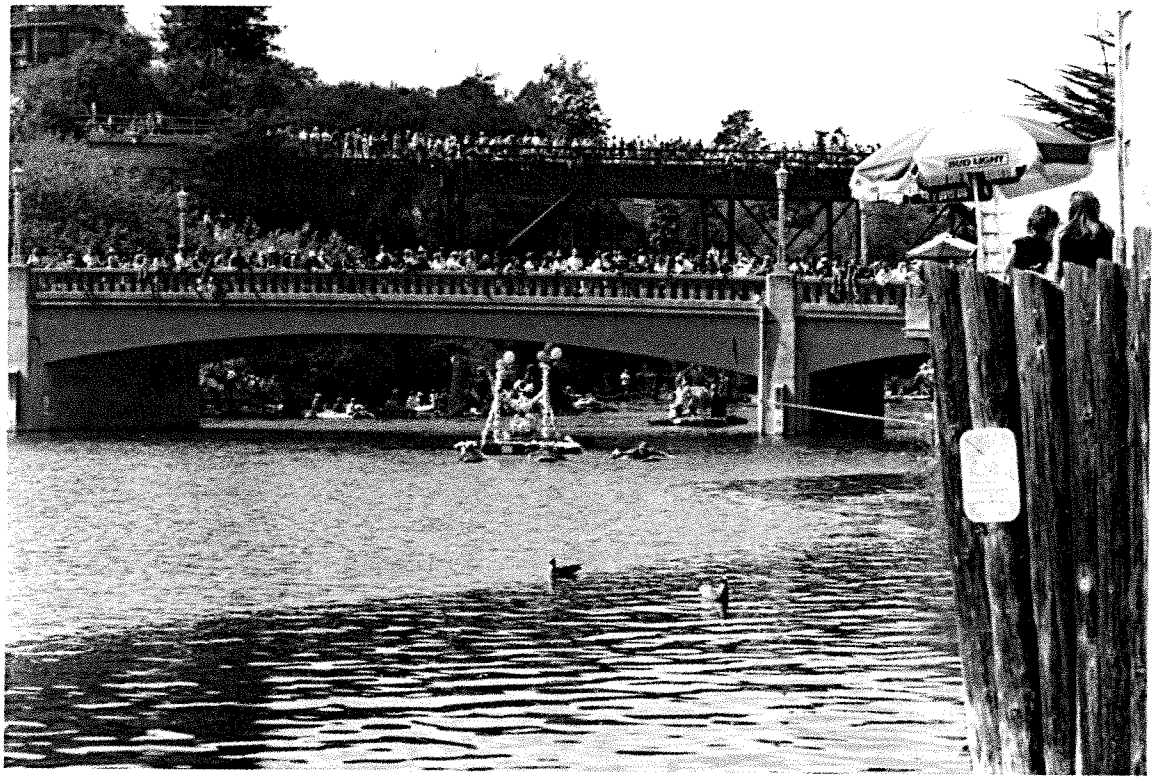
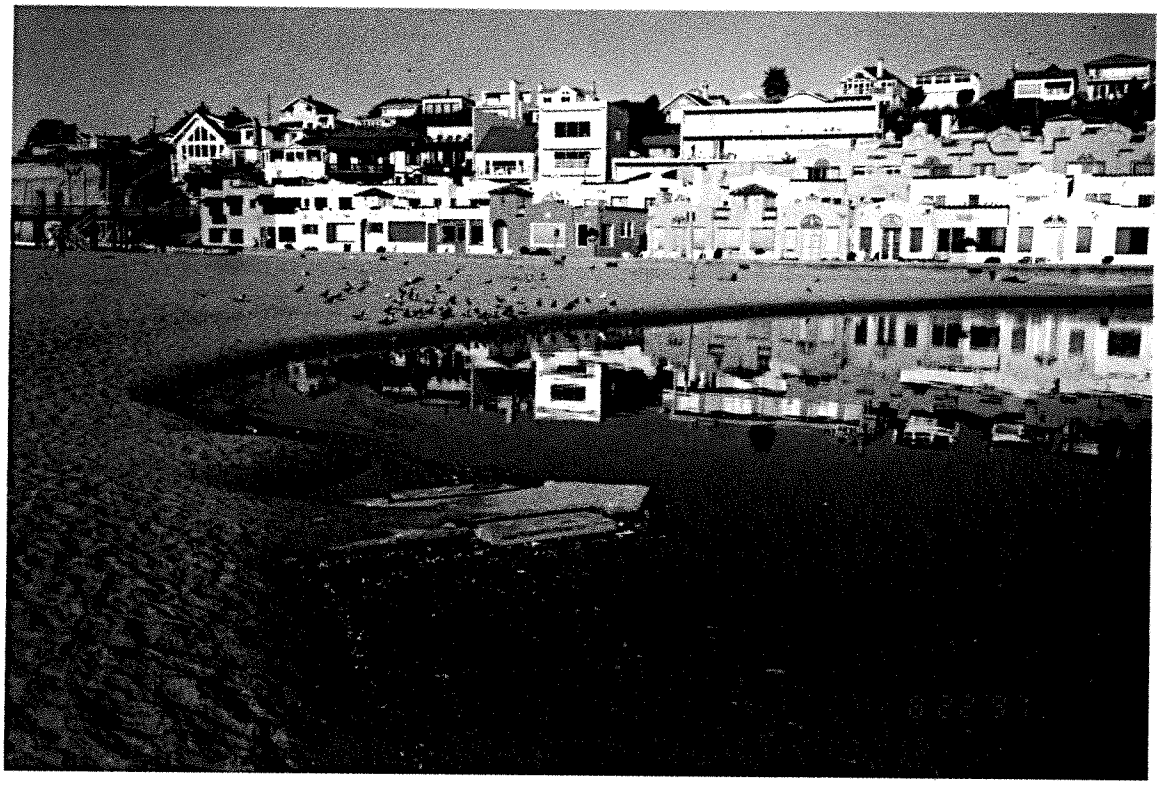
D.W. ALLEY & Associates aquatic biology



SOQUEL CREEK LAGOON MONITORING REPORT, 1997

February, 1998
Project #106-07



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SOQUEL CREEK LAGOON MONITORING REPORT, 1997

ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department in looking after the lagoon. Key people include Ed Morrison, Cary Oyama, Mark Sessions, Ed Garcia, Lance Elliot and Tim Callahan. Sandbar closure in May, 1997 went smoothly thanks to the experience of Bill Casalegno, the equipment operator. In normal fashion, Nels Westman and the Begonia Festival volunteers were effective in the flower clean-up after the Festival in September. In October, Ed Morrison aided in securing valuable parking access for fish sampling.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. They come from Friends of Soquel Creek- the Maders, the Forests, the Graves; Steve Leinau of Earth Links; members of Citizens for Responsible Forest Management (the Morganthalers); and other interested volunteers, including Gary Quail and the anonymous body builders. This long-term sampling provides a valuable index of fluctuation in fish populations in the lower Soquel Creek watershed. Carla Mader's photographs enhanced the report as they captured scenes from the annual fish sampling (**Appendix D**). All volunteers are very welcome on the first two Sunday mornings of each October. Kids enjoy the experience along with the rest of us big kids.

The year 1997 was a time when Susan Westman moved on to manage another city. She was one of the City of Capitola's primary contributors to the Soquel Creek Lagoon Management Plan, leading to federal and state permits to annually construct the sandbar and create the lagoon. First as Environmental Planning Director and then as City Manager, Susan was a strong facilitator of the Management Plan's implementation and lagoon monitoring. She was receptive to new ideas and supported projects to educate children and enhance the lagoon. Her guidance and trust in our abilities will be greatly missed. Fortunately, she and her husband, Nels, will retain their home in Capitola.

EXECUTIVE SUMMARY

Habitat conditions in the 1997 lagoon followed an above average rainfall year in which little rain came after January. The annual 1996-97 rainfall near hydrologist Brook Kraeger's residence on the East Branch was 48 inches, while the average is 44 inches. There was more algae and pondweed in the summer lagoon than the previous two wet years. Algae and pondweed was densest in September, though it was present throughout the summer. The most surface and sub-surface algae was noted in early September, before the Begonia Festival.

The Begonia Festival caused a detectable reduction in thickness and density of submerged algal and pondweed. No change in water quality was detected during or after the Festival. Aquatic plant production continued to be high through September and into October.

Noble Gulch continued to be a source of pollution in 1997, as indicated by the periodic filamentous algal blooms at its mouth. Gray water was noted in 1/3 of the observations other than after rainfall at the mouth of Noble Gulch in 1997.

The lagoon water quality is better when more stream inflow occurs. Water quality worsens at the end of the dry season when stream inflow is at a minimum. To maximize summer baseflow, water percolation into the aquifer must be maximized, and surface runoff must be minimized during the rainy season. Minimizing storm runoff also reduces flooding and streambank erosion. Summer water diversion must also be curtailed if surface streamflow becomes discontinuous.

Water quality for aquatic life was generally good with regard to oxygen, salinity and conductivity up off the lagoon bottom. Conditions were worse on the lagoon bottom. At the bottom near the flume, oxygen was in the "poor" or "critical" range in 8 of 9 monitorings. At the bottom at Stockton Avenue Bridge, oxygen was in the "poor" or "critical" range in 9 of 9 monitorings. At the bottom at the railroad trestle, oxygen was in the "poor" or "critical" range in 5 of 9 monitorings. At the bottom at Noble

Gulch, oxygen was in the "poor" or "critical" range in 8 of 8 monitorings. However, within 0.25 meters of the bottom where steelhead typically hold positions, oxygen dipped into the "poor" range only once at the flume, twice at the other three stations and did not reach the critical level. Oxygen was at good levels higher in the water column. The low oxygen levels near the bottom resulted partially from heavier saltwater on the bottom in 1997 that prevented mixing with oxygenated water above.

Two dry-season storms occurred in 1997 (mid-August and early October), which caused water turbidity, diminished photosynthesis and depressed oxygen levels, in addition to oxygen reductions caused by saltwater influxes.

The lack of mixing of the saline layer on the lagoon bottom also caused heating of the bottom layer. Water temperature was measured at within 0.25 meters of the bottom at monitoring stations during 9 monitorings beginning on 10 June. Water temperature increased into the poor range once at the flume, 3 times at the Bridge and twice at the trestle. Water temperature increased into the critical range once at the Bridge. Water temperature was also in the poor range at the Bridge for two days following sandbar closure, before lagoon depth was increased and saline water could be flushed out.

With saline water present and less stream in-flow compared to the past two years, it was necessary to maintain the shrouds on the flume inlet to maximize lagoon depth. September was the critically warm period in the lagoon in 1997, when streamflow had declined and saltwater still remained. Fortunately, the lagoon was deeper in 1997 than the previous two years, and Ed Morrison maintained a good gage height by managing the flume inlet through most of the summer. Sand plugging of the flume outlet was a reoccurring condition throughout the summer.

The lagoon water level was rated "critical" the first day after sandbar closure and on 5 October after likely vandalism. It was rated "poor" on 10 June and 20 August after rains.

In 1995-97, vandals working at night apparently created gaps

found between the flashboards in the flume inlet. This caused partial draining of the lagoon. The vandalism occurred on weekends, and was sometimes correlated with prior high water levels in the lagoon. In 1995 the lagoon nearly drained before the problem was reported to police by a concerned resident. This undoubtedly resulted in substantial steelhead mortality. A method is needed to secure the flashboards against vandalism on the one hand, while allowing addition or removal of boards.

Passage for steelhead smolts was usually adequate during the migration period ending by 1 July 1997. The baffle was replaced inside the flume in 1997.

When the estuary periphery and lateral channel across the beach were sampled before sandbar construction, fish captured included one juvenile steelhead (Oncorhynchus mykiss), 500-1000 juvenile staghorn (Leptocottus armatus) and prickly sculpins (Cottus asper) ranging in size from 20-100 mm Standard Length, less than 50 threespine sticklebacks (Gasterosteus aculeatus) and close to 500 very small juvenile fish (<20 mm Total Length) that looked cyprinid in nature. Captured fishes were placed in a live-car after each seine haul to be relocated in a deep area near the upstream side of a pier on the Stockton Avenue Bridge.

Our steelhead population estimate for the lagoon in fall 1997 was 560 juveniles +/- 182. A total of 57 juvenile steelhead ranging from 95 to 150 mm Standard Length (SL) were marked on 5 October, with no fish mortalities. On 12 October, 59 juvenile steelhead ranging from 105 to 261 mm SL were captured, with 6 being clipped recaptures from the previous week. There were no sampling mortalities. Other species captured in October by number with the 106-foot seine were 27 Sacramento suckers (Catostomus occidentalis) ranging from 107 to 300 mm SL, one staghorn sculpin (Leptocottus armatus), two prickly sculpins (Cottus asper) and small numbers of threespine stickleback (Gasterosteus aculeatus). One tidewater goby (Eucyclogobius newberryi) was captured with the fine-meshed seine in October, 1997.

Though no bird inventory was budgeted in 1997, several species of fish-eating birds were consistently observed, including 2-3 pied-

billed grebes, several kingfishers, a greenback heron, a great blue heron and a family of mergansers (a mother and 6 young most of the summer). Initially, there were two mother mergansers with their own clutches of young (7 and 10 ducklings each). Aside from fish-eaters, as many as 29 wild mallards were seen at the lagoon in August. They are important grazers of pondweed and algae. The number of domestic ducks appeared to be declining. The three geese were still present. California coots returned again in September.

In 1997, sandbar breaching was artificially facilitated on 13 November to prevent flooding. This was done on the fourth day after three days of struggle by Ed Morrison to maintain the sandbar in the face of high tides and elevated streamflow resulting from rainfall. The sandbar remained open for the rainy season after that.

The high stormflows of 1997-98 have caused bank erosion behind the wooden bulkheads along the lagoon. As of 16 February 1998, the no bird feeding sign at the railroad trestle had been undermined and had fallen. One of the interpretive signs on the east side of the lagoon, adjacent to the Stockton Avenue Bridge is in jeopardy of being undermined.

With Public Words approval, we approached an engineer in summer, 1997, to design an insert for the flume entrance in order to facilitate and manipulate the volume of water entering the flume. He designed a model based on crude drawings and photographs before seeing the flume and understanding the performance requirements. We showed him the flume and expressed concerns about his design. When asked to re-design the model, he became disinterested.

New Recommendations and Important Recommendations not Yet Implemented

1) As stated in the previous monitoring report, we continue to recommend that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume

through the flume. A design with vertical louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may be covered with a wooden sheet or flashboards which may also be removed if necessary. In this way, vandalism would be prevented and 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. With the louver design, the lagoon level may be easily maintained. This will prevent the lagoon level from lowering into the poor range when boards are not been added to the flume inlet as streamflow declines in summer.

2. 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.

3. We recommend that interpretive and informative signs be re-established on stable ground near the lagoon before they are lost.

4. When the new restaurant opens where Larry's Surf and Turf was, we recommend that the City encourage the new proprietor to develop a gull deterrence method over the roof windows that will eliminate the need to wash excrement into the lagoon each day. We recommend that "Gull Sweeps" sold by West Marine Products be installed around the windows to test their effectiveness in deterring gulls.

5. The City should encourage and influence environmental planners and architects through the permit review process to maximize water percolation and filtering out of surface runoff pollutants from new and existing land development. This influence should go beyond the City limits, upstream into the Soquel Creek watershed.

6. Regarding the Begonia Festival, recommend to the organizers that they request float propulsion by surfboard paddling rather

than wading. If wading is chosen by participants, set a limit of 3 waders per float. Allow passage of the floats in one direction only, presumably downstream, instead of down the lagoon and then back up through the lagoon before dismantling.

7. The City should request from the responsible flood control district that all sediment and grease traps leading into lower Soquel Creek and Lagoon be annually inspected and cleaned.

8. The City should express written concern and request an explanation from the National Marine Fisheries Service and the Department of Fish and Game regarding the practice of introducing hatchery-reared fingerling steelhead from Scott Creek into the upper Soquel Creek watershed. These are young fish that will remain in the stream for a period of months before out-migrating. This may interfere with native genetic stocks of steelhead and reduce genetic fitness.

9. The City should express written concern and request an explanation from the National Marine Fisheries Service and the Department of Fish and Game regarding the management practice of introducing hatchery-reared smolt-sized steelhead from Scott Creek into Soquel Creek. This may interfere with native genetic stocks of steelhead and reduce genetic fitness.

LAGOON AND ESTUARY FORMATION

This was the seventh year of monitoring and assisting with sandbar construction at Soquel Creek Lagoon. Six previous monitoring reports and a summary report were completed for past years (**Alley 1991-97**).

Sandbar Construction in 1997.

The City utilized a 1996 Fish and Game Permit (**Appendix A**) and a U.S. Army Corps Permit (Permit Number 20705S25) (1-8-96-F-19)) to close the sandbar. The Army Corps permit and conditions are contained in our 1995 monitoring report (**Alley 1996a**).

Onset of Construction Activities, 19 May 1997. The first activity accomplished on 19 May was enlargement of the would-be lagoon basin along the western margin. A berm was created along the west side of the existing, narrow estuary. Then the bulldozer was used to excavate behind the berm to enlarge the west side. Refer to **Appendix A** for photo-documentation of construction activities. More habitat was created by doing this.

20 May 1997. On 20 May, sand was stockpiled along the beach-side of the lateral channel. Considerable sand was on the beach.

21 May 1997. On 21 May 1997, Ed Morrison of the City of Capitola assisted Don Alley in making 11 seine hauls in the lateral channel leading southeast from the main estuary across the beach and along the east margin of the estuary up to the restaurants. Streamflow was estimated at 5-7 cubic feet per second. It had not rained for more than two months. Fish captured in the lateral channel and along the east margin included one juvenile steelhead (Oncorhynchus mykiss), 500-1000 juvenile staghorn (Leptocottus armatus) and prickly sculpins (Cottus asper) ranging in size from 20-100 mm Standard Length, less than 50 threespine sticklebacks (Gasterosteus aculeatus) and close to 500 very small juveniles (<20 mm Total Length) that looked cyprinid in nature, but could not be identified. These fishes were placed in a live-car after each seine haul to be relocated in a deep area near the upstream side of a Stockton Avenue bridge pier.

Next, 5 seine hauls were made along the west margin of the estuary from the flume toward Venetian Court. No fish were captured along the west margin. This portion of the basin had been created on 19 May by excavation of sand to enlarge the would-be lagoon and was very shallow. Heavy equipment had not been used in the water during the process. A 30 ft x 4 ft x 1/8-inch mesh seine was used. No tidewater gobies (Eucyclogobius newberryi) were found in the lower estuary. All captured fishes in the live-car were transported upstream to a deep area near the bridge pier that would stay watered during sandbar construction. If tidewater goby had been found, they would have been transported even further upstream where cover existed. It was concluded that tidewater goby were absent from the lower lagoon area in mid-May, 1997.

As required in the permit, the fisheries biologist (Don Alley) was present during all activities that could affect the fish habitat in the lagoon/estuary. 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 area adjacent to the flume could be traveled by the bulldozer.

Between 0900 hr and 0930 hr on 21 May, the lateral channel was blocked off from the lagoon. This was done after the fish were rescued and relocated. There had been no kelp in the zone of sand blockage, thus alleviating the threat of burying plant material under the sand. The interior of the flume was cleared of sand to maintain continuous ocean access for out-migrating steelhead.

22 May 1997. On 22 May the sandbar was opened along the flume at approximately 0530 hr. Then began the hand-raking of the kelp and sea grass out of the lagoon. There was not an abundance of this material in the lagoon this year. As the lagoon receded after the sandbar was opened, 1,000 to 2,000 small juvenile sculpins were rescued from 6-8 small puddles along 200 feet of the east bulkhead pilings of the lagoon, upstream of Stockton Avenue Bridge, and around a rootwad of a tree trunk laying under the

railroad trestle (**Appendix A**). Most sculpins were young-of-the-year except for six that were greater than 100 mm Standard Length. This problem of stranding above the Stockton Avenue Bridge was not noticed immediately, and four larger sculpins along with 5 larger sticklebacks and one juvenile steelhead died before they could be rescued. No tidewater gobies were observed.

This was the first year when puddles existed along the bulkhead pilings and around a large, downed tree in the lagoon. More attention will be paid to these areas along the bulkhead and around large woody debris in future years. In past years, the areas around the bridge piers were locations of fish rescue. The estimated fish mortality represented much less than 1% of each of the species populations in the lagoon.

The baffle was reinstalled inside the flume. The sandbar was closed at 0930 hr. Screens were installed over the flume inlet.

23-26 May 1997. The sandbar was left intact over the Memorial Day weekend. The blocked, lateral channel was left partially filled with sand.

27 May 1997. The sandbar was opened at 0600 hr, and the remainder of the kelp was raked out of the lagoon. No fish were observed in the bulkhead puddles, as had been observed on 22 May. Alley surveyed the lagoon, upstream past the second riffle, where there was a steep western slope occupied by Eucalyptus trees. A very large Douglas Fir had been cut down, bucked up and left along the west bank for unknown reasons. The exotic trees had been left standing. A cat was observed as it attempted to capture mallard ducklings along the residential east shoreline in the upper lagoon. Further downstream, a western pond turtle was observed on a downed cottonwood on the west side, across from Noble Gulch and downstream of the Shadowbrook Restaurant.

