SOQUEL CREEK LAGOON MONITORING REPORT, 2002

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Prepared for

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Figures (continued)

List of Figures (continued)

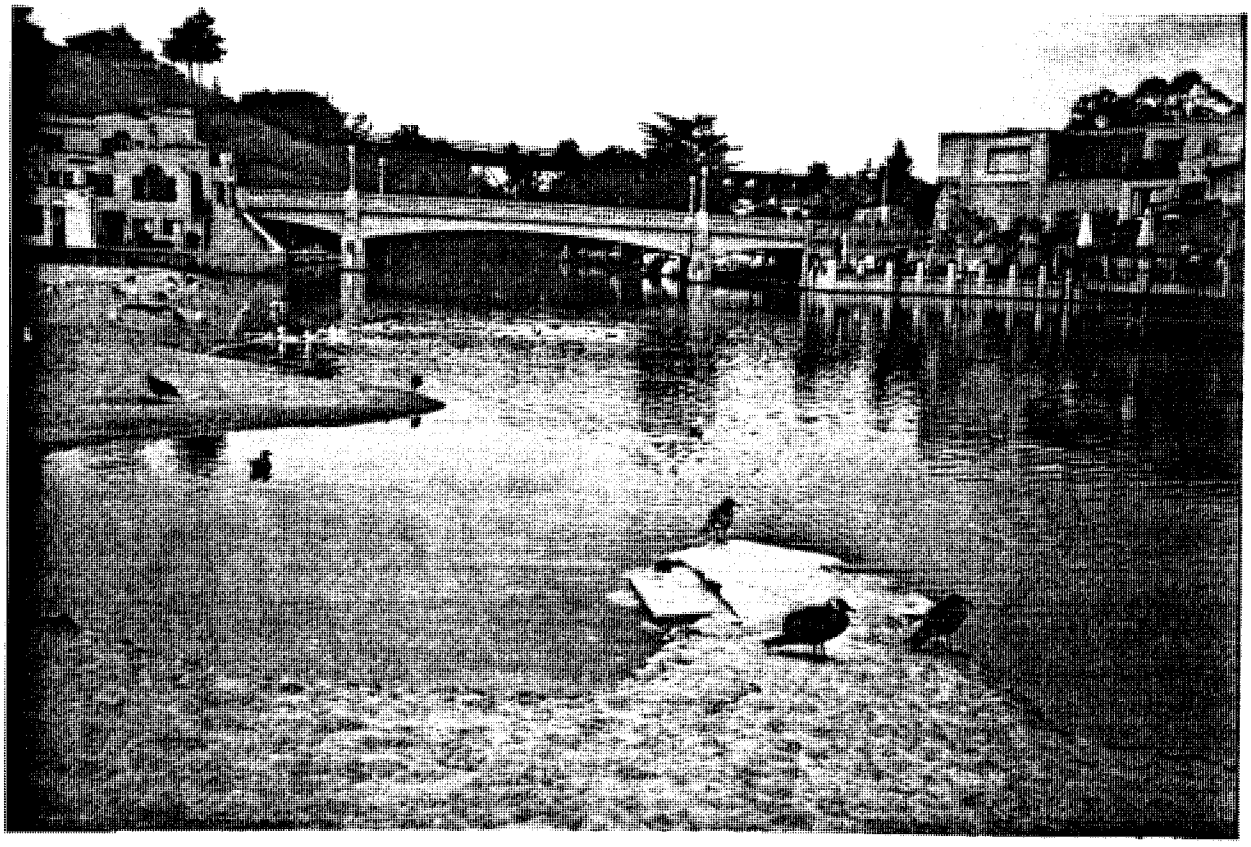
List of Figures (continued)

SOQUEL CREEK LAGOON MONITORING REPORT

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 Cary Oyama for helping with the fish relocation during sandbar construction. He has been an important man for many years in accomplishing what is needed during sandbar construction. We always appreciate his positive attitude and energy that he brings to the process. The Begonia Festival organizers and other volunteers effectively removed flowers after the Begonia Festival in September. We thank Nels and Susan Westman for the loan of their boat for fish censusing in October.

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. This was the twelfth year of 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

When the estuary periphery and lateral channel across the beach were sampled before sandbar construction on 21 May 2002, the fish captured in the lateral channel included staghorn sculpin (*Leptocottus armatus*) juvenile steelhead (*Oncorhynchus mykiss*) and threespine stickleback (*Gasterosteus aculeatus*). Many male sticklebacks were in spawning coloration. The diversity of fish species in the lateral channel across the beach was similar to past years. The fish density in the lateral channel was greater than previous years. No tidewater gobies (*Eucyclogobius newberryi*), prickly sculpins (*Cottus asper*) or juvenile Sacramento suckers (*Catostomus occidentalis*) were detected in the estuarine lateral channel.

Passage for steelhead smolts was provided during the out-migration season in 2002. The 2002 steelhead population estimate in fall was more than twice the previous year's estimate at 1,042 juveniles +/- 84. Other species captured in October were staghorn sculpin, Sacramento sucker, threespine stickleback and a striped bass (*Morone saxatilis*) for the first time. No tidewater gobies were detected in 2002, with the last detection occurring in 1997 before the El Niño storms of 1997-98. The lagoon sandbar breached on 11 November from tidal overwash after a notch had been cut. The flume was moving water at full capacity at the time.

Habitat conditions in the 2002 lagoon followed a drier winter than 2001, with summer baseflow similar to 2001, based on visual estimates. Streamflow at the Grange upstream was 1.28 cubic feet per second (cfs) in late September 2002 compared to 1.58 cfs in late October 2001. Inflow remained between 1 and 2 cfs at the least, which is much higher than drought conditions. Lagoon water temperature was much cooler than in 2001 without the tidal overwashes that occurred in 2001. However, the 2002 lagoon was generally warmer than in 1998-2000, although the lagoon in 2000 was especially warm in June due to tidal overwash. The median size for young-of-the-year steelhead was less in 2002 than in 2001, despite the reduced metabolic demand in 2002 resulting from cooler water temperature. However, there were twice as many juveniles in 2002, increasing the competition for food. The median size for juvenile steelhead was the lowest in the last 5 years at 105-109 mm Standard Length. Lagoon water temperatures were warmer than that of stream inflow in 2002 as had been the case in 2001. The reverse was true in 2000. However, the stream always cools down more than the lagoon at night.

Daily *minima* in the lagoon were consistently warmer than the stream above in 1999-2002. The daily *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2002, but not in 2000. The daily stream temperature fluctuated more in the stream than the lagoon. In the 2002 lagoon, 90% of the complete days measured (86 of 96 days- 3 July- 5 October) met the management goal of early morning temperatures less than 20°C. Only 2% of the days (2 of 96 days) did not meet the management goal of maximum daily temperatures below 22°C.

In analyzing temperature data from the 6 data loggers throughout the water column, results were consistent with temperature data collected at monitoring stations over the past 12 years. There was no thermocline, with complete mixing of the water column. Water temperature cooled

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 2002. The daily difference between the maximum daily temperature of the shallowest and deepest probes in 2002 ranged from zero to 1.15°C (2.06°F). The temperature difference through the water column at the minimum daily temperature was much less, ranging from zero to 0.38°C (0.69°F). Juvenile steelhead likely spent most of their time near the bottom, except when feeding on emerging aquatic insects.

The most significant water temperature differences between days during the summer likely resulted from differences in water temperature of stream inflow on those days. There was a warm period of 7 days in the first half of July when daily maxima near the lagoon bottom were above 21.3°C and even above 22°C on one day (**Figure 4e**). This warm period was then followed two days later by a relatively cool period of 6 days in mid-July when daily maxima near the lagoon bottom were mostly around 19.4°C, with two of the days going as high as 19.8°C. Regarding the stream inflow temperature, during the 7-day warm period the maximum daily water temperature ranged mostly from 20.2 to 21.3°C (although one day it reached only 19.4°C), with several days around 20.6° (**Figure 5e**). In the ensuing cool period, daily maxima in the stream ranged mostly between 18.7°C and 19.1°C, with one day's maximum only reaching 17.5°C. A similar cycle occurred with a warm period in the first half of August followed by a cool period the last half of August. This may indicate that foggy or overcast days may have a significant effect on 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°C (3.6°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 effect of sunny days without overcast would be somewhat mediated.

The creek site near Nob Hill in 2002 was the coolest of the past 4 years for July through September. At the 2002 creek site for the same 96 days measured in the lagoon, only 4 days (4%) failed to meet the management goal of no more than 4 hours a day at greater than 20°C. In 2002, one day (1%) had temperatures greater than 70° F. At the 2001 creek site, 11 days (10%) had temperatures greater than 70° F (41 days (51%) in 2000; 26 days (41%) in 1999 (**Figure 6b**)). At the 2002 stream site, 11 days (11%) had temperatures above 68°F. At the 2001 stream site, 25 days (23%) had temperatures above 68°F (45 days (56%) in 2000). With a water temperature goal of average weekly temperature of 16.7° C (62° F) for coho salmon, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

As is typical in Soquel Lagoon, algae and pondweed became dense in August and continued to be through October. Pondweed was first noted in mid-July as it was in 2001, about 1.5 months after sandbar construction. This was earlier than in 2000. Very little algae reached the surface in 2002. With the development of plant life in the lagoon comes the threat of low oxygen levels at dawn after nights of high cell respiration that uses oxygen. However, oxygen levels remained "fair to "good" throughout the summer. Water quality from Noble Gulch appeared to remain better than in 2000 and earlier, as no gray water was detected during monitoring. No gray water was detected in 2001, either. Algae concentrations were higher at the mouth of Noble Gulch than elsewhere in Reach 3, indicating a continuing nutrient input from Noble Gulch.

The lagoon near the beach was closed to human contact due to bacterial levels above the maximum acceptable level, though bacterial levels in the lagoon and along the beach were lower than past years until the fall rains came (**Ed Morrison, pers. communication**). The reason for the reduction is unknown. 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. The refuge cans situated on the beach have no lids. The gulls have excellent access to refuse that they drag 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.

New Recommendations and Those Not Yet Implemented

1. Replace 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. (Grant money has been secured to repair the flume.)

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

6. 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.

7. The flume inlet should be improved. The plan to drill a large hole in the top of the flume to drain water after the steelhead smolt out-migration and during small storm events in fall will be an improvement.

8. 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.

9. Regarding the Begonia Festival, 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.

10. If wading during the Begonia Festival is requested, perform more detailed water quality monitoring before and after the Begonia Festival to determine the effects of wading. Hydrogen sulfide levels may be measured.

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

12. 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.

13. In anticipation of a sandbar breach in the fall, the notch in the sandbar should be cut slightly lower than the piling bolt. *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.

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

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 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

On 21 May 2002, 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. The seine was 30 feet x 4 feet x 1/8-inch mesh. We decided again this year to have the lateral channel blocked off from the main estuary with a sand berm prior to fish rescue because the lateral channel was too deep and wide to allow effective seining. The lateral channel was allowed to partially dewater before seining began. In the upper lateral channel, the accumulation of sea grass and kelp was too thick to allow seining throughout. Approximately 80% of the lateral channel was seined over a period of several hours. As the channel became mostly dewatered, fish were rescued by dip net as a final effort. Captured fish were transported to the estuary in a water-filled bucket. The fish captured in the lateral channel included approximately 1,000 juvenile staghorn sculpin (*Leptocottus armatus*), approximately 300 threespine stickleback (*Gasterosteus aculeatus*) and 14 juvenile steelhead (*Oncorhynchus mykiss*). The lateral channel had a flowing stream section at its lower end where juvenile steelhead were captured. The upper end had a deeper, pooled section where the staghorn sculpin and threespine stickleback were captured. No steelhead were detected in this stagnant section. Many male sticklebacks were in spawning coloration. There were obvious signs of poor water quality in the sea grass as sticklebacks swam near the surface and staghorn sculpins swam into the shallow margin of the channel where they could be easily captured. An estimated 5-10% of the staghorn sculpins and threespine stickleback likely perished in the pooled area where seining was not possible. No steelhead mortality was observed. No tidewater goby (*Eucyclogobius newberryi*) were observed.

Fishes were placed in a live car after each seine haul. Fishes captured in the lateral channel were relocated in the main estuary. The lateral channel was observed continually as it became dewatered until no more fish were seen. No tidewater gobies were found in the lateral channel in

2002. If tidewater goby had been found, they would have been transported even further upstream where cover existed. No tidewater gobies have been captured in the lower lagoon since fall, 1997. The high stormflows of 1997-98 may have flushed tidewater goby out of the lagoon, and they have apparently not been re-established.

As required in the permit, the fisheries biologist, Donald Alley, was present during activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was the twelfth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Reports for the first 11 years are available at the City (**Alley 1991-2002**). 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 2002. A small storm had occurred on 19 May. There had been a sewage spill from Venetian Court the previous weekend due to faulty sewage pumps. Dry sand was excavated on the Venetian Court side of the estuary and a portion of the inside of the flume was cleared of sand.

21 May 2002. The first activity accomplished was the construction of channel along the east side of the flume at 0600 hr. Streamflow was visually estimated at 10-15 cfs. Then a berm was constructed across the upstream end of the lateral channel. The estuary then began to drain and fill with the tides along the new channel. It drained partially after the new channel was constructed, but the estuary width did not diminish, with it extending from bulkhead to bulkhead. The estuary was approximately 5+ feet deep near the restaurants and 6+ feet deep between Stockton Avenue and the railroad trestle. The channel beside the flume was closed off at 1200 hr, with the flume cleared of sand. The fish relocation from the lateral channel went on throughout the day. The dewatered lateral channel was covered over with sand at the end of the day.

22 May 2002. At 0900 hr the sandbar was re-opened along the flume. Streamflow was visually estimated at 6-8 cfs. The lagoon drew down very slowly this year. The periphery of the receded basin was searched for stranded fish. The lagoon was walked upstream as far as the Ortiz residence, where the stream environment existed above. No stranded fish were observed. No mergansers (*Mergus merganser*) were observed. Five adult steelhead were observed under the Stockton Avenue Bridge and one young-of-the-year steelhead was observed just downstream of Noble Gulch. With the lagoon at its lowest point, water depth between Stockton Avenue and the railroad trestle was approximately 5 feet maximum. Kelp and sea grass was raked out of the lower lagoon, downstream of the Stockton Avenue Bridge, by 5-6 Public Works personnel and Donald Alley until the channel to the ocean was blocked at 1545 hr to prevent saltwater influx. Considerable plant material was present, creating a layer 1-2 feet deep on the bottom.

23 May 2002. The berm across the outlet channel had breached during the night after the lagoon had filled to the top of the flume. A temporary berm was re-established to prevent kelp from entering the lagoon. None had entered as yet. The berm was re-opened between 1030 hr and 1100 hr as Alley and the Public Works crew of four men continued to rake plant material from the lagoon. Streamflow approximated 5 cfs. As the basin receded, the periphery was searched for stranded fish as far as the Ortiz residence. No stranded fish were found. The 5 adult steelhead from the previous day were absent and likely entered the ocean overnight. A school of approximately 20 juvenile steelhead were observed near the east pier of the Stockton Avenue Bridge and 6 juvenile steelhead were observed in pool habitat adjacent to the Ortiz residence. An adult Pacific lamprey (*Lampetra tridentata*) was observed during raking. Four large prickly sculpins (*Cottus asper*) were observed around the tree lying under the bridge when it was moved to the western portion of the lagoon. No mergansers were observed during the sandbar construction period. A pad was prepared at the flume inlet with filter fabric, visquine and sandbags around the flume. A half screen was placed in one side of the flume inlet with an 8-inch hole for adult access. The Venetian side of the flume inlet was boarded up. The sandbar was closed for the summer at 1450 hr.

24 May 2002. Gage height was 1.68 with the half screen in place. The intent was to increase the lagoon depth in succeeding days.

30 May 2002. Gage height was good at 2.14. The lagoon was warm at 1335 hr, with water temperature 21 C at the surface, 19.2 C mid column ant 21.8 C at the bottom with a layer of saltwater at least a quarter of a meter thick at Stockton Avenue Bridge. Very high tides the previous weekend (6+ feet) had apparently brought saltwater into the lagoon through the flume with the half screen present in the inlet. A shroud was placed on the inlet on 21 May to draw saline water off the bottom. An adult steelhead was observed under the Stockton Avenue Bridge. The 8-inch hole remained in the flume inlet for adult passage.

4 June 2002. Gage height was optimal at 2.46. No saltwater was detected in the lagoon at the Stockton Bridge. No adult steelhead were observed. Water temperature was cooler than the previous monitoring, with surface temperature of 18.7 C and bottom temperature of 17.8 C at 1303 hr at the Stockton Avenue Bridge. The shroud was to be removed on 7 June.

Effects of Sandbar Construction on Tidewater Gobies in 2002

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. The estuary receded after the lateral channel was blocked and the new channel was constructed along the flume. 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 were detected recently in Moran Lake and Aptos Lagoon after years of no detection, and they may repopulate Soquel Lagoon from adjacent populations.

Effects of Sandbar Construction on Steelhead in 2002

No negative impacts to the steelhead population were detected in 2002. 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 5 feet. The school of juveniles and the adults observed were under the bridge. When we walked the upper estuary during draw down, very few juvenile steelhead were observed, with only one near Noble Gulch and 6 at the upper end of the lagoon in pool habitat that was high in quality. No mergansers were present during sandbar construction. The previous rain on 19 May stimulated considerable smolt out-migration prior to construction. Although adults were still present in the Creek, access to the ocean was provided at the flume inlet via an underwater portal.

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 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. The water pumped into the flume to initially flush the sand out is pumped in from the artificial outlet channel cut parallel and adjacent to the flume. This pumping does not reduce water levels in the lagoon or cause turbidity problems. The intake hose for the pump will be screened in the future.

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. This would allow more tidal overwash of saltwater during especially high tides and further elevation of temperature, making the lagoon less hospitable for steelhead.

Recommendations for Lagoon Preparation and Sandbar Construction

1. In low-flow years such as 2002, closing the sandbar in late May is better than mid-June or later because streamflow is greater then. Fortunately in 2002, the storm of 19 May provided sufficient outflow to keep the flume open throughout the night.

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, 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.

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. 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 2002-2003 Rainy Season.

7 November 2002. The sandbar breached at approximately 1200 hr after it had rained through the night. The tide and surf were high, and tidal overwash ultimately breached the sandbar adjacent to the flume and near Venetian Court. Prior to breaching, the City had graded a wide swath of sand across the beach to facilitate breaching. The surf traveled up this swath and

breached the sandbar. The flume had been opened up on both sides with approximately 20 inches of open space on both sides. The notch in the sandbar was 15-20 feet wide at the head of the flume and 50-60 feet wide at the surf. The estuary remained intact with a gage height of 2.68 at 1240 hr. Ed Morrison called Kevan Urquhart of Fish and Game prior to the breach. Morrison was given the okay to try to re-close the sandbar if the storm appeared to be subsiding. It appeared there was a lull between storms. Matt Kotila of the City closed the sandbar at 1500 hr. However, rainfall resumed later, and the sandbar again breached naturally by 2030 hr.

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 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.

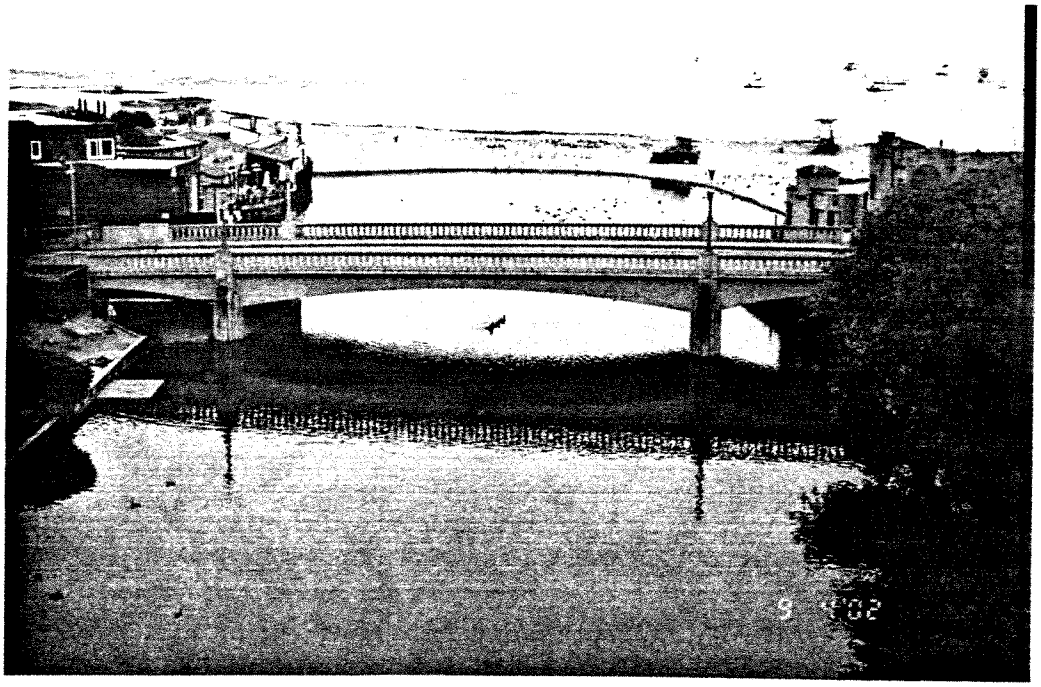
3. Just as the first storm of the fall season begins, remove one board from each side of the flume if a small storm is anticipated. Remove two boards from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit. Clear the sand away from 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. After the stormflow subsides, replace the cover until the next storm.

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

5. 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.

6. 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.

7. As was recommended in earlier reports (1996-2002), the flume inlet should be redesigned to allow rapid accommodation of higher stormflows and better stage control as inflow to the lagoon declined through the summer. The currently intended design includes a grated hole in the top of the flume. Flashboards may be removed to remove sand from the flume at the beginning of the summer season or at the end to maximize flume capacity during small, fall storms. With an improved inlet with a grated hole in place, flooding may be more easily prevented before the sandbar breaches. Also, early, small stormflows would be less likely to breach the sandbar prematurely with this louver design. During the summer, operation with the top hole would make it easy to maximize the lagoon height as the streamflow declined through the summer. As the streamflow drops, lagoon depth must be maximized. The present effort of removing screens and replacing them with smaller screens and boards as the streamflow declines could be much reduced, while doing a better job of maximizing lagoon water depth. However, fish must be prevented from becoming impinged on any grated hole.



Reaches 1 and 2 Downstream of the Railroad Trestle

WATER QUALITY MONITORING, 2002

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 of Water Quality Monitoring

Water quality was monitored in early morning near first light at four stations. The first station was at the flume inlet (**Figure 1**). The second station was reached off 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.

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 2002 as in the past 3 years, two temperature data loggers were installed. They were place near the bottom in Soquel Creek above the lagoon and in the lagoon in lower Reach 3 from 10 June to 6 October. Temperature was recorded in 30-minute intervals. It was determined on 6 October that the lagoon logger had been stolen. However, as a requirement of the Fish and Game Permit for lagoon closure, 6 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. This was a deeper portion of the lagoon. These loggers were launched on 2 July for the deepest two and on 9 July for the remaining 4 loggers that had to be ordered. All 6 were removed on 6 October 2002.

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. Maximum daily water temperature should not reach 26.5°C (79.5°F). 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 for 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).

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

Appendix A provides detailed data on water quality. Table 3 rates habitat conditions.

Lagoon Level. The lagoon level was monitored 14 times in 1 to 2-week intervals from 24 May to 25 October 2002. For 2002, the measurements of lagoon level as measured on the staff gage were rated "good" on 12 occasions (86%), "fair" on 1 occasion (7%) and "poor" on the first occasion soon after sandbar closure (**Table 3; Figure 2a**). Maintaining the lagoon depth has improved since the pre-1996 summers, particularly late in the dry season (**Figure 2b**). 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 2002. The shroud was in place on one side from 31 May to late July (observed removed on 30 July), which prevents board dislodging. Plywood was nailed to the flashboards later in the season, which prevents dislodging. Placement of a hole in the top of the flume may prevent negative effects of tidal back pressure and vandalism if the boards are adequately secured.

No vandalism was detected in 2002. 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 remained in place in May 2002 to insure water depth inside the flume entrance. The flume was partially cleared of sand before the sandbar was closed the first day of construction activity and cleared completely before final sandbar closure, to insure steelhead smolt passage during and after sandbar construction. Sufficient baseflow in 2002 resulted in excellent passage for steelhead smolts. The sandbar breaching was artificially facilitated at noon on 7 November 2002 to prevent flooding during a sizeable storm event. The flume was flowing at near full capacity. The sandbar was closed by the City at 1500 hr, but had breached naturally again at 2030 hr that night. The sandbar remained open afterwards.

Water Temperature. In 2002, 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 2002. Of the 11 early morning monitorings, Station 1 at the flume and Station 4 at Noble Gulch were rated "good" most of the summer (90% at Station 1 and 100% at Station 4). Station 2 at the Stockton Avenue Bridge had a "good" rating 7 times and a "fair" rating 4 times (36%). Maintaining a deep lagoon for most of the summer helped to minimize water temperature. The water was especially deep in the vicinity of the railroad trestle, with its bedrock footing on the west side. Lagoon water temperatures were generally cooler in the years immediately prior to the drier year 1997, except during the dry year of 1994 (**Figure 3b**). There was more tree canopy over the stream prior to 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 analyzing temperature data from the 6 data loggers throughout the water column, results were consistent with temperature data collected through the water column at monitoring stations over

the past 12 years. There was no thermocline, with complete mixing of the water column. Water temperature cooled 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 2002. Maximum and minimum water temperature measurements through the water column at 10-day intervals (except for the first and last day of data) showed the difference between the maximum daily temperatures at the deepest probe (0.5 feet from the bottom) and the shallowest probe (5.5 feet from the bottom and less than 1 foot from the surface) varied between zero and 1.15°C (2.06°F) of warming from bottom to top for the 10 days considered, averaging 0.72°C (1.31°F) difference (**Table 4**). The largest difference detected in 2002 was 1.15°C. The temperature difference through the water column at the minimum daily temperature was much less, ranging from zero to 0.38°C (0.69°F). Juvenile steelhead likely spent most of their time near the bottom, except when feeding on emerging aquatic insects. This assumption was based on years of underwater observations of salmonids.

