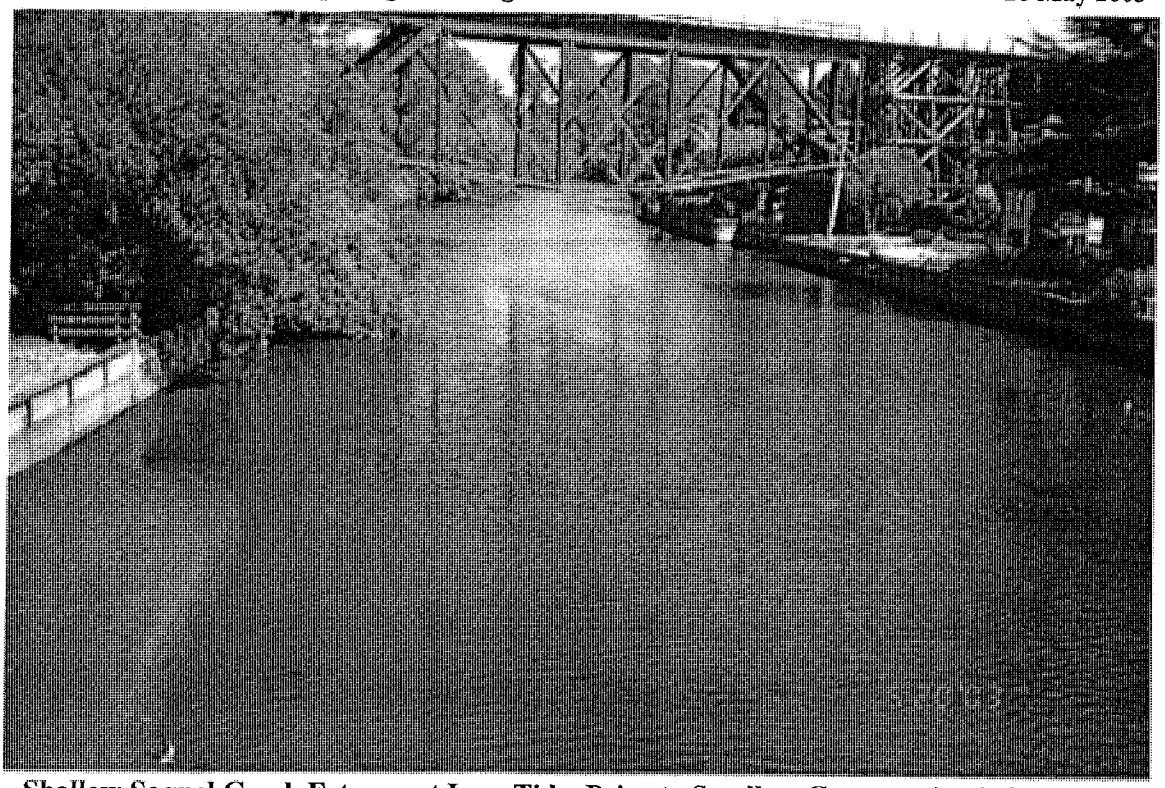
Merganser near the Railroad Trestle **18 August 2003**



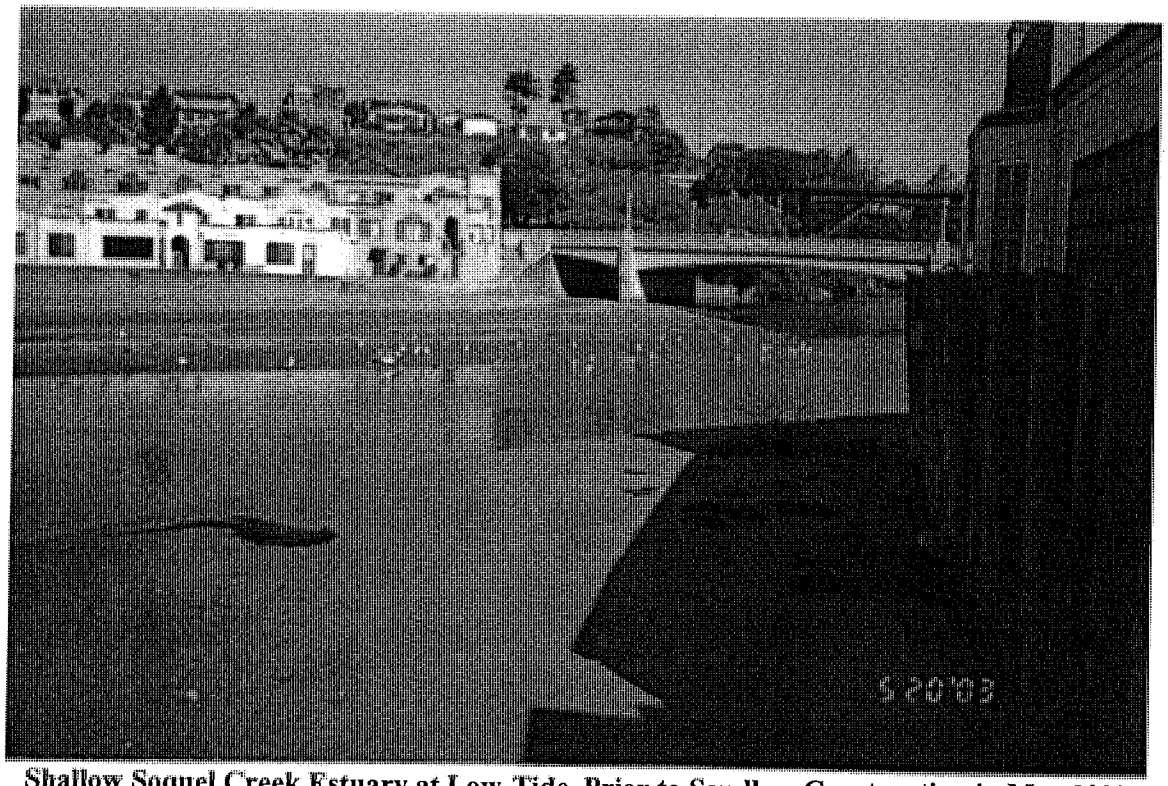
Construction of Grated Opening on Flume Entrance