Approximately 95% of the kelp had been removed from the lagoon by raking before the sandbar was closed. A deep thalweg existed along the restaurant margin, where large boulders had been exposed from winter scour. This was the first time in 7 years that these boulders were visible.

Plastic visquine sheets were laid down around the flume entrance and were overlain with geo-fabric before being covered with sand by the bulldozer. This preparation would hopefully prevent water from seeping out of the lagoon, along the outside of the flume through the sandbar. This had been a problem in 1995.

The sandbar was closed off for the season at 1130 hr. Later in the afternoon, many juvenile steelhead were observed feeding on the surface above the Stockton Avenue Bridge. A female merganser with 10 young were observed in the same vicinity.

Recommendations for Lagoon Preparation and Sandbar Construction

1. 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.

2. 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 and at the mouth of Noble Gulch.

3. Dispose of kelp from the lagoon during sandbar closure 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 has no problem with this so long as kelp is spread out over a wide area (**J. Ricker, County Environmental Health, pers. comm.**).

4. Bring back the wide rakes that were used in previous years.

5. Evaluate the structural integrity of the flume and its supports. Sizable stormflows may have damaged the flume over the past winter of 1997-98. Repair cracks and supports as necessary.

6. 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 at low tide to drain out more kelp.

7. Search under the 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 number of instances of artificial fluctuation of lagoon water level. Gathering of a maximum number of personnel to rake out the decomposing kelp and clear the flume, will minimize the days needed to secure the lagoon for summer. In 1997, only two sandbar openings and closings were necessary, with two days of kelp-raking and flume preparation. This was as quickly as can be expected for completion of the process.

8. Seal off storm drains on the west side of the street in front of the Esplanade. This should be the case from May 15 to after the clean-up from the Wine Festival in mid-September. Seal off any storm drain pipes leading from the street to the lagoon in front of the restaurants. This will reduce pollution from restaurant clean-up. Many smokers leave cigarette filters on sidewalks, which are then swept or washed into storm drains. These filters are mistaken as food by fish and ingested if they reach the water. This may cause serious digestive problems and potential fish mortality.

9. Attempt to make the area around the flume the deepest part of the lagoon so that heavy salt water will collect there and be pulled out easily by the shroud.

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

11. Re-install the 1-foot high baffle inside the flume, if necessary, until July 1 for safe entrance of out-migration of smolts into the flume inlet as they travel through the flume to the ocean.

12. Continue to maintain a 6 to 8-inch depth at the outlet of the flume until July 1. Install 4"x 4" planks in the outlet, if necessary, as George Heise (CDFG expert) originally recommended.

Sandbar Breaching During the 1997-98 Rainy Season.

10 November 1997. During a rainstorm at 0330 hr on this Monday morning, Ed Morrison pulled all boards out of the flume to increase flow through the flume and retain the sandbar. At 0630 hr the flume outlet was plugged with sand. The outlet was to be unplugged later that morning.

11 November 1997. We observed that the sandbar was intact with ponding on the beach. The flume entrance was submerged and the flume exit was open.

12 November 1997. Ed Morrison reported that boards had been re-installed in the flume inlet, with an 8-inch opening on one side and two boards out on the other side. The high tide was 5.9.

13 November 1997. It had rained overnight. Morrison reported that the lagoon was 8 inches below the piling bolt at 0710 hr. The flume exit was plugged with sand from the high tide and could not drain. The breaching procedure was instigated. A notch was being cut in the sandbar. High tide was to be 6.1 at 0845 hr. We arrived at the lagoon at 0850 hr. The notch had been cut, but little flow was exiting the lagoon because of the high tide. A backhoe and front loader were working on the beach channel. The lagoon level was above the piling bolt. Puddles from stream overtopping of the bulkheads were present on the walkway to Noble Gulch. The stream had overtopped the bulkhead by approximately 2 inches at most and was receding. The berm at 445 Riverview had at least another foot of free-board before overtopping could occur. The sandbar remained open for the winter.

Regarding sandbar breaching in the fall, in general, the desire is to maintain an intact sandbar and lagoon until middle to late November, when the size and frequency of storms increase. The intent is to delay sandbar breaching until streamflow has increased sufficiently to provide adequate, sustained passage flows for migrating steelhead to reach spawning grounds without becoming stranded. Elevated streamflow also keeps the sandbar open with free circulation of water as the estuary fills and empties with the daily tidal fluctuations. Thus, a lagoon full

of decaying kelp and seagrass in stagnant water is prevented. Plant decomposition causes foul odors and poor water quality.

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. Street sweepers with water and suction may be necessary. In addition, road-work such as repaving and application of fresh petro-chemicals to pavement should be done early in the summer to allow sufficient time for penetration and drying before the rainy season. These chemicals can be lethal to fish.

2) The notch in the sandbar should be cut slightly lower than the piling bolt. 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 hole 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) 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.

5) 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 in the lagoon and unable to migrate upstream because of insufficient streamflow.

6) We continue to recommend as we did in the 1996 report that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. A design with vertical louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may have a secured wooden sheet or boards, as is presently the case, it may also be removed if necessary. In this way, 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.

Rating Criteria

Water quality parameters were rated according to the tolerances of steelhead. This was because other fishes were more tolerant to low oxygen, higher salinity and higher temperatures than steelhead. 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 ppm 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 3-4 C by the end of a sunny day.

Oxygen levels critical to the survival of 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**). Early morning oxygen 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 ppm 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 that exist in Soquel Creek Lagoon, carbon dioxide is poorly dissolved and is believed not to be a problem (Jerry Smith, pers. 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 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 that is not directly under control by the City is change in streambed elevation resulting from scour or fill during the winter. The lagoon shallowed in 1995 due to sedimentation during the winter and apparent sand movement after the sandbar was closed in June.

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.

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

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.

Results of Water Quality Monitoring After Sandbar Closure

Appendix B provides detailed data on water quality. **Table 3** summarizes conditions at each monitoring time, based on the rating criteria.

Table 3. Water Quality Ratings in Soquel Creek Lagoon, 1997, Within 0.25 Meters Off the Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow (cfs) visual est.
28May97	open	critical 1.44	poor		poor	5-6
29May97	open	good 2.32	poor		poor	
30May97	open	good 2.36	fair		poor	
4Jun97	Rain.					
6Jun97	closed	good 2.70				
10Jun97	open	poor 1.72	good	good	good	2.5-3
16Jun97	open	good 2.49				
19Jun97	open	good 2.43				
20Jun97	closed	good 3.40				
23Jun97	open	good 2.44	good fair fair good	good good good fair	fair poor good good	2
7Jul97	closed	good 3.50				
7Jul97	open	good 2.46				
8Jul97	open	good 2.41	fair poor fair good	good	good	2
14Jul97.	open	fair 2.00				
21Jul97.		good 2.81				
23Jul97	open	fair 2.10	poor critical good good	good	fair fair good fair	1.5
4Aug97	closed	good 2.49	good fair fair good	fair good good good	good	1.25
18Aug97		good 2.89				
19Aug97	Rain.					
20Aug97	open	poor 1.80				
22Aug97	open	fair 2.04	fair	poor	good	2.5
6Sep97	open	good 2.48	good poor poor fair	good good good fair	good	1.0
7Sep96	Begonia Festival.					
7Sep97	open	good 2.49	fair		good	
8Sep97	open	good 2.47				
12Sep97	open	good 2.49	fair poor poor	good good fair	good	
10ct97	Rain.					
40ct97	open	good 2.95	good fair good good	poor	good fair good good	1.2
50ct97	open	critical 1.40				

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

Lagoon Level. The lagoon level was monitored 25 times from 28 May to 5 October. Many of the readings were taken by Ed Morrison. In 1997, lagoon level was rated "good" on 18 occasions, "fair" on 3 occasions, "poor" on 2 occasions and "critical" on 2 occasions (**Table 3; Figure 2**).

The instances of critically low lagoon level occurred on the first day after the sandbar was formed and in early October. The former indicated that more boards could have been installed early on. The later incident indicated vandalism. Fortunately the problem was detected on a Sunday during fish sampling before the lagoon drained. The two instances of poor ratings came after rain storms in which boards had been removed for the storms, but not replaced yet. It indicated difficulty in manipulating flume water volume with boards during and after increased streamflow conditions.

In 1995-97, vandals apparently created gaps found between the flashboards in the flume inlet. This caused partial draining of the lagoon. The vandalism occurred on weekends, and was sometimes correlated with high water levels in the lagoon prior to vandalism. In 1995 the lagoon nearly drained by Saturday morning before the problem was reported to police by a concerned resident. This undoubtedly resulted in substantial steelhead mortality. A method is needed to secure the flashboards against vandalism on the one hand while allowing convenient adjustment or removal of boards when necessary. In the past, wooden wedges have been driven into the gaps between the boards and the concrete slots to secure the boards. While securing the boards against all but the most determined vandals, this method does not allow convenient adjustment or removal of boards when surface algae and debris needs to be drained out or sandbar breaching is to be prevented. During a major portion of the summer of 1997, the shrouds were in place. They aided in removing saltwater, maintaining a good gage height and preventing vandalism. However, after a small storm in early October, the shrouds had been removed, and the the vandalism occurred.

Flume Passability. According to the Management Plan (1990), fish passage is to be maintained until July 1. The desire is to

maintain the flume depth at the entrance at 12 inches or deeper until that time. Passage for steelhead smolts was usually adequate during this period in 1997. However, the unusually large beach and frequent high tides plugged the flume during the night on several occasions in June. In each case, the flume was opened the next morning. The wooden baffle inside the flume was replaced in 1997.

The sandbar breached early in 1997, and the Creek was passable to adult spawning migration without the use of the flume.

Water Temperature. Lagoon water temperature was "poor" within 0.25 meters off the bottom for at least one station on 6 monitorings in 1997 (**Table** 3). This was caused by the presence of a saltwater lens forming in deeper areas of the lagoon throughout the summer. At times the saltwater was flushed out only to return presumably by tidal overwash and back-flushing of the flume. The lack of mixing of the saline layer on the lagoon bottom also caused heating of the bottom layer. At within 0.25 meters off the bottom at monitoring stations during 9 monitorings beginning on 10 June, water temperature increased into the "poor" range once at the flume, 3 times at the Bridge (**Figure** 3) and twice at the railroad trestle. Water temperature increased into the "critical" range once at the Bridge. Water temperature was also in the "poor" range at the Bridge for two days following sandbar closure before lagoon depth was increased and saline water could be flushed out.

With the saline water in the lagoon and lessened stream in-flow compared to the past two years, it was critical to maintain the shrouds in place and to maximize lagoon depth.

September was the critically warm period in the lagoon in 1997, when streamflow had declined and saltwater still remained in the lagoon. Fortunately, the lagoon was deeper in 1997 than the previous two years, and Ed Morrison maintained a good gage height by managing the flume inlet through most of the summer.

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 levels were measured and rated.

Water quality for aquatic life in the lagoon was generally good with regard to oxygen, salinity and conductivity except on the lagoon bottom. Oxygen levels were lowest along the lagoon bottom. At the bottom near the flume, oxygen was in the "poor" or "critical" range in 8 of 9 monitorings (**Table 3; Appendix B**). At the bottom at Stockton Avenue Bridge, oxygen was in the "poor" or "critical" range in 9 of 9 monitorings. At the bottom at the railroad trestle, oxygen was in the "poor" or "critical" range in 5 of 9 monitorings. At the bottom at Noble Gulch, oxygen was in the "poor" or "critical" range in 8 of 8 monitorings. However, above the lagoon bottom within 0.25 meters of the bottom where steelhead typically hold positions, oxygen dipped into the "poor" range only once at the flume and twice at the other three stations (**Figure 4**) and did not reach the critical level. Oxygen was at "good" levels higher in the water column.

The low oxygen levels near the bottom resulted partially from heavier saltwater on the bottom in 1997 that prevented mixing with oxygenated water above. Two dry-season storms occurred in 1997 (August and early October), which caused water turbidity, diminished photosynthesis and resulting depressed oxygen levels, in addition to those caused by saltwater.

The lagoon water level was rated "critical" the first day after sandbar closure and on 5 October after likely vandalism. It was rated "poor" on 10 June and 20 August after rains.

We have recommended in the past that all of the storm drains leading to the lagoon be redirected away from the lagoon in summer. Included in these is underground culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch (**Alley 1995; 1996b**). Stimulation of algal growth has annually occurred at the mouth of Noble Gulch, with consistently greater growth there compared to elsewhere in the lagoon. This indicates elevated nutrient inputs probably associated with bacteria. A degree of oxygen depletion is consistently registered there.

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. This water could be pumped out for irrigation purposes, provided that lagoon depth is being adequately maintained.

By minimizing the stream inflow from Noble Gulch, there may be a reduction in nutrients and bacteria entering the lagoon. 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 runoff could be redirected into the sewer system during the summer.

There was a noticeable decline in the number of piles of dog excrement along the lagoon path after the installation of plastic bag dispensers and refuse cans at either end of the path in 1996.

Salinity. Salinity along the lagoon bottom was a chronic condition in deeper portions of the lagoon during most of the summer of 1997. It contributed to more stressful conditions for steelhead by heating up the lagoon in late July and early September (**Appendix B**). The shrouds appeared useful in pulling out saltwater until streamflow dropped below approximately 1.5 cfs. If the area around the flume could be made the deepest portion of the lagoon, the shrouds would be more effective. However, there would be difficulty in preventing leakage of water through the sandbar along the outside of the flume if this was done. Construction of a higher sandbar would prevent tidal overwash.

Conductivity. High conductivity was a chronic condition associated with saltwater at the bottom and just off the bottom during much of 1997.

Stream In-Flow to the Lagoon. On 10 June 1997, we estimated 2.5-5 cfs coming into the lagoon at Nob Hill (**Table 3**) compared to 12-15 cfs on the same day the previous year. In 1997, the lowest estimated in-flow to the lagoon was 1.0 cfs on 6 September (**Table 3; Appendix B**). It increased to 1.2 cfs after the storm on 1 October. The lowest estimated summer baseflows in 1995 and 1996 had been 2.5 cfs and 2.25 cfs, respectively. In 1994, in-flow declined below 1 cfs in late July and fell to an estimated 0.05 cfs by late September.

The lagoon water quality is better when more stream inflow occurs. Water quality worsens at the end of the dry season when stream inflow is at a minimum. 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 must also be curtailed if surface flow becomes discontinuous.

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. The inspection report is contained in **Appendix C.**

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

1. Re-install the 12-inch high wooden baffle inside the flume, if necessary, prior to directing water through the flume during the first day of sandbar construction.

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

3. 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 hole for adults. Close the adult hole by July 1 in any event. If adult steelhead are seen in the lagoon after June 1 and the adult hole has been closed, then open the hole for a week, allowing them to out-migrate.

4. After July 1, do not open the flume exit if it closes, unless flooding is eminent. Install plastic sheeting on the outside of the flume boards to prevent leakage into the flume. Put as many boards as possible into the flume entrance to raise the lagoon level as much as possible.

5. Secure the flume boards so that vandals may not raise the boards and drain the lagoon.

6. 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.

7. Road repaving and application of petro-chemicals should be done early in the summer. This will allow these substances to penetrate and dry before fall rains.

8. Do not reduce the lagoon level for the Begonia Festival.

9. 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.

10. We recommend that an insert be designed for at least one side of the flume inlet that will allow easy manipulation of water volume through the flume. This will prevent the lagoon level from lowering into the poor range because insufficient numbers of boards have been added to the flume inlet as streamflow

progressively declines through the summer or after small summer or early fall storms occur. With a louver system, the lagoon level may be easily maintained without the threat of vandalism that drains the lagoon and causes steelhead mortality. The louver system would also facilitate the opening of the flume inlet to pass increased water volume during small storms, thus protecting the sandbar from breaching.

We approached an engineer in summer, 1997, to design an insert for the flume entrance to facilitate and manipulate the volume of water entering the flume. He designed a model based on crude drawings and photographs before seeing the flume and understanding the performance requirements. We showed him the flume and expressed concerns about his design. When asked to re-design the model, he became disinterested.

11. We recommend that interpretive and informative signs be relocated on stable ground near the lagoon before they are lost.

12. When the new restaurant opens where Larry's Surf and Turf was, the new proprietor should be encouraged to develop a gull deterrence system for the large roof windows. This would eliminate the need to wash excrement into the lagoon each day. We recommend that "Gull Sweeps" sold by West Marine Products ($32.00 each and 6 feet across) be installed around the roof windows 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."

13. Regarding the Begonia Festival, recommend to the organizers that they encourage float propulsion by surfboard paddling rather than pulling and pushing by wading. If wading is chosen by participants, set a limit of 3 waders per float. Allow passage of the floats in one direction, presumably downstream, instead of down the lagoon and then back up through the lagoon before dismantling.

14. We recommend that the City encourage and influence environmental planners, architects and property owners through the permit review process to maximize water percolation and

filtering out and collection of surface runoff pollutants from new and existing land development within the City limits and upstream in the Soquel Creek watershed.

15. We recommend that the City request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned.

FISH CENSUSING

Effects of Sandbar Construction Regarding Tidewater Gobies

It did not appear that tidewater gobies used the lower estuary in mid-May, 1997, based on seining prior to sandbar construction. Tidewater gobies present in the estuary likely 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 the sandbar construction activity when the sandbar is closed overnight to prevent incursion of saltwater and kelp, followed by reopening in the morning to allow more kelp-raking. This would require tidewater gobies to retreat to deeper water as water surface receded in the upper estuary. We do not believe that tidewater goby nests would be disturbed because normal estuary fluctuations caused by tidal influences would be similar to the artificial fluctuations caused by sandbar construction.

However, as the lagoon receded on 22 May after the sandbar was opened, 1,000 to 2,000 small juvenile sculpins were rescued from 6-8 small puddles along 200 feet of the east bulkhead pilings of the lagoon, upstream of Stockton Avenue Bridge, and around a rootwad of a tree trunk laying under the railroad trestle (**Appendix A**). Most sculpins were young-of-the-year except for six that were greater than 100 mm Standard Length. This problem of stranding above the Stockton Avenue Bridge was not noticed immediately, and four larger sculpins along with 5 larger sticklebacks and one juvenile steelhead died before they could be rescued. No tidewater gobies were observed. Depressions will be more closely watched during future sandbar constructions.

The seasonal effect of removing organic material and constructing the sandbar is to create cooler, freshwater conditions with reduced potential for eutrophication and biological oxygen demand. These activities create better aquatic habitat for fishes, including tidewater goby, than if the sandbar was allowed to close naturally. Natural closure would allow considerable kelp and often sea grass to be trapped in the lagoon to

decompose. Considerable saltwater would also be trapped in the lagoon to create an unmixed, anoxic layer on the lagoon bottom, which would collect heat and substantially raise the lagoon temperature. The naturally formed sandbar would be lower in stature, allowing more tidal overwash of saltwater during especially high tides, further elevating water temperature.

Even with a freshwater lagoon created in most years 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. If sufficient saltwater was present in the lagoon, water temperatures could become lethal for steelhead. For the first time since monitoring began, in 1997 saltwater entered the lagoon through the flume the day after the sandbar had been closed, following a very high tide. A saltwater layer formed on the bottom. As a result, morning water temperature on the bottom reached 29.5 C by 8 July. With the flume shrouds in place, it had partially dissipated by 23 July, and bottom temperature had cooled to 22.5 C.

Steelhead Plantings in Soquel Creek with Discussion

In March 1997, smolt-sized steelhead (7.2/lb.) from Scott Creek were planted in three locations in Soquel Creek (**Final Report from the Cooperative Fish Rearing Program, Monterey Bay Salmon and Trout Project**). An estimated 2,340 steelhead were planted in East Branch Soquel Creek at the Quarry Weigh Station crossing. An estimated 2,880 were planted in West Branch Soquel Creek at the Olson Road Bridge crossing. An estimated 2,780 were planted in Soquel Creek at Hartman's Nursery off Cherryvale Road. In October, 1997, steelhead fingerlings (92/lb.) from Scott Creek were planted in two locations in Soquel Creek. An estimated 2,502 fingerlings were planted downstream of the Olson Road Bridge crossing on the West Branch. An estimated 1,501 fingerlings were planted in The East Branch from Highland Road, 2.5 miles above Ashbury Falls.

The planting of fingerling steelhead into the upper watershed results in competition for food and cover between hatchery fish

from a genetically different stock and the native, stream-spawned steelhead in Soquel Creek and/or resident rainbow trout if they are planted above is a migrational barrier. There was no indication that the planted stream sections were below carrying capacity or that they had adequate food and cover for these thousands of introduced fish. We suspect that the stream habitat where plantings occurred in the West Branch Soquel Creek was fully seeded with juvenile steelhead or nearly so. We are uncertain where Olson Road is. However, we know of no steelhead barrier downstream of the dam near the confluence of Laurel and Burns creeks at channel mile 6.5 on the West Branch. We are less certain about the presence of steelhead where they were planted on East Branch Soquel Creek above the former Ashbury Falls. The information is that the Falls has been modified and is no longer an absolute barrier. It is highly likely that planting of 1,500-2,500 fingerlings in short stretches of both Branches will decrease the survival rate of native steelhead or resident rainbow trout already present. These channels are very small with little streamflow in October, when the plantings occurred. Probably, very few of the planted fish survived either. If the goal is to increase juvenile production of steelhead in an effort to increase adult returns, the biologically and genetically sound approach is to increase juvenile habitat quality, spawning access and spawning success.