The most significant water temperature differences between days during the summer likely resulted from differences in water temperature of the stream inflow on those days. There was a warm period of 7 days in the first half of July when daily maxima near the lagoon bottom were above 21.3°C and even above 22°C on one day (**Figure 4e**). This warm period was then followed two days later by a relatively cool period of 6 days in mid-July when daily maxima near the lagoon bottom were mostly around 19.4°C, with two of the days going as high as 19.8°C. Regarding the stream inflow temperature, during the 7-day warm period the maximum daily water temperature ranged mostly from 20.2 to 21.3°C (although one day it reached only 19.4°C), with several days around 20.6° (**Figure 5e**). In the ensuing cool period, daily maxima in the stream ranged mostly between 18.7°C and 19.1°C, with one day's maximum only reaching 17.5°C. A similar cycle occurred with a warm period in the first half of August followed by a cool period the last half. 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°C (3.6°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 effect of sunny days would be somewhat mediated.

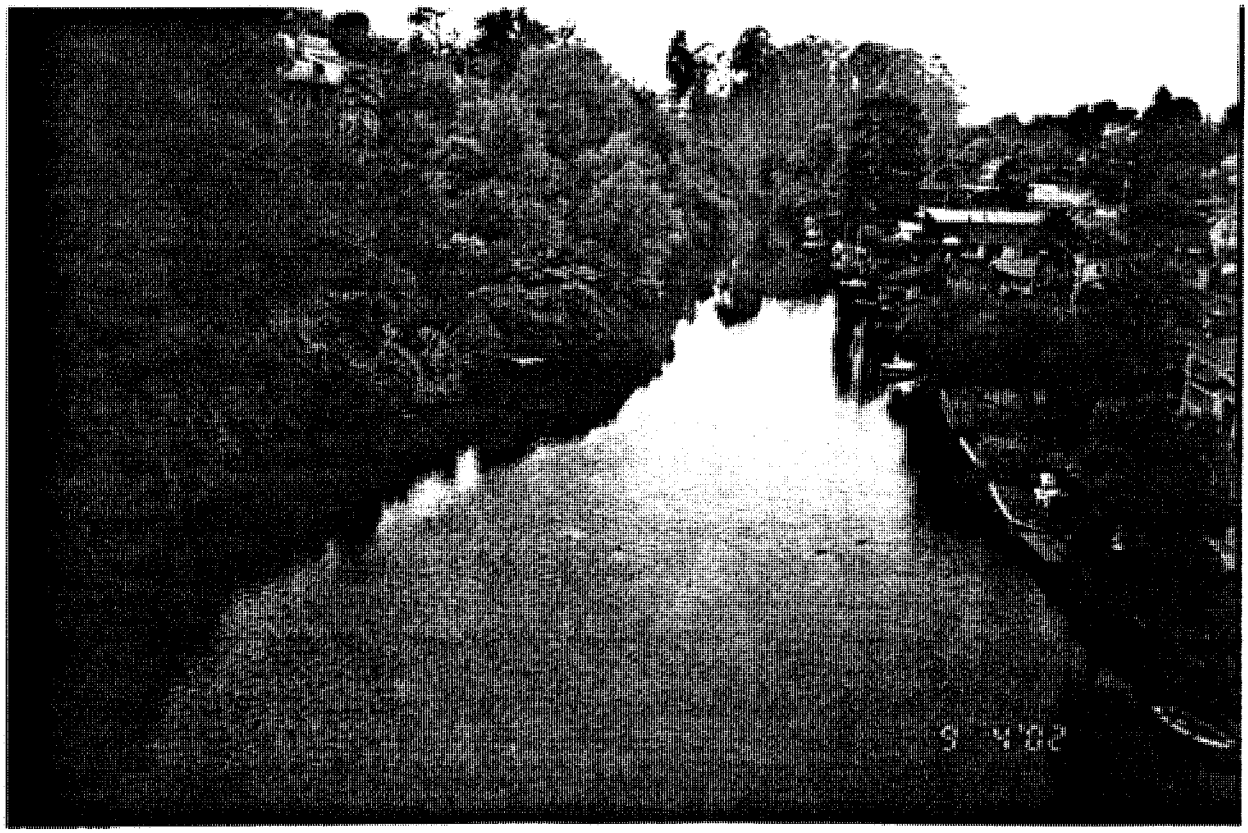
Lagoon water temperatures were probably not stressful for juvenile steelhead in 2002, unlike the previous year when there had been two tidal overwashes. In 2001 for 14 days, daily temperatures near the bottom fluctuated between approximately 23 and 26°C. It would have been stressful for coho salmon for much of the summer in 2001 because water temperatures above 20° C (68° F) are considered limiting to juvenile coho salmon in lagoons in the presence of steelhead (depending on food abundance), and lagoon temperatures below approximately 16° C (60.8° F) are preferred (**J. Smith, personal communication**).

Daily *minima* in the lagoon were consistently warmer than the stream above in 1999-2002. The daily *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2002, but not in 2000. The daily stream temperature fluctuated more in the stream than the lagoon. In the 2002 lagoon, 90% of the complete days measured (86 of 96 days- 3 July- 5 October) met the

management goal of early morning temperatures less than 20°C. Only 2% of the days (2 of 96 days) did not meet the management goal of maximum daily temperatures below 22°C.

The 2002 lagoon was cooler than in 1999 and 2001 and slightly warmer than in 2000. In the 2002 lagoon, 14 of 96 days (15%) had maximum temperatures greater than 70° F (21.1° C). In the 2001 lagoon with its two tidal overwashes, 22 of 108 days (20%) had temperatures greater than 70° F (only 1 day of 80 days (1%) in 2000). In the 2002 lagoon, 37 days (38%) had maximum temperatures above 68° F (20°C). In the 2001 lagoon, 45 days (42%) had temperatures above 68° F (20°C) (27 days (34%) in 2000; 31 of 64 days (48%) in 1999 (**Figure 6a**)).

The creek site near Nob Hill in 2002 was the coolest of the past 4 years for July through September. At the 2002 creek site for the same 96 days measured in the lagoon, only 4 days (4%) failed to meet the management goal of no more than 4 hours a day at greater than 20°C. In 2002, one day (1%) had temperatures greater than 70° F. At the 2001 creek site, 11 days (10%) had temperatures greater than 70° F (41 days (51%) in 2000; 26 days (41%) in 1999 (**Figure 6b**)). At the 2002 stream site, 11 days (11%) had temperatures above 68°F. At the 2001 stream site, 25 days (23%) had temperatures above 68°F (45 days (56%) in 2000). With a water temperature goal of average weekly temperature of 16.7° C (62° F) for coho salmon, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.



Reach 3 Upstream of the Railroad Trestle

Table 3. Water Quality Ratings in Soquel Creek Lagoon, 2001, Within 0.25 Meters Of the Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
24 May02		1.68 poor				
30 May02		2.14 good				
10June02	open	2.44 good	good*	good	good	
01July02	open	2.35 good	good fair fair good	good	good	2.5-3 cfs
15July02	open	1.98 fair	good fair fair good	good fair fair fair	good	2.5 cfs
30July02	open	2.57 good	good fair fair good	good good fair good	good	2.25 cfs
12Aug02	open	2.52 good	fair fair fair good	good good good fair	good	2.0 cfs
26Aug02	open	2.53 good	good	good	good	1.75- 2 cfs
01Sept02 (Begonia Festival)	open	2.53 good	good	good	good	1.5- 1.75 cfs
01Sept02 (afternoon)	open	2.55 good	- fair fair -	-	- good good -	
04Sept02	open	2.53 good	- good good -	- good good -	- good good -	
17Sept02	open	2.48 good	good	good	good	1.5 cfs
30Sept02	open	2.56 good	good	good good fair fair	good	1.25 cfs
25Oct02	open	2.66 good	good	good good fair good	good	
07Nov02	Sandbar breached.					

* Four ratings refer to Reaches 1-3 and Noble Gulch. One rating refers to all reaches.

Table 4. 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. 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 1999-2002 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 3a**).

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 measured and rated. Algae and pondweed was first noted in mid-July of 2002, a month and a half after sandbar closure. It was observed at the same time in 2001. As in 2000 and 2001, pondweed became dense in August 2002, and remained so into October. Pondweed was not noticed until 14 August in 2000 and not until 20 August in 1999.

As in previous years, surface algae was not prevalent in 2002. It covered 1-2% of the surface at Noble Gulch in mid-July and late August (**Appendix A**). Algae covered 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 2002, oxygen levels for steelhead were either "fair" or "good" near the bottom at stations during monitorings, with it staying above 5 mg/l (**Table 3, Figure 8; Appendix A**). In 2001 they had been rated "good" near the bottom on all monitorings except at the railroad trestle in October (**Figure 7**).

Salinity. Salinity was not an issue in summer, 2002, unlike in 2001 with tidal overwash on 21 July. The warm water effects were seen until 25 August 2001. Salinity was detected on the bottom below the Stockton Bridge on 30 May, 7 days after sandbar construction. Saltwater may have backwashed through the flume when the half-screens had been in place. With the shroud in place on the flume, the salinity was gone by 4 June 2002.

Conductivity. Conductivity was registered as stressful at Station 2 under the Stockton Avenue Bridge on 30 May 2002 (**Appendix A**). Conductivity near the bottom was approximately 23,000 umhos near the bottom. Conductivity was back to freshwater conditions by 4 June.

Stream In-Flow to the Lagoon. Inflow to the lagoon ranged from 2.5-3 cfs (visually estimated) on 1 July down to 2.25 cfs at the end of July (**Table 3**). By the end of August, estimated flow had receeded to 1.5-1.75 cfs as it had in 2001. Streamflow continued to decline to an estimated 1.25 cfs by the end of September. Streamflow was measured at 1.28 cfs on 22 September 2002 near the Grange in Soquel Village compared to 1.58 cfs on 21 October 2001. Flow in 2002 was less than in 2000 when 8 cubic feet per second (cfs) was visually estimated in late June and 3.5 cfs

was estimated in early October (**Table 3**). On 23 October 2000, 2.32 cfs was measured at the Grange. Streamflow was somewhat higher in 1999, when a visually estimated 8-10 cfs was recorded in mid-June and a measured 3.7 cfs was recorded 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 3; 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, it should be easier to maintain lagoon depth and prevent fluctuations with more baseflow. However, this potential has not been fully realized (**Figures 2a and 2b**). 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. 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 (**Figure 8**) and other years, although oxygen concentration was in the good range throughout 2001 (**Figure 7**) and 2002. 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. The refuge cans currently on the beach have no lids. The gulls have excellent access and commonly drag refuge out of the 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.

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, the trestle could be screened so that roosting areas were eliminated. This may also reduce bird pollution.

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. Look into screening the railroad trestle in order 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. The flume inlet should be improved. The plan is to drill a hole in the top of the flume and place a grate over it. The flume inlet will be completely boarded up except for slots in the top boards for smolt emigration and adult passage through an underwater portal. Once the smolt emigration is over by 1 July, the water can be allowed to drain out through the grated hole. The hole will have a high flow capacity. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this grated hole, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the grated hole, the lagoon level may be more easily maximized in summer, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not added quickly as streamflow declines in summer.

13. "Gull Sweeps" sold by West Marine Products ($32.00 each and 6 feet across) 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 have been successfully used on restaurants in San Diego (**Y. Sherman, personal communication**).

14. Regarding the Begonia Festival, we recommend that float propulsion by surfboard paddling 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.

15. If wading during the Begonia Festival is requested, perform more detailed water quality monitoring before and after the Begonia Festival to determine the effects of wading. Hydrogen sulfide levels may be measured.

16. 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.

17. 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, no steelhead were planted in Soquel Creek in 2002.

Results of Fish Sampling in Soquel Creek Lagoon

Even with a freshwater lagoon created by the City of Capitola, the water temperature sometimes reaches to near 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. Saltwater was not an issue in 2002, and lagoon water temperature was not elevated from saltwater intrusion. 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.

Fall sampling for steelhead was undertaken on 6 and 13 October 2002, from just upstream of the

Stockton Avenue Bridge and downstream. The 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 the Bridge. Juvenile steelhead congregate in the shade under the Bridge. The seine was pulled into the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. On 6 and 13 October, a total of 509 unclipped juvenile steelhead ranging from 65 to 268 mm Standard Length (SL) were measured, having marked 363 juveniles from four good seine hauls on 6 October (**Figure 9**). The 5 mm increment with the median size of steelhead captured was 105-109 mm SL in 2002 and 125-129 mm SL in 2001 (**Figure 10**). In 2000, the median size increment was 135-139 mm SL (**Figure 11**). In 1999 it had been 120-125 mm SL (**Figure 12**). In 1998, the most popular size increment was 115-119 mm SL (**Figure 13**).

Our steelhead population estimate for fall 2002 was 1,042 juveniles +/- 84 compared to 454 juveniles +/-27 in 2001 (**Table 5, Figure 14**). Other species captured with the 106-foot seine on the two days combined were 18 staghorn sculpins, 5 juvenile Sacramento suckers (*Catostomus occidentalis*) and a piscivorous striped bass (*Morone saxatilis*) (225 mm SL). This was the first instance of a striped bass capture in the lagoon.

The 2002 steelhead population estimate for the lagoon was the highest since 1994, though it was similar to the 1999 and 2000 estimates (**Table 5**). Somewhat more than half as many steelhead were produced in the lagoon in 2001 compared to 2000. Spawning redds were observed in lower Soquel Creek in 2002, with perhaps the best spawning conditions in many years due to better gravels and no late winter storms to scour or smother redds. We observed at least three redds just upstream of the lagoon. Our sampling of lower Soquel Creek in fall, 2002, indicated the highest juvenile densities since 1997 (**Alley 2003**), though densities of juvenile steelhead in the lower 2 miles of stream habitat above the lagoon are generally low (**Alley 2001; 2002; 2003**). 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 6 October 2002, 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. Only threespine sticklebacks were captured and no tidewater gobies. 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 goby have been recently reported in adjacent lagoons, Moran Lake and Aptos. They may re-populate Soquel Lagoon in the future from these sources.

Table 5. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2002.

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.

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 has an easier time of maximizing water depth in years with intermediate streamflows, such as 1999-2002, rather than 1998, with the existing 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. 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 with surface diversions upstream 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. Complete loss of surface flow should be avoided.

2. Maximize lagoon depth by adding boards to the flume 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. As recommended in the 1997-2002 reports, we continue to recommend that the flume inlet be modified. The plan is to drill a hole in the top of the flume and place a grate over it. Once the smolt emigration is over by 1 July, the water can be allowed to drain out through the grated hole. The hole will have a high flow capacity. Vandalism would be prevented. Also, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. The lagoon level may be maximized, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not added quickly as streamflow declines in summer.

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FIGURES

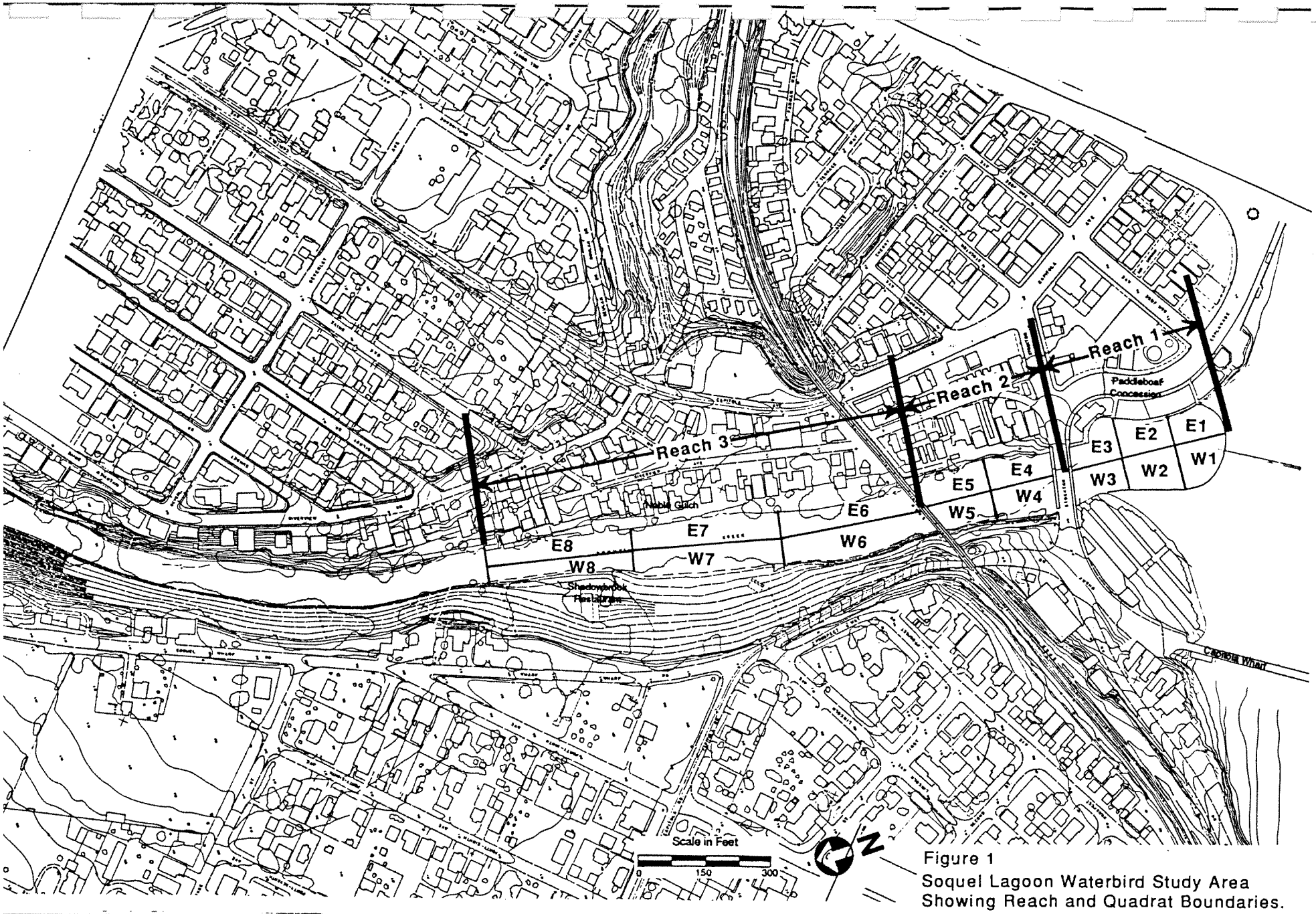


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.

Figure 1	SOQUEL LAGOON Management & Enhancement Plan	May 1990

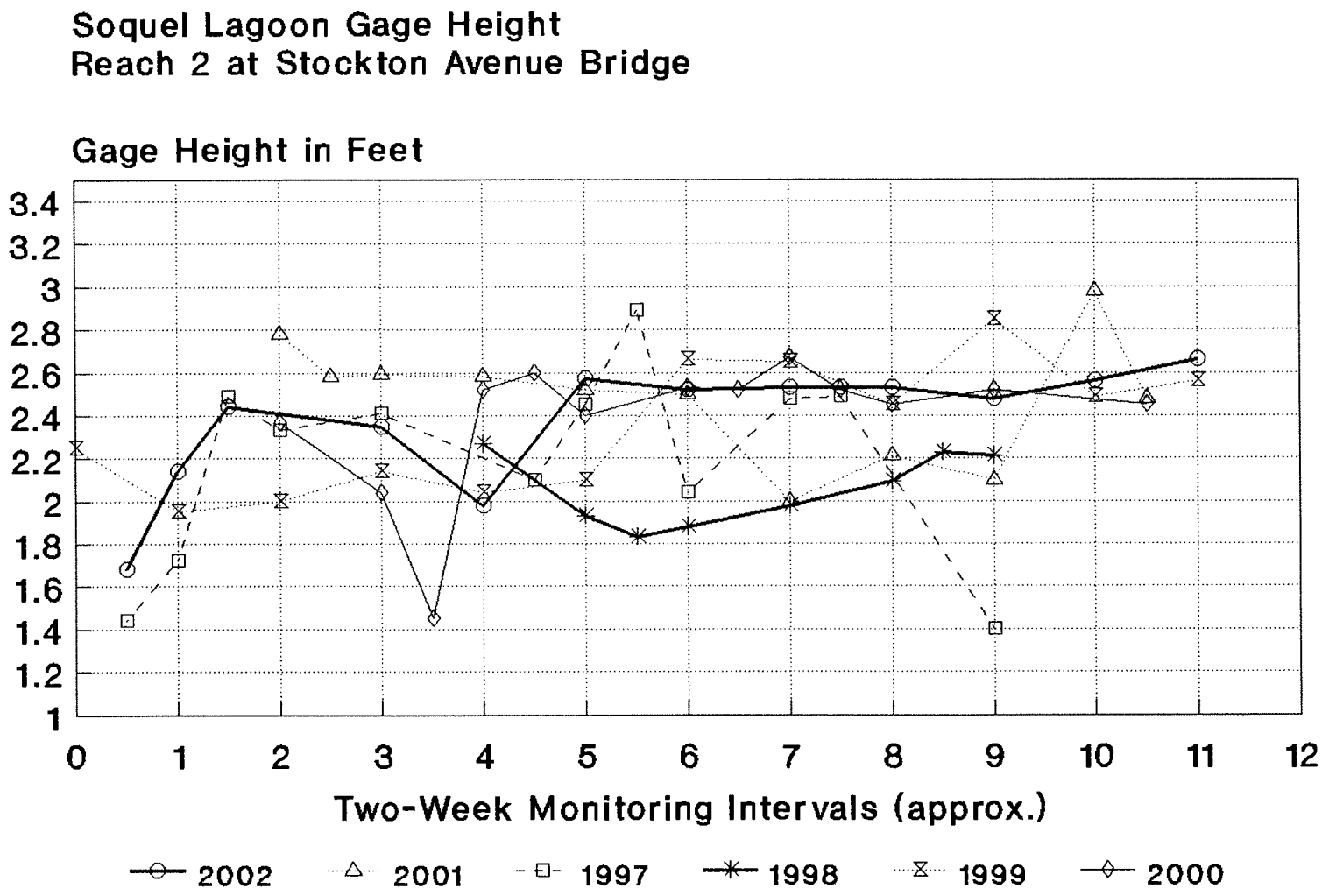


Figure 2a. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 1997-2002.

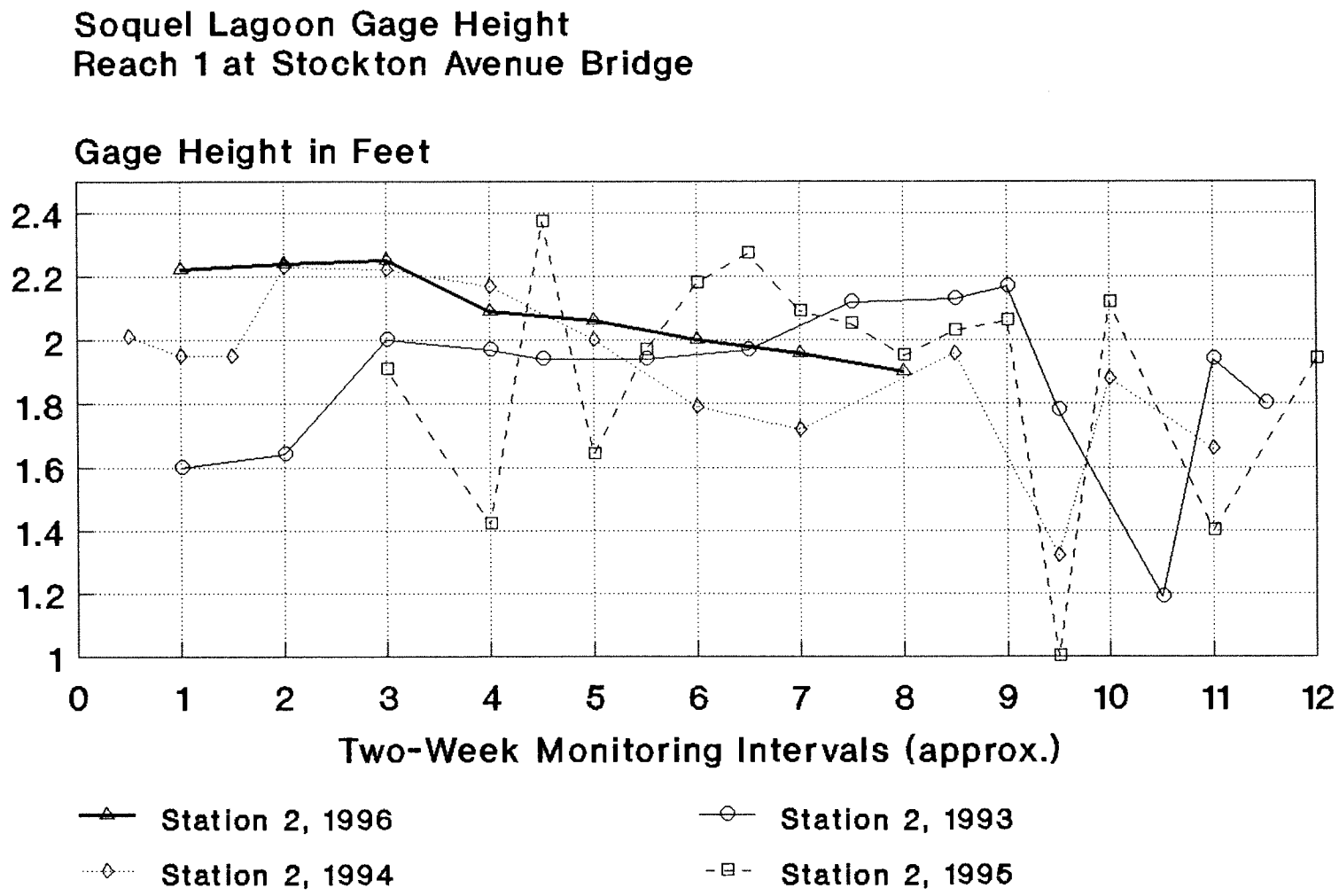


Figure 2b. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Late May to Late October, 1993-96.