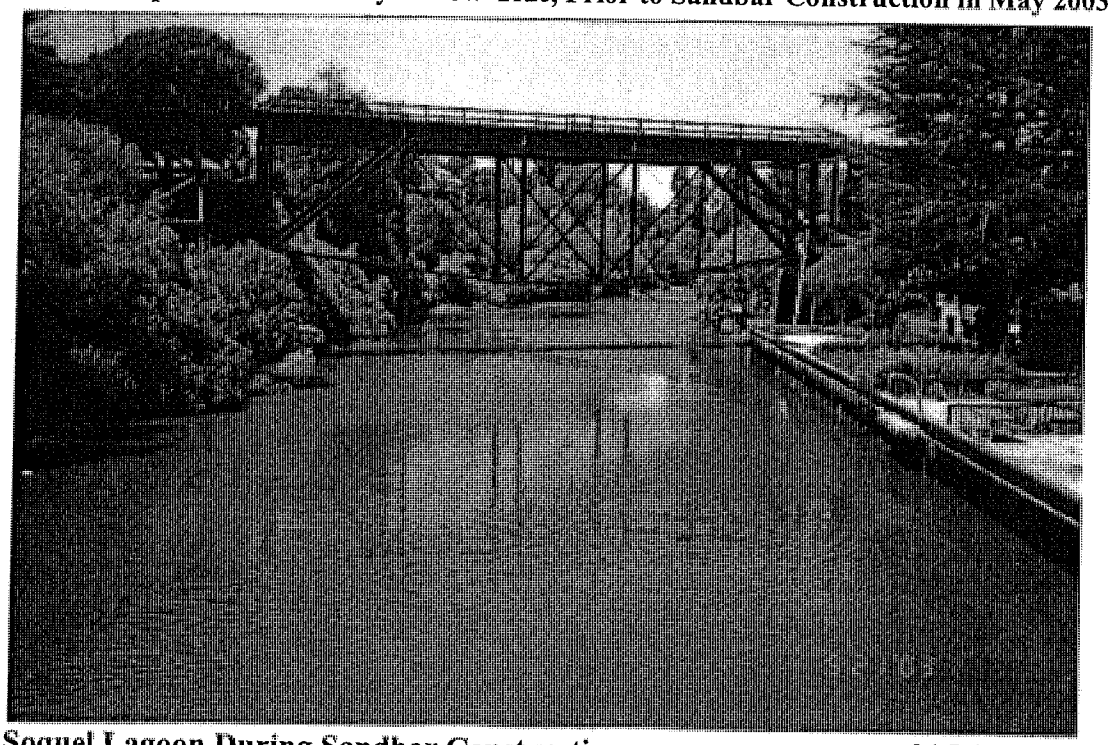
Newly Installed Grated Opening in Ceiling of the Flume Inlet **20 May 2003**



Shallow Soquel Creek Estuary at Low-Tide, Prior to Sandbar Construction in May 2003

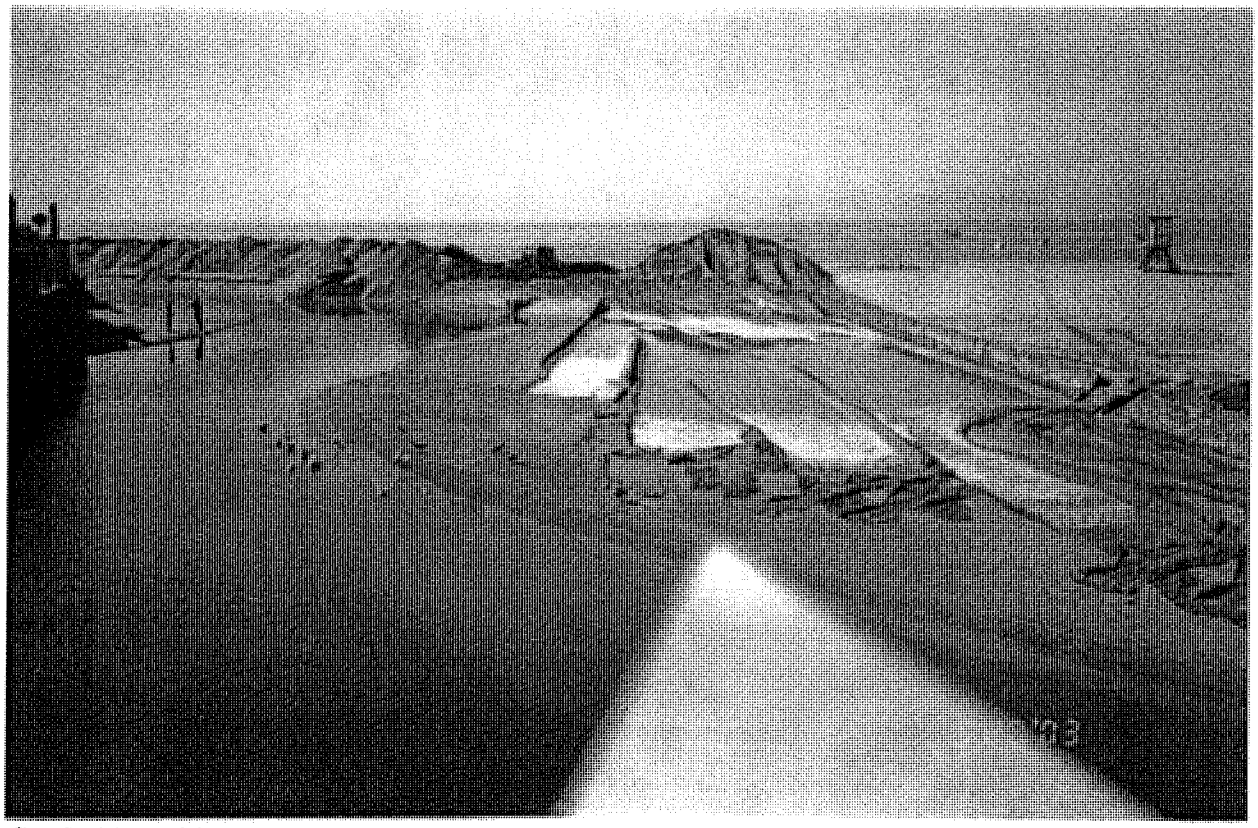


Shallow Soquel Creek Estuary at Low-Tide, Prior to Sandbar Construction in May 2003