There are genetic considerations that raise the concern that hatchery plantings from Scott Creek steelhead will reduce the genetic fitness of Soquel Creek steelhead/rainbow trout. This is in addition to the problem of competition from planted fish and reduced survival of native, stream-spawned steelhead/ rainbow trout. During our 1997 fall sampling of thousands of juvenile steelhead in the San Lorenzo River and Soquel Creek, the morphology (shape) of steelhead from the two watersheds appeared different in some individuals, indicating potentially different genetic makeup. Some of the Soquel Creek juveniles had thicker caudal peduncles before the tail and somewhat thicker and deeper bodies than San Lorenzo River steelhead. They were not coho salmon. According to the evolutionary theory of natural selection and survival of the fittest, there is genetic adaptation to the environment. If two populations of steelhead are genetically

isolated due to their homing behavior to their natal stream and are subject to different habitat conditions, then it is likely that genetic differences will arise between the populations. There is evidence of this from genetic studies of different populations along the California coastal streams.

Genetic studies of steelhead juveniles that we collected in Corralitos Creek in 1994 compared to those we collected in the San Lorenzo River indicated that genetic differences exist between the populations (**Cramer et. al 1995**). We may conclude from the theory of natural selection that the genetic makeup of steelhead/rainbow trout spawned and reared in Soquel Creek is best adapted to that Creek. We also suspect that the genetic stocks of rainbow trout above any steelhead migrational barriers also contribute steelhead smolts to the gene pool of ocean-run fish, so that their genetic contribution is important and unique to Soquel Creek steelhead.

Soquel Creek steelhead may be more warm-water-adapted than Scott Creek steelhead. Soquel Creek is warmer than the more shaded Scott Creek (the origin of the planted fingerlings) in summer. Different populations of steelhead inhabiting their own natal streams may have different physiological tolerances for warm water or low oxygen levels. They may have different swimming abilities at varying water temperatures based on differences in shape or physiology leading to muscular endurance. Better swimmers more easily move into faster water to feed when water temperature becomes too warm to find sufficient food in pools.

Juvenile steelhead inhabiting different streams may have different environmental cues that affect the timing of out-migration as smolts. Steelhead smolts in Soquel Creek may out-migrate at different times than Scott Creek fish. Scott Creek's sandbar closes earlier each spring than most in Santa Cruz County, thus selecting for earlier out-migration. This behavior may not be optimally adaptive in Soquel Creek. Juvenile steelhead that stay longer in the stream will be larger when entering the ocean than early smolts to improve their survival rates. There may be a number of behavioral differences between steelhead from different creeks.

If introduced Scott Creek steelhead survive and breed with Soquel Creek-reared adults, the native genetic stock of Soquel Creek steelhead will be changed and may become less adapted to environmental conditions in Soquel Creek. Therefore, such plantings of hatchery fish may be a harmful management activity, resulting in an inferior strain of Soquel Creek steelhead. If augmentation of stream production of juvenile steelhead is deemed necessary with hatchery plantings, it would be best to obtain brood stock from Soquel Creek itself for hatchery propagation. Then the genetic stock would be protected.

For the same genetic reasons expressed above, we find the continued introduction of Scott Creek smolt-sized steelhead to Soquel Creek to be a potentially destructive management activity. The risk of breeding potentially less fit Scott Creek adult steelhead wi Soquel Creek fish is even greater when smolts are planted instead of fingerlings. These smolt-sized fish may immediately out-migrate without facing mortality factors affecting young that must survive from egg to smolt in the stream. Hatchery smolts are more likely to survive to adulthood than hatchery fingerlings, and they faced no environmental selection while being fed in the hatchery.

Results of Fish Sampling in Soquel Creek Lagoon

On 5 October 1997, four 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. No tidewater gobies were captured on 5 October. On 12 October 1997, four more seine hauls were made in the same vicinity with the goby seine. One young-of-the-year tidewater goby was captured, 20 mm Standard Length, to the east of the flume.

In fall, 1992, two tidewater gobies were captured during sampling. In fall, 1994, 35 tidewater gobies had been captured

after four seine hauls. In fall, 1993, 1995 and 1996, no tidewater gobies were captured. The low number captured in 1992-97 probably indicated a lack of backwater areas to be used as refuges during high winter stormflows.

Fall sampling for steelhead was undertaken on 5 and 12 October, 1997, in the same vicinity as the tidewater goby sampling. 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. It was pulled into the beach in front of Venetian Court. Refer to **Appendix D** for action-packed photographs of fish sampling activities. With this larger, coarser-meshed seine, no tidewater gobies were captured. On 5 October, a total of 57 juvenile steelhead ranging from 95 to 150 mm Standard Length (SL) were marked from three good seine hauls. There were no steelhead mortalities that day. On 12 October, 59 juvenile steelhead ranging from 105 to 261 mm SL were captured from 4 seine hauls, with 6 being clipped recaptures from the previous week. No hatchery steelhead were detected in 1997. There were no sampling mortalities. Our steelhead population estimate for fall 1997 was 560 juveniles +/- 182. Other species captured by number with the 106-foot seine were 27 Sacramento suckers ranging from 107 to 300 mm SL, one staghorn sculpin, two prickly sculpins and uncommon threespine stickleback. Refer to **Table 4** for a summary of juvenile steelhead estimates through the years of monitoring.

Table 4. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-97.

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 seinings.
1993-	2,787 +/- 306 (95% confidence interval.) 1,046 fish were 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.

There may have been few juvenile steelhead moving into the lagoon from the lower Creek in 1997, as in 1996, because little spawning may have occurred in lower Soquel Creek. There was good spawning access to the upper watershed and a preponderance of sand and poor spawning conditions in the lower Creek that may have discouraged spawning in the lower reaches. Our sampling of lower Soquel Creek in fall, 1997, indicated very low densities of juvenile steelhead in the lower 2 miles of stream habitat leading into the lagoon.

In 1997 the lagoon offered deeper habitat than in 1995 and 1996, and was more similar to 1993 depths. A pondweed forest developed in 1997 to provide escape cover and plant life to support insect larvae that steelhead feed upon.

There was a serious reduction in lagoon depth in early October, presumably due to vandalism. But the problem was detected immediately during fish sampling. The shallow conditions lasted less than a day and probably did not result in significant steelhead mortality. The first day of lagoon formation brought shallow conditions, but this was corrected by the second day. There were 7 mergansers in the lagoon (a mother and her clutch) for most of the summer. These ducks may have consumed steelhead, though they eat other fish species, as well. Initially there had been two mother mergansers with their clutches (7 and 10 ducklings each.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced, and the City must maintain the water level as high as possible throughout the summer until sandbar breaching, without large fluctuations. It is easier to maintain good water quality and water depth with higher streamflow into the the lagoon in summer (known as summer baseflow). 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.

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 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.

2. Maximize lagoon depth after 1 July by adding boards to the flume as streamflow declines and by sealing the boards with plastic.

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. Look into better ways of sealing the cracks between the boards in the flume inlet. Sandwiching rubber strips between the boards may solve the problem.

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

6. Do not remove flume boards for the Begonia Festival or prior to taking fall vacation time.

7. 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.

8. 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 in 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.

9) As recommended in 1997, we again recommend that an insert be designed and installed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. This will prevent the lagoon level from declining into the poor range because sufficient boards have not been added to the flume inlet as streamflow declines. A design

with louvers that may be actuated independently would allow quick and easy closing of the flume entrance. The other side of the flume entrance may have a secured wooden sheet or boards, as is presently the case, that may also be removed if necessary. In this way, the lagoon level may be easily maintained and vandalism may be prevented. Furthermore, sustaining a maximum time for lagoon habitat until later in fall when storm frequency and streamflows increase, will maximize the lagoon's benefit to juvenile steelhead.

10. The City should express written concern and request an explanation from the National Marine Fisheries Service and the Department of Fish and Game regarding the practice of introducing hatchery-reared fingerling steelhead trout from Scott Creek into the upper Soquel Creek watershed. These are young fish that will remain in the stream for a period of months before out-migrating.

11. The City should express written concern and request an explanation from the National Marine Fisheries Service and Department of Fish and Game regarding the introduction of hatchery-reared, smolt-sized steelhead from Scott Creek to Soquel Creek.

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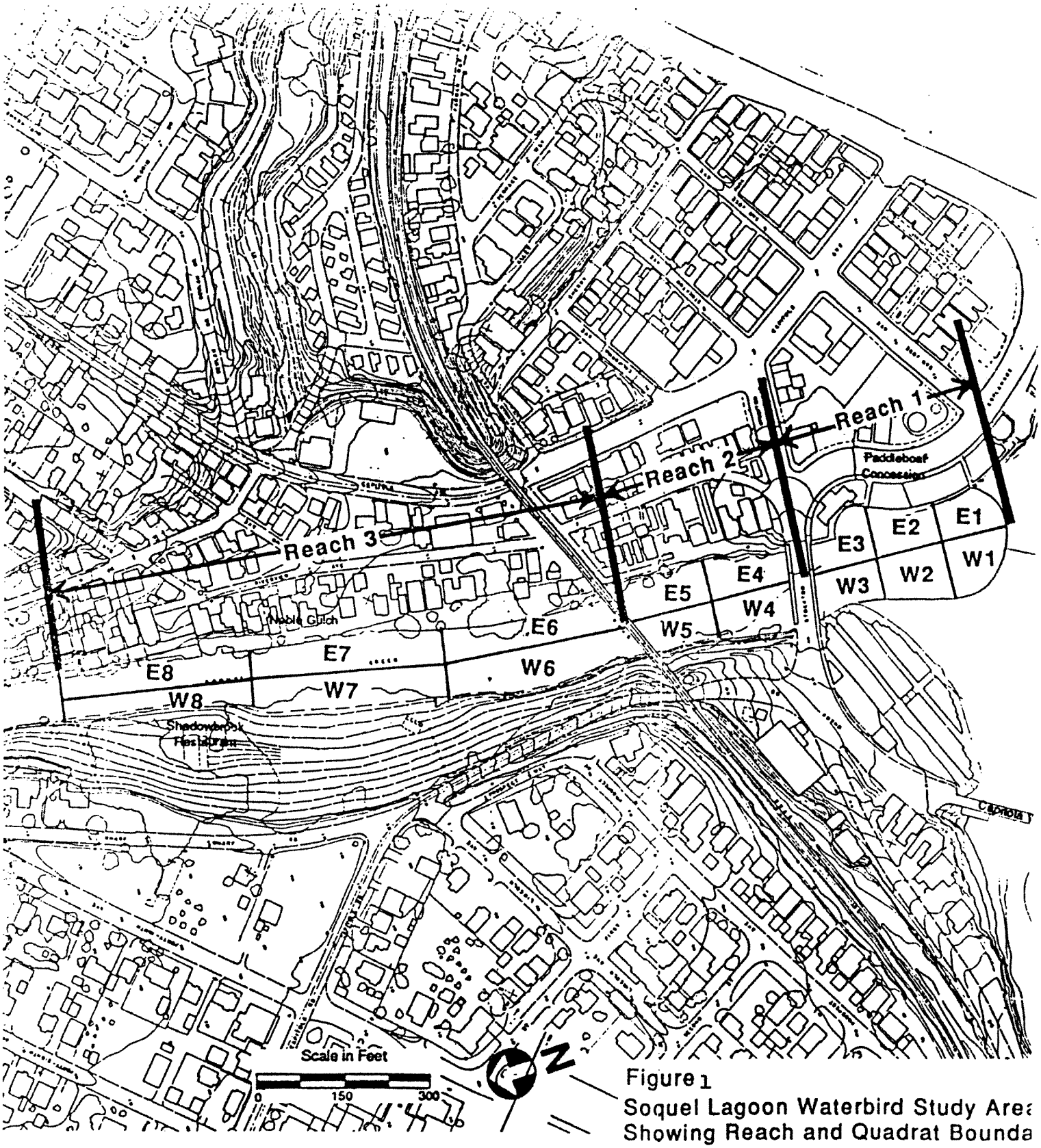


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries

SOQUEL LAGOON Management & Enhancement Plan	Habitat Restoration Group	May 19 424-0

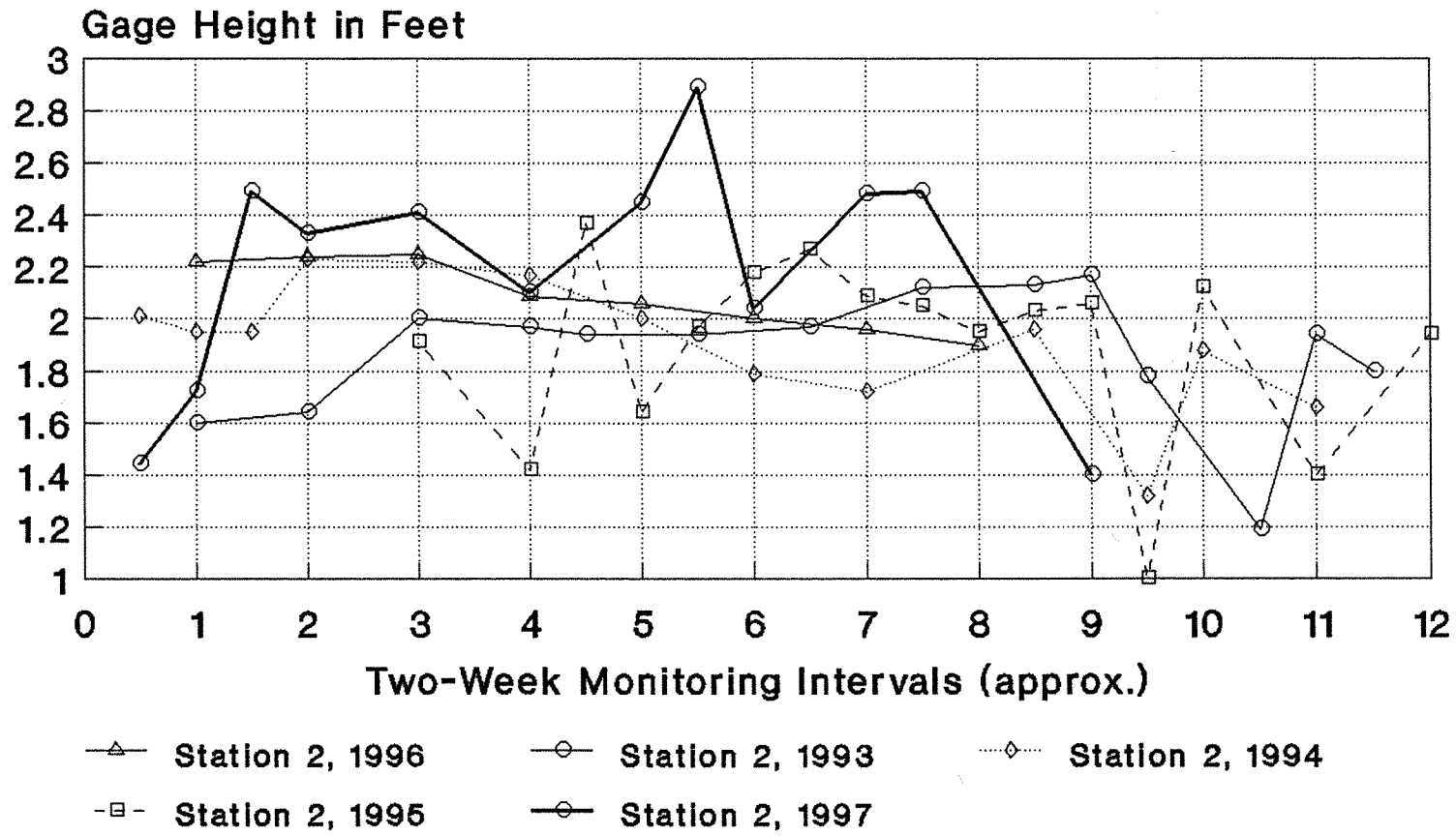


Figure 2. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Late May to Late October, 1993-97.

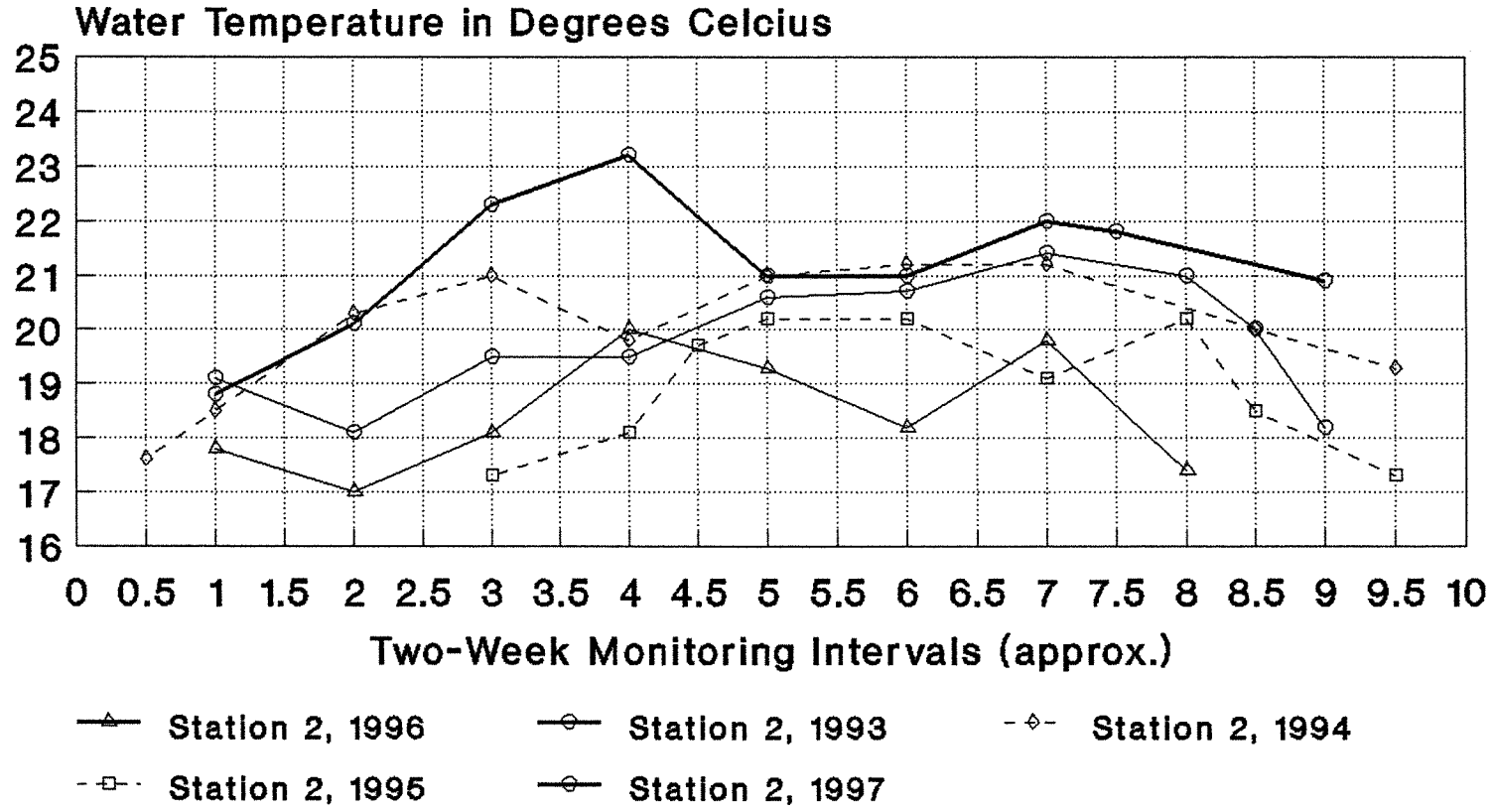


Figure 3. Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Late May to Late September 1993-97.

Soquel Lagoon Oxygen, 1997
Within 0.25 Meters of the Bottom, At
the Flume, Bridge, Trestle and Noble G.