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

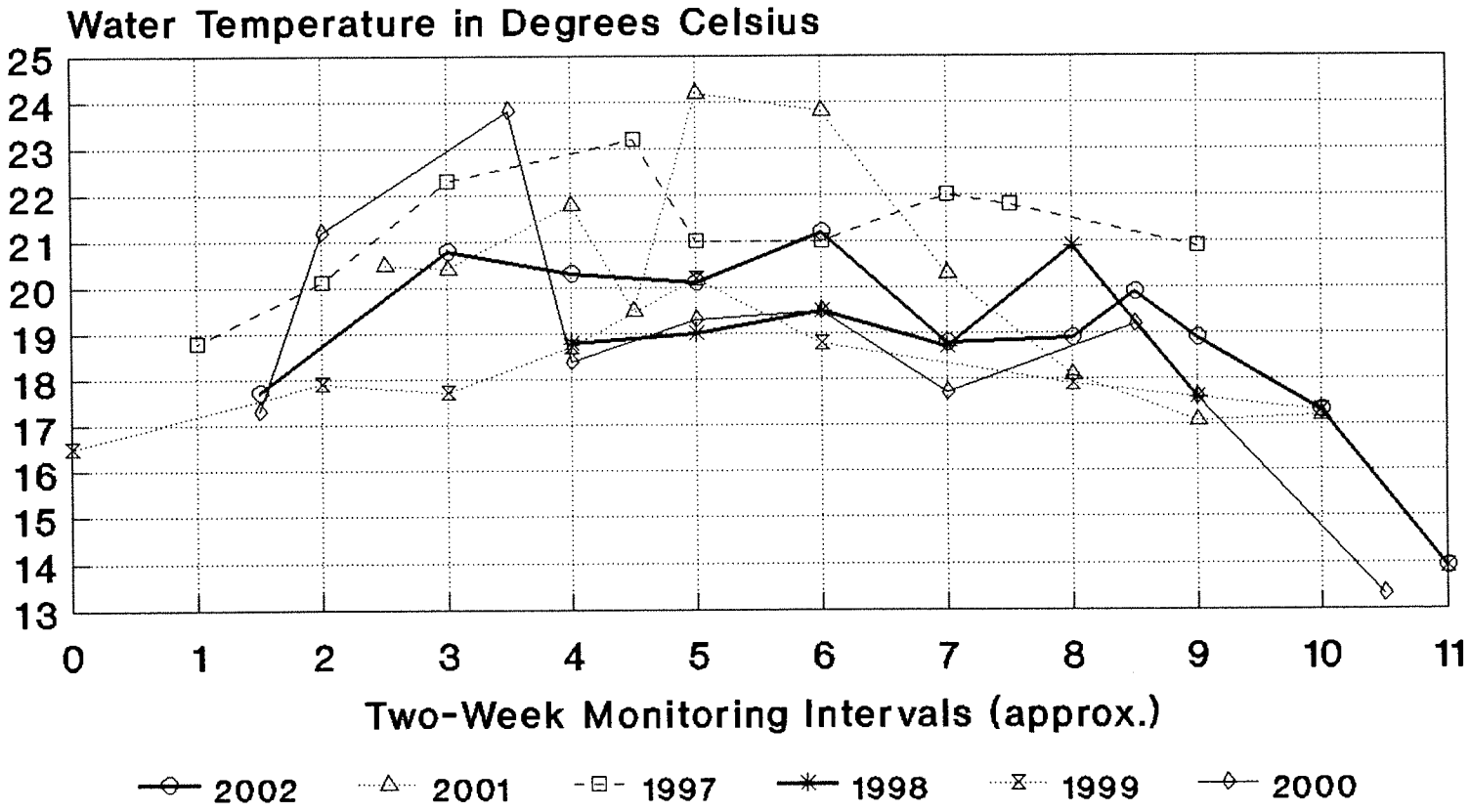


Figure 3a.Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Mid-May to Late October 1997-2002.

Soquel Lagoon Water Temperature
Reach 1 at Stockton Avenue Bridge
Within 0.25 M of Bottom, 1993-96

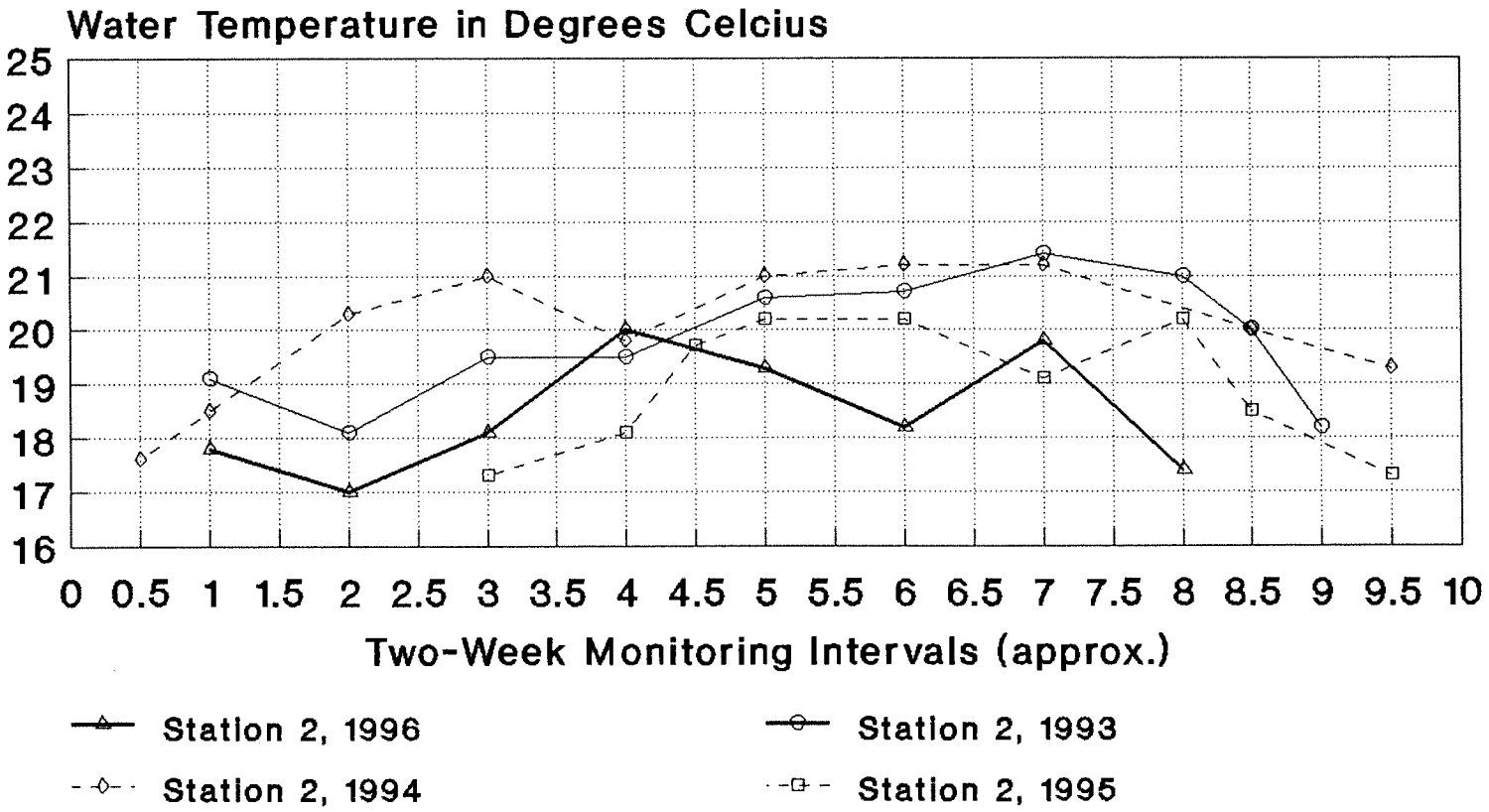


Figure 3b.Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Late May to Late September 1993-96.

Figure 4a. Water Temperature (Degrees Centigrade) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 26 June to 16 September 2000.

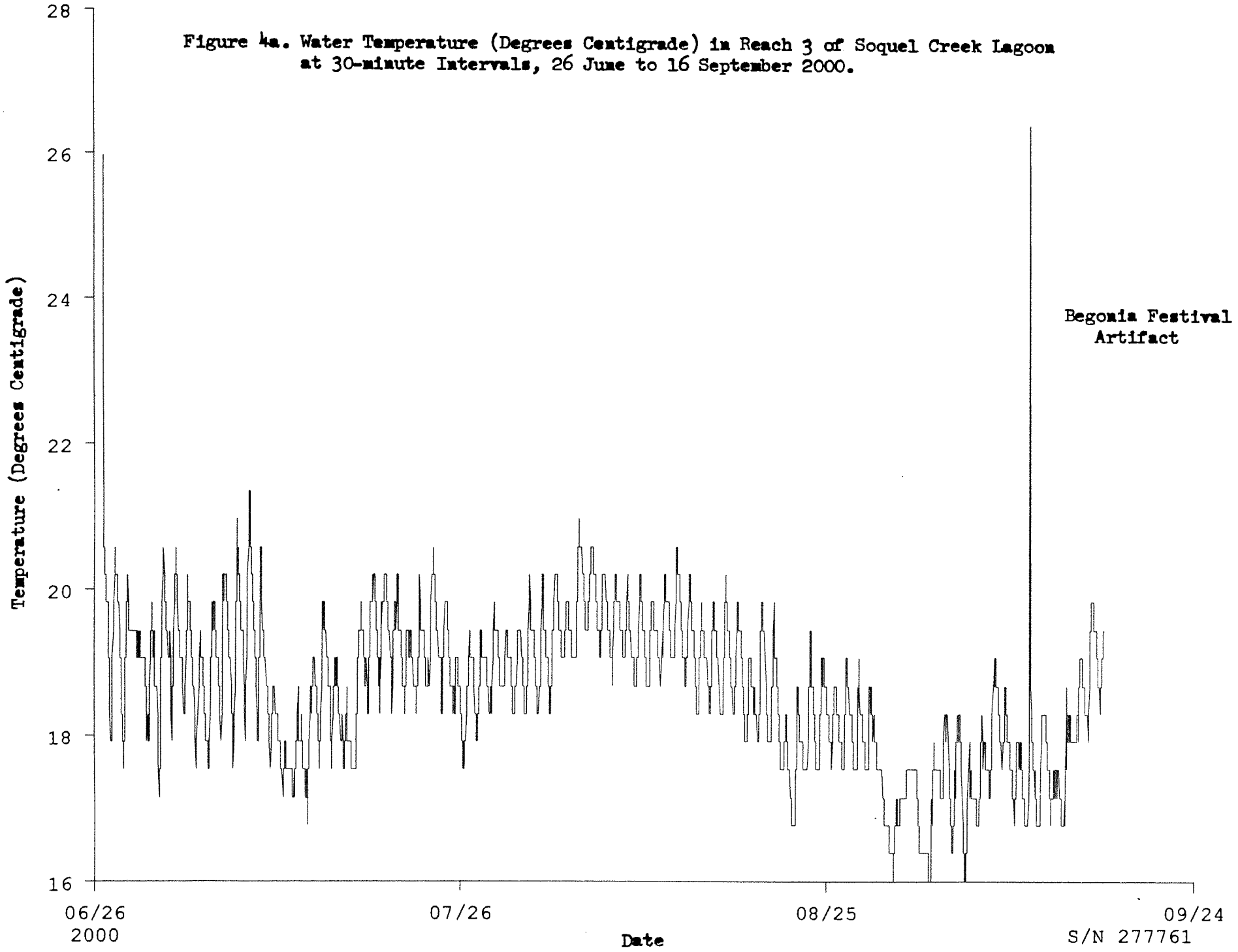


Figure 4b. Water temperature (Degrees Farenheit) in Reach 3 of Soquel Creek Lagoon at 30-minute intervals, 26 June to 16 September, 2000.

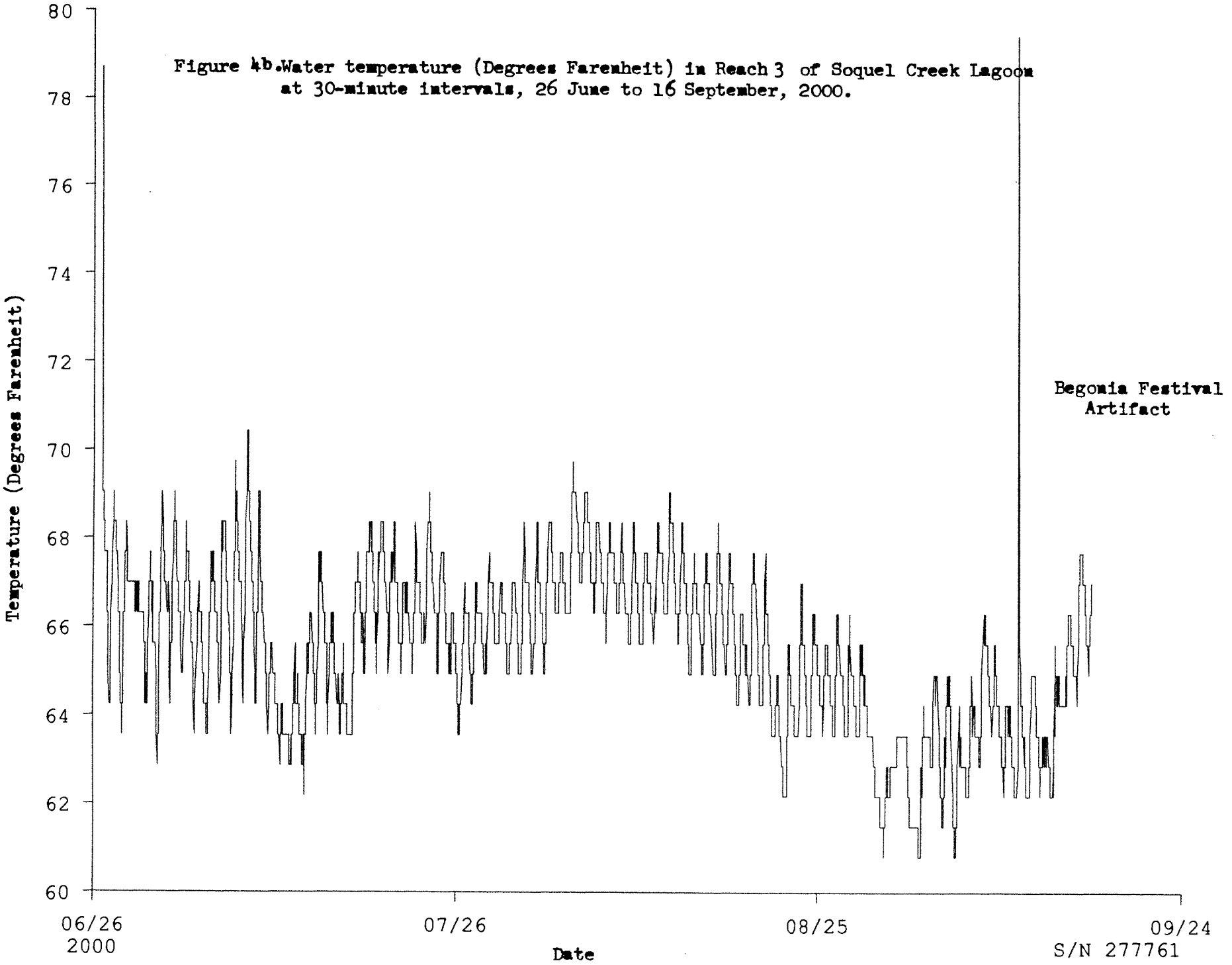


Figure 4c. Water Temperature (Degrees Farenheit) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 23 June to 10 October, 2001.

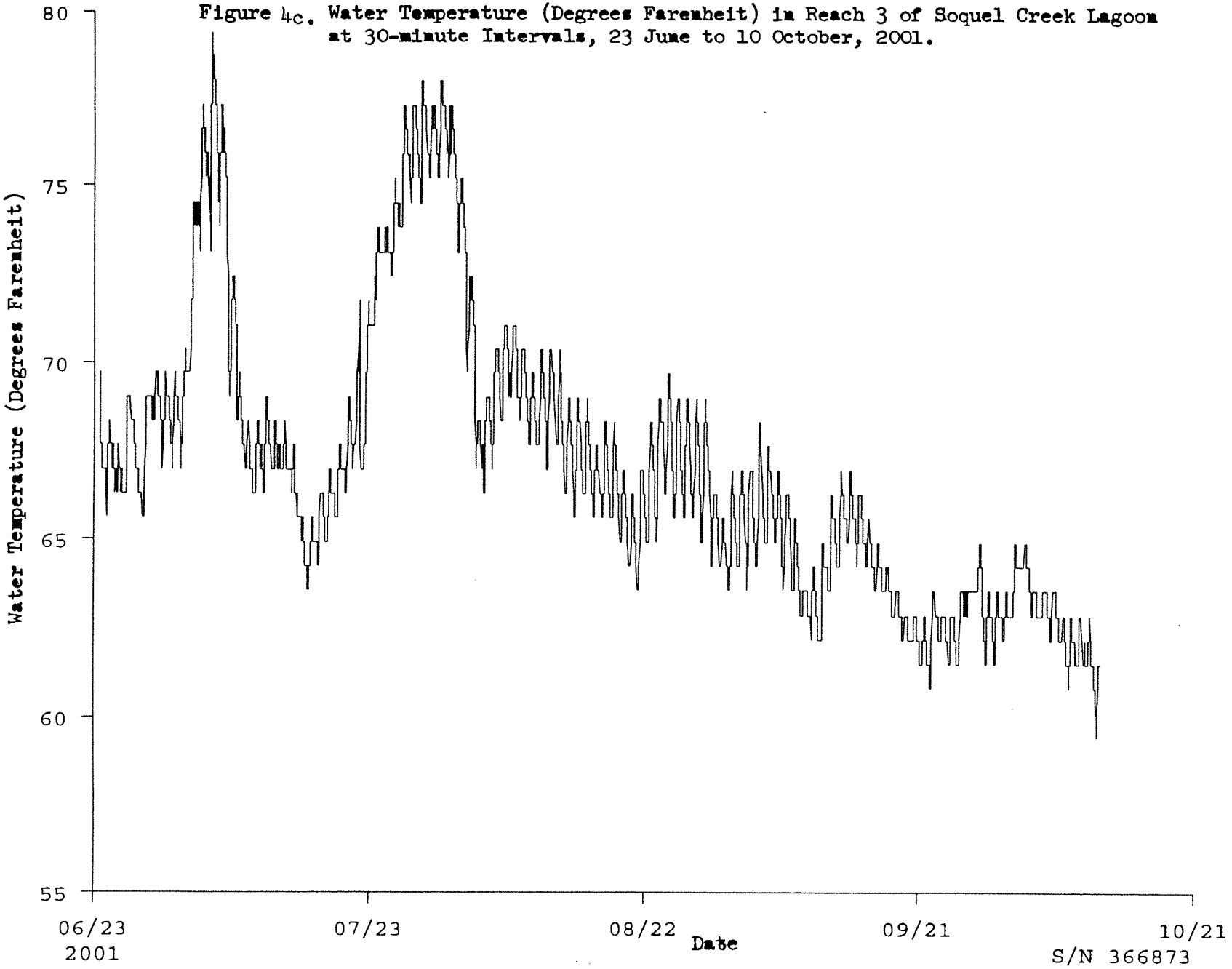
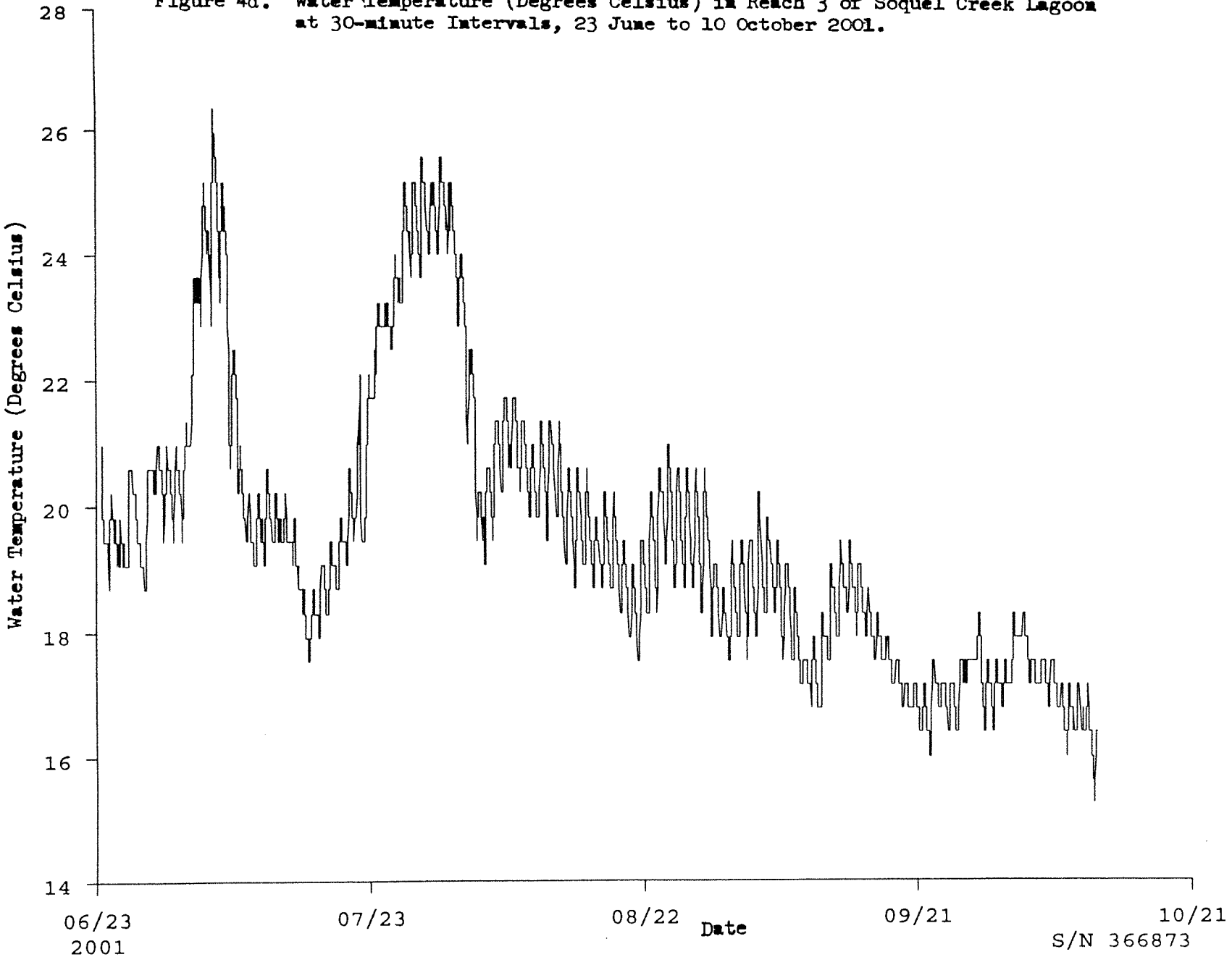


Figure 4d. Water Temperature (Degrees Celsius) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 23 June to 10 October 2001.