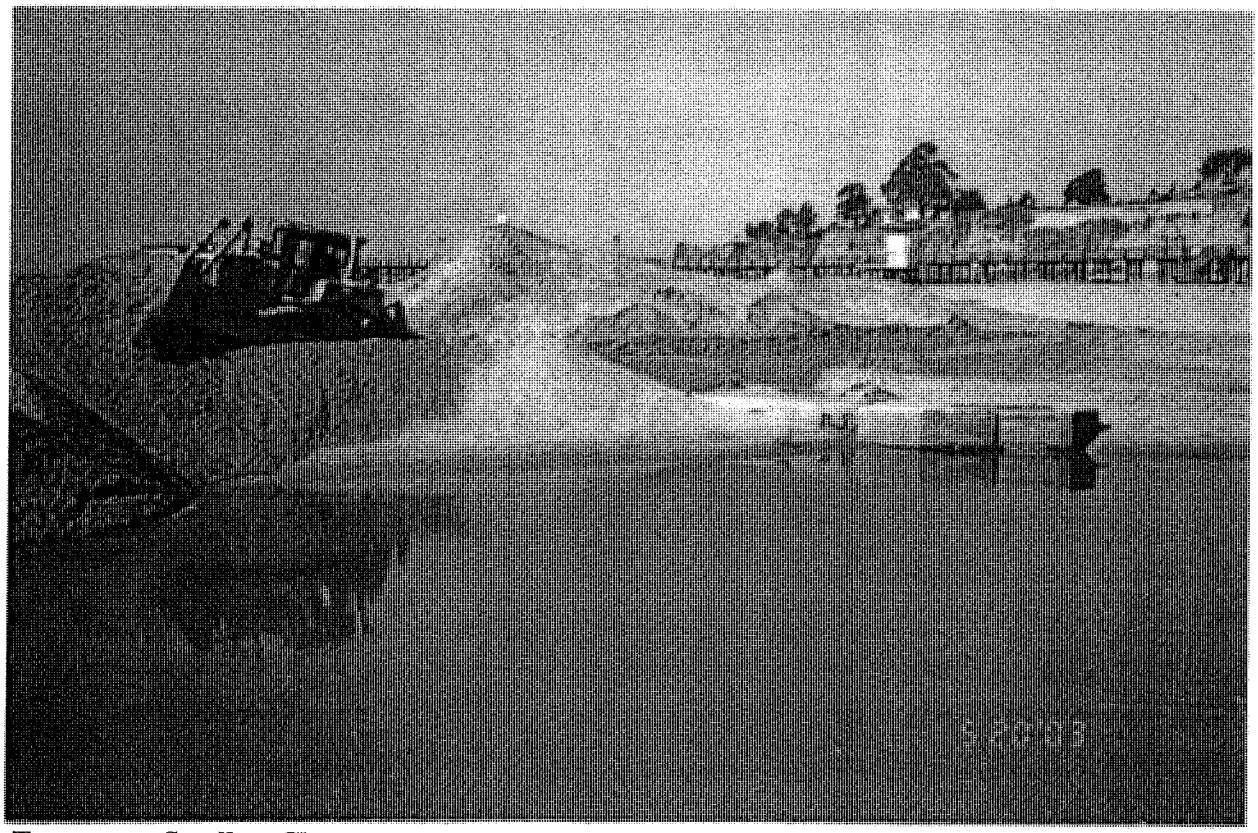
Soquel Lagoon During Sandbar Construction 21 May 2003