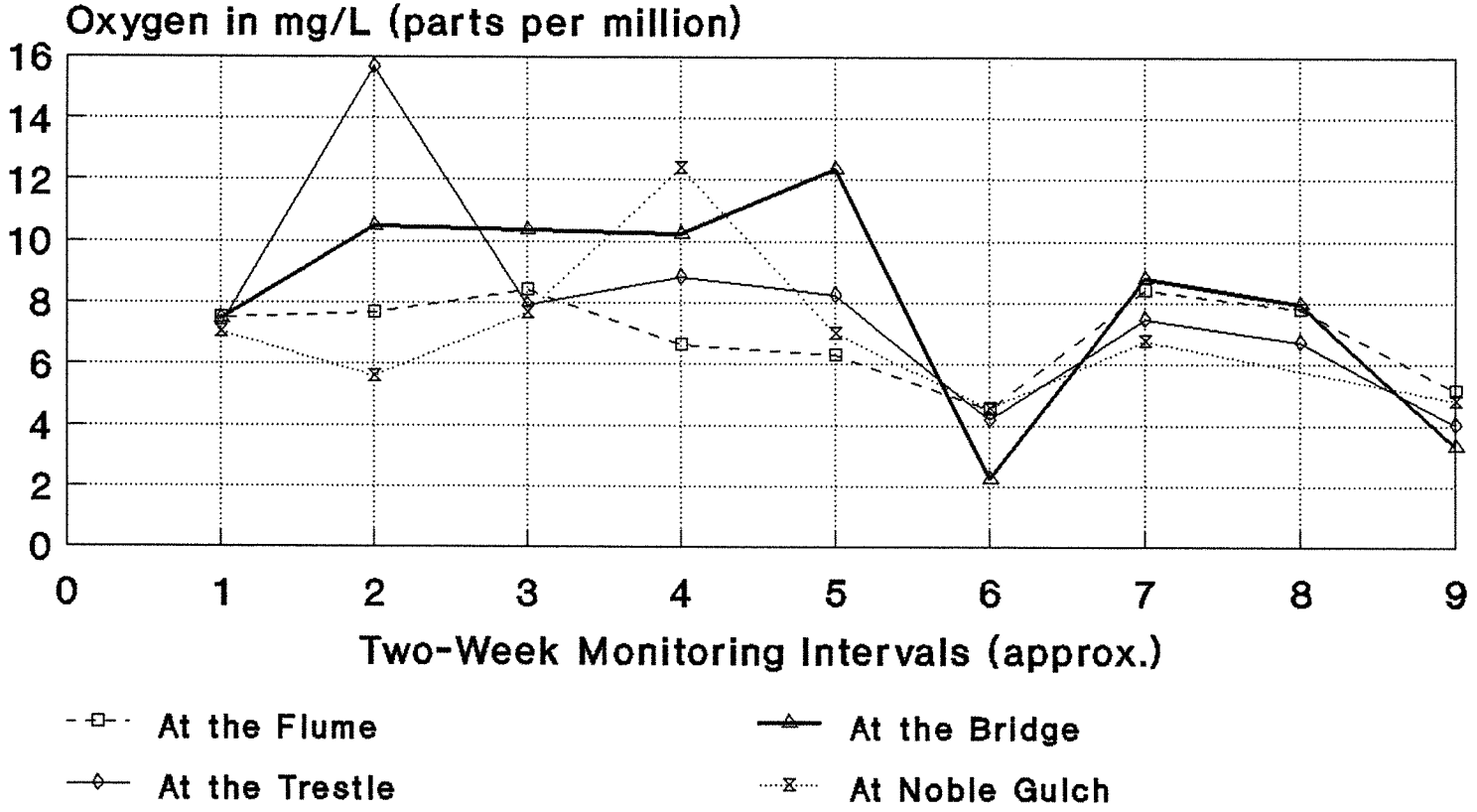


Figure 4. Oxygen Level at Four Stations,
Soquel Lagoon Near the Bottom at Dawn;
10 June - 4 October, 1997.

APPENDIX A.

FISH AND GAME AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION, 1997.

Notification no. **0503-97**

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and **Ed Morrison / City of Capitola** of Santa Cruz, State of California, hereinafter called the operator, is as follows:

WHEREAS, pursuant to Division 2, Chapter 6 of California Fish and Game Code, the operator, on the 15th day of May, 1996, notified the Department that s/he intends to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: Soquel Creek in the County of Santa Cruz, State of California, S__T___ R

WHEREAS, the Department (represented by C. Babich has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: Salmon, steelhead, nongame fish, tidewater gobies, riparian habitat and it's related species, reptiles, amphibians, birds, etc.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife during the operator's work . The operator hereby agrees to accept the following recommendations as part of his/her work: Numbers **4, 7, 9, 10, 20, 21, 22,** from the list of recommendations attached to this page and the following special recommendations:

A. All work in or near the stream shall be confined to the period 5-15-96 through 10-15-96.
B. This agreement is limited to the damming of Soquel Creek at the mouth as per submitted application.
C. A new straight line breach may be made. The existing channel shall be seined, with all fish being placed in the lagoon, prior to a plug of sand being placed at the head of the outflow channel. Prior to the filling of any holes along the edge of the lagoon, these areas shall be seined and netted of to prevent fish from re-entering the area.
D. The Operator shall put the flume in operation during all construction and during all daily closures during construction.
E. All seaweed shall be removed from the channel bottom before damming occurs.
F. The steel shroud put in place in 1992, shall be placed on the flume. A minimum of 8-12 inches of water shall be maintained through the flume. The flume shall be kept open to the ocean until at least 7-1-97. After final damming, no draw down will be allowed without prior Department approval. The Operator shall contact the Department prior to breaching, unless flooding is imminent.
G. The Operator shall keep the lagoon as deep as possible throughout the summer. Once the boards are in place they shall not be removed without prior Department approval. In addition, the Operator shall make the boards vandal proof so they are not removed accidentally.

The operator, as designated by the signature on this agreement, shall be responsible for the execution of all elements of this agreement. A copy of this agreement must be provided to contractors and subcontractors and must be in their possession at the work site.

If the operator's work changes from that stated in the notification specified above, this agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this agreement and with other pertinent Code Sections, including but not limited to Fish and Game Code Sections 5650, 5652, and 5948, may result in prosecution.

Nothing in this agreement authorizes the operator to trespass on any land or property, nor does it relieve the operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. **THIS AGREEMENT IS NOT INTENDED AS AN APPROVAL OF A PROJECT OR OF SPECIFIC PROJECT FEATURES BY THE DEPARTMENT OF FISH AND GAME. INDEPENDENT REVIEW AND RECOMMENDATIONS WILL BE PROVIDED BY THE DEPARTMENT AS APPROPRIATE ON THOSE PROJECTS WHERE LOCAL, STATE, OR FEDERAL PERMITS OR OTHER ENVIRONMENTAL REPORTS ARE REQUIRED.** This agreement becomes effective when signed by both parties.

Operator Ed Morrison
Title Asst. Public Works Director
Organization City of Capitola
Date 5/20/97

Department Representative C. Babich
Title Fish and Game Warden
Department of Fish and Game, State of CA
Date 5-17-97

APPENDIX B.

WATER QUALITY DATA 28 MAY - 4 OCTOBER, 1997.

28 May, 1997. This was the day after sandbar construction was completed. Surface water temperature at the flume was 76 F (24.4 C) at 1730 hr. Two female mergansers were present near the Stockton Avenue Bridge; one had a clutch of 7 chicks and the other had a clutch of 10 chicks.

Station: Beside Esplanade restaurants at 1500 hr, clear day. Gage Height= 1.44.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surface	23.5	0.0	-	950
bottom	28.5	16.8	-	28,600

Station: Stockton Ave Bridge, downstream side in thalweg, 1510 hr Secchi depth to bottom.

surf	23.5	0.0	-	880
0.25	23.5	0.0	-	880
0.50	23.5	0.0	-	860
0.75	23.5	0.0	-	870
1.00	23.5	0.0	-	880
1.25	22.8	0.2	-	1200
1.50	24.8	17.5	-	28200
1.75(bot)	25.0	18.3	-	31000

Conclusion: Water temperature was quite high and potentially stressful to steelhead, particularly near the flume. A temperature inversion existed at the bottom with saltwater present. The lagoon was quite deep this year, despite the shallow gage height. Merganser predation on steelhead would be a factor in determining population size in 1997. Ed Morrison was notified of the saltwater so that he would have the shrouds installed. He was advised to increase lagoon depth.

29 May 1997. The shrouds were in place on the flume inlet to pull out saltwater. Considerable sand was deposited beyond the flume exit, unlike any previously monitored year. The flume was open. Water temperature at the lagoon inflow near Nob Hill parking lot was 75.8 F (24.3 C).

Station: Stockton Avenue Bridge at 1535 hr, Clear. Gage Height= 2.32. Air temperature 26.5 C and breezy.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	23.5	0.0	-	750
0.25	23.6	0.0	-	750
0.50	23.6	0.0	-	750
0.75	23.5	0.0	-	740
1.00	22.5	0.0	-	690
1.25	22.2	0.0	-	680
1.50	21.8	0.1	-	960
1.75	23.7	17.5	-	28500
2.00	25.5	21.8	-	34500
2.05(bot)	25.8	21.5	-	34200

Conclusions: The lower Soquel Creek drainage was particularly warm this year, which would make it difficult to maintain cool lagoon water temperatures on sunny days. Saltwater was still in the lagoon. The lagoon depth had improved substantially with the shrouds in place.

30 May 1997.

Station: Stockton Avenue Bridge at 1640 hr, Clear. Gage Height= 2.36. Air temperature 25.0 C and windy.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	23.5	0.0	-	680
0.25	23.7	0.0	-	680
0.50	23.6	0.0	-	690
0.75	23.8	0.0	-	680
1.00	23.3	0.0	-	670
1.25	22.6	0.0	-	650
1.50	22.2	0.0	-	650
1.75	22.8	9.2	-	14800
2.00	23.5	11.3	-	18900
2.05(bot)	23.5	12.1	-	19500

Conclusions: The lagoon was still quite warm, but had a slight cooling in the middle of the water column. Saltwater was gradually leaving the lagoon with reduced salinity readings.

2 June 1997. The flume outlet plugged with sand from tidal action. The flume level went to 3.50 overnight, according to Morrison.

3 June 1997. Rain was forecasted. Morrison pulled the shrouds in the morning and put in a half-screen on one side of the flume inlet. It rained lightly throughout the day. A half-screen was placed on the other side of the inlet in the afternoon.

4 June 1997. It sprinkled through the night. Morrison checked the flume outlet at 1830 hr on 3 June, 2130 hr and then at 0030 hr on 4 June. The lagoon was 4 inches above the flume inlet at 0030 hr. Morrison cleared flume outlet and pulled screens, as well as a board on either side. By morning the sandbar was intact with the flume still submerged and light drizzle. Half-screens were re-installed.

6 June 1997. Gage height was 2.7 in the morning. The sandbar was plugging the flume outlet each night. It was re-opened each morning. Quarter-screens were to be put in this day without shrouds.

10 June 1997. We saw no mergansers this day. Ed Morrison saw them on the flume the previous day. The creek continued out beyond the flume in a channel through the beach. Streamflow at Nob Hill was 2.5-3.0 cfs. No surface algae present at the lagoon.

Reach 1 with 35% of bottom covered with .3-.6 feet thick algal mat. Reach 2 with 35% algae on bottom at .3-1.0 feet thick. Reach 3 with 15% bottom algae .3-.6 feet thick. At mouth of Noble Gulch there was a 10x20 foot algal mat .5-1.0 feet thick on bottom.

Station: Flume at 0720 hr, overcast. Gage Height= 1.72. Air temperature = 14.7 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	19.1	0.00	7.97	630
0.25	19.1	0.00	7.90	630
0.50	19.0	0.00	7.85	630
0.75	19.0	0.00	7.85	630
1.00	19.2	0.01	7.80	650
1.25	19.3	0.05	7.52	1230
1.50(bot)	23.8	8.6	1.23	14800

Station: Stockton Ave Bridge, 0815 hr. Secchi depth to bottom.

surf	18.3	0.00	7.95	620
0.25	18.7	0.00	7.76	620
0.50	18.7	0.00	7.65	620
0.75	18.8	0.00	7.70	630
1.00	18.8	0.00	7.67	630
1.25	18.8	0.00	7.46	630
1.50(bot)	20.8	6.50	0.83	9600

Station: Railroad trestle, 0835 hr.

surf.	19.1	0.0	7.53	620
0.25	18.9	0.0	7.40	620
0.50	18.3	0.0	7.35	620
0.75	19.0	0.0	7.25	620
0.87(bot)	18.8	0.0	5.58	575

Station: Mouth of Noble Gulch, 0850 hr.

surf	17.5	0.00	6.82	605
0.25	17.7	0.00	6.80	600
0.50	17.7	0.00	6.84	590
0.75	17.5	0.00	7.03	580
0.90(bot)	17.5	0.00	4.55	580

Conclusion: Water quality conditions were good for steelhead in all reaches except for oxygen below 5 ppm at the bottom at three of four stations at the bottom. However, just above the bottom oxygen levels were good, as were temperatures. The salinity continued to decline in the deeper portions. The gage height was poor. We requested that the lagoon level be increased.

11 June 1997. The shrouds were installed to raise the lagoon level to within 2 inches of the top of the flume overnight.

12 June 1997. Gage height of 2.49.

19 June 1997. Gage height of 2.43. Shrouds still in place. Outlet became plugged overnight.

20 June 1997. Lagoon level reached 1 foot above flume. Removed shrouds and installed 1/3- screen on one side.

23 June 1997. It was Monday. Lagoon level at 2.44 feet. Surface algae was not present. Bottom algae increased since last time. Reach 1 with 80% of bottom covered with 0.3-1.0 thick algae averaging 0.6 feet. Reach 2 with 65% bottom algae .3-1.0 thick. Reach 3 with 40% bottom algae .3-.8 feet thick. Gray water at Noble Gulch with thick surface film prevented bottom observations. One adult merganser seen and no young. Considerable steelhead feeding hits seen on the surface that were too frequent to count. Streamflow at Nob Hill approx. 2 cfs.

Station: Flume at 0645 hr, sunny. Gage Height= 2.33.
Air temperature 9.8 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	17.3	0.02	9.05	950
0.25	17.6	0.02	9.05	950
0.50	17.7	0.02	9.05	970
0.75	17.7	0.02	8.85	1030
1.00	17.7	0.08	8.87	1390
1.25	18.2	9.6	7.65	12100
1.50(bot)	18.5	16.3	3.22	22600

Station: Stockton Ave Bridge, 0728 hr.

surf	18.1	0.02	8.90	930
0.25	18.2	0.02	8.88	930
0.50	18.2	0.02	8.85	950
0.75	18.2	0.02	8.83	980
1.00	18.2	1.75	8.65	3100
1.25	19.7	9.20	9.30	13700
1.50	20.1	13.5	10.5	19500
1.60(bot)	19.8	14.8	4.45	21700

Station: Railroad trestle, 0753 hr.

surf.	18.1	0.00	9.15	770
0.25	18.3	0.00	9.05	770
0.50	18.3	0.00	8.98	770
0.75	18.8	0.00	8.92	770
1.00	21.2	2.7	15.65 (algae)	4540
1.05(bot)	21.1	4.4	10.04	5100

Station: Mouth of Noble Gulch, 0808 hr.

surf	17.6	0.00	8.05	680
0.25	17.9	0.00	8.05	680
0.50	18.0	0.00	7.98	680
0.75	18.0	0.01	7.95	820
1.00	19.3	2.8	5.60	4630
1.05(bot)	19.3	2.9	2.75	4620

Conclusions: Algae had grown substantially in two weeks. Tidal overwash had occurred over the weekend since the last monitoring as evidenced by increased salinity at the bottom. Water temperature was slightly cooler through the water column than previously. Oxygen levels were better than before near the bottom. We requested that the shrouds be put back on the flume.

7 July 1997. Gage Height = 3.50. Flume was plugged with sand.

8 July 1997. It was Tuesday. The shrouds were in place. In Reach 1 there was 1% surface algae. Glare prevented bottom observations there. Reach 2 had no surface algae with 40% of the bottom covered with pondweed and algae 1.5-2 feet thick. Sixty percent of the bottom was algae alone at 1 foot thick. Reach 3 had no surface algae, 35% of the bottom with pondweed and algae 1-2 feet thick and 65% of the bottom with algae alone less than 0.5 feet thick. At Noble Gulch no algae reached the surface. Algae and pondweed surrounded the mouth 1-2 feet thick with none right at the mouth. Seven mergansers seen. A green-back heron was feeding under the bridge. Steelhead were hitting the surface in Reach 2 at 180-200 hits per minute. Mr. Hayford stated that he was working the entrance booth at Pt. Lobos State Park on the day that John Steinbeck's ashes were spread over Monterey Bay from a boat that was put in at Whaler's Cove. Several limousines were involved. It was a misty, foggy day at Pt. Lobos. Stream inflow to the lagoon was approximately 2 cfs at Nob Hill, where a greenback heron was observed and water temp. was 65 F at 0920 hr.

Station: Flume; 0659 hr. Overcast. Gage height= 2.41. Air temp. 13.7 C. Flume exit = 1.0 ft deep.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.8	0.01	8.66	860
0.25	20.8	0.01	8.63	850
0.50	20.8	0.01	8.55	850
0.75	20.8	0.01	8.55	870
1.00	20.8	0.01	8.48	870
1.25	21.2	0.02	8.40	870
1.50(bot)	29.5	13.5	3.89	20000

Station: Stockton Avenue Bridge, 0745hr. Secchi depth to bottom.

surf.	19.9	0.00	8.65	720
0.25	20.2	0.00	8.90	720
0.50	20.5	0.00	8.80	720

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
0.75	20.6	0.00	8.80	720
1.00	20.6	0.00	8.80	730
1.25	20.6	0.01	8.92	940
1.50	22.3	2.5	10.38	4700
1.65(bot)	23.8	3.6	2.38	5600

Station: Railroad trestle, 0759 hr.

surf.	20.2	0.00	8.16	660
0.25	20.2	0.00	7.98	660
0.50	20.3	0.00	7.96	660
0.75	20.3	0.00	7.96	660
1.00	20.5	0.00	7.90	660
1.05(bot)	20.5	0.00	5.80	660

Station: Mouth of Noble Gulch, 0848 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	17.8	0.00	7.82	630
0.25	18.0	0.00	7.75	630
0.50	18.0	0.00	7.75	630
0.75	18.2	0.00	7.68	630
1.00(bot)	18.0	0.00	4.65	680

Conclusions: The maintained salinity indicated that tidal overwash had possibly occurred again. Water temperature near the bottom had increased from good to fair at the flume. Upstream, water temperatures were still good as were oxygen concentrations. The high oxygen concentration near the bottom was puzzling.

14 July 1997. Gage Height = 2.00.

21 July 1997. Gage height = 2.81.

22 July 1997. Ed caught a 35 pound chinook salmon today in the Monterey Bay. He didn't give me any.

23 July 1997. It was Wednesday. We saw our first pied bill grebe. The shrouds were in place. It looked like there had been an algae and pondweed die-off. In Reach 1 30% of the bottom had algae 0.4-0.8 feet thick without surface algae. Reach 2 had 1% surface algae with 60% of the bottom with algae 0.3-0.8 feet thick. Reach 3 had 2% surface algae with 95% of bottom with algae 0.3-1.0 feet thick. At Noble Gulch 70% of the bottom had algae 1.5-2 feet thick without surface algae. Streamflow was 1.5 cfs at Nob Hill. We saw no mergansers.

Station: Flume; 0702 hr. Overcast, warm with sprinkles. Gage height = 2.10. Air temperature 16.0 C. Flume exit = 1.3 ft deep.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.

				(umhos)
surf.	18.5	0.02	9.38	860
0.25	19.4	0.02	9.35	860
0.50	19.4	0.02	9.30	860
0.75	19.5	0.03	9.15	1020
1.00	20.4	4.2	7.20	7800
1.25	22.2	9.6	6.64	13700
1.50(bot)	22.5	12.5	4.02	18000

Station: Stockton Avenue Bridge, 0734hr. Secchi depth to bottom.

surf.	19.4	0.00	9.58	520
0.25	19.7	0.01	9.50	820
0.50	19.7	0.01	9.53	820
0.75	19.8	0.02	9.62	880
1.00	21.3	4.2	9.05	6700
1.25	23.2	9.2	10.23	14700
1.50(bot)	23.0	11.5	0.85	18400

Station: Railroad trestle, 0759 hr.

surf.	19.2	0.00	8.95	710
0.25	19.2	0.00	9.10	710
0.50	19.3	0.00	9.15	720
0.75	19.5	0.00	8.85	720
0.95(bot)	20.7	1.6	1.05	3350

Station: Mouth of Noble Gulch, 0820 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	19.0	0.00	8.75	650
0.25	19.0	0.00	8.93	650
0.50	19.0	0.00	8.85	650
0.75	19.0	0.00	8.85	660
1.00	18.8	6.0	12.1	8500
1.25(bot)	20.8	6.2	2.3	9680

Conclusions: More saltwater was in the lagoon than earlier. Water temperature near the bottom had increased considerably at some stations. The high oxygen levels near the bottom were puzzling.

4 August 1997. There was insufficient flow (1.25 cfs inflow) to keep the sandbar open. No surface algae was present on the lagoon. Reach 1 had 60% pondweed and algae 1-2 feet thick on the bottom and 40% with a 0.3 feet algae carpet. Reaches 2 and 3 had 50% algae and pondweed 0.5-1 feet thick and 50% 0.3 feet thick algae on the bottom. Noble Gulch had 50% surface algae and 60% of the bottom with algae and pondweed 1-1.5 feet thick. Water temperature at Nob Hill lagoon inflow was 67 F (19.4 C) at 0920 hr and the greenback heron was observed.

Station: Flume, 0655 hr, clear. Gage height = 2.45 at 0730 hr and 2.49 at 0845 hr. Air temperature was cool 11.8 C (53.2 F).