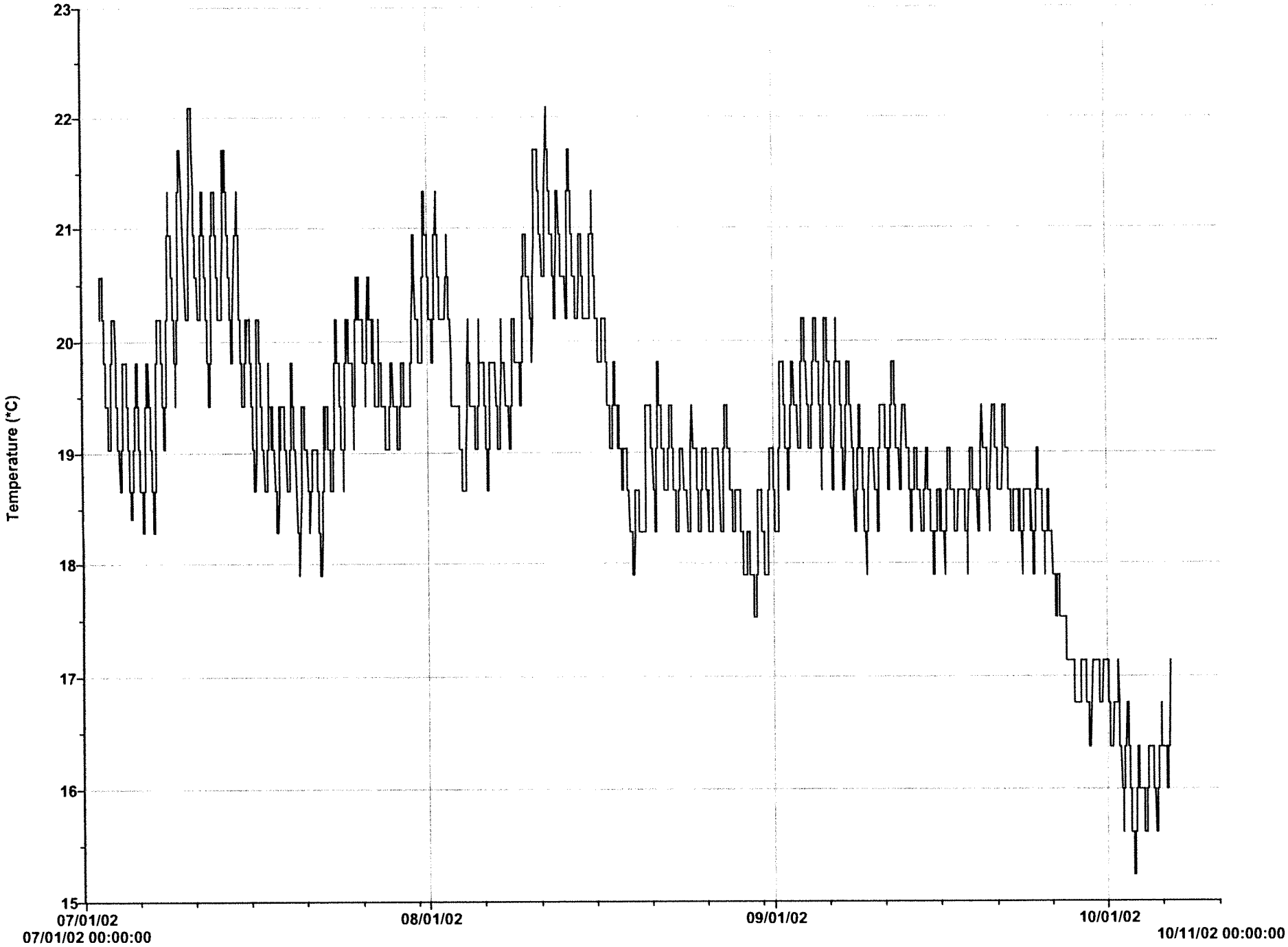


Figure 4e. Water Temp. (*C) Above Trestle 0.5 ft from Bottom, 2 Jul-6 Oct 2002, 30-min Interval

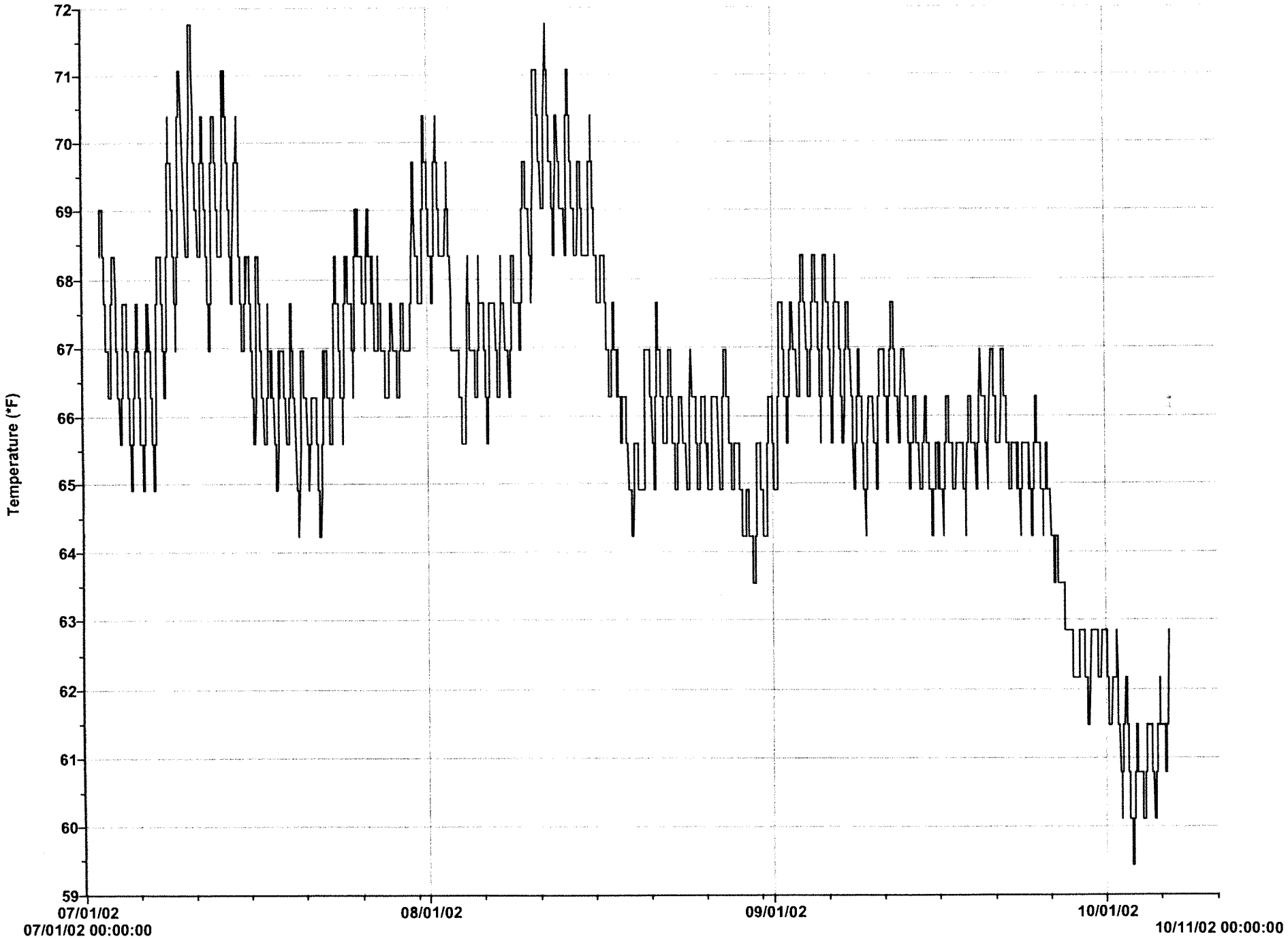


Figure 4f. Water Temp. (*F) Above Trestle 0.5 ft from Bottom, 2 Jul-6 Oct 2002, 30-min Interval

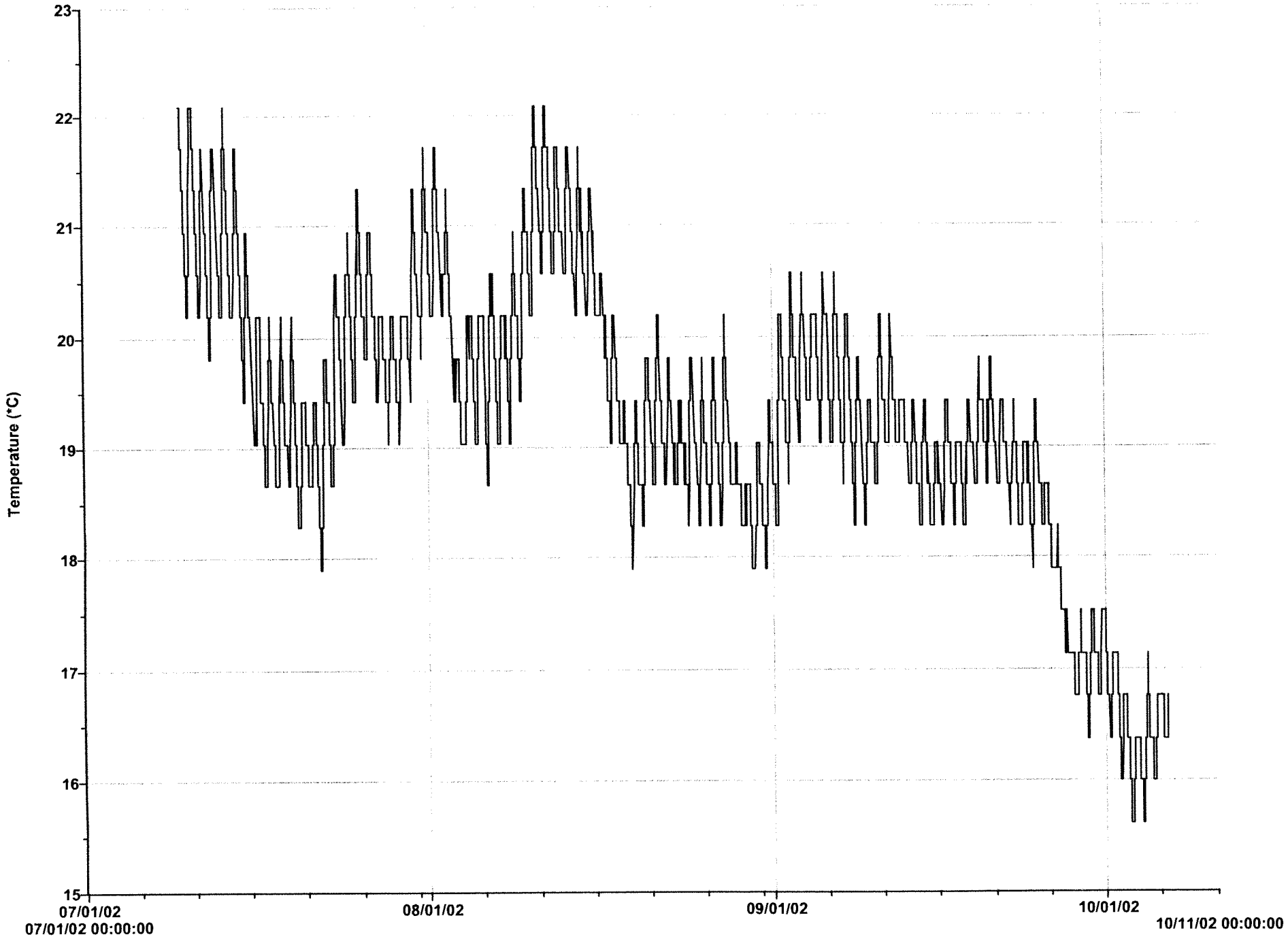


Figure 4i. Water Temp. (*C) Above Trestle 2.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

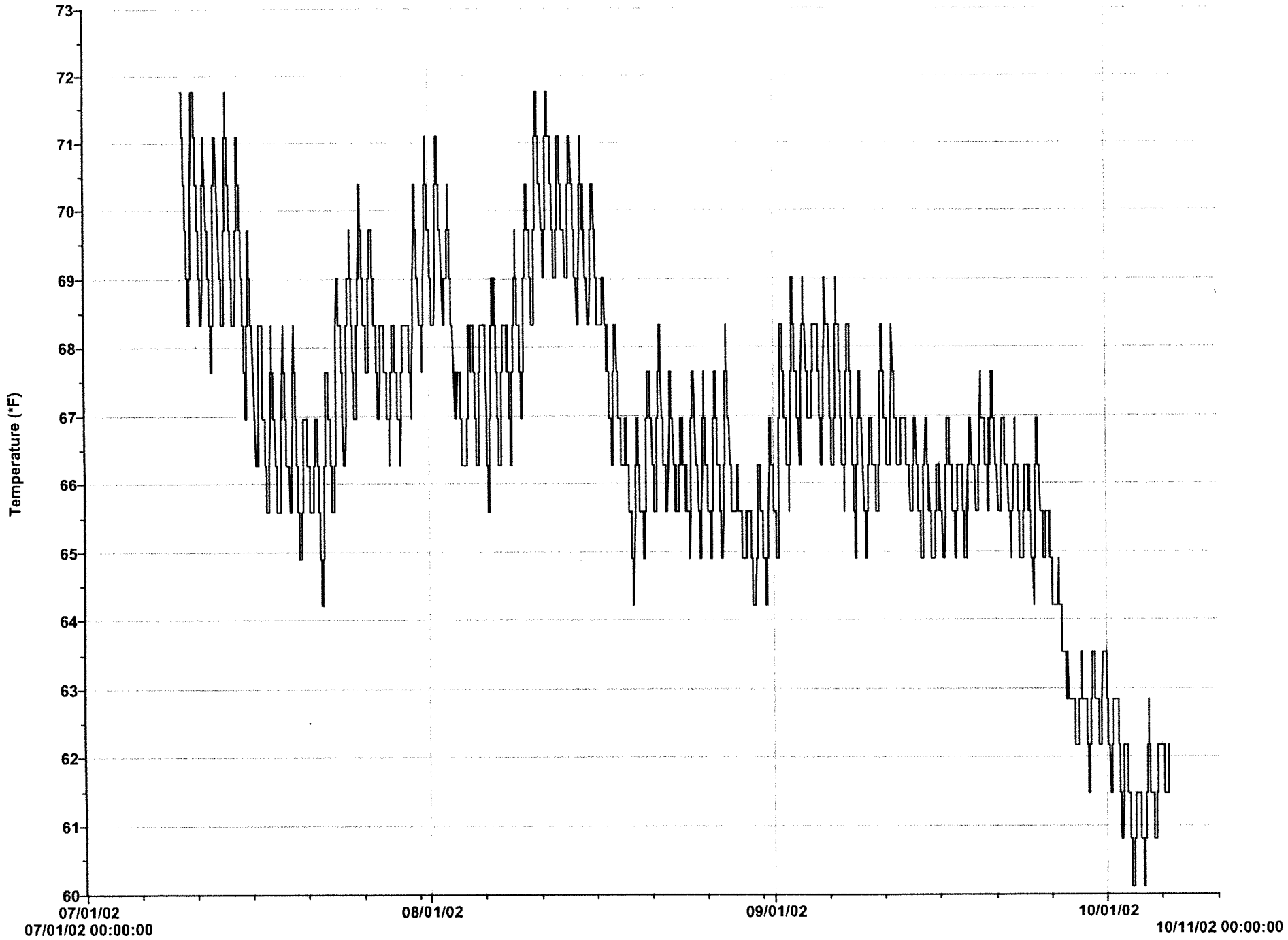


Figure 4j. Water Temp. (*F) Above Trestle 2.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

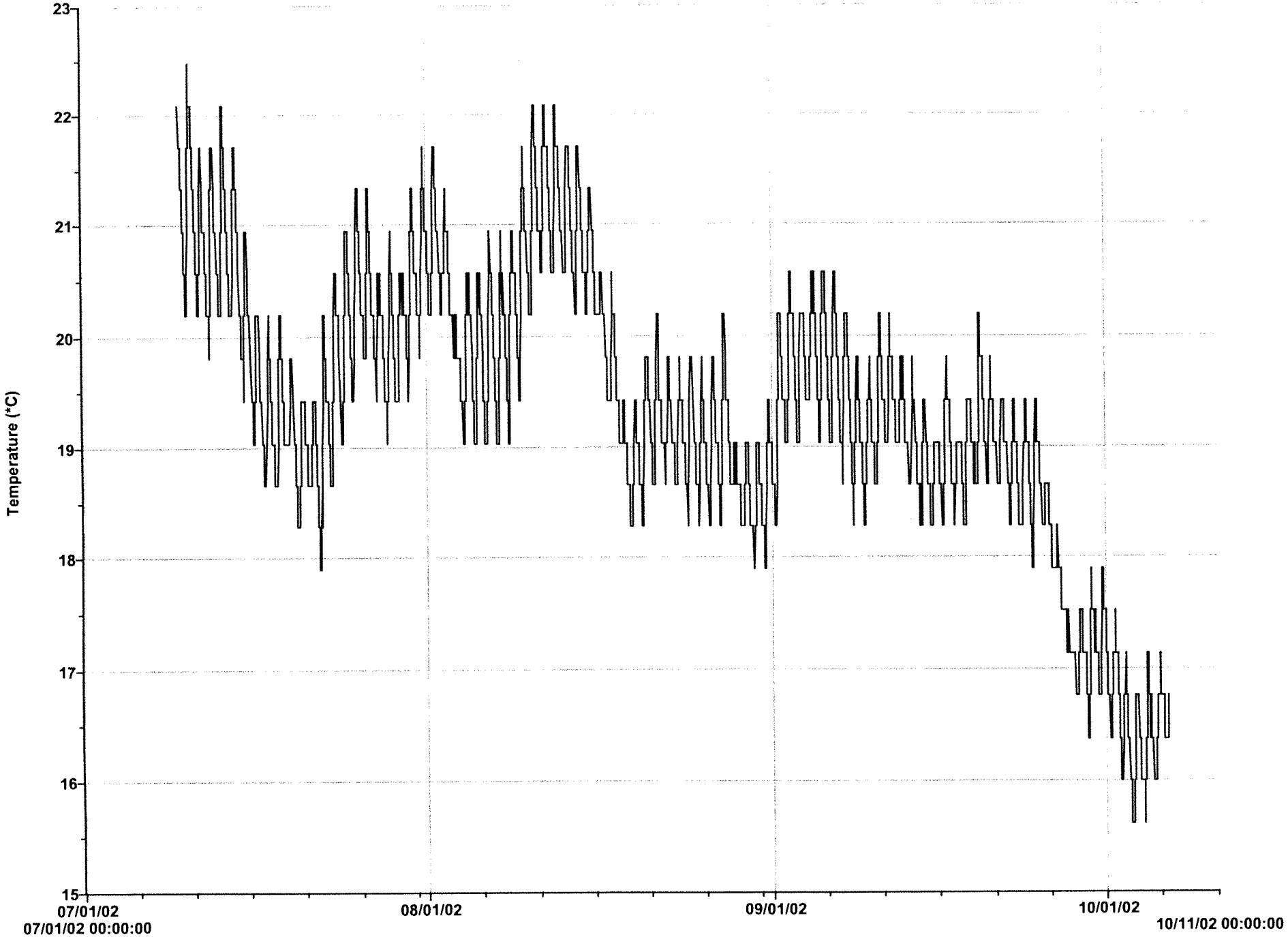


Figure 4k. Water Temp. (*C) Above Trestle 3.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

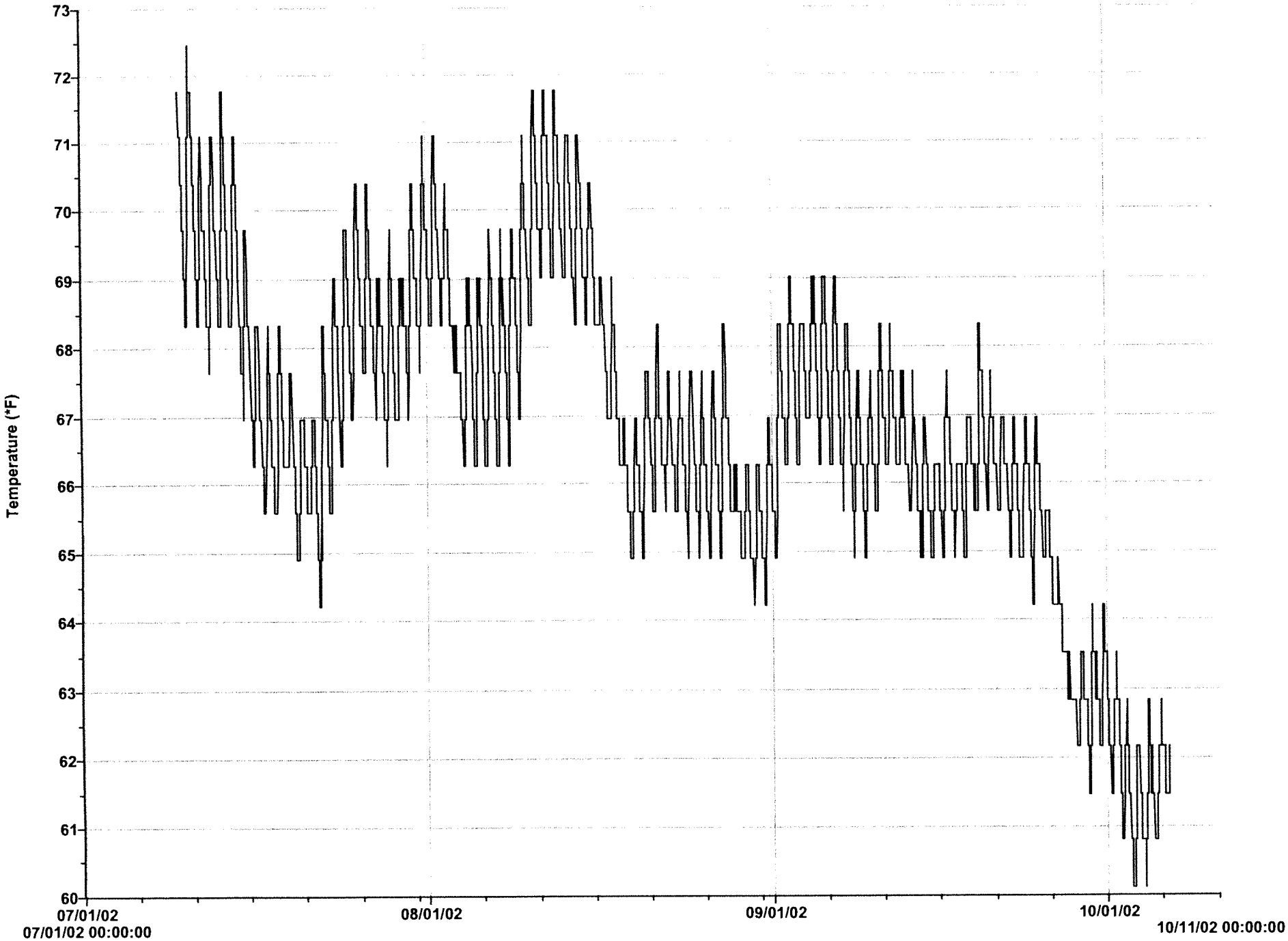


Figure 4l. Water Temp. (*F) Above Trestle 3.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

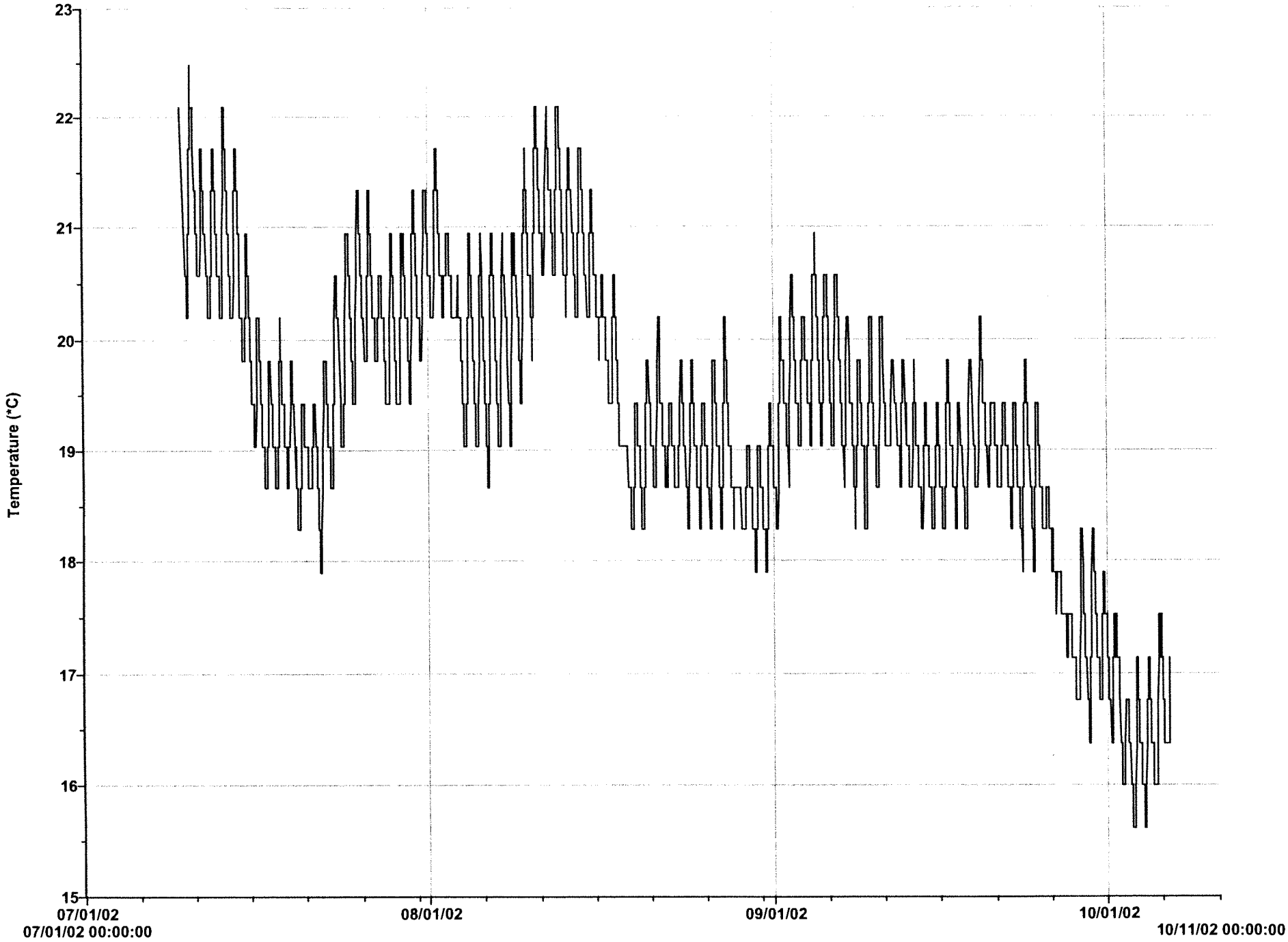


Figure 4m. Water Temp. (*C) Above Trestle 4.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