Upper Soquel Lagoon During Sandbar Construction **22 May 2003**

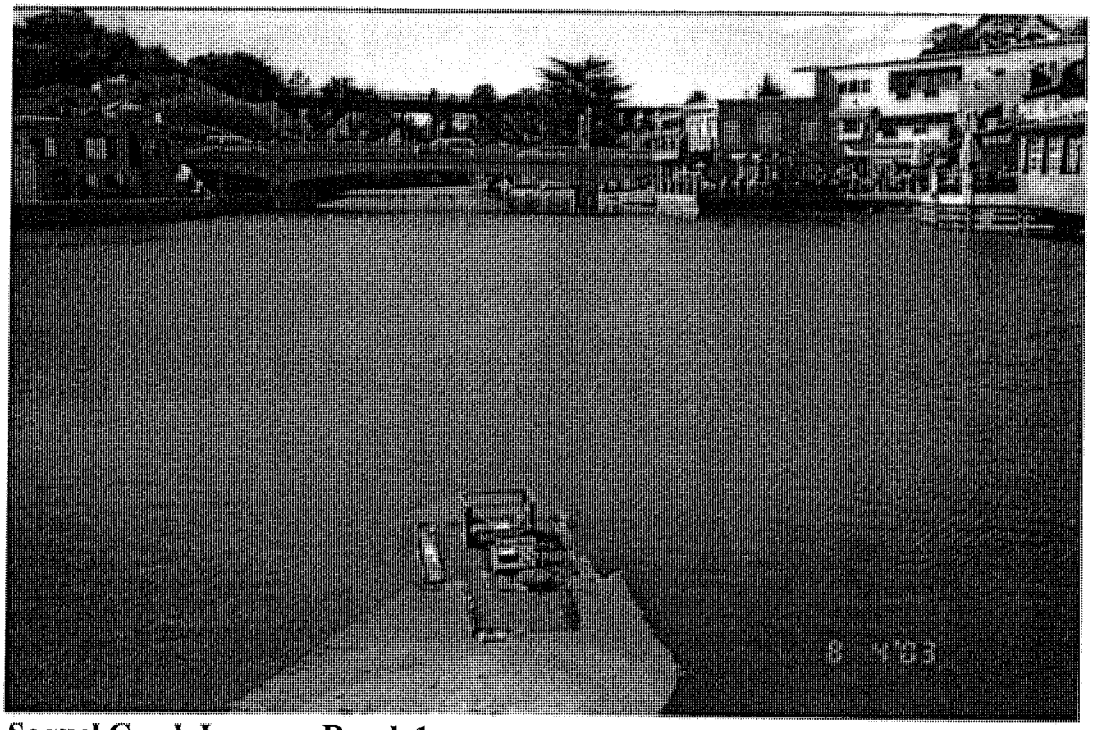


Stockpiling of Sand and Deepening of Reach 1 **20 May 2003**

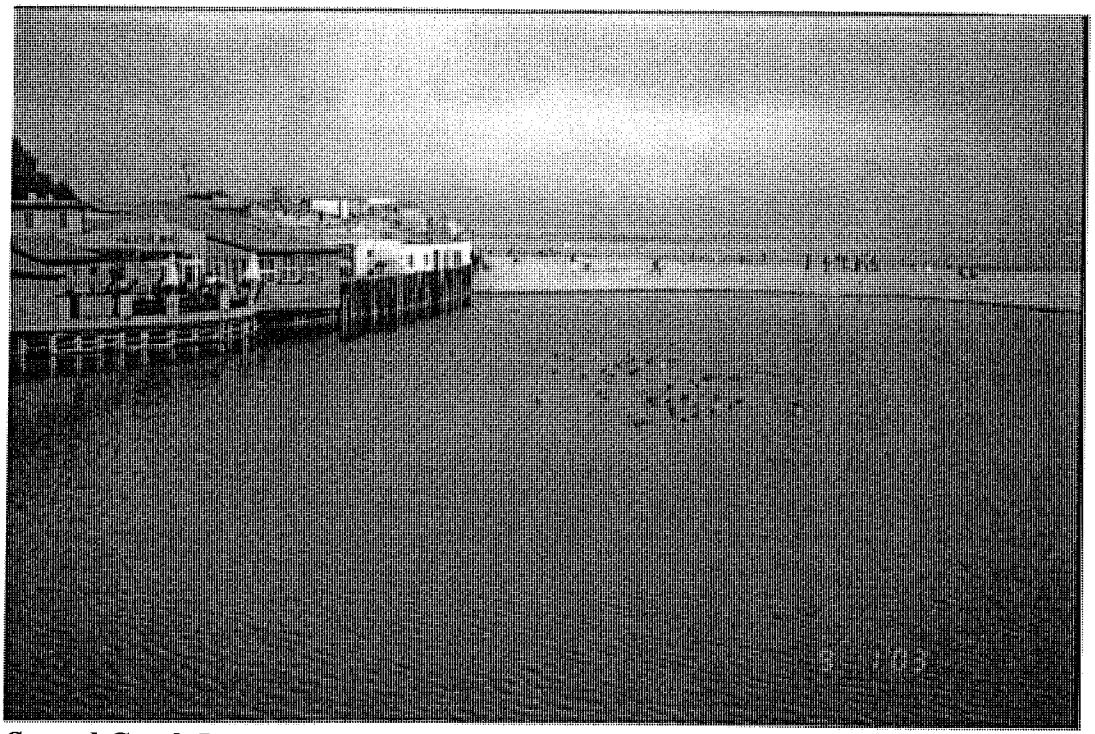
Preparation of the Flume Inlet Prior to Lagoon Closure **22 May 2003**