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	16.8	0.01	9.47	860
0.25	17.2	0.01	9.65	850
0.50	17.2	0.01	9.45	850
0.75	17.4	0.01	9.45	850
1.00	17.5	0.01	9.35	860
1.25	17.6	0.01	9.33	870
1.50	17.6	0.02	6.33	920
1.65(bot)	24.8	12.7	0.76	21200

Station: Stockton Avenue Bridge near bulkhead, 0720 hr.

surf.	20.5	0.00	8.88	820
0.25	20.8	0.00	8.85	820
0.50	20.8	0.00	8.85	820
0.75	20.8	0.00	8.85	830
1.00	20.8	0.00	8.85	880
1.25	20.9	0.1	9.03	1100
1.50	21.0	3.3	12.34	5800
1.65(bot)	23.5	6.7	0.95	12100

Station: Railroad trestle, 0740 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.5	0.00	8.45	720
0.25	20.6	0.00	8.50	720
0.50	20.8	0.00	8.50	720
0.75	20.8	0.00	8.50	720
1.00	20.9	0.00	8.25	720
1.05(bot)	20.9	0.00	5.35	720

Station: Mouth of Noble Gulch, 0800 hr.

surf.	18.3	0.00	7.05	660
0.25	18.5	0.00	7.0	660
0.50	18.6	0.00	7.05	650
0.75	18.6	0.00	7.05	650
1.00	18.6	0.00	7.0	580
1.20	18.5	0.00	0.2	580

Conclusion: Water temperature had warmed into the fair range in the central stations. It was remarkable to see the difference in water temperature between the flume and the Bridge with cool air temperatures. The gage height had improved with the flume being plugged. Saltwater had re-entered the lagoon, warming the bottom at the flume and Bridge. Oxygen levels were good.

22 August 1997. It rained 3 nights previously, one inch of rainfall in Brookdale. Streamflow at Nob Hill was 2.5 cfs. Water was tea-colored in the lagoon, and the bottom could not be seen to estimate algae densities. Reach 1 had no surface algae. Reach 2 had 1% surface algae and Reach 3 had 3% surface algae.

Station: Flume, 0700 hr. Air temp. = 15.5 C. Gage height = 2.04.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.5	0.00	4.8	630
0.25	20.5	0.00	4.65	630
0.50	20.5	0.00	4.6	630
0.75	20.5	0.00	4.6	630
1.00	20.5	0.00	4.5	630
1.25(bot)	20.5	0.00	1.5	680

Station: Stockton Avenue Bridge, 0718 hr. Secchi depth was to the bottom, barely.

surf.	20.5	0.00	4.60	650
0.25	20.8	0.00	4.60	640
0.50	20.8	0.00	4.55	630
0.75	20.8	0.00	4.53	620
1.00	20.8	0.00	4.65	700
1.25	21.0	1.5	2.24	3350
1.45(bot)	21.8	6.5	0.05	10300

Station: Railroad trestle, 0747 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.7	0.00	4.15	620
0.25	20.7	0.00	4.10	620
0.50	20.7	0.00	4.20	620
0.75	20.7	0.00	4.18	630
0.95(bot)	20.7	0.00	0.75	630

Station: Mouth of Noble Gulch, 0758 hr.

surf.	20.3	0.00	4.55	660
0.25	20.3	0.00	4.70	660
0.50	20.5	0.00	4.65	660
0.75	20.3	0.00	4.58	670
1.00(bot)	19.8	0.00	1.65	580

Conclusion: Water temperature had improved into the fair zone. Oxygen levels had decreased to the poor range because photosynthesis had been depressed. Steelhead were probably becoming stressed by reduced oxygen, but that probably improved once the sun came up to stimulate some photosynthesis. Saltwater had been washed out with the increased flow.

6 September 1997. It was Saturday before the Begonia Festival. The shrouds were in place. Lagoon inflow at Nob Hill had declined to 1 cfs and was 66.5 F (19.2 C) at 0951 hr. Aquatic plant life was the most dense of the summer. In Reach 1, 90% of the bottom had algae and pondweed 1-3 feet thick, averaging 2.5 feet. Ten percent of the surface in Reach 1 was covered with algae. In

Reach 2, 100% of the bottom had algae and pondweed 1-3 feet thick and averaged 1.5 feet thick. No surface algae was present in Reach 2. Reach 3 had no surface algae either, but 100% of the bottom had algae and pondweed 0.5-2 feet thick, averaging 1 foot. At Noble Gulch there were bright green tufts of algae present with 60% of the bottom with pondweed and algae 1 foot thick. A plume of cloudy water 25 feet by 50 feet existed out from the mouth without surface algae. there was 10% surface algae. Three pied-billed grebes were seen in Reach 1, the most of the season. No mergansers were seen. A group of 30 steelhead juveniles congregated in Reach 2, down from the trestle.

Station: Flume, 0728 hr. Weather overcast. Gage height= 2.48. Air temperature = 15.6 C (60.1 F). Flume exit 1.2 feet deep.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.5	0.00	8.48	860
0.25	20.8	0.00	8.60	880
0.50	19.8	0.00	8.55	880
0.75	19.6	0.00	8.60	870
1.00	19.6	0.00	8.58	870
1.25	19.1	0.00	8.40	860
1.45(bot)	27.6	10.5	4.55	15600

Station: Stockton Avenue Bridge, 0755 hr. Secchi depth to bottom.

surf.	21.8	0.00	9.16	820
0.25	21.9	0.00	9.10	820
0.50	22.0	0.00	8.98	820
0.75	22.0	0.00	8.90	820
1.00	22.0	0.00	8.82	820
1.25	22.0	0.00	8.82	820
1.50	22.0	0.00	8.78	800
1.75(bot)	26.8	6.5	0.00	10300

Station: Railroad trestle, 0820 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	21.2	0.00	7.60	760
0.25	21.2	0.00	7.45	760
0.50	21.6	0.00	7.55	760
0.75	21.6	0.00	7.65	760
1.00	21.8	0.00	7.45	760
1.10(bot)	21.8	0.00	4.48	760

Station: Mouth of Noble Gulch, 0835 hr.

surf.	20.5	0.00	6.65	730
0.25	20.6	0.00	6.50	730
0.50	20.6	0.00	6.55	730
0.75	20.0	0.00	6.60	730
1.00	20.0	0.00	6.75	650
1.15(bot)	20.2	0.00	4.71	650

Conclusion: Water temperature had warmed into the poor range at the Bridge and trestle. This was the warmest lagoon of the season and was stressful to steelhead in the afternoon. Oxygen was holding in the fair to good range except right at the bottom where it was poor. Saltwater remained in the lagoon.

7 September 1997. It was Sunday at the Begonia Festival. I never before saw so many attractive women in one place! They must like flowers and pageantry. Some floats had as many as 6 waders to propel the floats. Floats were brought down the lagoon and then were pushed back up the lagoon. The means of propulsion with the least impact was power by surfboard. Three to five thousand spectators were present who filled the Stockton Avenue Bridge, the railroad trestle and the periphery of the lower lagoon. Nels Westman was acknowledged for his many years of service in organizing the Begonia Festival. I was grateful for his supervision of clean-up.

Station: Stockton Avenue Bridge, 1703 hr. Secchi depth 1.5 m.

surf.	24.0	0.01	-	900
0.25	24.0	0.01	-	890
0.50	23.2	0.01	-	870
0.75	23.2	0.01	-	870
1.00	23.2	0.01	-	870
1.25	23.0	0.01	-	870
1.50	23.0	0.01	-	870
1.60(bot)	23.0	0.01	-	870

Conclusions: Water temperature was stressful to steelhead after the Begonia Festival, but was cooler than would have been expected from warm conditions the previous morning. Salinity was not detected at the bottom, perhaps due to mixing that resulted from waders with floats. Impact from wading could be reduced if fewer waders were used per float and if floats were taken down the lagoon but not back up. They could be left below Stockton Avenue Bridge for viewing until they were dismantled.

8 September 1997. Gage Height = 2.47.

10 September 1997. Nearly all begonias had been cleaned up. Only a few along the western, riparian edge remained to pose no problem with decomposition.

12 September 1997. Reach 1 was least affected with 90% of the bottom with pondweed and algae 2-2.5 feet thick, averaging 2 feet. Reach 2 had 80% of the bottom covered with algae and pondweed 0.5-2 feet thick and averaging 1 foot thick. The tallest pondweed was on the sides where waders did not tread. Reach 3 had 85% of the bottom covered with shorter algae and pondweed 0.5-1 foot thick, averaging 0.5 feet thick. There were no algae or begonias on the surface.

Station: Flume, 0728 hr. Gage height = 2.49. Sunny. Air temp. 17.0 C (62.6 F).

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	21.2	0.0	8.63	780
0.25	21.3	0.0	8.52	780
0.50	21.3	0.0	8.60	780
0.75	21.3	0.0	8.53	780
1.00	21.3	0.0	8.50	780
1.25	21.3	0.0	7.80	780
1.50(bot)	18.9	2.1	4.53	3850

Station: Stockton Avenue Bridge, 0758 hr. Secchi depth to bottom.

surf.	21.6	0.0	8.63	850
0.25	21.7	0.0	8.18	850
0.50	21.8	0.0	8.08	850
0.75	21.8	0.0	8.08	850
1.00	21.8	0.0	8.05	850
1.25	21.8	0.0	7.98	850
1.50	21.8	0.0	7.95	850
1.75(bot)	21.9	0.0	1.50	850

Station: Railroad trestle, 0820 hr.

surf.	21.3	0.00	6.81	730
0.25	21.4	0.00	6.73	730
0.50	21.5	0.00	6.73	730
0.75	21.6	0.00	6.70	730
1.00	21.6	0.00	6.70	730
1.10(bot)	21.7	0.00	3.95	730

Conclusions: Aquatic plants appeared to have been reduced somewhat by the Begonia Festival activities, with a smaller percent of the bottom covered with algae and pondweed and a reduction in thickness throughout the three Reaches. Saltwater was essentially gone from the lagoon.

4 October 1997. It was Saturday before our first steelhead sampling on Sunday. It had rained Wednesday night. Pondweed was present but the bottom was invisible due to tea-colored water. No surface algae existed. Streamflow was 1.2 cfs at Nob Hill.

Station: Flume, 0740 hr. Gage height = 2.95. Sunny. Air temp. 13.8 C (56.8 F).

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	18.5	0.2	5.45	1050
0.25	18.5	0.2	5.32	1040
0.50	18.6	0.2	5.25	1040
0.75	18.8	0.2	5.15	1040
1.00	18.8	0.2	5.14	1040

1.25	18.9	0.2	3.02	1040
1.50	18.9	2.8	-	5500
1.75(bot)	20.5	8.8	-	17700

Station: Stockton Avenue Bridge, 0810 hr. Secchi depth= 1.3 m (4.2 ft).

surf.	18.6	0.1	5.13	950
0.25	18.9	0.1	4.84	960
0.50	18.9	0.2	4.75	950
0.75	19.0	0.2	4.72	960
1.00	19.0	0.2	4.67	960
1.25	20.2	3.2	4.40	5000
1.50	20.9	9.2	3.30	13800
1.75(bot)	21.0	9.5	0.00	14200

Station: Railroad trestle, 0830 hr.

surf.	18.8	0.00	4.12	910
0.25	19.0	0.00	4.05	910
0.50	19.0	0.00	4.02	910
0.75	19.0	0.00	4.02	910
1.00	19.0	0.00	4.04	910
1.22(bot)	19.0	0.00	2.55	910

Station: Mouth of Noble Gulch, 0845 hr.

Depth(m)	**Temp.(C)**	**Salin.(ppt)**	**Oxygen(ppm)**	**Cond. (umhos)**
surf.	18.3	0.00	4.52	700
0.25	18.3	0.00	4.42	700
0.50	18.3	0.00	4.55	690
0.75	18.3	0.00	4.72	690
1.00	18.3	0.00	4.80	690
1.25(bot)	18.3	0.00	0.3	680

Conclusion: As occurred in August after a storm, oxygen levels were depressed in association with the turbid water that reduced photosynthetic rates of aquatic plants. Oxygen levels were in the poor range at three of four stations. With the saline water and low oxygen levels at the Bridge, conditions were the most inhospitable to steelhead. This is usually a congregating location for steelhead. Fish seining was approached with caution the following day. The gage height was the highest detected for the season. The flume boards had been vandalized that night with lagoon levels much reduced on 5 October to gage height = 1.40.

APPENDIX C.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 1996.

CITY OF CAPITOLA

Office of the
Building Official

==========

TO: Susan Westman, City Manager

FROM: Daniel J. Kostelec, Building Official

DATE: May 19, 1997

SUBJECT: Drain Line Tests

==========

The restaurants contiguous with the Soquel Creek lagoon that have accessible plumbing systems have been tested for leaks and repaired as necessary.

1997
DRAIN LINE TEST FOR RESTAURANTS
CONTIGUOUS WITH SOQUEL CREEK LAGOC

RESTAURANT	INITIAL CONTACT	TEST DATE	C IMENTS	SIGN OFF
Beach House ✓ 207 Esplanade Linda Simpson 475-5846	LTR MAILED 4/24/97 ZJK SITE VISIT 4/24/97 ZJK	5/6/97	SEWER TESTED O.K. GREASE TRAP WASTE TESTED O.K.	
Ocean View 209 Esplanade Perry Choy 475-0205 688-5975 H 688-3869		5/6/97		
Pizza My Heart ✓ 209(A) Esplanade Keith Holtaway ~~425-1441~~ 426-2511		✓	SODA MACHINE & OTHER WASTE TERMINATES IN FLOOR SINK WITHOUT BENEFIT OF AIR GAP.	
Fog Bank ✓ 211 Esplanade ~~Jim Williams~~ 462-1881 ✓ LINDA KENNETT		✓		
Larry's 215 Esplanade Larry 475-6215 OCEANSIDE PROPERTIES			OK PER CRITTER & L 5/16/97	

✓

JIMMIE SMITH
PLUMBING INC.
PLUMBING CONTRACTOR

3098 WINKLE AVENUE 475-5700
SANTA CRUZ, CA 95065
LIC. NO. 266069

May 16, 1997

City of Capitola
420 Capitola Ave.
Capitol. Ca. 95010

Attn: Daniel

Re: Larry's Surf and Turf

This is notification that on May 13, 1997 our plumber Mario Capetillo repaired leaks on the Grease Trap Line. He then retested the Sewer Line and the Grease Trap Line. They held test.

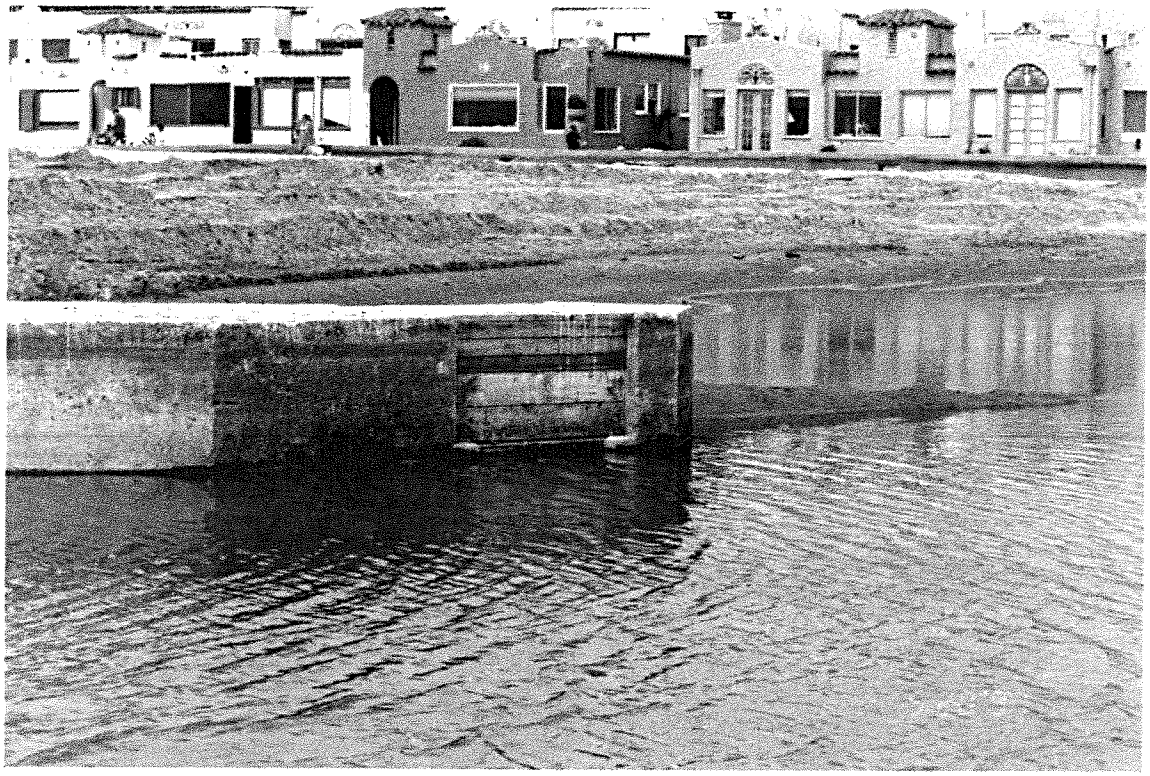
If you have any questions please feel free to call, 475-5700.

Sincerely,

Catherine Smith

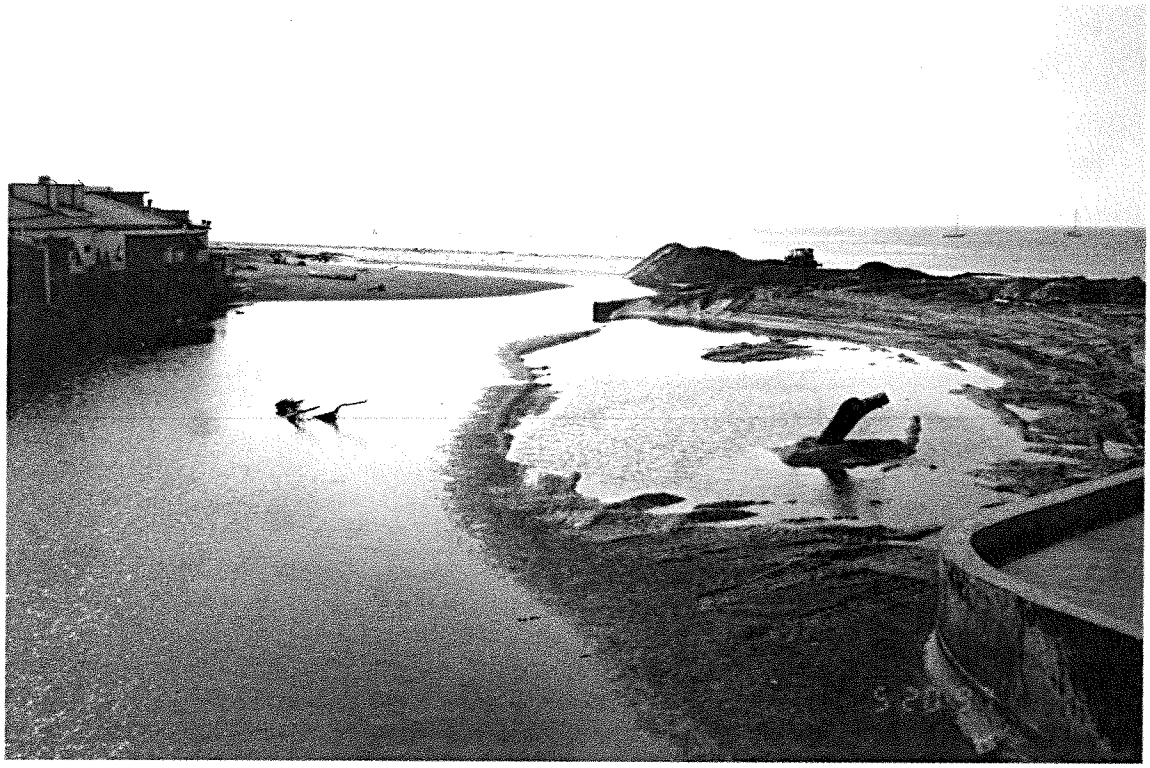
Catherine Smith

APPENDIX D. PHOTOGRAPHS OF SANDBAR CLOSURE, FISH CENSUSING AND THE BEGONIA FESTIVAL, 1997.