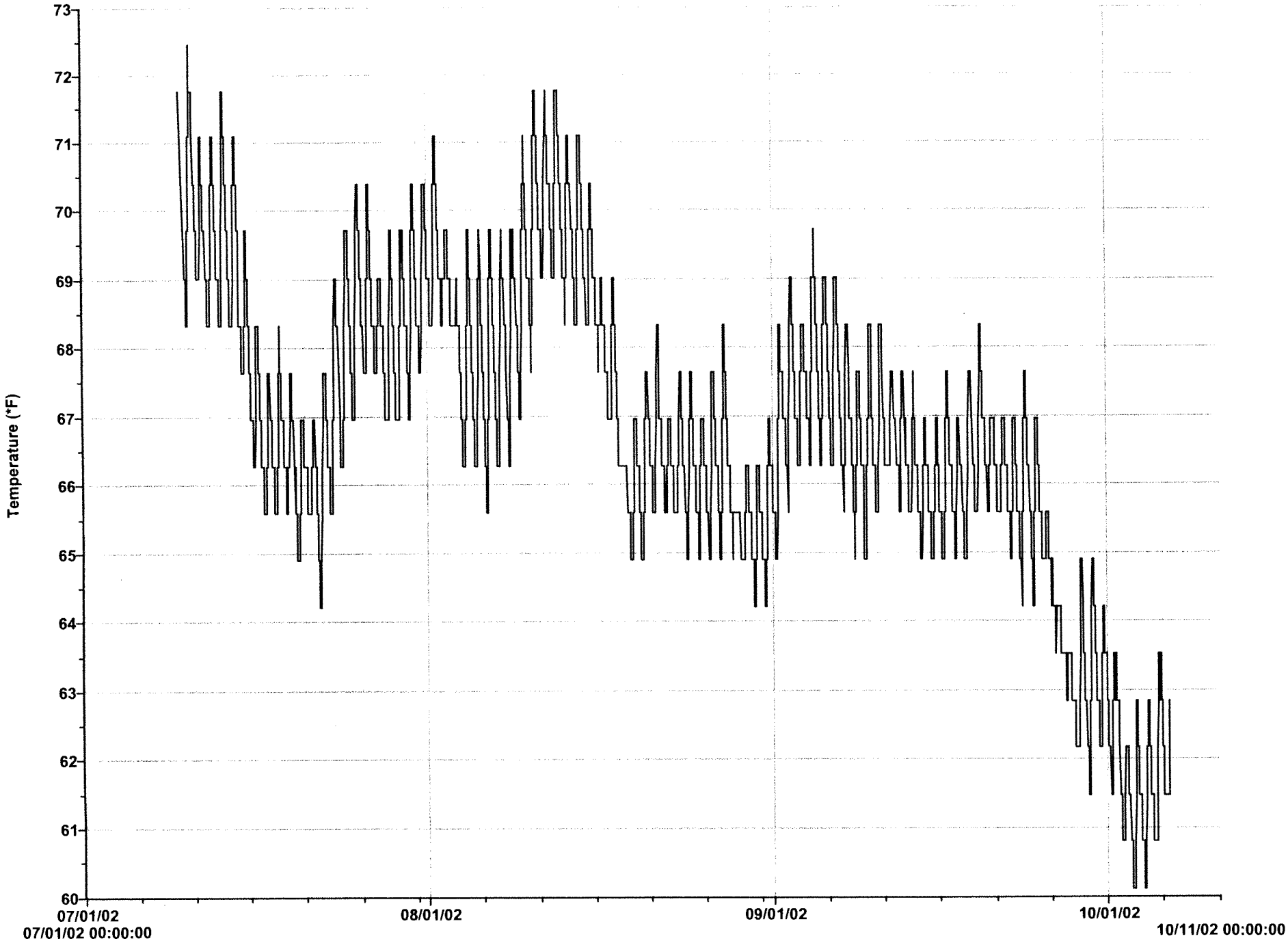


Figure 4n. Water Temp. (*F) Above Trestle 4.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

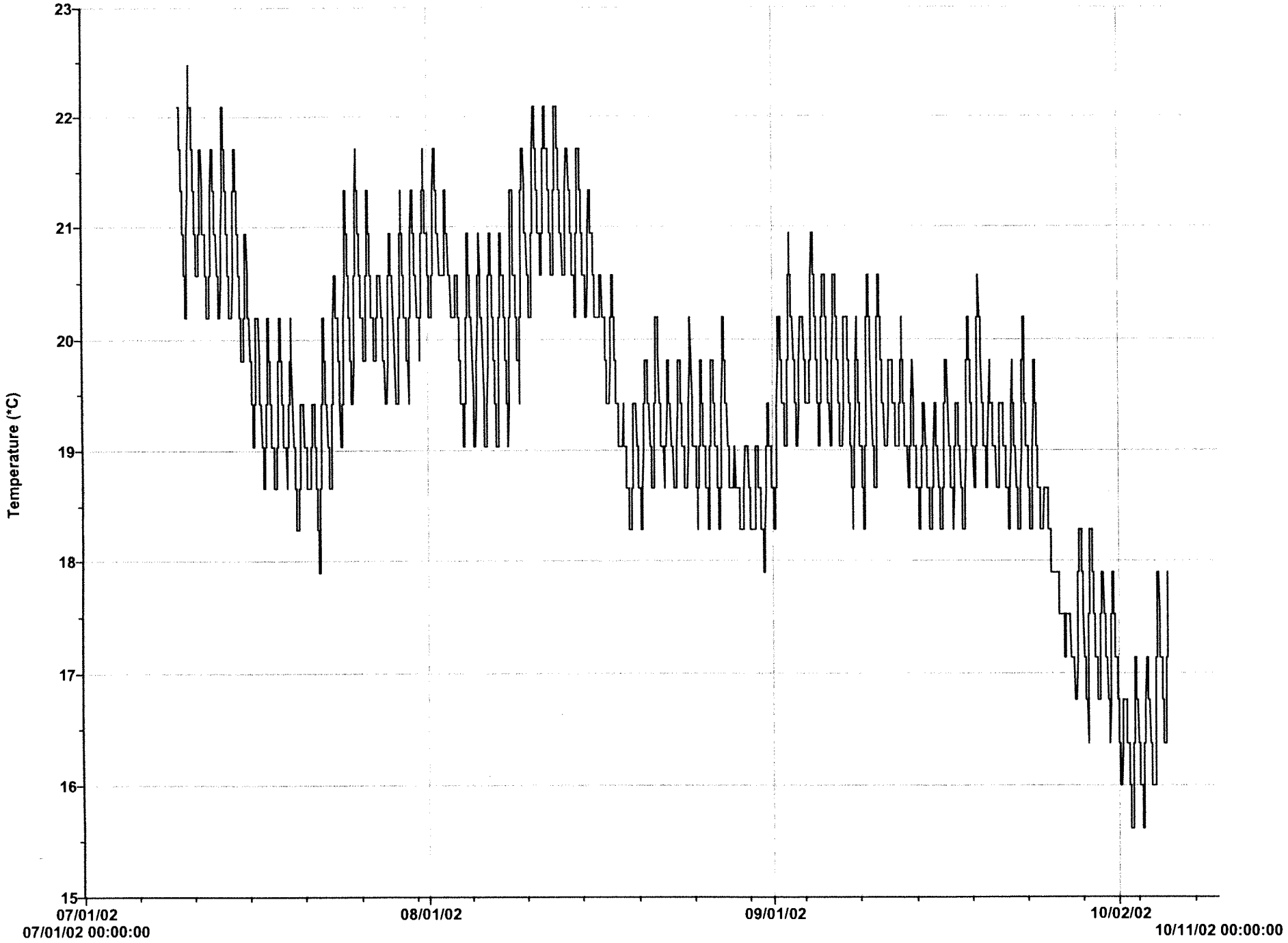


Figure 4o. Water Temp. (*C) Above Trestle 5.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

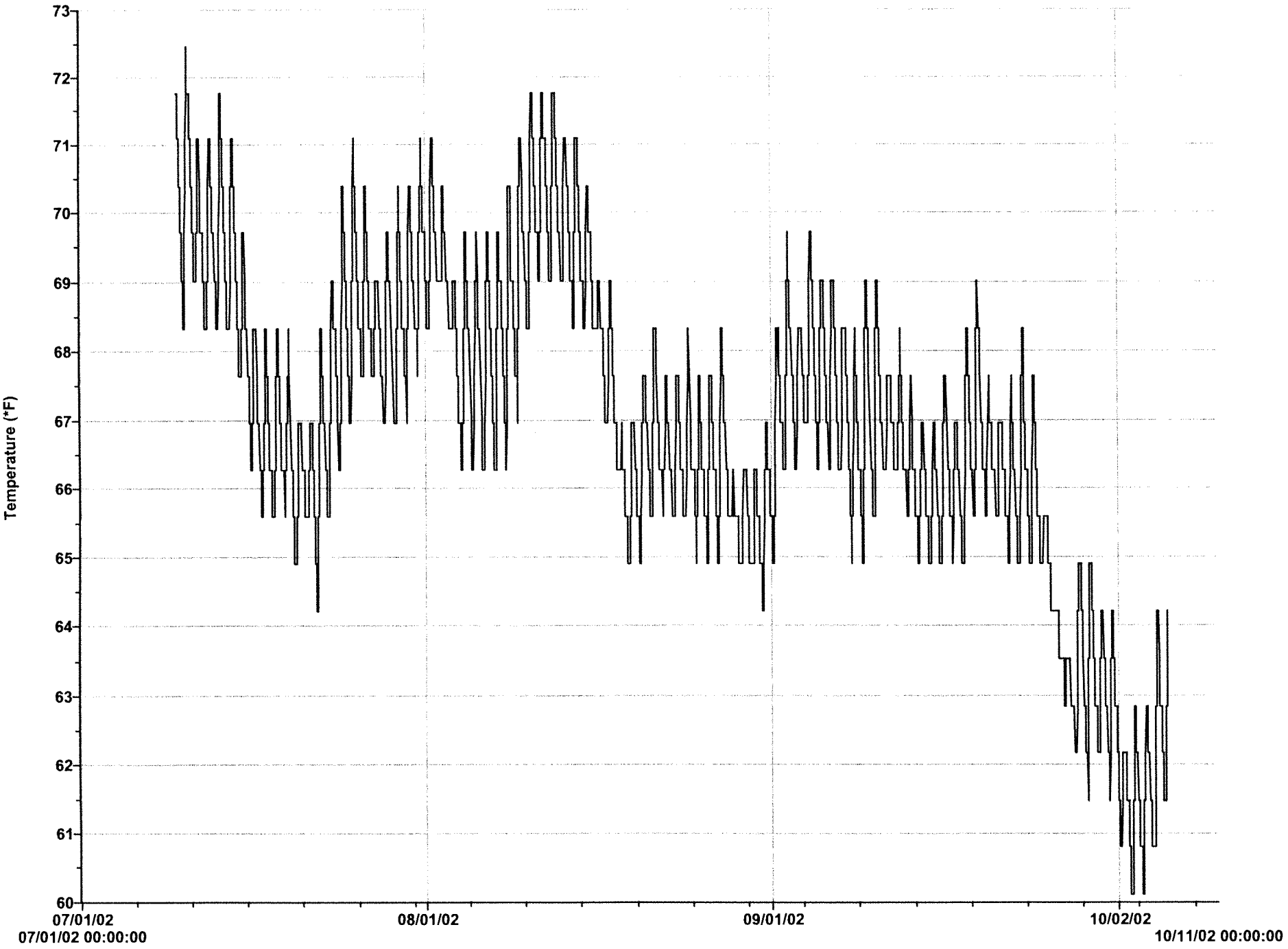


Figure 4p. Water Temp. (*F) Above Trestle 5.5 ft from Bottom, 9 Jul-6 Oct 2002, 30-min Interval

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

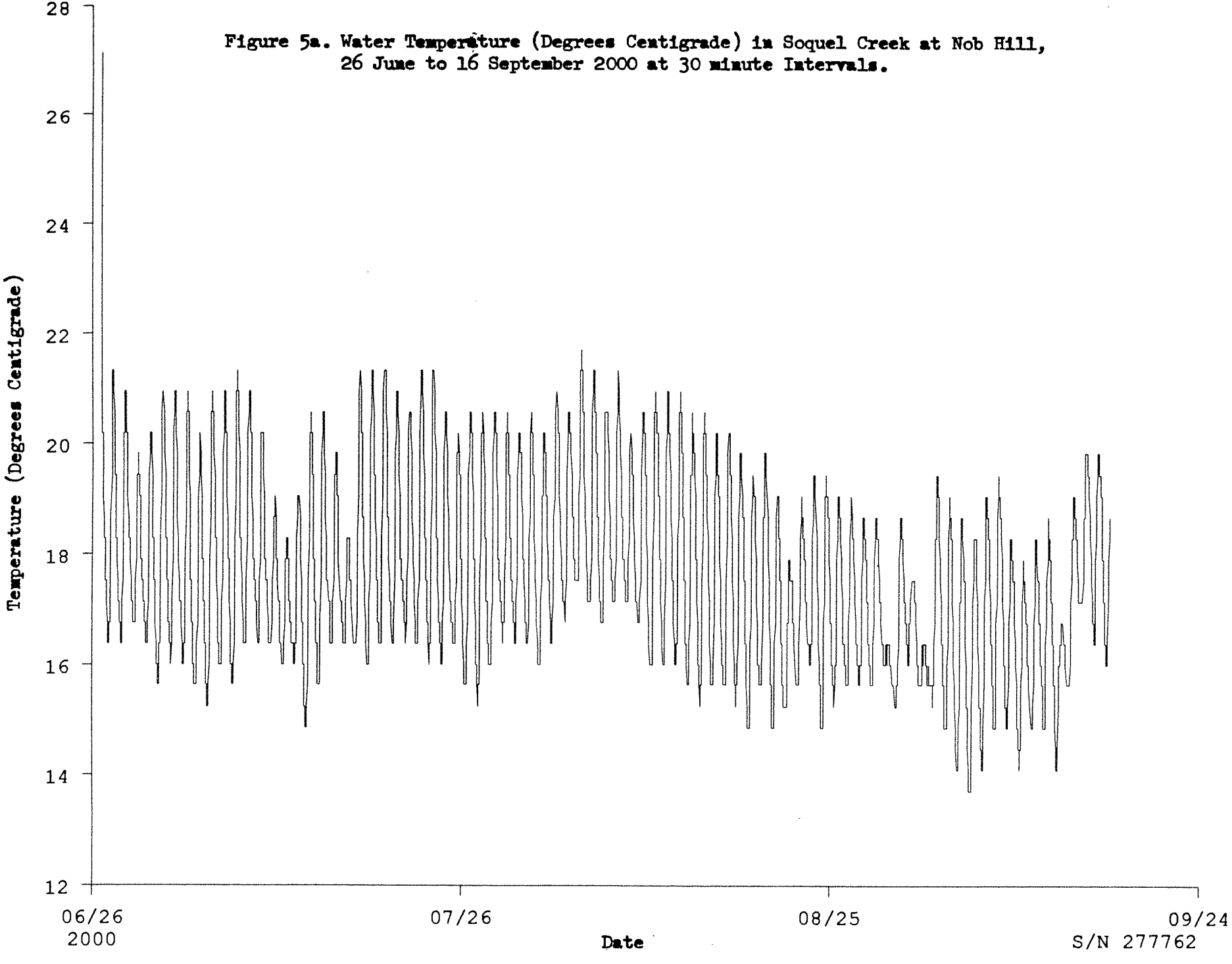


Figure 5b. Water temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

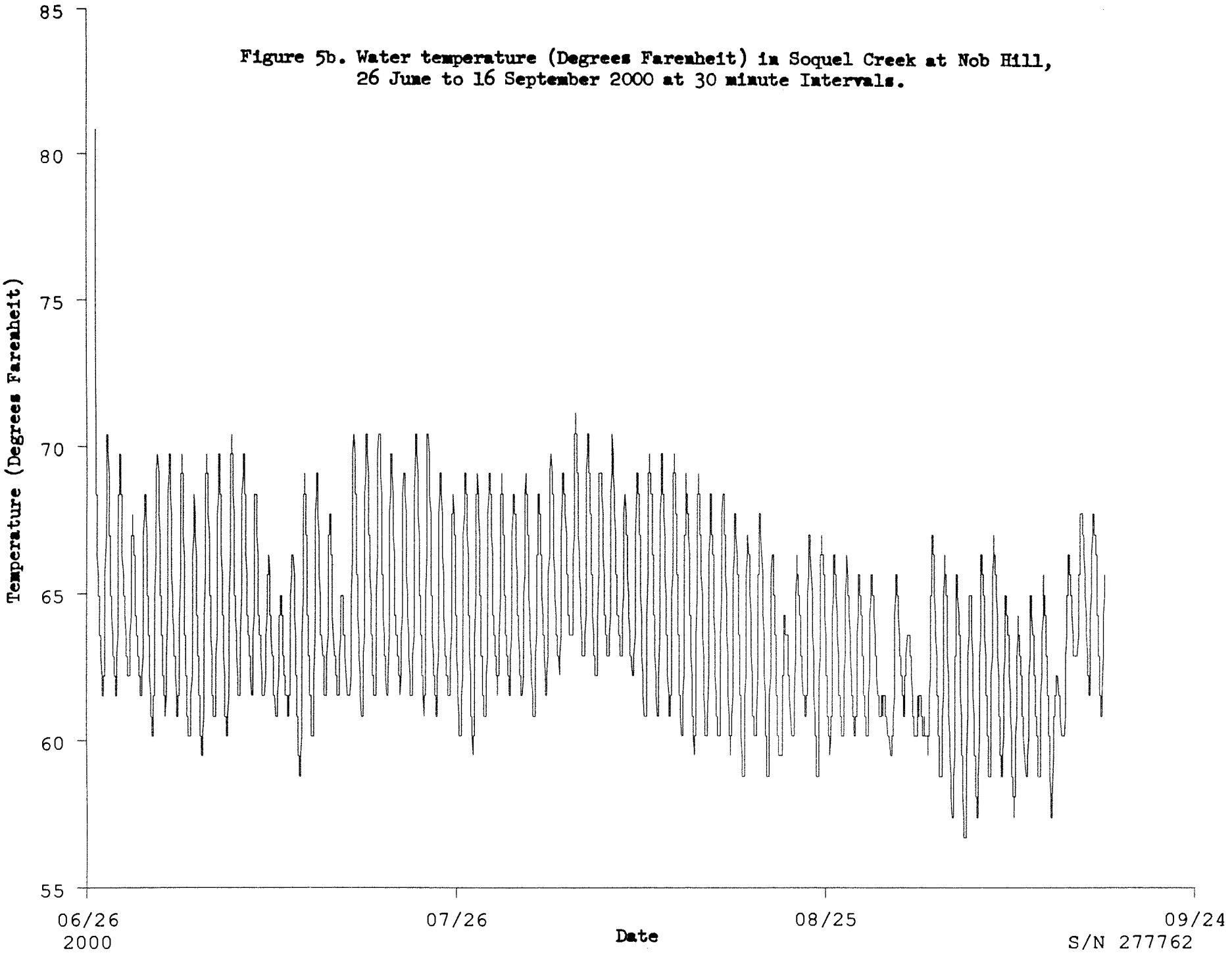


Figure 5c. Water Temperature (Degrees Celsius) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.

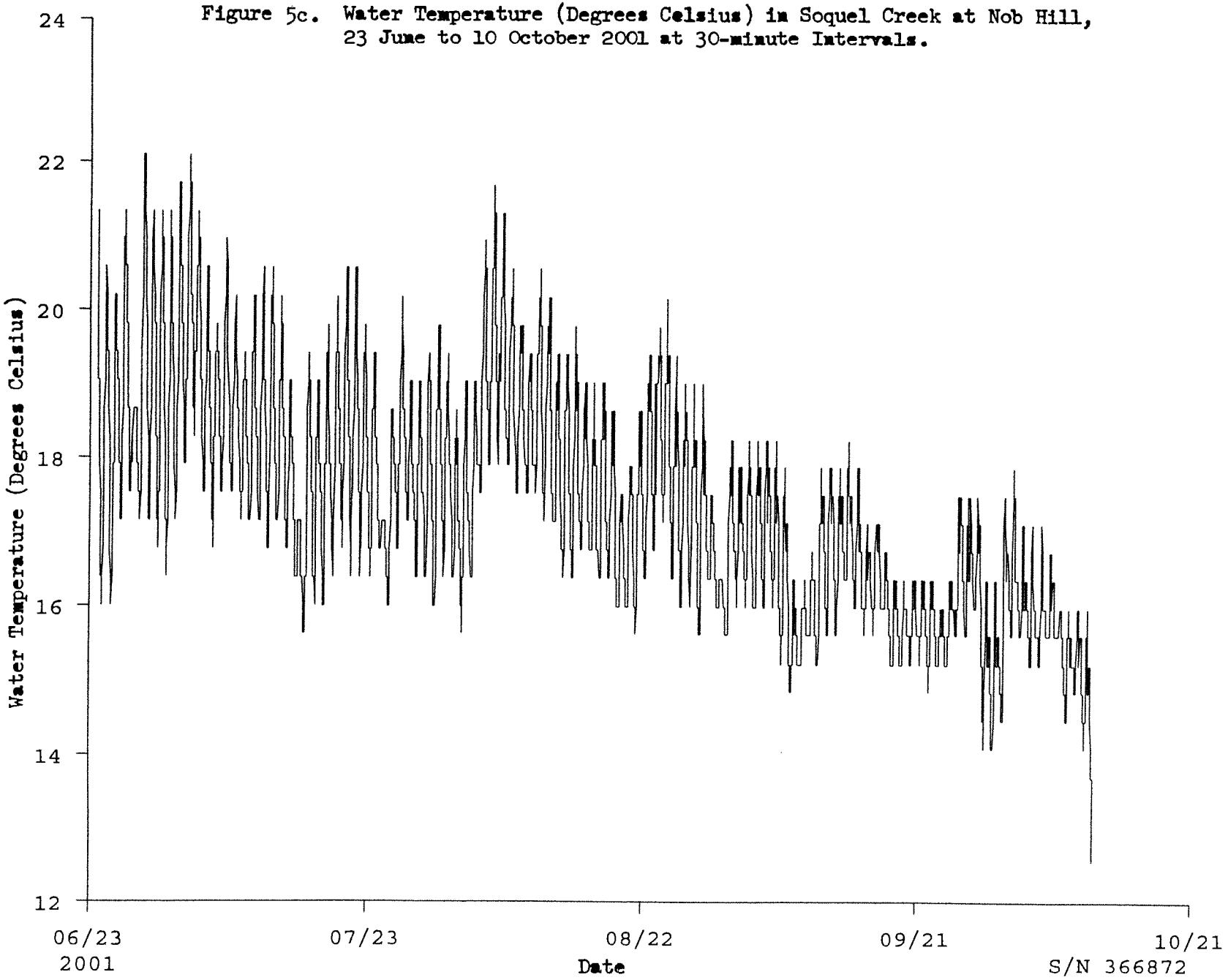
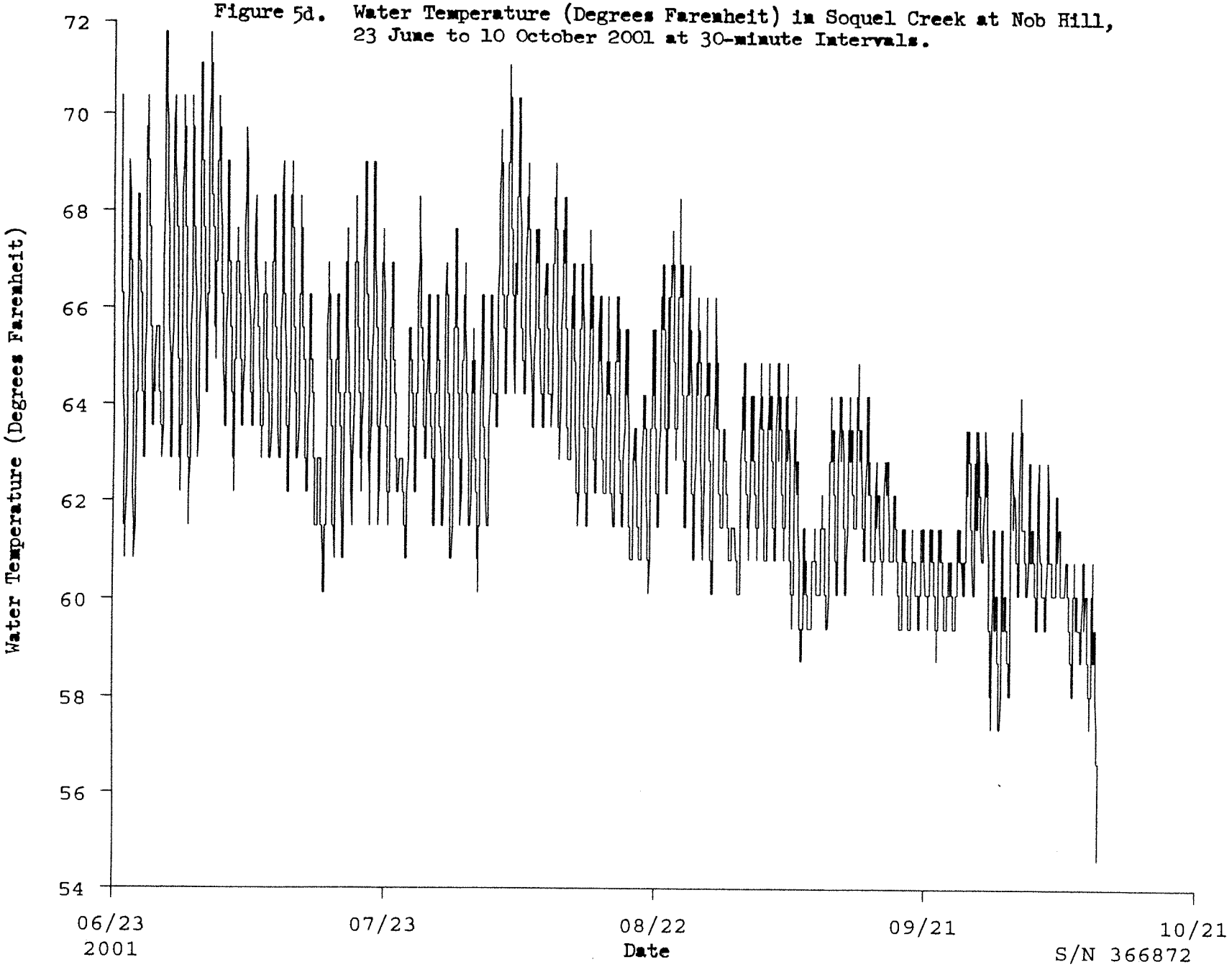


Figure 5d. Water Temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.