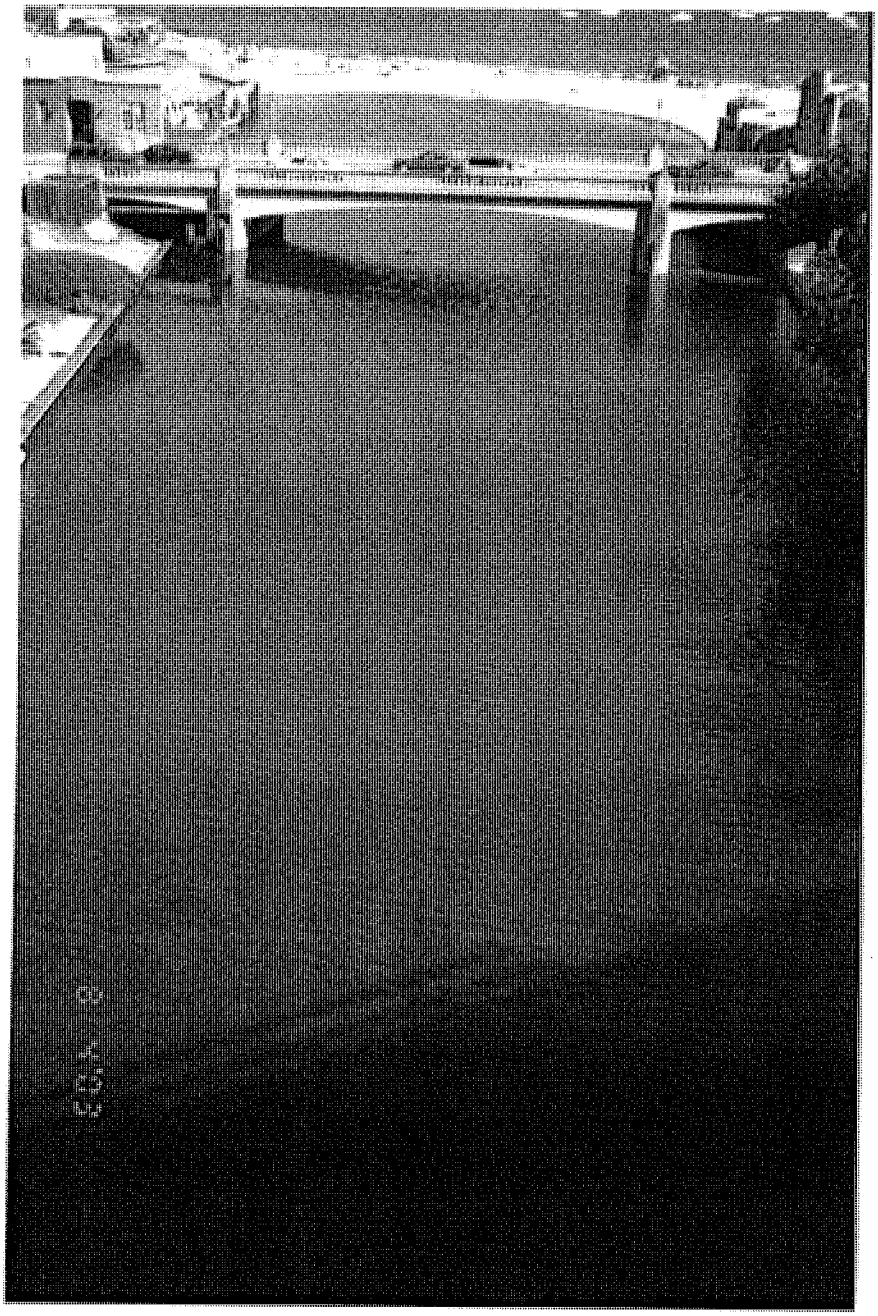
Temporary Sandbar Closure **20 May 2003**



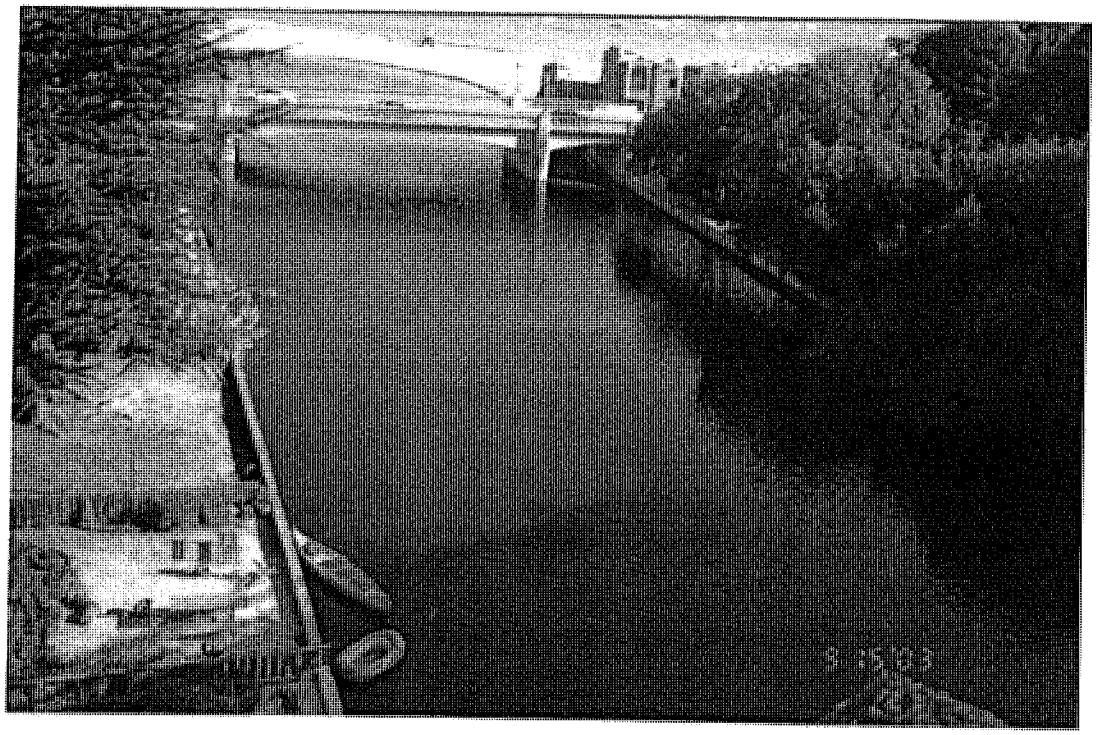
Soquel Creek Lagoon- Reach 1 4 August 2003