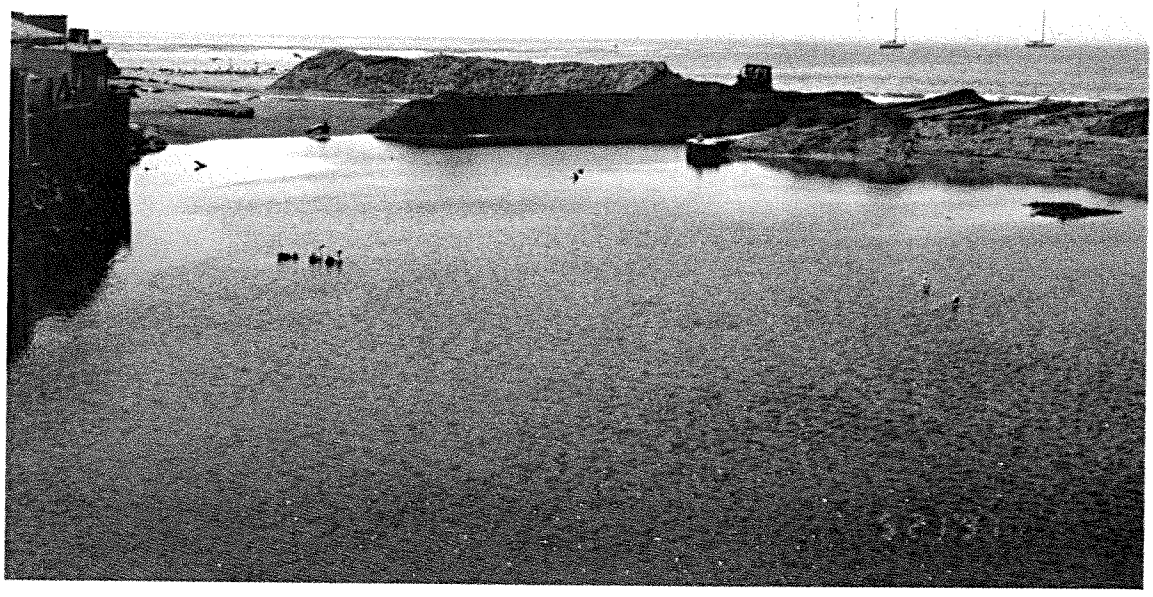


Flume Inlet Before Sandbar Construction Began, 20May97

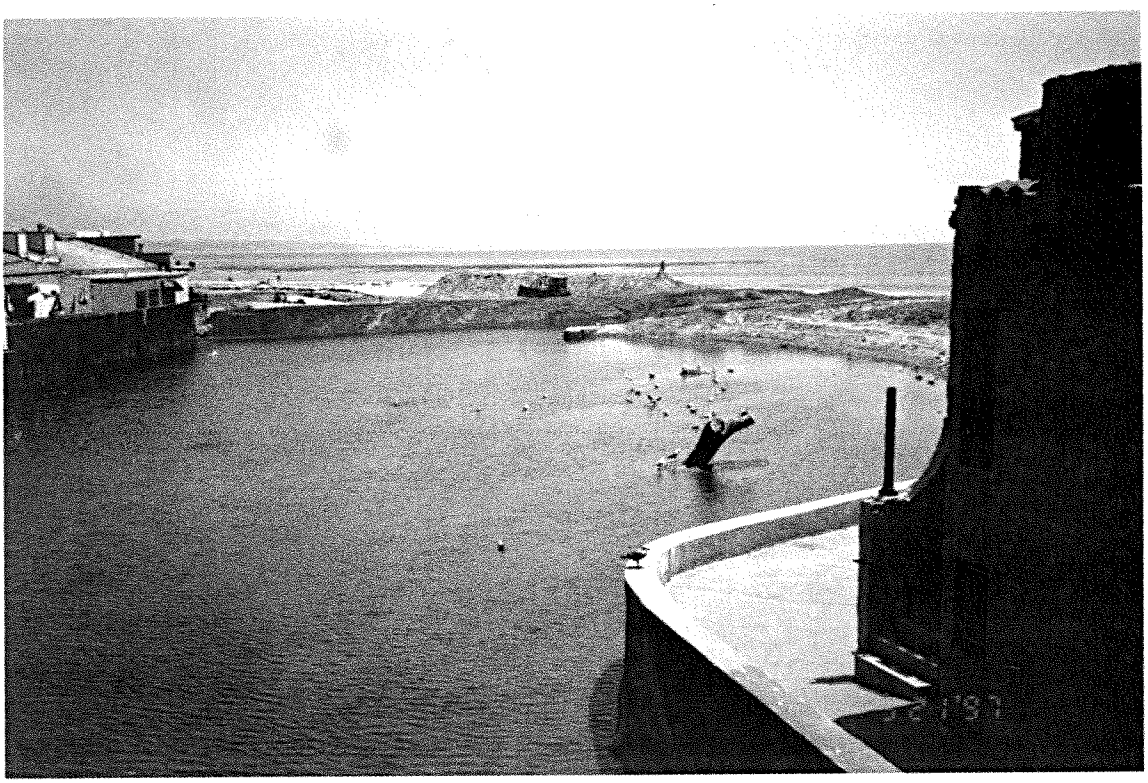
Soquel Creek Estuary Before Sandbar Construction, 20May97



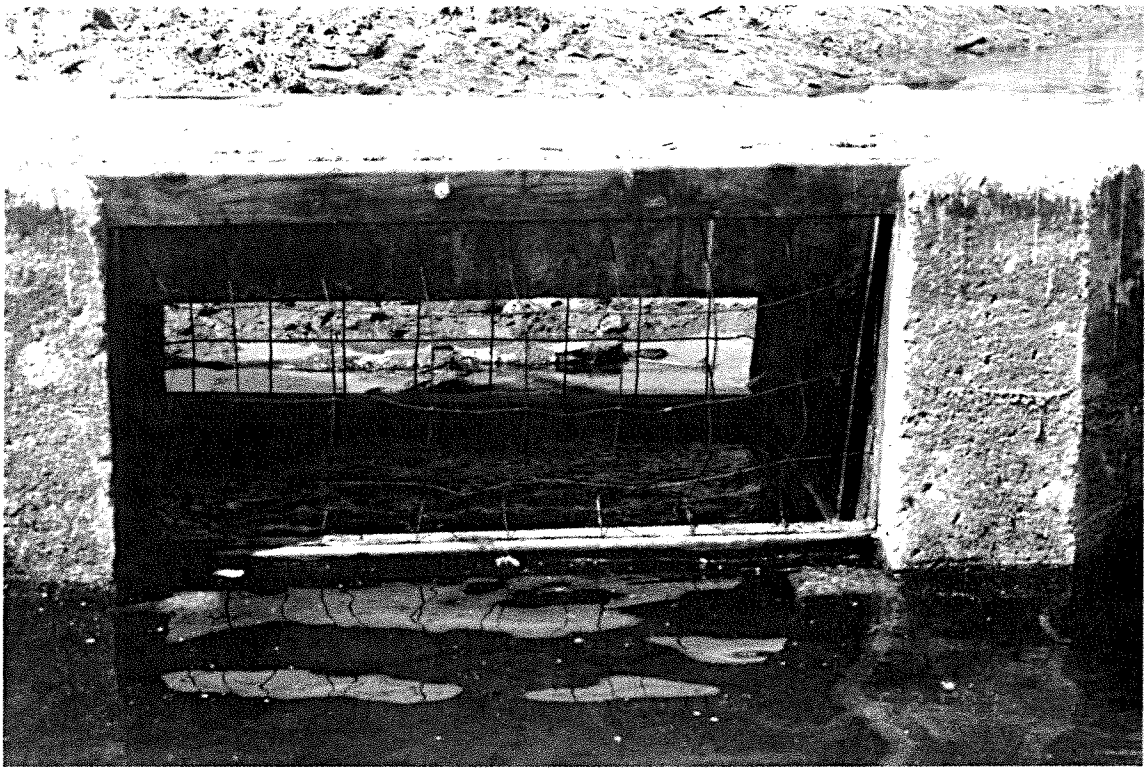
Estuary Showing Excavated Area on Right, Lateral Channel Across Beach and Stock-piling of Sand for Blockage, 20May97



Lateral Channel Blocked Off From Main Lagoon, 21May97

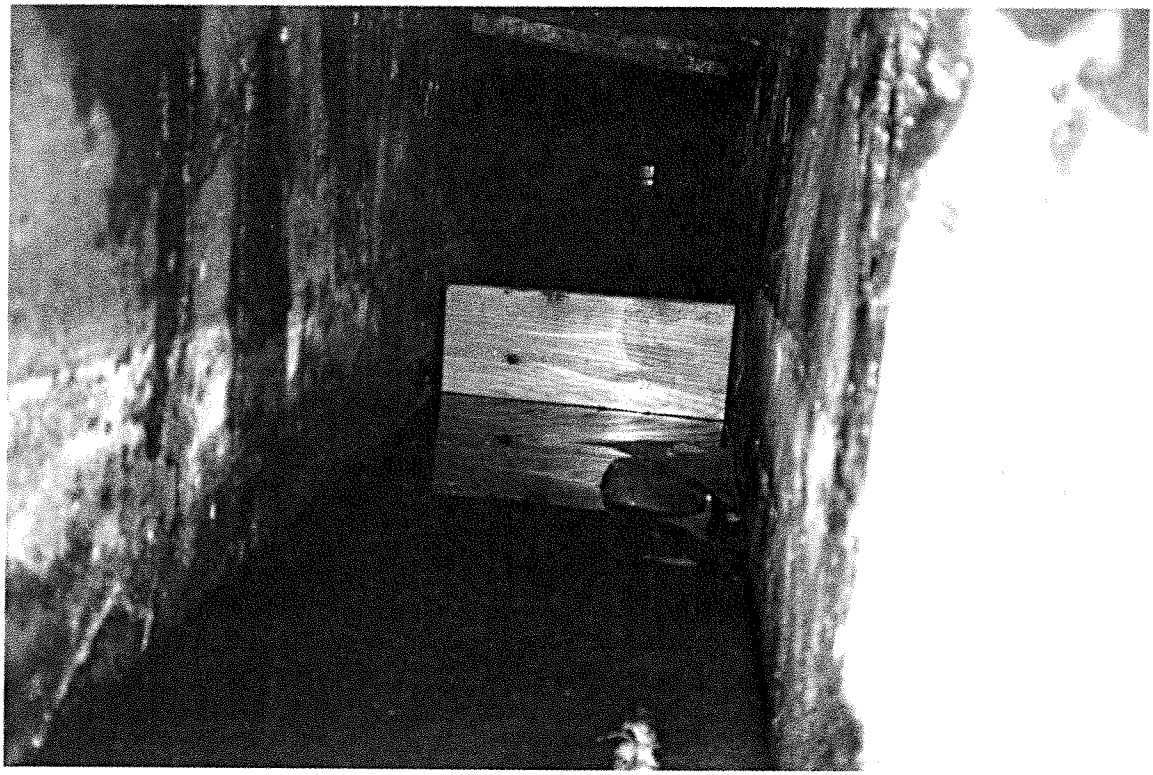


Lagoon Filling After Lateral Channel was Blocked Off, 21May97



Soquel Creek Flowing Through the Flume Entrance, 21May97

Baffle Being Installed Inside the Flume by Ed Morrison, 22May97

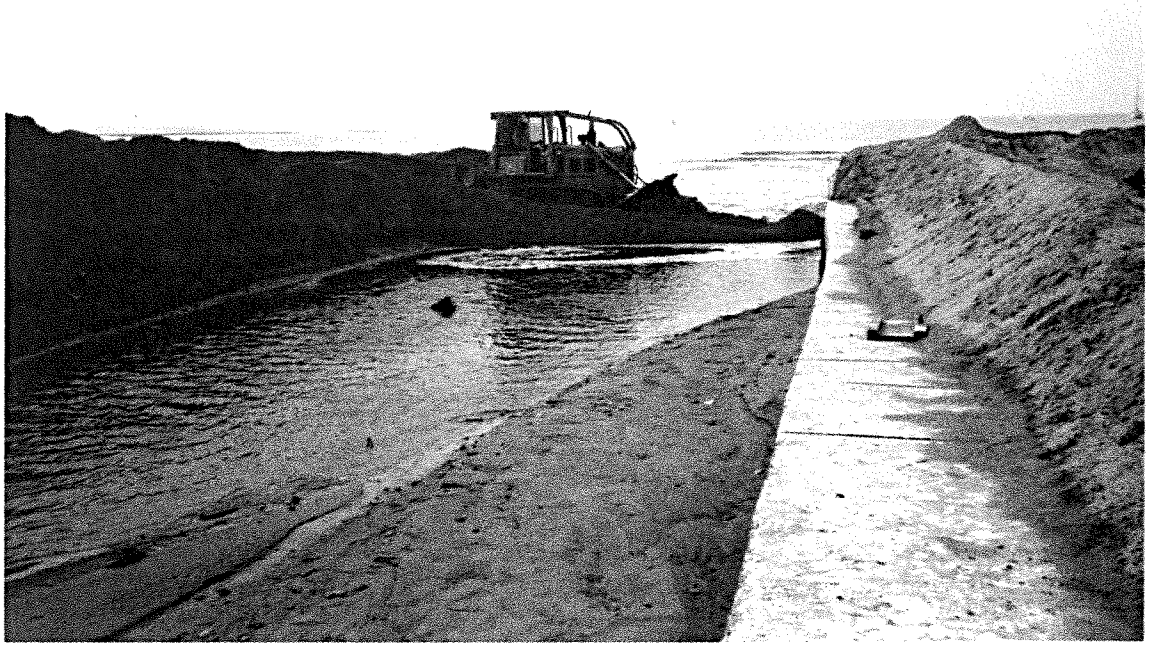


Installation of the Baffle is Completed, 22May97

Lower Lagoon with Sandbar Open, Gulls Bathing on Right, 22May97

Flume Entrance With Sandbar Open, 22May97

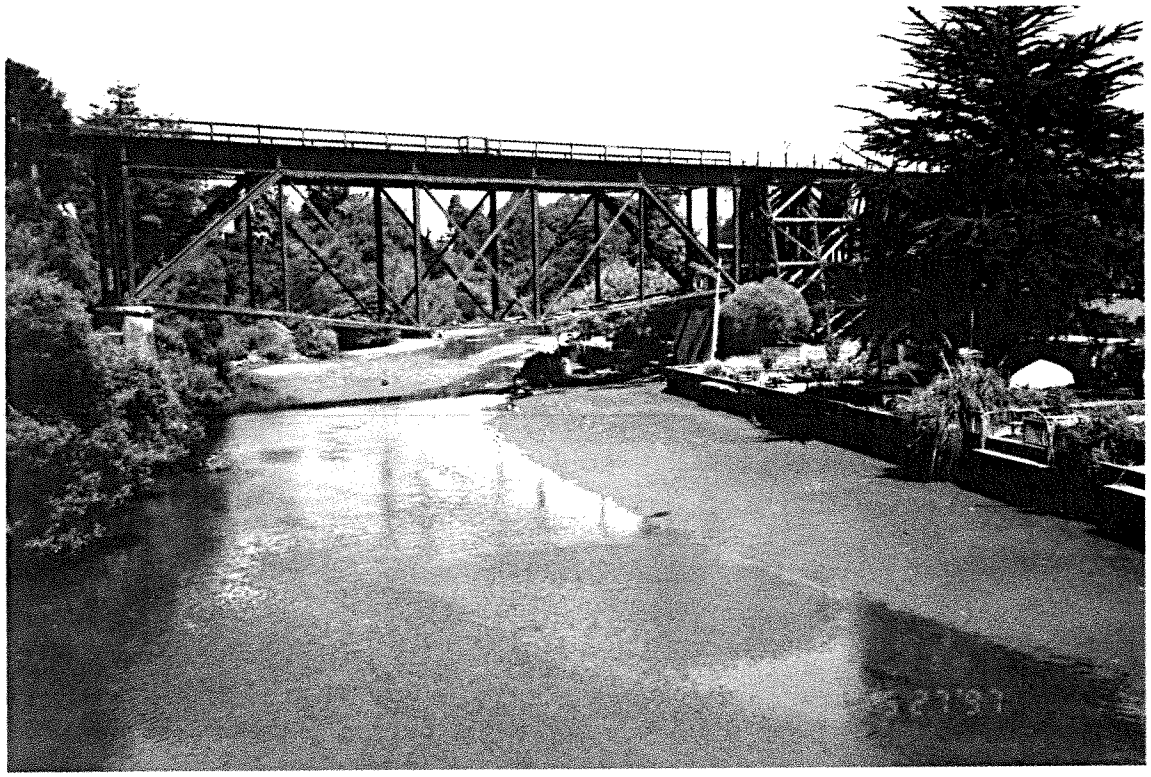
Receded Lagoon with Sandbar Open, 22May97



Sandbar Closure, 22May97

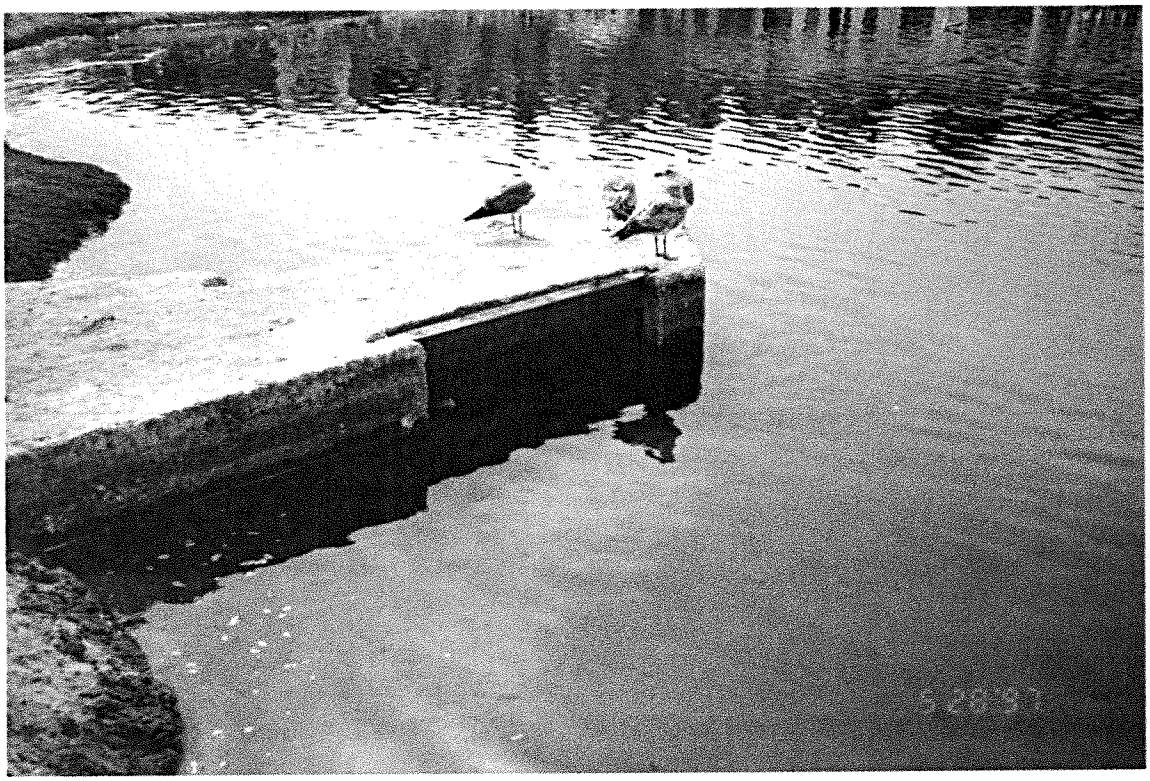
City Staff Spreading Geo-fabric Over Visquine Around Flume Entrance, 27May97

City Staff and Equipment Operator, Bill Casalegno, Covering Geo-fabric With Sand, 27May97

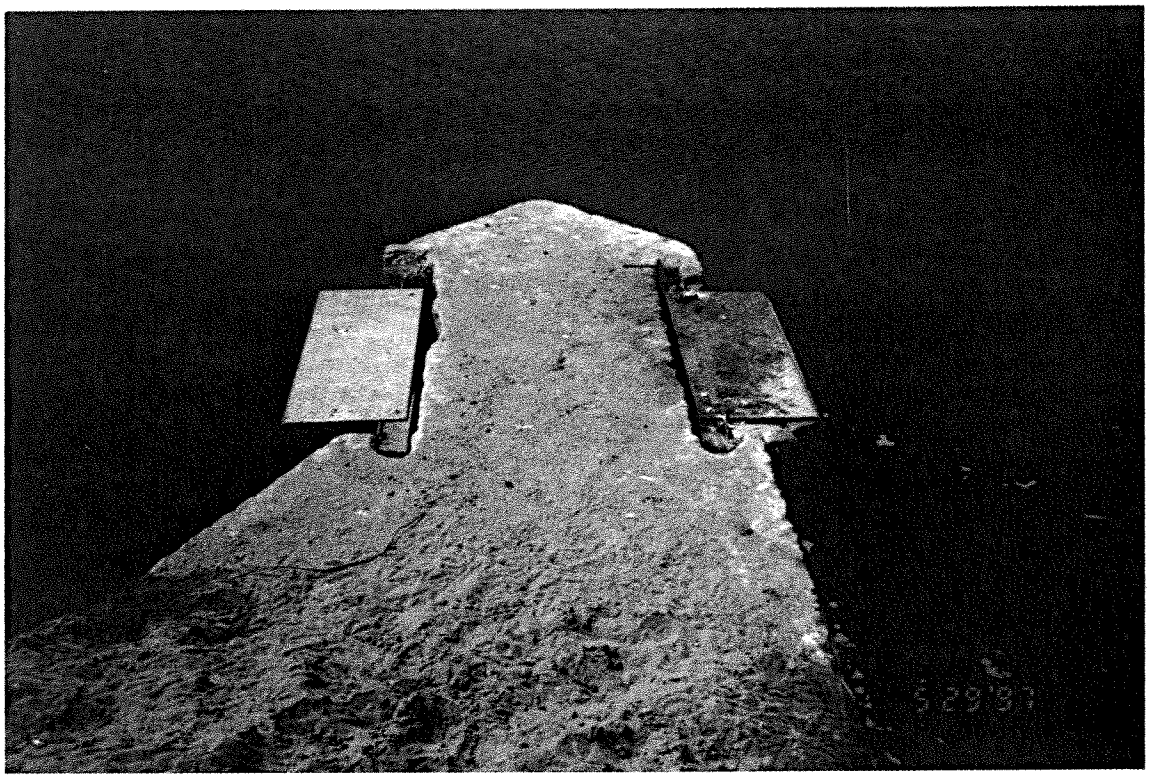


Receded Lagoon with Sandbar Open, 27May97; Bulkhead on Right and Rootwad Under Trestle where Puddles Formed and Fish were Rescued