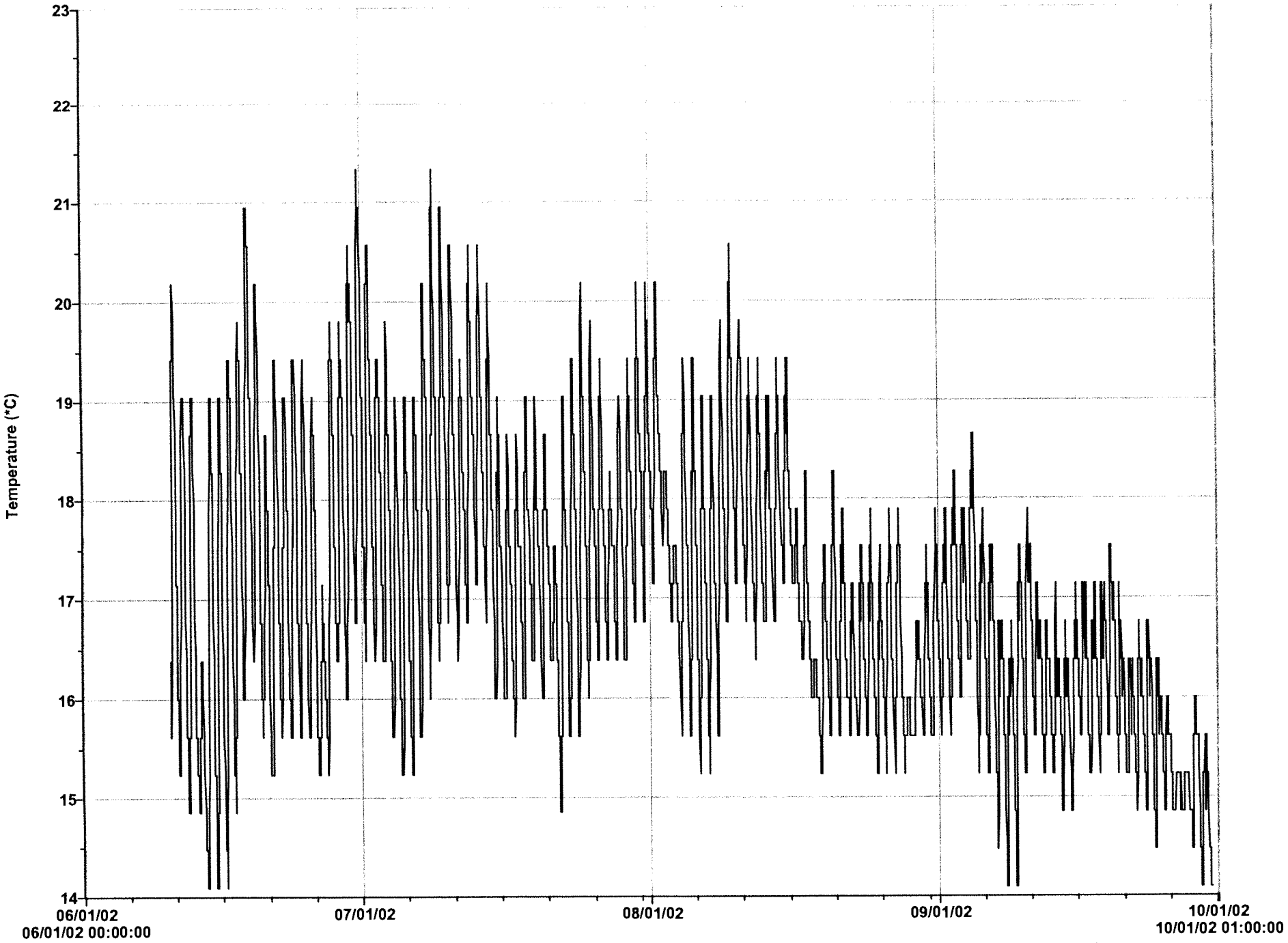


Figure 5e. Water Temp. (*C) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

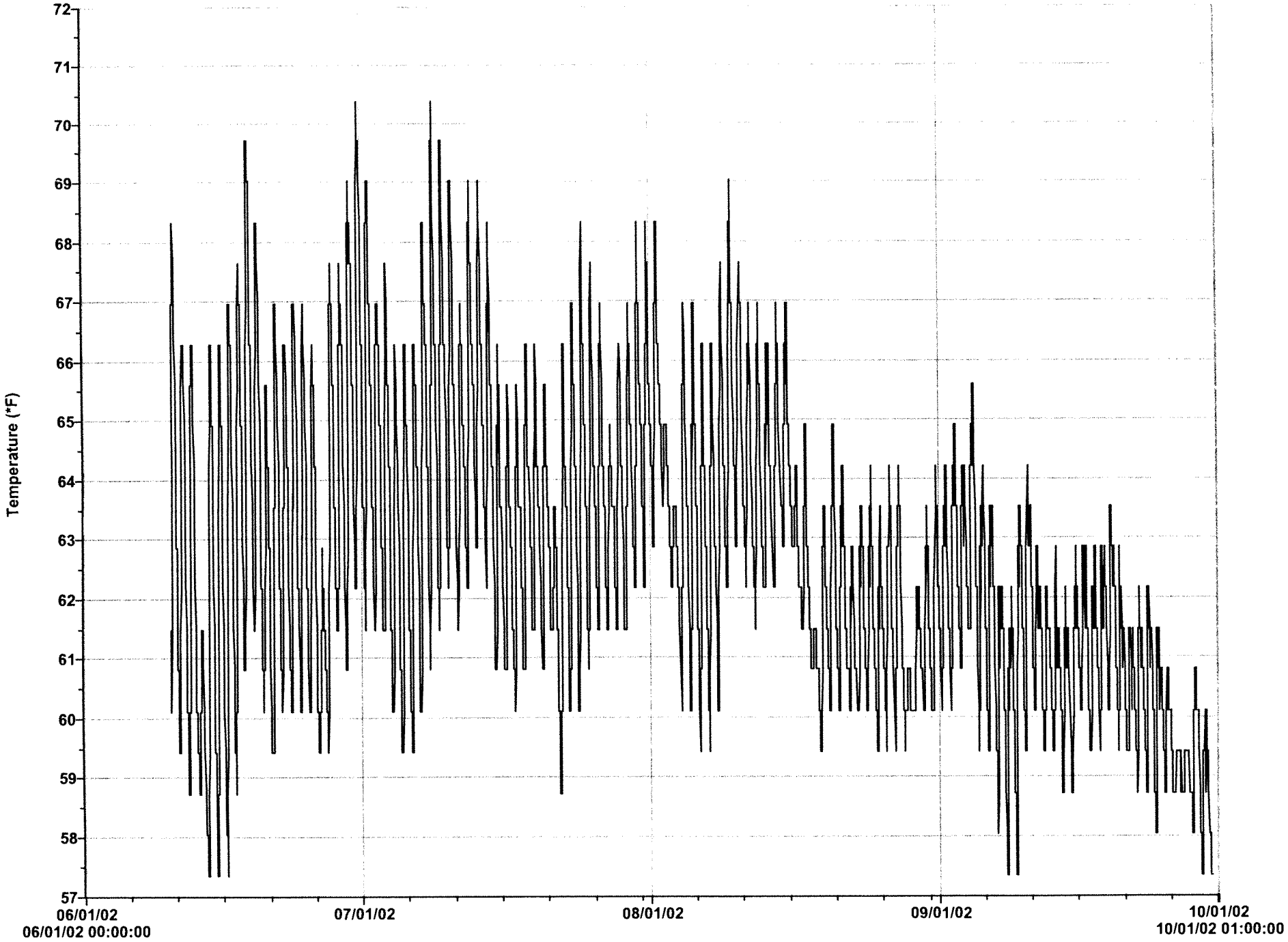


Figure 5f. Water Temp. (*F) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

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

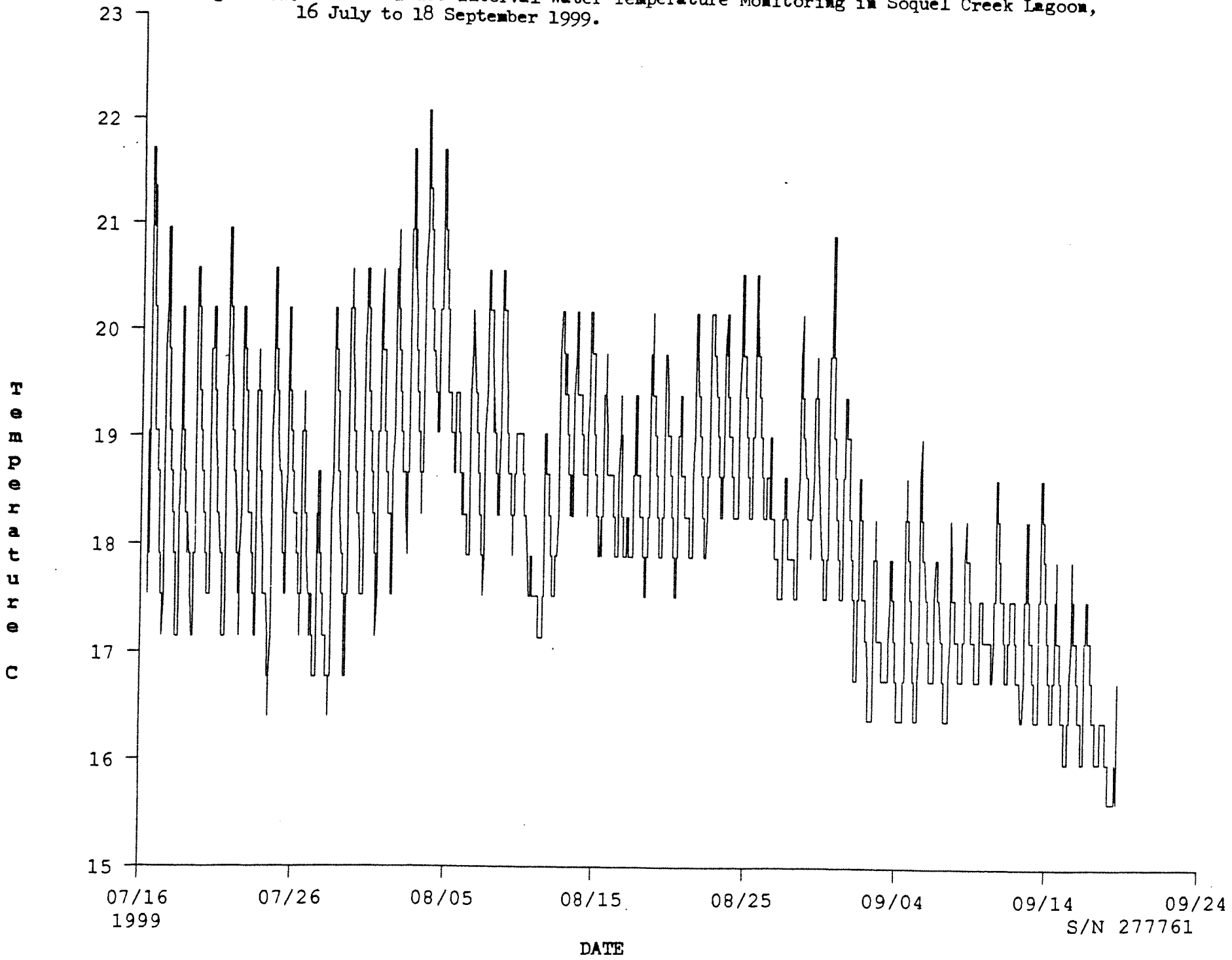


Figure 6b. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek at Nob Hill, 16 July to 18 September 1999.

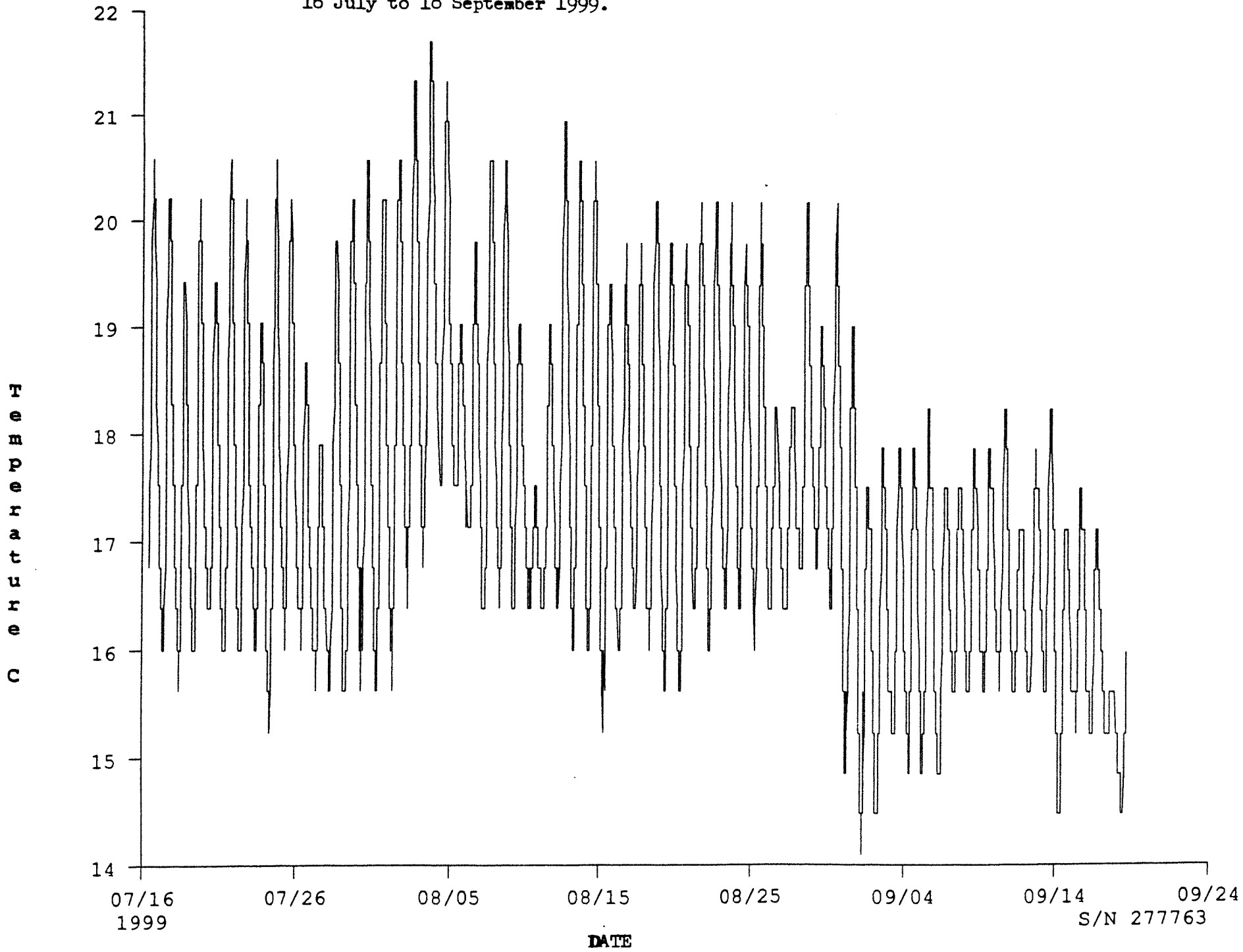


Figure 6c. Hourly Water Temperature Monitoring at Nob Hill on Soquel Creek, July 23 - September 4, 1998.

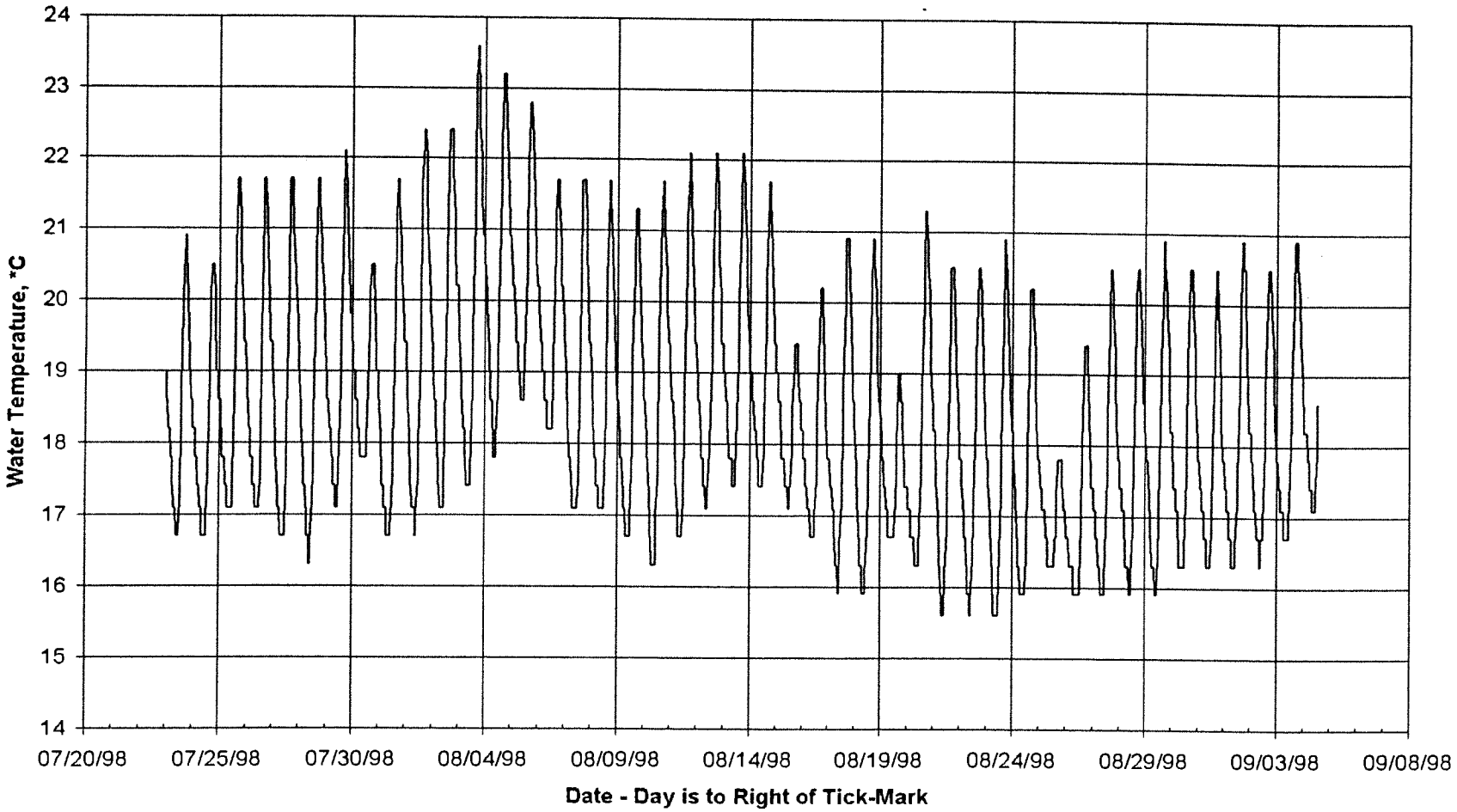


Figure 7. Soquel Lagoon Oxygen Concentration at Dawn, 29 June - 8 October 2001, Within 0.25 Meters of the Bottom at 4 Stations.

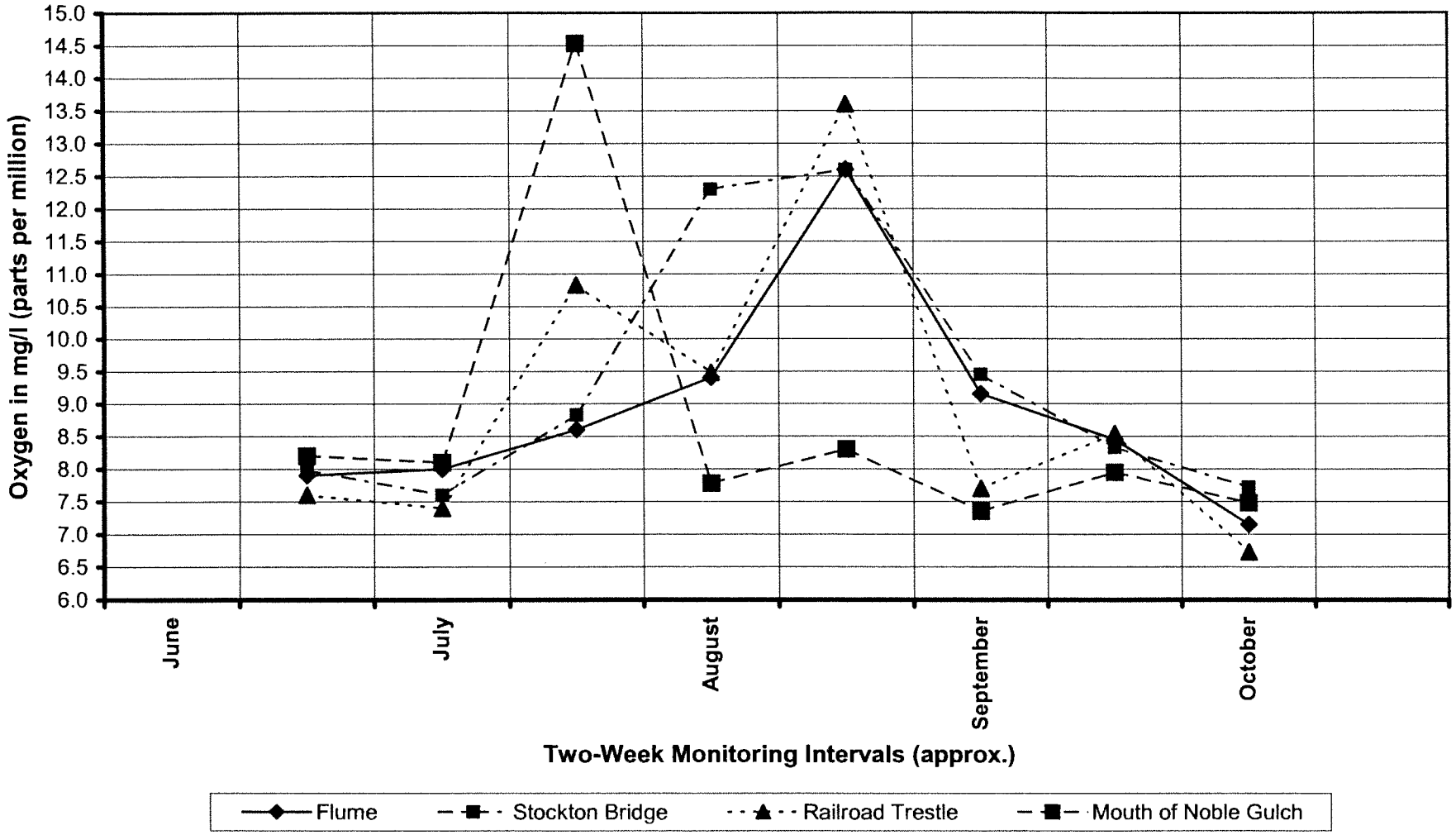


Figure 8. Soquel Lagoon Oxygen Concentration at Dawn, 10 June - 25 October 2002, Within 0.25 Meters of the Bottom at 4 Stations.

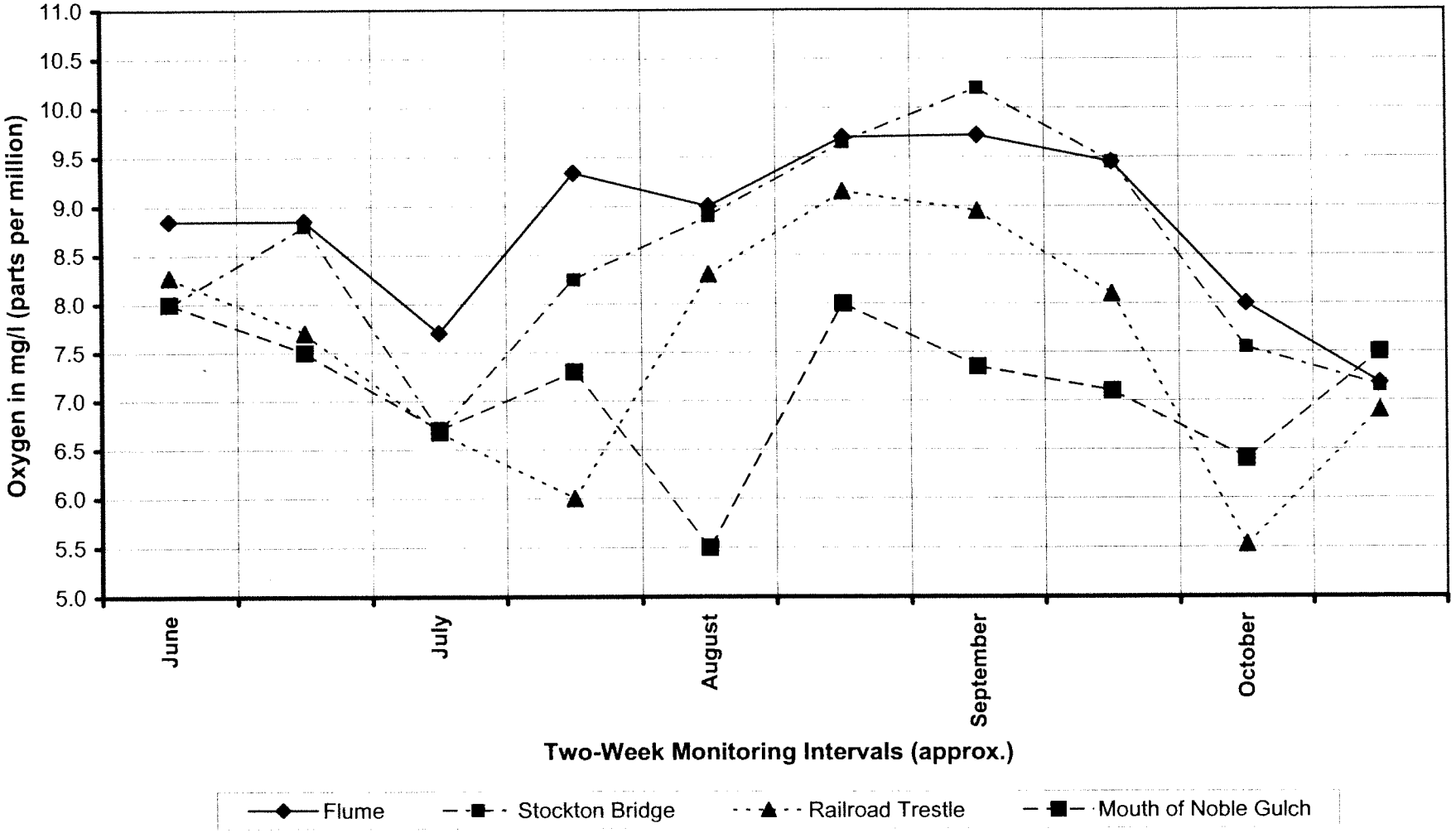


Figure 9. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002, in Soquel Lagoon.