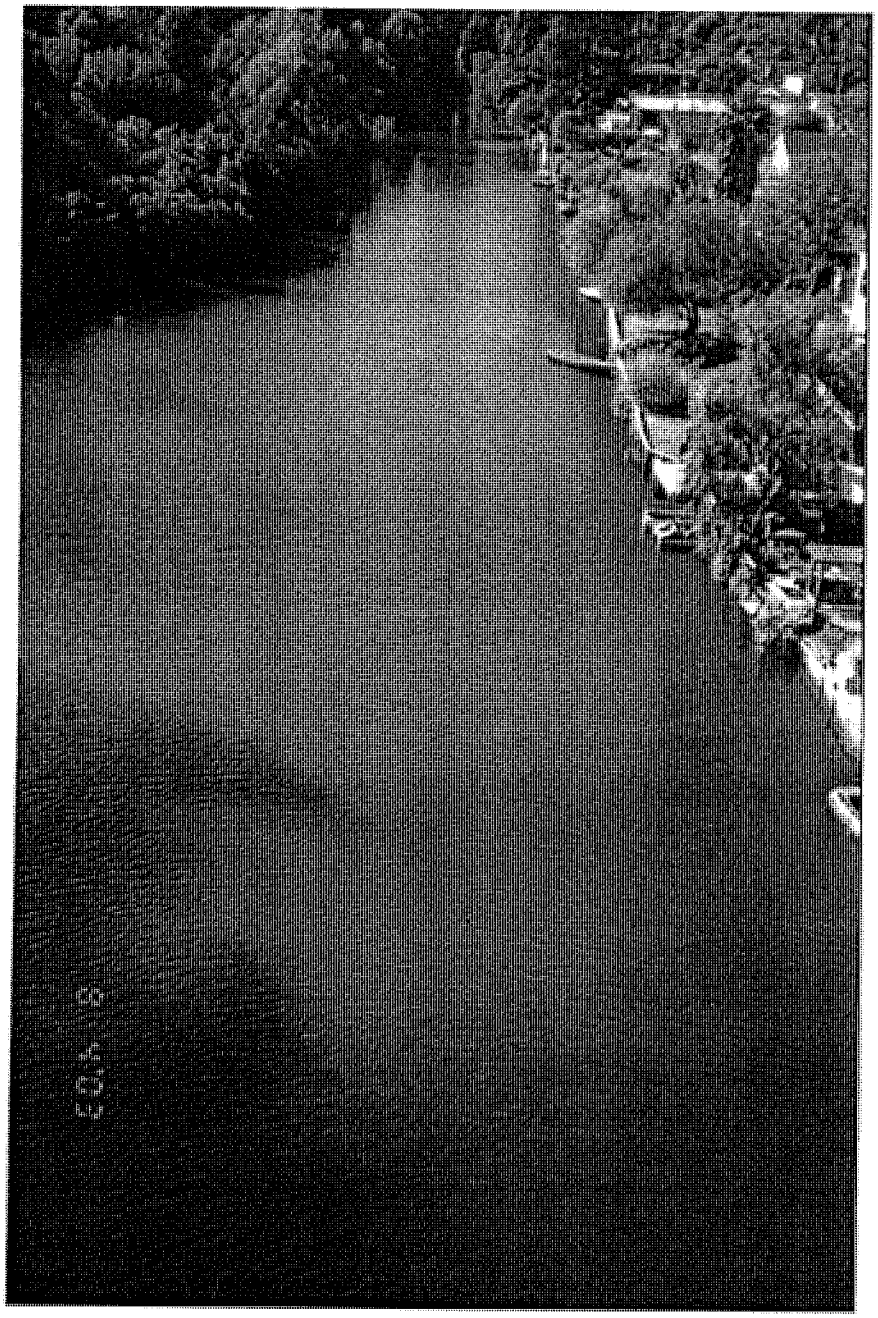
Soquel Creek Lagoon- Reach 1 1 September 2003



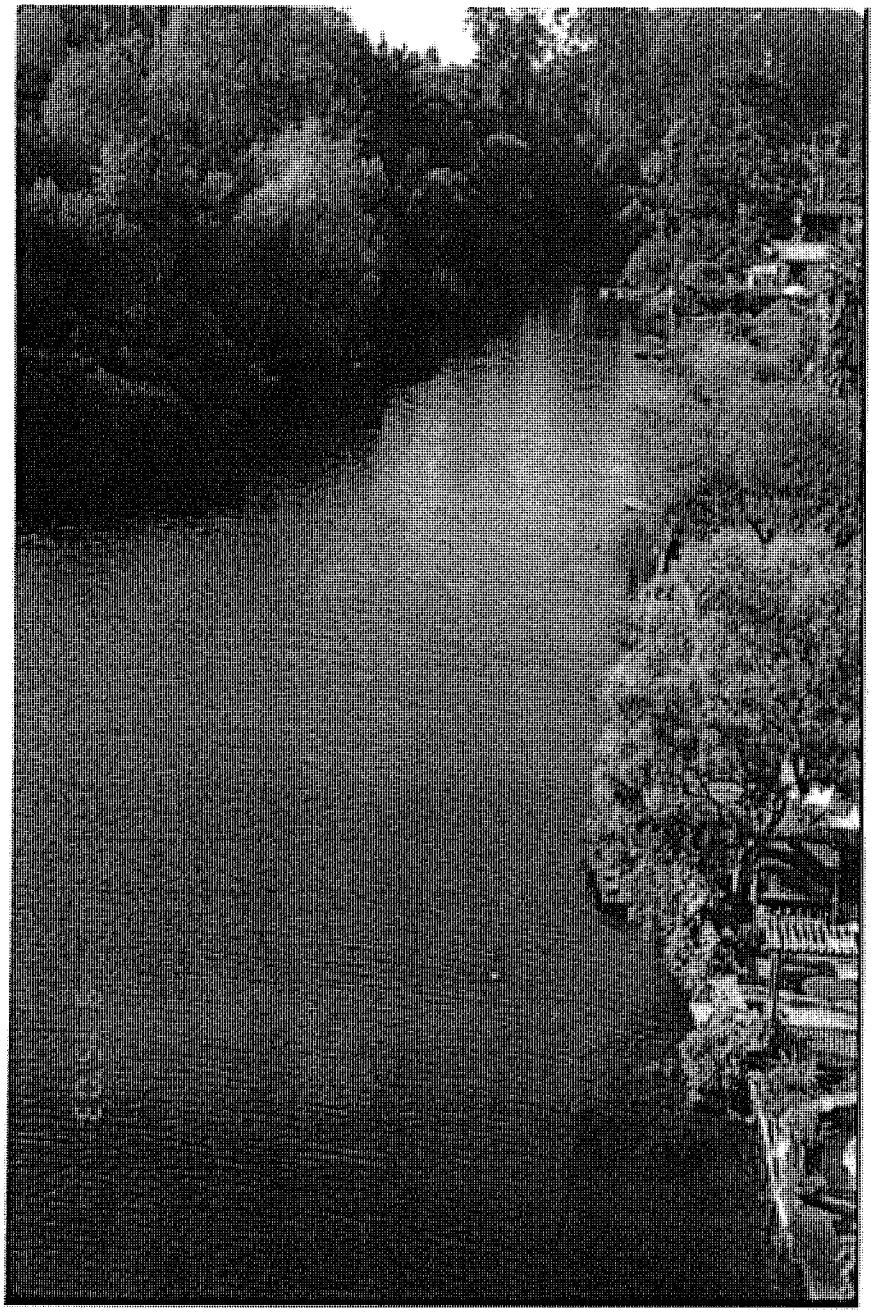
Soquel Creek Lagoon- Reach 2 (Foreground) 4 August 2003