Final Sandbar Closure, 27May97



Screen In Place on One Side of the Flume, 28May97



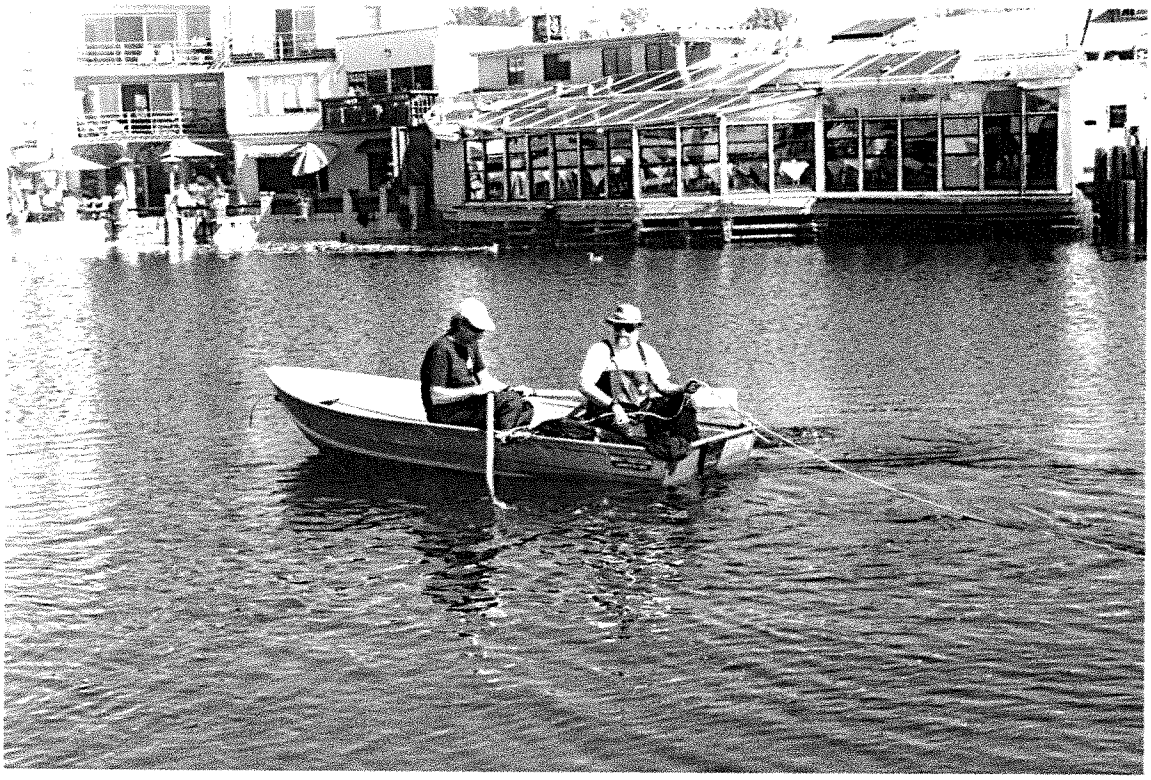
Flume Shrouds Installed to Remove Saltwater from Bottom of the Lagoon, 29May97

Lower Lagoon after Sandbar Construction, 29May97

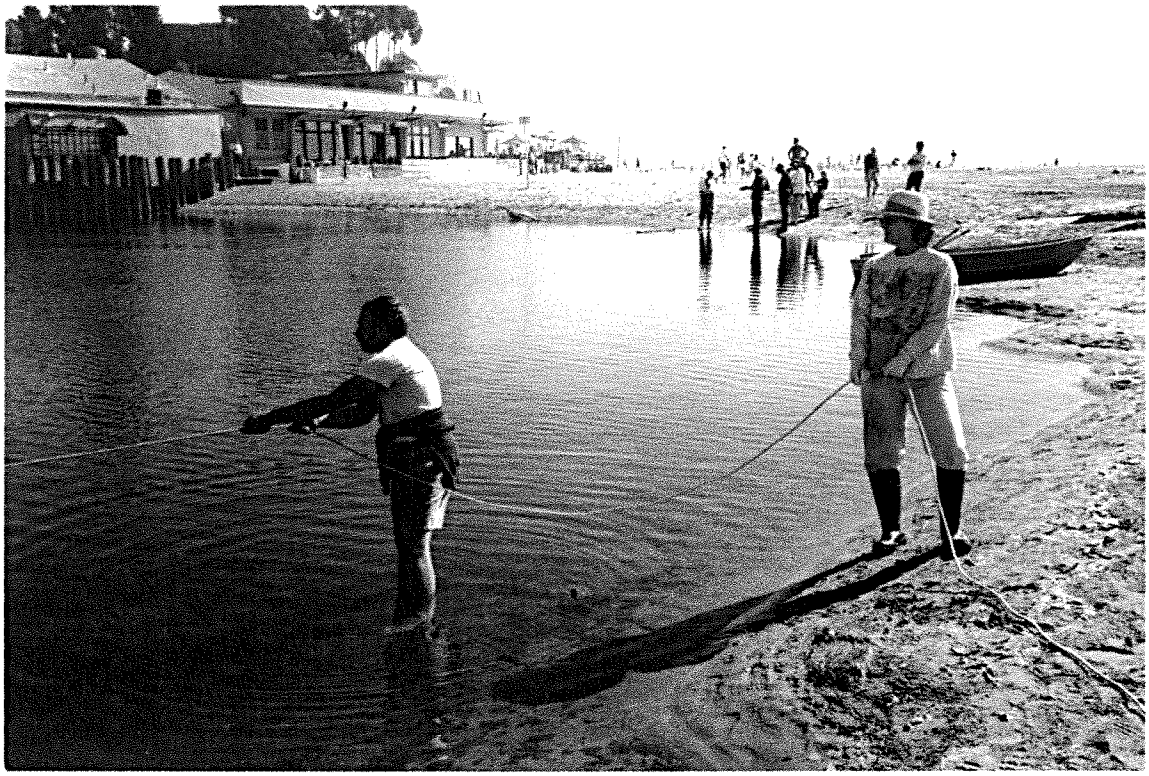
Soquel Creek Exiting through Flume Outlet, 29May97

Female Merganser and Her Ten Ducklings as They Hunt for Fish, 28May97

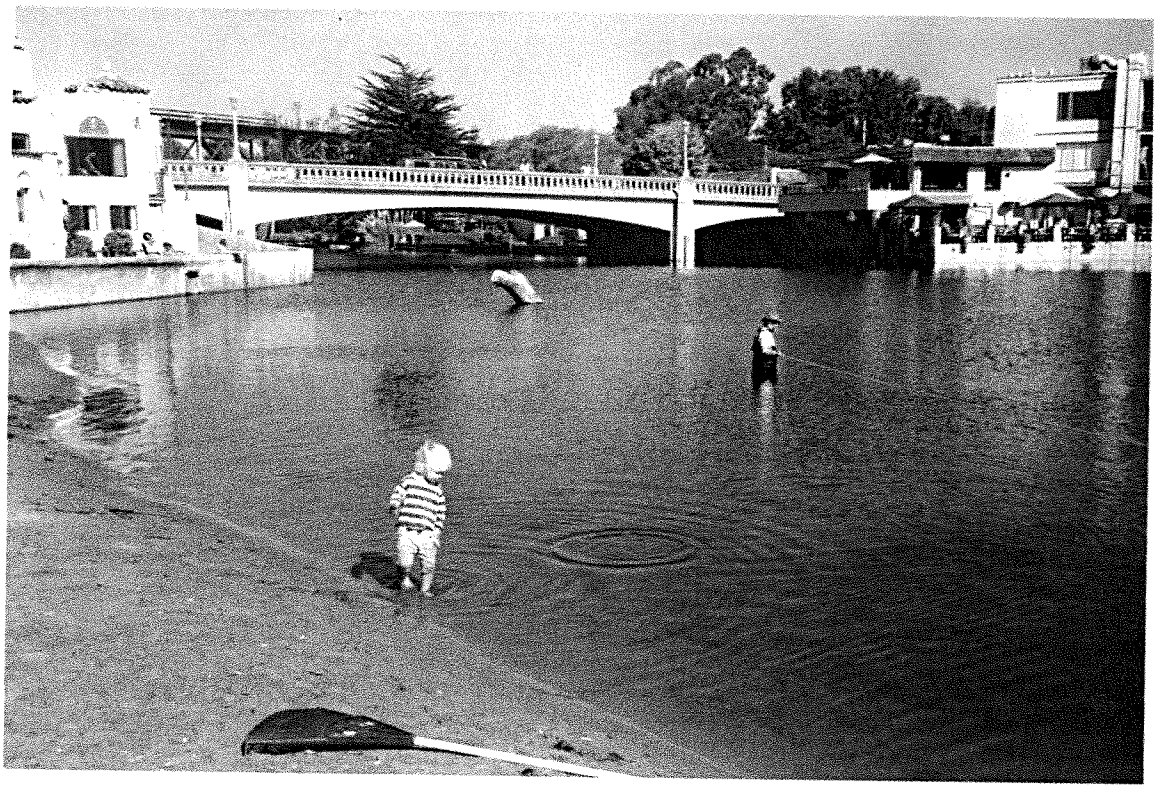
Three Long-Time Residents, Posing for Photos (Ed Morrison in a Supporting Role), 22May97



Taking the seine to beyond the Bridge to set it.

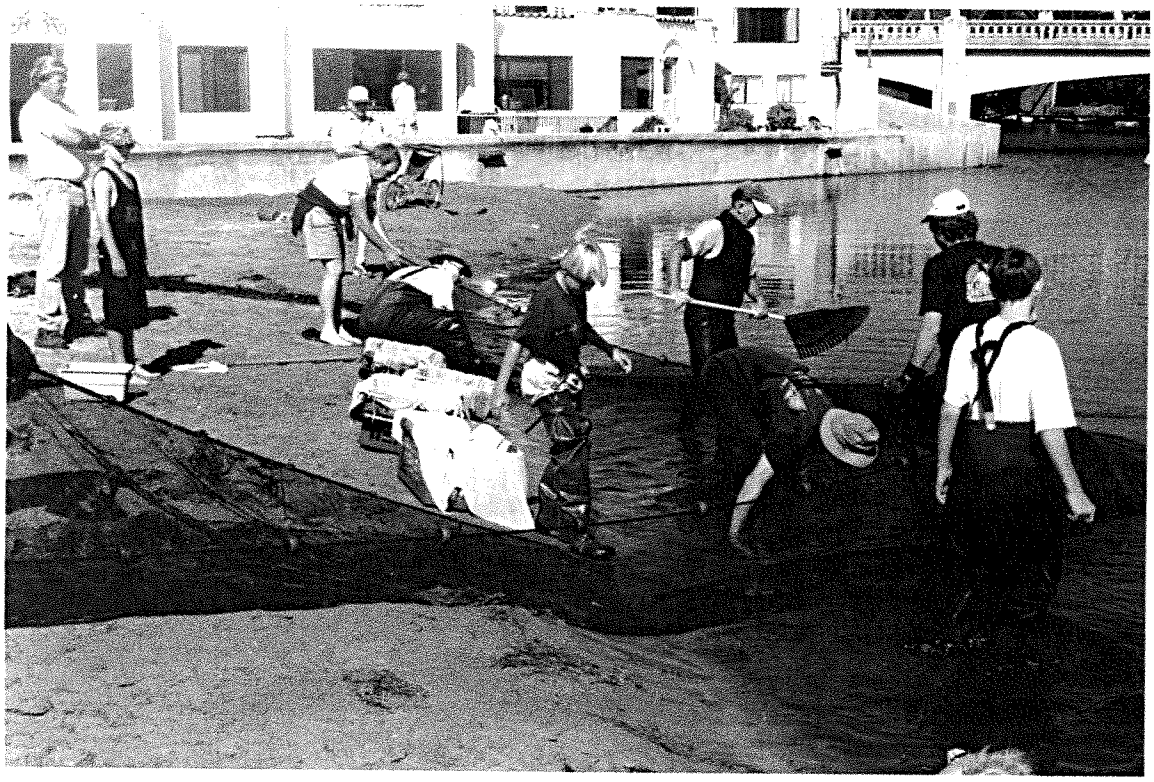


Two groups readying to pull in the seine.



Beginning to pull in the seine.

More pulling in the seine.



Removing algae from the bag of the seine for pulling it onshore.

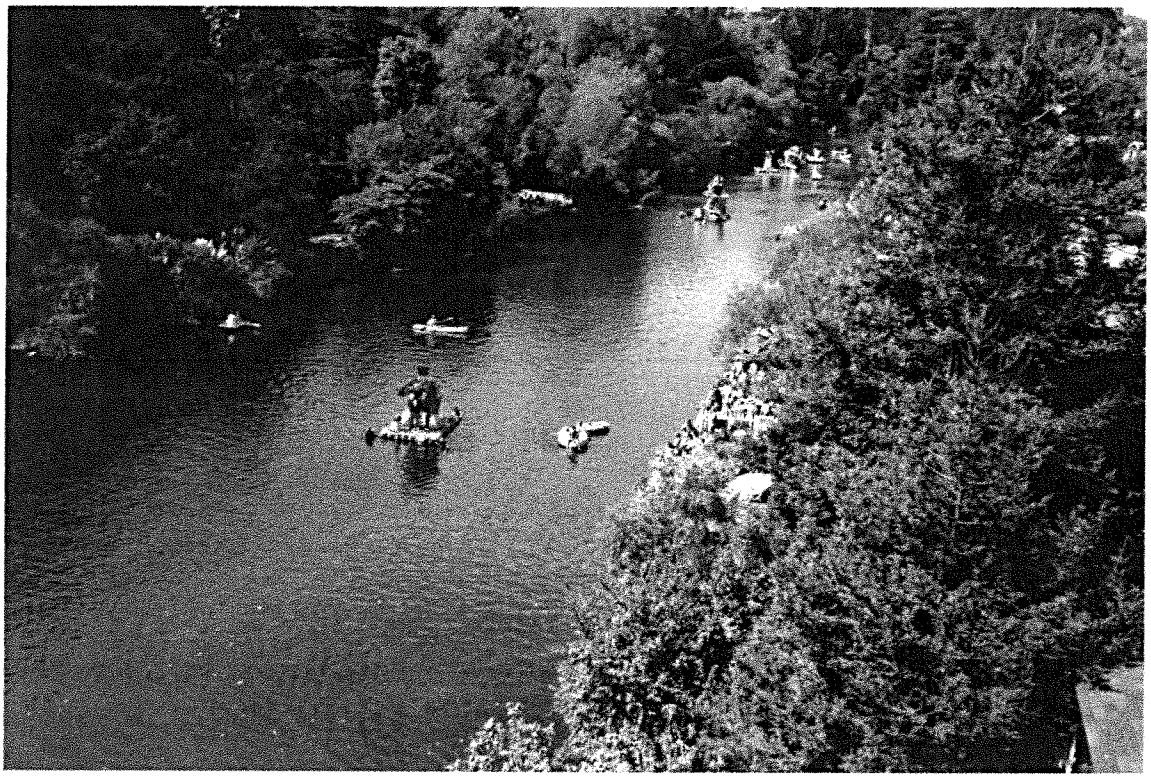
Pulling the bag of the seine onshore.

Picking out the steelhead from the algae.

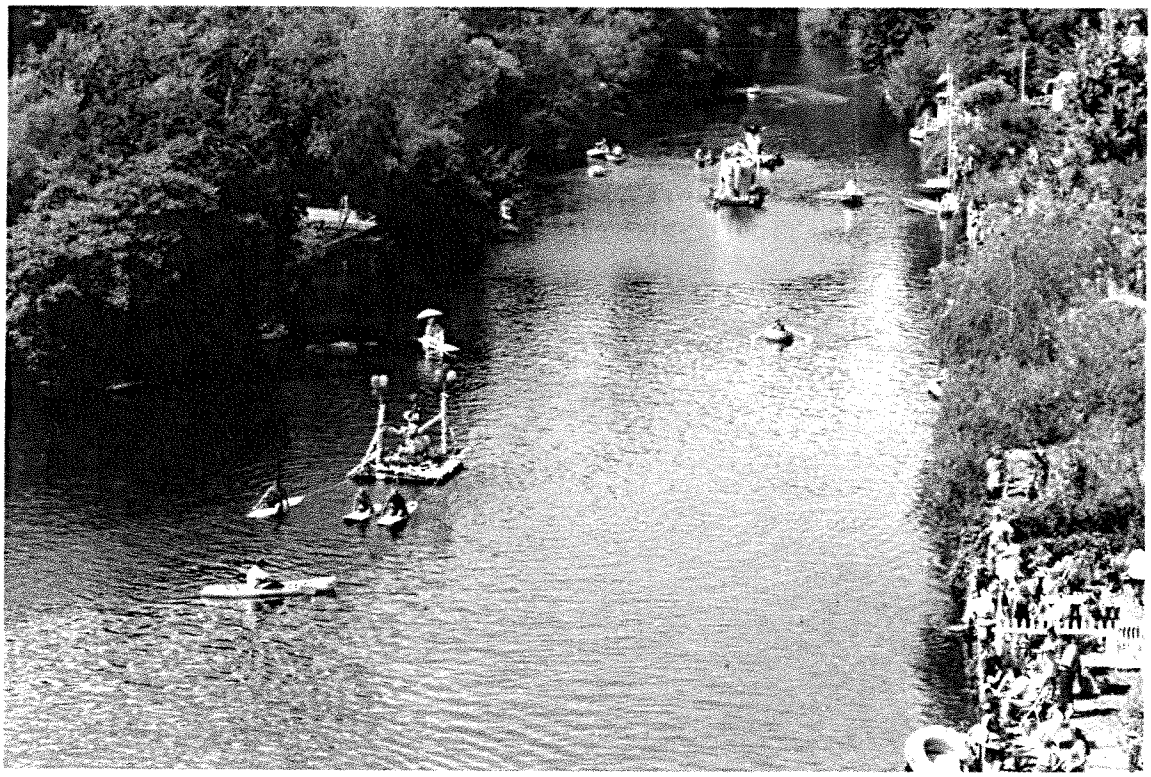
Holding a Sacramento sucker.

Loading the seine back into the boat for another set.

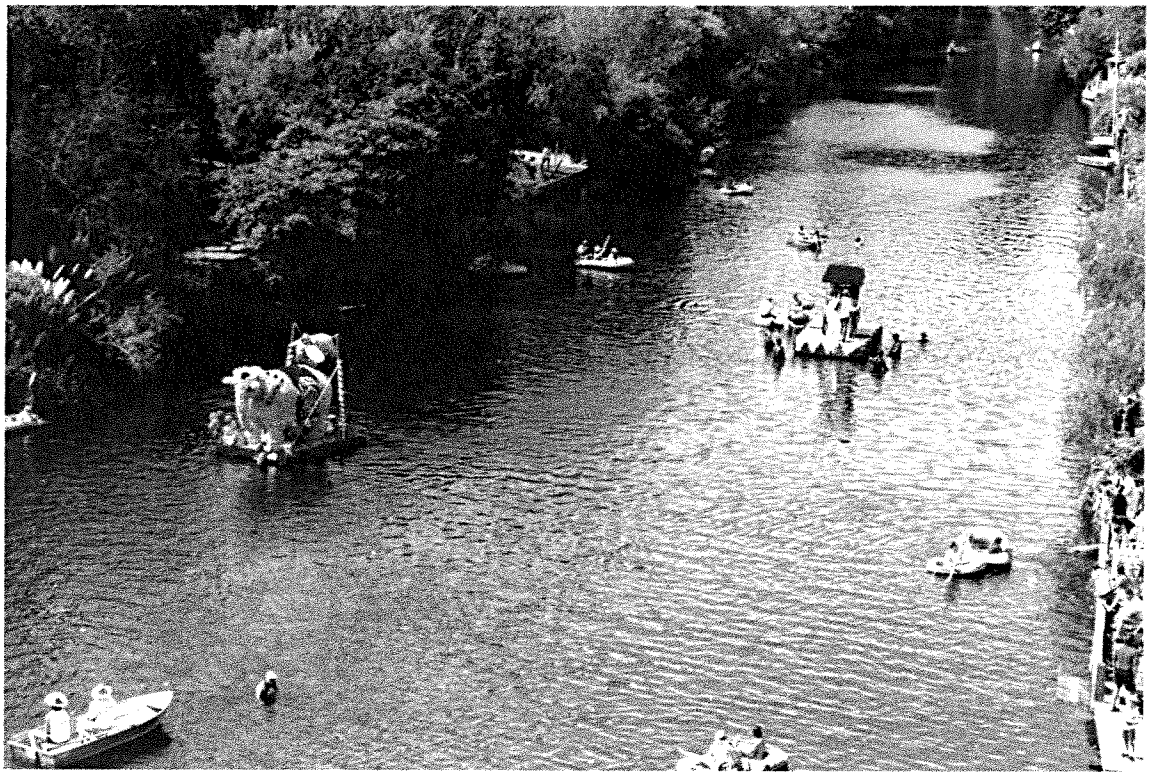
Tidewater gobies (from San Simeon Creek Lagoon).