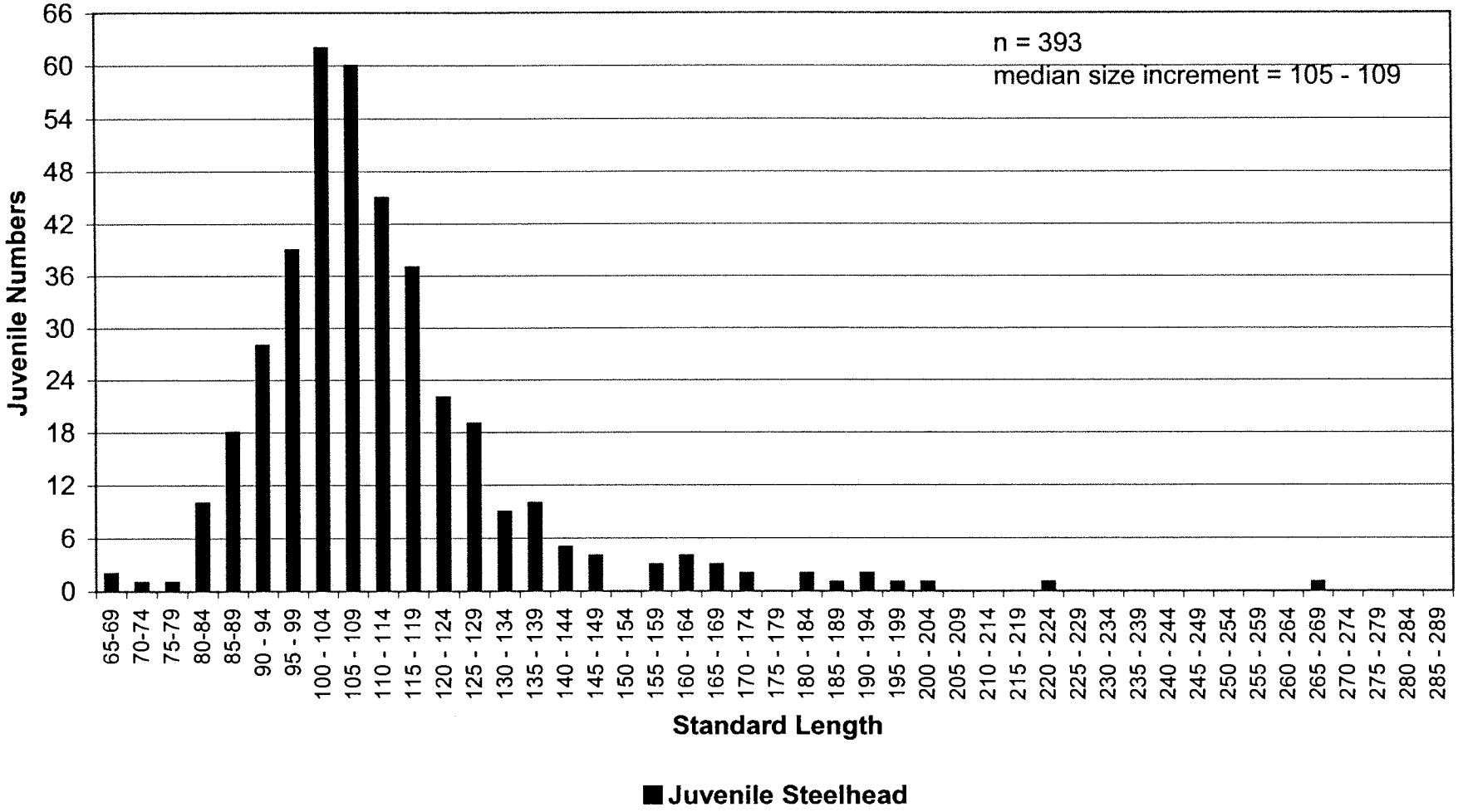


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001, in Soquel Lagoon.

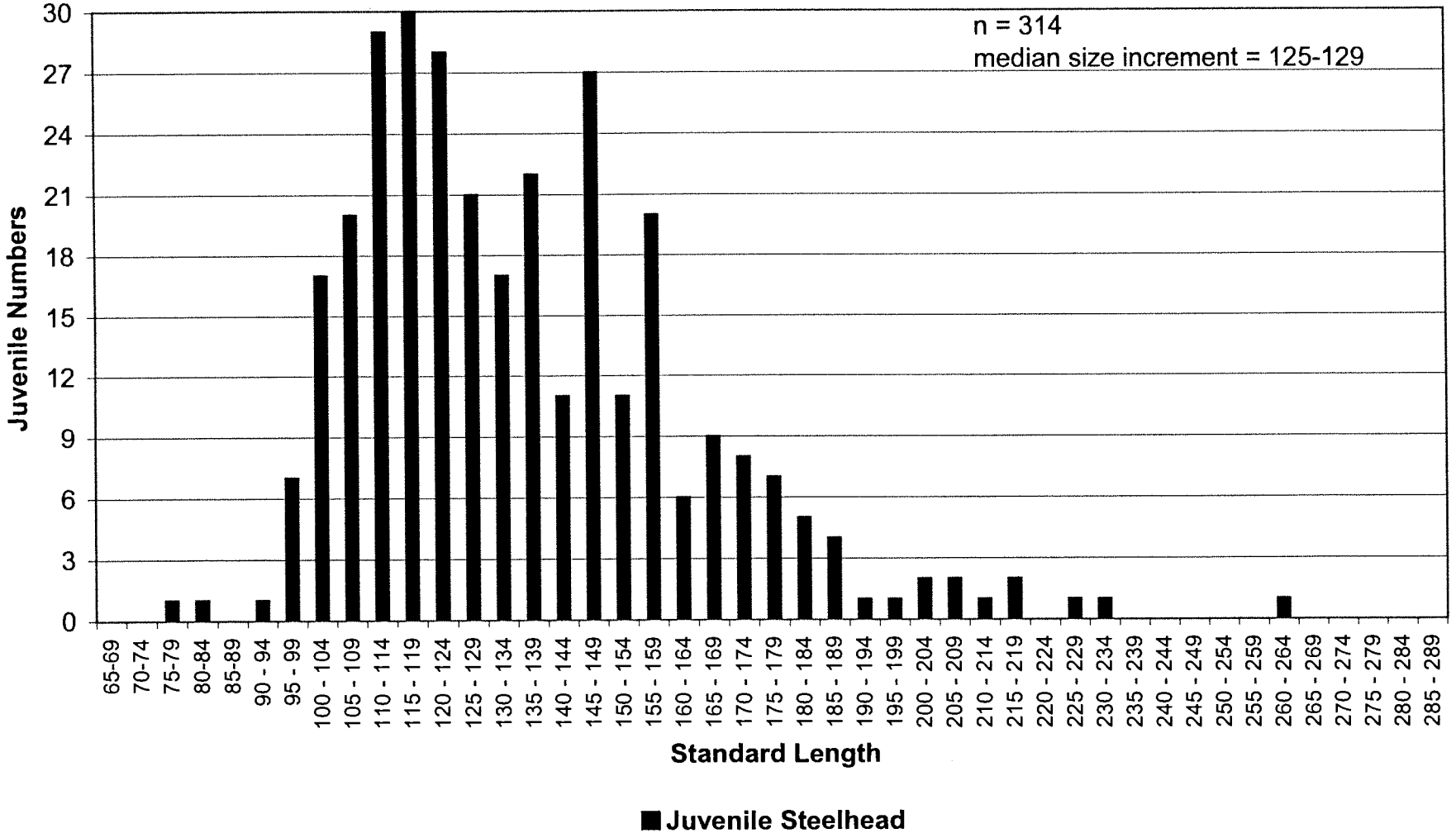


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000, in Soquel Lagoon.

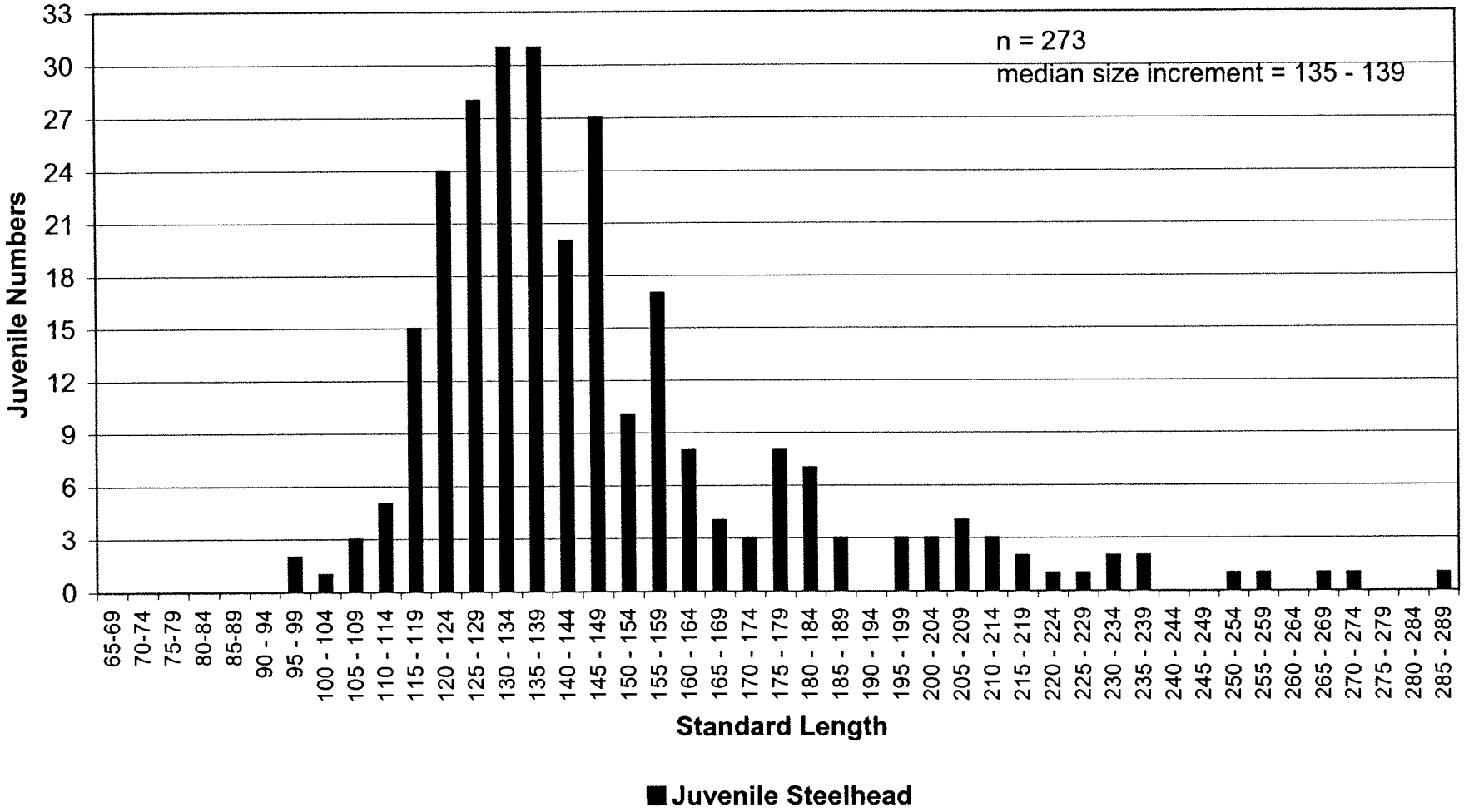


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999, in Soquel Lagoon.

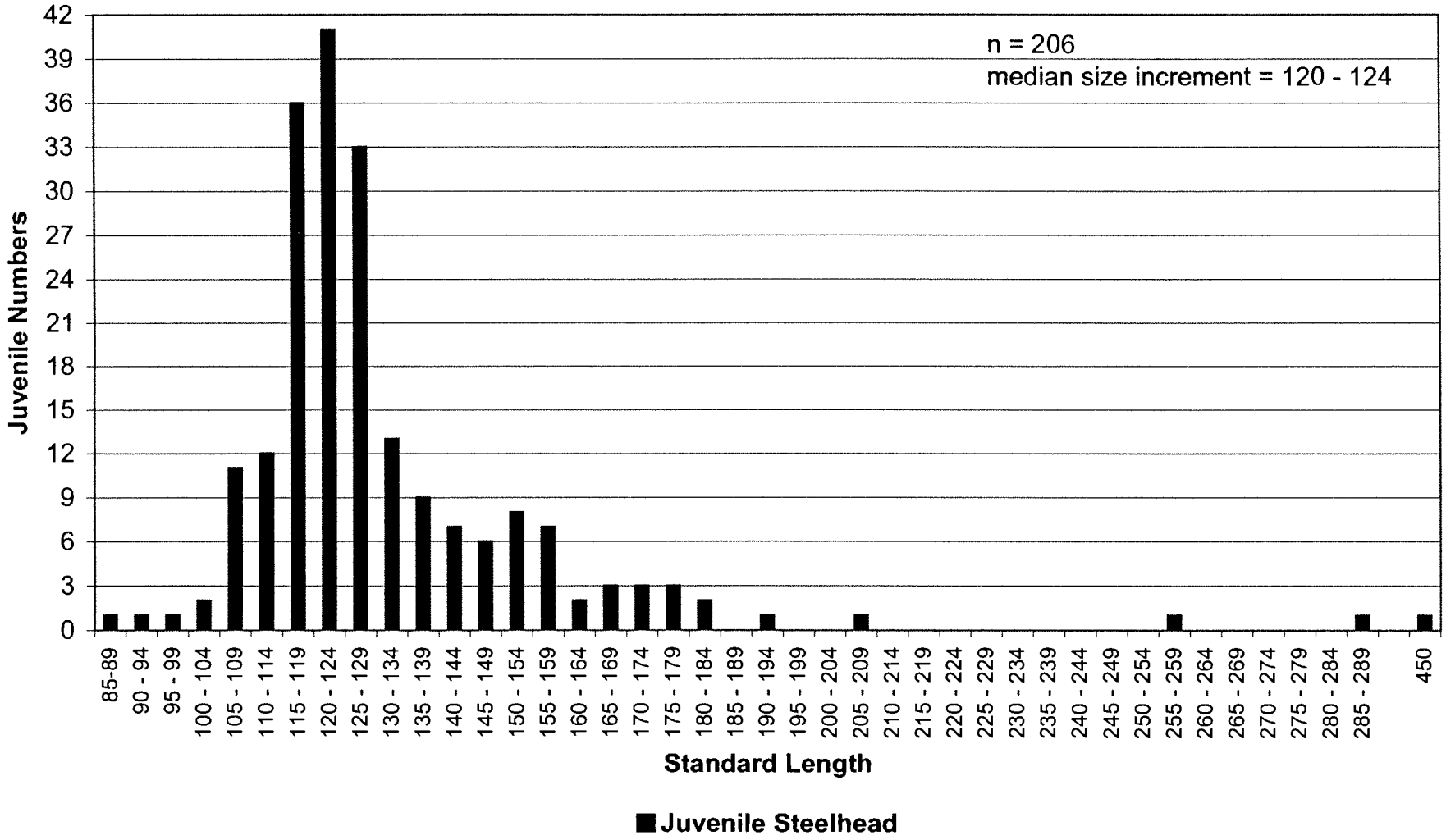


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

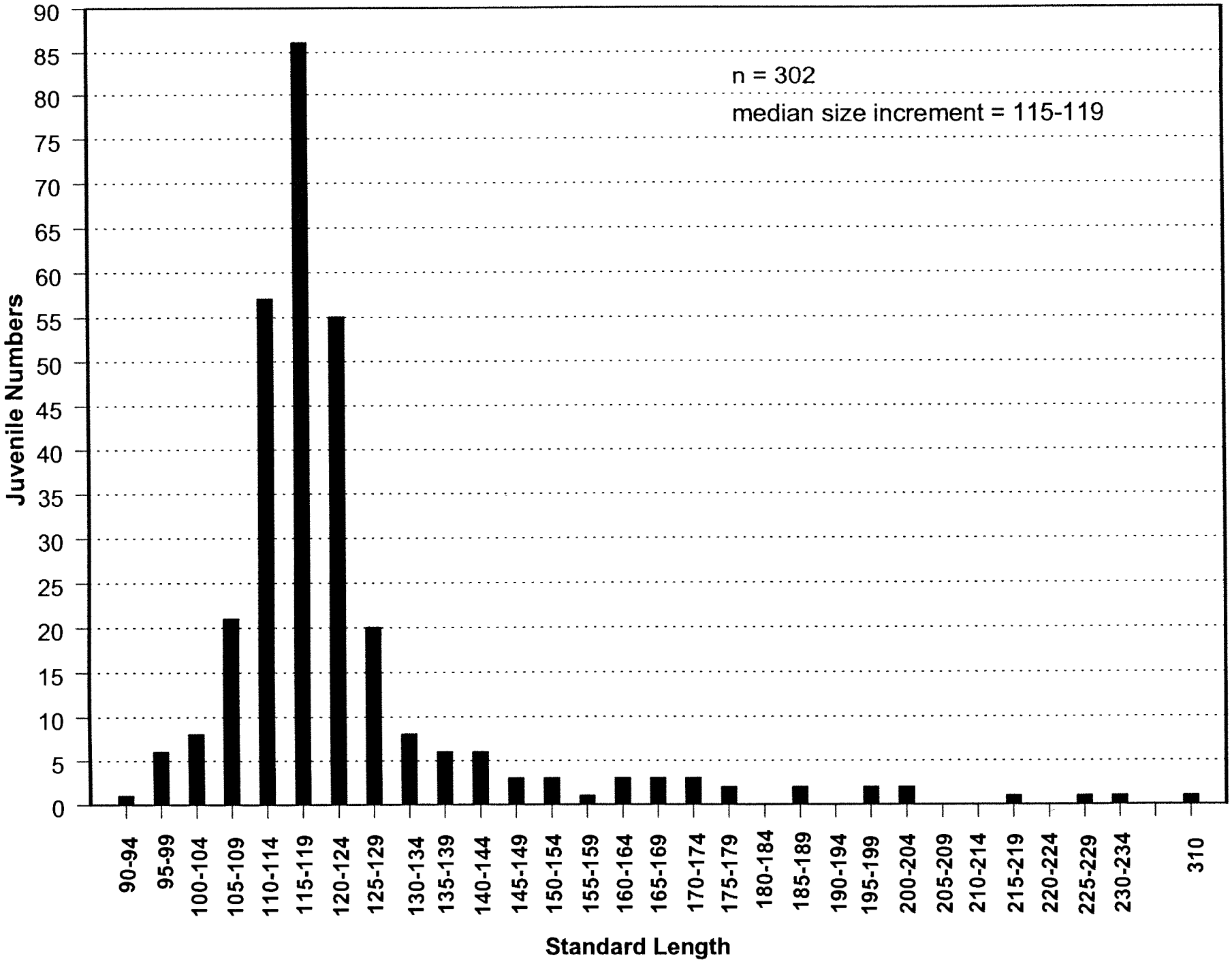
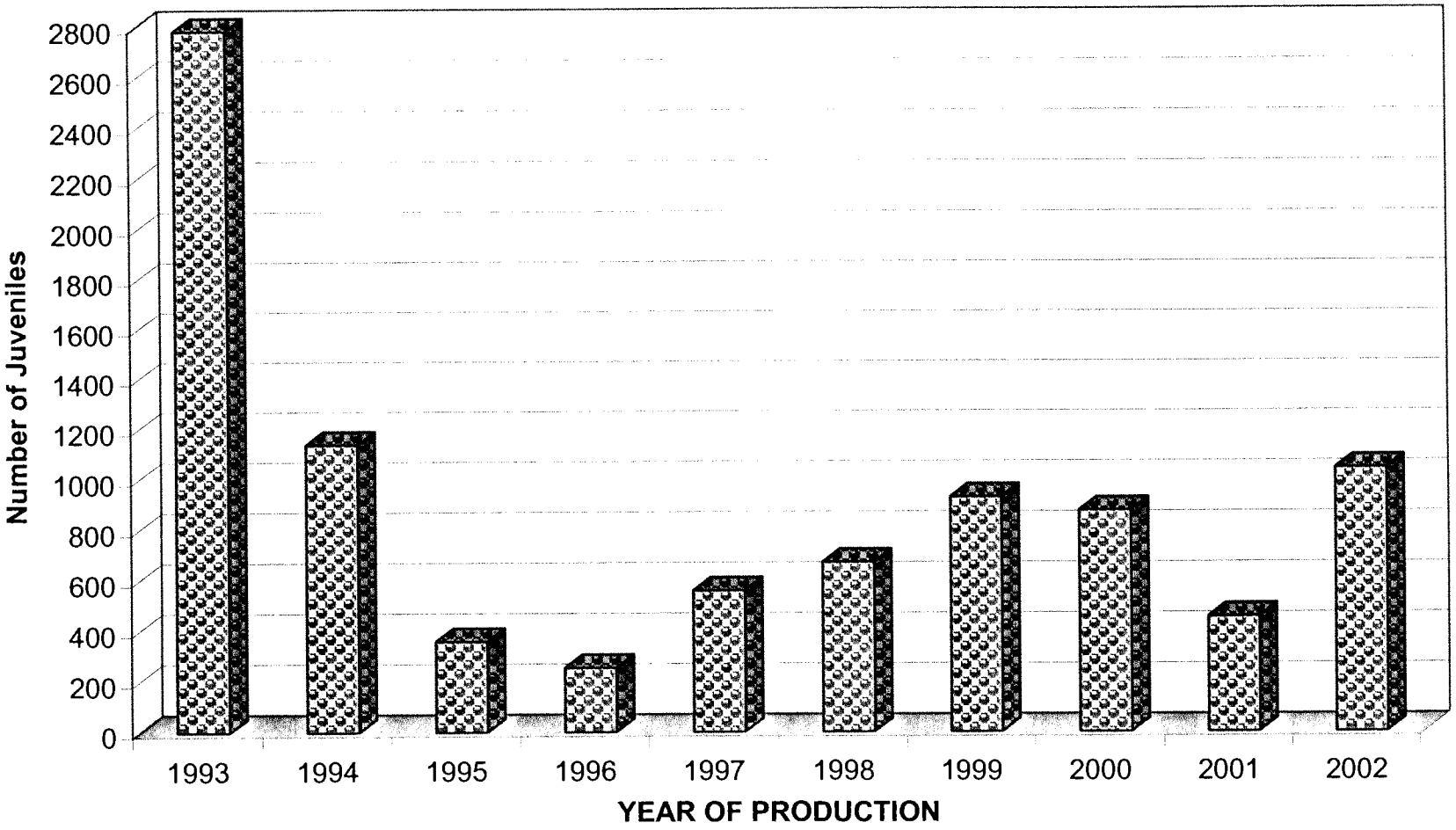


Figure 14. Juvenile Steelhead Production in Soquel Creek Lagoon, 1993-2002, Estimated by Mark and Recapture



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION, 30 MAY – 25 OCTOBER 2002.

30-May-02								
	Flume				Stockton Avenue Bridge			1335hr
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00					21.0	0.0		620.00
0.25					20.8	0.0		620.00
0.50					20.4	0.0		610.00
0.75					20.3	0.0		600.00
1.00					19.5	0.0		600.00
1.25					19.2	0.1		640.00
1.50					19.2	0.2		750.00
1.75					21.3	15.5		23200.00
Bottom2.00					21.8	16.0		28500.00

30-May-02								
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00								
0.25								
0.50								
0.75								
1.00								
1.25								
1.50								

24 May 2002. Gage height of 1.68.
30 May 2002. Gage height of 2.14.

Station 2: Stockton Avenue Bridge at 1335 hr. Secchi depth to bottom. 1 adult steelhead observed under the bridge, approximately 30 inches in length.

	4-Jun-02							1303hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	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

	4-Jun-02							
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00								
0.25								
0.50								
0.75								
1.00								
1.25								
1.50								

Gage Height of 2.46

0717hr			10-Jun-02				0737hr
	Flume				Stockton Avenue Bridge		
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00	17.2	0.0	8.75	600	17.8	0.0	8.55	580
0.25	17.2	0.0	8.75	600	17.8	0.0	8.40	580
0.50	17.2	0.0	8.80	600	17.8	0.0	8.28	580
0.75	17.2	0.0	8.85	600	17.8	0.0	8.20	580
1.00	17.2	0.0	8.85	600	17.8	0.0	8.10	580
1.25	17.2	0.0	8.80	600	17.8	0.0	7.98	580
1.50					17.8	0.0	7.98	580
1.75					17.7	0.0	7.98	580
2.00					17.7	0.0	0.20	600

0804hr			10-Jun-02				0820hr
	Railroad Trestle				Mouth of Noble Gulch		
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00	17.3	0.0	8.58	570	17.2	0.0	7.58	580
0.25	17.5	0.0	8.40	570	17.3	0.0	7.65	580
0.50	17.5	0.0	8.35	570	17.3	0.0	7.65	580
0.75	17.2	0.0	8.20	570	17.3	0.0	7.55	580
1.00	17.2	0.0	8.27	570	17.3	0.0	7.50	580
1.25	17.2	0.0	5.20	570	17.3	0.0	8.00	580
1.35					16.7	0.0	6.30	560

10 June 2002. Gage height of 2.44. Sunny. Air temperature of 12.5°C. Flume inlet with shroud in place; outlet 1.3 feet deep. Storm drain pipe on Esplanade capped. Hobo temperature sensors placed in the lagoon below the trestle at 1000 hr and in Soquel Creek at Nob Hill at 1030 hr.