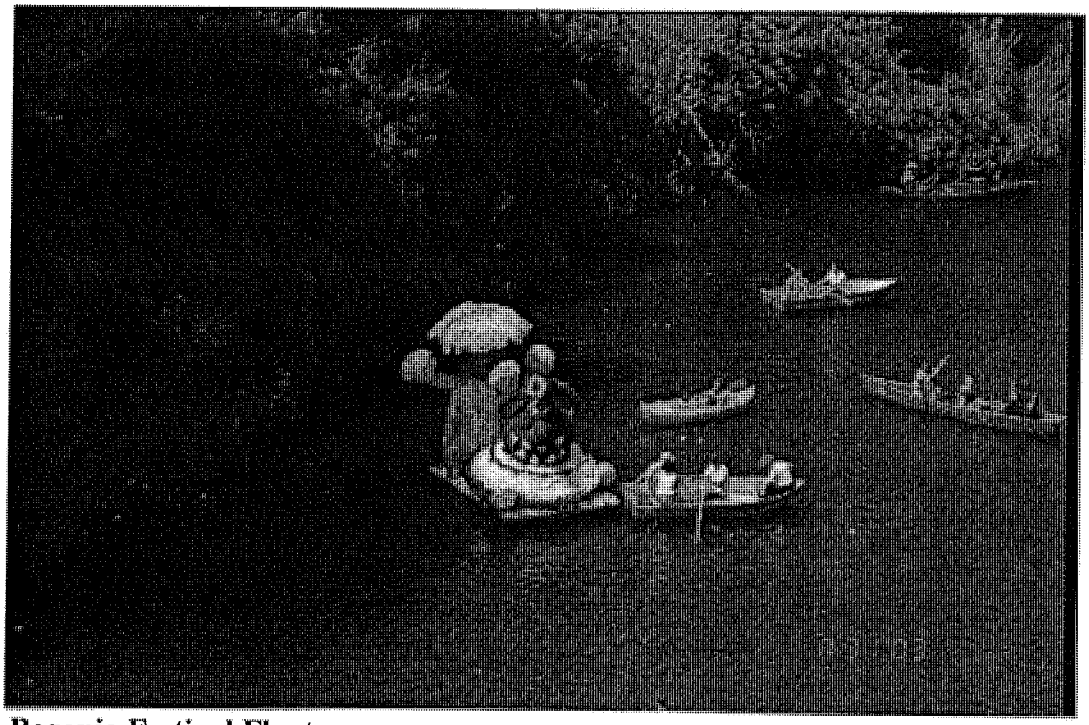
Soquel Creek Lagoon- Reach 2 with Pondweed Clumps **15 September 2003**



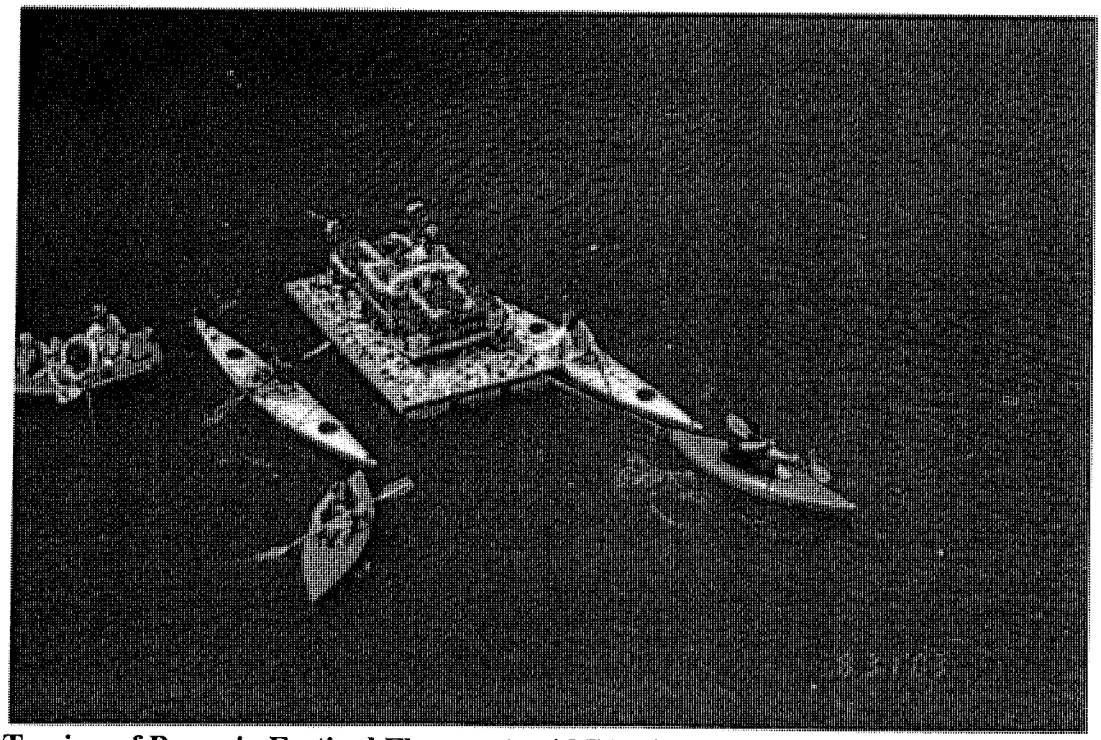
Soquel Creek Lagoon- Reach 3 **4 August 2003**