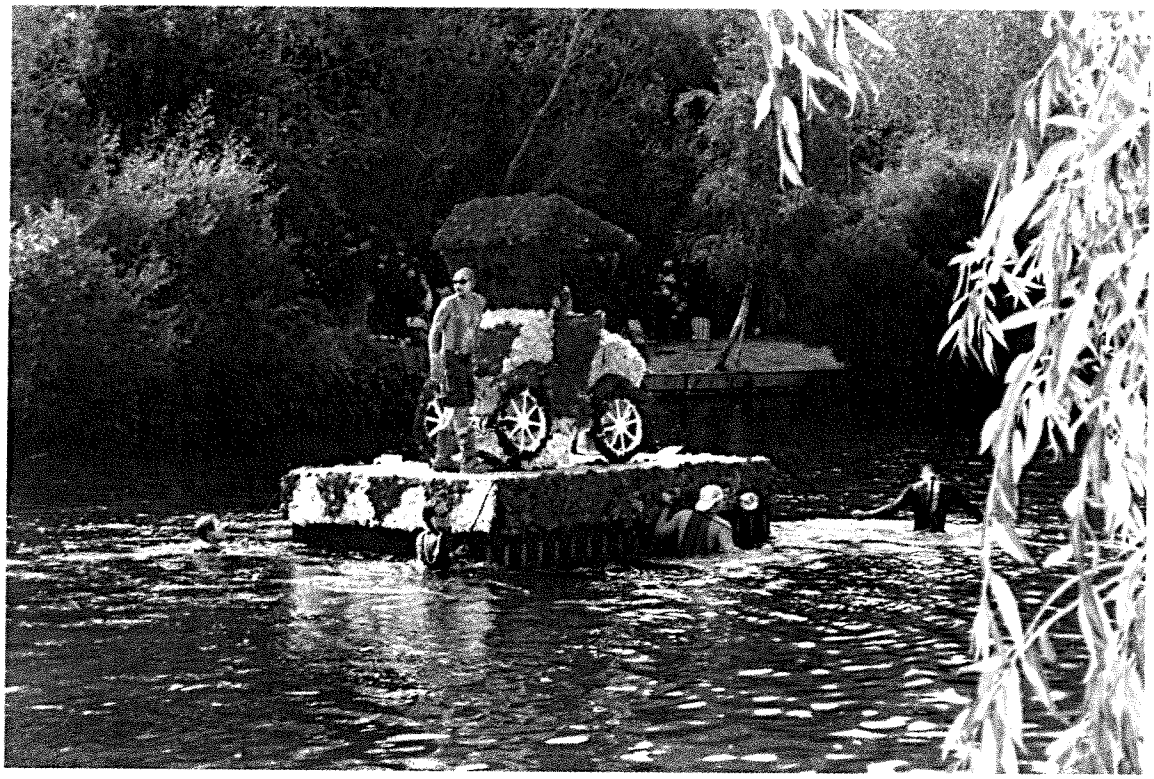
Floats of the Begonia Festival heading downstream.



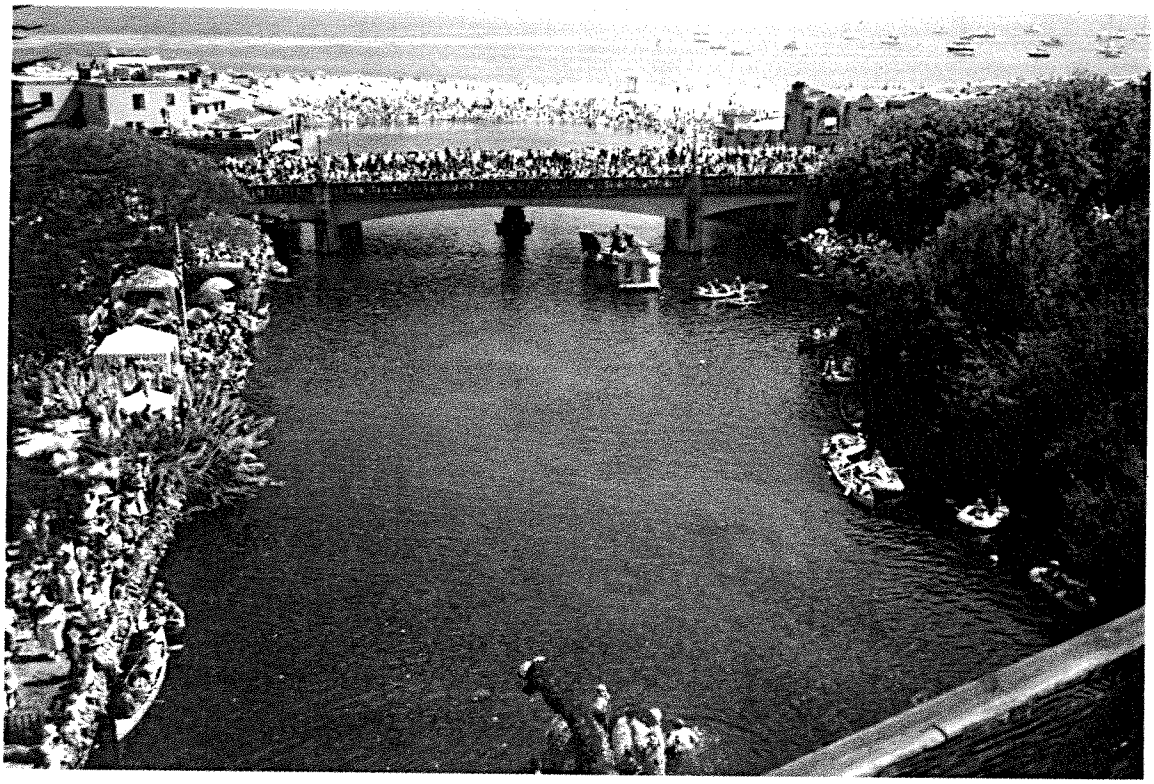
Float propelled by surfboard paddling.



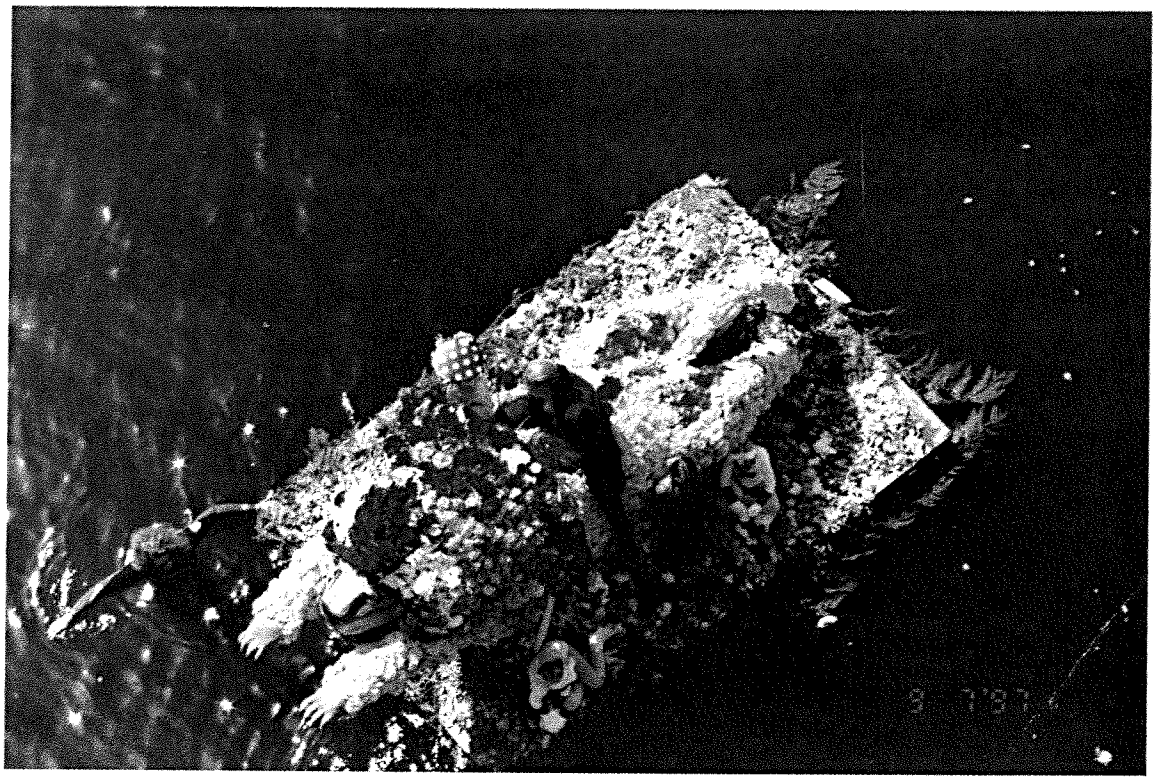
Float propelled by 6 waders.



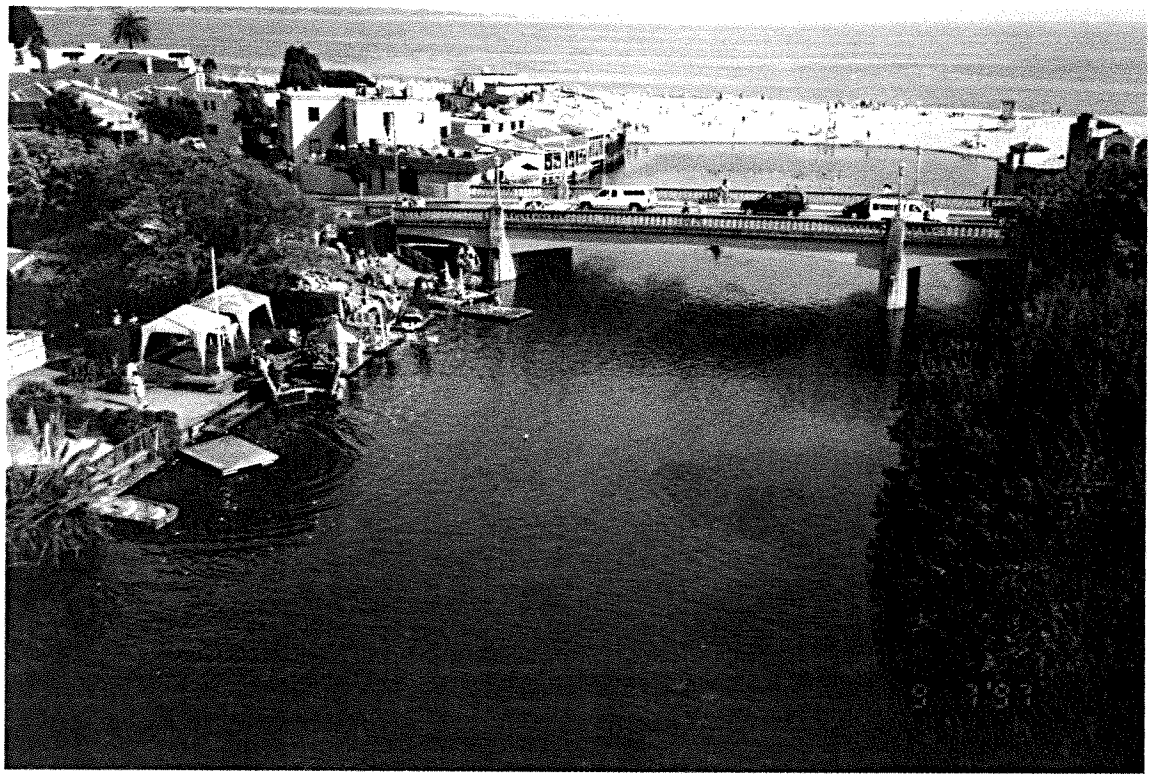
Float with six waders. Can four waders do the job or 3 surfers?



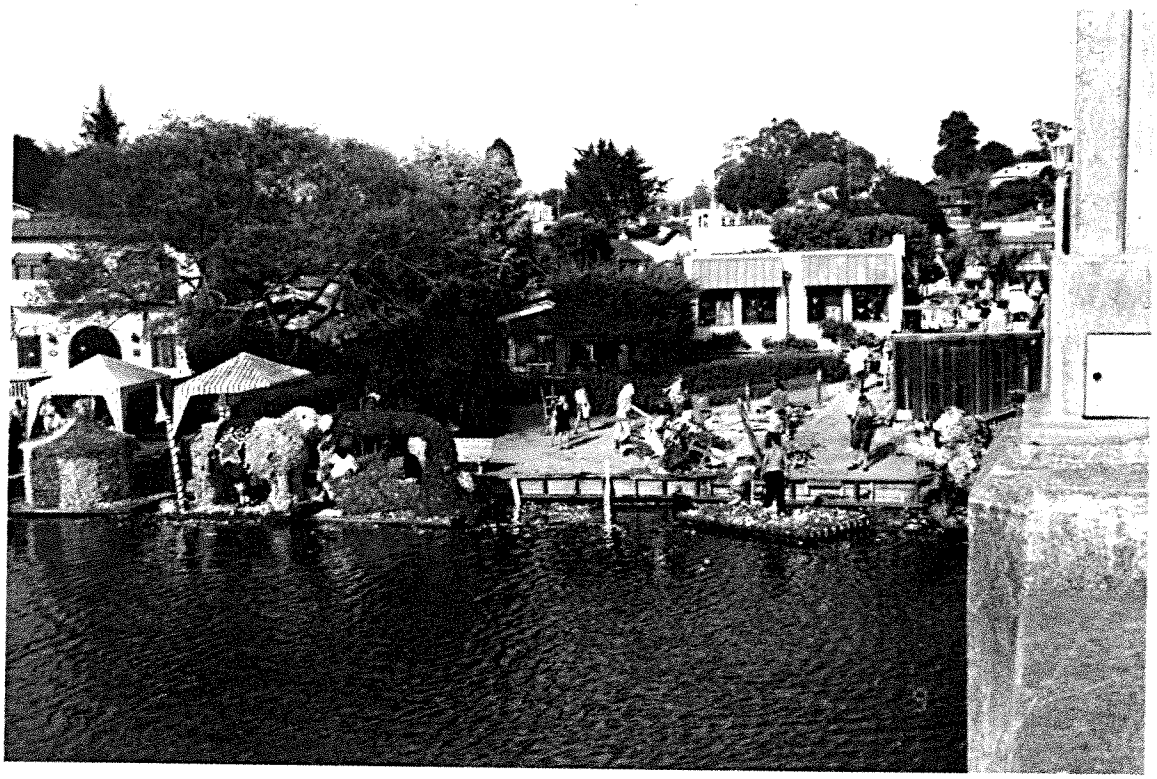
The Begonia Festival viewed from the railroad trestle.



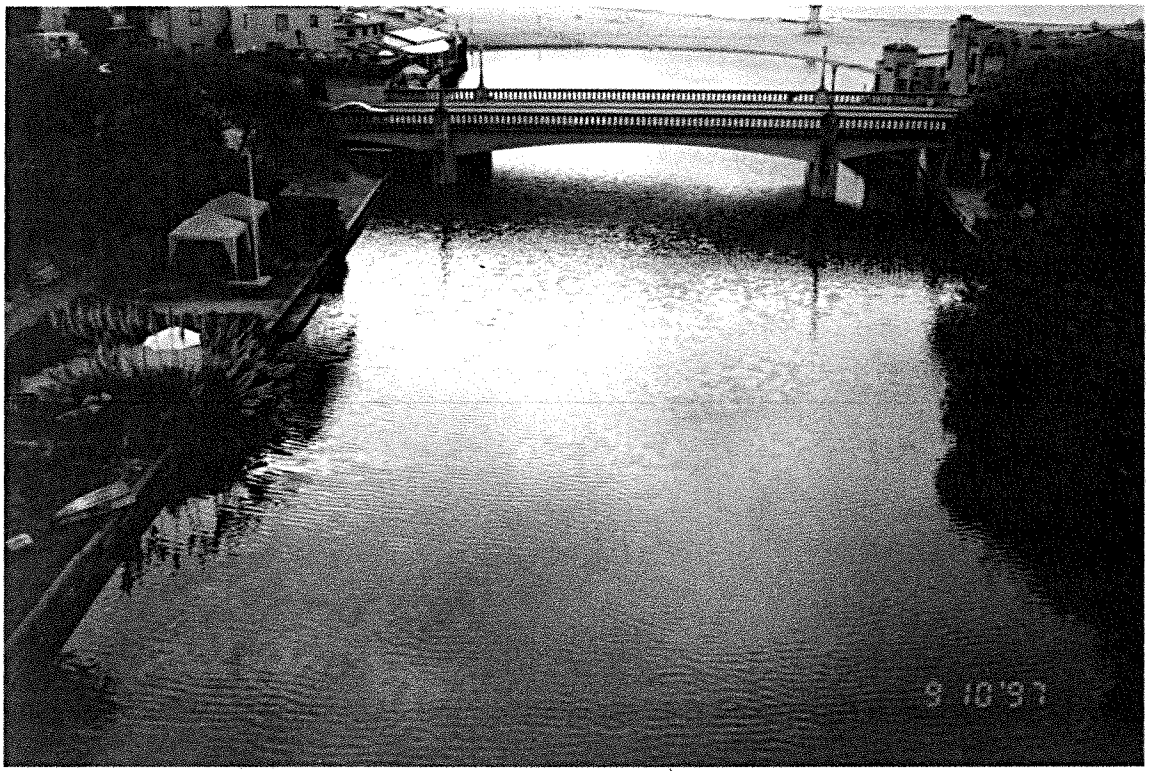
The Begonia Festival viewed from the Stockton Avenue Bridge.



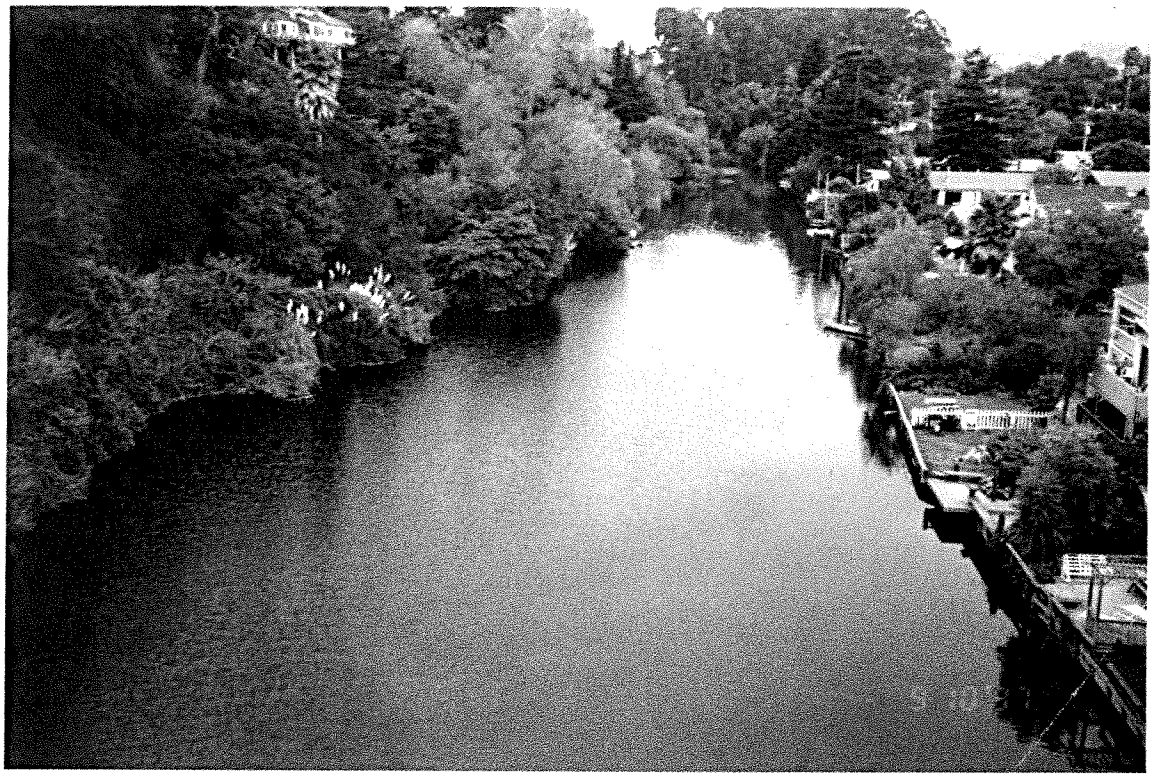
Dismantling of the floats after the Festival.



More dismantling of the floats after the Festival.



Soquel Creek Lagoon after the Begonia clean-up; Reaches 1 and 2.



Soquel Creek Lagoon after the Begonia cleanup; Reach 3.