Station 1: Flume at 0715 hr. Reach 1- no surface algae, film on bottom, phytoplankton bloom in all three reaches. Adult steelhead near bridge.

Station 2: Stockton Avenue Bridge at 0737 hr. Leaf debris on surface from windstorm. Reach 2- no surface algae, thick film on bottom.

Station 3: Railroad Trestle at 0804 hr. Reach 3- no surface algae, thick film on bottom. In Reach 3- Female Merganser and 4 young observed 100m above trestle, 1 Great blue heron, 14 mallards and 1 Pied-billed grebe.

Station 4: Mouth of Noble Gulch at 0820 hr. Reach 3- no surface algae, film on bottom. 1 Gull perched on cottonwood across from Gulch.

Station: Nob Hill at 0957 hr. Water temperature 15.2°C. Conductivity 560 umhos.

0640hr				1-Jul-02				0700hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 Umhos
0.00	19.8	0.0	9.10	660	20.3	0.0	9.30	650
0.25	19.9	0.0	9.10	660	20.5	0.0	9.25	650
0.50	19.9	0.0	9.10	660	20.6	0.0	9.16	650
0.75	19.8	0.0	9.10	660	20.8	0.0	9.00	650
1.00	19.8	0.0	8.85	660	20.8	0.0	8.96	650
1.15	19.8	0.0	7.64	670				
1.25					20.8	0.0	8.95	650
1.50					20.8	0.0	8.90	650
1.75					20.8	0.0	8.80	650
2.00					20.8	0.0	1.35	660

0720hr				1-Jul-02				0820hr
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos
0.00	19.8	0.0	8.18	660	19.2	0.0	7.90	620
0.25	20.0	0.0	8.38	660	19.3	0.0	7.65	620
0.50	20.2	0.0	7.90	660	19.5	0.0	7.65	620
0.75	20.2	0.0	7.85	660	19.5	0.0	7.55	620
1.00	20.2	0.0	7.70	660	19.5	0.0	7.50	620
1.25	20.2	0.0	4.50	660	18.7	0.0	5.55	620

1 July 2002. Gage height of 2.35. Patchy fog and clear. Sunny previous day and 85°F. Air temperature of 13.8°C (56.8°F) at 0640 hr. Flume outlet at 0.8 ft depth. Shroud in place on east side, portal in flashboards for adult passage. Stainless-steel covers under sidewalk grates, cap in place on Esplanade storm drain.

Station 1: Flume at 0640 hr. No surface algae. Cannot see bottom. 4 Mallards, 3 Mergansers observed feeding in Reaches 1 and 2 at 0900 hr.

Station 2: Stockton Avenue Bridge at 0700 hr. Fog rolling in. Secchi depth to bottom. No surface algae in Reach 2; 30% bottom covered with 0.6-2 ft thick algae. Cannot see pondweed.

Station 3: Railroad Trestle at 0720 hr. Reach 3- no surface algae. 50% bottom covered with 0.6-2 ft thick algae. Cannot see pondweed.

Station 4: Mouth of Noble Gulch at 0820 hr. No surface algae. 30% of bottom covered with 1-2 ft thick algae. 2 turtles on cottonwood.

Station: Nob Hill at 1000 hr. Water temperature 17.8 °C. Conductivity 620 umhos. Estimated streamflow of 2.5- 3 cfs.

0715 hr					15-Jul-02				0737 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	19.8	0.0	7.85	650	20.0	0.0	7.90	670	
0.25	19.9	0.0	7.82	660	20.2	0.0	7.85	670	
0.50	19.9	0.0	7.82	660	20.2	0.0	7.78	670	
0.75	19.9	0.0	7.82	660	20.3	0.0	7.78	670	
1.00	19.9	0.0	7.70	660	20.3	0.0	7.75	670	
1.05	19.9	0.0	6.25	680					
1.25					20.3	0.0	7.23	670	
1.50					20.3	0.0	6.70	670	
1.75					20.3	0.0	0.20	680	

0756 hr					15-Jul-02				0815 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos	
0.00	19.8	0.0	7.10	660	18.8	0.0	6.80	640	
0.25	20.0	0.0	7.10	660	19.0	0.0	6.96	650	
0.50	20.2	0.0	7.10	660	19.0	0.0	7.02	650	
0.75	20.3	0.0	6.90	660	19.0	0.0	6.85	620	
1.00	20.2	0.0	6.68	660	18.8	0.0	6.70	600	
1.20	20.2	0.0	4.02	660	18.3	0.0	4.95	620	

15 July 2002. Gage height of 1.98. Overcast. Air temperature at 14.6 °C. Flume exit at 0.8 ft. Shroud in place on flume inlet.

Station 1: Flume at 0715 hr. Reach 1- no surface algae. 60% of bottom covered by algae 1-2 ft thick. Steelhead jumping at 16 hits per minute. 4 Mergansers observed.

Station 2: Stockton Avenue Bridge at 0737 hr. Secchi depth to the bottom. Reach 2- no surface algae. 40% of bottom covered by algae 1-2 ft thick and 5% algae and pondweed 2-3 ft thick.

Station 3: Railroad trestle at 0756 hr. Reach 3- no surface algae. 50% of bottom covered by algae 1-2 ft thick and 10% algae and pondweed 2-3 ft thick.

Station 4: Mouth of Noble Gulch at 0815 hr. 2% surface algae. 50% of bottom covered by 0.5-2 ft of algae.

Station: Nob Hill at 0914 hr. Water temperature at 16.3°C. Conductivity 590 umhos, Oxygen 7.85 mg/l. Estimated streamflow approximately 2.5 cfs.

0728hr					30-Jul-02				0753hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	19.7	0.0	9.33	630	19.8	0.0	9.00	640	
0.25	19.8	0.0	9.40	630	20.0	0.0	8.85	640	
0.50	19.8	0.0	9.40	630	20.0	0.0	8.80	640	
0.75	19.8	0.0	9.40	630	20.0	0.0	8.70	640	
1.00	19.8	0.0	9.34	630	20.0	0.0	8.55	640	
1.25	19.8	0.0	6.70	630	20.0	0.0	8.40	640	
1.50					20.1	0.0	8.40	640	
1.75					20.1	0.0	8.25	640	
2.00					20.1	0.0	3.42	650	

0824hr					30-Jul-02				0841hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos	
0.00	19.5	0.0	8.35	650	19.2	0.0	8.90	620	
0.25	19.8	0.0	8.20	650	19.5	0.0	8.90	620	
0.50	20.0	0.0	8.20	650	19.5	0.0	9.00	620	
0.75	20.0	0.0	8.20	650	19.5	0.0	9.10	620	
1.00	20.0	0.0	7.90	650	19.5	0.0	7.23	620	
1.25	20.0	0.0	6.00	650	19.2	0.0	7.30	580	
1.32	20.0	0.0	4.16	650	18.7	0.0	3.50	580	

30 July 2002. Gage height of 2.57. Overcast. Air temperature of 16.2°C. Flume outlet at 0.8 feet. Shroud removed. Underwater portal for adults sealed off. Saw no mergansers.

Station 1: Flume at 0728 hr. Reach 1- no surface algae. 60% of bottom covered with algae 1-2 ft thick, and 20% algae and pondweed 2-3 ft thick. 5 mallards observed.

Station 2: Stockton Avenue Bridge at 0753 hr. Secchi depth to bottom. Reach 2- no surface algae. 40% of bottom covered with algae 1-2 ft thick, and 10% algae and pondweed 1-3 ft thick, remainder has film. 5 mallards observed.

Station 3: Railroad Trestle at 0824 hr. Reach 3- no surface algae. 50% of bottom covered with algae 1-2 ft thick, and 20% algae and pondweed 2-4 ft thick, remainder has film. 32 mallards and 1 goose observed.

Station 4: Mouth of Noble Gulch at 0841 hr. No surface algae. 80% of bottom covered by algae 1-2 ft thick, and 20% algae and pondweed 2-3 ft thick.

Station: Nob Hill at 0950 hr. Water temperature 17.5 °C. Conductivity 560 umhos, Oxygen 8.72 mg/l. Estimated streamflow of 2.25 cfs.

0729 hr					12-Aug-02				0752hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 Umhos	
0.00	20.2	0.0	9.00	680	21.0	0.0	9.20	680	
0.25	20.4	0.0	9.10	680	21.2	0.0	9.10	680	
0.50	20.5	0.0	9.10	680	21.2	0.0	9.10	680	
0.75	20.5	0.0	9.10	680	21.2	0.0	9.10	680	
1.00	20.6	0.0	9.00	680	21.3	0.0	9.05	680	
1.2	20.9	0.0	7.60	680					
1.25					21.2	0.0	9.05	680	
1.50					21.2	0.0	8.90	680	
1.75					21.2	0.0	8.90	680	
2.00					21.3	0.0	3.45	680	

0814 hr					12-Aug-02				0829hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos	
0.00	20.0	0.0	8.45	680	19.4	0.0	7.80	650	
0.25	20.5	0.0	8.40	680	19.8	0.0	7.90	640	
0.50	20.7	0.0	8.48	680	19.8	0.0	7.80	640	
0.75	20.8	0.0	8.26	680	19.8	0.0	7.75	640	
1.00	20.9	0.0	8.30	680	19.7	0.0	5.50	640	
1.25	21.0	0.0	8.30	680	19.6	0.0	2.10	630	
1.30	21.0	0.0	5.25	670					

12 August 2002. Gage height of 2.52. Foggy. Air temperature of 12.5 °C. Flume outlet at 0.8 feet.

Station 1: Flume at 0729 hr. Reach 1- no surface algae. 70% of bottom covered by algae 1-2 ft thick, and 30% algae and pondweed 2-4 ft thick. Hundreds of gulls on beach.

Station 2: Stockton Avenue Bridge at 0752 hr. Reach 2- no surface algae. 80% of bottom covered by algae 0.6-2 ft thick, and 20% algae and pondweed 2-3.5 ft thick.

Station 3: Railroad Trestle at 0814 hr. Reach 3- no surface algae. 65% of bottom covered by algae 1-2 ft thick, and 35% algae and pondweed 2-4 ft thick. 1 Pied-billed grebe.

Station 4: Mouth of Noble Gulch at 0829 hr. No surface algae. 70% of bottom covered by algae 1-2 ft thick, and 30% algae and pondweed 2-3 ft thick. 1 Merganser on downed cottonwood.

Station: Nob Hill at 0932 hr. Water temperature of 16.7 °C . Conductivity of 600 umhos, Oxygen 8.30 mg/l. Estimated streamflow of 2 cfs.

0710 hr			26-Aug-02				0735 hr	
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00	18.0	0.0	9.75	620	18.3	0.0	9.96	620
0.25	18.3	0.0	9.70	620	18.5	0.0	9.80	620
0.50	18.5	0.0	9.70	620	18.7	0.0	9.80	620
0.75	18.5	0.0	9.70	620	18.7	0.0	9.80	620
1.00	18.5	0.0	9.70	620	18.7	0.0	9.75	620
1.25	18.5	0.0	6.35	620	18.7	0.0	9.75	620
1.50					18.8	0.0	9.65	630
1.75					18.8	0.0	1.70	630

0800 hr			26-Aug-02				0815 hr	
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos
0.00	18.3	0.0	9.25	620	17.2	0.0	7.35	580
0.25	18.4	0.0	9.18	620	17.6	0.0	7.90	580
0.50	18.5	0.0	9.18	620	17.7	0.0	7.88	580
0.75	18.5	0.0	9.20	620	17.7	0.0	7.00	580
1.00	18.6	0.0	9.20	620	17.7	0.0	8.00	580
1.25	18.6	0.0	9.15	620	17.7	0.0	5.40	580
1.30	18.6	0.0	5.90	620				

26 August 2002. Gage height 2.53. Overcast. Air temperature of 12 °C. Flume outlet at 0.9 ft. No mergansers observed.

Station 1: Fume at 0710 hr. Reach 1- no surface algae. 40% bottom covered by algae 1-2 ft thick, 20% algae and pondweed 2.5-4 ft thick, 40% thick film in shallows. 4 mallards observed. Beach covered by gulls with 30-40 bathing in the lagoon.

Station 2: Stockton Avenue Bridge at 0735 hr. Secchi depth to bottom. Reach 2- no surface algae. 70% of bottom covered by algae 1-3 ft thick, 30% algae and pondweed 2.5-4 ft thick. 7 mallards and 3 geese observed. We gained 2 geese!

Station 3: Railroad Trestle at 0800 hr. Reach 3- no surface algae. 60% bottom covered by algae 2-3 ft thick, and 40% algae and pondweed 2.5-4 ft thick. 4 mallards and 3 geese moved had moved upstream.

Station 4: Mouth of Noble Gulch at 0815 hr. 1% surface algae. Bottom covered by 60% algae 1-2.5 ft thick, and 40% algae and pondweed 2-3 ft thick. 5 mallards roosting on cottonwood.

Station: Nob Hill at 0920 hr. Water temperature 15.2°C. Conductivity 580 umhos, Oxygen 8.50 mg/l. Estimated streamflow 1.75-2 cfs.

0710 hr			1-Sep-02					0732 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 Umhos
0.00	18.4	0.0	9.90	630	18.4	0.0	10.40	630
0.25	18.6	0.0	10.00	630	18.6	0.0	10.20	630
0.50	18.6	0.0	10.00	630	18.7	0.0	10.30	630
0.75	18.7	0.0	9.75	630	18.8	0.0	10.30	630
1.00	18.7	0.0	9.72	630	18.9	0.0	10.30	630
1.20	18.9	0.0	6.90	630				
1.25					18.9	0.0	10.40	630
1.50					18.9	0.0	10.30	630
1.75					18.9	0.0	10.20	630
2.00					19.0	0.0	3.15	630

0755 hr			1-Sep-02					0810 hr
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos
0.00	18.2	0.0	9.10	630	17.6	0.0	8.25	580
0.25	18.3	0.0	9.18	630	17.8	0.0	8.30	580
0.50	18.4	0.0	9.15	630	17.8	0.0	8.40	580
0.75	18.5	0.0	9.20	630	17.8	0.0	8.45	580
1.00	18.5	0.0	9.25	630	17.8	0.0	7.35	570
1.25	18.6	0.0	8.95	630	17.8	0.0	5.05	560
1.32	18.6	0.0	5.55	630				

1 September 2002. Begonia Festival Day. Gage height of 2.53. Foggy. Air temperature of 13.2 °C . Flume outlet at 1.1 ft.

Station 1: Flume at 0710 hr. Too dark to estimate plant life on bottom in Reach 1. 1Black-crowned night-heron and 1 Pied-billed grebe observed.

Station 2: Stockton Avenue Bridge at 0732 hr. Secchi depth to bottom. Reach 2- 5% surface algae. 70% bottom covered by algae 1-2 ft thick, and 30% algae and pondweed 3-4 ft thick – hedge cropped by mallards.

Station 3: Railroad Trestle at 0755 hr. Reach 3- 5% surface algae. 60% of bottom covered by algae 1-2 ft thick, and 40% algae and pondweed 2-4 ft thick.

Station 4: Mouth of Noble Gulch at 810 hr. No surface algae. 60% bottom covered by algae 2 ft thick, and 40% algae and pondweed 2-3 ft thick. 1 Pied-billed grebe observed.

Station: Nob Hill at 0920 hr. Sunny. Water temperature 16 °C. Conductivity 570 umhos, Oxygen 8.70 mg/l. Estimated streamflow 1.5-1.75 cfs.

	1-Sep-02							1515 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00					20.8	0.0		630
0.25					20.6	0.0		630
0.50					20.6	0.0		630
0.75					20.4	0.0		630
1.00					20.4	0.0		630
1.25					20.4	0.0		630
1.50					20.3	0.0		630
1.75					20.3	0.0		630
2.00					20.3	0.0		630

1535 hr	1-Sep-02							
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00	21.0			630				
0.25	20.8			630				
0.50	20.8			630				
0.75	20.5			630				
1.00	20.4			630				
1.25	20.3			630				
1.32	20.2			630				

1 September 2002. After the Begonia Festival. Gage height of 2.55. Sunny and windy. Air temperature of 23.8°C.

Station 2: Stockton Avenue Bridge at 1515 hr. Secchi depth to bottom.

	4-Sep-02							0808 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00					19.7	0.0	9.73	620
0.25					19.8	0.0	9.60	620
0.50					19.8	0.0	9.63	620
0.75					19.8	0.0	9.68	620
1.00					19.8	0.0	9.58	620
1.25					19.8	0.0	9.45	620
1.50					19.8	0.0	9.55	620
1.75					19.9	0.0	9.50	620
2.00					20.0	0.0	6.25	630

0828 hr	4-Sep-02							
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00	19.6	0.0	8.05	620				
0.25	19.8	0.0	7.90	620				
0.50	19.8	0.0	7.98	620				
0.75	19.8	0.0	7.98	620				
1.00	19.8	0.0	7.98	620				
1.25	19.8	0.0	7.80	620				
1.30	19.8	0.0	4.67	620				

4 September 2002. Gage height of 2.53. Overcast. Air temperature of 17.5 °C at 0814 hr.

Station 2: Stockton Avenue Bridge at 0808 hr. Secchi depth to bottom.

0712 hr					17-Sep-02				0737 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	18.2	0.0	9.50	580	18.3	0.0	9.75	610	
0.25	18.3	0.0	9.40	580	18.6	0.0	9.60	610	
0.50	18.3	0.0	9.30	580	18.8	0.0	9.60	610	
0.75	18.3	0.0	9.45	580	18.9	0.0	9.50	610	
1.00	18.2	0.0	9.45	580	18.9	0.0	9.53	610	
1.15	18.2	0.0	4.75	580					
1.25					18.9	0.0	9.45	610	
1.50					18.9	0.0	9.45	610	
1.75					18.9	0.0	5.05	610	
807				17-Sep-02					819
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos	
0.00	18.0	0.0	8.46	610	17.5	0.0	7.40	580	
0.25	18.4	0.0	8.25	610	17.7	0.0	7.15	570	
0.50	18.5	0.0	8.30	610	17.8	0.0	7.15	570	
0.75	18.6	0.0	8.30	610	17.8	0.0	7.15	570	
1.00	18.6	0.0	8.25	610	17.6	0.0	7.10	570	
1.25	18.6	0.0	8.10	610	17.5	0.0	5.20	550	
1.30	18.7	0.0	5.15	610					

17 September 2002. Gage height of 2.48. 2.50 to top of flume. Overcast. Air temperature of 12.8 °C. Flume outlet 1.5 ft. Incoming tide.

Station 1: Flume at 0712 hr. Reach 1- no surface algae. 70% bottom covered by algae <0.5 ft thick, 20% algae and pondweed 3-4 ft thick, and 10% bare sand around margins. Occasional steelhead surface hits, gulls bathing, 1 cormorant present.

Station 2: Stockton Avenue Bridge at 0737 hr. Secchi depth to bottom. Reach 2- 5% surface algae. 30% bottom covered by algae 1 ft thick, 40% algae and pondweed 3-4 ft thick, and 30% bare sand. Occasional steelhead hits at surface. 2 coots observed.

Station 3: Railroad Trestle at 0807 hr. Reach 3- 5% surface algae. 60% bottom covered by algae 2-3 ft thick, 40% algae and pondweed 3-5 ft thick. Occasional steelhead hits.

Station 4: Mouth of Noble Gulch at 0819 hr. 5% surface algae. 70% bottom covered by algae 1-2 ft thick, and 30% algae and pondweed 3-4 ft thick. Occasional steelhead hits. 4 Mallard, 1 Pied-billed grebe, 1 Western grebe, 1 Belted kingfisher observed and Great blue heron perched on downed cottonwood across from the Gulch.

Station: Nob Hill at 0921 hr. Water temperature 16.6°C. Conductivity 570 umhos, Oxygen 8.05 mg/l. Estimated streamflow 1.5 cfs.

0730 hr					30-Sep-02				0750 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	16.7	0.0	8.20	580	16.7	0.0	7.94	580	
0.25	16.8	0.0	8.08	580	17.0	0.0	7.75	580	
0.50	16.8	0.0	8.05	580	17.1	0.0	7.70	580	
0.75	16.8	0.0	8.08	580	17.1	0.0	7.73	580	
1.00	17.0	0.0	8.00	580	17.2	0.0	7.64	580	
1.13	17.1	0.0	5.10	580					
1.25					17.2	0.0	7.65	580	
1.50					17.3	0.0	7.55	590	
1.75					17.3	0.0	3.50	600	

0815 hr					30-Sep-02				0830 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos	
0.00	16.6	0.0	6.38	580	16.1	0.0	6.50	570	
0.25	16.8	0.0	6.27	580	16.5	0.0	6.55	570	
0.50	16.9	0.0	6.23	580	16.5	0.0	6.48	570	
0.75	17.0	0.0	6.20	580	16.6	0.0	6.50	570	
1.00	17.0	0.0	6.25	580	16.6	0.0	6.40	570	
1.25	17.1	0.0	5.53	580	16.6	0.0	2.17	570	
1.30	17.1	0.0	4.34	580					

30 September 2002. Gage height of 2.56. Overcast. Air temperature of 13.5 °C . Flume outlet 0.6 ft deep. Sand filled 2/3 of outlet.

Station 1: Flume at 0730 hr. Too dark to estimate plant life on bottom in Reach 1. 1 Great blue heron on beach.

Station 2: Stockton Avenue Bridge at 0750 hr. Secchi depth to bottom, barely. Reach 2- no surface algae. 40% bottom covered by algae and pondweed 3-4 ft thick, with a thin algal film covering the remainder.

Station 3: Railroad Trestle at 0815 hr. Reach 3- no surface algae. 60% of bottom covered by algae 1 ft thick, and 40% algae and pondweed 3-4 ft thick.

Station 4: Mouth of Noble Gulch at 0830 hr. No surface algae. 30% of bottom covered by algae and pondweed 2-3 ft thick, too dark for seeing more. 1 Cormorant on cottonwood. Also in Reach 3- 1 Western grebe, 1 Pied-billed grebe, 4 Coots and 3 Mallards observed.

Station: Nob Hill at 1030 hr. Air temperature 15.6 °C , water temperature 14.5 °C . Conductivity 530 umhos, Oxygen 8.90 mg/l. Estimated streamflow 1.25 cfs.

0730 hr					25-Oct-02				0755 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 Umhos	
0.00	13.5	0.0	7.42	530	13.7	0.0	7.52	540	
0.25	13.6	0.0	7.38	530	13.8	0.0	7.32	540	
0.50	13.7	0.0	7.35	530	13.8	0.0	7.23	540	
0.75	13.7	0.0	7.28	530	13.9	0.0	7.24	540	
1.00	13.7	0.0	7.18	530	13.9	0.0	7.18	540	
1.12	13.8	0.0	4.70	530					
1.25					13.9	0.0	7.20	540	
1.50					13.9	0.0	7.27	540	
1.75					13.9	0.0	7.15	540	
2.00					14.0	0.0	4.90	550	
0823 hr					25-Oct-02				0841 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 Umhos	
0.00	13.4	0.0	7.03	530	13.2	0.0	7.30	520	
0.25	13.6	0.0	6.95	530	13.2	0.0	7.35	520	
0.50	13.6	0.0	6.95	530	13.3	0.0	7.44	520	
0.75	13.7	0.0	6.93	530	13.3	0.0	7.46	520	
1.00	13.7	0.0	6.90	530	13.3	0.0	7.50	520	
1.25	13.7	0.0	6.90	530	13.3	0.0	7.50	520	
1.32	13.7	0.0	4.45	530					
1.39					13.3	0.0	3.90	520	

25 October 2002. Gage height 2.66. Partly cloudy. Air temperature 9.8 °C. Flume outlet 1.3 ft. Bottom too dark to see algae alone throughout lagoon Restaurant worker from Beach House feeding bread to geese and ducks at 0720 hr. Pigeons congregating around door in walkway.
Station 1: Flume at 0730 hr. Reach 1- no surface algae. Bottom too dark for algae and pondweed estimate. 2 Cormorants observed.

Station 2: Stockton Avenue Bridge at 0755 hr. Secchi depth to bottom. Reach 2- no surface algae. 30% of bottom covered by algae and pondweed 2-4.5 ft thick.

Station 3: Railroad Trestle at 0823 hr. Reach 3- no surface algae. 30% of bottom covered by algae and pondweed 2-4.5 ft thick. 3 Geese observed.

Station 4: Mouth of Noble Gulch at 0841 hr. No surface algae. Bottom too dark. 2 Cormorants from Reach 1 now roosting on downed cottonwood. 1 Pied-billed grebe, Mallards and Coots observed.

Station: Nob Hill at 0940 hr. Water temperature 12.6 °C. Conductivity 520 umhos, Oxygen 9.20 mg/l.

APPENDIX B.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 2002.

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	5/15/02	5/17/02	PASSED	MW
CALLOWAY'S 209 ESPLANADE LAURIE & MARCIE (831) 768-9220	15-May-02	5/17/02	PASSED	MW
PIZZA MY HEART 209-A ESPLANDE CHUCK HAMMER (831) 426-2511	5/15/02	5/17/02	SMALL LEAK AT P-TRAP CORRECTED	MW
FOG BANK 211 ESPLANDE LINDA BENNENT (831) 462-1881	5/15/02	5/17/02	LEAK AT FLOOR SINK CORRECTED	MW
PARADISE BAR & GRILL 215 ESPLANADE STEVE YATES (831) 425-2625	5/15/02	5/17/02	1) SECURE DWV PER CODE 2) FLOOR SINK IS CLOGGED 3) FLOOR SINKS LEAK CORRECTED	MW