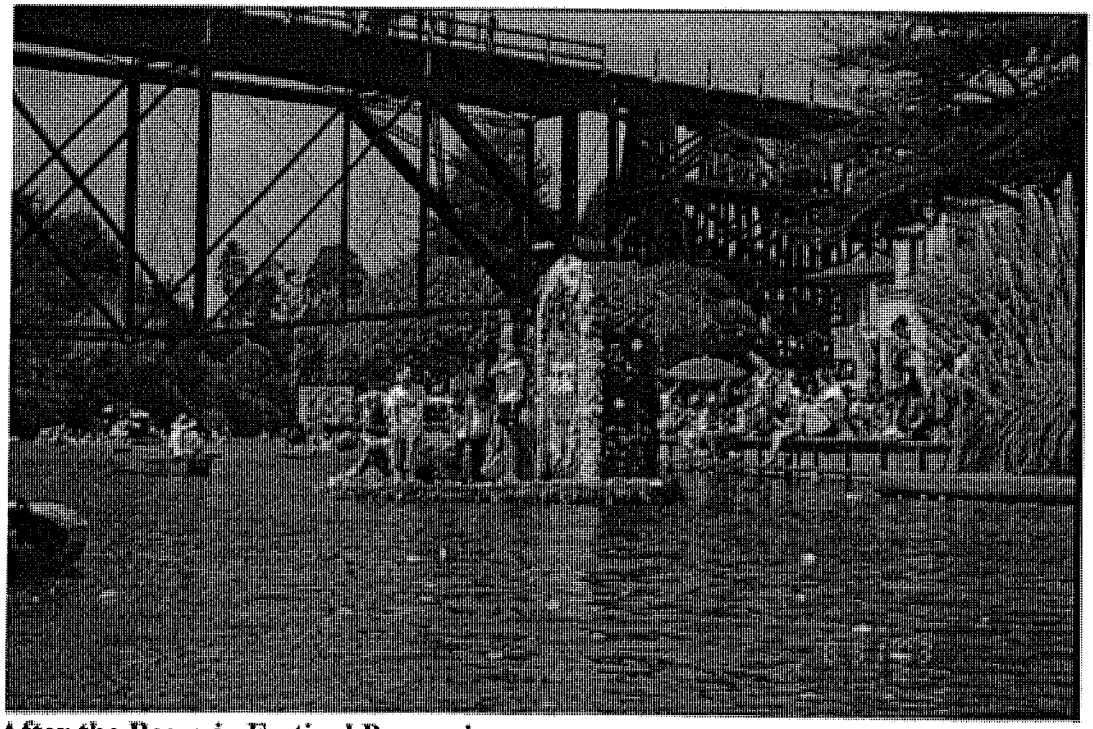
Soquel Creek Lagoon- Reach 3 with Pondweed Clumps 15 September 2003



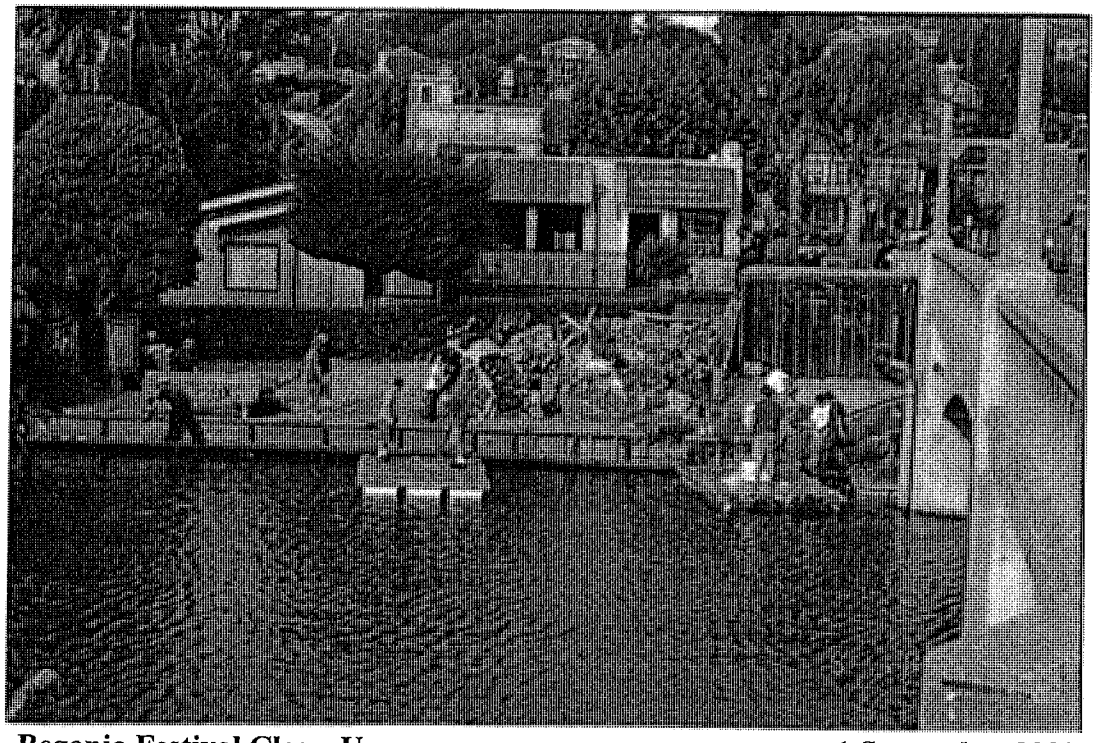
Begonia Festival Float **31 August 2003**



Towing of Begonia Festival Float to Avoid Wading **31 August 2003**



After the Begonia Festival Procession **31 August 2003**



Begonia Festival Clean-Up **1 September 2003**